2.1.3 W52 v.51

WESTERN ELECTRICIAN

8 FEB 1905

EVERY SATURDAY

LIBRARY OF ELECTRICAL ENG'G.

VOLUME XXXV.

NUMBERS 1—27

July 2—December 31, 1904

ELECTRICIAN PUBLISHING COMPANY
CHICAGO

Central-station Accident in Chicago....480, 481
Central-station Company, President of, Held Responsible for Lineman's Death.... 101
Central-station Equipment, Storage Batteries as an Adjunct to. By Gerhard Goettling. Illustrated. With discussion. (International Electrical Congress)....246, 247, 378, 379
Central Station for Light, Heat and Power in Aurora, Ill., the New. Illustrated....1, 2, 3
Central-station Managers, Hints for.... 97
Central-station Service, The Internal Combustion Engine as Applied to. By E. E. Arnold. With discussion. (National Electric Light Association)....30, 31, 32
Central-station Work in Winter, Summer Preparations for. (Editorial).... 44
Central Stations, Electric Heating and the Field It Offers. By James I. Ayer. With discussion. (National Electric Light Association)....46, 47
Central Stations, Heating (Hot-water) Rates of.... 81
Central Stations, Relation of Electric-heating Devices to. By H. W. Hillman. Illustrated. With discussion. (Ohio Electric Light Association)....170, 171
Central Telephone and Electric Company's Exhibit at St. Louis Exposition. Illustrated.... 293
Century Electric Company's Single-phase Motors. Illustrated.... 354
Chamber of Delegates of the International Electrical Congress of 1904, Report of the.... 236
Chattanooga, Proposed Power Development for.... 519
Chemical Industry, Society of....25, 215, 262
Chemists, Electric Oven for.... 61
Chemnitz, Electrical Industry in.... 523
Chess Playing by Telegraph....474, 475
Chicago and Milwaukee Electric-railway System, Betterments of the. Illustrated....459, 460, 461, 462
Chicago and New York, Municipal Electrical Employes in.... 435
Chicago Branch of the American Institute of Electrical Engineers, Meeting of the.... 442
Chicago, Central-station Accident in....480, 481
Chicago Charter Amendment. (Editorial)....288, 370
Chicago Charter Amendment, All Parties Favor.... 313
Chicago-Cincinnati Telephone Line, New.... 67
Chicago City Railway Franchise Ordinance....117, 132, 175, 389
Chicago City Railway Franchise, Proposed. (Editorial).... 116
Chicago Drainage Canal Power Plant, Waterwheels for....203, 349
Chicago Drainage Canal Water, Hydro-electric Power Development at and Near Joliet, Ill., Using. By Thomas T. Johnston. With discussion. (Western Society of Engineers)....100, 101
Chicago Elevated-railroad Traffic....36, 53, 119, 126, 258, 278, 301, 394, 474
Chicago Electric Freight Tunnels. Illustrated....45, 90, 189, 405, 406, 428, 430, 523
Chicago, Electric Freight Haulage, Underground, in. (Editorial).... 428
Chicago First National Bank Building, Temporary Power Plant of. Illustrated....75, 76
Chicago, Foreign Electrical Delegates in. Illustrated. 214
Chicago International Electrical Congress of 1893. Illustrated.... 197
Chicago-Kansas City Wireless Transmission.... 501
Chicago-New York Telephone Line for Railroad Service....292, 376
Chicago River, North Branch of, Electrically Operated Bridge over. Illustrated....477, 478
Chicago, South Side Elevated Railroad of, Extensions of....232, 233
Chicago-St. Louis Wireless Transmission. Illustrated....147, 238, 239
Chicago Street-lighting Statistics.... 86
Chicago Street-railway Situation....27, 42, 65, 90, 96, 116, 117, 132, 175, 252, 284, 367, 389, 407, 430, 456, 487, 501, 521
Chicago Subway Company Acquires Freight Tunnels in Chicago....430, 441, 523
Chicago Subway, Proposed. Illustrated....307, 389, 407, 479
Chicago, University of, Prospect of an Engineering School for the. (Editorial).... 482
Chicago's Automatic Telephone Exchange. Illustrated....111, 112, 113, 114
Chile, Electrical Concessions in, Control of.... 407
China, Electric-railway Project in.... 99
Churchward's Adaptation of Synchronous Motor for Railway Work. Illustrated.... 132
Cincinnati, Interurban Freight Service in.... 250
Cincinnati Telephone Situation.... 337
Cincinnati-Toledo Electric Railway, Proposed.... 349
Circuit-breakers, Westinghouse Oil. Illustrated.... 488
"Circular Tour" of Foreign Electrical Engineers. Illustrated....196, 214, 235, 236, 263, 465
Civil Engineers, British, Arrive.... 215
Clement, Edward E. (The Telephone Patent Situation)....273, 274
Clerici's Liquid-expansion Electric Meter. Illustrated.... 59
Cleveland, Automobile Transit Company for.... 81
Cleveland-St. Louis Wireless Transmission.... 381
Coal-handling Apparatus, Electric, on Dock at Superior, Wis. Illustrated....365, 366
Coal Mine, Ohio, Electricity in an.... 489
Coal, Production of.... 144
Coal, Spontaneous Ignition of. (Editorial).... 522
Coal Testing and Timber Preserving at St. Louis Exposition.... 119
Cockerill Gas Engine. Illustrated.... 448
Coin-controlled Turnstiles, Electric, at St. Louis Exposition.... 33
Collins, W. Forman, Death of. Portrait....505, 523
Colonial Sign and Insulator Company's Fireproof Porcelain Sign Letters. Illustrated.... 468
Colorado Electric Light, Power and Railway Associa-
Commercial Schools. (Editorial).... 350
tion at Colorado Springs.... 269
Commercial Telegraphers' Union of America.... 85
Commutator Truing Devices (Fort Wayne). Illustrated.... 431
Compass, Alleged Magnetic Deviations of the. (Editorial).... 288
Compensated Motors on Ballston Electric Railway, Alternating-Direct Working with. Illustrated....148, 149, 150, 151
Conchos River, Large Hydro-electric Power Plant for the....262, 320
Condensing Outfits for Steam Turbines.... 205
Conductivity of Steel Contact Rails. By J. A. Capp. Illustrated. (American Institute of Mining Engineers).... 228
"Conductometer (The) and Electrical Conductivity." By R. Appleyard. (Book Review).... 435
Conductors, Electrical, The Transposition of. By Frank F. Fowle. Illustrated. With discussion. (American Institute of Electrical Engineers)..412, 413
Connecticut, Electric Railways in....160, 327
Contact Rails, Steel, Conductivity of. By J. A. Capp. Illustrated. (American Institute of Mining Engineers).... 228
Contractor, Electricity and the. By Howard S. Knowlton.... 447
Controller, Automatic, for New York Subway Cars. Illustrated....368, 369
Controller for Electric Furnaces, Johnson's. Illustrated.... 97
Controller, Westinghouse Automatic Pump. Illustrated.... 431
Controllers for Machine-tool Motors, Cutler-Hammer. Illustrated....86, 87
Converters, Synchronous, Operation of. By S. C. Lindsay. (American Institute of Electrical Engineers)....139, 140
Cornell, A. B., Death of. Portrait.... 326
"Copper Handbook." By Horace J. Stevens. (Book Review).... 50
Copper Market....4, 76, 175, 374, 451
Copper Production of the World.... 43
Cost, Elements of, Which Go to Make up the Selling Price of Electric Current. By Samuel C. Mumford. (Michigan Electric Association).... 329
Costs, Graded, of Electric Supply. By M. E. Turner. (Ohio Electric Light Association)....204, 205
Couch & Seeley's Automatic Telephone Purifier. Illustrated.... 315
Crew, Prof. Henry: (The Modern Theory of the Arc and Spark).... 505
Crocker, E. C. (The Steam Turbine and Its Uses. Illustrated).... 151, 152
Crocker-Wheeler Alternators, Large.... 508
Crocker-Wheeler Motor on Swing Saw. Illustrated.. 373
Crocker's "Electric Lighting." (Book Review)..... 505
Crompton, Col. R. E. B. (Standardization of Dynamo-electric Machinery and Apparatus)....254, 255
Cuba, Alcohol Motors and Pumps in.... 268
Current, Unaccounted-for. By W. E. Richards. With discussion. (Ohio Electric Light Association).... 203
Cutler-Hammer Controllers for Machine-tool Motors. Illustrated....86, 87
Cutler's Two-wire System for Train Operation. Illustrated....444, 445

D

D. & W. Fuse Company's Exhibit at St. Louis Exposition. Illustrated.... 119
Danville, Ill., Railroad Shops at, Electric Power in. Illustrated....519, 520, 521
Davies, F. H. (Artificial Loads for the Dissipation of Electric Power. Illustrated)....223, 224
Davis, F. M. (Some Notes on the Edison Storage Battery)....392, 393
Davis, H. P. (A Proposed System of Standard Instruments for Operating Companies)....118
Dean's Improvement in Toll-line Telephone Systems. Illustrated....426, 427
Deaths by Electric Shock, Damages Given for..313, 468
Decorations, Electrical, at a Lawn Party. Illustrated.... 43
De Courcy, A. (Production of the Diamond in the Electric Furnace. Illustrated)....346, 347
De Fodor, Etienne. (Rates for Electricity Supply)....221, 222
De Moura's Phonetic Interrupter for Space Telegraphy. Illustrated.... 348
Depositing Metals, Vacuously, Edison's Apparatus for. Illustrated.... 175
Derail System, Electric.... 339
Design, Sub-station, Tendencies in. By Howard S. Knowlton....63, 64
Des Moines, Telephone Fight in.... 274
Detroit Electric Company's Pocket Volt-ammeter. Illustrated.... 430
Detroit, Electrical Outlook in.... 505
Detroit-Jackson Electric Railway....77, 162, 400
Detroit, Public Lighting in....132, 257
Diamond, Production of the, in the Electric Furnace. By A. De Courcy. Illustrated....346, 347
Diesel Engine, Locomotive to be Operated by....362, 430
Diesel Engine, The American. By E. D. Meier. Illustrated. With discussion. (American Street Railway Association).... 328
Dining Cars, Electric, in Indiana.... 142
Diplock's Pedrail Tested.... 117
Direct-current Distributing Systems, The, of American Cities. By Alex Dow. With discussion. (International Electrical Congress)....251, 252
Direct-current Generators, Compound-wound, Division of Load Between. (Question Box of National Electric Light Association).... 78
Distant-control Apparatus, Hanna's Electrical. Illustrated.... 328
Distribution, Direct versus Alternating-current, for Large Cities. (Papers and discussion at International Electrical Congress)....250, 251, 252
Distribution, Electrical. (Editorial).... 240
District of Columbia Standard of Measure, What Is?.... 215
Divining Rod, An Electrical. (Editorial).... 116
Diviss, Procopius, a Neglected Scientist. By Dr. J. Rudis-Jicinsky. Illustrated.... 173
Dixon, James. (The Telautograph. Illustrated)....372, 373
Dommerque, F. J. (The Telephone Problem in Large Cities).... 356
Double-deck Cars. (Editorial).... 44
Dow, Alex. (The Direct-current Distributing Systems of American Cities).... 251
Drainage Canal Power Plant, Waterwheels for..203, 349
Drainage Canal Water, Chicago, Hydro-electric Power Development at and near Joliet, Ill., Using. By Thomas T. Johnston. With discussion. (Western Society of Engineers)....100, 101
Drill Clamp, Security (Bissell). Illustrated.... 86
Drill, Electric Mine and Quarry (Gardner). Illustrated.... 509
Drysdale, Dr. C. V., on Electricity for Railroad Work. (Institution of Electrical Engineers)..243, 244
Dublin, Municipal Electric Lighting in....276, 298, 399, 453
Dumbwaiters, Electric (Burdett-Rowntree). Illustrated.... 136
Duncan Meter Patent Litigation.... 431
Dynamo. (See also Alternator and Generator.)
Dynamo-electric Machinery and Apparatus, Standardization of. By Col. R. E. B. Crompton. With discussion. (International Electrical Congress)....254, 255
Dynamo, First, Described in a United States Patent.... 60
"Dynamo, Motor and Switchboard Circuits." By William R. Bowker (Book Review).... 50
Dynamo with Longitudinal Armature Plates. By Alfred Gradenwitz. Illustrated.... 427

E

Earthquakes, Have, an Electrical Origin? (Editorial).... 390
Eastern Wisconsin Railway and Light Company, Interurban System of the. Illustrated...284, 285, 286
East St. Louis Electric Railways....283, 284
Edison Convention at Newcastle, N. H., The....137, 189
Edison Medal, Prize Design for an.... 452
Edison Storage Battery, Some Notes on the. By F. M. Davis. With discussion. (Western Society of Engineers)....392, 393
Edison Storage Battery, The. (Editorial).... 266
Edison Storage Battery, The Present Status of the. By A. E. Kennelly and S. E. Whiting. Illustrated. (International Electrical Congress)....271, 272
Edison's Apparatus for Vacuously Depositing Metals. Illustrated.... 175
Edison's Laboratory, Foreign Electrical Delegates at. 263
Edison's Method of Rendering Storage-battery Gases Non-explosive. Illustrated.... 188
Edstrom, J. Sigfrid. (Electrical Extraction of Nitrogen from the Air. Illustrated)....295, 296
Eglin, W. C. L. (Rotary Converters and Motor-generator Sets)....318, 319
Elbs, Dr. K. (Recent Advances in Applied Electrochemistry).... 492
Election Returns, Use of Electricity in Spreading... 411
Electric and Street Railways, Census Statistics of..23, 24
Electric Coal-handling Apparatus on Dock at Superior, Wis. Illustrated....365, 366
Electric Development of Eastern Railroads, The. By George E. Walsh....2, 3, 4
Electric Equilibrium of the Sun (Arrhenius)..... 50
Electric Freight Tunnels, Chicago. Illustrated....45, 90, 189, 405, 406, 428, 430
Electric for Steam Traction, Advisability of Substituting. By J. G. White. (International Engineering Congress)....375, 376
Electric Furnace, Production of the Diamond in the. By A. De Courcy. Illustrated....346, 347
Electric Handshaker, Possibilities of the..... 136
Electric Heating. (See also Heating, Electric.)
Electric Heating and the Field it Offers Central Stations. By James I. Ayer. With discussion. (National Electric Light Association)....46, 47
Electric Light. (See also Light.)
Electric-light versus Telephone Circuits. By H. M. Rounce.... 269
Electric Lighting. (Notes)....18, 36, 53, 72, 90, 108, 125, 126, 143, 163, 183, 184, 207, 208, 232, 257, 258, 278, 300, 301, 321, 322, 341, 362, 381, 401, 420, 437, 438, 455, 456, 473, 495, 513, 532
"Electric Lighting." By Francis B. Crocker. (Book Review).... 505
Electric Locomotives, New York Central's. Illustrated....3, 342, 371, 407, 408, 409
Electric Locomotives in Use in Chicago Freight Tunnels. Illustrated....405, 406
Electric Oven for Chemists.... 61
Electric "Pearls," The Weissmann. Illustrated....93, 94, 347, 425
Electric Power, Artificial Loads for the Dissipation of. By F. H. Davies. Illustrated....223, 224
Electric Power in Agriculture, Uses of. By V. M. Arana....424, 425
Electric Power in Italy....57, 58
Electric Railway. (See also Railway and Tramway.)
Electric Railway, A Four-track. (Editorial)..... 464
Electric Railway, Good Speed on..... 351
Electric Railway, Lighting and Heating Plant at Bloomington and Normal, Ill. Illustrated..21, 22, 23
Electric-railway Accidents Rare in England. (Editorial).... 26
Electric-railway Motors, Steam Locomotives and, Fuel Cost of Operating. (J. G. White before International Engineering Congress)..... 371
Electric-railway Operation, Aurora-Elgin-Chicago, Some Interesting Features of. Illustrated....499, 500
Electric Railway, Steamship Company to Build.... 99
Electric-railway Test Commission of the St. Louis Exposition....13, 137, 311, 512
Electric Railways. (Notes)....18, 19, 36, 53, 54, 72, 90, 108, 126, 143, 144, 163, 164, 184, 208, 232, 233, 258, 278, 301, 322, 341, 342, 362, 381, 401, 402, 420, 438, 456, 473, 474, 495, 496, 513, 532
Electric Railways, Express Company for, Ohio Men to Form.... 175
Electric Railways in Germany, Costs and Profits of. By Frank H. Mason. (Consular Report)..... 122
Electric Railways, The History and Development of. By Frank J. Sprague. (International Electrical Congress)....290, 291, 312, 313
Electric Railways, The Storage Battery as Applied to. By W. E. Winship. (Franklin Institute)....224, 225
Electric Resistance Furnace for Laboratory and Dental Purposes (Hewe's). Illustrated..... 521
Electric Shock, Damages Given for Deaths by...313, 468
Electric Storage Battery Company's Exhibit at St. Louis Exposition. Illustrated....200, 201
Electric Supply, Graded Costs of. By M. E. Turner. (Ohio Electric Light Association)....204, 205
Electric Supply in Great Britain, The Law of..122, 123
Electric Traction, Heavy, Problems of. By O. S. Lyford, Jr., and W. N. Smith. Illustrated. With discussion. (American Institute of Electrical Engineers)....442, 443, 444
Electric Traction, Problems of. (Editorial)..... 446
Electric-transmission Mechanism for Automobiles, Simonds'. Illustrated.... 503
Electrical Decorations at a Lawn Party. Illustrated 43
Electrical Construction, Underground. By Louis A. Ferguson. Illustrated. (International Electrical Congress)....387, 388, 425
"Electrical Engineer," A Misuse of the Term. (Editorial).... 266
Electrical Engineering Graduates, Records of. Illustrated.... 133
Electrical Extraction of Nitrogen from the Air. By J. Sigfrid Edstrom. Illustrated. (International Electrical Congress)....295, 296
Electrical Fire Hazard, The. By C. J. H. Woodbury. (Brooklyn Institute of Arts and Sciences)....469, 470, 471
"Electrical Furnaces." By J. Wright. (Book Review).... 505
Electrical Generating Stations and Transmission. By L. B. Stillwell. (International Engineering Congress)....398, 399
"Electrical Machinery for Heavy Manufacturing." By Ernest Schalz. (Book Review)..... 505
Electrical Means, The Mechanical Equivalent of Heat Measured by. By Howard T. Barnes. (International Electrical Congress)..... 297
Electrical Method of Thawing Water Pipes. By George S. Huley. Illustrated. (National Electric Light Association)....502, 503
Electrical Properties, Storms Damage....176, 183, 274, 409, 437
Electrical Securities Corporation....339, 362
Electrical Trades Association at Dinner..... 468
"Electrical Transmission of Energy." By A. V. Abbott. (Book Review)..... 505
Electrically Controlled Track Switches on the Long Island Railroad at Ozone Park. Illustrated....190, 191, 192
Electrically Operated Warship Models at the Naval Show on the "Pike." Illustrated....345, 346
Electricians Are Pretty Good..... 196
Electricity, Application of, to Steam Railways. By Bion J. Arnold. (Presidential address to American Institute of Electrical Engineers)....241, 242
Electricity, Arrhenius on..... 160
Electricity, Atmospheric, Application of Salts of Radium to the Study of. By Th. Moureaux. Illustrated....42, 43
Electricity and Gas, Relative Selling Price of. (Question Box of National Electric Light Association).. 99
Electricity and the Contractor. By H. S. Knowlton. 447
Electricity Day at the World's Fair..... 249
Electricity, Influence of, on Vegetation....22, 23
Electricity, Locating Ore by....116, 298
Electricity, Physics and. By Prof. William Hallock. (New York Electrical Society)..... 486
Electricity Supply, Rates for. By Etienne de Fodor. With discussion. (International Electrical Congress)....221, 222, 245, 246
Electricity, Thawing Ice in Water Pipes by. Illustrated....169, 297, 448, 502, 503, 504
Electricity, What Is the Nature of?..... 59

Electrochemistry. (Editorial) 482
Electrochemistry, Applied, Recent Advances in. By Dr. K. Elbs 492
Electrochemistry, The Relation of the Hypothesis of Compressible Atoms to. By Prof. T. W. Richards. (International Electrical Congress) 222
Electrolytic Hydrogen and Oxygen Cell, Hazard-Flamand. Illustrated 76
Electrolytic Rectifier, Scheidel. Illustrated 133
Electrolysis on Warships, Curious Russian Experiment in Relation to. (Editorial) 154
Electrolysis of Underground Conductors Discussed at International Electrical Congress 247
Electrolysis Question in St. Paul 231
Electropneumatic Control for Metropolitan Elevated Railway in Chicago. Illustrated 39, 40, 41
Electrotherapeutics, The Principles of. By Dr. T. Proctor Hall. (International Electrical Congress) 298
Electrothermic Production of Iron and Steel. By Alfred Stansfield. Illustrated. (Canadian Society of Civil Engineers) 78, 79
Elevated Roads, Chicago, "Noise Cure" for, Rejected. 347
Elevators, Electric, Ries' Patent for, in Litigation.. 346
Ellicott, Mr., on Electrical Features of the St. Louis Exposition. (Western Society of Engineers) 7
Ely, W. Caryl. Protrait 325
Ely's, President, Address to American Street Railway Association 331, 332
Emerson Electric Manufacturing Company's Small Induction Motor. Illustrated 468
Emmet, W. L. R., on Steam Turbines and Reciprocating Engines 330
Emmet-Junggren Steam-turbine Set, Small. Illustrated 348, 349
Engine, Gas. (See Gas Engine.)
Engines and Dynamos, Standardization of. (American Society of Mechanical Engineers) 479
Engines, Reciprocating, and Steam Turbines, Combined Use of. (Editorial) 330
Engineer, the Embryo, Homely Advice for 160
Engineers Should Have a Good Knowledge of English 50
Engineers' Society of Western Pennsylvania. (Paper) 103, 104
Engineering Education, Society for the Promotion of. 222
Engineering School for the University of Chicago, Prospect of an. (Editorial) 482
Engineering Schools, Military Possibilities of. By George W. Melville. (Franklin Institute) 213
England. (See also Great Britain).
England, Municipal Ownership in 153, 276, 298, 319, 379, 418, 435, 441
England, Municipal Telephony in 379, 418, 435
England, Waterpower Development in, First Electrical 87, 105, 256
English, Engineers Should Have a Good Knowledge of 50
English Impression of American Electrical Engineering 465
English Telephone Statistics 105, 205
Erie Canal, The Electrification of the. By George E. Walsh 130
Erie Railroad Lines in New Jersey, Electrification of, Contemplated 353, 415
Erie Railroad May Establish Cleveland-New York Telephone Line 253
Evans, David E. 163
Evanston, Elevated Trains to Run to 33, 456
Evansville, Ind., Changes in Lighting System in.... 386
Evansville, Ind., Telephone Situation 450, 466
Exhibits Power Plant at St. Louis Exposition. By Richard H. Pierce 429
"Experiments with Alternate Currents of High Potential and High Frequency." By Nikola Tesla. (Book Review) 394
Exports, Electrical, American and German 114
Exports, Electrical, by Months. 24, 99, 193, 289, 371, 468
Exports, Electrical, for the Year Ended with June, 1904 99
Exposition Awards. (Editorial) 428
Exposition Electrical Club 33
Express Company for Electric Railways, Ohio Men to Form 175

F

Facsimile Letter Writing by Wireless 333
Factories and Workshops, English, Regulations for the Use of Electricity in 379
Fahnestock Spring Binding Posts for Dry Battery. Illustrated 11
Fairbanks, Morse & Co.'s Direct-connected Gas-engine Unit. Illustrated 375
Fall Trade Outlook, Interviews on the 267
Fans, Electric, to Increase Efficiency of Radiators and Registers 523
Fargo Rejoices Over Its Street Railway 489
Farmers Buy Power from Electric Railway 500
Fedden, S. E. Portrait 168
Feilden, Mr., is Much Impressed 289
Ferguson, Louis A. (Underground Electrical Construction. Illustrated) 387, 388, 425
Field's, Stephen Dudley, Amplifier for Space Telegraphy 362
Finsen, Dr. Niels R., Death and Funeral of. Portrait 269, 300
Finseo's, Dr., Death. (Editorial) 266
Fire-alarm and Police-patrol Systems, Electric. (Census Bulletin) 50
Fire Hazard, The Electrical. By C. J. H. Woodbury. (Brooklyn Institute of Arts and Sciences). 469, 470, 471
Fires Due to Carelessness with Electrical Apparatus. 386
Fires, Many Alleged Electrical, Not Electrical 114
First National Bank Building, Chicago, Temporary Power Plant of. Illustrated 75, 76
FitzGerald, Desmond G., Death of 361
Flatirons, Electric, Rheostat Stand for (Simplex). Illustrated 140
Flasher, Sign, Guthrie. Illustrated 508
Floor Outlet Box (G. I.) 268
Flour, Electrical "Purification" of. (Editorial) ... 522
Flume Construction. (Editorial) 134
Flywheels, Bursting of, Benjamin on the. (American Society of Mechanical Engineers) 478
Fond du Lac-Oshkosh Interurban Railway. Illustrated 284, 285, 286
Football Games, Reporting, Use of the Telephone in. 450
Foreign Delegates to the International Electrical Congress, "Circular Tour" of the, in the United States. Illustrated 196, 214, 235, 236, 263, 465
Foreign Electrical Delegates, A Hearty Welcome for. (Editorial) 134
Foreign Trade Exploitation, A Systematic Study of. (Editorial) 350
Foreign Trade Opportunities 5, 268, 350, 452
Fort Wayne Electric Works' Commutator Truing Devices. Illustrated 431
Fort Wayne, Ind., Lighting and Traction Merger in. 89
Four-track Electric Railway, A. (Editorial) 464
Fowle, Frank F. (The Transposition of Electrical Conductors. Illustrated) 412, 413
Fox River Light, Heat and Power Company's New Central Station in Aurora, Ill. Illustrated. 1, 2, 3
Francis', D. R., Welcoming Address to the International Electrical Congress 217, 218
Franklin, Did Diviss Anticipate? (Editorial) 172
Franklin Institute. (Papers) 213, 224, 225
Fredet Storage Battery at St. Louis Exposition 94
Freeport, Ill., Damages Given for Death by Electric Shock in 313
Freight Haulage in Cities by Electric Railway. (Editorial) 116
Freight Haulage, Underground Electric, in Chicago. (Editorial) 428
Freight, Interchange of, between Steam and Electric Railroads 430, 494, 504
Freight Question, Ohio Interurban Men Discuss the.. 430
Freight Tunnels, Chicago Electric. Illustrated 45, 90, 189, 405, 406, 428, 430, 523
French Electrical Exhibits at the St. Louis Exposition. Illustrated 93, 94
Frequency 160
Frequency Meter, New German Astatic Wattmeter and. Illustrated 153
Frueauff, Frank W. (Office Methods and Accounting) 159, 160
Fuel Cost of Operating Steam Locomotives and Electric-railway Motors, J. G. White on. (International Engineering Congress) 371
Furnace, Electric, for the Production of Iron and Steel. Illustrated 78, 79
Furnace, Electric, Production of the Diamond in the. By A. De Courcy. Illustrated 346, 347
Furnace, Howe's Electric Resistance, for Laboratory and Dental Purposes. Illustrated 521
Furnace, Steiometz's Pyro-electrolytic. Illustrated.. 445
Furnaces, Johnson's Controller for Electric. Illustrated 97
Fuse Box, New Pole-line (Johns-Manville). Illustrated 355
Fuse Exhibits at St. Louis Exposition. Illustrated.. ..... 119, 273

G

Gardner Company's Electric Mine and Quarry Drill. Illustrated 509
Gardner Electric Drill and Machinery Company's Exhibit at St. Louis Exposition. Illustrated 229
Gary, Theodore. Portrait 507
Gas, Electricity and, Relative Selling Price of. (Question Box of National Electric Light Association) 99
Gas (Internal-combustion) Engine, The, as Applied to Central-station Service. By E. E. Arnold. With discussion. (National Electric Light Association) 30, 31, 32
Gas Engine, Cockerill. Illustrated 448
Gas Engine, Recent Development of the. By George E. Walsh 391
Gas Engine, Sargent Complete-expansion. Illustrated 489
Gas-engine Plant for Electric Railway 430
Gas-engine Unit, Direct-connected (Fairbanks, Morse & Co.). Illustrated 375
Gas-engine Unit for Private Lighting Plants (Ideal). Illustrated 200
Gas Engines, 6,000-horsepower, 4,000-kilowatt Alternators to be Driveo by 508
Gas Engines, High-power, in Electric Stations in Spain and Holland. By Frank C. Perkins. Illustrated 385, 386
Gas Engines, Induction Sparker for (Bissell). Illustrated 316
Gas Turbines 399, 410
Gases, Storage-battery, Edison's Method of Rendering, Non-explosion. Illustrated 188
Gaskill, D. L. (Joint Use of Poles by Public-service Companies) 152
Gasoline Motors for Steam Railroads 203, 267
General Electric Compensated Motors on Ballston Electric Railway. Illustrated 148, 149, 150, 151
General Electric Company, Purchase of Allis-Chalmers Company by, Denied 47
General Electric Company, St. Louis Exposition Awards to the 357
General Electric Transformer for Thawing Ice in Water Pipes. Illustrated 527
General Incandescent Arc Light Company's Floor Outlet Box 268
General Incandescent Arc Light Company's New Punched Clip Lever Switch. Illustrated 136
Generating Stations and Transmission, Electrical. By L. B. Stillwell. (International Engineering Congress) 398, 399
Generator. (See also Alternator and Dynamo.)
Generators, Compound-wound Direct-current, Division of Load between. (Question Box of National Electric Light Association) 78
German Astatic Wattmeter and Frequency Meter, New. Illustrated 153
German Commercial Schools. (Editorial) 350
German-Dutch Cable in the Far East 205
German Electrical Exports 114, 268
Germany, Costs and Profits of Electric Railways in. By Frank H. Mason. (Consular Report) 122
Germany, Electrical Industry in. (Editorial) 80, 134
Germany, Electric Railways in, Statistics of 474
Geographers Send Signals Around the World 214
Gerry, M. H., Jr. (Conditions for Continuous Service Over Lines Operated in Parallel) 9, 10
Gladstone-Lalande Battery. Illustrated 157
Glasgow Municipal Telephones 48, 49, 66, 67, 87
Glazebrook on Electrical Units (International Electrical Congress) 219
Globe Electric Company's Exhibit at St. Louis Exposition 230
Glogau & Co., H. M., Color-reflecting Show-window Light of. Illustrated 230
Goettling, Gerhard. (Storage Batteries as an Adjunct to Central-station Equipment. Illustrated) 246, 247, 378, 379
Gorlunoff's Experiments in the Reproduction and Transmission of Sound 181
Gornergrat, Switzerland, Rack Railway to the. By Franz Koester. Illustrated 261, 262
Government Coastwise Space-telegraph Stations to be Controlled by Navy 94, 160, 362
Government Delegates to the International Electrical Congress of 1904 and Their Work. With Portraits 187, 188, 219, 236, 237, 241
Government Departments in Washington, Private Telephone System for, Suggested 158
Government Reports on Space Telegraphy 160, 467
Graded Costs of Electric Supply. By M. E. Turner. (Ohio Electric Light Association) 204, 205
Gradenwitz, Alfred. (The Weissmann Electric "Pearls." Illustrated) 347
Gradenwitz, Alfred. (Dynamo with Longitudinal Armature Plates. Illustrated) 427
Graham, T. W. (A Run of Stone) 215
Gramme, Société, Exhibit of the, at St. Louis Exposition. Illustrated 93
Grammont, A., Exhibit of, at St. Louis Exposition. Illustrated 94
Grand Rapids, Wis., Electrically Operated Paper Mill at. Illustrated 388, 389
Grand Trunk Tunnel at Port Huron, Electricity for the 350, 419
Gray, Elisha, as the Inventor of the Telephone.... 15
Grayne, R. G. (Telephone Scouts of the Militia. Illustrated) 307
Great Britain. (Correspondence) 16, 34, 51, 69, 87, 105, 123, 141, 161, 182, 205, 230, 256, 276, 298, 299, 319, 339, 359, 379, 380, 399, 418, 435, 436, 453, 471, 493, 511, 529
Great Britain, Industrial Depression in 493
Great Britain, Space-telegraph Licenses in 123, 141, 182, 339
Great Britain, The Law of Electric Supply in...122, 123
Great Lakes, Hydro-electric Enterprises as Affecting the Level of the. (Editorial) 464
Great Salt Lake, Aerial Cable Across 79
Greely, General, Reports on Alaskan Telegraph System 433
Griffin, G. Brewer. (Points for Consideration When Purchasing Series Alternating-current Arc Lamps) 180, 181, 198, 199
Grivolas, Appareillage Electrique, Exhibit of, at St. Louis Exposition. Illustrated 94
Ground Detector, Westingbouse Three-phase Static.. 227
Ground Shields in Transformers, The Use of. By J. S. Peck. With discussion. (American Institute of Electrical Engineers) 9
Grounds, Testing Primary Circuits for. (Question Box of Iowa Electrical Association) 94
Grounds on Underground Conductors, Method of Locating. Illustrated 425
Guanajuato Power Transmissioo in Mexico.... 206, 277
Guarini, Emile. (Electric Power in the Linz Railway Shops in Austria. Illustrated) 441, 442
Guarini, Emile. (Differential Registering Kinemometer. Illustrated) 329
Guarini on the Influence of Electricity on Vegetation 22, 23
Guinier, E., Exhibit of, at St. Louis Exposition. Illustrated 93
Guthrie Sign Flasher. Illustrated 508
Guy Anchors, American Bull-tongue, Testing Illustrated 358

H

Haber, F., and L. Bruner. (The Carbon Cell) 316
Hagnech, Switzerland, Small Industries at, Hydro-electric Plant for. By Franz Koester. Illustrated. 517, 518, 519
Haley, George S. (Electrical Method of Thawing Water Pipes. Illustrated) 502, 503
Haley's Method of Determining the Demand upon Individual Transformers. Illustrated 61
Hall, Dr. T. Proctor. (The Principles of Electrotherapeutics) 298
Hall's "Manufacturing Cost." (Book Review) 317
Hallock, Prof. William. (Physics and Electricity). 486
Hamburg-Berlin Electric Railway, Proposed 72
Hammond, John Craig. (The Next Convention of the National Electric Light Association. Illustrated). 481
"Handbook" Telephone, The Latest Form of. Illustrated 480
Handshaker, Electric, Possibilities of the 136
Hanger for Lamp Cords, Adjustable (Innovate). Illustrated 415
Haona's Electrical Distant-control Apparatus. Illustrated 328
Harthan's Double-carbon Arc Lamp. Illustrated.... 377
Haskins, Clark C. (Editorial) 194
Haskins, Clark C., Death of. Portrait 199
Havana, Electric Elevated Railway in 59
Havre, Compagnie des Trefileries du, Exhibit of, at St. Louis Exposition. Illustrated 94
Hayes, Dr. Hammond Vinton. (Loaded Telephone Lines in Practice. Illustrated) 252, 253
Hazard-Flamand Electrolytic Hydrogen and Oxygen Cell. Illustrated 76
Heat, Electric, Production of Iron and Steel by. Illustrated 78, 79
Heat, Electric, Bank Vault Opened by 291
Heat, Light and Power in Aurora, Ill., The New Central Station for. Illustrated 1, 2, 3
Heat, The Mechanical Equivalent of, Measured by Electrical Means. By Howard T. Barnes. (International Electrical Congress) 297
Heating Devices, Electric, Relation of, to Central Stations. By H. W. Hillman. Illustrated. With discussioo. (Ohio Electric Light Association)..170, 171
Heating, Electric, and the Field it Offers Central Stations. By James I. Ayer. With discussion. (National Electric Light Association) 46, 47
Heaters, Electric (Prometheus), in New York Subway. Illustrated 394
Heating, Electric, Kryptol—a New Substance for. By Frank H. Mason. Illustrated. (Consular report) 351
Heating (Hot-water) Rates of Central Stations 81
Heating, Lighting and Electric-railway Plant at Bloomington and Normal, Ill. Illustrated..21, 22, 23
Heavy Electric Traction by Alternating Currents. By P. M Lincoln. (Canadian Electrical Association) 40, 41, 42
Heligoland, Electric Lighthouse at. Illustrated..... 61
Hewitt's Starting Devices for Mercury-vapor Lamps. Illustrated 179
Hewitt's Vapor Lamp with Radio-active Material. Illustrated 305
Homan's "Self-propelled Vehicles." (Book Review).. 417
Holophane Glass Company's Exhibit at St. Louis Exposition. Illustrated 201
Hospital, Emergency, in Sturtevant Factory 144
High Potentials, Very, Transformers for. Notes on Experiments with. By Harold B. Smith. Illustrated. (International Electrical Congress)...326, 327
High-speed Printing Telegraph Systems, Modern. By J. C. Barclay. (International Electrical Congress). 275, 276
High-tension Insulators. By R. Scott. Illustrated. 131, 132
High-tension Transmission Convention of the Institute in Chicago 8, 9, 10
High-voltage Experiments at Niagara Falls 291
Hillman, H. W. (Relation of Electric-heating Devices to Central Stations. Illustrated) 170, 171
Hoge, J. B. Portrait 264, 292
Hoge, J. B., on the Value of Organization. (Independent Telephone Association) 264, 265
Hollos, Joseph. (Simultaneous Telegraphy and Telephony) 223
Hot-wire Measuring Instruments, Whitney. Illustrated 317
Howe's Electric Resistance Furnace for Laboratory and Dental Purposes. Illustrated 521
Hub Motor, The. (Editorial) 134
Hull, England, Municipal Tramways of. (Editorial) 44
Hull, Mass., Trackless Trolley for 88
Hülsmeyer's Telephonogram. Illustrated 114
Humiston, John M. Portrait 357
Hydro-electric Enterprises as Affecting the Level of the Great Lakes. (Editorial) 464
Hydro-electric Plaot. (See also Power, Power Transmission and Waterpower.)
Hydro-electric Plant, British, at Oates-Royd Mills. Illustrated 77
Hydro-electric Plant at Ivo, Japan 258
Hydro-electric Plant, A Swiss, for Small Industries. By Franz Koester. Illustrated 423, 424
Hydro-electric Plants, Cost of 394
Hydro-electric Plants of the World 220
Hydro-electric Power Development at and near Joliet, Ill., Using Chicago Drainage Canal Water. By Thomas T. Johnston. With discussion. (Western Society of Engineers) 100, 101
Hygienic Resonator for Telephones 528
Hydrogen and Oxygen Cell, Hazard-Flamand Electrolytic. Illustrated 76
Hydro-electric Plant for Small Industries at Hagnech, Switzerland. By Franz Koester. Illustrated 517, 518, 519
Hypothesis of Compressible Atoms, The Relatioo of the, to Electrochemistry. By Prof. T. W. Richards. (International Electrical Congress) 222

I

Ice in Waterpower Plants, Fighting. Illustrated. (Question Box of National Electric Light Association) 45
Ice on a Third Rail, Thawing, by Electricity..... 264
Ice on the Third Rail, Calcium-chloride Treatment for. Illustrated 499, 500
Ice, Thawing, in Water Pipes by Electricity. Illustrated.....169, 297, 448, 502, 503, 504, 527
Iceland-Scotland Cable 342
Ideal Electric and Manufacturing Company's Gas-engine Unit. Illustrated 200
Illinois, Central, Independent Telephone Association 102
Illinois Central Railroad's Long-distance Telephone Line 83
Illinois Central Suburban Service Should be Electrically Equipped. (Editorial) 116
Illinois Electrical Contractors, Semi-annual Meeting of 486
Illinois State Electric Association, Decatur Meeting of the 305
Illinois Tunnel Company's Work in Chicago. Illustrated 45, 90, 189, 405, 406, 428, 430
Illumination in Honor of Knights Templars in San Francisco. Illustrated 71, 143, 239
Importer May Elle Corrected Invoice..... 491
Incandescent Lamp. (See also Lamp.)
Incandescent Lamps, Making, in the Palace of Electricity at St. Louis. Illustrated.....24, 25
Incandescent Lamps, Special Decorative, Novelties in (Sterling). Illustrated 526, 527
Independent Telephone Association of the United States (Convention in St. Louis, September 21-23, 1904). Illustrated 264, 265, 270, 273, 274, 293, 294
Independent Telephone Man, How to Make an. By Prof. J. C. Kelsey. (Indiana Telephone Association) 28
Independents, Effective Organization of, in Ohio and Other States 120
Indexing of Question Boxes. (Editorial) 6
Indiana. (Correspondence) 17, 18, 34, 52, 70, 89 142, 277, 299, 300, 436, 454, 466, 472, 494, 512, 530
Indiana Independent Mutual Telephone Association. (Convention at Lafayette, June 28 and 29, 1904).. ..... 28, 29
Indiana, Telephone and Telegraph Service in..467, 485
Indiana Telephone Items. (Correspondence)..... .....14, 30, 432, 450, 485, 509, 510, 528
Indianapolis-Cincinnati Single-phase Railway..... 258
Indianapolis Electric Railway Terminal Station.... 227
Indianapolis Telephone Company to Build..... 467
Induction Motor, Small Automatic-starting (Emerson). Illustrated 468
Induction Motors, Starting Device for, Meyer's. Illustrated 287
Innovate Manufacturing Company's Adjustable Hanger for Lamp Cords. Illustrated..... 415
Institution of Electrical Engineers (British), Joint Meeting of the, with American Institute of Electrical Engineers at St. Louis.....241, 242, 243, 244
Institution of Electrical Engineers. (Papers and discussions).....48, 49, 66, 67, 243, 244, 447, 453
Instruments in Telephone Testing, Use of. Illustrated 202
Instruments, Measuring, Whitney Hot-wire. Illustrated 317
Instruments, Standard, for Operating Companies. A Proposed System of. By H. P. Davis. With discussion. (National Electric Light Association).. 118
Instruments, Standard, Westinghouse System for the Care of 140
Insulators, High-tension. By R. Scott. Illustrated. 131, 132
Insulators, Porcelain, Customs Classification of..... 161
Insurance Companies, Mutual, Formed by Ohio Electrical Interests 152, 206
"Interborough Rapid Transit." (Book Review)... 358
Interborough Rapid Transit Company, Power Equipment of the. Illustrated..217, 218, 219, 220, 235, 236, 237, 241, 242, 243, 244, 245, 246, 247, 248, 249
International Electrical Congress (Papers and discussions of the) 219, 220, 221, 222, 223, 244, 245, 246, 247, 248, 250, 251, 252, 253, 254, 255, 271, 272, 275, 276, 290, 291, 295, 296, 297, 298, 306, 307, 308, 312, 313, 315, 316, 318, 319, 326, 327, 330, 352, 353, 356, 358, 359, 378, 379, 387, 388, 416, 417, 425, 451, 452
International Engineering Congress..... .....215, 289, 313, 371, 374, 375, 376, 398, 399
International Geographical Congress 214
International Telephone Manufacturing Company's Apparatus for Brazil 293
International Tramway Conference..... 389
Interrupter, Phonetic, for Space Telegraphy, De Moura's. Illustrated 348
Interrupter, Wehnelt, Electrolyte for the..... 77
Interurban Electric-railway System, Aurora-Elgin-Chicago, Some Interesting Features of. Illustrated 499, 500
Interurban Electric-railway System, Chicago and Milwaukee, Betterments of the. Illustrated.... .....459, 460, 461, 462
Interurban Men, Ohio, Discuss the Freight Question 430
Interurban Railway, Fond du Lac-Oshkosh. Illustrated 284, 285, 286
Interurban Railways Prosperous in Iowa..... 61
Interurban Rights in City Streets..... 24
Interurban Service, Westinghouse Single-phase Railway System for. Illustrated 395
Interstate Independent Telephone Association. (Convention in Chicago, December 13-15, 1904). Illustrated 483, 484, 485, 506, 507, 508, 510
Invention, Delay in..... 442
Invention, Joint 333
Invention, Secrecy and..... 394
Ionic Theory, Arrhenius on the..... 160
Iowa Electrical Association, Question Box of the... 94
Iowa, Interurban Railways Prosperous in..... 61
Iron and Steel, The Electrothermic Production of. By Alfred Stansfield. Illustrated. (Canadian Society of Civil Engineers) 78, 79
Iron Ores, The Production of, in 1903..... 291
Isolated Plant Versus Central Station. (Editorial).. 504
Italy, Electrical Opportunities in..... 268
Italy, Recent Tariff Changes in..... 161
Italy, Utilization of Electric Power in.....57, 58, 268

J

Jackson's George W., Proposed Subway System for Chicago. Illustrated 479
Japan, Hydro-electric Plant in..... 258
Japan, Trade of 268
Japs' Methods of Destroying Electrically Charged Entanglements 488
Johns-Manville Company, H. W., Exhibit of the, at St. Louis Exposition. Illustrated.....230, 273
Johns-Manville Company, H. W., Unique Advertising Card of the. Illustrated..... 317
Johns-Manville Company, H. W., New Pole-line Fuse Box of. Illustrated 355
Johns-Manville Company, H. W., Lamp-socket Ring of. Illustrated 375
Johnson's, W. McA., Controller for Electric Furnaces. Illustrated 97
Johnston, Thomas T. (Hydro-electric Power Development at and Near Joliet, Ill., Using Chicago Drainage Canal Water) 100, 101
Joint Use of Poles by Public-service Companies. By D. L. Gaskill. (Ohio Electric Light Association) 152
Joliet, Ill., Hydro-electric Power Development at and Near, Using Chicago Drainage Canal Water. By Thomas T. Johnston. With discussion. (Western Society of Engineers).....100, 101
July, 1904, Electrical Exports for..... 193
June, 1904, Electrical Exports for..... 99
Jungfrau Railway 72, 140
Jurors of Award, Electrical, at St. Louis Exposition. With portraits 173, 501

K

Kankakee, New Independent Telephone Exchange at. Illustrated 4, 5
Kansas and Oklahoma, Telephone Development in. 82, 377
Kansas City-Chicago Wireless Communication..... 501
Kansas City, Long-distance Telephone Connections with 337
Kansas City, Space-telegraph Station at. Illustrated 394
Kansas, Southeast, Telephone Association..... 158
Kansas, The Telephone in. (Correspondence)..83, 102
Kellogg's "Uses of Electricity on Shipboard." (Book Review) 68
Kelsey, Prof. J. C. on "How to Make an Independent Telephone Man." (Indiana Telephone Association) 28
Kennelly, A. E. Portrait 187, 188
Kennelly, A. E., and S. E. Whiting. (The Present Status of the Edison Storage Battery. Illustrated) 271, 272
Kennelly on Electrical Units. (International Electrical Congress) 219
Kerr, Walter C. (The Point of View).....434. 435
Kewanee-Geneseo Single-phase Railway..... 130
Kilowatt-hour Basis, Wausau, Wis., Lighted on a.. 90
Kinemometer, Differential Registering. By Emile Guarini. Illustrated 329
Kingston, Ont., Electric Lighting in.....17, 51, 108
Kinloch Long-distance Telephone Company's Plans. 138
Kinloch Telephone Building in St. Louis..... 49
Knife for Cutting Cable Sheath (Bissell). Illustrated 157
Knights Templars in San Francisco, Illumination in Honor of. Illustrated.....71, 143, 239
Knowlton, Howard S. (Electricity and the Contractor) 447
Knowlton, Howard S. (Tendencies in Sub-station Design) 63, 64
Koester, Franz. (A Swiss Hydro-electric Plant for Small Industries. Illustrated).....423, 424
Koester, Franz. (Hydro-electric Plant for Small Industries at Hagneck, Switzerland. Illustrated).. .....517, 518, 519
Koester, Franz. (Rack Railway to the Gornergrat, Switzerland. Illustrated) 261, 262
Kryptol, a New Substance for Electric Heating. By Frank H. Mason. Illustrated. (Consular Report) 351

L

Laboratory, Inexpensive Testing. (Question Box of National Electric Light Association)..... 85
Lackawanna and Wyoming Valley Electric Railway. 144
Ladies, Distinguished, Inspect Electrical Novelties.. 488
Lafayette, Ind., Proposed New Railway Power House at 430
Lake Baikal in Siberia, Electricity in the Construction of the New Railroad Around..... 4
Lake Baikal in Siberia, Space Telegraphy Across.... 168
Lake Shore Railroad's Long-distance Telephone Line 292, 376
Lamme, B. G., on Alternating Current for Railway Work (International Electrical Congress)....220, 243
Lamme, B. G. (Synchronous Motors for Regulation of Power Factor and Line Pressure)..... 10
Lamme's B. G., Single-phase Railway Improvements. Illustrated 95
Lamp Cords, Adjustable Hanger for (Innovate). Illustrated 415
Lamp Suspension over Workbench. Illustrated..... 133
Lamp-renewal Data (Ohio Electric Light Association)..... 155
Lamp-socket Ring (Johns-Manville). Illustrated... 375
Lamp-testing Device for Central Stations. Illustrated 77
Lamps, Renewal of, During Peak Load..... 94
Lane, T. S. (Methods of Handling Toll Business). 82
Langley, John W. (Electrical Purification of Drinking Water) 315
Lang's Stage Plug and Receptacle. Illustrated..... 317
Lanyon Zinc Company's Exhibit at St. Louis Exposition. Illustrated 119
Lasche's Automatic Control for Railway Motors. Illustrated 500, 501
Laundry Girls are Progressive. (Editorial)..... 446
Lawn Party, Electrical Decorations at a. Illustrated 43
League of American Municipalities..... 316
Leith to Have Electric Railways..... 289
Les Clees-Yverdon Hydro-electric Plant in Switzerland. Illustrated 423, 424
Letter Writing, Facsimile, by Wireless..... 333
Lewis and Clark Centennial Exposition. By Frank L. Merrick. Illustrated 462, 463
Lewis and Clark Exposition, Lighting the. By James R. Thompson 463
Life-saving Service, Electric Railway in..... 99
Light, Electric. (See also Electric Light.)
Light, Heat and Power in Aurora, Ill., The New Central Station for. Illustrated.....1, 2, 3
Lighthouse, Electric, at Heligoland. Illustrated.. 61
Lighting, Commercial, The Nernst Lamp as a Factor in. By E. R. Roberts. Illustrated. (Michigan Electric Association) 336, 337
Lighting, Electric, at the Alhambra Theater. Illustrated 129, 130
Lighting Plans, Private, Gas-engine Unit for. Illustrated 200
Lighting, Heating and Electric-railway Plant at Bloomington and Normal, Ill. Illustrated.21, 22, 23
Lighting the Lewis and Clark Exposition, By James R. Thompson 463
Lightning Arrester, New (American Electric Fuse Company). Illustrated 157
Lightning as a Fire Hazard. (Editorial) 26
Lightning Strikes a Trolley Car..... 144
Lincoln, P. M. (Adaptation of Alternating Currents to Railways)..... 103
Lincoln, P. M. (Heavy Electric Traction by Alternating Currents).....40, 41, 42
Line Construction, High-tension, Discussed at International Electrical Congress..... 215
Line Construction, Long Spans in.....6, 8, 9
Lineman's Death, President of Lighting Company Held Responsible for..... 101
Lineman's Testing Instrument (Whitney). Illustrated 415
Lindall, John. (Maintenance and Inspection of Electrical Equipment)..... .....310, 311
Lindsay, S. C. (Operation of Synchronous Converters) 139, 140
Linz Railway Shops in Austria, Electric Power in the. By Emile Guarini. Illustrated.....441, 442
Liquid-contact Voltage Regulator, McGary's. Illustrated 480
Liquid-expansion Electric Meter of Clerici. Illustrated 59
Live-wire Testing Devices, Recent. Illustrated.68, 69
Loaded Telephone Lines in Practice. By Dr. H. V. Hayes. Illustrated. With discussion. (International Electrical Congress).....247, 252, 253
Locating Grounds on Underground Conductors. Illustrated 425
Locke Insulator Manufacturing Company's Exhibit at St. Louis Exposition.....229, 230
Locomotive, Electric, for the Reading Railroad..... 184
Locomotive Engineers Face the Increasing Use of Electric Power on Railroads. (Editorial)..... 216
Locomotive, New Electric, on Jungfrau Railway.... 140
Locomotive to be Operated by Diesel Engine...362, 430
Locomotives, Electric, in Use in Chicago Freight Tunnels. Illustrated 405, 406
Locomotives, Electric. (Editorial)..... 410
Locomotives, Electric, New York Central. Illustrated 3, 342, 371, 407, 408, 409
Locomotives, Steam, and Electric-railway Motors, Fuel Cost of Operating, J. G. White on. (International Engineering Congress)..... 371
Lodge-Muirhead Oil-film Receiver for Space Telegraphy. Illustrated 27
London, A Record in Tramway Construction in. Illustrated 97
London, Big Pneumatic-tube Scheme for..... 96
London Times' Space-telegraph Service in Russo-Japanese War.....7, 154, 168, 169
London Underground Railways..... .....16, 161, 359, 399, 435, 471
Long-distance Connection for Oklahoma and Kansas Telephone Company 82
Long-distance Connections with Kansas City..... 337
Long-distance Telephone Line, Lake Shore Railroad's 292, 376
Long-distance Telephony, Some Interesting Phases of. By S. G. McMeen. With discussion. (Western Society of Engineers).....414, 415
Long-distance Telephone Trunk Line, New..... 67
Long-distance Telephone Plans, Kinloch..... 138
Long Island Railroad, Electricity to Replace Steam on. Illustrated 386, 420, 442, 443
Long Island Railroad at Ozone Park, Electrically Controlled Track Switches on the. Illustrated 190, 191, 192
Long Spans for Transmission Lines. By F. O. Blackwell. With discussion. (American Institute of Electrical Engineers).....8, 9
Lorain Surface-contact Electric-railway System, Operation of the..... .....69, 453
Louisiana Purchase Exposition. (See St. Louis Exposition).
Lundell-Lozier Department of National Electric Company 355
Luot's Phase Transformation. Illustrated..... 306
Lyford, O. S., Jr., and W. N. Smith. (Problems of Heavy Electric Traction. Illustrated)..442, 443, 444

M

Magnet, Large, for Surgical Purposes..... 105
Magnetic Club Outing 77
Magnetic Deviations of the Compass, Alleged. (Editorial) 288
Magnetic Track Brakes. Illustrated..... 68
Magnetism, The Earth's, L. A. Bauer on. (International Electrical Congress)..... 244
Mahoney's, Timothy, Sectional Third-rail Railway System. Illustrated 115
Maintenance and Inspection of Electrical Equipment. By John Lindall. With discussion. (American Railway Mechanical and Electrical Association). 310, 311
Manganese Ores, Barytes and Lithium, Production of, in United States..... 255
"Manufacturing Cost." By H. L. C. Hall. (Book Review) 317
Manufacturing Growth, Relative, of the United States and European Countries..... 268
Marconi Talks about Space Telegraphy.....264, 315
Marion, Ind., Light and Heating Company, New Power House for 269
Marshall, Mich., Telephone Situation in..... .....203, 314, 337, 396, 450
Mason, Frank H. (Costs and Profits of Electric Railways in Germany)..... 122
Mason, Frank H. (Kryptol, a New Substance for Electric Heating. Illustrated)..... 351
Mason, Frank C. Portrait 338
Maximum Distance, The, to Which Power Can be Economically Transmitted. By Ralph D. Mershon. Illustrated. With discussion. (American Institute of Electrical Engineers).....524, 525, 526
May, 1904, Electrical Exports for..... 24
McCulloch, Richard, Portrait..... 283
McCulloch, Robert, Portrait..... 283
McGary's Liquid-contact Voltage Regulator. Illustrated 480
McLennan on Radioactivity of Natural Gases. (Editorial) 330
McMeen, Samuel G. (Planning a Telephone System). 293, 294
McMeen, Samuel G. (Some Interesting Phases of Long-distance Telephony) 414, 415
McMurtie Electric Timing Clock..... 157
McQuarrie's Telephone Service Meter. Illustrated. 176, 177
Measured-service Meter for Telephones. Illustrated. 315
Mechanical Equivalent of Heat, The, Measured by Electrical Means. By Howard T. Barnes. (International Electrical Congress)..... 297
Mechanical Science, Some Refinements of. By Ambrose Swasey. (American Society of Mechanical Engineers) 490, 491
Meier, E. D. (The American Diesel Engine. Illustrated) 328
Melville, Admiral Geo. W. (Military Possibilities of Engineering Schools) 213
Mercury-vapor Lamp. (See also Vapor Lamp)
Mercury-vapor Lamps for Photographic Purposes. Illustrated 33
Mercury-vapor Lamps, Starting Devices for. Illustrated 179

Merrick, Frank L. (Lewis and Clark Centennial Exposition. Illustrated) 462, 463
Mershon on Maximum Length of Commercial Power Transmission. (Editorial) 482
Mershou, Ralph D. (The Maximum Distance to Which Power Can be Economically Trausmitted. Illustrated) 524, 525, 526
Mershon's High-voltage Experimeots at Niagara Falls 291
Meteorological Phenomenon, A Strange. (Editorial). 116
Meter, Liquid-expansion Electric, of Clerici. Illustrated 59
Meter Patent Litigation, Duncan 431
Meter Testing. (Ohio Electric Light Association).. 156
Metric Measurements. By Alexander Siemens. (Institution of Electrical Engineers) 447
Metropolitan Elevated Railway in Chicago, Electropneumatic Control for. Illustrated 39, 40, 41
Mexico (Correspondence) 17, 71, 124, 183, 206, 277, 320, 380, 472, 473, 530
Mexico, City of, Electric Lighting in the 355, 473
Mexico, City of, Telephone Plans of 414, 451
Mexico, Industrial Development in 1
Mexico, Recent Tariff Changes in 161
Mexico, Santiago River in, Proposed Power Plant on the 115
Mexico, Telegraph Lines in 317
Mexico, Waterpower Development in 7, 115, 206, 262, 277, 320, 380, 473
Miami Valley Telephone Association 14
Michigan. (Correspondence) 35, 51, 52, 70, 89, 107, 125, 142, 162, 182, 183, 206, 207, 231, 257, 299, 320, 340, 360, 361, 380, 400, 419, 437, 454, 455, 472, 494, 512, 530, 531
Michigan Electric Association. (Editorial) 330
Michigan Electric Association. (Formation of and First Convention in Detroit, Oct. 11 and 12, 1904) 47, 79, 327, 329, 336, 337
Michigau Electrical Machinery to be Tabulated.... 491
Michigan Telephone Matters. (Correspondence).... 49, 67, 68, 102, 120, 254, 292, 314, 432, 450, 510, 528
Microbes and Electricity. (Editorial) 308
Milde & Son, Exhibit of, at St. Louis Exposition. Illustrated 93
Militia, Telephone Scouts of the. By R. G. Grayne. Illustrated 307
Military Possibilities of Engineering Schools. By George W. Melville. (Franklin Institute) 213
Military Purposes, Portable Space-telegraph Stations for. Illustrated 57
Milk and Newspaper Delivery by Electric Railway. 500
Milk, Electrical Devices for Increasing the Secretion of 362
Millar, J. (Wheel Matters) 310
Miller, K. B., on the Automatic Telephone Exchange. (International Electrical Congress) 247, 248
Milwaukee, Chicago and, Electric-railway System, Betterments of the. Illustrated....459, 460, 461, 462
Milwaukee Considering a Municipal Lighting Plant 257, 258
Mine, Coal, Ohio, Electricity in ao 489
Mineral Products of the United States 491
Minerallac Company's Live-wire Testing Devices. Illustrated 68, 69
Minneapolis and St. Paul, Electrical Properties Damaged by Severe Storms in 176, 183, 274
Miscellaneous Notes.....37, 54, 72, 90, 91, 109, 126, 144, 164, 184, 208, 233, 258, 279, 301, 322, 342, 362, 382, 402, 403, 421, 438, 456, 475, 496, 514, 533
Missouri, Possible Waterpower Developments in.... 449
"Modern Practical Electricity." By R. M. Walmsley. (Book Review) 417
Moloney Electric Company's Exhibit at St. Louis Exposition. Illustrated 229
Montreal, New Shops at, for the Canadian Pacific Railway 296
Montreal, Tlephones in 158
Monterey County, Cal., Gas and Electric Company, New Equipment for 433
Monterey, Mexico, Street-railway Merger in..175, 206, 320
Moody's Neutralizing Winding for Transformers. Illustrated 397, 398
Moonlight, Schedule for 1905, Western Electrician's. (Book Review) 471
Mors Electric Timing Clock 109, 157
Motor-generator Sets, Rotary Converters and. By William C. L. Eglin. (International Electrical Congress) 318, 319
Motor-generator Sets, Synchronous, Division of Load Between, Obtained by Reactances. Illustrated.... 60
Motor, Induction, Small Automatic-starting (Emerson). Illustrated 468
Motor, Wagner Vertical Single-phase. Illustrated.. 508
Motor, Westinghouse Railway. Illustrated 33
Motor, Synchronous, Adapted for Railway Work. Illustrated 132
Motors, Alternating-current. By C. P. Steinmetz. Illustrated. (International Electrical Congress) 306, 307
Motors, Alternating-current Railway, Steinmetz and Lamme on. (American Institute of Electrical Engineers) 242, 243
Motors, Alternating-current, Mr. Steinmetz's Investigation of the Characteristics of the. (Editorial). 308
Motors for Cranes and Hoists, Westinghouse. Illustrated 527
Motors, Induction, Meyers' Starting Device for. Illustrated 287
Motors (Pillsbury's), Single-phase Alternating-current. By H. P. Andrews. Illustrated 354
Motors, Maintenance of. (Editorial) 26
Motors, Railway, Lasche's Automatic Control for. Illustrated 500, 501
Motors, Synchronous, for Regulation of Power Factor and Line Pressure. By B. G. Lamme. With discussion. (American Institute of Electrical Engineers) 10
Moureaux, Th. (Application of Salts of Radium to the Study of Atmospheric Electricity. Illustrated) 42, 43
Moving Pictures, Taking, by the Use of Vapor Lamps 47
Multiple-voltage Control (Bullock) for Variable-speed Motors. Illustrated 32
Multiple-unit System of Train Operation, Cutler's Two-wire System for. Illustrated 444, 445
Mumford, Samuel C. (Elements of Cost Which Go to Make Up the Selling Price of Electric Current) 329
Mundy's Method of Transmitting Sound Through Water. Illustrated 215
Municipal (Corporation) Telephones. By A. R. Bennett. With discussion. (Institution of Electrical Engineers) 48, 49, 66, 67
Municipal-ownership Daily Suspends Publication. (Editorial) 350
Municipal Ownership. (Editorial).....44, 172, 350
Municipal Ownership in Canada 4
Municipal Ownership in England 153, 276, 298, 319, 379, 418, 435, 441
Municipal Ownership, Waterworks and. (Editorial) 44
Municipal Ownership, Some Views on.....172, 225
Municipal Telephone Exchanges in Canadian Cities 274, 314, 450
Municipal Telephony in England.....379, 418, 435
Municipal Versus Private Ownership as Exemplified by the Philadelphia Gas Plant 486
Myers' Starting Device for Induction Motors. Illustrated 287

N

National Arm, Piu and Bracket Association at St. Louis 327
National Electric Company's Exhibit at St. Louis. Illustrated 137
National Electric Compaay, Lmdell-Lozier Department of 355
National Electric Company's Apparatus in Monterey, Cal. 433
National Electric Light Association, Next Year's Convention of the. (Editorial) 194, 446
National Electric Light Association, The Next Conventiou of the. By John Craig Hammond. Illustrated 481
National Electric Light Association, A Mistakeu View of the. (Editorial) 62
National Electric Light Association. (Papers and discussions)..30, 31, 32, 43, 45, 46, 47, 60, 61, 77, 78, 85, 94, 97, 99, 104, 105, 118, 159, 160, 502, 503
National Electric Light Association, Proceedings of the. (Book Review) 376
National Electric Light Convention of Next Year.. .....194, 197, 223, 305, 441, 442, 481
National Electrical Contractors' Association at St. Louis 272
National Independent Telephone Association, Formation of the. (Editorial) 266
Naval Show on the "Pike," Electrically Operated Warship Models at the. Illustrated 345, 346
Nerost Lamp, The, as a Factor in Commercial Lighting. By E. R. Roberts. Illustrated. (Michigan Electric Association) 336, 337
Nernst Lamps, H. N. Potter on. (International Electrical Congress) 247
New Brunswick, Telephone Companies in 377
New England. (Correspondence) 16, 17, 34, 51, 69, 70, 88, 106, 124, 141, 162, 182, 206, 230, 276, 277, 299, 319, 320, 340, 359, 360, 380, 399, 400, 418, 437, 453, 493, 511, 529
New England, Another Electric-railway Consolidation in 81
New England Telephone News. (Correspondence).. .....83, 314, 357
New England, Telephone Status in. By Vinton A. Sears 357
New Mexico, Telephone Extensions in 377
Newspaper and Milk Delivery by Electric Railway.. 500
New York and Chicago, Municipal Electrical Employes in 435
New York. (Correspondence) 16, 34, 51, 69, 87, 105, 106, 123, 124, 141, 161, 162, 182, 205, 206, 230, 231, 256, 276, 299, 319, 339, 340, 359, 380, 399, 418, 436, 453, 471, 493, 511, 529
New York Central Contemplates Further Electrical Equipment 59, 76, 161, 256
New York Central Railroad, Electrical Equipment of, in and Near New York City..... .....2, 3, 87, 90, 123, 144, 161, 418, 474
New York Central's Electric Locomotives. Illustrated 3, 342, 371, 407, 408, 409
New York City, Electrification of Steam Railroads in and Near. Illustrated 2, 3, 87, 90, 123, 141, 144, 161, 205, 386, 420, 442, 443, 474
New York City, Electric-railway Projects for the Northern End of 87, 106, 123, 141, 174
New York City, Telephones in 254
New York City, Police Telephone Call Boxes in. With portraits of M. R. Brennan and F. C. Mason. 338
New York City, Track Repairing in. Illustrated... 42
New York Edison Company, 2,000-kilowatt Rotary Converters for the. Illustrated 227
New York Electrical Society. (Meetings and papers). 11, 486
New York Entertainmeut for Foreign Electrical Engineers 196, 263
New York, Municipal Street-lighting Talk in 505
New York Rapid-transit Subway in Operatiou 599, 418, 436, 446, 453, 471
New York Rapid-transit Subway, Opening of tbe.. .....366, 367, 380
New York Rapid-transit Subway, Power Plant Equipment for the. Illustrated 211, 212, 213, 349
New York Rapid-transit Subway, Preparations for the Opening of the 34, 51, 69, 87, 105, 114, 144, 182, 205, 230, 256, 299, 339, 349
New York Rapid-transit Subway, Protection of Life in the. By Sydney W. Ashe. Illustrated....368, 369
New York Rapid-transit Subway Ready for Use. Illustrated. 349
New York Rapid-traosit Subway, The. (Editorial). 370
New York State Indepeodent Telephone Association Makes a Bad Precedent. (Editorial) 6
New York State Independent Telephone Association. (Convention at Buffalo, June 24 aod 25, 1904).. .... 15, 82
New York State, Probable Electric Railway Across.. .....59, 76, 161, 256, 508
New York Street Railway Association at Utica..... 258
New York to Boston in Electric Cars. With map... 486
New York, Westchester and Boston Railway Company, Franchise of the 174
New Zealand, Electrical Progress in 179
Niagara Falls. (Correspondence) 106
Niagara Falls, Foreign Electrical Delegates in..... 214
Niagara Falls, High-voltage Experiments at..... 291
Niagara Falls Power Company, Financial Reports of the 184
Niagara Falls, Power Development on the Canadian Side at 418, 452
Niagara River, Power Resources of the, Further Development of 85
Niagara-Rochester Power Transmission .....
Niagara-Toronto Power Transmission 201, 418
Nitrogen from the Air, Electrical Extraction of. By J. Sigfrid Edstrom. Illustrated. (International Electrical Congress) 295, 296
Nobel Prizes Awarded 488
Nobel Prizes, The Award of the. (Editorial)..... 522
"Noise Cure" for Chicago Elevated Roads Rejected. 347
North Sea Incident, "Wireless" and the.....390, 465
North Shore Electric Company to Build a Central Station at Waukegan 208
Northern Electrical Manufacturing Company's Exhibit at St. Louis Exposition. Illustrated..... 200
Northern Pacific to Use Telephone for Train Orders 158
Northwestern Cedarmen's Association 528
Northwestern States. (Correspondence) 18, 35, 52, 88, 107, 125, 142, 163, 183, 207, 231, 257, 278, 320, 321, 340, 341, 361, 400, 419, 437, 454, 494, 495, 512, 531
Northwestern Electrical Association, St. Louis Meeting of the 255
Northwest, Telephone News from the. (Correspondence) 14, 29, 49, 67, 83, 102, 120, 138, 158, 176, 202, 226, 227, 274, 292, 314, 337, 357, 376, 396, 414, 432, 450, 466, 485, 509, 528
N-rays 181
N-rays, Anesthetics and. (Editorial) 44
Nunn, P. N. (Work of the Telluride Power Company. Illustrated) 245, 352, 353, 367

O

Oates-Royd Mills, British Hydro-electric Plant at. Illustrated 77
October, 1904, Electrical Exports for..... 468
Office Building, Tall, The Power Plant of the. By J. H. Wells. (American Society of Mechanical Engineers) 64, 65
Office Building, Tall, The Power Plant of the. By S. H. Bunnell. (American Society of Mechanical Engineers) 508, 509
Office Methods and Accounting. By Frank W. Frueauff. With discussion. (National Electric Light Association) 159, 160
Ogden, Utah, Telephone Service in..... 466
Ohio. (Correspondence) 17, 34, 35, 52, 70, 88, 107, 124, 142, 162, 182, 206, 231, 256, 277, 278, 299, 320, 340, 360, 380, 381, 400, 419, 436, 437, 454, 472, 494, 511, 512, 530
Ohio Central-station Men Not Turning Out as They Should. (Editorial) 154
Ohio Electric Light Association. (Convention at Sandusky on August 16-18, 1904) 155, 156
Ohio Electric Light Association. (Papers)....151, 152, 160, 170, 171, 180, 181, 198, 199, 203, 204, 205
Ohio Electric Light Convention, (Programme for the) 99
Ohio Electrical Interests, Mutual Insurance Companies Formed by 152, 206
Ohio, Extensive Traction Project in..... 523
Ohio Independent Telephone Associatiou and District Meetings 83, 120, 138, 158, 176, 226
Ohio Interurban Line, 240 Miles Long, Proposed... 349
Ohio Interurban Railway Association.....212, 430
Ohio Men to Form Express Company for Electric Railways 175
Ohio Telephone Notes. (Correspondence) 14, 29, 30, 49, 67, 83, 102, 120, 138, 158, 176, 202, 226, 253, 274, 292, 314, 337, 376, 396, 414, 432, 450, 466, 485, 528
Oil-film Receiver for Space Telegraphy. Illustrated. 27
Oklahoma and Kansas, Telephone Development in.82, 377
Old-time Telegraphers' Reunion 214, 258
Ontario Power Company Contracting for the Delivery of Current 452
Oregon Power Company, New..... 371
Organization, The Value of. By J. B. Hoge. (Independent Telephone Associatioo).....264, 265
Osterberg, Max, Illness and Death of.....125, 381
Ottawa, Ont., Street-railway System in, May Become Property of City 429
Ottumwa Telephone Company Reorganized 451
Outlet Box, Floor (G. L.) 268
Oven, Electric, for Chemists..... 61
Overland Wireless Communication, Long.....501, 523
Owosso, Mich., Telephone Situation in....120, 158, 292
Oxygen and Hydrogen Cell, Hazard-Flamand Electrolytic. Illustrated 76
Ozone Park, Electrically Controlled Track Switches on the Long Island Railroad at. Illustrated..... .....190, 191, 192

P

Pacific Cable, British, Not a Paying Investment... .....177. 179, 360
Pacific Cable, German-Dutch 205
Pacific Coast Electric Transmission Association. (Convention at Monterey, Cal., June 21 and 22, 1904) 7, 178, 179
Pacific Slope. (Correspondence) 18, 35, 36, 52, 53, 71, 89, 107, 125, 143, 163, 183, 207, 232, 257, 278, 300, 321, 341, 361, 381, 400, 401, 419, 420, 437, 455, 473, 495, 512, 513, 531
Pacific Slope, Telephone Progress on the. (Correspondence) 14, 29, 314
Panama Canal Cable, Proposed. (Editorial)..... 522
Panama Canal Construction, Anticipating. By George E. Walsh 81
Panama Canal, Electrical Machinery for the. (Editorial) 80
Paper Mill, Electrically Operated, at Grand Rapids, Wis. Illustrated 388, 389
Parallel, Transmission Lines Operated in, Conditions for Continuous Service Over. By M. H. Gerry, Jr. (American Institute of Electrical Engineers)..9, 10
Paris, Defective Telephone Service in.....226, 377, 432
Paris-Orleans Railroad, Electric Terminal of..... 351
Parke, R. A. (Braking High-speed Trains)....451, 452
Parke, Roderick J. (Aluminum Electrical Conductors) 12, 13
Parsons, William Barclay, Leaves New York Rapid Transit Commission 468
Parsons, William Barclay. (Underground Railways) 374
Patent Office Statistics 258, 388
Patent Record, Illustrated Electrical.....19, 20, 37, 38, 55, 56, 73, 74, 91, 92, 110, 127, 128, 145, 146, 165, 166, 185, 186, 209, 210, 233, 234, 259, 260, 279, 280, 301, 302, 323, 324, 342, 343, 344, 363, 364, 382, 383, 384, 403, 404, 421, 422, 439, 440, 457, 458, 475, 476, 497, 498, 515, 516, 533, 534
Patent Situation, The Telephone. By Edward E. Clement. (Iodepeodent Telephone Association).. .....273, 274
Payne, Henry C., Death and Funeral of.....284, 321
"Pearls," The Weissmann Electric. Illustrated.... .....93, 94, 347, 425
Peck, J. S. (The Use of Ground Shields in Transformers) 9
Pedrail, Diplock's, Tested..... 117
Pennsylvania, Independent Telephone Men Organize in 292
Pennsylvania Railroad Case, Western Union Defeated in 488
Pennsylvania Railroad, Electrical Equipment of, Near New York City. Illustrated..... .....2, 3, 386, 420, 442, 443
Perkins, Frank C. (High-power Gas Engines in Electric Stations in Spain and Holland. Illustrated) 385, 386
Perkins, Frank C. (Neepsend, Sheffield, Turbo-electric Station. Illustrated) 167, 168, 169
Personal. (Notes) 18, 36, 53, 71, 89, 90, 107, 108, 125, 143, 163, 183, 207, 232, 257, 278, 300, 321, 341, 361, 381, 401, 420, 437, 455, 473, 495, 513, 531, 532
Personal-injury Responsibility in Telephone Construction Work and Maintenance, How Avoid. By Rome C. Stephenson. (Interstate Independent Telephone Association) 510
Peru, Second Electric Railway in..... 304
Phase Transformation, Lunt's Method of. Illustrated 306
Phase Transformer, Steinmetz's. Illustrated..... 58
Philadelphia, Conduit Deal in..... 346
Philadelphia, Foreign Electrical Delegates in..... 263
Philadelphia Gas Plant, Record of Private Ownership in 486
Philadelphia Rapid Transit Plans 157, 208
Philippine Tariff, Proposed Changes in 411
Philippines, Railroads in the. (Editorial)..... 504
Phonetic Interrupter for Space Telegraphy, De Moura's. Illustrated 348
Photographic Purposes, Mercury-vapor Lamps for. Illustrated 33
Physics and Electricity. By Professor William Hallock. (New York Electrical Society)..... 486
Pierce, Richard H. (Exhibits Power Plant at St. Louis) 429
Pillsbury's Single-phase Alternating-current Motors. By H. P. Andrews. Illustrated 354

Pisa, Italy, Large Space-telegraph Station at..... 147
Pittsburg and Allegheny Telephone Syndicate to Build a Lighting Plant 425
Pittsburg, Foreign Electrical Delegates in. Illustrated 263
Pittsburg Transformer for Thawing Ice in Water Pipes. Illustrated 448
Platinum 259
Plug and Receptacle, Lang's Stage. Illustrated.... 317
Plus-and-minus Selective Signaling. Illustrated..15, 16
Pneumatic-tube Scheme for London, Big..... 96
Point of View, The. By Walter C. Kerr.....434, 435
Poles, Chestnut 475
Poles, Joint Use of, by Public-service Companies. By D. L. Gaskill. (Ohio Electric Light Association) 152
Police-patrol and Fire-alarm Systems, Electric. (Census Bulletin) 50
Police Telephone Call Boxes in New York City. With portraits of M. R. Brennan and F. C. Mason..... 338
Polyphase Transmission with Single-phase Operation for Railway Purposes, Arnold's. Illustrated. 487
Popocatepetl, Mount, Proposed Electric Railway Up. 371
Porcelain Insulators, Customs Classification of.... 161
Portable Space-telegraph Stations for Military Purposes. Illustrated 57
Port Huron, Grand Trunk Tunnel at, Electricity for the 350, 419
Portland Exposition. (See Lewis and Clark Exposition.)
Porto Rico's Telegraph Service 121, 122
Postal Telegraph Extensions in the Rockies..... .....89, 132, 143, 300
Postoffice Telephone Experiment, British..... 510
Potter, H. N., on Nernst Lamps. (International Electrical Congress) 247
Potts, Louis M. (Printing Telegraphy. Illustrated) 416, 417
Power Can be Economically Transmitted, The Maximum Distance to Which. By Ralph D. Mershon. Illustrated. With discussion. (American Institute of Electrical Engineers).....524, 525, 526
Power Company, Telluride, Work of the. By P. N. Nunn. Illustrated. With discussion. (International Electrical Congress) 245, 352, 353, 367
Power Development, Hydro-electric, at and Near Joliet, Ill., Using Chicago Drainage Canal Water. By Thomas T. Johnston. With discussion. (Western Society of Engineers) 100, 101
Power Development in Mexico.....7, 115, 262
Power Equipment of the Interborough Rapid Transit Company. Illustrated 211, 212, 213
Power Factor and Line Pressure, Synchronous Motors for Regulation of. By B. G. Lamme. With discussion. (American Institute of Electrical Engineers) 10
Power Plant, Exhibits, at St. Louis Exposition. By Richard H. Pierce 429
Power Plant of the Tall Office Building. By J. H. Wells. (American Society of Mechanical Engineers) 64, 65
Power Plant of the Tall Office Building, The. By S. H. Bunnell. (American Society of Mechanical Engineers) 508, 509
Power Plant, Service, at St. Louis Exposition. Illustrated 303, 304, 305
Power Resources of the Niagara River, Further Development of 86
Power Transmission. (See also Hydro-electric, Transmission and Waterpower.)
Power Transmission. (Notes) 36, 54, 108, 109, 164, 184, 258, 322, 342, 402, 420, 438, 474
Power Transmission, Commercial, What Is the Maximum Length of? (Editorial) 482
Power Transmission, Electric, Possibilities of Single-phase Currents in. By H. A. Bullard and Sidney Sprout. (Pacific Coast Electric Transmission Association) 178, 179
Power-transmission Project in Russia. (Editorial).. 6
Price of Electric Current, Selling, Elements of Cost Which Go to Make Up the. By Samuel C. Mumford. (Michigan Electric Association) 329
Primary Battery, Gladstone-Lalande. Illustrated... 157
Primary Circuits, Testing, for Grounds. (Question Box of Iowa Electric Light Association)..... 94
Printing Telegraph System, Barclay's..... 521
Printing Telegraph Systems, Modern High-speed. By J. C. Barclay. (International Electrical Congress) 275, 276
Printing Telegraphy. By Louis M. Potts. Illustrated. (International Electrical Congress)..416, 417
Profit-sharing in the Telephone Business..... 102
Promethean Electric Heaters in New York Subway. Illustrated 394
Protection of Life in the New York Subway. By Sydney W. Ashe. Illustrated.....368, 369
Protector Litigation 315
Prussian System of Electric Train Lighting, The. By Carl Roderbourg. (International Electrical Congress) 358, 359
Publications. (Notes) 19, 54, 72, 90, 109, 126, 144, 164, 184, 208, 233, 258, 278, 279, 301, 322, 342, 362, 381, 382, 402, 421, 438, 456, 474, 496, 513, 514, 532
Public-service Companies, Joint Use of Poles by. By D. L. Gaskill. (Ohio Electric Light Association) 152
Pump Controller, Westinghouse Automatic..... 431
Pumping Plant, Automatic, for Residences..... 47
Pumps, Alcohol Motors and, in Cuba..... 268
Pyro-electrolytic Furnace, Steinmetz's. Illustrated. 445

Q

Question Box of Iowa Electrical Association..... 94
Question Box of National Electric Light Association. 43, 45, 60, 78, 85, 99
Question Boxes, Indexing of. (Editorial)..... 6

R

Radio-active Material, Vapor Lamp (Hewitt's) with. Illustrated 305
Radioactivity of Natural Gases, McLennan on. (Editorial) 330
Radium. (Editorial) 62, 216, 410
Radium, Prof. E. Rutherford on. (International Electrical Congress) 244
Radium, Prof. J. J. Thomson on. (International Electrical Congress) 244
Radium, Salts of, Application of, to the Study of Atmospheric Electricity. By Th. Moureaux. Illustrated 42, 43
Railroad Around Lake Baikal in Siberia, New, Electricity in the Construction of the..... 4
Railroad Business, Telephone for.....158, 202, 376
Railroad, Erie, Proposed Electrification Scheme of. 353, 415
Railroad, Paris-Orleans, Electric Terminal of..... 351
Railroad Service, Telephone Line from Chicago to New York for 292, 376
Railroad Shops at Danville, Ill., Electric Power in. Illustrated 519, 520, 521
Railroad Shops at Montreal, New Canadian Pacific.. 296
Railroad Telegraph Operators. (Editorial)..... 44
Railroad Terminal Electrification 413
Railroad Train Lighting by Electricity, Roderbourg on. (International Electrical Congress).....358, 359
Railroad Train, Telephone on..... 357
Railroad Trains, High-Speed, Braking. By R. A. Parke. (International Electrical Congress)..451, 452
Railroading (Electric Traction), Heavy, by Alternating Currents. By P. M. Lincoln. (Canadian Electrical Association) 40, 41, 42
Railroading (Traction), Heavy Electric, Problems of. By O. S. Lyford, Jr., and W. N. Smith. Illustrated. With discussion. (American Institute of Electrical Engineers) 442, 443, 444
Railroads, Eastern, The Electric Development of. By George E. Walsh 2, 3, 4
Railroads, Electrification of Steam. (Editorial)..... .....116, 390, 446
Railroads, Locomotive Engineers Face the Increasing Use of Electric Power on. (Editorial)..... 216
Railroads, Steam, Advisability of Substituting Electricity on. By J. G. White. (International Engineering Congress) 375, 376
Railroads, Steam and Electric, Interchange of Freight Between 430, 494
Railroads, Steam, Gasoline Motors for..... 203
Railroads, The Contest of Electricity with Steam on 115, 390, 488
Railroads, Transcontinental Steam, Electricity for.. 488
Rails, Steel, Electrically Tested at Varying Temperatures 137
Railway Across New York State, Probable Electric. 76
Railway, Electric. (See also Electric Railway.)
Railway, Electric, Ballston, Alternating-Direct Working with Compensated Motors on. Illustrated... .....148, 149, 150, 151
Railway Improvements, Scott and Lamme's Single-phase. Illustrated 95
Railway, Interurban, Fond du Lac-Oshkosh. Illustrated 284, 285, 286
Railway Motor, Westinghouse. Illustrated..... 33
Railway Motors, Lasche's Automatic Control for. Illustrated 500, 501
Railway Purposes, Arnold's Polyphase Transmission with Single-phase Operation for. Illustrated.... 487
Railway, Rack, to the Gornergrat, Switzerland. By Franz Koester. Illustrated 261, 262
Railway Shops in Austria, Linz, Electric Power in the. By Emile Guarini. Illustrated.....441, 442
Railway, Single-phase, Kewanee-Geneseo 130
Railway System, Mahoney's Sectional Third-rail. Illustrated 115
Railway System, Westinghouse Single-phase, for Interurban Service. Illustrated 395
Railway Systems, Arnold Electropneumatic..... 142
Railway Work, Alternating Current for. (Discussions at International Electrical Congress)..... .....220, 241, 242, 243, 244
Railway Work, Synchronous Motor Adapted for. Illustrated 132
Railways, Adaptation of Alternating Currents to. By P. M. Lincoln. With discussion. (Engineers' Society of Western Pennsylvania).....103, 104
Railways, Steam, Application of, Electricity to. By Bion J. Arnold. (Presidential address to American Institute of Electrical Engineers).....241, 242
Railways, Underground. By William Barclay Parsons. (International Engineering Congress)..... 374
Ramsay, Sir William, on Radium. (Editorial)..216, 410
Rapid-transit Subway, New York. (See New York Rapid-transit Subway.)
Rates for Electricity, Mumford on. (Michigan Electric Association) 329
Rates for Electricity Reduced in Brooklyn..... 339
Rates for Electricity Supply. By Etienne de Fodor. With discussion. (International Electrical Congress) 221, 222, 245, 246
Raymond's "Alternating-current Engineering." (Book Review) 376
Reactances, Division of Load Between Synchronous Motor-generator Sets Obtained by (Woodbridge Patent). Illustrated 60
Records of Electrical Engineering Graduates. Illustrated 133
Rectifier, Scheidel Electrolytic. Illustrated..... 133
Reddy, Thomas J. Portrait 5
Refrigerating Plant, Small Electric, for the Household. Illustrated 413
Reichsanstalt, Work of the, in 1903..... 319
Relay, Inverse Time-limit (Westinghouse). Illustrated 87
Renewal of Lamps During Peak Load..... 94
Republican National Convention, Telegraph and Telephone Facilities at the 14
Rheostat Stand for Electric Flatirons (Simplex). Illustrated 140
Rheostats, Water, Davies on. Illustrated.....223, 224
Rhodes, Samuel G. (The Organization and Equipment of an Arc-lamp Department) 104, 105
Richards, Prof. T. W. (The Relation of the Hypothesis of Compressible Atoms to Electrochemistry) 222
Richards, W. E. (Unaccounted-for Current)..... 203
Ries Patent for Electric Elevators in Litigation.. 346
Rio de Janeiro, Electrical Project for.....5, 162
Rise, Richard H. (Steam Turbines).....333, 334
Roberts, E. R. (The Nernst Lamp as a Factor in Commercial Lighting. Illustrated).....336, 337
Rocky Mountain States. (Correspondence)..... .....18, 35, 89, 125, 142, 143, 163, 183, 207, 231, 232, 278, 300, 361, 455, 495
Roderbourg, Carl. (The Prussian System of Electric Train Lighting) 358, 359
Roosevelt's, President, Message. (Editorial)..... 464
Rosettes, Trumbull Fuseless. Illustrated..... 508
Rotary Converters, 2,000-kilowatt, for the New York Edison Company. Illustrated 227
Rotary Converters and Motor-generator Sets. By William C. L. Eglin. (International Electrical Congress) 318, 319
Rounce, H. M. (Telephone Versus Electric-light Circuits) 269
Rubber, Another Substitute for 489
Rubber, Production and Price of.....96, 137, 169, 289
Rudis-Jicinsky, Dr. J. (Procopius Diviss, a Neglected Scientist. Illustrated)..... 173
Run of Stone, A.....175, 215
Runzel-Lenz Electric Manufacturing Company..... 123
Russia, Power-transmission Project in. (Editorial) 6
Russia, Telegraph and Telephone Extensions in.... 153
Russia, Trade in 369
Russian Experiment, Curious, in Relation to Electrolysis on Warships. (Editorial)..... 154
Russo-Japanese War, Space Telegraphy in the..... .....7, 32, 154, 168, 169, 208, 390, 465
Rust Water-tube Boiler. Illustrated.....228, 229
Rutherford on Radium. (International Electrical Congress) 244
Ryan, Harris J. Portrait.....187, 188, 495

S

Sacramento Valley Wants Electric Railways..... 133
St. Louis-Chicago Wireless Transmission. Illustrated 147, 238, 239
St. Louis-Cleveland Wireless Transmission..... 381
St. Louis Exposition, Allis-Chalmers "Big Reliable" at 65, 144, 357
St. Louis Exposition, American Electrical Exhibits at the. Illustrated 24, 25, 65, 119, 137, 144, 147, 200, 201, 229, 230, 273, 293, 303, 304, 305, 357, 374, 397
St. Louis Exposition, Awards at the..... 357
St. Louis Exposition, Closing of the..... 462
St. Louis Exposition, Coal Testing and Timber Preserving at 119
St. Louis Exposition, Electric Coin-controlled Turnstiles at 33
St. Louis Exposition Electrical Club..... 33
St. Louis Exposition, Electrical Features of the, Described by Mr. Ellicott. (Western Society of Engineers) 7
St. Louis Exposition, Electrical Jurors of Award at. With portraits 175, 501
St. Louis Exposition, Electricity Day at the..... 249
St. Louis Exposition, Electric-railway Test Commission of the 13, 137, 311, 512
St. Louis Exposition, Exhibits Power Plant at the. By Richard H. Pierce 429
St. Louis Exposition, French Electrical Exhibits at the. Illustrated 93, 94
St. Louis Exposition, Lanyon Zinc Company's Exhibit at. Illustrated 119
St. Louis Exposition, Naval Show of the, Electrically Operated Warship Models at the. Illustrated..345, 346
St. Louis Exposition, Palace of Electricity at the, Making Incandescent Lamps in the. Illustrated. 24, 25
St. Louis Exposition, President Francis Tells the International Electrical Congress about the..217, 218
St. Louis Exposition, Service Plant at the. Illustrated 303, 304, 305
St. Louis Exposition, Space Telegraphy at the. Illustrated 147, 238, 239
St. Louis Exposition, The (Editorial).....98, 428, 446
St. Louis Exposition, Visitors at the (Western Electrician's Register) 61, 77, 99, 117, 140, 160, 174, 196, 213, 249, 270, 294, 335, 336, 351, 377, 395, 411, 437
St. Louis Exposition, Weissmann Electric "Pearls" at the. Illustrated 93, 94, 425
St. Louis Exposition, Worthington Condensers at... 205
St. Louis, Kinloch Telephone Building in..... 49
St. Louis Street-railway Service in. Illustrated..36, 60, 90, 233, 281, 282, 283, 304, 341, 377, 438, 474
St. Petersburg, Electrical Power Transmission for. (Editorial) 6
St. Petersburg, Public Telephones in..... 15
Sando, W. J. Portrait..... 513
San Francisco, Knights Templars in, Illumination in Honor of. Illustrated.....71, 143, 239
San Francisco Street-railway Service to Be Operated by Current from Long-distance Transmission..481, 508
Santiago River, Mexico, Proposed Power Plant on the 115
Sargent Complete-expansion Gas Engine. Illustrated 489
Saw, Swing, Electric Motor on. Illustrated..... 373
Scheidel Electrolytic Rectifier. Illustrated..... 133
Schneider's Electric Train-lighting System. Illustrated 433
Schulz's "Electrical Machinery for Heavy Manufacturing." (Book Review)..... 505
Science, Mechanical, Some Refinements of. By Ambrose Swasey. (American Society of Mechanical Engineers) 490, 491
"Scientific American Reference Book." (Book Review) 435
Scott, R. (High-tension Insulators. Illustrated)..131, 132
Scott's, Charles F., Single-phase Railway Improvements. Illustrated. 95
Scribner and McBerty's Telephone Service Meter. Illustrated 176
Scribner-McBerty Patent Litigation..... 397
Searchlights Used in Announcing Election Returns.. 411
Sears, Vinton A. (Telephone Status in New England) 357
Sectional Third-rail Railway System (Mahoney's.) Selective Signaling, Plus-and-minus. Illustrated..15, 16
Illustrated 115
"Self-propelled Vehicles." By James E. Homans. (Book Review) 417
September, 1904, Electrical Exports for..... 371
Series Alternating-current Arc Lamps, Points for Consideration When Purchasing. By G. Brewer Griffin. (Ohio Electric Light Association)..... .....180, 181, 198, 199
Service Meters for Telephones, Recent Developments in. Illustrated 176, 177
Service Plant at the St. Louis Exposition. Illustrated 303, 304, 305
Shatzky, Dr. S., on the Action of Constant Current on Microbes. (International Electrical Congress) 308
Shawinigan Falls Hydro-electric Equipment....256, 257
Sheeting, Steel, New Interlocking. Illustrated..45, 189
Sheffield, England, Turbo-electric Station at. By
Shellac, About 289
Frank C. Perkins. Illustrated.....167, 168, 169
"Shipboard Electricity." By J. W. Kellogg. (Book Review) 68
Shipboard, Large Telephone Installation on..... 202
Shop, The Ideal. By W. D. Wright. Illustrated. With discussion. (American Railway Mechanical and Electrical Association).....309, 310
Shops, Railroad, at Danville, Ill., Electric Power in. Illustrated 519, 520, 521
Show-window Light, Color-reflecting (Glogau & Co.). Illustrated 230
Siberia, Lake Baikal in, Space Telegraphy Across.. 168
Siberia, New Railroad Around Lake Baikal in, Electricity in the Construction of the..... 4
Siberian Railroad, Shall the, be Electrified?...374, 375
Siemens, Alexander. (Metric Measurements)..... 447
Sign Letters, Fireproof Porcelain (Colonial). Illustrated 468
Signals Around the World, Geographers Send..... 214
Signal Corps of the Army, Work of the..... 433
Simond's Electric-transmission Mechanism for Automobiles. Illustrated 503
Simplex Rheostat Stand for Electric Flat Irons. Illustrated 140
Simultaneous Telegraphy and Telephony. By Joseph Hollos. (International Electrical Congress)..... 223
Single-phase Alternating-current Motors (Pillsbury's). By H. P. Andrews. Illustrated..... 354
Single-phase Currents in Electric Power Transmission, Possibilities of. By H. A. Bullard and Sidney Sprout. (Pacific Coast Electric Transmission Association) 178, 179
Single-phase Operation, Polyphase Trausmission with, for Railway Purposes, Arnold's. Illustrated..... 487
Single-phase Railway, Gas-engine Plant for..... 430
Single-phase Railway Improvements, Scott and Lamme's. Illustrated 95
Single-phase Railway, Indianapolis-Cincinnati..... 258
Single-phase Railway, Kewanee-Geneseo..... 130
Single-phase Railway System, Westinghouse, for Interurban Service. Illustrated..... 395
Sleeping Cars on Electric Railways.....88, 199
Smith, Harold B. (Notes on Experiments with Transformers for Very High Potentials. Illustrated) 326, 327
Societies and Schools. (Notes)..... ...36, 54, 72, 90, 109, 126, 164, 233, 258, 301, 322, 342, 362, 381, 402, 420, 421, 456, 474, 496, 513, 532
South Africa, American Business In.....62, 268
South Africa, Demand for Electrical Apparatus in. (Editorial) 62
Southeastern States. (Correspondence).....17, 35, 52, 89, 106, 107, 124, 142, 162, 163, 206, 231, 257, 277, 320, 340, 380, 400, 419, 437, 494, 511, 529, 530
Southeastern Telephone Developments. (Correspondence) 14, 68, 83, 138, 202, 227, 254, 274, 314, 337, 376, 396, 485, 528

Southern New England Telephone Company..... 49
Sound, Reproduction and Transmission of, Novel Experiments in the 181
Sound, Transmission of, Through Water (Mundy's Method). Illustrated 215
Space-telegraph Commission, Government...13, 160, 467
Space-telegraph Communication with Balloon..... 421
Space-telegraph Licenses in Great Britain..... .....123, 141, 182, 339
Space-telegraph Project, A Visionary. (Editorial).. 26
Space-telegraph Service on Steamships.....88, 487, 491
Space-telegraph Station at Kansas City. Illustrated. 394
Space-telegraph Station at Pisa, Italy..... 147
Space-telegraph Stations for Military Purposes, Portable. Illustrated 57
Space-telegraph Stations, Government Coastwise, to be Controlled by Navy 94, 160, 362
Space-telegraph System, The Stone..... 153
Space Telegraphy Across Lake Baikal in Siberia.... 168
Space Telegraphy and Submarine Cables....62, 141, 435
Space Telegraphy and the Distribution of Standard Time. (Editorial) 216
Space Telegraphy and the North Sea Incident. (Editorial) 390
Space Telegraphy at the Port of Boston..... 34
Space Telegraphy at the St. Louis Exposition. Illustrated 147, 238, 239
Space Telegraphy in the Russo-Japanese War..... .....7, 32, 154, 168, 169, 208, 390, 465
Space Telegraphy, De Moura's Phonetic Interrupter for. Illustrated 348
Space Telegraphy, Field's Amplifier for..... 362
Space Telegraphy on Lake Superior..... 142
Space Telegraphy, Marconi Talks about.....264, 315
Space Telegraphy, Oil-film Receiver for. Illustrated 27
Space. Telegraphy. (Notes).....54, 109, 164, 208, 279, 301, 362, 402, 421, 496, 514, 532, 633
Spark, Arc and, The Modern Theory of the. By Prof. Henry Crew. (Western Society of Engineers)... 505
Sparker, Bissell Induction, for Gas Engines. Illustrated 316
Speed on Electric Railway, Good..... 351
Spoken Word, Typewriter Said to be Actuated by the 174
Sprague, Frank J., on Electricity for Railroad Work. (American Institute of Electrical Engineers).... 244
Sprague, Frank J. (The History and Development of Electric Railways).....290, 291, 312, 313
Sprague's Electric-railway Work. (Editorial)..... 308
Springfield, Ill., Foreign Electrical Delegates in. Illustrated 214
Sprout, Sidney. (Possibilities of Single-phase Currents in Electric Power Transmission).....178, 179
Stage Lighting at the Alhambra Theater. Illustrated 129, 130
Standard Instruments for Operating Companies, A Proposed System of. By H. P. Davis. With discussion. (National Electric Light Association).. 118
Standard Instruments, Westinghouse System for the Care of 140
Standard Time, Space Telegraphy and the Distribution of. (Editorial) 216
Standardization of Dynamo-electric Machinery and Apparatus. By Col. R. E. B. Crompton. With discussion. (International Electrical Congress).. .....254, 255
Standardization of Engines and Dynamos. (American Society of Mechanical Engineers) 479
Stanley Electric Manufacturing Company's Oil Switch for High Voltages. Illustrated..... 355
Stanley Electric Manufacturing Company's Organization, Important Changes in..... 64
Stanley Instrument Case, Tesla Patents Upheld in. 272, 273
Stanley Transformer Patent Litigation..... 59
Stansfield, Alfred. (The Electrothermic Production of Iron and Steel. Illustrated).....78, 79
Starting Device for Induction Motors, Meyer's. Illustrated 287
Starting Device for Mercury-vapor Lamps. Illustrated 179
State Electrical Associations. (Editorial).....266, 330
Static Discharges, The Protection of High-pressure Transmission Lines from. By H. C. Wirt. With discussion. (American Institute of Electrical Engineers) 10
Static Electricity in Elecctrotherapeutics. (Editorial) 464
Steam-turbine Power Plants. By J. R. Bibbins. Illustrated. With discussion. (American Street Railway Association) 334, 335
Steam-turbine Set, Small Emmet-Junggren. Illustrated 348, 349
Steam Turbine, The, and Its Uses. By E. C. Crocker. Illustrated. (Ohio Electric Light Association) 151, 152
Steam Turbine, Stumpf, Improvements in the. Illustrated 27
Steam Turbines and Reciprocating Engines, Combined Use of. (Editorial)..... 330
Steam Turbines. By Richard H. Rice. With discussion. (American Street Railway Association) 333, 334
Steam Turbines, Condensing Outfits for..... 205
Steam Turbines Discussed at International Electrical Congress 247
Steam Turbines for New Baltimore Power Plant.... 488
Steamship Company to Build Trolley Line..... 99
Stebbins, Charles M., Death of..... 18
Steel Contact Rails, Conductivity of. By J. A. Capp. Illustrated. (American Institute of Mining Engineers) 228
Steel, New Method of Manufacturing..... 135
Steel Rails 61, 137
Steinmetz, C. P. (Alternating-current Motors. Illustrated) 306, 307
Steinmetz, C. P., on Alternating Current for Railway Work. (International Electrical Congress).. .....220, 242, 243
Steinmetz on the Luminous Electric Arc. (International Electrical Congress) 246
Steinmetz's Phase Transformer. Illustrated..... 58
Steinmetz's Pyro-electrolytic Furnace. Illustrated.. 445
Stephenson, Rome C. (How Avoid Personal-injury Responsibility in Telephone Construction Work and Maintenance) 510
Sterling Electrical Manufacturing Company's Incandescent-lamp Novelties. Illustrated.....526, 527
Stern, Dr. Gotthold. (The Superiority of Alternating Current for the Supply of Current to Large Cities) 250, 251
Stevens' "Copper Handbook." (Book Review)..... 50
Stillwell, L. B. (Electrical Generating Stations and Transmission) 398, 399
Stone Space-telegraph System, The..... 153
Storage Battery. (See also Accumulator.)
Storage Battery, Edison, Some Notes on the. By F. M. Davis. With discussion. (Western Society of Engineers) 392, 393
Storage Battery, Edison, The Present Status of the. By A. E. Kennelly and S. E. Whiting. Illustrated. (International Electrical Congress).....271, 272
Storage Battery, Fredet, at St. Louis Exposition.... 94
Storage-battery Gases, Edison's Method of Rendering, Non-explosive. Illustrated 188
Storage Battery, The, as Applied to Electric Railways. By W. E. Winship. (Franklin Institute) 224, 225
Storage Battery, When Is a, Fully Charged? (Question Box of the National Electric Light Association) 60
Storage Batteries as an Adjunct to Central-station Equipment. By Gerhard Goettling. Illustrated. With discussion 246, 247, 378, 379
Storage Batteries, The Origin and Development of. By E. B. Walker. (Canadian Electrical Association) 84, 85
Storm Recorders, Electric.....286, 287
Storms Damage Electrical Properties..... .....176, 183, 274, 409, 437
Stranahan, O. A. Portrait..... 513
Stratton, S. W. Portrait.....187, 188
Street and Electric Railways, Census Statistics of. 23, 24
Street-car Fares in Australia..... 65
Street-lighting Statistics, Chicago 86
Street Railway Accountants' Association, St. Louis Convention of the.....325, 332, 333
Street-railway Men in Convention at the World's Fair. Illustrated 325
Streets, City, Interurban Rights in..... 24
Stroud's Telephone Service Meter. Illustrated.... 177
Stumpf Steam Turbine, Improvements in the. Illustrated 27
Submarine Boats. (Editorial) 172
Sub-station Design, Tendencies in. By Howard S. Knowlton 63, 64
Subway, New York Rapid-transit. (See New York Rapid-transit Subway.)
Subway, Proposed Chicago. Illustrated..... .....367, 389, 407, 479
Subway Ventilation. (Editorial)..... 446
Sun, Electric Equilibrium of the (Arrhenius)...50, 244
Superior, Wis., Electric Coal-handling Apparatus on Dock at. Illustrated.....365, 366
Supply House, The Place of the, Boole on. (Ohio Electric Light Association)..... 160
Surface-contact Traction in England.....69, 453
Suspension, Lamp, over Workbench. Illustrated... 133
Swasey, Ambrose. (Some Refinements of Mechanical Science) 490, 491
Sweden, Government of, Discussing Electric Power for Railroads. (Editorial)..... 288
Swiss Hydro-electric Plant, A, for Small Industries. By Franz Koester. Illustrated.....423, 424
Switch Gear, Cellular, for Central Stations. Illustrated 445
Switch, New Punched Clip Lever (G. I.). Illustrated 136
Switch, Oil, for High Voltages (Stanley). Illustrated 355
Switch, Theater (Bissell). Illustrated..... 229
Switches, Track, Electrically Controlled, on the Long Island Railroad at Ozone Park. Illustrated..... ..... 190, 191, 192
Switzerland, Hagnech in, Small Industries at, Hydro-electric Plant for. By Franz Koester. Illustrated.....517, 518, 519
Switzerland, Rack Railway to the Gornergrat. By Franz Koester. Illustrated 261, 262
Synchronous Converters, Operation of. By S. C. Lindsay. (American Institute of Electrical Engineers) 139, 140
Synchronous Motor Adapted for Railway Work. Illustrated 132
Synchronous Motor-generator Sets, Division of Load between, Obtained by Reactances (Woodbridge Patent). Illustrated 60
Synchronous Motors for Regulation of Power Factor and Line Pressure. By B. G. Lamme. With discussion. (American Institute of Electrical Engineers) 10
Syracuse, Technology Club of..... 152
Syracuse-Utica Electric-railway Project 76

T

Telagirl, The. (New Use for the Telephone)..... 29
Telautograph Redivivus, The. (Editorial).....154, 370
Telautograph, The. By James Dixon. Illustrated. With discussion. (American Institute of Electrical Engineers) 372, 373
Teledattilograph, The 179
Telegraph. (Notes) 109, 126, 144, 184, 279, 342, 421, 438, 474, 475, 496, 514, 532
Telegraph and Telephone Facilities at the Republican National Convention 14
Telegraph Extensions, Postal, in the Rockies..... .....89, 132, 143, 300
Telegraph, Printing, Need of the. (Editorial).... 428
Telegraph Service, Porto Rico's.....121, 122
Telegraph System, Printing, Barclay's..... 521
Telegraph Systems, Modern High-speed Printing. By J. C. Barclay. (International Electrical Congress) 275, 276
Telegraphing Over Telephone Lines..... 376
Telegraphy and Telephony, Simultaneous. By Joseph Hollos. (International Electrical Congress)..... 223
Telegraphy, Printing. By Louis M. Potts. Illustrated. (International Electrical Congress)..416, 417
Telephone, Advertising the (Barnhart)..... 28
Telephone Associations Will Probably Unite. (Editorial) 482
Telephone Booth, Sound-proof (Yeshera). Illustrated 86
Telephone Business, Profit-sharing in the..... 102
Telephone Companies, New. (Notes)..... .....177, 274, 377, 450, 466, 510, 528
Telephone Construction Work and Maintenance, How Avoid Personal-injury Responsibility in. By Rome C. Stephenson. (Interstate Independent Telephone Association) 510
Telephone Exchange at Kankakee, New Independent. Illustrated 4, 5
Telephone Exchange, Automatic, K. B. Miller on the. (International Electrical Congress)....247, 248
Telephone Exchange, Chicago's Automatic. Illustrated.....111, 112, 113, 114
Telephone Exchange, Small, Underground Construction for. Illustrated 467
Telephone Exchanges, Municipal, in Canadian Cities. 274, 314, 450
Telephone Extensions and Improvements. (Notes) 49, 83, 120, 176, 202, 227, 254, 292, 414
Telephone for Train Orders, Northern Pacific to Use. 158
Telephone, "Handbook," The Latest Form of. Illustrated 480
Telephone in Reporting Football Games, Use of the. 450
Telephone Line, Long-distance, Lake Shore Railroad's 292, 376
Telephone Line, New Chicago-Cincinnati..... 67
Telephone Lines, Loaded, in Practice. By Dr. H. V. Hayes. Illustrated. With discussion. (International Electrical Congress) 247, 252, 253
Telephone Manufacturers and Dealers. (Notes).... .....121, 158, 293, 388, 432
Telephone, Measured-service Meter for. Illustrated. 315
Telephone Men. (Notes)..... .....14, 68, 120, 138, 202, 292, 357, 432
Telephone Message, Journey of a..... 415
Telephone News, General. (Notes)..15, 30, 50, 67, 83, 102, 120, 138, 158, 177, 203, 227, 274, 292, 314, 338, 357, 377, 396, 432, 450, 467, 485, 510, 528
Telephone, New Use for the..... 29
Telephone Operator, Cupid and the..... 14
Telephone Patent Litigation 397
Telephone Patent Situation, The. By Edward E. Clement. (Independent Telephone Association) 273, 274
Telephone Plans, Kinloch Long-distance..... 138
"Telephone Principles and Practice." By George W. Wilder. (Book Review)..... 199
Telephone Problem in Large Cities, The. By F. J. Dommerque. (International Electrical Congress). 356
Telephone Purifier, Couch & Seeley's Automatic. Illustrated 315
Telephone Rates—Why They Are Increased with Increase of Business. (Editorial)..... 62
Telephone Scouts of the Militia. By R. G. Grayne. Illustrated 307
Telephone Service in Paris, Defective..... 226
Telephone Statistics, English.....105, 205
Telephone System, Beard's Secret. Illustrated..... 238
Telephone System, Planning a. By Samuel G. McMeen. (Independent Telephone Association).. .....293, 294
Telephone Systems, Toll-line, Dean's Improvement in. Illustrated 426, 427
Telephone Testing, Use of Instruments in. Illustrated 202
Telephone, The Invention of the..... 15
Telephone Toll-line Business, Methods of Handling. By T. S. Lane. (New York State Independent Telephone Association)..... 82
Telephone Toll Rates in Southern California..... 102
Telephone Trouble Shooter, The.....396, 397
Telephone Versus Electric-light Circuits. By H. M. Rounce. 269
Telephone, Weather Forecasts by. (Editorial)..... 308
Telephone Work, Plus-and-minus Selective Signaling in. Illustrated 15, 16
Telephones, Black's Card-display Device for. Illustrated 102
Telephones, Corporation. By A. R. Bennett. With discussion. (Institution of Electrical Engineers) 48, 49, 66, 67
Telephones, Hygienic Resonator for..... 528
Telephones on Railroad Train..... 357
Telephones, Service Meters for, Recent Developments in. Illustrated. 176, 177
Telephones, Village, British Postoffice Department and 510
Telephoning "Want Ads" 319
Telephonogram, Hülsmeyer's. Illustrated..... 114
Telephony and Telegraphy, Simultaneous. By Joseph Hollos. (International Electrical Congress)..... 223
Telephony, Long-distance, Some Interesting Phases of. By S. G. McMeen. With discussion. (Western Society of Engineers) 414, 415
Telluride Power Company, Work of the. By P. N. Nunn. Illustrated. With discussion. (International Electrical Congress) 245, 352, 353, 367
Telluride, The Work at. (Editorial)..... 350
Tesla on Advertising 463
Tesla Patents Upheld in Stanley Instrument Case. 272, 273
Tesla's "Experiments with Alternate Currents of High Potential and High Frequency." (Book Review) 394
Testing Car in Toronto 351
Testing Devices, Recent Live-wire. Illustrated. .68, 69
Testing Instrument, Lineman's (Whitney). Illustrated 415
Testing Laboratory, Inexpensive. (Question Box of National Electric Light Association)..... 85
Testing Primary Circuits for Grounds. (Question Box of Iowa Electric Light Association)..... 94
Testing, Telephone, Use of Instruments in. Illustrated 202
Texas. (Correspondence) 17, 71, 124, 183, 277, 320, 380, 472, 473, 530
Texas, Telephone Mergers in.....80, 377
Texas, Waterpower Possibilities in 491
Thawing Ice in Water Pipes by Electricity. Illustrated 169, 297, 448, 502, 503, 504, 527
Theater, Alhambra, Electric Lighting at the. Illustrated 129, 130
Third Rail. (See also Contact Rail.)
Third Rail, Ice on the, Calcium-chloride Treatment for. Illustrated 499, 500
Third-rail Railway System, Sectional (Mahoney's). Illustrated 115
Third Rail, Thawing Ice on a, by Electricity..... 264
Third Rail, The. (Editorial).....6, 390
Thomas, James M., Illness and Death of. Portrait 292, 407
Thompson, James R. (Lighting the Lewis and Clark Exposition) 463
Thomson, Elihu. Portrait 187, 188
Thomson, Elihu, Gives Historical Data of Alternating-current Apparatus. (American Institute of Electrical Engineers) 244
Thomson, Prof. J. J., on Radium. (International Electrical Congress) 244
Thomson's, Elihu, Opening Address at International Electrical Congress 218, 219
Three-phase Static Ground Detector, Westinghouse.. 227
Thunderstorm Recorders, Automatic 286, 287
Timber Preserving and Coal Testing at St. Louis Exposition 119
Timber Seasoning Tests, Government to Conduct.. .....406, 407
Time-limit Relay, Inverse (Westinghouse). Illustrated 87
Timing Clocks, Mors and McMurtie.....109, 157
Toggle Bolt for Electrical Fixtures (Wrigley). Illustrated. 255
Toledo Franchise Situation..... .....124, 142, 206, 299, 360, 381, 419, 436
Toledo Home Telephone Company Gives a Reception. Illustrated 121
Toronto Telephone Decision 451
Track Repairing in New York City. Illustrated.... 42
Track Switches, Electrically Controlled, on the Long Island Railroad at Ozone Park. Illustrated.... .....190, 191, 192
Trackless Trolley Company, Obstacle for..... 123
Trackless Trolley for Hull, Mass..... 88
Trackless Trolley Roads, Cost of..... 79
Trade News. (Notes)..... 19, 37, 54, 78, 91, 109, 126, 144, 145, 164, 184, 185, 208, 233, 258, 259, 279, 301, 322, 323, 342, 362, 382, 403, 421, 439, 456, 457, 475, 496, 514, 533
Trade Outlook, Fall, Interviews on the..... 267
Trademarks, Registration of, in Foreign Countries. (Editorial) 350
Train Control, Electropneumatic, for Metropolitan Elevated in Chicago. Illustrated.....39, 40, 41
Train Lighting, Electric, The Prussian System of. By Carl Roderbourg. (International Electrical Congress) 358, 359
Train Lighting, Emmet-Junggren Horizontal Turbo-generator for. Illustrated 348, 349
Train-lighting System, Schneider's Electric. Illustrated 433
Train Operation, Cutler's Two-wire System for. Illustrated 444, 445
Trains, High-speed, Braking. By R. A. Parke. (International Electrical Congress) 451, 452
Tramway Construction in London, A Record in. Illustrated 97
Transformer for Thawing Ice in Water Pipes. Illustrated 448, 527
Transformer Litigation, Self-regulating..... 59
Transformer, Lunt's Phase. Illustrated..... 306

Transformer, Steinmetz' Phase. Illustrated..... 58
Transformers, Connections for Using, at Full Capacity. Illustrated 77
Transformers for Very High Potentials, Notes on Experiments with. By Harold B. Smith. Illustrated. (International Electrical Congress)..326, 327
Transformers, Individual, Haley's Method of Determining the Demand upon. Illustrated..... 61
Transformers, Moody's Neutralizing Winding for. Illustrated 397, 398
Transformers, The Use of Ground Shields in. By J. S. Peck. With discussion. (American Institute of Electrical Engineers) 9
Transmission, 200-mile 201
Transmission and Control, Long-distance, Banm on. (International Electrical Congress)..... 220
Transmission Convention of the Institute in Chicago. 8, 9, 10
Transmission, Electrical Generating Stations and. By L. B. Stillwell. (International Engineering Congress) 398, 399
Transmission Lines, High-pressure, The Protection of, from Static Discharges. By H. C. Wirt. With discussion. (American Institute of Electrical Engineers) 10
Transmission Lines, Long Spans for. By F. O. Blackwell. With discussion. (American Institute of Electrical Engineers) 8, 9
Transmission Lines Operated in Parallel, Conditions for Continuous Service over. By M. H. Gerry, Jr. (American Institute of Electrical Engineers)...9, 10
Transmission, Long-distance, Current from. San Francisco Street-railway Service to be Operated by 481, 508
Transmission of Sound Through Water (Mundy's Method). Illustrated 215
Transmission, Power. (See also Power Transmission.)
Transmitted, The Maximum Distance to Which Power Can be Economically. By Ralph D. Mershon. Illustrated. With discussion. (American Institute of Electrical Engineers) 524, 525, 526
Transposition of Electrical Conductors, The. By Frank F. Fowle. Illustrated. With discussion. (American Institute of Electrical Engineers)..412, 413
Trimming Arc Lamps by Automobile. Illustrated.. 264
Triumph Electric Company's Exhibit at St. Louis Exposition. Illustrated 229
Trolley Car, The Private..... 427
Trolley Day in Detroit..... 35
Trolley Song, Prize for the Best..... 201
Trumbull Enseless Rosettes. Illustrated..... 508
Tunnel at Port Huron, Grand Trunk, Electricity for the 350, 419
Tunnels, Chicago Electric Freight. Illustrated.... .....45, 90, 189, 405, 406, 428, 430, 523
Tunnels, Railroad, Accidents in, Electrical Operation Would Decrease. (Editorial) 350
Turbine, Steam. (See Steam Turbine.)
Turbo-electric Station at Sheffield, England. By Frank C. Perkins. Illustrated.....167, 168, 169
Turbo-generator for Train Lighting, Horizontal (Emmet-Junggren). Illustrated 348, 349
Turner Brass Works Enlarge. Illustrated..... 200
Turner, M. E. (Graded Costs of Electric Supply) 204, 205
Turnstiles, Electric Coin-controlled, at St. Louis Exposition 33
Typewriter Said to be Actuated by the Spoken Word 174

U

U. S. Incandescent Lamp Company's Factory Exhibit at St. Louis Exposition. Illustrated....24, 25
Unaccounted-for Current. By W. E. Richards. With discussion. (Ohio Electric Light Association)... 203
Underground Construction for Small Telephone Exchange. Illustrated 467
Underground Electrical Construction. By Louis A. Ferguson. Illustrated. (International Electrical Congress) 387, 388, 425
Underground Railways. By William Barclay Parsons. (International Engineering Congress)..... 374
Underwriters' National Electric Association, Electrical Committee of 486
Union Engineering Building in New York City.... .....59, 371, 478
United States and European Countries, Relative Manufacturing Growth of the..... 268
United States, Mineral Products of the..... 491
United States Telephone Company's Lines, Extensions of the 67, 83, 466
United Telegraph, Telephone and Electric Company of Chicago, Receivership Proceedings Against.... 177
Units, Electrical, Discussed at International Electrical Congress 219, 220, 236
Utica-Syracuse Electric-railway Project 76

V

Vacuously Depositing Metals, Edison's Apparatus for. Illustrated 175
Vapor Lamp. (See also Mercury-vapor Lamp.)
Vapor Lamp (Hewitt) with Radio-active Material. Illustrated 305
Vapor Lamps (Mercury) for Photographic Purposes. Illustrated 33
Vapor Lamps, Taking Moving Pictures by the Use of. 47
Variable-speed Motors, Multiple-voltage Control for (Bullock). Illustrated 32
Vault, Bank, Opened by Electricity..... 291
Vegetation, Influence of Electricity on.....22, 23
Vera Cruz, Electric Traction for.....71, 206
Vernier, A. J. Portrait..... 5
Victoria Falls of the Zambesi River, Power Possibilities of the. (Editorial)..... 98
Voltage Regulator, McGary's Liquid-contact. Illustrated 480
Volt-ammeter, Detroit Electric Company's Pocket. Illustrated 430
Voltmeters and Wattmeters, New Westinghouse. Illustrated 105

W

Wagner Vertical Single-phase Motor. Illustrated... 508
Walker, E. B. (The Origin and Development of Storage Batteries).....84, 85
Walmsley's "Modern Practical Electricity." (Book Review) 417
Walsh, George E. (Anticipating Panama Canal Construction) 81
Walsh, George E. (Recent Development of the Gas Engine) 391
Walsh, George E. (The Electric Developmeot of Eastern Railroads) 2, 3, 4
Walsh, George E. (The Electrification of the Erie Canal) 130
Waring, Richard S., Death of. Portrait..... 199
Warren-Crocker Steam Turbine. Illustrated....151, 152
Warren Electric and Specialty Company's Exhibit at St. Louis Exposition. Illustrated..... 229
Warren Electric Manufacturing Company's Exhibit at St. Louis Exposition. Illustrated..... 229
Warren, Pa., and Jamestown, N. Y., Single-phase Railway, Gas-engine Plant for..... 430
Warship Models, Electrically Operated, at the Naval Show on the Pike. Illustrated.....345, 346
Washington, D. C., Electric Automobiles for Express Service in. Illustrated.....448, 487
Washington, D. C., Foreign Electrical Delegates in. 263
Washington, Private Telephone System for Government Departments in, Suggested..... 158
Watch, Large Electric 140
Water, Drinking, Electrical Purification of. By John W. Langley. (International Electrical Congress) 315
Water Pipes, Thawing Ice in, by Electricity. Illustrated 169, 237, 448, 502, 503, 504, 527
Water Rheostats, Davies on. Illustrated.....223, 224
Water, Transmission of Sound through (Mundy's Method). Illustrated 215
Waterpower Development, First Electrical, in England 87, 105, 256
Waterpower Developments in Missouri, Possible.... 449
Waterpower in Mexico..... .....7, 115, 206, 262, 277, 320, 380, 473
Waterpower Plant. (See also Hydro-electric, Power and Power Transmission.)
Waterpower Plants, Fighting Ice in. Illustrated. (Question Box of National Electric Light Association) 45
Waterpower Plants, Operating Expenses of. (Question Box of National Electric Light Association) 43
Waterpower Possibilities in Texas..... 491
Waterwheels for Drainage Canal Power Plant..203, 349
Wattmeter, New German Astatic, and Frequency Meter. Illustrated 153
Wattmeter, Westinghouse Precision..... 174
Wattmeters and Voltmeters, New Westinghouse. Illustrated 105
Wausau, Wis., Lighted on a Kilowatt-hour Basis... 90
Wayne, Neb., Underground Telephone Construction in. Illustrated 467
Weather Forecasts by Telephone. (Editorial)..... 308
Webb, Herbert Laws, on Municipal Telephony in Glasgow 66, 67
Webber, Gen. C. E., Death of.....321, 339
Weber, H. F. Portrait..... 188
Wehnelt Interrupter, Electrolyte for the..... 77
Weissmann Electric "Pearls," The. Illustrated.... .....93, 94, 347, 425
Welland Canal, Electric Lighting of the..... 88
Wellman-Seaver-Morgan Company's Gas Engines. Illustrated 448, 489
Wells, James Hollis. (The Power Plant of the Tall Office Building) 64, 65
Wesco Supply Company's Exhibit at the St. Louis Exposition. Illustrated.....229, 230
Westchester, N. Y., Electric-railway Projects..... .....87, 106, 123, 141, 174
West Shore Road to be Used for Electric Cars..... 508
West Virginia and Kentucky. (Correspondence)... 277
Western Electric Company, Personnel of the..... 347
Western Electrician's Lamp-lighting Schedule, Moonlight System, for 1905. (Book Review)..... 471
Western Electrician's Register at the World's Fair. 61, 77, 99, 117, 140, 160, 174, 196,
Western Society of Engineers, Meetings of the Electrical Section of the.....7, 392, 393, 414, 501 213, 249, 270, 294, 335, 336, 351, 377, 395, 411, 437
Western Society of Engineers. (Papers)..... .....100, 101, 392, 393, 414, 415, 505
Western Union Defeated in Pennsylvania Railroad Case 488
Western Union Telegraph Company, Annual Report of 339
Westinghouse Automatic Pump Controller. Illustrated 431
Westinghouse Companies, St. Louis Exposition Awards to the..... 357
Westinghouse Electric and Manufacturing Company, District Managers of the, Convention of. Illustrated 449
Westinghouse Electropneumatic Train Control on Metropolitan Elevated in Chicago. Illustrated.. .....39, 40, 41
Westinghouse Factory, Canadian. Illustrated..... 11
Westinghouse Inverse Time-limit Relay. Illustrated. 87
Westinghouse Motors for Cranes and Hoists. Illustrated 527
Westinghouse Moving Pictures..... 47
Westinghouse Oil Circuit-breakers. Illustrated.... 488
Westinghouse Precision Wattmeter..... 174
Westinghouse Railway Motor. Illustrated..... 33
Westinghouse Service Plant at the St. Louis Exposition. Illustrated 303, 304, 305
Westinghouse Single-phase Railway System for Interurban Service. Illustrated..... 395
Westinghouse System for the Care of Standard Instruments 140
Westinghouse Three-phase Static Ground Detector.. 227
Westinghouse Voltmeters and Wattmeters, New. Illustrated 105
Weston Employes' Club..... 258
Weston Patents Sustained 13
Whale Fishery, Electric Boats for the..... 109
Wheel Matters. By J. Millar. With discussion. (American Railway Mechanical and Electrical Association) 310
White, J. G. (The Substitution of Electricity for Steam as a Motive Power).....371, 375, 376
Whiteside, Walter H., General Manager of Sales for Allis-Chalmers Company. Portrait.....10, 11
Whitney Electrical Instrument Company's Exhibit at St. Louis Exposition..... 230
Whitney Hot-wire Measuring Instruments. Illustrated 317
Whitney Testing Instrument for Linemen. Illustrated 415
Wilder's "Telephone Principles and Practice." (Book Review) 199
Wilgus, W. J., on New York Central's Electrical Equipment 59
Will Made by Telephone Admitted to Probate..... 177
Winnipeg River Power Possibilities..... 70
Winship, W. E. (The Storage Battery as Applied to Electric Railways).....224, 225
Wire Entanglements. Electrically Charged, Japs' Methods of Destroying 488
"Wireless" and the North Sea Incident.....390, 465
Wireless Communication, Long Overland.....501, 523
Wireless, Facsimile Letter Writing by..... 333
Wireless Telegraphy. (See also Space Telegraphy.)
Wireless Transmission, St. Louis-Chicago. Illustrated 147, 238, 239
"Wireless" Troubles and Triumphs at Wei-hai-wei.. 7
Wirt, H. C. (The Protection of High-pressure Transmission Lines from Static Discharges)..... 10
Wolff on Electrical Units. (International Electrical Congress) 219
Woodbridge's Method of Obtaining Division of Load between Synchronous Motor-generator Sets by Reactances. Illustrated 60
Woodbury, C. J. H. (The Electrical Fire Hazard).... .....469, 470, 471
Worcester Polytechnic Graduates, Records of. Illustrated 133
World's Fair at St. Louis. (See also St. Louis Exposition.)
World's Fair at St. Louis. Street-railway Men in Convention at the. Illustrated..... 325
Worthington Condensers at St. Louis Exposition... 205
Wright, W. D. (The Ideal Shop)..... 309
Wright's "Electrical Furnaces." (Book Review)... 505
Wrigley's Toggle Bolt for Electrical Fixtures. Illustrated 255
"Wrinkles" for Central-station Practice. Illustrated. (National Electric Light Association)..61, 77, 94, 97

X

X-ray Congress to be Held in Berlin..... 279

Y

Yesbera Manufacturing Company's Sound-proof Telephone Booth. Illustrated 86

Z

Zambesi River, Cableway across the. (Editorial)... 134
Zambesi River, Victoria Falls of the, Power Possibilities of the. (Editorial)..... 98
Zinc Exhibit at the World's Fair, A. Illustrated.. 119

WESTERN ELECTRICIAN

EVERY SATURDAY

Vol. XXXV. CHICAGO, JULY 2, 1904 No. 1

The New Central Station for Light, Heat and Power in Aurora, Ill.

A new central-station plant that is designed to furnish heat as well as light and power has recently been put in operation in Aurora, Ill., and is owned by the Fox River Light, Heat and Power Company. It is now running in connection with the old plant belonging to the company, but as soon as everything has been completed at the new station the old plant will be given up.

Aurora is a city of about 25,000 inhabitants, 40 miles west of Chicago, on the line of several steam railroads and the Aurora, Elgin and Chicago third-rail electric railway. The new central-station plant is located not far from the business center of the city on the banks of the Fox River, from which stream condensing and feed water is drawn. The picture of the side of the power house shown in Fig. 2 (on the next page) was taken from a spur of the Elgin, Joliet and Eastern railroad built out from the main line to the back of the power house for coal delivery.

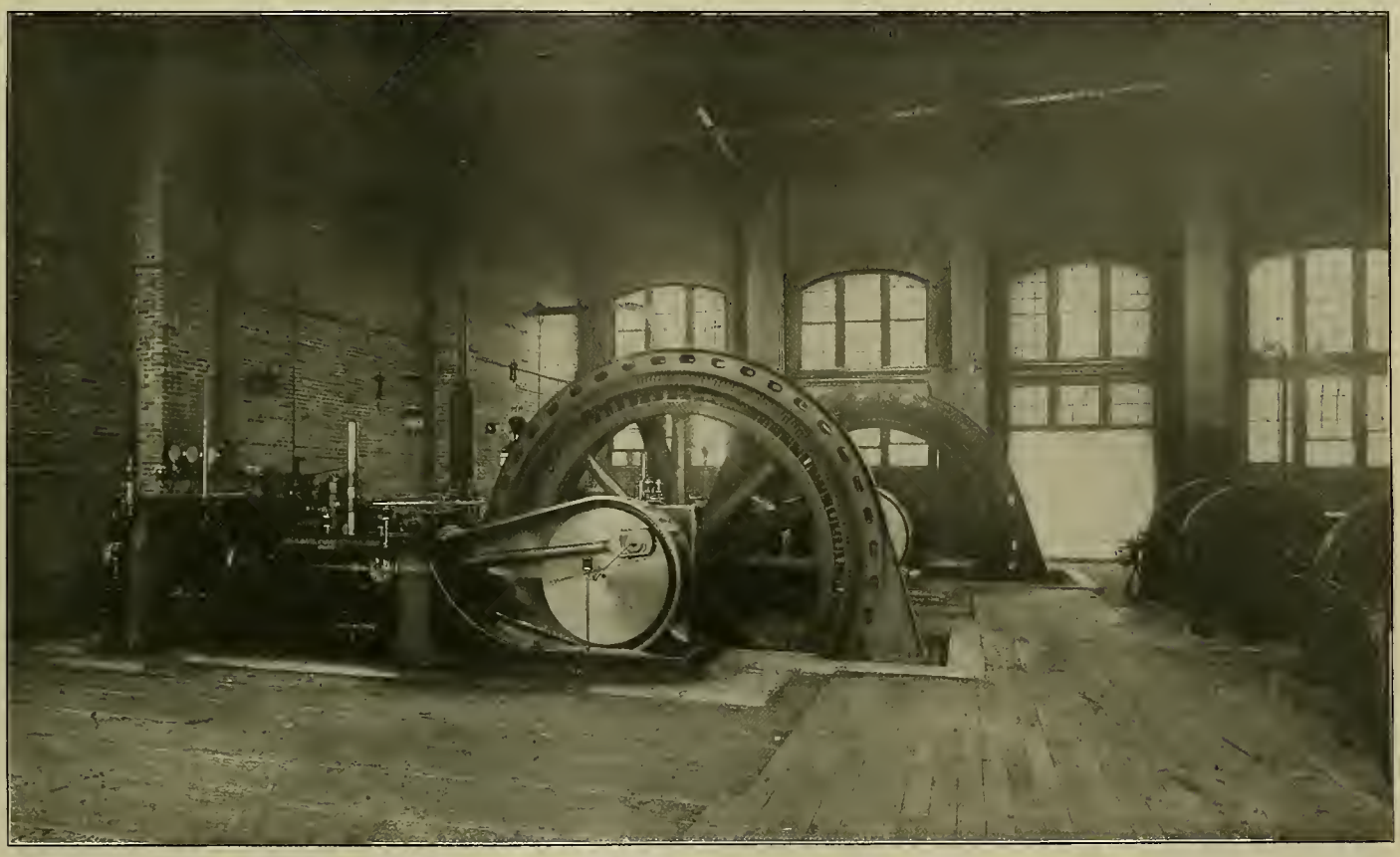


FIG. 1. THE NEW CENTRAL STATION IN AURORA.—ALTERNATING-CURRENT GENERATORS AND MOTOR-GENERATORS.

The power house contains two main rooms separated by a brick wall—one for the generating machinery and one for the boiler apparatus. The latter is in the end of the building nearer the railroad track.

The boilers are four in number, of 250 horsepower each and of Stirling make. They are hand-fired, the coal being dumped directly from the cars into storage space at the rear of the building, having a capacity of 250 tons, whence it is delivered to the front of the boilers through arches in the end of the building. The round brick stack is 150 feet high, with an internal diameter of eight feet. It is of the Custodis construction. Back of the boilers are located the pumping apparatus and a 1,000-horsepower feed-water heater. The arrangement of this part of the system is unusually flexible and is shown in detail in Fig. 3, which is a section of the building taken just behind the boilers. A 12-inch suction pipe draws water from the river, and from this a 12-inch pipe leads up to the main circulating pump, as shown. Tapped from the main feeder pipe is a 4½-inch pipe leading to the service pumps and also to the two duplex feed pumps shown on the extreme right in Fig. 3.

Exhaust steam from the engines is condensed in a Worthington central condenser, which is a type of barometric condenser not extensively used as yet, but which possesses points of advantage. The general arrangement of this condenser is shown at the left in Fig. 3 and is as follows: On the outside of the building is a hot well, and up from this well extends a pipe which is a few feet higher than the level to which a column of water would rise under an absolute vacuum, that is, something over 33 feet. This pipe terminates in an enlarged portion at the top, in which is located a spraying device through which cold water is passed from the circulating pump. The exhaust from the engine is conducted into the enlarged portion or dome by a 16-inch pipe and there comes in contact with the cold water and is condensed, the resulting hot water passing down into the hot well, to be pumped into the heater. The advantage of this system is that there is no possibility of condensing water flowing back into the engine cylinders, since the exhaust is always at a level above which even a perfect vacuum can lift the water from the hot well.

These details are clearly shown in Fig. 3, which also illustrates the arrangement of the steam piping. One long steam header, 14 inches in diameter, extends back of both boilers, and connected to this by suitable valves is a 6-inch auxiliary header which supplies all the auxiliary apparatus, the pipes to the large engines being connected to the main header.

Heat is not furnished at present in any considerable quantities nor is it expected that this item will form a large proportion of the income of the plant. There is now connected only one customer, with 7,000 square feet of radiation, although this amount will undoubtedly be increased in the future. The exhaust from the auxiliary apparatus now suffices for heating purposes. When the amount of radiation connected can no longer be supplied by the exhaust from the engines live steam may be admitted to the system through a suitable reducing valve. The service pipe connecting with the customer now supplied is six inches in diameter and is run through a wooden box, though just what method of protecting the piping will ultimately be adopted is not yet decided.

Electricity is furnished for both power and lighting purposes. There are now connected about 15,000 incandescent lamps, a series enclosed alternating arc-light system of 40 lights and 600 multiple arcs. The series arcs are for street-lighting purposes, and the city owns and operates the system, current being sold to the city at the switchboard. Power is furnished principally to factories, there being quite a number of industrial plants in the city. The Fox River Light, Heat and Power Company has recently bought the commercial light and power business of the Elgin, Aurora and Southern Traction Company, and this business now brings its motor load up to about 300 kilowatts.

Considering now the electrical generating end of the plant, Fig. 1 is an interior view of the generator room, showing the location of the principal machines. The two large direct-connected, revolving-field, alternating-current units are of 200 and 500-kilowatt capacity, the smaller machine being nearer to the observer. They were built by the National Electric Company of Milwaukee. These machines generate two-phase current at 2,200 volts, 60 cycles, and are direct-connected to Hamilton-Corliss cross-compound engines running at 100 revolutions per minute. Field excitation may be obtained from either of two sources—a steam-driven generating set or a motor-generator. Either of these two units is capable of furnishing the necessary exciting current, the motor-generator being ordinarily used and the steam-driven set held in reserve for cases of emergency. The generators of each of the exciting sets are of 50-kilowatt capacity, having a speed of 900 revolutions per minute and furnish current at 110 volts. These machines are not shown in Fig. 1, being located in the extreme right of the generator room.

For power purposes two motor-generator sets, running in synchronism with the main generators, are used. They are shown at the right in Fig. 1. They were also built by the National Electric Company and have each an output of 250 kilowatts, the motor end being rated at 275 kilowatts. They furnish direct current at 550 volts, which is transmitted at that pressure to the various motor installations about the city. Some of the largest power consumers are located but a short distance from the station, however, making the transmission losses relatively small. Fig. 4 is a longitudinal section through the power house showing the location of the principal machines.

Fig. 5 is a picture of the front of the 10-panel

switchboard, which is constructed of gray marble, and presents a handsome appearance. This board was furnished by the Walker Electric Company and is equipped with Westinghouse oil switches and alternating current instruments, I-T-E circuit breakers and Weston direct-current instruments. The power circuits terminate on the first panel at the right, next to which are two synchronous-motor panels for the motor-generator sets. Both circuit-breakers and fuses are supplied for these lines. The rheostats for these machines are mounted as shown on steel brackets on the back of the board and are operated by hand wheels on the panels through a chain-and-sprocket-wheel connection. Adjoining the motor-generator panels is one panel for two-phase power circuits, and although this character of service is not as yet given, it is expected that in the future two-phase motors will form an important part of the power load.

Next in order come three service panels for lighting load. The four-way switches on these panels are mounted on a pivot between marble shields, as shown in the picture, and are so connected, by the bus arrangement, to the two-phase circuits that either phase of any load circuit may be thrown on either phase of either generator. These circuits are provided with both breakers and fuses, and when any switch is pulled the circuit-breaker is made to open before the switch blades leave the contacts. As will be noticed, at the end of each shield of the four-way switches there is a small projecting point which is pushed in when the switch is closed. When the switch is opened this point follows and, being connected to the tripping device of the circuit-breaker, the latter is released before the switch leaves the contacts. The remaining panels at the left of the board are exciter panels.

FIG. 2. NEW CENTRAL STATION IN AURORA.

Cables from the machines are run through three-inch fiber conduit beneath the concrete floor to a trench back of the board about 18 inches wide by two feet deep, from which they are brought up to their various contacts. The outgoing cables are led from the trench back under the floor through similar conduits to the feeder tower, which is located just behind the partition back of the board, and pass up through it to the outside for distribution. Fig. 6 is a view of the rear of the switchboard, showing the wiring of the board and the mounting for the lightning arresters, which will be noticed on the concrete step-like bases against the rear wall. The lightning arresters for each circuit are mounted on the faces of these steps, and the shunt wires to the arresters pass through openings in the concrete to the rear, which is at the base of the feeder tower; here they are spliced onto the mains.

Robert W. Hunt & Co. of Chicago, consulting engineers, designed the plant, and William Willett of Aurora is the superintendent.

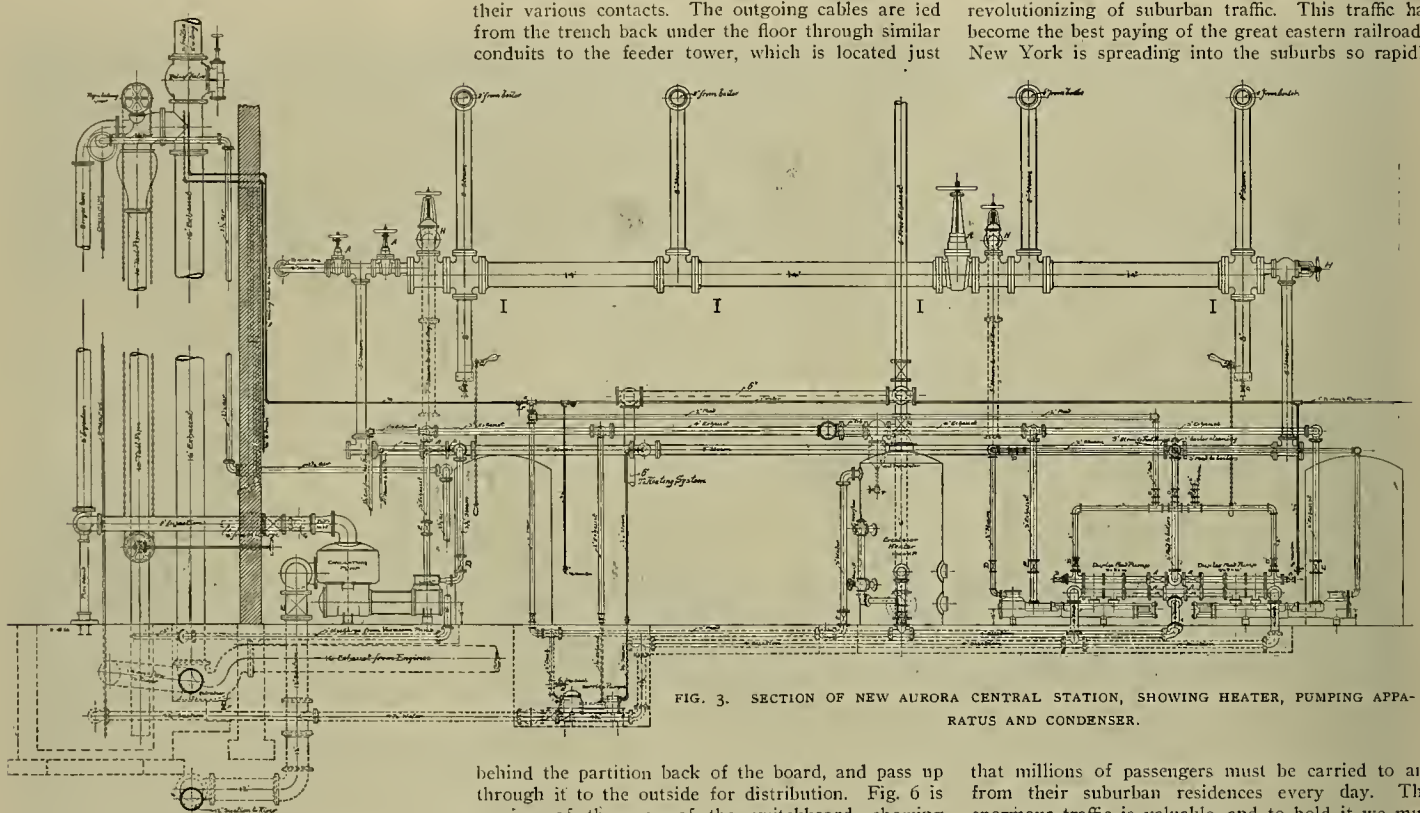


FIG. 3. SECTION OF NEW AURORA CENTRAL STATION, SHOWING HEATER, PUMPING APPARATUS AND CONDENSER.

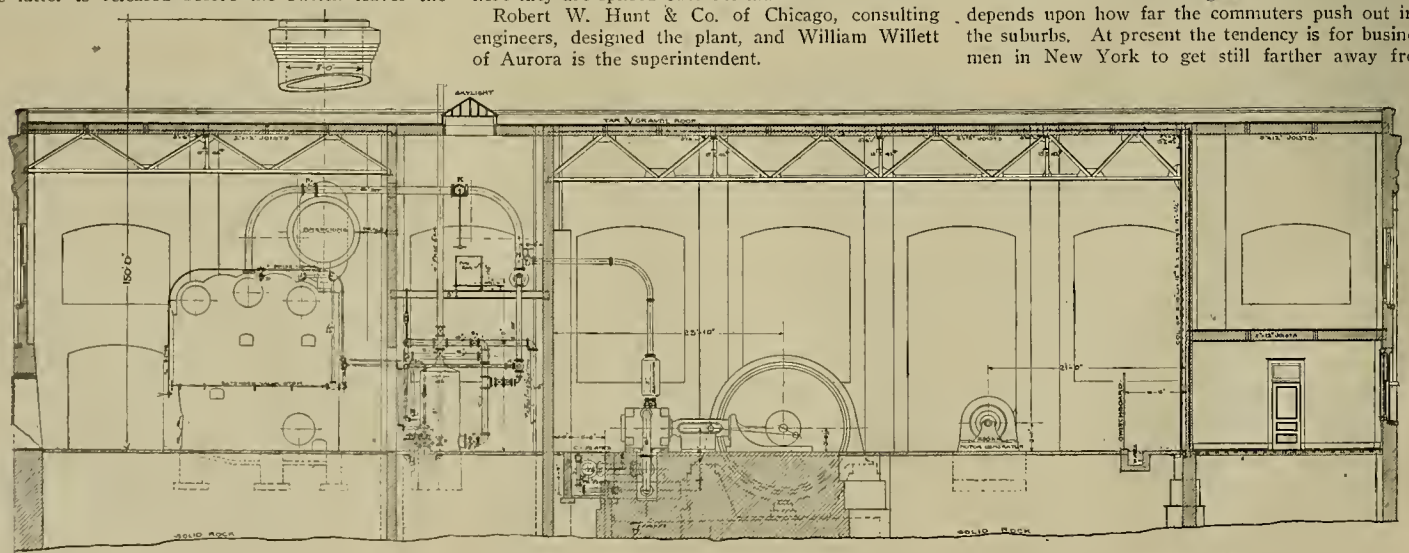


FIG. 4. LONGITUDINAL SECTION OF NEW AURORA CENTRAL STATION, SHOWING POSITION OF BOILERS, ENGINES AND GENERATORS.

The Electric Development of Eastern Railroads.

By George E. Walsh.

The rapid installation of the New York Central railroad with electric equipment for use in the tunnel entering the city, and the efforts of the Pennsylvania to push its tunnel to completion under the Hudson and install it with electric equipment for operating all trains passing through it, emphasize somewhat prominently the strides that electricity is making in the East in crowding the steam railroads for a part of their traffic. Electricity is the only power that can be used successfully and satisfactorily in tunnels, and hereafter it will be impossible for any road entering eastern cities through tunnels to secure the right-of-way unless electric power is employed for running the trains. It has taken some of the prominent railroads a long time to reach this conclusion, but public opinions, as well as business reasons, have forced them to it.

The building of the Pennsylvania tunnel and the electrical equipment of the New York Central tunnel mean a good deal more than is indicated on the surface. In the words of one of the Pennsylvania officers to the writer: "It foreshadows the complete revolutionizing of suburban traffic. This traffic has become the best paying of the great eastern railroads. New York is spreading into the suburbs so rapidly that millions of passengers must be carried to and from their suburban residences every day. This enormous traffic is valuable, and to hold it we must come up to date., Before the Pennsylvania tunnel is in full operation nearly the whole suburban traffic of the Pennsylvania road around New York will be carried by electricity. Plans are already being considered for adopting this motive power for all except through trains. It will extend at first only 30 or 40 miles out from the city, but in time it may include fast trains running a hundred miles. All depends upon how far the commuters push out into the suburbs. At present the tendency is for business men in New York to get still farther away from

the city for country homes, and in summer time in particular this traffic extends 50 and 60 miles out.

"The dust, cinders and smoke of the steam engine will not be tolerated by passengers traveling back and forth every day. This spoils the trip for them, and it has done more to drive people to the seashore in summer instead of the mountains than any other thing. A boat trip is much more desirable to thousands of commuters, no matter how slow, than a ride behind a smoking, steaming engine. To save our traffic we must therefore adopt electricity as the motive power for all suburban trains. The trolley has forced us to this, and year by year it is making it harder for us to hold our own. But, after all, the function of the trolley is to supply purely local accommodations, and they should be feeders to the railroads. We are just beginning to realize this in its true light. We must have fast electric trains that can make travel of 40 or 50 miles in summer a pleasure rather than an inconvenience. This will be accomplished within a few years, and, with open cars going at the rate of 40 or 50 miles an hour, what commuter will object to living a long distance from the city?"

This unusual attitude of the Pennsylvania people toward the electrically operated service is further emphasized by the more enlightened officers and engineers of the New York Central and New York and New Haven roads. These two roads have not always been considered as the most enlightened and progressive in this respect; but the change of front of both is very gratifying to those who have to travel on their trains. It is true that the latter has experimented with electric cars and trains for the last half dozen years on many of its branch New England roads. But that was because it was forced to it to save the traffic from complete demoralization. The trolley invaded New England more than any other part of the country, and nearly all of the states were gridironed by trolley lines. The local trade was taken away from the steam railroad, so that the latter had to enter the trolley service and buy and equip lines to save its very existence. This struggle between the steam railroad and the trolley systems of New England has been the most interesting of all modern railroad questions. At first the trolleys were mere feeders to the railroad, and then they extended their lines and carried through passengers. When the all-trolley route from Boston to New York was first announced the steam railroad controlling the whole New England district awakened from its apathy. Even its freight department was affected, for the trolley lines offered to carry freight cheaper and more satisfactorily than the railroad.

The solution of the fight has been gradually to define the respective spheres of the two competing systems. The trolley is primarily to feed railroads and to be of local service. But the railroads must give good service to their patrons, or the trolley stands ready to carry away its traffic. The New Haven road has now equipped a number of its short branch lines with electrical engines and trains, which run 40 miles an hour, and give excellent service. This service has proved so successful that new branches are being projected. Today the road operates more miles of electrical lines than any other railroad corporation East or West. Yet on its line entering New York, the electrical equipment has ben almost totally neglected; and it is the sudden appearance in the field of the Pennsylvania with improved electrical equipment and the work of the New York Central in installing its tunnel with electricity that have brought the matter home to the New England road. Its local service and suburban traffic will soon be revolutionized. The fight made by this railroad to keep the new Portchester electric road from entering the city is an indication of the need felt by the railroad of a change of motive power.

"Within a few years we shall abolish steam entirely except for long-distance and through trains," promised one of the officials to the writer. "Of course, under the new conditions of the Central tunnel, the rights of which we lease to enter New York, we must use electric power for our trains, and it will be a simple matter to extend this power to all the suburban trains. We shall then put up power houses, so that trains running 30 and 40 miles out will be operated entirely by electricity. Yes; it is demanded by our patrons. They demand it in the summer in particular. Gases, cinders and smoke from an engine are not productive of comfort and cheer among passengers in hot weather, when windows must be kept open. The change to electric power will undoubtedly increase our suburban traffic greatly. We shall make preparations to carry one-third more people in the first year of the change than we carry today, and each year provisions will be made to accommodate any further increase. This is necessary, because of the rapidly increasing population of the country through which we pass. New York is getting too crowded for people, and they are moving more and more to the suburbs. We must accommodate this crowd, for they number tens of thousands today on our lines, and next year they may nearly double. By another decade the commuters will form an army that would make half a dozen respectable cities. Electricity is our only hope for the traffic solution."

The New York Central has just ordered the new electric locomotives for use in the tunnel, and they will begin operations within a year or two, or just as soon as the tunnel equipment is completed. This change from steam to electric power in the tunnel really represents a stupendous work, for while the construction and changes were being made the same time, and with a somewhat lighter train load. Such an electric express, carrying passengers through the tunnel without smoke, cinders and gas, should prove the most notable achievement in electric-train operation in the East.

"In actual performance," explained an engineer of the Central's staff, "the new electric locomotives are expected to give better results than any engine ever before placed on rails, whether steam or electric. With a light train, these locomotives will make from 70 to 80 miles an hour, and if it is found necessary to maintain this high speed for heavier trains it can be done by coupling two or more of the locomotives together. By working two or more together as a single unit we can get almost any power and speed desired.

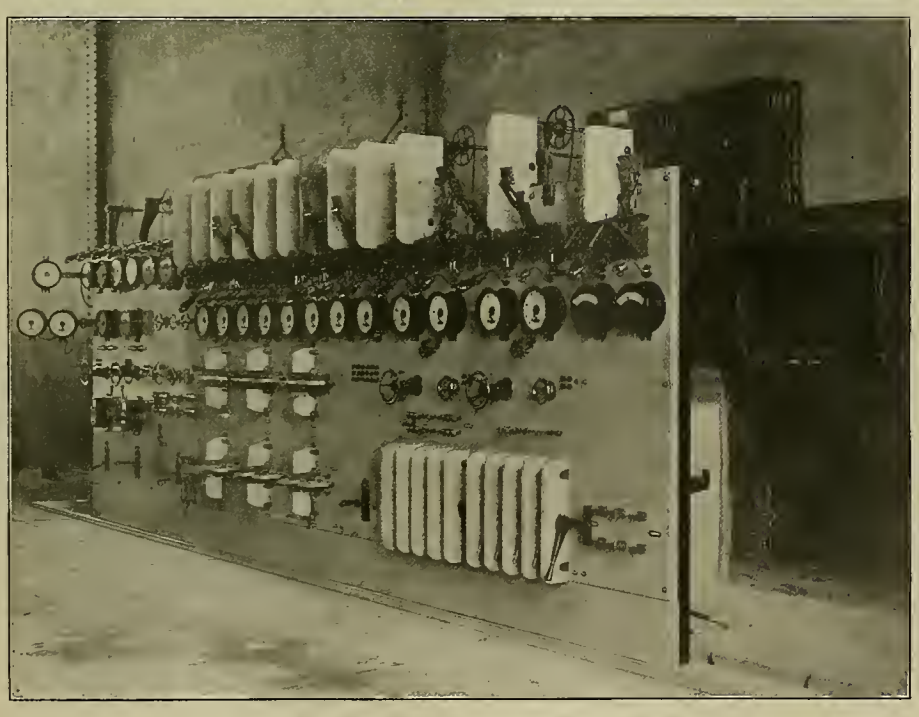


FIG. 5. SWITCHBOARD IN NEW AURORA CENTRAL STATION.

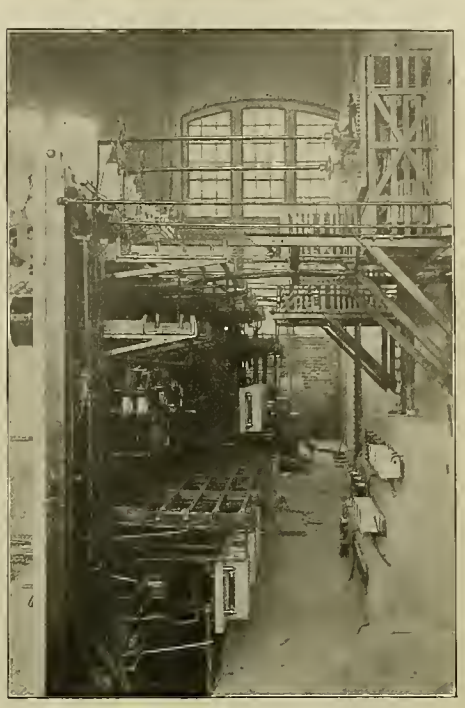


FIG. 6. REAR OF SWITCHBOARD IN NEW AURORA CENTRAL STATION, SHOWING SWITCHBOARD-WIRING AND MOUNTING OF LIGHTNING ARRESTERS.

"The locomotives will be unusual in many respects, for they will be electric throughout. The air brakes will be operated by electric air compressors, and the sanding device will be of an electro-pneumatic design. The control system of the engines will be complete, and also the signaling. The engineer cannot exceed a certain speed, which is assigned to his train, and if the engine should break away it could only make a certain limited speed over the track. Likewise, if one of two engines coupled together should break loose, the current is automatically cut off from the second one.

"We are developing a new system of tunnel signaling by employing novel electric cut-off devices. Although this part of the work has not been entirely worked out yet, it is possible that a system will be adopted which will enable the train dispatcher at headquarters to take the control of an engine from the hands of the engineer. For instance, if an engineer should pass unheeded a danger signal set against him, the fact is instantly known at headquarters by the ringing of an electric bell in the train dispatcher's office. This alarm gives ample warning in time to prevent an accident. By touching a button the official in charge can cut off the power from the engine, and bring it to a sudden stop. Thus, there is a double control of the engines, which makes security against accidents so much the stronger. Hurried, careless or sick engineers could not in this way precipitate an accident by colliding with a train ahead without the sanction of the train dispatcher. Ordinary tunnel collisions that have happened in the past would be a physical impossibility. Not only that, but the stories of dead engineers at their post would no longer have any terror. Danger from such a thing would be avoided."

In regard to the general improvement of the suburban service by the adoption of electricity for operation, the same official added: "The service will, according to our estimates, develop so rapidly under the new conditions of affairs that within five years the number of people carried on the trains should be doubled. This is anticipating a tremendous gain, but we do not think we are placing the mark too high. The suburban traffic has been increasing so rapidly in recent years that it has been difficult to keep pace

number of passenger trains had to make their regular trips.

The new electric system will be one of the finest and most complete in the world. There is to be no slackening of speed of trains through the adoption of electricity, but rather a great increase, as may be seen by the specifications for the new engines. The new electric locomotives must be able to run from the Grand Central Station to Croton without a stop in 44 minutes, with a total train load of 435 tons. To compare that with modern steam conditions, it is only necessary to state that the Empire State Express, which is famous for its speed, is scheduled to cover the same distance in exactly the

with it. We shall work on this idea in installing the road with electricity, adding new branch lines and auxiliary feeders until the whole system is brought to completion. Electricity has thus entered the railroad field to stay, and it promises, for all short-haul lines, to revolutionize past conditions as much as the trolley changed local traffic a decade ago. Will it likewise change the long-haul traffic, and compete for freight haul, in the same successful manner? That's something no man can answer today, but it looks as if it might in time."

Electricity in the Construction of the New Railroad Around Lake Baikal in Siberia.

The results obtained in western Europe and in America by the use of electrically operated drills in the construction of railroads determined the Russian engineers who had charge of the construction of the railroad around the southern part of Lake Baikal to employ the same method, in order to facilitate the difficult construction work on the new line. In one portion of that railroad, 16 miles in length, the contractors are obliged to build 13 tunnels, 2½ miles in total length, besides making numerous cuttings in the rocky soil of that region.

A central power station has been established at the middle point of the section, and high-tension cables extend on both sides along the tracks. The station contains a boiler house and a generating set of 120-horsepower output. A three-phase generator produces alternating current under pressure of 2,200 volts. The high-tension cables carry the current to four sub-stations, each of which contains an alternating-current motor operating a dynamo. Some of the dynamos generate alternating current at 110 to 130 volts, while others produce direct current for driving pumps and ventilators and also for lighting purposes. The alternating current is distributed through the whole plant, where 25 to 30 electric drills are constantly in operation. From the direct-current machines current is supplied to eight arc lamps and 200 incandescent lamps. The direct current is also employed for driving six rotating pumps and six ventilators, which are employed for air purification after each explosion in the tunnels. Notwithstanding the temperature of 14° below zero, the installation was completed in less than three months.

Municipal Ownership in Canada.

In his annual address as president of the Canadian Electrical Association, delivered at Hamilton, Ont., on June 15th, Mr. J. J. Wright, manager of the Toronto Electric Light Company, said that he was pleased to note that the legislation which requires a municipality to purchase at a fair valuation the plant of a company with which it would otherwise go into competition still remains upon the statute books of the province. There appears to be a growing tendency on the part of the municipal socialist to endeavor to obtain the control of what he pleases to term public utilities, but while this legislation remains in force Mr. Wright did not see anything for the capitalist to be alarmed at in this passing whim. It was much to the capitalist's advantage that he let the municipality take the risk of depreciation in an uncertain business while he provides the funds for the debentures, the returns on which are absolutely guaranteed to him by a mortgage on every bit of property in the municipality. The capitalist gets his dividends without effort and lets the other fellow do the necessary worrying. What the taxpayer may have to say later is another matter. It only requires a few more failures on the part of Canadian municipalities, such as are now becoming manifest, to disgust the payer of taxes with municipal socialism.

Developments in the Copper Market.

Quoted values in copper show a declining tendency, and of late the chief concern of the trade is to determine the most favorable time to replenish stocks. Within a month prices have declined from 13¼ cents to 12½ cents a pound for electrolytic wire bars. The course of the market thus far has been to defer purchases with expectation of future concessions. Shipments of copper from this country during the last five months were the largest on record, amounting to 97,765 tons, or 42,534 tons more than for the corresponding period last year. The domestic production is estimated at the high figure of 30,000 tons a month. Foreign copper dealers have been "bearing" the market to facilitate purchases at a reduction, and they have been assisted in these tactics by conditions on both sides of the Atlantic.

New Independent Telephone Exchange at Kankakee.

The new Independent telephone plant at Kankakee, Ill., was formally transferred to the Eastern Illinois Independent Telephone Company by the Independent Construction Company on June 7th at a meeting of the board of directors of both companies. The Kankakee system includes, besides the Kankakee city plant, the exchanges at Manteno, Grant Park and Bonfield. Chebanse, Momence and St. Anne are also to be equipped, and this will give the new Independent Telephone Company access to all important points in Kankakee County. The Kankakee plant as well as the other smaller exchanges are well built and well equipped.

In the city of Kankakee over 16,000 feet of underground work was done in the main streets. The only pole work that is visible is the circle tops that supply the connections to the business houses. All poles that were used for distribution are Idaho cedar. Over 50,000 feet of cable was used in the city, which also includes the cable used in the towns of Bradley and Bourbonnais. These towns, it may be explained, are operated from the Kankakee exchange. One hundred and fifty miles of pole line is supplying the farmer, toll and city lines in the county. The farmer lines already built have a capacity for 600. Four hundred farmers are now being served from these lines, and from the present outlook the demand for the Independent company's instruments among the farmers will tax the lines to the limit. Six hundred subscribers are being served from the Kankakee exchange, and as fast as the work can be completed those on the waiting list will be connected up.

MAIN SWITCHBOARD OF NEW INDEPENDENT TELEPHONE EXCHANGE AT KANKAKEE.

The service that the new Independent company is giving is excellent and has received many compliments. The switchboard and instruments are of the Stromberg-Carlson Telephone Manufacturing Company's make.

The main distributing frame is equipped with an immediate capacity of 1,600 lines, terminating underground cables on the cable side, using 100-pair lead-covered, wool-insulated cables, spliced into the main underground cables to avoid the use of potheads. The arrester side of the main distributing frame is equipped with American Electric Fuse Company's combination lightning and sneak-current arresters of the self-soldering type, mounted in strips of 100 pairs each, provided with guide wire strips, numbered to correspond with the switchboard numbers. The intermediate distributing frame is equipped for the immediate operation of 1,600 lines, equipped with both answering-jack and multiple terminals for cross-connecting the subscriber lines.

The switchboard consists of one visual-signal, series-multiple, central-energy switchboard of 3,000 lines frame capacity, equipped for the immediate operation of 60 generator-call farmer-line equipments and 1,500 regular-subscriber lines distributed in 12 regular operators' positions. It consists of five sections of three-operators' positions each, of the six-panel type in the multiple, trunk and answering-jack space.

The first position of the first section of the switchboard serves as a multiple annex position. The second position of the first section is wired and equipped for 60 generator-call farmer-line equipments, consisting of tubular drops with associated double cut-off jacks. The keyboard is equipped with 12 pairs of cords, arranged for connecting either generator call with generator-call lines, or generator-call with central-energy lines. The cord pairs are so arranged that any pair may be used for either purpose by the operation of a selector key. The farmer-line position is also equipped with incoming trunks from the toll-board terminating on plugs with disconnect lamps. For nights and Sundays the toll lines are switched to this farmer-line position so that the operator may do all the toll trunking. The operator may put up all toll connections at this position. The third position of the first section, likewise the first, second and third positions of each of the second, third and fourth sections are each wired and equipped complete for 140 visual-signal line equipments. The first position of the fifth section is wired and equipped for 100 visual-signal line equipments, making a total of 1,500 central-energy line equipments. The second and third positions of the fifth section are equipped as multiple-annex positions. No answering jacks or keyboard equipment are installed at the present time. All unequipped space in the answering-jack and multiple space in the multiple switchboard is filled in with neat ebonized panels.

Each equipped regular central-energy operator's position contains an operator's telephone talking set complete, including a solid-back transmitter suspended by means of flexible cords to an adjustable transmitter support, operator's head telephone and band attached by means of cord to an operator's plug, two operators' cut-in jacks wired in multiple and so arranged that when an operator's plug is removed from either jack the operator's telephone battery circuit is opened. Each keyboard of each equipped operator's position is equipped for 15 pairs of cords, with double-lamp supervisory signals, ringing and listening keys and associated cord apparatus. Each keyboard is equipped with five order-wire keys.

Each equipped regular operator's position has two supervisory pilot lamps mounted in the bar immediately below the answering jacks—one indicating calls coming in on the respective operators' positions, the other being a ringing supervisory pilot lamp. The line-call pilot lamps are wired in the night-bell circuit, controlled by the night-bell switch.

The framework of the multiple switchboard is made of iron, covered on the face and ends with well-seasoned quarter-sawed oak, highly polished. The keyboards are hinged and are built up of five layers of oak securely glued together so as to prevent warping. The plug shelves are covered with the best grade of belt leather. The pilot lampbars in front of the plugs are likewise covered with mottled brown leather.

In the upper part of the face of the switchboard

in each regular position the line signals, consisting of magnetic visuals, are mounted in strips of 20 and protected by ground glass plates having alternate clear and ground glass spaces. Each position has a capacity for 100 line visuals. Below the visual-signal space in each section of three positions is provided a multiple space for an ultimate of 3,000 lines, distributed in six panels. Below the multiple space is

A. J. Vernier, General Manager.

T. J. Reddy, Superintendent of Construction.

INDEPENOENT TELEPHONE OFFICIALS AT KANKAKEE.

provided trunk space in each section for an ultimate of 12 strips of trunk jacks. The answering-jack space for each operator's position has a sufficient capacity for an ultimate of 140 answering jacks provided with removable number plates.

Each of the five sections of the multiple switchboard is equipped with a full complement of 1,500 multiple jacks to enable each operator, including the farmer-line operator, to have complete access to the multiple. The multiple jacks are so arranged that when additional sections are added the present multiple cables may be extended without change in the present cabling. The multiple jacks are mounted in strips of 20 and are provided with individual tip, sleeve and busy-test thimbles for each line. The jacks are numbered in banks of 100, from 0 to 99—100 numbers being distinctly shown on the stile strips.

The talking circuits, both line and cord circuits, are free from any apparatus that would offer impedance to the voice currents. All circuits are balanced, impedance coils being provided on the tip side of each line. Cord circuits are provided with full double-lamp supervisory signals, enabling the operator to have complete supervision of the connections without "listening in." The answering and calling supervisory lamps are under the direct control of the subscribers with whose lines they are associated during connections.

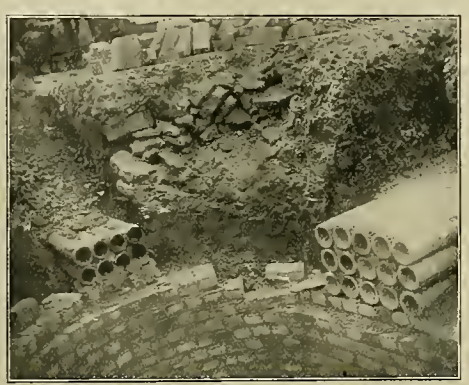
A chief operator's desk is provided with the necessary monitor and pilot equipment, so as to enable the chief operator to "monitor" the line operators without the knowledge of the operators. A wire chief's desk is provided with all necessary testing apparatus for making insulation, condenser and ground tests of either the central-energy or toll and farmer lines.

A complete storage battery and power plant is installed, consisting of 40-volt system using a duplicate set of Electric Storage Battery Company's accumulators in glass jars. These storage cells are charged by means of a Roth Bros. motor-generator operating from a 500-volt power circuit. A duplex set of ringer machines of Roth Bros.' make furnishes the necessary ringing current. Independent transformer windings are used for ringing on the central-energy and toll lines, respectively. A white Italian marble power switchboard is equipped with Weston instruments, overload and underload circuit-breakers, Cutler-Hammer starting boxes and rheostats; also all necessary switches so arranged as to enable either set of storage batteries to be charged or discharged alternately, or charged and discharged simultaneously.

All power wiring, where concealed, is done with armored conduit. All cabling is carried overhead on iron cable racks so as to prevent any possible interference with the service, due to accidental flooding of the operating or terminal room floors.

A separate tollboard is used for handling the toll-line service during the daytime, consisting of a flat-top desk with drawers in each end and having mounted on top a turret for mounting therein the necessary line apparatus. The tollboard is provided for 40 toll lines, 20 trunks to the main board, 10 incoming trunks from the main board and five order-wire circuits. The keyboards are equipped with 10 pairs of cords with ringing, listening and ring-back keys, repeating coils and controlling keys. The outgoing trunks to the multiple board are provided with necessary repeating coils and supervisory lamps so as to enable the toll operator to ring the central-energy subscribers direct, thus having complete supervision of the connections.

In the operating room there are 10 girls during the day to take care of the city, farmer and long-distance work. Seven girls are working on the city boards, two on the toll and one on the farmer lines. At night until nine, four girls are retained, but from that time until seven in the morning only two are on duty. The operating room is in charge of a competent chief whose duty at all times is to see to the welfare of the subscribers.



NEW TELEPHONE SYSTEM AT KANKAKEE.—CONDUITS LEADING TO MANHOLE.

The company occupies nine rooms, the entire second floor of the new Fraser building, which was especially built and equipped for the company. The operating room is large and airy, giving fresh air and comfort to the operators at all times. Adjoining this is the reception or lounging rooms for the exclusive use of the operators. In connection are also the lockers and toilet rooms. The offices occupy four large rooms. The remaining rooms are used by the terminals and battery plant, public booth operators, etc.

The Eastern Illinois Independent Telephone Company is purely a home company, composed of leading business men of Kankakee. The rates are reasonable enough to allow every one the use of a telephone—$30 a year for a business telephone, $18 for residence instruments and $15 for the rural service.

The Independent Construction Company, which built the Kankakee system, has its offices in Archbold, Ohio, and Kankakee, Ill. The company is incorporated in Ohio and has built several fine plants in the last seven years. A. J. Vernier, the general manager of the Construction company and also of the telephone company, is a man of wide experience in the handling and building of telephone systems. He has good executive ability and is an aggressive force in Independent telephony.

The entire construction work of the Kankakee system was under the personal supervision of Thomas J. Reddy of Kalamazoo, Mich. Mr. Reddy's ability is plainly shown in the up-to-date and faithful manner in which he built this exchange, and it is surely a credit to him as a construction superintendent.

Canadian Capitalists Plan Large Electrical Project for Brazil.

Toronto and Montreal capitalists have embarked in the largest project ever undertaken by Canadians outside of Canada. They have promoted a company called the Rio de Janeiro Tramway, Light and Power Company, with a capital of $50,000,000, and expect to outdo the Sao Paulo and Mexican projects. Among the largest interests in the new company, which has just applied to the Dominion government for a charter, are Senator Cox, William Mackenzie, Sir William Van Horne, E. R. Wood, Frederic Nicholls and F. S. Pearson. By the options that have already been obtained on the different franchises, the company will have a monopoly of all electric business in the city of Rio de Janeiro, Brazil. The company has secured the only big waterfall situated within the radius from which power could be brought to the city; it is 75 miles in a straight line from the city. The new company has bought out all the existing power and lighting companies in Rio de Janeiro. The four tramways purchased are the Sao Cristarao, the Villa Isabel, the Carris Urbano and the Carioca. At the outset the company will issue $25,000,000 bonds, which will provide for the purchase of equipments and the properties and provide a working capital of $2,000,000.

Trade Opportunities Abroad.

In a recent report on the possibilities of American firms securing trade abroad, United States Consul-general Richard Guenther at Frankfort, Germany, enumerates the following, among other items:

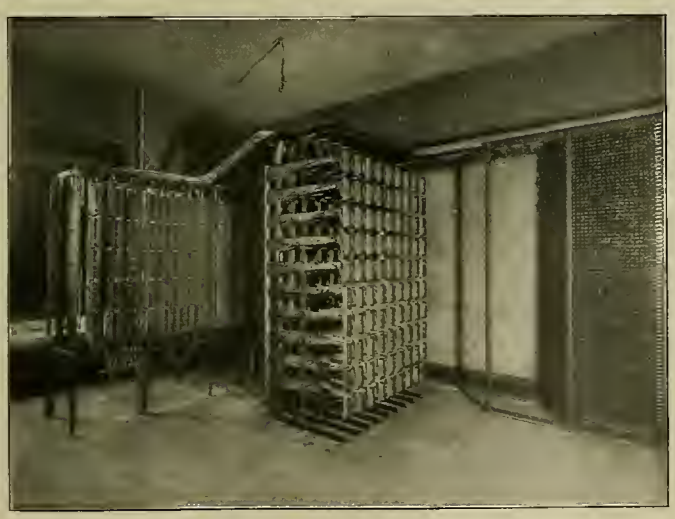
The Town Council of Queenstown, Cape Colony, contemplates putting up a plant for telephone and waterworks service; the estimated cost is nearly $350,000.

The city authorities of Turin and Brescia, Italy, have granted permission for the building of electric tramway lines.

The towns of Zweisimmen (canton of Berne) and Murg (canton of St. Gall), in Switzerland, are intending to erect plants for electric lighting and supplying power.

The Belgian consul-general at Cape Town, South Africa, reports that that city will soon extend its tramway system and contemplates making large purchases of material (steel rails, etc.) for that purpose.

Spain and Argentina should receive close attention from our railway contractors and electrical works, who ought to send experts to these countries.



Terminal and Intermediate Frames.

Power Board, Ringing Machines and Battery.

NEW INDEPENDENT TELEPHONE EXCHANGE AT KANKAKEE.

WESTERN ELECTRICIAN

EVERY SATURDAY.

PUBLICATION OFFICES:
510 Marquette Building, • CHICAGO.
TELEPHONE MAIN 1746.

Eastern Office, 193 Times Building, New York.
Telephone, 3806J Cortlandt.

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted. This paper is entered at the Chicago postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the **old address** as well as the new should be given.

CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—**the only general electrical paper published in the West**—thoroughly covers a territory *exclusively its own.* THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be furnished on application.

REMITTANCES.—All checks, drafts and other remittances should be made payable to the order of the publishers, **the Electrician Publishing Company,** and addressed to the offices of publication, Suite 510, Marquette Building, (204 Dearborn Street), Chicago, Illinois, U. S. A.

CONTENTS OF THIS NUMBER.

The New Central Station for Light, Heat and Power in Aurora, Ill. Illustrated 1, 2, 3
The Electrical Development of Eastern Railroads. By George E. Walsh 2, 3, 4
Electricity in the Construction of the New Railroad Around Lake Baikal in Siberia 4
Municipal Ownership in Canada 4
Developments in the Copper Market 4
New Independent Telephone Exchange at Kankakee. Illustrated 4, 5
Canadian Capitalists Plan Large Electrical Project for Brazil 5
Trade Opportunities Abroad 5
Editorial 6
"Wireless" Troubles and Triumphs at Wei-hai-wei 7
Pacific Coast Electrical Transmission Association 7
Electrical Features of the St. Louis Exposition Described by Mr. Ellicott 7
Industrial Development in Mexico 7
High-tension Transmission Convention of the Institute in Chicago, June 21 and 22, 1904 ..... 8, 9, 10
Long Spans for Transmission Lines. By F. O. Blackwell. With discussion 8, 9
Protection of Cables from Arcs Due to the Failure of Adjacent Cables. By W. G. Carlton. With discussion 9
The Use of Ground Shields in Transformers. By J. S. Peck. With discussion 9
Conditions for Continuous Service Over Lines Operated in Parallel. By M. H. Gerry, Jr. 9, 10
The Protection of High-pressure Transmission Lines from Static Discharges. By H. C. Wirt. With discussion 10
Synchronous Motors for Regulation of Power Factor and Line Pressure. By B. G. Lamme. With discussion 10
Walter H. Whiteside, General Manager of Sales for Allis-Chalmers Company. Portrait 10, 11
Spring Binding Posts for Dry Battery. Illustrated 11
New York Electrical Society 11
Canadian Westinghouse Factory. Illustrated 11
Aluminum Electrical Conductors. By Roderick J. Parke. (Canadian Electrical Association) 12, 13
Electric-railway Tests at St. Louis 13
Government Space-telegraph Commission 13
Delegates to and Programmes of the International Electrical Congress 13
Weston Patents Sustained 13
Indiana Telephone Items 14
Telephone News from the Northwest 14
Ohio Telephone Notes 14
Telephone Progress on the Pacific Slope 14
Southeastern Telephone Developments 14
New Independent Association in Ohio 14
Telephone Men 14
Telegraph and Telephone Facilities at the Republican National Convention 14
Cupid and the Telephone Operator 14
Bell Output for May 14
New York State Independent Telephone Association 15
The Invention of the Telephone 15
Public Telephones in St. Petersburg 15
General Telephone News 15
Plus-and-minus Selective Signaling. Illustrated 15, 16

DEPARTMENTS.

Correspondence 16, 17, 18
Great Britain 16
New York 16
New England 16, 17
Dominion of Canada 17
Southeastern States 17
Texas and Mexico 17
Ohio 17
Indiana 17, 18
Northwestern States 18
Rocky Mountain States 18
Pacific Slope 18
Personal 18
Electric Lighting 18
Electric Railways 18, 19
Automobiles 19
Publications 19
Trade News 19
Business 19
Illustrated Electrical Patent Record 19, 20
Special Mention 20

DATES AHEAD.

Ohio Electric Light Association (annual convention), Sandusky, August 16th to 18th.

International Electrical Congress, Hall of Congresses, St. Louis Exposition, September 12th to 17th.

International Association of Municipal Electricians (annual meeting), St. Louis, September 13th and 14th.

American Electrotherapeutic Association (annual convention), St. Louis, September 13th to 16th.

VISITORS to the Louisiana Purchase Exposition at St. Louis who are interested in electricity or electrical literature are cordially invited to call at the booth of the Western Electrician, which is in Block 1 (Section 13) of the Palace of Electricity, just west of the main northern entrance to the building. Here will be found copies of the current issue of the paper, bound volumes of the Western Electrician from the first number, a careful selection of electrical books exhibited by the Electrician Publishing Company, and other objects of electrical interest. Chairs are provided for weary sight-seers, and an attendant will extend a hearty welcome to all readers or friends of the paper.

CONGRESS is not the only influential body that gives "leave to print," for we observe by the report of last week's convention of the New York State Independent Telephone Association that "In order that the delegates might have time to go on a visit to Niagara Falls it was decided to dispense with the reading of the papers which had been prepared. These will be printed in pamphlet form and distributed to the members." This course, it must be confessed, is a little unusual. Often the technical programme of an electrical convention is neglected, but we do not recall any case where, after several papers had been prepared, their actual presentation and discussion were abandoned altogether. The Buffalo convention has set a precedent, but it is not a good precedent, for discussion forms the most valuable feature of all conventions.

AMID all the distractions of war Russia finds time to consider electrical enterprises of moment, and one of the important projects seriously discussed at the present time is the electrical transmission of power from waterfalls in the vicinity of St. Petersburg. We are informed that the subject was taken up by the "Committee of City Railways" at a special meeting held on March 6th last. It was pointed out at that meeting that the falls of the River Vouoksa, situated at a distance of 150 miles from St. Petersburg, would be the most suitable for the purpose, and a commission, composed of several engineers, was appointed at that time. In a report of this commission it is said that, if steam engines were used for driving generators, the kilowatt-hour cost would be 1.53 cents; with gas engines the figure was placed at 1.02 cents, while a waterpower plant would still lower the cost to 0.985 cent, supposing the loss of energy to be 22 per cent. The enterprise would demand an investment of 14,000,000 to 16,000,000 rubles ($7,000,000 to $8,000,000 approximately); that is, about 100,000 rubles a mile. In order to avoid any interruption in the service, it is expected that two independent transmission lines will be built, if this important project is carried out. It is probable that no steps in the way of actual construction work will be taken while the war lasts, but when peace is declared something may be done.

LOCATION of the third rail of electric railways in relation to the track rails exhibits no uniformity of practice; and it is evident that when the electric railway arrives at the stage in its development when extensive interchange of traffic begins it will be necessary to have a standard system of third-rail construction, if, indeed, the third rail is at that time the accepted method of conveying the current to the motors in heavy railroading. Therefore, a committee of the Master Car Builders' Association has been considering the subject, and at the Saratoga convention of last week it presented a report on "Standard Location of Third Rail for Electrical Operation." The committee found that the representatives of various railroads about New York city, after much consideration of the subject, have fixed upon a location for third rail which is very apt to be standard in the electrical construction on steam railroads about New York city. This location is (considering the center of the third rail) 27 inches from and outside of the gauge line of that track rail which is nearer the third rail. As to altitude, the third rail is 3½ inches above the top of the nearer track rail. This location is considered by the committee as "the most pronounced standard" and the one "which, no doubt, will be followed more or less closely by such roads as may take up, in the future, electrical operation." At present the divergence in the lateral distance of the contact rail from the nearer track rail (where the third rail is outside the track, as is usually the case) is from 19½ to 30 inches, while the difference in height between third rail and track rail is from 1½ to 7⅞ inches. On the Chicago elevated roads these distances are 20⅛ and 6½ inches, respectively.

THE QUESTION BOXES of the various electrical associations contain much valuable material which would be more readily accessible if the books were more carefully indexed. The index should show, by page or paragraph numbers, where to look for references to "Motors," "Meters," "Storage Batteries," "Methods of Charging," "Waterwheels" and the many other subjects covered. The indexing should be done thoroughly and with care and intelligence, for few things are more exasperating to the seeker after information than the poor index, whether too barren or too intricate, while the good index, enabling one to put his finger on the spot at once or to rest assured that there is no spot, is indeed refreshing to the spirit. To make a suitably indexed volume it will be necessary, of course, to have all of the material in hand well in advance of the convention—say a month. But a complete index will so enhance the value of the question box—which is not intended to be read through like a novel—that the time and labor spent upon it will be more than repaid.

BEARING directly upon the problem of transmission proper, the paper by Mr. F. O. Blackwell upon "Line Construction with Steel Supporting Structures and Long Spans" probably excited the most discussion at the high-tension transmission convention held in Chicago last week. Are we about to enter upon a new era in the matter of line construction? This question is one upon which engineers today are divided, and with good reason, for there is something to be said both for and against the use of long spans. Though steel or iron towers located at considerable distances apart for carrying a transmission line are by no means untried, especially in those localities where poles are hard to obtain, or in which they are not easily transportable, still it may be said that as yet this method is still on probation, and therefore Mr. Blackwell's paper was a timely one.

One of the strongest points in favor of the long span is that the number of points at which the line must be insulated is reduced thereby. This certainly is a distinct advantage, but still there are complications arising which detract from the benefit achieved. For instance, there will likely be an increase in the cost of repairing a break when it does occur, and the interruption to service due to a break will surely be longer than in the case of a short span, where the repairs may be more easily and quickly effected. In relation to the matter of protection from lightning by the steel towers, the opinion of those at the convention seemed to be principally favorable, and instances were cited where lines in tropical countries in which wooden poles were replaced by iron towers were relieved of much of the trouble due to this cause. Deterioration in a well galvanized steel or iron tower is very slight, as has been proved by windmill and marine work, and when it is considered that the life of a wooden pole is only from five to 25 years, according to climatic conditions and the material used, and that each pole replaced means a shutdown of the line, it would appear that the steel tower has decidedly the advantage in this respect.

Reliability and continuity of service are factors of prime importance, and should be considered as such in the construction of a transmission line. If the steel tower with long spans comes nearer fulfilling these requirements, even at an increased first cost, well and good; it will ultimately come into general use. If, on the other hand, the advantages which are ascribed to the tower are counterbalanced by its disadvantages, there is, of course, no reason why we should seek to change from old and well-tried methods. The question is one of much interest to the engineer, mechanical as well as the electrical, and the discussion which took place at the recent Chicago convention will throw much light on the subject.

"Wireless" Troubles and Triumphs at Wei-hai-wei.

Dated at De Forest Wireless Station, Wei-hai-wei, North China, April 10th, the space-telegraph operator of the London Times sends a very interesting account of the installation of the wireless apparatus for the use of the war correspondents of that paper. The use of space telegraphy in the Russo-Japanese war has attracted a great deal of attention, particularly as at one time the Russian government threatened to treat as spies correspondents using this method of communication. The following extracts from the operator's letter are here reprinted from the London Electrician:

"I have delayed writing until I could give definite statement about the work. Owing to the movements of the boat we did not have an opportunity to get a good test out until last night. Before saying more I will relieve your mind. One hundred and fifty miles both ways in calm weather and 125 at other times will be good enough, don't you think? That was the result of the test last night, first test, and I am sure it will stand good. In rough weather the boat rolls, shakes and jars so badly that Brown can't hear me beyond 125 miles. The troubles and snags I've been up against on other jobs fade to a mere shade compared to this. Placed as we are, in an out-of-the-way corner, where it is well-nigh impossible to get anything done, it doesn't take much to put you in a bad hole in this work. A few more jobs like this and I'd begin to sprout gray hairs . . . that's no dream. Perhaps the importance of our mission and the fact that all eyes were upon us, as it were, spurred us on. The country is full of wireless, and we are showing 'em a thing or two. I can't begin to tell you all the trouble we had. Anyway, it would make poor reading, and I don't know that I care to rehearse it either.

"The topmasts fitted on the boat at Shanghai went down the first night out. On our arrival here there were a few old junk masts lying on the ground, no houses for us, nothing even started. It took several weeks to raise a mass of rotten wood about 170 feet high. The country hereabout, by the way, is almost devoid of timber, and it is very hard to get any kind of poles. Several of our cases were badly damaged on the trip, mostly the Secor stuff, and that gave us a lot of trouble. The engine houses fared worst, and small parts on the engine were broken and bent in bad shape. The bright gentleman who packed the engine oil put the tins in a box and drove nails through them. About half the oil, rather nearly all in some cans, had leaked out when we unpacked. That damaged engine gave me the time of my life, but I finally mastered it, and now it is doing its part all right. While the Haimun was coaling in Japan another topmast was fitted up, but only one, so that we can only run wires straight up and not across from mast to mast. They didn't seem to want to go to the trouble of two topmasts, so we get along with one. Owing to the peculiar circumstances in erecting the pole, the shacks were not built until the pole was up, and of course with Chinese to build the shacks, that in itself was a big job. A Chinaman works half an hour and then sits down and smokes for a quarter of an hour. If there are 20 on a job, five will be working and the others squat around smoking and looking on. At the time the shacks were built it was the Chinese New Year, which lasts from one to three weeks. It was very difficult to get any of them to work, and those who did went their own gait or not at all.

"Although the putting up of the poles and the houses took several weeks, the correspondents seemed to have an idea our part would take no time at all, and as soon as their part was finished were in a great hurry. You said in your memo.: 'Stations must be working within three weeks.' Including nearly, or the best part of, 3½ days' work on engine and generator, we equipped the shore station in six days, and equipped the boat in one day completely. We didn't twiddle our thumbs much that week. Nine days after we began to work the pole blew down and another week was required to repair it. During that week I strung up two wires about 80 feet high, and we worked that 60 miles, losing no time on our work. There is an almost continuous succession of high winds here, and my antennæ have been carried away three or four times.

"On the boat we were grounded to the hull, and have a four-wire antenna a little less than 100 feet high. With the repaired pole on the shore station we have a scant 150 feet of antenna. The site is on the top of a cliff, about 150 feet above the sea, with a rocky hill sloping sharply up to one side, rising higher than the pole. I forgot to mention that we are on an island 1½ by two miles in area, a mass of rocky hills rising several hundred feet above sea level. The site we have is the best procurable on the island, Liukungtao, and there is no suitable site on the mainland within four or five miles of the office. I am going to have several photos taken and will forward them within two weeks.

"As I said before, the country is full of wireless, and we have any amount of competition, not in press work, however. All the British warships, from the third-class cruisers up, are equipped with Marconi, about 24 in all; nearly all the Japs have wireless equipment; the Russian ships are equipped, and several German vessels. One or another of them can be heard any time, day or night. The Japs are particularly numerous, and we are at it all the time. We laugh at them, for we have struck some good points in tuning, which settle them very nicely. On the boat when receiving our stuff two of the four wires are grounded directly, which gives best results. Any resistance between those wires and the ground weakens the signals. If we want to hear the Japs call, disconnecting ground wire entirely from syntonizer of the receiver brings them in strong; while with the ground wire on, as in receiving our stuff, the Japs come very faintly. On the shore station it is different. Three wires are best in receiving up to 100 miles, with the other two wires free, at which time the Japs come in weakest. By grounding the other two wires the Japs come in very strong and our stuff weakest. Above 100 miles our stuff comes best with two wires grounded directly. That of course allows others to come in, but they are not strong enough to prevent my reading through. So far that tuning is best and certainly gives very satisfactory results. There are always one or more British warships lying here, and we have them all wondering. The lieutenants of two torpedo boats have told me they do not depend on more than 40 or 45 miles regularly, and another says he can depend on 60 miles. The last one has 160 feet of wire to do his 60 miles, while our boat has a scant 100 feet of wire, and easily covers more than double the distance. Our speed is a source of wonder and admiration to these British officers. I saw some of their tape after we got through with it, and couldn't read a word."

Pacific Coast Electrical Transmission Association.

The eighth annual convention of the Pacific Coast Electrical Transmission Association was held at Monterey, Cal., June 21st and 22d, and was attended by about 60 electrical representatives, including many of the leading engineers of this coast. The mayor of Monterey, R. F. Johnson, addressed the meeting, and many excursion trips were taken after business hours. Papers of great interest and importance were read and discussed. The writers were A. J. Bowie, Jr., A. M. Hunt, R. W. Van Norden, E. G. de Wald, H. G. Aylsworth, H. A. Russell, H. A. Bullard, Sidney Sprout, W. F. Lamme and R. B. Elder. The latter four presented papers on "Single-phase Electrical Machinery" and its application to electric-railway work. In the evenings two illustrated lectures were given.

Among those who attended were C. H. Pennoyer, C. L. Cory, J. A. Lighthipe, H. L. Shannon, W. W. Briggs, C. W. Hutton, W. H. Hall, A. D. Wempe, F. J. Cram, R. B. Elder, M. A. Farnsworth, George H. Rowe, W. C. Clark, F. E. Smith, W. W. Hanscom, R. W. Van Norden, C. W. Whitney, G. R. de Vore, George P. Low, Orion Brooks, E. V. D. Johnson, S. J. Hendy, J. L. Holland, H. A. Russell, Robert McF. Doble, John R. Cole, F. A. Ross, Frank Fowden, Milton Shulaw, J. A. Clay, L. F. Munhall, T. W. Tetley, F. V. T. Lee, W. D. Ward, E. B. Bolger, F. G. Baum, Clem A. Copeland, R. B. Daggett, A. H. Babcock, E. Dressler, J. G. Scrugham, E. C. Holbertson and P. M. Downing.

The officers elected were: President, H. W. Goode, who is president of the Portland General Electric Company and director-general of the Lewis and Clark Exposition; vice-president, C. H. Pennoyer of the United Gas and Electric Company of San Jose; secretary, George P. Low of San Francisco, who has been secretary ever since the organization. The constitution and by-laws of the association were amended so as to permit corporations and individuals engaged in the generation and distribution of electric power to become members. Heretofore, the membership was limited to those engaged in the actual transmission of electric power to a distance.

Electrical Features of the St. Louis Exposition Described by Mr. Ellicott.

A meeting of the Electrical Section of the Western Society of Engineers—the last one of the season—was held in Chicago June 24th. The attendance was not large, but those present listened with much interest to the talk of Mr. E. B. Ellicott, chief mechanical and electrical engineer of the Louisiana Purchase Exposition, upon the electrical features of the exposition and the difficulties which were overcome in the installation of the system.

Chairman W. B. Hale called the meeting to order, and Secretary J. H. Warder read a set of by-laws which had been prepared for the government of the Electrical Section. These by-laws were not acted upon officially, but it was decided to refer them to the consideration of the Western Society of Engineers, after which they are to be submitted to the vote of the Electrical Section at the next meeting, to be held some time in the fall.

Mr. Hale then introduced the speaker of the evening. Some lantern slides were used in connection with the lecture, which showed some of the principal buildings and also some of the principal installations of machinery. Mr. Ellicott made the interesting statement that there was not a single belt connected with the entire electrical generating plant, which is in marked contrast with some previous expositions.

A high-pressure waterworks system is one of the important features of the exposition. Connections are to be had with this system in every building on the ground, and a dozen streams of water can be concentrated in a few minutes time at any point where a fire can possibly originate.

Cables of the electric-light and power systems are carried in a system of subways and conduits, which would seem at first to be a very satisfactory arrangement. Considerable trouble has been encountered, however, from the leakage of water into the subways from the lagoons. The extent of the system may be better realized when it is known that there are 102 miles of three-phase cables now laid in these subways.

The speaker dwelt at some length upon the lighting effects of the exposition. The total number of incandescent lights used in decorative lighting alone is now 142,000. He said that few people viewing the beauties of the cascades realized that under them there was a pumping system the like of which has never before been installed. The motors under the cascades, being in a very damp place, at first gave trouble on account of the insulation, which was quickly impaired. To overcome this difficulty the rotors are now locked each day and for six or seven hours current is passed through to dry out the coils. This scheme has proved satisfactory and will be employed throughout the rest of the exposition period.

Industrial Development in Mexico.

Manufacturing in Mexico is as yet in its infancy, but it is bound to grow very rapidly within the next few years, says Edward M. Conley, vice and deputy consul-general at Mexico City. It is commonly asserted that the principal obstacle to manufacturing in Mexico is the lack of native fuel, but this is actually not so great an obstacle as it appears. The people are just beginning to wake up to the vast, unused waterpower of the country, which, fortunately enough, exists in great abundance near the larger centers of population.

Of the great abundance of waterpower with which Mexico is supplied, it is estimated that not more than 250,000 horsepower is being utilized or is in the course of development at the present time. The potential horsepower has never been estimated with any degree of accuracy. According to an article which appeared in the Mexican Herald, the average cost of power derived from steam in the City of Mexico is between $190 and $225 Mexican currency, or $100 United States currency, per horsepower per annum. The Mexican Light and Power Company, a Canadian company, which is installing an electric power plant at Necaxa, in the state of Puebla, proposes to sell electric power in Mexico City at $120 to $125 Mexican currency, or $55 United States currency, per horsepower per year. This company proposes to develop about 100,000 horsepower, of which 80,000 horsepower will be transmitted to the City of Mexico. At present, according to the same authority, the total horsepower derived from steam plants in the city is less than 32,000.

The Guanajuato Electric Light and Power Company, whose power house is situated on the Duero River, in the state of Michoacan, has a capacity of about 8,000 horsepower, 4,000 of which has already been developed. The Falls of Juanacatlan, near Guadalajara, furnish several thousand horsepower, which is transmitted as electrical power by means of aerial lines to Guadalajara, where it is used for lighting and commercial purposes. This section of Mexico has an immense potential waterpower, which will no doubt be used in the near future for the generation of electrical power.

The San Ildefonso Company of the City of Mexico generates electrical power from waterpower near the city in the rainy season, and uses steam power in the dry season. Another large undertaking in prospect is that of the Mexican railway, which purposes utilizing water from the Atoyac River to generate electrical power for use over that part of its line which lies between Orizaba and Esperanza, where the steep grade makes steam power as motive power extremely expensive. Many cotton mills and electrical plants in the region of Orizaba are now operated by waterpower. The Teziutlan Copper Company has a plant at Teziutlan, in the state of Puebla, for the generation of electrical power.

Recently a great many concessions have been granted by the Department of Public Works of the Mexican government to companies and individuals for the utilization of water from the streams of the republic for the generation of power. The government is fully awake to the desirability of having the waterpower of the country fully developed, and it offers very liberal concessions to bona-fide companies or individuals who desire to utilize it.

In a recent thunder storm, while the family was temporarily absent, lightning struck the dwelling of Jerry Crandall in the town of Ballston, N. Y. It ripped up the kitchen floor, and in igniting the woodwork smashed a large water jar, the contents of which extinguished the flames.

HIGH-TENSION TRANSMISSION CONVENTION.

The high-tension transmission convention of the American Institute of Electrical Engineers, held in Chicago on June 21st and 22d, was a decided success. The attendance came well up to expectations and those present entered with spirit into the discussion of the papers presented. Bion J. Arnold, president of the Institute, was present at all the sessions and presided, and Secretary Ralph W. Pope was also in attendance. The rooms of the Western Society of Engineers were the scene of the convention meetings. Those registered at the convention were the following-named gentlemen:

Bion J. Arnold, Chicago; Morgan Brooks, Urbana, Ill.; C. H. Wilmerding, Chicago; Geo. M. Mayer, Chicago; Otto E. Ostboff, Chicago; Prof. C. E. Freeman, Chicago; S. B. Storer, Syracuse, N. Y.; John S. Peck, Pittsburg; J. R. Cravath, Chicago; W. Wells, New York; W. E. Carlton, Chicago; Homer E. Niesz, Chicago; E. E. R. Tratman, Chicago; A. A. Radtke, Chicago; C. A. Keller, Chicago; F. S. Hickok, Berwyn, Ill.; B. J. Jones, Cbicago; F. Woodmansee, Chicago; John E. Snow, Chicago; B. S. Lanphear, Ames, Ia.; R. F. Schuchardt, Chicago; H. C. Wirt, Schenectady, N. Y.; C. W. Burkett, Milwaukee; D. H. Kelley, El Paso, Tex.; Ernest Gonzenbach, Youngstown, O.; F. O. Blackwell, Schenectady; Guy R. Radley, Milwaukee; F. R. Winders, Urbana, Ill.; E. Schidhauer, Chicago; George N. Eastman, Chicago; D. W. Roper, Chicago; Ernest Lunn, Cbicago; H. W. Young, Chicago; E. Sandborgh, Pittsburg; J. W. Shuster, Madison, Wis.; John H. Quincy, St. Louis; Charles F. Scott, Pittsburg; H. Almert, Oak Park, Ill.; Benzette Williams, Chicago; W. T. Dean, Chicago; Ernest H. Noyes, Chicago; William Hoopes, Pittsburg; T. P. Gaylord, Chicago; Frank L. Perry, Chicago; P. Junkersfeld, Chicago; F. B. Spencer, Chicago; V. W. Bergenthal, Chicago; Ralph H. Rice, Chicago; W. D. Ball, Chicago; A. S. Hatch, Detroit; George B. Foster, Chicago; Merton H. Bentley, Indianapolis, Ind.; W. H. Beattys, Jr., Chicago; H. B. Alverson, Buffalo; Thomas F. Clohesey, Cincinnati; S. M. Kintner, Pittsburg; E. J. Peters, Cannon Falls, Minn.; A. T. Jenkins, Pittsburg; John J. Loreth, Chicago; O. C. Hovland, Chicago; A. L. Landsberg, Chicago; C. G. Y. King, Chicago; Irving Parker, Chicago; W. B. Jackson, Madison, Wis.; S. H. Finney, Chicago; S. O. Swensen, Chicago; N. J. Neall, Pittsburg; Ralph D. Mershon, New York; J. M. Bryant, Urbana, Ill.; James Lyman, Chicago; O. M. Rau, Milwaukee; David L. Otis, Chicago; Henry M. Hope, Evanston, Ill.; R. M. Wallace, Peoria, Ill.; M. M. Fowler, Chicago; F. R. Schalck, Chicago; D. C. Jackson, Madison, Wis.; John Geesin, Chicago; W. D. McDonald, Chicago; George H. Lukes, Evanston, Ill.; J. D. Downer, Chicago; Bertrand P. Rowe, Pittsburg; Edw. N. Lake, Chicago; E. Warner, Chicago; Ralph W. Pope, New York, W. E. Keily, Chicago; F. A. C. Perrine, Pittsfield, Mass.; W. L. Waters, Milwaukee; Irving E. Brooke, Chicago; Arthur L. Rice, Chicago.

Six introductions to discussions were read at the convention. Five of these were read and discussed on Tuesday, and on Wednesday the remaining one was read, after which all were opened for discussion.

A pleasant diversion on Wednesday was a short trip through a part of the underground system of the Illinois Tunnel Company. The party was made up at the society rooms after lunch, and from there went to an entrance of the tunnels, where they were taken down and given a ride on the new electric cars which run 40 feet below the surface of the Chicago streets.

After the tunnel trip the party returned to the society rooms, where more discussion of the papers and also of the report of the Institute transmission committee on data collected took place. The report of the committee, which was composed of Ralph D. Mershon, F. O. Blackwell, C. E. Chesney, P. M. Lincoln and A. M. Hunt, contained answers to questions relative to high-tension transmission which had been sent to various companies. The total number of plants responding was 46, ranging from high-tension systems transmitting under 12,500 volts to those transmitting at 40,000 to 60,000 volts. This report contains much valuable data in regard to methods of bracing, conductors, crossarms, poles, pins, lightning protection, transformers and other questions of vital importance to the successful operation of a transmission system. Consideration of some of the points brought out in this report may be given in the Western Electrician at a future date.

After the work of the convention was finished came the entertainment features, provided by several of the large electrical companies of Chicago, as mentioned last week. The members and guests at the convention after the closing session of Wednesday were taken to the Chicago Yacht Club, where an excellent collation was provided. The party then boarded the U. S. S. Dorothea and were taken for a short moonlight cruise on Lake Michigan. The Dorothea is a fourth-class cruiser used as a training ship for the naval reserves of the state of Illinois. Through the efforts of Mr. L. A. Ferguson of the Chicago Edison Company Captain S. E. Darby courteously extended the services of his ship, though he was unable to command in person. His place, however, was well filled by Commander C. G. Y. King, who did all in his power to make his guests enjoy themselves. James Lyman of the Chicago office of the General Electric Company and Peter Junkersfeld of the Chicago Edison Company, who had so much to do with the success of the convention as members of the local committee, were also on board. The whole party numbered about 100.

The papers or introductions to discussion are here given in the order in which they were read, together with some of the most important points brought out in the discussion. The discussion of a certain paper was not confined to any one period, but members were allowed to ask questions at any time upon any paper that had been read.

Long Spans for Transmission Lines.

BY F. O. BLACKWELL.

Many cities today are dependent for their lighting, transportation, water supply and the operation of their industries upon electric power transmitted over considerable distances.

Unfortunately, interruptions of the power service occur not infrequently, and when they do happen they so inconvenience the public as to be most conspicuous. The impression that long-distance power transmissions are unreliable has some basis of fact that seriously interferes with their development. Although absolutely continuous service may not be possible, many of the troubles now experienced can be either altogether eliminated or greatly reduced. Among the principal causes of interruption, so far as the line is concerned, may be mentioned:

Short-circuiting of lines by branches of trees, wires, or by large birds getting across them.

Burning of wooden pins, cross-arms and pole-tops by leakage or electrostatic discharges from the conductors.

Burning of wooden poles at the ground from forest or prairie fires.

Failure of insulators from puncture by the current or their destruction by missiles discharged maliciously.

Lightning damaging the apparatus connected to the circuits and sometimes destroying poles.

Accidents due to heavy winds overturning the poles or to floods washing them out.

The deterioration of a line requires its replacement in from five to 20 years, depending on climatic conditions and the material which is used in its construction. This replacement of the poles with new ones can only be done by shutting off the current or at the risk of accidental interruptions.

Let us see what can be gained by substituting a steel-tower construction with long spans for a wooden-pole line. Short-circuits are by far the most common difficulty, the only remedy for which is to put the wires so far apart that they are unlikely to be bridged across. This can readily be done even with more than one circuit when a steel cross-arm is employed. Burning is of course entirely done away with where metal construction is used.

Failure of insulators from electrical causes can be obviated by getting larger and better insulators; this is practicable where the spans are long and the number of insulators is small. Insulators on high towers are much poorer targets than when they are near the ground and so are less liable to be broken.

Each metal tower is a lightning arrester, and as they are the highest points in the line they materially assist in its discharge; and the tower itself, being a conductor, cannot be injured by lightning. Steel structures can be exactly figured to meet safely any strains that can come upon them and can generally be located only at safe places where there is no danger of washouts.

The deterioration of a properly constructed and well-galvanized steel tower is very slight, as is proved by marine and windmill experience, and is practically negligible so far as the pins and cross-arms are concerned. Any part of a steel tower can be readily removed and replaced without interrupting the service.

By far the greatest gain obtained from long spans is in the reduction of the number of parts. If one insulating support takes the place of four or five, line troubles will be reduced nearly in direct proportion, the inspection and repair of the line will be much simplified and its cost of maintenance correspondingly diminished.

The cost of a tower construction as compared with wooden poles depends on the locality. Where the right kind of timber exists it is of course cheaper; but in tropical countries where wooden poles would have to be transported long distances the towers are much less expensive.

The first and most important consideration for long spans is the material of the conductor. Copper, aluminum and iron are available for this purpose. Various alloys of copper have great strength, but their conductivity is too low and their cost too high to compare favorably with the more common metals. Copper wire varies widely in its characteristics, depending on the methods used in its manufacture. The copper is received at the wire mill in the form of cast-wire bars, weighing 300 to 350 pounds. It is then rolled into rods and the rods are drawn into wire of the required size. The temperature at which the metal is rolled, the reduction of area both in rolling and drawing and the amount of annealing which the wire is given—all have an important bearing on its characteristics. As the size of the original wire bar is limited the smaller the wire, the more it is worked and in general the better the result.

Each strand should be a continuous wire without joints. Joints in the cable should be as few as possible and made by means of sleeves, as brazing or soldering anneals the wire and much reduces its strength.

The advantage of aluminum is that it weighs less than copper for the same conductivity, but for long spans its lesser strength, greater diameter and higher coefficient of expansion are against it. Steel wire has about nine times and iron wire or cable about six times the resistance of copper so that they are more expensive as a conductor than copper. In order to avoid oxidization it is necessary to galvanize iron or steel wire; this partially anneals it and reduces its strength.

The strains upon the conductor are those due to its own weight and the wind acting upon its surface. In a cold climate in addition sleet may form upon the wire, increasing the weight and the surface exposed to the wind. On a line carrying any considerable amount of power it is improbable that sleet will ever form on account of the losses in the conductor slightly heating it. In order to be on the safe side, however, it is best to assume in the North a coating of ice one inch thick all around the conductor. The wind velocity could never exceed 100 miles an hour, which would give a pressure of 40 pounds per square foot on a flat surface, or 20 pounds on a cylindrical surface such as that of a wire. The weight is of course a vertical stress and the wind a horizontal one at right angles to the wire. The greatest strain is caused by the resultant of these two. The worst conceivable condition is sleet on the wire, followed by extreme cold weather with high winds.

The maximum sag may be due to the conductor being loaded with sleet or to heating of the wire in a hot sun. The latter will generally be found to give the greater sag. Owing to the conductor being elastic, it is not necessary to consider the greatest deflection from a horizontal line between supports as the vertical sag of the wire. The wind pressure causes the wire to swing to one side, and it is elongated by the combined strain of wind and weight, but as soon as it is relieved of the wind pressure it swings back to a vertical position and contracts to the length required to carry its weight alone. The sag due to heating of the wire is also somewhat less than it otherwise would be, because when expanded the strain is less and the wire contracts.

The cross-arm is of course subjected as a beam to the weight and wind strains transferred to it from the cable, but in addition there is a torsional strain due to the breaking of a conductor that can best be borne by a pipe. The length of the cross-arm should be sufficient to space the wires well apart and prevent short-circuits either from objects thrown over the line or from the wires swinging together. The former is the more important, and if a safe distance apart, say six feet, is chosen it will be sufficient to guard against the latter, as on short spans with relatively less distance between wires they invariably swing together and never touch each other.

The most economical tower construction is one in which the spread of the legs at the ground is about one-quarter to one-third the height of the tower. If a less spread is used, the weight of the legs becomes excessive and with a greater spread the cross-bracing must be much increased in size. For a single circuit the common windmill tower construction in which the legs are locked together at the top has the advantage of reducing the strains to a simple compression of the legs on one side and tension on the other, the only function of the cross-bracing being to prevent the legs buckling when in compression.

Where there are two or more circuits the length of the cross-arm is so great as to require two points of support. The tower can then be made with a width at the top approximating that at the bottom, and the cross-bracing has to bear its full share of the lateral strains. A truss construction with the fewest number of parts and opportunities for slack motion and racking of the tower is preferable.

Discussion.

Regarding the reduction of line troubles by reducing the number of insulators, which is a result of long spans, Ralph D. Mershon said that it had not been an important item in his experience. "My experience with line troubles has been that I get less trouble from insulators than any other thing; most of the trouble has been from burnt-off poles in case of forest fires and short-circuits, due to either building wire thrown over the line maliciously, or careless construction. When a line is first put up, it is almost always the case that a number of the insulators are broken, maliciously or mischievously, but after a little while it is my experience that few insulators are broken, even in the western country."

A. S. Hatch gave some interesting facts upon the present condition of the towers which were erected in Detroit 20 years ago for lighting purposes. The principal points of weakness in these towers he found to be in buckling of the pipe legs and in the rusting of the threads at the pipe joints. As a protection against lightning a grounded switch is used on these towers, and as a general thing after severe thunderstorms this switch is found punctured, which shows that the towers really do act as lightning conductors and relieve the overhead system of static discharges.

Charles F. Scott pointed to the fact that present methods of line construction were evolved from telegraph and telephone-line construction, and not much difference exists except as to size and number of poles, strength of insulators, size of conductors, etc. He thought that it is very probable that we are on the verge of a new era in line construction for high tensions which will see the use of high

towers and long spans; for this reason Mr. Blackwell's paper was a timely one.

Upon being asked by N. J. Neall as to the effectiveness of iron towers as lightning protectors, Mr. Blackwell replied that he knew of many pipe towers put up in tropical countries where great difficulty had been experienced with wooden poles, and that there had been less trouble with the former, the lightning discharges seeming not to go along the line but down the towers instead.

Maurice Hoopes noted that in the paper a sag of 53 feet as a maximum was given. He then went on to tell of a line erected two years ago for experimental purposes with four spans, 1,000 feet each, of aluminum wire. At present the sag, with 80 degrees temperature, is only 22 feet. He then went on to show that the conditions as to wind velocity, temperature difference, etc., were taken rather high in the paper. The most trying condition which a line is likely to meet is a maximum wind velocity of 40 miles an hour, occurring from zero to 23 degrees above. Tornado velocities are not to be considered, as no line will withstand them.

Mr. Mershon thought that, in regard to repairs, it would be much easier to repair a pole line of short spans than one with long spans, owing to the less time during which power service is suspended.

Mr. Scott said that first cost in line construction was of secondary importance and that better and more reliable service was the real thing to aim at. If the steel-tower construction had a tendency in this direction, it should be seriously considered, even if more expensive at the start.

Dr. F. A. C. Perrine agreed with Mr. Scott on the point of reliability being the prime factor to be considered. He said that the insulators in a transmission system are perhaps the weakest point, and the less we have of them the better; this tends toward lengthening the spans. The question of the value of the tower as a lightning arrester is a very important one. The value of a grounded barbed or naked wire as a protection against lightning is unquestionable. But the question also arises as to whether the disadvantage of the breaking of this wire does not more than counterbalance its effectiveness as a static discharger. Mr. Mershon, on the other hand, thought that the jumping of the lightning discharge from the line to the tower always breaks the insulators, which leaves the wires free to come in contact with the tower and be grounded. W. B. Jackson, however, did not agree with him, citing instances where the line was struck and the insulators remained uninjured.

Mr. Junkersfeld called attention to the fact that transmission is only a commercial proposition, and that in constructing a line the producer and consumer, at the two ends of the line, must not be forgotten. Therefore the cost of the line is not the whole thing. Reliability is the main feature.

Protection of Cables from Arcs Due to the Failure of Adjacent Cables.

BY W. G. CARLTON.

On account of the large amount of energy carried by high-pressure cables their protection is of the utmost importance. High-pressure transmission cables operate usually at from 5,000 to 15,000 volts and are nearly always three-conductor cables. It is to the protection of such cables that this paper refers particularly, although it will generally be found that protection is needed more from burn-outs on low-pressure cables than from those on high-pressure ones. High-pressure cables are usually protected by automatic overload devices, and if these are satisfactory they will disconnect the cable before any large amount of damage is done. On the other hand, low-pressure cables may continue to burn without drawing enough current to cause them to be cut off. Cables generally break down in manholes, due to poor work in jointing or to careless handling during installation. Various methods are in use for fireproofing and isolating them from one another.

A method employed in a number of places is to wrap the cables with asbestos paper or tape about one-eighth inch thick, using two layers and binding the asbestos on by means of steel or brass tape. The metal tape is wrapped either in an open spiral leaving an inch or more between turns, or with the edges touching, leaving no open space. With the metal tape wrapped close there is less danger of the asbestos disintegrating on account of water in manholes or of other causes. The asbestos wrapping should be carried well into the duct. This protection has been found adequate by several large companies. Its life, however, is uncertain, particularly on underground work. One disadvantage is that in the case of loaded cables the heat is less easily radiated on account of the asbestos covering. Asbestos paper soaked in silicate of soda has been used for wrapping cables; this has the advantage of not requiring any metal tape for a binder, as the paper treated in this manner is cemented to the cable. It is doubtful if the silicate-of-soda treatment will be satisfactory for use in manholes that are likely to be flooded, although it should be in dry places.

A second method of isolating and protecting cables consists in providing separate chases or runways for them. Sometimes this is done by building special long and thin bricks into the wall of the manhole, leaving them projecting so as to form a shelf. Soapstone slabs are also laid in the wall, forming shelves or boxes for the cables. The cables may be further protected with asbestos if desired. It is difficult with this method of protection to make a satisfactory job where the cables enter the ducts, unless there has been a very elaborate spreading of the ducts.

The third method of protection, which is very satisfactory when the cables run fairly straight through the manholes, consists of a covering of vitrified-clay tile. Ordinary single-duct clay tile in 18-inch lengths is used, the tile being cut nearly through before baking, so that it is easily broken in halves.

High-pressure cables should be covered, not only to protect them from the failure of adjacent cables, but also on account of the dangers which may arise from an unconfined arc. Oscillations may be set up which will produce pressures many times in excess of that at which the cable is working, and these high pressures are liable to break down the insulation on the cables or on the switchboard apparatus, transformers or generators, which may be connected to the cables. For this reason one large company in New York has installed on all cables within a mile of the power house, in addition to the regular asbestos covering, a sheet-iron armor one-sixteenth inch thick; this armor being rolled and especially prepared to meet curves or bends in the cable, each section lapping the next one. This sheet iron is clamped together so as to make a strong, mechanical covering.

Discussion.

Mr. Wells: Regarding the method spoken of by Mr. Carlton, the protection with clay tile, making practically two different lines costing not much more than one single line, we have gone a little further than that and put in four lines following the different routes to the sub-stations. Each sub-station has entirely a different route from the main station to the sub-station, so that in the case of a manhole caving in or any trouble on the line, there is only one-quarter of the general cable to become ineffective.

Mr. Mershon, in speaking of the extra expense involved in separating the ducts, said that there might in the end be no extra expense in so doing, since the capacity of a subway is not necessarily proportionate to the number of ducts in it, owing to the decreased capacity of the cables of the inner ducts of a subway, due to heating. He thought that with duplicate ducts, which are separated, it might be that the increased capacity of the subways would make the construction cheaper in the end. Mr. Carlton answered that with the separated conduit the cost of construction is much larger, owing to the cost of repaving the street, and this cost more than overbalances the increased capacity of the cables.

Mr. Carlton further remarked in connection with his paper that if a high-voltage, three-conductor cable burns out and the circuits break there will not be any asbestos or cable either left where the arc occurs. In some cases he has known three or four feet to be gone entirely.

If the cables were laid on tile shelves and not wrapped and confined in iron sheaths, Mr. Mershon believed that the arc which occurred would not be confined and would not do as much damage as if it were confined by the wrappings and the pressure allowed to rise to a higher point.

The Use of Ground Shields in Transformers.

BY J. S. PECK.

The ground shield is a metallic shield so placed between the high and low-pressure windings of a transformer that the high pressure cannot break through to the low pressure without first going to ground. The ground shield should be made, preferably, of copper, of a thickness of approximately one thirty-second inch, though it may be of any conducting material, and of practically any thickness, desired. A convenient arrangement is to connect the ground shield to the core of the transformer, which is grounded directly, or through the case. It is obvious that since the ground shield surrounds the magnetic circuit it must not form a complete turn, and for this reason it is cut through in one place and the joint insulated.

While upon first thought the use of a ground shield would appear to eliminate entirely the possibility of an abnormal pressure existing between low-pressure winding and ground, there are, nevertheless, ways in which it may fail in accomplishing its purpose, and there are numerous practical difficulties in its use, particularly in large high-pressure transformers.

Some of the objections to the ground shield are:

1. It does not prevent the possibility of an abnormally high pressure existing between low-pressure winding and ground, due to a connection between high and low-pressure leads inside the case, or in the wiring exterior to the transformer.

2. The ground shield must be of thin material. With transformers of large size, where enormous current may flow in case of a short-circuit, it is possible that a portion of the shield may be burned away or that the connection between it and the ground connection may be burned off, thus leaving the high and low-pressure windings connected, but insulated from ground.

3. The introduction of the ground shield into a transformer increases its cost, or lowers its efficiency, or both; for the same amount of insulation must be placed between the high-pressure winding and the ground shield as is ordinarily placed between high and low-pressure windings; and, in addition, the ground shield must be insulated from the low-pressure winding.

4. In transformers there is a leakage magnetic field between high and low-pressure coils. In that portion of the coils outside the iron this leakage field cuts through the ground shield, producing eddy currents, which may greatly increase the transformer losses. This is particularly true on high-pressure transformers, where it is necessary for insulation purposes to make a difference in the lengths of the coils. On such transformers it is necessary to use very thin sheet metal for the shield, and to slit it at the ends into a number of narrow strips, which are insulated from each other, except at one point.

Conclusions.—Since the ground shield does not afford absolute protection, and as it increases the cost or reduces the efficiency of the transformer, and on account of the mechanical and electrical difficulties involved in its use, it would seem that for large high-pressure transformers the ground shield is a theoretical, rather than a practical, means of protection.

It is believed that the grounding of the low-pressure winding at the neutral point is a safer, more practical, and cheaper method of protection than is the use of the ground shield.

Discussion.

Mr. Mershon was of the opinion that it would be unsafe to install high-voltage feeding systems in a city without having either the neutral grounded or else having ground shields on the transformer; these methods are more reliable than spark-gaps.

H. C. Wirt, in speaking of ground shields, said that most of the transformers so provided are now made for foreign orders, the number used in this country being insignificant. He thought that in grounding the neutral there was some danger, but the danger is not so great as that of having the high-tension turns come in on the circuit, to which, he believes, most of the electrical fires are due.

Conditions for Continuous Service over Lines Operated in Parallel.

BY M. H. GERRY, JR.

In order to maintain a continuous service nearly all the more important transmission systems have installed two or more pole lines, each carrying one or more circuits. As a rule, the circuits are operated in parallel, but are so arranged that at least one of them may be entirely disconnected without interrupting the delivery of energy.

Two sets of conditions are met with in practice—first, normal operating conditions; secondly, accidental conditions. It is possible by design to provide for the first and, in the main, for the second. The normal operating conditions include inspection, repairs and additions to the circuits. But little work can be done on high-pressure circuits while in service, and it follows that adequate switching devices must be provided such that any circuit may be disconnected without an interruption of the service.

Both the air-break type of switch and the oil switch are now available for pressures to 60,000 volts, and may be installed in various ways to obtain the desired results. They may be operated either automatically or manually. There are in use several systems of switching transmission circuits in parallel. Some arrangements provide for connecting only the low-pressure side of the transformers; others only the high-pressure side, and still others provide for the connecting of both the high and low-pressure sides in multiple.

In addition to normal operation, the accidental conditions which may arise and affect the continuity of the service should be anticipated and provided for. These conditions, whatever may be their primary cause, usually result in an open circuit, a short-circuit, or a grounding of the conductors. Whenever one of these occurs it is essential that the entire circuit, or at least the defective section, be immediately isolated from the other circuits of the system. This may be accomplished either by automatic devices or by the attendants. The automatic methods, on account of the time element involved, are undoubtedly superior, but the apparatus should be of thoroughly reliable construction and should be frequently tested if the best results are to be obtained. The best practice calls for circuit switches controlled automatically by means of time-limit overload relays at the generating end, and similar switches controlled by time-limit reverse-current relays at the receiving end. These devices, properly installed, will effectually isolate a transmission circuit in case of trouble, but other conditions must also be considered if the service is to be uninterrupted. Whenever a parallel circuit is disconnected it disturbs the entire system and especially affects the electrical pressure. A long transmission circuit represents a considerable capacity, inductance and resistance, and when this is removed or placed in parallel to other circuits, it becomes necessary to readjust the pressure. This is usually done by the attendants at the generating station, but a reliable automatic device would be of value for this purpose if designed to meet all the requirements of transmission service.

A considerable change in pressure at the receiving end of the line may result in an interruption if induction motors or synchronous apparatus be operated by the current. The greater the number of circuits in parallel, the smaller the amount of disturbance produced by removing a single circuit.

Many of the better high-pressure transmissions depend, however, upon two lines of one circuit each, and in case of accidental difficulty with one of the circuits, the entire load is carried temporarily on the other line. By a proper design this may be successfully accomplished, and even in the case where one of the circuits is suddenly isolated by automatic devices, the variation of pressure may be kept within such limits that there will be no interference with the service.

The Protection of High-pressure Transmission Lines from Static Discharges.

BY H. C. WIRT.

Overhead ground wires have been used in several transmission plants. It is evident that if efficient protection can be secured at the power house and sub-stations, it is superfluous to use such an overhead wire. If a ground wire be used, it must be large enough not to break and of material that will stand corrosion: a suitable wire will cost almost as much as an additional transmission wire.

A certain power-transmission plant, having three power houses and seven sub-stations, operating 90 miles of overhead transmission lines at 40,000 volts, has protected the greater part of its transmission system by No. 4 galvanized-iron wire placed at the top of the poles, half the length being barbed wire, the other half plain wire—the wire being grounded at every fifth pole. This wire was installed about 14 months ago; before that time many of the poles had been shattered by lightning, but since then no pole has been damaged, but some apparatus has suffered from lightning, the arc jumping from the transformer lead above the oil, in all cases. If lightning arresters had been placed at all the stations, and no overhead wire used, there would probably have been less damage to apparatus, but the poles would have been shattered. It is not at present the custom to use lighning arresters on transmission lines, and it is not known whether poles can be protected in any other way than by an overhead ground wire. It would be of interest to have data upon the frequency of interruption of service of transmission lines on account of poles being damaged by lightning. My opinion at present is that a transmission line can be protected from lightning discharges by suitable apparatus placed in the stations, and that it is not necessary to use ground wires; but an exception will probably have to be made in cases where poles are shattered with great frequency.

Another installation, operating at 25,000 volts, uses lightning arresters at stations and sub-stations, with reactive coils, constructed to break down at 50 per cent. above the working pressure, and with a resistance in the ground connection. The arresters have a series of gaps, and are equipped with the "multiplex connection," giving a minimum breakdown distance between line and line. Prior to the installation of this equipment, there was frequent loss of apparatus at the stations, but since, no apparatus has failed on account of lightning, although there have been many severe storms. The management of this plant had begun to equip the transmission lines with a ground wire, but has decided not to proceed with this plan.

We have in these two cases entirely opposite methods of protecting lines. In one case, the management is so well satisfied with ground wires that lightning arresters will not be used; in the second case, the management is so well satisfied with lightning arresters that ground wires will not be used. These two plants are in country very similar in its physical characteristics, and are only a few hundred miles apart.

Much difference of opinion has existed among engineers on the value of reactive coils, in connection with lightning arresters. Some recent tests made with the best types of lightning arresters show that the arresters did not protect the apparatus until reactive coils were used; it seems now that there can be no question that reactive coils are effective, and therefore they should always be used.

Many arresters are now supplied, adjusted for a breakdown pressure only 50 per cent. greater than the generator pressure; it can be determined only by experience whether it is feasible to set arresters nearer the generator pressure than this; generators are in many cases insulated to stand only 50 per cent. increase above the working pressure, and in this case there is no difference between the breakdown pressure of the insulation and the spark gap; but the insulation of the machine stands a one-minute test and the static stresses exist only momentarily, which is undoubtedly the reason that apparatus has not burned out more frequently. Present experience indicates that apparatus, to be safe, should stand an insulation test of 100 per cent. greater than rated pressure for one minute; such apparatus may have to be insulated for higher pressure than the present Institute standard, as it is extremely difficult to protect apparatus unless it will stand the double-pressure test.

Discussion.

John S. Peck opened the discussion by calling attention to a point in Mr. Wirt's paper, in which he said: "Many arresters now are supplied adjusted for a breakdown pressure only 50 per cent. greater than the generator pressure." Mr. Peck thought that all types of high-voltage arresters are provided with series arresters to limit the current at the time of discharge. He said that he had found that in testing different arresters one giving a breakdown test of 2,000 volts would have this pressure raised if a condenser were suddenly discharged through the arrester, and that after such a discharge a breakdown pressure of 10,000 or 15,000 volts might be required.

Mr. Neall believed that the matter of the lightning arrester should not be left to the operator. It is a matter of the highest importance and calls for the highest order of understanding.

Mr. Blackwell remarked that the greatest difficulty encountered in judging of the value of lightning arresters lies in the fact that the trap is set and then we wait for a couple of years to see what happens, and when something at last does happen we are never sure whether our trap was in order or not.

Mr. Wirt, in explaining what a static arrester is, said that it is simply a gap between line and line. He at one time had a transformer installed on 10,000 volts which burned out continually. He set coils, but could not prevent it. After putting in a spark-gap across the line the trouble was done away with.

Synchronous Motors for Regulation of Power Factor and Line Pressure.

BY B. G. LAMME.

Mr. Lamme, after giving a general discussion of this subject in his paper, gives the following summary, which brought out the main points to be discussed.

1. A synchronous motor can be used to establish leading or lagging currents in its supply system by suitable field adjustment, and can thus affect or control power-factor or phase relations of the current in the alternating-current system.

2. A synchronous motor will set up leading or lagging currents in its supply system if its field strength is held constant, and the pressure of the supply system is varied above or below that generated by the synchronous motor. Such leading or lagging currents in the supply system will tend to vary the pressure of the system. A synchronous motor can thus act as a regulator of the pressure of its supply system.

3. This regulating action is greatest with synchronous motors which have the closest true inherent regulation (as indicated by high field magnetomotive force compared with the armature magnetomotive force) in distinction from machines which have close apparent regulation obtained by saturation of the magnetic circuit.

4. If the synchronous motor is used both for regulating the power factor for neutralizing the effect of other apparatus on the circuit, and for regulating or steadying the pressure of the supply system, its normal capacity for regulating will be diminished.

5. The most suitable speeds for best electrical conditions will in general be considerably below highest possible speeds as limited by mechanical conditions.

6. Heavy dampers will increase the effectiveness of the regulating tendency.

7. If the synchronous motor can be used for power purposes as well as for regulation, its apparent capacity is increased. This is due to the fact that the regulation is obtained by means of a wattless component and the power from the energy component, and the arithmetical sum of these two is greater than their resultant which fixes the current capacity of the machine.

8. Synchronous converters in general are not suited for regulating the pressure or controlling the power factor of an alternating-current system.

9. The costs of synchronous motors for regulating purposes will in general be lower than for alternating-current motors or generators of customary speeds, and will approach more nearly to turbo-generator practice.

Discussion.

Mr. Blackwell was of the opinion that alternators of extremely high pressure were not economical to build; a speed of about half the maximum, the possible speed for which the machine may be designed, is the cheaper to build, because extreme strains are avoided in the machine, which require special construction to avoid. He thought that in a large plant anything other than a power factor of 100 per cent. was extravagant to consider, as the copper increases greatly with even small drops in power factor.

W. L. Waters spoke in regard to the effect of an over-excited motor on the current. The effect is that it takes the current from the line and the effectiveness of the machine ought to be gauged by the amount of leading current it can take.

W. B. Jackson mentioned the possibility of synchronous motors carrying the pressure at the end of the line even higher than the generator pressure. He said that he knew of plants where this was done.

Dr. Perrine mentioned in connection with this point that such operation was carried on in some of the national plants, and also that a reserve of steam machinery was used as a compensation for large leading current on the line. Again, in some of the mining plants supplied from long-distance lines, where the charge had been made on the basis of the maximum current, it has been found advantageous to install synchronous condensers for maintaining high-power factor, the plants being operated by induction motors.

The objection to synchronous motors in general, according to Mr. Scott, is that a large number of them scattered over a working system do not operate in harmony. They may run all right for a time, but sooner or later are bound to get out of order. The induction motor is the simple motor for power purposes, and in cases where low-power factor is objectionable, as in long-distance lines, then it is all right to correct this and bring up the power factor by means of a large synchronous machine, which is in general under the control of the operating system.

S. B. Storer made mention of the fact that a synchronous motor in a large system has the effect of increasing the short-circuit obtainable at a given point. The present tendency is to have a short-circuit limited to as small an amount as is consistent with fair regulation. With the use of a synchronous regulator in the sub-station the short-circuit which it is possible to obtain will be so much larger that it will be a serious menace to the safety of any one near the circuit.

Walter H. Whiteside, General Manager of Sales for Allis-Chalmers Company.

The new management of the Allis-Chalmers Company is certainly drawing to itself a group of the ablest men in their respective lines in the country. The latest acquisition is Mr. Walter H. Whiteside, who has until within the last few days occupied one of the most important positions in the Westinghouse

WALTER H. WHITESIDE.

organization, having been the manager of the Detail and Supply Department of the Westinghouse Electric and Manufacturing Company of Pittsburg and at the same time general manager of the Sawyer-Man Electric Company of New York.

But Mr. Whiteside's experience has been by no means confined to the electrical field. His first business connection dates back to 1881, when he entered the employment of the Hercules Powder Company, the high-explosive or dynamite branch of the Dupont Powder Company of Wilmington, Del. He introduced the high-explosive products of this company into the Lake Superior regions, including the Calumet and Hecla mines, as well as into other mining districts. Four years later he became associated with the Cleveland Electrical Manufacturing Company of Cleveland, Ohio. He remained with that concern nearly 12 years, serving during the first two years in various capacities, and for the remainder of the time being the manager of the Chicago office.

In 1896 Mr. Whiteside was appointed manager of engine sales for the Gates Iron Works of Chicago. In 1898 the Westinghouse Electric and Manufacturing Company made him the manager of its Washington office. In that position he became associated not only with the largest electrical projects undertaken in the district which his office covered but in other places farther afield. His engineering work in connection with the installation of electrical power in the dry docks of the Navy Department, especially the docks at Portsmouth, League Island and Boston, was widely recognized. To him was largely due the credit for effecting the change in voltage standardization from 80 to 125 volts in the electric-lighting and power installations on board the vessels of the United States navy.

But Mr. Whiteside's best work in the commercial sense was the building up of that immensely successful branch of the Westinghouse electric organization known as the Detail and Supply Department. Into this department he injected a new life and vigor of

administration that brought an admirable reaping of profitable results and won him recognition for marked executive ability.

About a year ago Mr. Westinghouse appointed Mr. Whiteside general manager of the Sawyer-Man Electric Company of New York, thereby practically doubling his duties, for he continued the management of the Detail and Supply Department of the parent company at Pittsburg. His continued success drew to him the attention of men high placed in competing lines.

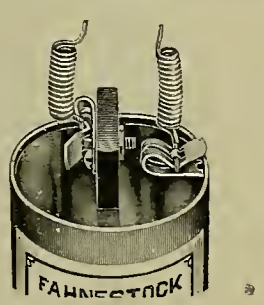
Mr. Whiteside is a man of force and also of delightful personality. There is no man at the commercial end of the great industrial companies better known throughout the country than he. Everyone who has had dealings with him has confidence in him, because everyone knows that he is a man who keeps his word whether he speaks it or writes it. He is a strong man for any industrial concern.

It is a striking fact but one which was fully expected by all who know the methods and the policy of the president of the Allis-Chalmers Company that in so short a time the reorganization of the personnel of that corporation should have brought together as chiefs of staff men who are so conspicuously able as those who have within the last two or three months accepted positions of great responsibility.

Mr. Whiteside's position will be that of general manager of sales for all departments of the Allis-Chalmers Company, including, of course, the Bullock Electric Manufacturing Company, which has become the electrical department of the Allis-Chalmers Company. His experience thoroughly qualifies him for this important duty, which he takes up with the good wishes of his very wide circle of business acquaintance. Mr. Whiteside will enter upon his new duties about the middle of July.

Spring Binding Posts for Dry Battery.

In considering the question of dry batteries, at first glance it would seem difficult to imagine a more simple or convenient method of connecting the wires to them than by the usual screw and nut so universally found on this type of cell. The Fahnestock Transmitter Company of 132 Havemeyer Street, Brooklyn, N. Y., lays claim, however, to having made an improvement, and the cut shows a dry battery equipped with the new spring binding post that this company is placing upon the market. In this connector the wire is gripped by the action of a spring, and it is asserted that all possibility of a loose contact at the battery is eliminated and also



SPRING BINDING POSTS FOR DRY BATTERY.

that the wire can be put in or taken out in one-tenth the time it takes to adjust a screw post. The connector will grip any size wire up to No. 12 B. & S., and in making the connection no screw driver or pliers are needed. The Fahnestock company recommends this connection on dry batteries for use on automobiles, as it says that no amount of vibration or jar will affect the contact.

New York Electrical Society.

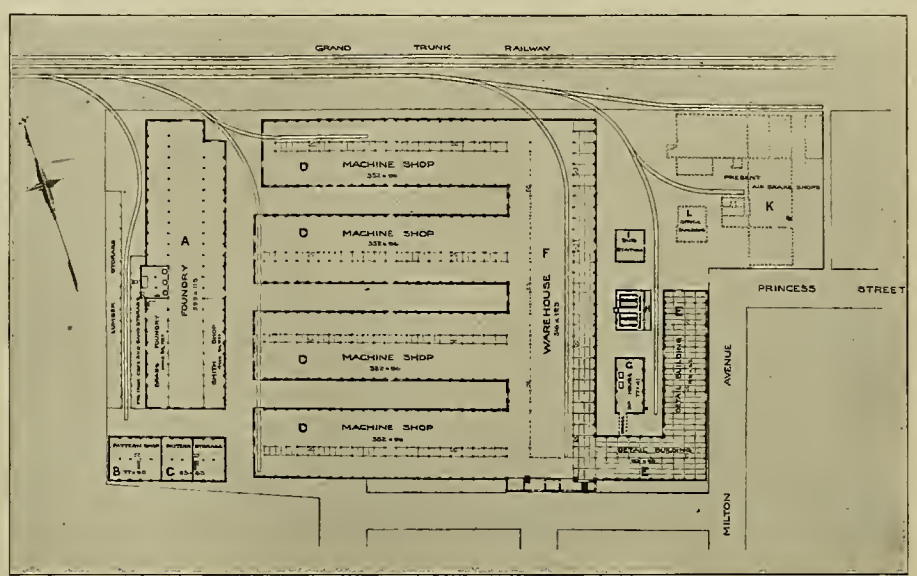
At the annual meeting of the New York Electrical Society last month the report of Secretary Guy showed a total membership of 631. The revised constitution and by-laws were read for the second time and adopted. F. W. Jones, Gano S. Dunn and Arthur Williams received the thanks of the society as the committee making the revision. The following-named officers were elected: President, Frank J. Sprague; vice-presidents, C. G. Young (re-elected), E. H. Mullin (re-elected), F. C. Bates (re-elected), Albert F. Ganz, Louis B. Marks, W. S. Rugg; secretary, George H. Guy (re-elected); treasurer, Henry A. Sinclair (re-elected).

As the result of difficulties between the city and the Consolidated Gas Company over the municipal lighting contract serious consideration is being given by Mayor McClellan and Controller Grout to the possibility of establishing a municipal gas plant in New York city. Under a new section of the charter passed by the last Legislature, it is asserted the Board of Estimate can issue bonds at any time for establishing such a plant.

Canadian Westinghouse Factory.

An interesting manufacturing plant is that under construction at Hamilton, Ontario, for the manufacture of the electrical appliances of the Westinghouse Electric and Manufacturing Company. From the time when electricity was first made use of in Canada the Westinghouse Electric and Manufacturing Company of Pittsburg has furnished much of this apparatus in the Dominion, until now the time has arrived when in justice to its customers it is found advisable to establish a distinctively Canadian factory to secure that intimacy of relation which is so advantageous alike to the manufacturer and client. To join under one management the existing air-brake business and the electric business to be instituted, a new organization was formed under the name of the Canadian Westinghouse Company. The Canadian company will operate under the enjoyment of an agreement with the Pittsburg companies, by which all designs and processes of the older companies will be at its disposal.

The lines of manufacture to be taken up comprise alternating and direct-current generators; alternating and direct-current motors, including railway motors; controllers, transformers, switchboards and switches, rheostats, instruments and meters; arc lamps and various subsidary apparatus.



PLAN OF HAMILTON SHOPS OF CANADIAN WESTINGHOUSE COMPANY.

The new buildings provided consist of foundry, pattern shop, pattern storage, general machine shop, detail machine shop, warehouse, insulation-treating building, boiler house and transformer building. On the diagram of the property shown in the accompanying illustration these are lettered from (A) to (L), inclusive, in the order just recited. (L) is the brake plant and (K) the office building.

In laying out the manufacturing buildings on the property two cardinal points were kept in view—the first, that progress of material from raw to completed state should, as far as possible, be in a continuous direction; and the second, that the plan adopted should lend itself to an initial installation which would constitute a complete unit and also be capable of reproduction along its own lines to an extent limited only by the total available property. On the latter point it may be said that something less than half of the total installation is at present under construction, the northern half of the foundry and warehouse along with corresponding machine-shop wings being left for future extensions. Regarding progress of material through the plant, it may be pointed out that with raw material received on the track west of the foundry progress is in general from this point to the warehouse, from which all shipments are to be made over tracks conveniently located within the building for this purpose.

The foundry is of monitor roof construction, with middle and two side bays. In the west bay are located the cupola house, the coreroom and the brass floor, while just outside along the west wall are located the bins for pig, sand, limestone, etc. An electrically driven elevator is provided to deliver iron from yard to charging floor, and a coke conveyor, also electrically driven, receives coke from the railroad cars and deposits it in an appropriate bin on the charging floor.

The pattern shop, located conveniently near the foundry, is three stories in height, besides a basement to accommodate shafting for machinery on first floor; the first floor is devoted to carpenter and cabinet-shop uses, while the second and third floors are for pattern making. An electric elevator serves this building from basement to top floor. The pattern storage building adjoining is similar in construction, except the basement, which is unnecessary.

The general machine shop is arranged with a high bay covered by a 20-ton crane and the low bay with a five-ton crane. In the former the heavier machine tools are located, and it is here that the stationary parts of generators and motors will mainly be finished, while the low bay will be devoted to preparation of rotary parts, and the gallery floor above the latter will provide space for the manufacture of commutators, brushholders, bearings, etc., also for the tool room and controller department. Toilet rooms and heating and ventilating fans are placed on a narrow mezzanine floor between high and low bays, the same being reached by stairways from both the ground and gallery floors. The elevators also pass up through this floor and industrial tracks run under the mezzanine along by the foot of the elevators on the ground floor.

The warehouse has a high bay in the middle, with one gallery on the west side and two galleries on the east side. The machines delivered, as just described, from the general machine shop, are passed from the testing floor on the west side of the main bay, and after tests are finished, painted and shipped on cars from the warehouse track. This track also is the means for entry into the plant of the less bulky material and supplies, which are stored in this building for ready distribution to both the general and detail machine shops. The floor east of the tracks is at car-floor level to facilitate handling of such material, and elevators are of course provided for distributing to the various floors. The detail machine shop has two floors throughout, besides the ground floor at levels corresponding to the two galleries on the east side of the warehouse.

The insulation-treating building is separate from the main group, so that this work, involving the use of inflammable materials, can be isolated. Convenient communication with the detail building is provided by a two-story enclosed bridge, cut off at each end by fire doors.

The boiler house is small in comparison with the main plant, which is due to the fact that the use of steam will be largely restricted to heating and drying purposes. Most of the steam for drying will be used in the insulation-treating building next adjoining, but for heating the building it will be piped to nests of coils suitably installed in each building, with fans to distribute the air heated by these coils.

Power for manufacturing and testing purposes as well as for lighting is to be obtained from the local electric power company, which draws its supply from Decew Falls. Current will be received in the transformer house at 2,400 volts and distributed at 440 volts for general shop purposes, although lighting distribution will be at 110 volts, and transformation to direct current will be made to supply some of the cranes and tools.

The construction of the buildings, which is in the hands of Westinghouse, Church, Kerr & Co. of New York as engineers and general contractors, is of the most modern approved type. The foundations and walls up to the window-sill line are of concrete, above which the walls are brick, laid up in cement mortar. Floors and roofs are of reinforced concrete throughout, and in the detail machine shop and pattern buildings even the columns are of this construction.

Transportation between the foundry and all buildings, including the air-brake plant, will be by industrial railway, operated by a storage-battery locomotive. The standard gauge tracks on the property are directly connected with the main line of the Grand Trunk railway for receipt of material and shipment of product.

An interesting exhibit in the Utah State Building at the fair is a photograph made with a piece of ore containing radium. The ore was obtained from Richardson, Grande County, Utah, where it is being mined for commercial purposes. The photograph was taken by T. T. Whitaker, director-general of the state exhibit, by simply placing the piece of ore on the opaque shutter of a plate holder and leaving it over night.

Aluminum Electrical Conductors.[1]

By Roderick J. Parke.

The use of aluminum for electrical conductors has grown to an extent which renders imperative the consideration of its possibilities when designing any system of distribution.

It is so far the only material which possesses the requisite properties to render practical its substitution for copper. Previous to 1898 aluminum was little known in the commercial world, but since that year, when it was first placed upon the market in the form of solid drawn conductors, the consumption has rapidly increased until in 1902, the date of the latest complete statistics available to the writer, the world's product was estimated at 8,000 tons per annum. The corresponding production of copper is estimated at 497,000 tons per annum for all purposes. The statistics available up to the present, however, show that the production and consumption of aluminum are rapidly increasing and that it has become a very strong competitor of copper for electrical conductors.

There are now nine plants in the world producing aluminum, of which three are in America, two in France, and one each in Great Britain, Germany, Switzerland and Austria. The total power utilized in the production of the aluminum is from 36,000 to 40,000 horsepower, practically all waterpower.

The following figures are for commercial aluminum and commercial copper of sizes commonly used in practice, the copper being hard drawn:

	Aluminum.	Copper.
Specific gravity	2.68	8.93
Conductivity (Matthiessen standard)	62.00	97.00
Tensile strength (per square inch)	28,000	45,000
Coefficient of linear expansion	.0000128	.0000093
Coefficient of temperature resistance	.00114	.00117
Modulus of elasticity	9,000,000	14,000,000

Using the above figures we find that the cross-section of aluminum will have to be $\frac{97}{62}$ or 1.564 times that of copper to have the same resistance per foot. The weight of aluminum will therefore be $\frac{2.68 \times 1.564}{8.93}$ times that of the copper, or 0.47.

The tensile strength of the aluminum will be $\frac{28{,}000 \times 1.564}{4{,}500}$ or 0.96 that of the copper.

The diameter of the aluminum will be $\frac{\sqrt{1.564}}{\sqrt{1}}$ or 1.25 that of the copper.

The price of aluminum for equal cost would be $\frac{1}{0.47}$ or 2.13.

Tabulating these results we have:

	Aluminum.	Copper.
Cross section for equal resistance	1.56	1
Diameter for equal resistance	1.25	1
Weight for equal resistance	0.47	1
Tensile strength for equal resistance	0.96	1
Price for equal cost	2.13	1
Rate of temperature change (resistance)	1.00	1

By inspection of the above table we see at once that the principal difference which exists from an engineering standpoint is that aluminum possesses less than half the weight of copper for equivalent resistance. This is a marked advantage and results in benefit in three ways:

First.—The cost of transportation of aluminum is less than that of copper.

Second.—The cost of erection of the aluminum is less.

Third.—The durability of the line is greater and cost of maintenance is less on account of the smaller strains to which poles, crossarms, pins and insulators are subjected.

An additional advantage of aluminum is that on account of its peculiar nature it retains for years some of the grease used in drawing, and this grease prevents any great amount of sleet from forming upon it, thus avoiding one of the serious causes of interruption to service over pole lines. This result is rather surprising and its announcement is often greeted with incredulity, but the fact has been noted often enough to be well established.

To balance the advantages cited there are the following disadvantages:

First.—Difficulty in making joints.

Second.—Greater sag due to larger coefficient of expansion.

Third.—Insufficient strength for conductors of the sizes used for telephone and telegraph wires.

Referring again to the question of sleet affecting metallic conductors, the writer was informed by a friend of his, who is an electrical engineer for one of the large companies in the United States, of a very practical illustration. He states that he was called to Kansas City to make an inspection of the Kansas City and Leavenworth Railroad. He happened to get there on a day while there was a very severe sleet storm in progress, and he found the copper trolley wires so badly covered with sleet that it was almost impossible to run the cars at all, and they were running scrapers instead of trolley wheels and were compelled to keep a man on top of the car to assist in knocking the ice from the wire. On the other hand the aluminum feeders, located on poles adjoining the tracks, were entirely free from sleet, and he states that this condition was not due to the fact that the wires were carrying sufficient current to warm them, because that was not the case, as there was only one car on the line between the power house and the part of the line referred to, and the feeder system was of ample size, so that the temperature rise was insufficient to have any effect in preventing the formation of sleet. In addition to this there would be from half an hour to an hour at a time when no car would be on the line at all, and then no current whatever would be passing over the line.

It does not follow, however, that sleet will never gather on aluminum wire anywhere, because in the neighborhood of railroads and manufacturing plants the wires are likely to become coated with smoke or some other foreign substance upon which the sleet will form. In general, however, it may be safely assumed that sleet does not form upon aluminum wires.

Joints.

The difficulty of soldering aluminum is well known, and, while it can be done, the operation in the majority of cases is attended with so much difficulty that unsoldered joints are preferable. The difficulty in soldering aluminum arises from three causes:

First.—Because solder does not alloy with aluminum at a low temperature. It will alloy with copper at approximately 460° F., but the alloying temperature with aluminum is about 200° F. higher.

Second.—Because of the high thermal conductivity of aluminum the latter metal conveys the heat away very rapidly from the solder and from the soldering iron, making it difficult to maintain a soldering temperature.

Third.—When aluminum is exposed to the air a thin invisible coating of oxide of aluminum instantly forms upon the surface, although in this respect aluminum is not different from all other metals, because the surface of any metal becomes covered with its oxide immediately after exposure to the atmosphere. It is well known that it is necessary to remove this oxide coating in order to permit of the formation of an alloy between the solder and the metal, because the alloying can only take place on a clean surface of metal and the interposing film of oxide prevents the solder from coming into actual contact with the metal. In regard to other metals than aluminum, the oxide coating can be dissolved by means of soldering salts, but no such salt or flux, so far as the writer can learn, has been discovered for aluminum; hence the difficulty in soldering it. Attempts have been made to use various materials as fluxes to remove the oxide coating of the aluminum, but the results have not been satisfactory, and, in fact have been in most cases detrimental to the aluminum because of the resulting formation of a chemical compound which interferes with soldering instead of facilitating it.

By joining aluminum wires smaller than No. 0000 B. & S. gauge the two ends are inserted into a piece of flattened tube and the tube given two and one-half twists by means of two pairs of ordinary wire connectors. This makes a perfectly satisfactory joint of low resistance and as strong as the wire joined.

Larger sizes are conveniently joined in any of three ways.

First.—By means of the ordinary dovetail cable splice. (The Niagara Falls-Buffalo line, consisting of 500,000 circular mils aluminum cable, is joined in this way, and has been in use for three years and has given perfect satisfaction.)

Second.—By means of terminals compressed on the ends of the cables at the factory, these terminals being threaded and thus adapted to be united in the field by a threaded stud.

Third.—By inserting the ends to be joined into a cast sleeve and compressing the sleeves between dies in a small portable press.

Taps are made by means of aluminum clamps, one of which carries a lug into which the tap wire is either soldered or secured by set screws. Soldering into a lug is one of the pieces of aluminum soldering which can be readily accomplished.

It will be seen from the above that the difficulties of making aluminum joints have been reduced to an extent which leaves almost no disadvantage whatever.

Sag.

The sag of aluminum conductors is somewhat greater than that of copper in hot weather, and on ordinary spans on account of the fact that the coefficient of expansion of aluminum is 38 per cent. greater than that of copper.

The sag is not as much greater as might be expected, however, because the lower modulus of elasticity of aluminum causes it to contract more as the strain is relieved from it and because the weight of aluminum, for equal areas, is only three-tenths that of copper, while the strength of it is two-thirds that of copper. This causes aluminum to start with a smaller minimum sag than copper.

One curious result of this is that whereas aluminum will have a maximum sag of three or four inches more than copper in a 100-foot span, it will have actually a smaller maximum sag in a 1,000-foot span, for while the span moves farther or deflects more rapidly than copper for a given temperature change, it starts with so much smaller sag at low temperature that it never overhauls the copper when long spans are used. On this account and that of its small weight, it would seem to be the best material for long-span work.

The use of a reliable dynamometer for stringing aluminum wire is strongly recommended, as experience seems to indicate that it is a difficult matter to obtain linemen experienced in handling aluminum wire or who can be depended upon to provide that proper sags shall be set when stringing the wire. The use of the dynamometer does not involve any greater expense for the stringing of aluminum conductors than its non-use when stringing copper conductors, because, owing to lighter weight of the former, the material can be handled much more easily and quickly than the copper can, size for size.

General Conclusions.

The third objection for aluminum applies only to telegraph and telephone lines and similar work. The smallest size of aluminum which it would be advisable to use in pole-line work is No. 4 B. & S. gauge, which has a breaking strength of about 1,000 pounds, which is the minimum strength that should be allowed in any conductor on a pole line if uninterrupted service must be given over it.

The principal uses of aluminum conductors have been for railway feeders, high-tension transmissions and bus bars. Its use in Canada has not been very extensive, due to the fact that the beginning of its manufacture here is of rather recent date. But there are very few places in the United States where it is not found in service. Very little need be said about its use for railway feeders, which have absorbed nearly two-thirds of what has so far been used. This use, however, presents no problems with which engineers are not familiar. For power transmission its use has become very extensive. The longest and largest transmissions in the world are now made over aluminum. From information furnished me by one of the manufacturers of aluminum conductors I have selected the following list and data which may be of interest:

Location.	No. of Cables.	Miles Per Cable.	C. M. Area of Each.
Niagara Falls to Buffalo	3	20	500,000
Shawinigan Falls to Montreal	3	85	183,708
Electra to Mission San Jose	3	100	471,034
Colgate to Oakland	3	144	211,000
Farmington River to Hartford	3	11	336,420
Lewiston, Me.	3	3.5	144,688
Ludlow, Mass.	6	4.5	135,247

In addition to the foregoing list the lines of the Telluride Power Transmission Company in Utah, Colorado and Montana use nearly 2,000 miles of wire, involving transmission distances of 130 miles.

The question of the durability of aluminum conductors has frequently been raised since they have been brought into active competition with copper, but so far the information available shows that aluminum has thoroughly established itself as a conductor material offering no disadvantages which are not, in other respects, proportionately found in regard to copper or iron. Aluminum is not readily oxidizable, and the greater number of mineral acids seem to have no chemical effect upon it, but chlorine in any of its unstable combinations is more or less detrimental to it, particularly where the conductors are exposed to sea air or where they are installed within the vicinity of certain chemical works.

On the other hand, copper is liable to be detrimentally affected by atmospheres laden with acid fumes; consequently it would hardly be fair to condemn aluminum for lack of permanency any more than it would be to condemn copper. The most common impurity of aluminum is sodium, which forms a very unstable alloy, readily attacked and corroded in even slightly moist atmospheres. This defect can be provided against by the manufacturers, and no doubt the consumer can depend upon the purity of aluminum furnished by any responsible manufacturer as readily as he can depend upon the guaranteed qualities or characteristics of copper purchased from any responsible copper manufacturer.

Aluminum conductors were first placed on the market in the form of solid drawn wire, and in this form a considerable quantity of it was installed on transmission lines. Subsequent experience has demonstrated that the tensile strength of any given aluminum conductor is increased somewhat by building it up of several smaller strands wound together, and since this form has been adopted the writer has not been able to learn of any instances in which the conductors have broken on account of deficient tensile strength, where they have been properly installed.

In connection with the installation of the electric-lighting and power-distribution system along the Welland Canal, this work being now in progress, the government purchased a quantity of aluminum and copper conductors for the transmission and distributing circuits.

The writer's specifications called for No. 0, No. 2, No. 4, No. 6 and No. 10 B. & S. copper conductors, the No. 6 B. & S. to be medium hard-drawn and the No. 10 to be hard-drawn. Tenders were also taken, as alternative, for the supply of aluminum conductors of conductivities equivalent to those of copper conductors specified, and on comparing tenders it was found that the No. 000, No. 0 and No. 2 B. & S. aluminum conductors offered as equivalents for the No. 0, No. 2 and No. 4 copper would cost less than the copper, and the aluminum was purchased. The aluminum equivalent for No. 6 copper, taking

1. A paper (somewhat abridged) read before the Canadian Electrical Association at Hamilton, Ont., on June 15, 1904. Mr. parke is a consulting electrical engineer of Toronto.

into consideration the tensile strength specified for the medium hard-drawn copper, was found to be more expensive than the copper, consequently copper was purchased for the No. 6 and No. 10 gauges. The writer desires to explain that the gauge numbers just mentioned for the aluminum conductors do not represent the correct relative proportions as compared with copper, but are the nearest gauge numbers corresponding to the area of the aluminum conductors representing the copper equivalent.

The writer tested a proportion of the aluminum conductors for cross-section, tensile strength, torsion and resistance, and found the results given in the table below:

Approximate Gauge.	Number of Strands.	Approximate Gauge of Strands.	Twists in 6 Inches.	Breaking Strains Per Square Inch.	Per Cent. Elongation in 6 inches.	Resistance Per 1,000 Ft. at 75° F.
000	7	7 B. & S.	21	29,100 lbs.	2	.106
0	7	9 B. & S.	22	33,000 lbs.	2⅔	.172
2	7	10 B. & S.	30	35,500 lbs.	3⅓	.262

The above-mentioned results of the tests seem to show that the tensile strength increases somewhat with a reduction in area of the smaller strands composing the conductor.

Also it will be seen that the conductivity of the aluminum conductors as compared with that of pure copper conductors of the equivalent smaller gauges specified is approximately 99.3, 98.5 and 99 per cent., respectively, and the respective breaking strains of the aluminum per square inch exceed the breaking strain usually allowed for soft copper (pure), namely, 23,600 pounds.

The questions are often asked with relation to alternating-current work as to the respective capacity, self-induction and skin effects of aluminum and copper.

As aluminum is one-quarter greater in diameter than equivalent copper, it is evident that the self-induction of the line will be the same when the aluminum wires are separated 25 per cent. more than the copper wires.

The static capacity of the aluminum will be approximately five per cent. greater than that of copper with the same spacing.

The skin effect will be exactly the same with either of the two metals, since the effect of the greater diameter of the aluminum is exactly offset by its greater specific resistance in making the calculations for the per cent. increase of resistance.

All practical transmission lines possess sufficient excess of self-induction over capacity to cause a slight lag in alternating currents, and the power factor over an aluminum line would therefore be slightly better than that over a copper line on account of the smaller self-induction and greater capacity. The difference is small, but what there is is in favor of aluminum.

The market prices of aluminum and copper have always been such for the last five years that from five to 15 per cent. can be saved by the purchase of aluminum.

For instance, the present market price of copper is about 14 cents. An equivalent price of aluminum would be 29.8 cents, whereas aluminum can be had today for 27.5 cents, or the equivalent of 13-cent copper.

In view of all the facts it would seem that we are no longer compelled to confine ourselves to a single material for carrying current, as was formerly the case.

Electric-railway Tests at St. Louis.

In an article in The World Today on the work of the Electric Railway Test Commission of the St. Louis Exposition, Professor Henry H. Norris says: "The actual planning and conduct of the tests are in direct charge of an executive committee of which the chairman is Prof. W. E. Goldsborough, chief of the Department of Electricity, Universal Exposition. Prof. H. H. Norris of Sibley College, Cornell University, is superintendent of electric-railway tests, and associated with him as assistant superintendents are Profs. B. V. Swenson of the University of Wisconsin and Prof. H. T. Plumb of Purdue University. About 35 young men from these institutions will perform the actual observations, and these are already undergoing a special preparation for their important work. In order that the conduct of tests may be as efficient as possible, each of the three large companies which manufacture electric-railway machinery has appointed a representative to act upon an advisory committee. These are as follows: General Electric Company, Mr. A. H. Armstrong; Westinghouse Electric and Manufacturing Company, Mr. Clarence Renshaw; Allis-Chalmers Company and the Bullock Electric Manufacturing Company, Mr. W. S. Arnold."

Government Space-telegraph Commission.

On June 25th President Roosevelt appointed Rear Admiral Robley D. Evans, Rear Admiral Henry N. Mann, Brigadier General A. W. Greely, Lieutenant Commander Joseph L. Jayne and Professor Willis S. Moore, chief of the Weather Bureau, as a board to consider the question of wireless telegraphy in the service of the national government.

Delegates to and Programmes of the International Electrical Congress.

As readers of the Western Electrician are aware, a number of national electrical bodies have already arranged to co-operate in the International Electrical Congress of St. Louis. In America a number of these co-operating bodies are to hold simultaneous conventions in St. Louis during the congress week and to hold joint sessions with specified sections of the congress on definitely appointed days. Other bodies are not going so far as to hold simultaneous conventions and joint sessions, but have accepted their invitations to send delegates to the congress. Invitations to send delegates have been sent to 30 national electrical and scientific bodies all over the world.

The following-named bodies have already promised to hold simultaneous conventions and joint sessions: American Institute of Electrical Engineers, American Electrochemical Society, American Physical Society, International Association of Municipal Electricians and American Electrotherapeutic Association.

The following-named bodies have promised to send delegates to the congress: National Electric Light Association, Association of Edison Illuminating Companies.

In Europe the following-named bodies have promised to send delegates to the congress: Société Internationale des Électriciens, Sweizerischer Elektrotechnischer Verein. It is expected that the Institution of Electrical Engineers of Great Britain and the Electrotechnischer Verein of Berlin will also send delegates. It is hoped that other European national electrical bodies will also co-operate.

The delegates accredited to the congress from various co-operating bodies are not expected to be called upon to vote upon any questions of national importance. All matters concerning units, standards, etc., will lie within the province of the chamber of government delegates. All delegates of the co-operating bodies are invited to read papers before any section of the congress they select. Such papers will be printed in the congress transactions as being offered by the delegate on behalf of the co-operating body. The paper and discussion thereon will subsequently be offered by the congress to the co-operating body for incorporation in its own transactions if desired.

The delegates of the American Institute of Electrical Engineers and their papers to the congress are as follows:

Ralph D. Mershon (Sec. D).—"The Maximum Distance to Which Power Can Be Economically Transmitted."

Prof. M. I. Pupin (Sec. A).—"Electrical Impulses and Multiple Oscillators."

Prof. C. P. Steinmetz (Sec. D).—"The Theory of the Single-phase Motor."

The delegates of the Electrochemical Society and their papers to the congress are as follows:

Prof. W. D. Bancroft (Sec. C).—"The Chemistry of Electroplating."

Prof. H. S. Carhart (with Dr. G. A. Hulett, Sec. C).—"The Preparation of Materials for Standard Cells and Their Construction."

Prof. L. Kahlenberg (Sec. C).—"The Electrochemical Series of the Metals."

The delegates of the National Electric Light Association and their papers to the congress are as follows:

George N. Eastman (Sec. E).—"Protection and Control of Large High-tension Distributing Systems."

G. Ross Green (Sec. E).—"American Meter Practice."

Dr. F. A. C. Perrine (Sec. D).—"American Practice in High-tension Line Construction and Operation."

The delegates of the Association of Edison Illuminating Companies and their papers to the congress are as follows:

W. C. L. Eglin (Sec. E).—"Rotary Converters and Motor Generators in Connection with the Transformation of High-tension Alternating Current to Low-tension Direct Current."

L. A. Ferguson (Sec. E).—"Underground Electrical Construction."

Gerhard Goettling (Sec. E).—"Storage Batteries as an Adjunct to Station Equipment."

The delegates and papers of the other co-operating bodies have not yet been appointed.

In response to invitation the following-named foreign governments have appointed delegates:

Switzerland.—Prof. Ferdinand Weber and Prof. Francois Louis Schule.

Norway and Sweden.—Prof. G. Arrhenius.

India.—Mr. J. C. Shields.

Mexico.—Mr. Rafael R. Arizpe.

The appointments from Great Britain, France, Germany, Austria-Hungary, United States, Belgium, Italy, Denmark, Spain, Portugal, Australia, Japan, China, Brazil, Chili and Peru have not yet been made. It is stated that appointments are being made.

The following are the programmes of papers promised for sections F and G. Similar programmes of sections A, B, C, D and E, have already been published:

Section F. Electric Transportation.—Chairman, Dr. Louis Duncan; secretary, A. H. Armstrong.

Ernst Danielson.—"Theory of Compensated Repulsion Motor."

Philip Dawson.—"Electrification of British Railways."

F. J. Eichberg.—"Single-phase Electric Railways."

Prof. F. Niethammer.—"Alternating vs. Direct-current Traction."

Prof. Rasch.—"The Puffer Machine in Railway Service and Its Most Suitable Control."

A. H. Armstrong.—"The Electrification of Steam Lines."

B. J. Arnold.—"Electric Railways."

Louis Duncan.—"General Review of Railway Work."

J. B. Entz.—"The Storage Battery in Electrical Railway Service."

C. O. Mailloux.—To be announced.

E. H. McHenry.—"Some Qualifications of Electric Railway Equipment for Trunk Lines."

R. A. Parke.—"Braking High-speed Trains."

W. B. Potter.—"Electric Railways."

F. J. Sprague.—"The History and Development of the Electric Railway."

L. B. Stillwell.—"Notes on the Electrical Equipment of the Wilkesbarre and Hazleton Railway Company."

H. G. Stott.—"Central-station Economics and Operation."

W. J. Wilgus.—"Equipping the Central Terminal."

Section G. Electric Communication.—Chairman, F. W. Jones; secretary, B. Gherardi.

Senor Don Julio Cevera Baviera.—"Electric Communications in Spain."

Dr. J. A. Fleming, F. R. S.—"The Present State of Wireless Telegraphy."

John Hesketh.—"A New Danger to Lead-covered Aerial Telephone Cables."

Joseph Hollos.—"Simultaneous Telegraphy and Telephony."

Saitaro Oi.—"Telephony and Telegraphy in Japan."

V. Poulsen.—"System for Producing Continuous Electrical Oscillations."

G. de la Tonanne.—"Questions Connected with Rates and Management in a Telephone Exchange."

J. C. Barclay.—"Printing Telegraph Systems."

Dr. Albert C. Crehore.—"Rapid Telegraphy."

Dr. Lee De Forest.—"Wireless Telegraph Receivers."

Patrick P. Delaney.—"Rapid Telegraphy."

Hammond V. Hayes.—"Telephony."

Franz J. Dommerque.—"The Telephone Problem in Large Cities."

Reginald A. Fessenden.—"Wireless Telegraphy."

J. C. Kelsey.—"Features of Two-strand Common-battery Systems."

Kempster B. Miller.—"Problem: Automatic vs. Manual Telephone Exchange."

F. A. Pickernell.—"Telephony."

Louis M. Potts.—"Printing Telegraphy."

Colonel Samuel Reber.—"Military Use of the Telephone, Telegraph and Cable."

Prof. George F. Sever.—"Electrolysis of Underground Conductors."

L. W. Stanton.—"Economical Features in Modern Telephone Engineering."

John Stone Stone.—"The Theory of Wireless Telegraphy."

Up to June 23d 1,776 adhesions to the congress had been received and over 150 papers promised. Twelve of these papers have already been delivered. Arrangements are now being completed for printing papers in advance of the congress, so that all that are received in sufficient time will be ready for circulation among the congress members at St. Louis. Efforts are being made to secure as many of the promised papers as possible in advance.

Weston Patents Sustained.

The Weston Electrical Instrument Company of Newark, N. J., has recently secured favorable decisions in two suits bearing on infringements of its patents. One suit is against the Empire Electrical Instrument Company to restrain infringement of Dr. Weston's patent No. 497,482, covering shunt connections. Judge Holt of the United States Circuit Court in the Southern District of New York, in his opinion, says that the proof of infringement is conclusive and directs that there should be a decree for the complainant, granting a perpetual injunction. This decision upholds Dr. Weston's inventions of the modern station ammeters, using shunts, that are utilized as indicating instruments for measuring the strength of current in direct-current circuits.

The other case was against the Jewell Electrical Instrument Company and Edward Jewell. The application for a temporary injunction restraining the defendants from infringing patent No. 392,387, issued November 6, 1888, to Edward Weston, and covering certain electrical measuring apparatus, was granted in the United States Circuit Court, Northern District of Illinois. The judge says that, from the records, there seems to be no doubt as to the defendants' infringement.

The electrical department of the U. S. S. Kentucky is unusually complete, and not only are all of the turret motors electric, but the ammunition hoists, deck winches and boat cranes are electric. The bunker chutes load directly to the coal bunkers, and this feature, combined with fast electric deck winches, makes the Kentucky a rapid and easy ship to coal. The crew in one working day put in over 1,100 tons of coal.

Indiana Telephone Items.

The Wilmott Mutual Telephone Company, capitalized at $10,000, has been incorporated and will build an exchange in Wilmott and lines throughout Whitley County. J. W. C. Scott and Franklin Hunt are among the incorporators. Another new company is the Urbana Independent Telephone Company of Urbana. The capital stock is $10,000. The leading directors are Emanuel Staver, Adam Cook and E. F. Baker.

The Brownstown Telephone Company has purchased and taken over the property of the Jackson Telephone Company, with a small exchange at Tampico.

The Delaware and Madison Counties Telephone Company is adding upward of 90 miles of wire to its system, principally reaching into the rural neighborhoods in the vicinity of Anderson, Muncie and Elwood.

The Mt. Pleasant Telephone Company of Medford has completed its system and is now in operation. It will have two trunk-line connections with Muncie.

The Citizens' Telephone Company of Terre Haute has extended its toll line to Lewis. The company is contemplating other extensions and improvements.

The Fulton Telephone Company held its annual meeting last week and elected officers as follows: President, George Rentschler; secretary and superintendent, H. L. Becker; treasurer, Elmer E. Jackson.

The Home Telephone Company of Elkhart is extending its lines with a view of connecting the Granger exchange.

It is reported that the work of overhauling and reconstructing of the Merchants' Mutual Telephone Company's system at Michigan City is progressing rapidly. The company will expend $20,000 in betterments.

The annual convention of the Indiana Independent Mutual Telephone Association, scheduled for Lafayette this week, promises to be well attended. The sessions will be in Thompson's Hall. Those expected to be present and read papers are: Hon. Hugh A. Dougherty, Bluffton; H. B. Sales, Indianapolis; J. F. McHugh, S. B. Fowler, Lafayette; E. M. Coleman, Louisville; Henry A. Barnhart, Rochester, and Professor J. C. Kelsey of Purdue University. Among the list of entertainments provided by the local committee, visits to the Sterling Electric Company's plant and Purdue University are planned. F.

Telephone News From The Northwest.

Telephone connection has been completed between Thief River Falls, Minn., and Holt, New Folden and Middle River.

Complaints are loud and numerous at Alexandria, Minn., over a raise in telephone rates announced by the Interurban Telephone Company.

The Minnesota Mutual Telephone and Telegraph Company of Princeton, Minn., is offering prizes to its operators for proficiency in performing their work.

The council of Willmar, Minn., has voted to grant a franchise to the Tri-state Telephone and Telegraph Company for a toll line through that city, upon payment of $1,000 for a 10-year franchise.

The Zenith Telephone Company of Duluth, Minn., has served notice on patrons that, after July 1st, rates will be raised to $36 per year for business connections, or $30 for party-line service.

A 20-year telephone franchise has been voted at Watertown, S. D.

A. L. Wells will put in an exchange at Brewster, Minn.

The Dakota Central Telephone Company has built a line from Kulm to Wishek, N. D., and is building one to Ashley.

The Interstate Telephone Company is putting in a toll line from Mederville to Elkader, Iowa.

The contract for installing a telephone system in the state insane asylum at Cherokee, Iowa, has been let to the New State Telephone and Telegraph Company of Odebolt, Iowa.

The Sumner (Iowa) Telephone Company's system has been sold to Fred. Pleggenkuhle of Hawkeye, Iowa.

The telephone company at Cushing, Iowa, will be reorganized. Mr. Hutton of Holstein will manage the business. R.

Ohio Telephone Notes.

The City and Suburban Telephone and Telegraph Company of Cincinnati has secured an injunction against the village of Oxford to prevent its removing the company's poles from the streets and alleys. The construction men were recently arrested for raising poles without having secured authority from the village, and plans were made to tear down those that had been erected.

A line from Cadiz to Uhrichsville is being built by the United States Telephone Company. The terminus at Cadiz will be the exchange of the Harrison Telephone Company.

The telephone system at Austinburg will shortly be connected with Jefferson and some of the other larger towns in that section.

Harry B. Gates said in an interview a few days ago that work would be commenced on the construction of a plant in Cincinnati by the Queen City Telephone Company within a short time. The underground difficulties, he said, are not so great as was at first anticipated, and the cost of construction for this reason may be lower than the first estimates, although it is believed about $3,000,000 will be necessary to equip a good plant. The company will probably erect its own building, and provision will be made for 100,000 subscribers. It is said the Cincinnati people are anxious for an automatic exchange, but Mr. Gates said the company has not decided on that question yet. Careful experiments will be made before any conclusion is reached. The representatives of the company have been looking for a site for the building for some time. C.

Telephone Progress on the Pacific Slope.

John Hansen, owner of the Davenport (Wash.) exchange of the Inland Telephone Company, is negotiating for the purchase of the Reardon (Wash.) exchange. Mr. Hansen has extended the lines of the farmers' system until a large area is covered, and exchanges are established in several towns. Mr. Hansen was the originator of the barb-wire telephone in this country, but has since transferred his lines to poles, and now has one of the most efficient country systems in the state.

The exchange of the Skagit Mutual Telephone Company at Snohomish, Wash., is nearing completion. The switchboards have arrived and will be installed at once. It is expected to have the exchange in operation early in July.

The Independent Telephone Company is making a hard fight for a franchise in Tacoma, Wash. The Sunset Telephone Company has been circulating a petition for over a week, protesting against the council giving the new company a franchise. The franchise committee is divided on the proposition.

The Tualco Telephone Company has been incorporated by F. E. Ferguson, F. E. Phelps and T. W. Bennett, with a capital stock of $1,000. The principal place of business is Monroe, Wash.

The Home Telephone Company has its wires into Chehalis, Wash., but as the details of the arrangement with the Sunset Telephone Company have not been closed, the wires are not working satisfactorily. The company has pay stations at Mossyrock, Silver Creek, Ethel, Salkum, Mayfield and Forrest, Wash. P.

Southeastern Telephone Developments.

The town of Albany, Ga., has granted a franchise to the Blakely Telephone Company, under which the company will be allowed to bring its lines to the town.

George Mimms and others are interested in a movement to have a new telephone system at Trenton, Ky., to compete with the Cumberland Telephone Company.

The Southern Bell Telephone Company at Pratt City, Ala., is making extensive improvements in the local system. This company has just bought out the entire plant of the Charlotte Telephone Company, and the two systems will be merged, putting the Bell in complete control. The Bell has recently made very extensive improvements in the Charlotte plant, putting the wires underground and completing other improvements.

The Randleman (N. C.) Telephone Company will soon be connected with the exchange at High Point and other exchanges.

The Columbus (Ga.) Automatic Telephone Company is enlarging its quarters, making room for more selector boards. The company now has in the neighborhood of 1,000 subscribers, and has met with much success in Columbus. L.

New Independent Association in Ohio

At a meeting of representatives of 25 Independent telephone companies, held in Piqua, Ohio, a few days ago, the Miami Valley Telephone Association was organized. All the Independent companies in Miami, Clark, Shelby, Logan, Champaign and Darke counties were represented at the meeting. A committee was appointed to nominate officers, and the election will take place at a meeting at the same place early in July. General Manager M. B. Oberly of the United States Telephone Company was present and assured the representatives that work on connecting lines will be begun at once, so that service with Chicago and the West may be had within a short time. J. S. Brailey, Jr., of the Central Construction Company also attended the meeting.

TELEPHONE MEN.

A. A. Garris has resigned as manager of the Iron Range Telephone Company's exchange at Bemidji, Minn.

A. H. Foster has resigned as superintendent of the Rochester (Minn.) Telephone Company and will engage in the electrical supply business with his brother at Red Wing, Minn.

J. J. Lane has succeeded E. C. Drews as manager of the telephone exchange at Colfax, Wash. Mr. Drews will assume management of the electric-light plant in Marshfield, Ore., in which he is interested.

The Tuscola Telephone Company of Tuscola, Ill., and the Home Telephone Company of Champaign, Ill., have both increased their capital stock—the former from $5,000 to $10,000 and the latter from $25,000 to $100,000.

Telegraph and Telephone Facilities at the Republican National Convention.

That there was little anxiety or doubt as to the probable outcome of the Republican national convention in Chicago last week, and that on this account there was a lack of the usual enthusiastic interest, was shown by the comparatively small amount of business done by the telegraph and telephone companies. Both the Western Union Telegraph Company and the Postal Telegraph-cable Company had made preparations to handle any amount of matter, but the fact that only about half the amount of business expected was offered made it easy for these companies to serve their patrons in the most satisfactory way. The Western Union estimates that it handled an average of 250,000 words a day, this including all press matter, bulletins and private messages originating from the convention. Forty operators disposed of the work with ease. The Postal places its figures at something over 200,000 words a day. About 150 operators were held in readiness, but less than one-third of the force was necessary. Many of the large newspapers throughout the country had made arrangements for special connections betwen the Coliseum and their headquarters at the various hotels and then direct to the editorial rooms. There was no wire connection from the speaker's stand to the various delegations, but communication was possible from the stand to the committee rooms.

The telephone companies gave excellent service in the convention hall. Long-distance instruments were conveniently placed by the American Telephone and Telegraph company, and were freely used. This service was admirable. Bulletin boards all over the country were supplied from the wires of this company and many of the newspaper secured their reports by telephone. In a number of cases it is said the telephone company delivered press matter earlier than the telegraph companies. The Chicago Telephone Company, with the long-distance company, had 12 telephones in the hall. This gave access to the Chicago local system, besides the special circuits which had been connected. Instruments had been placed conveniently on the speaker's stand and special connections were made with the committee rooms and to the hotels where the state delegations had their headquarters. The service offered by the Chicago company was a great convenience, and, together with the long-distance connections, was indispensable.

A new feature in telephonic communication at conventions of this kind was the automatic service given by the telephone department of the Illinois Tunnel Company. Ten automatic instruments were placed in the building and connected with the city system. Special connections had also been made with the local newspapers, all of which were pleased with the efficiency and accuracy of the instruments. The automatic service attracted a great deal of attention, especially from out-of-town delegates, many of whom used the instruments for the first time. The system was the subject of many complimentary remarks and some of the specially interested delegates were shown through the tunnels and exchange by President Wheeler.

Cupid and the Telephone Operator.

Another complaint of crippled telephone service on account of the marriage of so many of the telephone operators comes from Muncie, Ind. General Manager Thomas E. Bromley of the Delaware and Madison County Telephone Company says: "The marriage of our pretty telephone operators is the cause of most of our trouble. No sooner do we train a girl until she becomes an expert than somebody marries her. In the last few weeks six of our skilled operators have left the exchange at Cupid's demand. I don't know what to do about it unless we employ homely girls in the future, and then I am not sure that would help, for I believe men fall in love with the girls' voices before they meet them. We might get some ancient spinsters, with rasping voices; but then, perhaps, our steady patrons would complain because their voices were not pleasant."

Bell Output for May.

Following is the American Telephone and Telegraph Company's statement of instrument output for May and the first five months of the current year, with comparisons:

May—	1904.	1903.	1902.
Gross output	103,897	102,907	104,429
Returned	51,721	42,338	43,491
Net output	52,176	60,572	60,938
Since January 1—			
Gross output	508,372	404,475	410,390
Returned	203,046	151,325	160,137
Net output	305,326	253,150	250,253
Outstanding, May 31	4,084,843	4,032,667	3,400,573

New York State Independent Telephone Association.

The convention of the New York State Independent Telephone Association was opened in the Genesee Hotel, Buffalo, on June 24th. Besides the guests from other states there were more than 100 members of the association present. The organization was formed three years ago and has grown to where it is said to represent 600 exchanges and 150,000 telephones in all parts of the state, meaning an investment of millions of dollars.

The first session was called to order by President George R. Fuller of Rochester. He introduced Councilman Stoddard, who made the address of welcome, and then Mr. Fuller gave his address, which was well received. He said that about 75 per cent. of the cities of the United States have Independent telephones, and those telephones are controlled by about 7,000 companies. Competition acts as an incentive and helps the progress of the companies.

Following Mr. Fuller the following delegates spoke: B. G. Hubbell of Buffalo, J. S. Brailey, Jr., of Toledo, Ohio; F. M. Potter of Syracuse, T. Harvey Ferris of Utica, H. W. Blake of Naples, J. Fisher of Grand Rapids, Mich.; A. M. Taylor of Penn Yan. These men spoke very interestingly of their experiences in organizing and installing Independent telephone systems.

At 4:30 p. m. the meeting adjourned and the delegates were taken on a visit to the plant of the Frontier Telephone Company by Charles B. Hill.

In the evening a banquet was enjoyed at the Ellicott Club. Each table was provided with a telephone suspended from the ceiling. B. G. Hubbell of Buffalo was the toastmaster. To his right sat President Fuller and to his left H. D. Critchfield of Chicago. Others who occupied seats at the speakers' table were E. C. Lufkin, Charles B. Hill, Buffalo; E. B. Fisher, Grand Rapids, Mich.; J. G. Splane, Pittsburg; W. D. Banard, Philadelphia; J. S. Brailey, Jr., Toledo, Ohio; Frank H. Mott, Jamestown; A. L. Tetu, Louisville, Ky., and W. L. Cary, Cleveland.

J. S. Brailey was the first speaker and he told of the success of the Independent movement in the West. He said the Independent movement originated in the West and gradually moved eastward. E. B. Fisher, president of the Michigan state organization, told of the beginning of the widespread movement of the Independent lines in Grand Rapids nine years ago. W. L. Cary, counsel for several Independent telephone companies throughout Ohio, told of the growth of the Independent lines in that state. H. D. Critchfield said that the outlook for the Independents in Chicago was more than promising. Frank H. Mott of Jamestown told of the success of the Independent lines in his part of the state. J. G. Splane of Pittsburg said that the Independent lines in that city were in the lead and the outlook was very bright, and A. L. Tetu of Louisville, Ky., said that the competing lines did not have a show in his state with the Independent companies.

The second day's session was opened with the reports of the various committees. The question whether the association should be composed in the future of one official representative from each Independent company or of individuals brought out a warm debate. It was finally decided that all employes of Independent telephone companies be admitted as associate members with the right to vote on all questions. They are, however, to be denied the right to hold elective offices. The active members are to consist of representatives from each Independent telephone company in the state.

In order that the delegates might have time to go on a visit to Niagara Falls it was decided to dispense with the reading of the papers which had been prepared. These will be printed in pamphlet form and distributed to the members. The papers on the programme were as follows: "Telephone Construction and Its Proper Care," by W. H. Johnston of Buffalo; "Methods of Exchange Operating and Its Relation to the Public," by F. M. Potter of Syracuse; "Methods of Handling Toll Business," by T. S. Lane of Buffalo; "Methods of Exchange Accounting," by George R. Fuller of Rochester; "Telephone Conditions in Great Britain and Central Europe," by M. S. Conner of Rochester.

The resolution adopted by the association relating to the encroachment by Independent companies upon the territory of other companies is of special significance in that it is thought that it will materially diminish, if not entirely eliminate, competition among Independent telephone interests, which has heretofore been considered an important factor in influencing investors.

The election of officers resulted as follows: President, Henry H. Persons, Buffalo; first vice-president, Howard Hendrickson, Albany; second vice-president, Boyd McDowell, Elmira; treasurer, T. Harvey Ferris, Utica; secretary, T. S. Lane, Buffalo; executive committee, George R. Fuller, Rochester; Henry H. Persons, Buffalo; B. G. Hubbell, Buffalo; Edward Davis, Philadelphia, Pa.; C. H. Poole, Utica; S. B. Rosser, Elyria, Ohio; James S. Brailey, Jr., Toledo, Ohio; J. S. C. Edwards, Johnstown; T. B. Busselin, Groghan; F. M. Potter, Syracuse; J. F. Stockwell, Oswego.

The next meeting will be held in Albany, N. Y., in 1905, the date to be fixed by the executive committee. Before adjourning a resolution was adopted thanking the members of the local committee for their efforts in making the convention a success.

The Invention of the Telephone.

Apparently the old controversy about the invention of the telephone will never die out. A recent contribution to it appeared in the columns of a daily paper and was written by W. M. Goodridge of Highland Park, Ill., in advocacy of the claim of the late Elisha Gray. Mr. Goodridge says: "The writer of this article was associated with Mr. Gray 10 years, commencing in April, 1874; assisted him in every experiment he made; knows just what he did, and also what he expected to do with his invention. Multiple telegraphy was the principal object of his invention, and to this feature Mr. Gray devoted most of his time and energy, but the speaking telephone was included in it and was in his mind from the very start, and frequently the matter was discussed between us as to the construction of instruments for the purpose. Each succeeding experiment served to confirm him in his idea of the proper instruments, and led up finally to a fixed plan in his mind, which he proceeded to embody in a caveat which he filed in the Patent Office in Washington in February, 1876, to protect his rights until such time as he could give it proper attention. This caveat contained the first description of a speaking telephone given to the world."

Public Telephones in St. Petersburg.

The municipality of St. Petersburg is now considering a project to establish telephone stations for the convenience of the public, at different points of the city. Some of the booths will be located at railroad stations, points along the harbor and in large hotels and restaurants, while others will be placed in squares and public gardens. At the beginning there will be 40 of these stations. Some of them will be arranged so as to enable anyone to establish a communication by a "nickel-in-the-slot" device. In others there will be employes in charge of the apparatus, who will sell tickets. A call inside the city, not exceeding three minutes, will cost 15 kopeks (7½ cents). For outside calls the price will be double. The maximum length of a city call cannot exceed six minutes. The duration of suburban calls may be 15 minutes.

GENERAL TELEPHONE NEWS.

The Utah Independent Telephone Company will have its system in shape for operation by July 5th, according to a statement recently made by the management.

A telephone system is to be installed at Temple Hill, Ill., by the Egyptian Mutual Telephone Company, which has been incorporated by W. C. Holmes, H. M. Stokes and John Mann.

Harry W. Bishop has secured a franchise for constructing a telephone system in Eustis, Fla. Mr. Bishop also contemplates organizing a company for establishing long-distance lines.

The differences between the striking linemen of the Rocky Mountain Bell Telephone Company and the management have been referred to an arbitration committee, and the men have resumed work.

The Bell Telephone Company of Canada has decided to extend its lines in the near future through the Gatineau Valley district. The line will be extended to Gracefield and probably to Lakefield later on.

W. W. Boulden and R. H. Traylor of Bay City, Texas, and A. W. McNabb of Matagorda, Texas, are interested in the Bay City and Matagorda Telephone Company, which has just been incorporated with a capital of $50,000.

The People's Union Telephone Company, recently incorporated at Gillett, Ark., with a capital of $25,000, will begin at once the construction of about 50 miles of telephone line. The construction will be under the management of L. S. Haller.

A telephone line has been built to connect the cities of Lisbon and Oporto, in Portugal. It was constructed and is operated by the government, although the exchange systems in the two cities are owned by private companies.

The farmers of Shiawassee County, Mich., have organized the Rural Telephone Patrons' Protective Association, to secure concessions in the matter of more improvements and cheaper rates. Mr. A. L. Chandler is president and Senator Cook is secretary of the association.

At a meeting of the Grayson County Telephone Company held at Denison, Texas, it was decided to extend and improve the system in Denison and Sherman. The purchase of $50,000 worth of material, to be used in making these extensions and improvements, was authorized. J. C. Rorick of Wauseon, Ohio, is heavily interested in the company.

Plus-and-minus Selective Signaling.

A reader of the Western Electrician has encountered some difficulty in the operation of a plus-and-minus system of signaling on his common-battery single-relay multiple switchboard, and it is possible that others have met with the same trouble. He says:

"We have a 20-volt central-energy system which employs but one relay which is permanently bridged across the line, serving as a line-lamp relay and also as retardation to battery current to subscriber's telephone. We are giving selective party-line service, but find it hard to get proper adjustment on bells. We employ no relays, but bridge ringers to ground through 4,000 ohms non-inductive resistance, using 2,000-ohm ringers. You see the above arrangement gives a constant-battery leakage to ground, which works in conjunction with the biasing spring on stations 2 and 3, but on 1 and 4 the conditions are just the reverse, which does not allow of the proper range of adjustment. We are ringing with generators rated at 80 volts, but only giving 50. Is it not a fact that the ringing current is not of a high enough voltage to properly ring circuits arranged as above?"

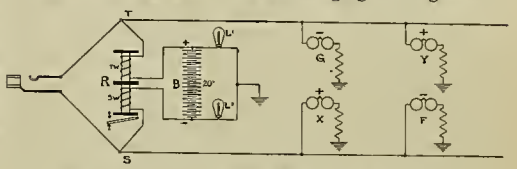


FIG. 1. PLUS-AND-MINUS SELECTIVE SIGNALING.

The difficulty lies in two of the bells connected to the circuit not responding. Fig. 1 gives a plain diagrammatic representation of conditions present in the exchange. That is to say the conditions present with respect to the line connections and the method of supplying current to the line. (R) represents the line relay having two windings, (TW) which connects to the tip side of the line and plus side of the battery, and (S) which connects to the sleeve side of the line and minus side of the battery. Line wire (T) connects to the minus bell on the line shown by (G) and the plus bell (Y). The sleeve wire (S) connects to the plus bell (X) and the minus bell (F). Under normal conditions, with the line in its unused position, current from battery (B) would pass out from the plus side through the (TW) winding of the relay (R) and over the line wire (T), dividing through the (G) and (Y) telephone station ringers and returning to the minus side of the battery through the divided path provided by the ringers (X) and (F), the sleeve wire (S) and relay winding (SW). This flow of current is constantly present and, being in a plus direction from the tip wire out, there is a tendency of the plus

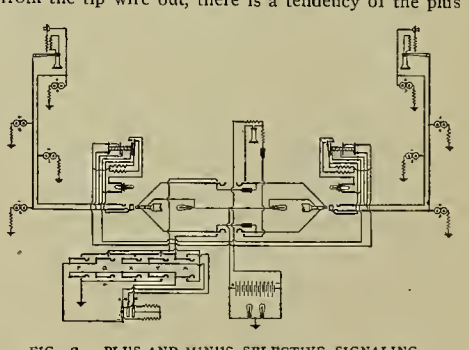


FIG. 2. PLUS-AND-MINUS SELECTIVE SIGNALING.

current to increase the pull on the armature of the ringer (G) and also the ringer (X). On the other hand, this plus current from the tip wire passes through the ringer (Y) and weakens the sticking tendency of the (Y) ringer as well as the (F) ringer for holding the armature in its biased position.

A careful study of Fig. 1 will show these features. It is, of course, understood that the resistance in series with the 2,000-ohm ringers is placed there for the purpose of preventing too great a flow of battery current, which would result in operating the line relay as well as a great loss in current. As arranged, however, there are 6,000 ohms resistance across the two line wires, there being two parallel paths of 12,000 ohms each from wire to wire.

While the inquiry does not state which bells stations Nos. 2 and 3 are, it is to be presumed that stations (G) and (X) are meant, as it is these stations in which the armature is more strongly attracted.

In the absence of any information in detail as to the arrangement of the switchboard circuits, it is to be taken for granted that Fig. 2 shows the selective key and cord-circuit connections as well as

the line-circuit connection of the system operated. It will be observed that from the plus-and-minus side of the battery (B) resistance lamps (L') and (L") are connected to ground. This feature is really shown better in Fig. 1. Fig. 2, however, shows the selective-key connections and cord circuits in detail. While discussing the problem it will be well, however, to refer to Fig. 1, as it is the simplest diagram of the system. The purpose of the resistance lamps is to produce a ground connection at the central office. This is for the purpose of preventing interference.

Suppose it is desired to ring out minus on the sleeve circuit. If no ground were present on the battery the ringing current while passing out over the sleeve would also pass through the battery and over the tip circuit, thus ringing both bells of a like kind. If the ground were produced by means of the lamps, as shown, not enough current would flow through the batteries to the opposite side of the circuit for ringing the remaining bell. It will further be observed that with the battery grounded between the two lamps as shown, the conditions while ringing out on either tip or sleeve circuit will be alike. Now if the battery were grounded without the resistance lamps, say, on the plus side, there would be a greater leakage of battery over the line relays and through (X) and (F) telephones, for there would be the additional resistance to pass through on the tip side of the line. The current would pass directly through the (SW) winding and the parallel resistance of the (X) and (F) telephones back to the positive side of the battery. This, however, is not the only effect which would be present. When either the positive or negative side of the battery is grounded a different circuit condition exists. Suppose the positive side is grounded. The two bells (G) and (Y) are practically permanently bridged by the (TW) winding of the relay (R), this winding measuring about 100 ohms. Thus it will be observed that there is a resistance of 100 ohms in parallel with the (G) and (Y) bells, and to attempt to signal either of the above bells calling current must be sent out over the (T) line in parallel with this low resistance; in other words, the (G) station being signaled with the minus current. This equipment measures 6,000 ohms, and it is only possible to ring the (G) station bell when the minus current delivered by the (SP) generator is of sufficiently great strength to satisfy the current requirement of the (TW) winding of the (R) relay and leave enough current over for operating the (G) bell.

Perhaps the very difficulty existing in the system is due to the battery being permanently grounded instead of being grounded through the resistance lamps, and it may be that the bells which he designates as the 2 and 3 stations connect to the line on the ground side of the batteries, in which case the trouble may probably be removed by clearing the ground connection and producing a new ground by inserting the resistance lamps as shown in Figs. 1 and 2.

That increasing the voltage of the ringing generator might overcome the difficulty, does not appear applicable, for when the voltage is increased sufficiently for operating the (G) and (Y) bells, when the positive side of the battery is grounded, there is introduced a new difficulty. The line relay (R) contains two windings, and these windings act inductively upon each other. If the voltage of the generator is increased to 90, so great a quantity of current will be passed through the (TW) winding as to induce a sufficiently strong secondary current in the (SW) winding to operate the (X) and (F) bells; in fact, operating both of them, although the (F) bell more quickly, as the (X) bell is being traversed by a battery current tending to hold the armature fast.

In answering the inquiry it is necessary to cover the theoretical operation of the system, in order to aid in locating the difficulty and appreciating the importance of keeping both sides of the battery grounded through an equal resistance. If the directions given are followed, the difficulty will probably be cleared sufficiently to permit the successful operation of the system.

Articles of incorporation have been filed at Madison, Wis., for a new electric railway between Chicago and Milwaukee. It is named the Chicago and Milwaukee Electric Railroad Company, and the capital stock is $300,000. The directors and incorporating stockholders are all Chicago men, Albert C. Frost being the controlling stockholder. The proposed line is to be built from a point on the state line between Illinois and Wisconsin in the town of Pleasant Springs, Kenosha County, and will run to Milwaukee, traversing the counties of Kenosha, Racine and Milwaukee.

CORRESPONDENCE.

Great Britain.

London, June 18.—The final sitting of the Royal Commission on London Traffic for the purpose of hearing evidence, which was held last week, was more interesting than the sittings have been for many months. During the early evidence the London County Council made a number of allegations as to the manner in which the Underground Electric Railways Company of London had conducted its business in relation to the acquisition of the tube railways, under the guidance of Mr. Yerkes. It was stated that a huge scheme of locomotion had been put in hand without the consent of Parliament, that the lines were overcapitalized and that the public had not been sufficiently safeguarded. At that time Mr. Edgar Speyer asked permission and was allowed to explain. He went into the whole matter at great length, defending Mr. Yerkes, and pointing out that the Underground Railways Company of London had merely taken over a number of tube railways, as it was authorized to do by Parliament, without in the slightest degree attempting to evade the statutory responsibilities. The capitals of the various lines had not been—and, indeed, could not be—increased, and, as a matter of fact, the cost per mile would be within a very little of the figure which applied in the case of the Central London railway, in spite of the bad condition of the money market and the higher price of materials and labor now, as compared with five or 10 years ago. He contended that the company was endeavoring to make a useful concern out of a number of bankrupt and non-paying railways, and in such a matter he thought he had a just complaint that the council was opposing instead of supporting him.

It is notorious that certain tramway schemes of the London County Council are, so to speak, doomed almost before they are promoted. For instance, a line along the Victoria Embankment into the city by the River Thames has been promoted every year for many years and has been invariably refused by Parliament. In a similar manner the council has been desirous of constructing a tramway along Tottenham Court Road, one of the busiest thoroughfares in the west of London. Hitherto, however, the barrier has been that the local authority would not consent. This year, however, the local authority did consent, but when the bill came before the House of Commons committee, only half of the line was allowed, owing to the remainder of the roadway being too narrow. When the bill came up for the consent of the House itself, the other half was refused, and so once more a large expenditure of the taxpayers' money has gone for nothing.

It has now been definitely stated that the government will not give the National Telephone Company notice to acquire its undertaking at the end of this year, as it has power to do under the terms of the company's license. This notice would have to be given before the 30th of June, but the negotiations which are said to be proceeding between the government and the company are said to be too incomplete to permit of this. In the meantime the company is rapidly converting its London area to the central-battery system, and a large new exchange has just been opened in Holborn. The conference which was recently held in London upon the matter has not yet made another move.

The compulsory running powers over the Newcastle corporation tramways, which were recently granted by the House of Lords, have now been confirmed by the House of Commons, and so the bill of the Tyneside Tramway Company becomes law. This is the first time in this country that such compulsory running powers have been granted, but in view of the bitter feeling that exists between the corporation and the company, it will be interesting to watch how they are put into effect.

In December last the Institution of Electrical Engineers presented to the Colchester corporation a fine painting representing Dr. Gilbert describing his experiments in electricity and magnetism to Queen Elizabeth, Colchester being the birthplace of Gilbert. On Saturday last a visit was paid to Colchester to witness the unveiling of the picture in the town hall.

A ladies' automobile club has been formed in London and, on the occasion of the opening meet, a large number of electric vehicles took part.

The London County Council has just passed its annual money bill through Parliament, which includes, this year, the sum necessary to enable the Marylebone Borough Council to complete the purchase of the portion of the Metropolitan Electric Supply Company's undertaking within its area. So far as borrowing the money is concerned, this is apparently the last that will be heard of the troubles of Marylebone's electric light. G.

New York.

New York, June 25.—Signs are not wanting of the ultimate electrification of the Pennsylvania railroad system, and when the installation of electric traffic on the Long Island railroad is once proved to be a financial success, the scheme will doubtless be well advanced. The Pennsylvania railroad has just completed the purchase of real estate to the value of over $700,000 for a new terminal at Philadelphia. The Taylor Signal Company of Buffalo and Chicago is supplying a number of electric-signal switches to the Long Island Railroad Company. Some have already been placed in position on the Rockaway Beach division, the traffic in which section will be operated by electricity early in 1905.

Influential residents at Mount Vernon, N. Y., are petitioning for an extension of the New York subway system to their locality, with a suggested five-cent fare from City Hall, and an eight-minute schedule, the trip to be accomplished in three-quarters of an hour.

The New York Stock Exchange committee of arrangements on Thursday morning took out the telephones of 11 members, for alleged breaches of regulations. The committee is said to have caused the instruments to be connected to their private rooms, and acted as a result of what was overhead in messages to and from the Consolidated Exchange.

The municipal art commissioners have approved of a design for a statue representing "Electricity," to be placed on the Reade Street façade of the New Hall of Records. Plans now before the art commissioners suggest that the towers of the new Manhattan Bridge (to be known as Bridge No. 4) shall be outlined at dusk with festoons of incandescent lamps.

Electrical equipment to the estimated value of $4,500 is to be put in Public School No. 57, Manhattan. The Department of Education will provide in next year's budget for a complete system of fire-alarm boxes in all the public schools in the Borough of Brooklyn.

The American Push Button Company will be henceforth known as the Anders Push Button Company. The business will be carried on at the old address, 141 Liberty Street, New York city, and under the same general management of Mr. Burton Thompson.

The Twombley Power Company, with a capital of $45,000 and offices in New York city, has been incorporated this week, with a directorate which includes C. C. Dodge and W. I. Twombley.

Mr. H. H. Vreeland of the New York City Street Railway Company (formerly the Metropolitan) attributes the increased expenditure of the last quarter to the hard winter. The figures for the last quarter as given out this week are: Gross earnings from operation, $3,262,844, as compared with $3,573,469 for the corresponding period last year. Operating expenses for the same quarter were $2,052,466 this year and $1,835,804 last year, and the net earnings for the present quarter are $1,210,378, against $1,737,664 a year ago. Other income brought the gross earnings for the stated quarter this year up to $1,400,994, as against $1,889,000 last year. The quarterly returns for the Third Avenue Railway Company also show a diminution.

The business of George Wiedermann of this city has been incorporated under the title of the George Weidermann Electric Company, with a capital of $15,000. Associated with the enterprise are C. E. Ellis and T. H. Cooper of Brooklyn.

George Westinghouse, writing to the New York Times last Monday, compared the British Board of Trade regulations for the prevention of fire in subways to those insisted upon in this city. The New York methods are said to be theoretically ahead of those at London in several respects, as, for example, in the continuous lighting of the tunnels by independent circuits.

Miss Lulu McKibbin, telephone operator at North Brother Island, was one of the heroines of the General Slocum disaster. She saw the burning steamship in the distance and immediately telephoned to every hospital in Manhattan for ambulances. Afterward she went into the water and rescued several children.

The rapid-transit commissioners will shortly announce an examination for the position of assistant engineer. D. W. W.

New England.

Boston, June 25.—The Boston Suburban Electric Companies' stockholders have decided to issue 15,848 shares each of preferred and common stock. The proceeds will be devoted to payment of indebtedness and acquisition of additional properties.

Negotiations are pending, it is stated, for another change in the control of the Waltham Electric Light and Gas Company at Waltham, Mass. When the Boston Suburban Companies acquired the plant and adjacent land it was for the purpose of eventually having car shops and power stations there. Now it is proposed that the lighting system shall be disposed of to the Edison Electric Illuminating Company of Boston, if terms can be agreed upon, and the gas-manufacturing portion of the plant would then go to other owners. The Edison Company, of course, would supply lighting current in that event from its South Boston power plant.

The Providence Telephone Company, which proposes to operate in the town of North Attleboro, in this state, has purchased a site in that place for its telephone building, and contemplates the erection of a structure costing $6,000 to $8,000, with modern equipment. Application has been made for the right to lay conduits for the company's wires in the streets.

On Tuesday a visiting delegation from the Institution of Mechanical Engineers of Great Britain devoted the principal part of the forenoon to an inspection of the various departments of the Massachusetts Institute of Technology in this city. The building occupied by the department of electrical engi-

neering and the work done there attracted chief attention from the visitors. In the afternoon a harbor trip was enjoyed, two special cars of the Boston Elevated Railway Company conveying the party to the wharf, where the United States revenue cutter Algonquin was placed at their service. The harbor fortifications were passed in close review, and the party then proceeded to the Fore River Ship and Engine Company's plant at Weymouth, where they were shown over the works.

The Massachusetts railroad commissioners have authorized the issue of additional stock to the amount of $50,000 by the Templeton Street Railway Company.

The municipal authorities of New London, Conn., have granted the New London Street Railway Company, which is owned principally in Boston, the right to construct a line through Broad Street in that city. B.

Dominion of Canada.

Ottawa, Ont., June 24.—The contract of the city of Kingston, Ont., with the Kingston Light, Heat and Power Company has terminated. The city will likely enter action against the company for specific performance and for possession of the plant. By arbitration, the city was ordered to pay $170,000 for the electric and gas plants of the company, but the company wanted the city, in addition, to care for $100,000 of bonds, to run for 13 years. These bonds call for five per cent., while the city asserts it can get money at three per cent. The city offers its bonds in exchange at three per cent., but the bondholders demur. Until the city gets possession of the plants, the streets will remain in darkness.

In January, 1898, an act incorporating the Toronto and York Radial Railway Company was passed by the Ontario Legislature, giving power to acquire and take over the franchises, rights, powers, privileges and property of the Toronto and Scarboro Electric Railway, Light and Power Company; the Toronto and Mimico Electric Railway and Light Company; the Toronto Suburban Street Railway Company, and the Metropolitan Railway Company. This company is being used as a holding company for the Toronto street railway, and at a meeting of the shareholders, recently, that body authorized the acquisition of the shares, bonds and debentures of the Mimico, the Scarboro and the Metropolitan companies, and the Schomberg and Aurora Railway Company as well as the Radial company.

The cars to be used on the Toronto and Hamilton electric railway, whose right-of-way has been purchased, will be large coaches, and will be run in trains. Differing entirely from the ordinary electric cars, they resemble the most modern coaches on steam railways. The mode of propulsion will also differ from that of the electric lines at present operating in the vicinity of Toronto. It is understood that the company has practically settled upon what is known as the wireless trolley, which does away with the overhead wire and trolley poles. The power travels by a single wire in a conduit, and is stored in boxes at intervals of 16 feet along the track, each box having a capacity of 300 horsepower. On these boxes are metal buttons, which come in contact with a series of magnets attached to the bottom of the cars, and thus communicate power to the propelling apparatus. By this system, it is claimed that great power and high speed are possible. It is also contended that the wireless trolley can be constructed at much less cost than the present system.

The railway employes of the Toronto electric street railway have accepted the new agreement drawn up by the company, covering a period of three years. The new wage schedule is as follows: Motormen and conductors, first year, 18 cents an hour; for the second year, 20 cents; for the third year and thereafter, 21½ cents; shed foremen, 21½ cents; assistants, 18 cents; car washers, foremen, 22 cents; assistants, 18 cents; motor and truck shopmen, same pay as conductors. The company will pay half the cost of uniforms of motormen and conductors who have been with the company for one year, and will provide uniforms for those in service for more than two years.

The taxpayers of the city of St. Catharines, Ont., have voted to take $20,000 stock in the Niagara, Queenstown and St. Catharines electric railway. St. Catharines has for many years wanted railroad connection with Niagara-on-the-Lake, and the latter town has aided the company also. This railway will run from St. Catharines through the rich fruit belt of Grantham to Niagara-on-the-Lake, thence to Queenstown, along the bank of the Niagara River, returning to St. Catharines through Niagara Township, thus forming a belt line of about 30 miles.

According to a special report just brought down in the Canadian House of Commons, the government owns 6,042 miles of telegraph lines and 348 miles of cable. The average yearly number of messages sent is 96,500, of which the Yukon lines carried 42,000. The expenditure last year on the service was $373,348 and the receipts $132,422. The Yukon line cost to maintain $242,211 and the revenue is $113,606.

Street lighting in Winnipeg, Man., has been shut down for a week to enable the company to install its new generator, so as to be in readiness to supply the demand expected for private and public illumination of the city during the Dominion Exhibition, which is to be held in Winnipeg this year. W.

Southeastern States.

Charlotte, N. C., June 25.—The promoters of the proposed electric railway from Anderson, S. C., to Atlanta, Ga., have secured a charter in the state of Georgia, and other developments in the projected movement are reported.

At the annual meeting of the Charleston (S. C.) Light and Water Company directors were elected for the ensuing year and officers were then chosen, with A. H. S. Post, president, and Zimmerman Davis, secretary and treasurer.

Representatives of the American Automobile Association will go to Charleston, S. C., during the month of July to visit Palm Beach, with a view to transferring their racing meets to that point from points farther south.

The big dam of the North Georgia Electric Company, which has been nearly two years in building, has just been completed. The dam is located on the Chattahoochee River near Gainesville, Ga., and is 38 feet high.

It is reported that James U. Jackson, the well-known electric-railway man of Augusta, Ga., is still considering the feasibility of extending the Augusta-Aiken electric line to the city of Columbia, S. C. The preliminary surveys and necessary maps are already completed.

The town of Oxford, N. C., has voted to permit the installing of electric lights and water. The plant will be owned by Edwin I. Frost of Salisbury, N. C., and the town will pay $3,500 annually for the service.

It is said that the cutting off of the water supply below Columbus, Ga., by the closing of the dam of the North Georgia Electric Company on the Chattahoochee River, may raise a decided protest from the owners of factories and boats below Columbus, and the War Department may be called upon to settle the matter.

The corporation commission at Richmond, Va., has granted the right to the Chesapeake Transit Company to increase its capital stock from $1,000,000 to $1,500,000.

The Norfolk (Va.) Railway and Light Company, in order to improve schedules, is contemplating several extensions to its lines in the vicinity of Norfolk.

There are indications that the Calhoun waterpower on the Savannah River near Elberton, Ga., will soon be developed. Application will be made to the next Legislature for the right to dam the river at a point 12 miles from Elberton.

The town of Lancaster, S. C., is discussing the question of voting bonds for a municipal lighting plant. There is also talk of securing the power from a local cotton mill.

The Electric Light and Power Company of Anniston, Ala., is making rapid progress with the big dam on Choccolocoo Creek, where 3,000 horsepower is available. The dynamos will be installed about September 1st. L.

Texas and Mexico.

Austin, Texas, June 23.—A movement is on foot to build an interurban electric railway between Fort Worth and Cleburne, Texas. The route of the proposed road is via the towns of Burleson and Joshua.

Hon. Marshall Hicks, W. H. Schuwirth, P. Garcia and R. H. Wester, all of San Antonio, Texas, have been investigating the situation at San Luis Potosi, Mexico, with the view of establishing a large electric-light and power plant in that city. They will apply to the government for a concession for the enterprise.

J. W. Taylor of El Paso, Texas, is preparing to install an electric-light and power plant at Guaynopita, Mexico.

The Federal District Street Railway Company of the City of Mexico is making important improvements and extensions. It is announced that the company will build a line of electric railway from the City of Mexico to the town of Texcoco, touching the towns of Namalco, Santiaguito, Los Nopales, Salina Alta, San Bernabe and other smaller places. The company also contemplates double-tracking the line to the suburb of Coyoacan.

Weetman D. Pearson, who is at the head of the British contracting firm of S. Pearson & Son, is preparing to enlarge the electric power plant at the Santa Gertrudis cotton mill at Orizaba, Mexico, which he owns.

Frank Brennan, who recently applied to the Mexican government for a concession to utilize the waters of the Atoyac River, near Zapotitlan, Mexico, for the operation of an electric power plant, has made arrangements for the early fulfillment of the enterprise. The electric power will be utilized by adjacent towns and manufacturing concerns. H.

Ohio.

Cleveland, June 25.—Arrangements are under way for operating excursion cars from Erie, Pa., to Cleveland. For some months Cleveland electric-railway men have been looking toward the East with a view to making traffic connections for regular through cars, and this will probably be done also when all the gaps are closed up between Cleveland and some of the larger cities of Pennsylvania and western New York.

To date 12 electric roads in the state have agreed to adopt the mileage coupon plan, but they have not yet chosen a surety company to give the bond agreed upon. The executive committee of the Interurban Railway Association is at work on the plan.

The Toledo Railways and Light Company, in response to a demand from laboring people, has made application for a renewal of its franchise in Toledo. Nothing is said in the application regarding the fare question, but it is believed that the company will be willing to grant a rate of six tickets for 25 cents and universal transfers. Mayor Jones is asking for a three-cent fare, but the company is not willing to grant this concession.

The Toledo division of the Lake Shore Electric is now showing an increase in earnings. The damage by floods last winter put the division in bad condition, but it is recovering from this.

The G. C. Kuhlman Car Company of Cleveland has notified the secretary of state of an increase of capital stock from $300,000 to $500,000.

The Toledo and Point Place Electric Railway Company of Toledo has been incorporated with a capital stock of $30,000 by John A. Dunn, W. R. Leflet, August Lang, W. C. Gertz and others. The company will build a line from the Casino at Toledo to the Michigan line. At the former point it will connect with the Toledo Railways and Light Company.

The Northern Ohio Traction and Light Company has ordered five new passenger cars to be delivered this fall.

The Marion and Tiffin Traction Company has planned to begin work on July 1st. Offices have been opened in Bucyrus.

Preliminary surveys of the Toledo, Indianapolis and Southwestern have been completed and the engineers are now engaged in making estimates of the cost of construction over the different routes.

The committee on street railways of the Cleveland City Council has refused to recommend the Walker resolution, which provides that the franchises of the Cleveland Electric Railway Company should be extended in return for the sale of seven tickets for 25 cents. President Andrews, it is said, would oppose an ordinance of that kind, and it is thought that negotiations between the railroad officials and Mayor Johnson on the fare question have fallen through.

Power was turned onto the third rail of the Scioto Valley Traction Company from the power house at Rees' station on Saturday in order to get the machinery into working order. It has not been decided when the road will be put into operation.

A report is current that the American Railways Company, which owns the local lines in Springfield, has secured control of the Springfield-Xenia line and another from Xenia to Dayton.

The Niles Electric Company of Niles has been incorporated with a capital stock of $10,000 by F. W. Stillwagon, W. H. Smiley and others. O. M. C.

Indiana.

Indianapolis, June 27.—A movement is on foot to extend the Evansville and Princeton traction line to Petersburg. The new express and freight cars for the Evansville and Princeton electric lines have been received and put in service. They are 46 feet long and splendidly constructed. They have wide doors on each side near the end, making it convenient for the reception of freight.

The Northwestern Traction Company ran a car from Indianapolis to Crawfordsville on the 22d on a tour of inspection. Those in the party were Chauncy Eldridge of Boston, George Townsend, W. S. Reed, C. C. Reynolds, Howard Eldridge, Thomas Pittinger, Winthrop Smith, N. N. Moran and Colonel Clifton Wise.

The authorities at Peru have granted a 30 days extension of time to the Indianapolis and Northern Traction Company in which to complete its road to the city, the ravages of the flood and loss of bridges having made it impossible to complete the line in the specified time. It is now the intention to complete the line and have cars running by July 15th.

The commissioners of Huntington County have granted a 50-year franchise to the Portland, Montpelier and Huntington Traction Company. The company is to secure a private right-of-way and build its own bridges.

Work has been resumed by the Fort Wayne, Van Wert and Lima Traction Company. A part of the line will be in operation by September 1st. The road will parallel the Fort Wayne division of the Pennsylvania railroad.

Arrangements are being made by the Fort Wayne and Southwestern Traction Company to transfer its property to the Fort Wayne and Wabash Valley Traction Company on July 1st. Under the new management the Indiana Union Traction Company will be in control.

The report that the Electric Company of America had purchased the Muncie, Hartford City and Fort Wayne traction line, now operating between Muncie and Bluffton, is denied by Manager Isaac Schlesser. The Electric Company of America recently bought the Muncie Electric Light and Heating Company's plant, paying $500,000 therefor.

The annual report of the Richmond Electric Light Commission for the fiscal year ended May 31st has been filed with the City Council. The net loss of the plant for the year was $8,288.96, not including

interest on bonds or depreciation. The expenditures include the amount expended in new construction, $15,246.39. Without this item the plant earned $6,957.43, not including depreciation and interest. The total receipts were $40,175.44 and the total expenditure $40,964.40. F.

Northwestern States.

Minneapolis, June 25.—The Stillwater (Minn.) Gas and Electric Light Company is having plans prepared for a new power house, which will be erected shortly.

The Chisholm (Minn.) Light and Power Company has been incorporated with a capital stock of $20,000. N. Anderson of Virginia, Minn., heads the list of stockholders.

An election will be held to pass upon $10,000 worth of bonds for an electric-lighting plant at Royalton, Minn.

The Winona (Minn.) Railway and Light Company has been granted a 25-year franchise.

A company has been organized at Green, Iowa, to start an electric-light plant.

Plans are being prepared for a municipal electric-light plant at Spring Valley, Wis.

The Clinton (Iowa) Gas Company will build an addition to its plant for the purpose of furnishing electricity for the State Electric Company for the street-car line. The contract has already been made.

The proposed trolley line from Oskaloosa, Iowa, to Buxton will be extended from the latter place to Albia, Iowa.

Grundy Center, Iowa, has voted a three per cent. tax for an interurban electric-railway to that place from Marshalltown.

The street-car system at Cedar Rapids, Iowa, will be extended to Linwood Cemetery and Elm Park. Plans are also being prepared for new car barns.

The Davenport (Iowa) and Suburban Railway Company will build a line to Offermann's Island.

The Iowa City (Iowa) Electric Company has been awarded a five-year contract for street lighting in that city. R.

Rocky Mountain States.

Salt Lake City, June 24.—A consolidation of the Bonanza Land, Power and Light Company, the American Falls Power, Land and Light Company and the Tarbet Company, all operating at American Falls, Idaho, has been effected, and articles of incorporation of the Idaho Consolidated Power Company have been filed under the laws of the state of Wyoming, with a capital stock of $2,000,000. The power available by this company is practically without limit, and will not only be distributed throughout Southern Idaho, but transmission lines will be operated as far as Montana and Utah. Improvements of note will immediately be inaugurated in the plants, which are already furnishing electrical energy to numerous Idaho cities. The officers of the corporation are: President, A. H. Tarbet of Salt Lake City; general manager, J. H. Brady of Pocatello; treasurer, D. W. Stanrod of Pocatello; secretary, W. S. Chaney.

New reservoirs are being built by the Reno Power, Light and Water Company at Reno, Nevada, at a cost estimated at over $50,000. The larger of the reservoirs will have a capacity of 60,000,000 gallons. The company has in view the issuance of bonds to the amount of $750,000, this amount to be expended for improvements and extensions in the system. A site for a third reservoir of a still larger capacity has already been purchased by the company.

Articles of incorporation of the Crane Falls Power, Transportation and Development Company of Boise, Idaho, have been filed in Boise. The capitalization is $5,000,000.

An electric-light plant to supply electrical energy at Richfield, Utah, will be constructed in the near future. Thomas Brown of that city is the chief promoter of the enterprise.

At a recent meeting of the Washoe Power and Development Company, held at Reno, Nev., it was decided that all necessary machinery and equipment for the plant would be ordered upon receipt by the directors of the report of the electrical engineer. The plant, it is expected, will be in operation within six months. G.

Pacific Slope.

Seattle, Wash., June 23.—The money for the construction of an electric railway from Bridgeport, Wash., on the Columbia River, to Waterville, Wash., has been subscribed and construction will be rushed. The proposed line will be approximately 100 miles in length. Power for operating it will be generated from the Chelan River. J. T. Sullivan is the principal promoter.

The Puyallup Light and Water Company of Puyallup, Wash., is contemplating the expenditure of $20,000 in extensions and improvements.

The City Council of Ashland, Ore., is wrestling with the question of a new contract with the Ashland Electric Light and Power Company for lighting the city. Manager Steel has submitted a proposition to the city on a basis of the municipality furnishing the wires and lamps, which would mean an expenditure of $2,500.

The City Council of Northport, Wash., has refused the request of E. K. Henry, lessee of the Morrill waterpower, for a contract for lighting the town. Mr. Henry states that construction of the $50,000 power plant will continue just the same, as the town lighting would require only a small portion of the power they expect to develop.

The Snohomish County (Wash.) commissioners have granted a trolley franchise to P. J. Farley, as trustee, for a trolley line from Everett northward to Skagit County, going by the way of Silvana, Florence and Stamwood. This line will connect with the Seattle and Cherry Valley line at Everett. Its northern terminus will be Mount Vernon. P.

PERSONAL.

Lieutenant G. C. Sweet of the United States Navy has been assigned to special duty at Cavite, in connection with space telegraphy.

Paul M. Mowry, vice-president, and C. W. Wheelock, general manager of the Engineering Company of America, were in Chicago this week.

J. C. McQuiston, the recently appointed superintendent of the Westinghouse Companies' Publishing Department, paid a short visit to Chicago last week.

G. F. Mansell has resigned as general auditor of the Appleyard system of electric railways at Columbus, Ohio, and will probably enter business for himself as an expert auditor and accountant.

S. P. Grace, chief engineer of the Central District and Printing Telegraph Company of Pittsburg, has been made the recipient of the honorary degree of master of engineering conferred by the University of Michigan.

A. H. Kreitler, general manager of the Moline Incandescent Lamp Company of Moline, Ill., was in Chicago early in the week. Mr. Kreitler runs a well-equipped lamp factory in Moline, and he reports that business is excellent.

J. A. Walker has resigned the presidency of the Central Light, Heat and Power Company of Rockford, Ill. The company intends making a number of improvements, including the installing of several large generators and two 500-horsepower boilers.

Irving Seaman, who until recently has been employed in the experimental laboratory of the Electric Storage Battery Company in Philadelphia, is now connected with the sales department of that company in the Chicago office. Mr. Seaman is a graduate of the electrical engineering department of the University of Wisconsin.

Mrs. Hunting, wife of Mr. F. S. Hunting, sales manager of the Fort Wayne Electric Works, died at the Hotel Windermere, Chicago, on June 26th. The deceased lady, who had been in failing health for several years, is survived by her husband and three young sons. The funeral services were held at Fort Wayne. Mrs. Hunting was a most estimable lady, and the bereaved husband and family are the recipients of the warm sympathy of their friends.

T. T. Lyman, manager of the asbestos department of the H. W. Johns-Manville Company of New York, was presented a beautiful silver loving service by the New York League of Heat and Cold Insulation as a token of the high esteem in which he is held by his fellow-members for his efforts in their behalf during the trying times in the building trades during the last year. Mr. Lyman is chairman of the executive committee of the league, which represents the steam-pipe and boiler-covering industry of this country and which held its first annual dinner in New York recently.

C. M. Swift of Detroit, president of the electric-railway and light company of Manila, P. I., has returned from a visit of inspection of the electric line. He says that 38 miles of electric road has been built where formerly a horse tramway was operated, the only other mode of transportation being by two-wheel vehicles. The capital of the company is $5,000,000, of which $3,500,000 has been spent in the construction of the road. Other Detroit men interested in the Manila enterprise are John T. Nichols, William J. Gray, Truman H. Newberry, Colonel Hecker and J. H. Avery.

The death is reported at Berlin on June 16th of Charles M. Stebbins, one of the pioneers of the telegraph west of the Mississippi River. Mr. Stebbins was born in 1829, and he constructed lines from St. Louis via Syracuse and Springfield, Mo., to Fort Smith, Ark., and from St. Louis via Kansas City, Leavenworth and Omaha to Julesburg, Nebraska Territory. Robert C. Clowry, the present head of the Western Union Telegraph Company, served under him as superintendent of the St. Louis and Missouri River Telegraph Company, of which Mr. Stebbins was president.

A. M. Mattice, chief engineer of the Allis-Chalmers Company, has returned from his European tour of inspection, and has now settled down to the duties of his position in Milwaukee. While in Europe Mr. Mattice visited the hydraulic machinery works of Escher, Wyss & Co. of Zurich, and arranged important details concerning the manufacture in the United States of their lines of product. He also inspected the Nuremberg Gas Engine Works at Nuremberg, and at the well-known engineering establishment of Willans & Robinson, at Rugby, England, he paid particular attention to the products and methods of manufacture of the Steam Turbine Advisory Syndicate, of which important organization Allis-Chalmers Company is the American member. Mr. Mattice had several important consultations in London with Mr. Yarrow, the famous torpedo-boat builder, on the subject of turbines for marine purposes, and while on the Continent he made, in the Allis-Chalmers interests, a series of exhaustive tests of the Zoelly steam turbine, of which so much has recently been heard. The results of Mr. Mattice's European visit of inspection will be awaited with a good deal of interest by American engineers.

ELECTRIC LIGHTING.

The power house of the Vicksburg Railway and Light Company, Vicksburg, Miss., suffered a loss of about $5,000 recently by the blowing out of the main generator.

At a recent election the city of Aberdeen, Miss., voted a bond issue of $70,000 for the construction of an electric-light plant and a system of waterworks and sewerage.

The Galesburg Railway and Light Company of Portland, Me., with capital stock of $1,500,000, has been licensed to do business in the state of Illinois, with a capital of $100,000.

An electric-light plant and a telephone system are to be installed at once at Booneville, Miss., by the Citizens' Electric Light and Telephone Company, which was recently organized.

The National Electric Light and Power Company of Trenton, N. J., has increased its capital from $10,000 to $4,000,000, divided equally into common and six per cent. preferred stock.

The Morrisonville (Ill.) Electric Company has been incorporated with a capital of $6,000 to operate a heat, light and power plant. The incorporators are William Lewis, J. F. Lewis and others.

The City Council of Wayne, Neb., has authorized the city electrician to receive bids for the purchase of a new dynamo and engine and also to prepare plans for the other proposed improvements to the plant.

Providing insulation sufficient to withstand lightning which may strike the wires is held, in a recent case in Arizona, not to be within the obligation of an electric-lighting company in carrying its wires into a building for the lighting of which it has contracted to furnish electricity.

The Commonwealth Electric Company has made its first payment of compensation to the city of Chicago under its 50-year franchise. The amount is $38,972.97, this being three per cent. of the gross receipts from operation of the plant for the year ended May 31st, the sixth year of operation. Under the terms of the ordinance, compensation for the city did not begin to run until the sixth year and for the rest of the 50 years, which expire in 1947, it is to be three per cent. a year.

The Moscow Electric Light and Power Company of Moscow, Idaho, has secured a 10-year contract from the city of Genesee for lighting the streets and pumping the city water, and will put in a substation in that town, taking current from the new transmission lines being run to Moscow by the Lewiston Water Power Company. It is expected that the line will be complete to Genesee before September 1st and to Moscow October 1st. Power is being transmitted at 22,000 volts over a 60-mile line from Asotin, Wash.

ELECTRIC RAILWAYS.

J. F. Turk of Hammondsport, N. Y., is in New York city for the purpose of negotiating for the construction of the Hornellsville and Branchport (N. Y.) trolley line.

Belmar and Spring Lake, N. J., will shortly be connected by a trolley line. This line will complete a circuit of the tracks between Trenton, Lakewood, Asbury Park and the beach resorts adjacent.

The Louisville and Interurban electric-railway system of Louisville, Ky., is now making extensive additions to the lines in and about the city. Part of the new lines will open about August 1st.

An increase in capital stock from $50,000 to $300,000 has just been made by the Springfield, Lincoln, Bloomington, Pekin and Peoria electric railway of Bloomington, Ill., recently incorporated.

Sixty-one motormen on the South Orange (N. J.) division of the Public Service Corporation's trolley system have signed a petition asking for improved facilities for stopping the cars upon steep grades.

Work on the Freeport and Dixon (Ill.) interurban railway will be begun soon. It is estimated that the company will spend over a million dollars to make the interurban line one of the best electric railways in the state.

The Russian Ministry of Communications is considering a project of establishing electric traction on the Oranienbaum portion of the Baltic railroad. The trains, which are now composed of 16 or more cars, will be of smaller size, three or four cars only, but they will leave the station every three or four minutes. There are many other railroad lines in the

vicinity of the two Russian capitals, where such an improvement would be of great importance.

The St. Joseph Interurban Railroad Company of St. Joseph, Mo., has been chartered, with a capital stock of $100,000. The incorporators are George C. Simms, Alice Butler, Samuel F. Moore, James E. Patrick and John J. Lea.

The automobile collision at Austin Avenue, Chicago, in which Mr. and Mrs. George E. Dixon of LaGrange, Ill., lost their lives by being struck by a swiftly moving train on the Aurora, Elgin and Chicago third-rail electric railway, has caused the City Council to order prepared an ordinance providing for elevating the tracks of the electric line within the city limits.

The proposed new electric railway from Steubenville to Canton, Ohio, will pass over the picturesque old stage-coach line that became famous in the annals of the early history of Ohio, crossing the original home of the red men on the banks of the "Tuscaroras" River. The route is perhaps the most feasible in Ohio, as it follows a gradual rise in the country from the river to Canton, its terminus, being almost a direct route from the river to the interior of the state.

A scheme for a great triangle of electric railway in Washington contemplates the building of a belt line of railways from Spokane to the mouth of the Spokane River at its junction with the Columbia, and up the Columbia River through the wealthy Fruitland, Hunter Creek, Meteor and Daisy districts to Kettle Falls, thence back on the third leg of the triangle through the Colville valley farming and mining districts to Spokane, thus forming a complete triangle, with a magnificent waterpower at each of the three points—Spokane, Kettle Falls and at the mouth of the Spokane River—with nearly equal distance between the power points.

The construction and operation of an electric street railway in St. Augustine, Fla., seems to meet with popular approval, provided the city shall be properly safeguarded. A joint meeting of members of the council and citizens was held recently and was well attended. The proposed ordinance was read and discussed. The company asks for a franchise covering 30 years, at the expiration of which time the city shall have the right to buy the plant at what may then be its appraised value. This franchise is to cover an electric street railway, belting the town, with branches into New Augustine, North City and South Beach. It also gives the right to supply electricity for commercial use.

The long controversy incident to the discussion of a franchise granting the Illinois Central Traction Company the right to operate electric cars in Springfield, Ill., has come to a close by the passing of an ordinance granting the company permission to run its cars over the tracks of the Consolidated Railway Company for a period of 50 years. Mayor Devereaux, who refused to sign the perpetual franchise passed some time ago, and which failed of passage over his veto, has signed the 50-year grant and the company has also accepted it. Only a few connections were necessary to be made to allow the interurban cars to enter the city at once. The cars will run from Springfield to Riverton, Woodside, Chatham and Auburn. For the present power will be furnished by the Consolidated company until the interurban company completes its power house at Riverton.

In a few weeks, says the Los Angeles Record of recent date, announcements will be made of a reorganization of the Harry E. Huntington electric railway companies of Southern California, whereby all of the several present companies will be merged into two corporations—one the Los Angeles Railway Company, to own and operate as it does now the distinctly urban lines, the other the Pacific Electric Railway Company, to hold all of the interurban railways in Los Angeles and other cities. The new Pacific Electric Railway Company will have a capital of $50,000,000 with which further extensions of the railroad will be made. The present Pacific Electric company was formed with a capital stock of $10,000,000, which later was increased to $20,000,000, and the Interurban company has a capital stock of $10,000,000. To this combined capital will be added another $20,000,000.

Mayor W. W. Pearce of Waukegan, Ill., has signed the ordinance recently passed by the City Council granting to the Chicago and Milwaukee Electric Railway Company a perpetual franchise over a proposed route through the west side of the city on the terms asked by the company. The action of the council was bitterly opposed by many taxpayers and is said to have been taken after the city attorney had advised the aldermen that the interests of the city were left unguarded.

AUTOMOBILES.

The postal authorities in Paris are about to put in service a number of electric motor vans for the rapid conveyance of the mails between the postoffices and the railway stations. The vans are designed to carry a load of 1,200 pounds at a speed of about 12 miles an hour, as compared with the eight miles attained by the horse-drawn vehicles. The vans are equipped with a battery of 44 accumulators, one charge of which will enable the vehicles to cover a distance of about 25 miles.

At a recent meeting of the Farmers' Horse-thief Detective Association of Montgomery County, Ind., held at Crawfordsville, many Indiana farmers asserted that frequent runaways result from the appearance and noise of the automobiles. Among other resolutions the following was passed: "Resolved, That we band ourselves together for the protection of ourselves and families, and if civil measures should fail to afford resonable protection, we may feel compelled to resort to harsher methods. Let the offenders take warning."

PUBLICATIONS.

A circular from the Foos Gas Engine Company of Springfield, Ohio, is devoted entirely to "Some Significant Facts" about Foos gas engines. This is somewhat different to the ordinary circular, there being no attempt made to describe the apparatus. Only the points of advantage of the engine are pointed out, and in themselves these make quite a formidable array.

The Bullock Electric Manufacturing Company of Cincinnati, Ohio, in a bulletin on multiple-voltage speed control, describes in detail the system which it now has upon the market. Illustrations of the balancing sets, controllers and applications of the motors to machine driving are freely interspersed with the reading matter, which describes clearly the theory and operation of the system. Another bulletin describes multipolar motors and generators.

Stationary and portable motor-driven air compressors for continuous and intermittent service are described in the latest bulletin from the National Electric Company of Milwaukee. In general appearance, as illustrated in the bulletin, these compressor sets are extremely neat and compact. They are provided with automatic governors, and some of the types are water-jacketed. Portable types are also shown, consisting of a compressor complete, with cover, mounted on a truck together with the storage cylinders.

Copies of a second and enlarged edition of "Il Radio ed il Selenio," a brochure in Italian, published at Turin, have come to hand. The Italian text and its supplement are the work of Signor Adolfo Hess, who has based the first part of the work on Mr. W. J. Hammer's recent publication on this subject. The first edition appeared last December, and the preface to the second edition is dated April. The work, which runs to 86 pages, gives full credit to the several American workers in the field of radioactivity, and includes an exhaustive bibliography, citing no less than 218 works.

TRADE NEWS.

The Reading Electric Company of New Jersey has filed a certificate of dissolution.

Alvin Etheredge, who has invented an electrical appliance for indicating the amount of water in a boiler, contemplates establishing a plant at Saluda, S. C., for the manufacture of his device.

A new corporation, to manufacture electric elevators, etc., has been organized at Rochester, N. Y. This is the Ricker Manufacturing Company, with the capital of $25,000, and a directorate which includes Wentworth C. Ricker.

For the 11 months ended May 31, 1904, the value of electrical machinery exported from the United States to Japan was $715,057. For the corresponding period ended May 31, 1903, like exports were valued at $426,562.

Sealed proposals will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until three p. m. on July 26, 1904, for the installation of a conduit and electric-wiring system for the United States Court House and postoffice at Salt Lake City, Utah, in accordance with the drawings and specifications, copies of which may be obtained at the above office, or at the office of the superintendent of construction, Salt Lake City, Utah.

The Crocker-Wheeler Company announces that it has retained the firm of Dodge & Day, engineers of Philadelphia, whose services will be placed at the disposal of the customers of the company. These engineers will give expert advice upon shop practice as well as purely engineering advice upon the design and installation of electrical apparatus for shop equipment. The advice and recommendations about which Crocker-Wheeler customers may consult Dodge & Day need not be confined to electrical details, but may include all problems of shop equipment and management.

BUSINESS.

The Westinghouse Companies are sending out a handsomely engraved invitation to visit their exhibits at the Louisiana Purchase Exposition.

Hall L. Brooks, the widely known cedarman of Tomahawk, Wis., was in Chicago last week in the interest of his constantly growing business. Mr. Brooks says that so far this year he has done as much business as he did during the whole of 1903, and the prospects for future business are exceedingly bright. Mr. Brooks recently closed several large orders for poles in the western states.

The George H. Smith Steel Casting Company of Milwaukee has placed an order with the American Electric Fuse Company of Chicago to equip its entire plant with Allen-Bradley electric crane controllers. Thirteen controllers will be installed for use with the four Pawling & Harnischfeger cranes used by the George H. Smith Company. The American Electric Fuse Company states that it guarantees every Allen-Bradley controller for one year, and will give three months' free trial to intending purchasers, guaranteeing satisfaction.

A representative of the Western Electrician recently visited the factory of the Speer Carbon Company at St. Marys, Pa., and found the company's business in a flourishing condition. Vice-president and General Manager J. S. Speer states that during the last two months the company has done a better business in Speer carbon brushes than during any like period since the company's organization. The Speer self-lubricating brushes are now known wherever electrical machinery is used; the company's export business has grown to a surprising degree. The success of the Speer company, it is safe to say, is largely due to its devoting itself to a specialty. Mr. Speer is actively interested in St. Marys' industries. Among other things he has built up an electric-lighting service that is a credit to the city. This lighting plant is driven by gas engines and is a model of its kind.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued (United States Patent Office) June 21, 1904.

762,881. X-ray Apparatus. William B. Churcher, Cincinnati, Ohio, assignor to Kennon Dunham, Cincinnati, Ohio. Application filed April 11, 1904.

A secondary coil supplies current to the generator. A primary coil induces a current in the secondary, and an electrolytic cell has an electrode adapted to freely pass current of one polarity and to resist the passage of current of opposite polarity. Another electrode exposes a restricted surface to the electrolyte to interrupt the current. (See cut on following page.)

762,927. Composite Incandescent-lamp Bulb and Reflector. Otis A. Mygatt, New York, N. Y. Application filed January 29, 1904.

Combined with a lamp bulb having its upper body of reduced diameter and carrying the exhaust seal on this reduced part is an external reflector having its lower edge resting on the body of the bulb, and covering the exhaust seal, the reflector forming a symmetrical continuation of the enlarged portion of the lamp bulb.

762,957. Partial Circuit for Electric Currents. Guion Thompson, Duluth, Minn., assignor to the Thompson Safety Appliance Company. Application filed August 2, 1902.

In a normally open electric circuit is included an electromagnet and a normally open circuit-controlling contact. An armature for the magnet is adapated when operated to close the contact. A partial circuit comprises a normally open circuit-controlling contact governed by the armature, and conductors extending from the opposite points of the contact and provided at their outer ends with normally open contacts.

762,988. Electrical Drive for Centrifugals. William L. D'Olier, Philadelphia, Pa. Application filed November 9, 1901.

The fixed element of the motor is supported by a frame and a hollow shaft is rotatable on a fixed shaft and operatively connected to the rotatable element of the motor.

762,993. Circuit Interrupter for Jump-spark Coils. Charles H. Fischer, Cincinnati, Ohio. Application filed April 11, 1904.

An electromagnet and vibrator spring are associated with an internally and externally threaded slitted sleeve having a tapered end. An adjusting screw for the spring screws into the sleeve, and a nut screws over the sleeve, the nut having an inner face taking against the tapered end for clamping the screw in the sleeve. (See cut on following page.)

762,997. Railway Switch-operating Apparatus. Marquis D. Hanlon, Wilkinsburg, Pa., assignor to the Union Switch and Signal Company, Swissvale, Pa. Application filed October 8, 1903.

An electric motor controllable from the switch tower moves the switch.

763,002. Electric-lighting Apparatus. William Knobloch, New York, N. Y., assignor to John Knobloch, New York, N. Y. Application filed October 1, 1903.

In an apparatus for electric lighting is a suitable support or base of non-conducting material having an electric heater embedded therein and provided with a reflecting surface. Glowers are mounted at intervals adjacent to the surface.

763,011. Signaling Device for Pasteboard-making Machines. Otto Mietaschk, Görlitz, Germany. Application filed December 28, 1903.

An electric bell and a dial signaling device are brought into circuit by an arm connected with the winding

mechanism of the machine to indicate the amount of the material wound.

763,016. Ball-bearing Trolley Wheel. James A. Norton, Wilkesbarre, Pa., assignor of one-half to W. L. Raeder, Wilkesbarre, Pa. Application filed October 22, 1903.

In a trolley arc combined a harp, a separable ball-bearing wheel having a flange rotatably mounted on each arm of the harp and a removable middle section connecting the flanges.

763,026. Apparatus for Treating Sewage. William J. Schweitzer, Whiteplains, N. Y. Application filed July 31, 1903.

Apparatus for treating sewage and other fluids, comprises a receiving chamber, an electrolyzer, a skimmer, a grease tank for receiving the material after it leaves the skimmer and a settling chamber in communication with the grease tank. Comb-like electrodes are used in the electrolyzer.

763,031. Electric-motor Controller. Walter N. Vance, Chicago, Ill., assignor to the Miehle Printing Press and Manufacturing Company, Chicago, Ill. Application filed June 29, 1903.

Combined with a rotatable contact-bearing drum are opposing contacts disposed alongside of the drum, one of which is hinged or pivoted and arranged so that its contact-making part may swing out of apposition or position of possible contact with its corresponding rotatable contact on the drum. Means such as a spring tend always to swing the hinged contact-making part out of apposition, and the magnet is adapted to hold the part in apposition.

763,046. Pneumatic System of Motor Control. Fred B. Corey, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed December 5, 1902.

Pneumatic means actuate the controller and also the reversing switch. Two pipes are operatively connected to the controller and reversing-switch-actuating means. A device admits compressed fluid to one of the pipes to operate the reversing switch and also for admitting compressed fluid to both of the pipes to operate the controller after the reversing switch has been operated.

763,047. Motor-control System. Fred B. Corey, Schenectady, N. Y., assignor to the General Electric Company. Application filed December 5, 1902.

A step-by-step mechanism in the controller is actuated by compressed air.

763,054. Gas Regulator. George T. Gamble, Grand Rapids, Mich. Application filed May 5, 1903.

Electromagnets are arranged to regulate the flow of the gas through a chamber by a cup-shaped device.

763,071. Motor-control System. Charles L. Perry, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed July 22, 1903.

A motor controller is made up of a number of separate pneumatically-actuated contacts, a valve or valves for controlling the successive admission of compressed air to the actuatiog means for the contacts, and means for operating the valve or valves so as to produce an automatic acceleration of the motor. (See cut.)

763,082. Telegraph Transmitter. Joseph F. X. Trotier, Montreal, Canada. Application filed July 29, 1903.

The mechanical parts are described.

763,108. Electric Brake. Frank C. Newell, Wilkinsburg, Pa., assignor to the Westinghouse Air Brake Company, Pittsburg, Pa. Application filed April 1, 1902.

Associated with one or more generators, is a braking switch or controller adapted to connect up the generators in a braking circuit. A brake-magnet coil in the circuit and a ground connection for one end of the coil, the field outlets in the brakiog circuit being insulated from the ground, are the other features.

763,151. Process of Electrically Extracting Essential Oil. George D. Burton, Boston, Mass., assignor to the Boston Leather Process Company, Portland, Me. Application filed June 27, 1898.

A process of obtaining essential oil from bark or other vegetable matter consists in immersing the vegetable matter containing the oil to be extracted in a suitable menstruum, passing through the menstruum an electric heating current of such a voltage and amperage as will raise the menstruum to a temperature sufficieot to extract the oil, and condensing the vapors arising from the operation.

763,152. Apparatus for Making Extracts by Electricity. George D. Burton, Boston, Mass., assignor to the Boston Leather Process Company, Portland, Me. Application filed June 27, 1898.

The vegetable matter from which the oil is to be extracted is heated by an electric current, the vapor being condensed.

763,164. Apparatus for Determining the Length of Waves and Observing the Oscillations in Electric Oscillation Systems. Johannes Dönitz, Berlin, Germany, assignor to the Gesellschaft fur Drahtlose Telegraphie, G. M. B. H., Berlin, Germany. Application filed September 15, 1903.

An electrical measuring instrument consists of a closed resonator including a condenser, the capacity of which is slowly changeable, and a self-induction coil which may be interchanged with coils of greater or smaller self-induction. Means for adjusting the capacity of the condenser, and means for indicating as to wave-length the result of the adjustment are further provided.

763,168. Current Regulator. Justus B. Entz, Philadelphia, Pa., assignor to the Electric Storage Battery Company, Philadelphia, Pa. Application filed May 7, 1903.

A booster for a regulator comprises carbon operatively arranged in respect to the booster field to influence the booster to regulate the operation of the storage battery. Means responsive to variations in the circuit to be regulated change the pressure upon the carbon.

763,183. Ultra Violet-ray Electrode. Charles F. W. Horn, New York, N. Y. Application filed April 25, 1904.

A casing of insulating material is supplied with studs of conducting material set within the casing, two of the studs having prolongations at the exterior of the casing to form terminals for connection with the circuit. Means within the casing cause an electric discharge to pass consecutively through all of the studs.

763,223. Safety Device for Strong-current Overhead Conductors. Christian C. van der Valk, Voorburg, near The Hague, Netherlands. Application filed September 10, 1903.

A hanger for high-tension conductors is described which consists of a sort of pulley sheaf containing two pulleys, to which the two ends of a conductor can be fastened, making contact with the pulleys and with each other through the axle of the pulleys.

763,237. Electric-light Fixture. George H. Young, Elmira, N. Y. Application filed April 2, 1904.

A lining for canopies of electric-light fixtures comprises a conical shell of insulating material of substantially the same depth as the canopy and adapted to be inserted between the canopy and the circuit wires.

763,321. Storage Battery. Henry C. Porter, Waukegan, Ill., assignor to the Porter Battery Company, Chicago, Ill. Application filed November 25, 1901.

A battery plate comprises a grid filled with active material, inclosed within a metallic sheath and provided at its lower end with a shoe of non-conducting material.

763,322. Battery Plate. Henry C. Porter, Waukegan, Ill., assignor to the Porter Battery Company, Chicago, Ill. Application filed July 14, 1902.

A battery plate comprises a casing closed on all sides except on one edge, and formed with depressions at the open edge. An active material is arranged in the plate and also means adapted to co-operate with the depressions to close the plate.

763,330. Electric Furnace. Charles P. E. Schneider, Le Creusot, France. Application filed December 22, 1903.

Electrodes in a chamber are arranged to be lowered and raised and a pipe leading from and returning to the bottom of the chamber is adapted for circulating the molten metal. A transformer links the pipe and heats the metal.

763,332. Relay. Burdette S. Smith, Elyria, Ohio. Application filed February 14, 1903.

A primary circuit includes a magnet, an armature, a yoke and a non-conducting strip pivotally mounted within the yoke and extending over and under the contacts of the wires of the secondary circuit respectively. Conducting strips upon the pivoted non-conducting strip complete the circuits between the contacts of each of the first mentioned pairs.

763,345. Means for Tuning and Adjusting Electric Circuits. Ferdinand Braun, Strasburg, Germany. Application filed August 5, 1901.

The device comprises closed oscillation circuit, to which is added a piece of wire and a condenser for restoring the symmetry disturbed by the sending or receiving wire.

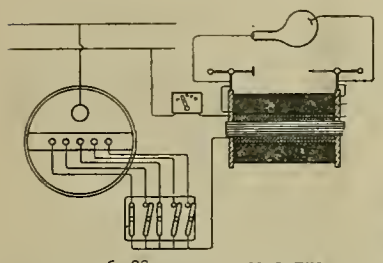
REISSUE.

12,232. Connection Counter for Telephone Exchanges. Charles E. Scribner, Jericho, Vt., assignor to the Western Electric Company, Chicago, Ill. Application filed May 25, 1904. Original No. 680,890, dated August 20, 1901.

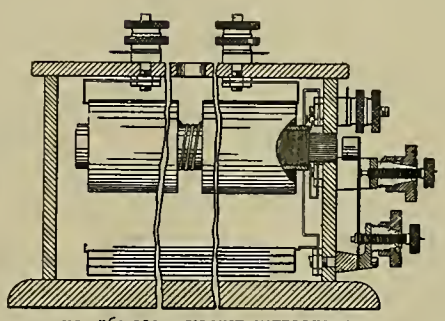
A service meter is associated with one of the lines and a supervisory relay is responsive to current in the other line determined by a telephone switch at the station of the line. A local battery circuit connected with a local contact piece of the springjack of the called line is closed through a registering contact piece of the plug in the springjack, and has two branches adapted to be closed alternately by the supervisory relay.

12,235. Recording Electrical Measuring Instrument. Edward Weston, Newark, and Adelbert O. Benecke, Vailsburg, N. J. Application filed August 6, 1903. Original No. 713,257, dated November 11, 1902.

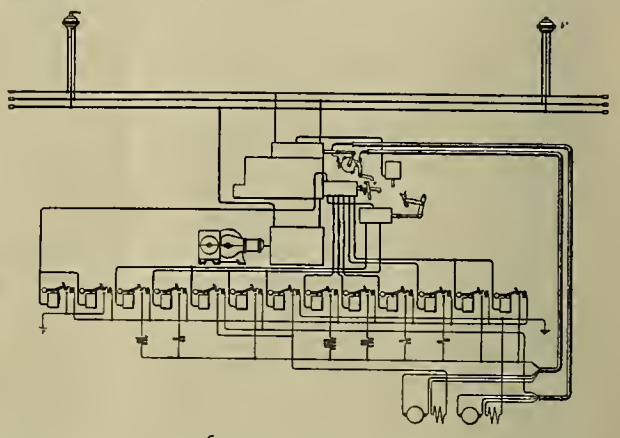
An electric motor having a rotary armature capable of making either a fractional part of a revolution or a number of revolutions in opposite directions, operates a recording instrument having a recording stylus operatively connected to the armature by means adapted to move it in a right line. Associated with this apparatus are circuits and circuit connections between the motor, the movable part of the measuring instrument and a source of electricity, whereby any substantial variation of movement imparted to the movable part will cause a permanent record of the nature and duration of the variations.



NO. 762,881.—X-RAY APPARATUS.



NO. 762,993.—CIRCUIT INTERRUPTER.



NO. 763,071.—MOTOR CONTROLLER.

EXPIRING PATENTS.

Following is a list of electrical patents (issued by the United States Patent Office) that expired on June 28, 1904:

365,384 Incandescent Electric Lamp. Philip O. Jenkins, Washington, D. C.
365,414 Hanger for Electric Lamps. Frederick Thomson, Montreal, Quebec, Canada.
365,493 Electric Alarm-clock. Max Stecher, Philadelphia, Pa.
365,495 Incandescent Electric Lamp. Edward T. Thomson, Elizabeth, N. J.
365,499 Incandescent Electric Lamp. C. Gustav Anderson, Hartford, Conn.
365,509 Filament for Incandescent Electric Lamps. Thomas A. Edison, Menlo Park, N. J.
365,553 Electric Arc Lamp. Elihu Thomson, Lynn, Mass.
365,585 Electrical Contact Changer. Daniel Davis, Jr., Boston, Mass.
365,639 Fire Extinguisher. Charles H. Shaffer, Rockford, Ill.
365,705 Printing Telegraph. George B. Scott, Brooklyn, N. Y.
365,726 Electric Circuit-testing Apparatus. George F. Bulen, Jersey City, N. J.
365,460 Electric Lighting of Railway Cars. Charles E. Buell, Springfield, Mass.

SPECIAL MENTION.

S. E. Thompson of Tenstrike, Minn., dealer in cedar poles, posts, ties, etc., asserts that he can save the consumer 10 per cent. because he is on the ground.

The Automatic Electric Company of Chicago announces that it has just been awarded contracts to install Automatic telephone systems in the cities of Battle Creek, Mich., and Van Wert, Ohio, replacing manual systems. The Citizens' Telephone Company of Grand Rapids, Mich., which replaced its manual exchange in that city with the automatic exchange last winter, is the owner of the Battle Creek system. The new automatic exchange at Battle Creek is to have a present installation of 1,000 instruments, with an ultimate capacity of 10,000. The Van Wert exchange is to have a present installation of 925 instruments, with an ultimate capacity of 10,000. The Automatic company furnishes complete central office and subscribers' equipment in each case.

A large variety of telephone apparatus is described in three bulletins coming from the Sumter Telephone Manufacturing Company of Sumter, S. C. One of the bulletins is devoted to Sumter Bullseye express boards and party-line switchboards, illustrating and giving circuits of each type. Subscribers' apparatus, with diagrams of connections, are shown in another of the bulletins, while the third discusses the apparatus in detail. Under "Pertinent Points" in the last bulletin are a few good hints on grounded telephone work, and the best method of making a good and permanent ground is described.

An interesting suggestion is contained in the following, dated June 23d, and addressed to the L. B. Allen Company, 1334 Columbia Avenue, Chicago: "Kindly enter our order for (blank) Allen soldering sticks, to be shipped us via express. We have been very successful in our work, using your make of stick, and lately have tried to procure it from general supply dealers, but somehow we have always received some other make which they claimed was just as good. Our experience has been to the contrary." The above was received from a leading electrical manufacturing and repair company and tells its own story.

WESTERN ELECTRICIAN

EVERY SATURDAY

Vol. XXXV. CHICAGO, JULY 9, 1904 No. 2

Electric Railway, Lighting and Heating Plant at Bloomington and Normal, Ill.

The Bloomington and Normal Railway, Electric and Heating Company of Bloomington, Ill., has within a year made some important additions to its equipment which bring the system up to the front rank among the central-station installations of the smaller cities. The plant furnishes commercial light, heat and power in the city of Bloomington, which has a population of over 24,000, and operates the street-railway system in that city, together with a short interurban line to the town of Normal, three miles distant. In addition to this the town of Normal and the State Normal School situated there are supplied with arc lights under contract.

In 1867 the first car line between Bloomington and Normal was built, and operated until 1890 by steam dummy engines and by horses. In the latter year electricity was adopted and the system was operated with a double-trolley, 250-volt equipment, until 1892, when the present single-trolley system was put in use. Twenty miles of street railway have been built in and between Bloomington and Normal. The lighting load consists of about 300 multiple arcs, between 8,000 and 9,000 incandescent lamps and a 70-light series-alternating - enclosed arc light system in Normal. The heating business has steadily increased and now amounts to 80,000 square feet of radiating surface. To supply power for all these purposes a plant of considerable size and flexibility is required, and the company has recently completed the enlargement and equipment of its station.

Figs. 1 and 2 are views taken in the engine room of the power house, showing the lighting and railway ends of the plant, respectively. The two large alternating-current generators shown at the left in Fig. 1 take care of the lighting load, and, together with the remainder of the electrical apparatus in the station, were built by the Westinghouse Electric and Manufacturing Company. The larger unit is composed of a revolving-field, 60-cycle, two-phase, 2,200-volt generator of 400-kilowatt capacity directly coupled to a 20 by 32 by 42-inch St. Louis Corliss cross-compound engine running at 100 revolutions a minute. The smaller unit delivers current of a similar character and is of 300-kilowatt capacity. The prime mover in the latter set is a compound 20 by 42-inch engine running at 100 revolutions a minute. All of the engines of the plant run non-condensing.

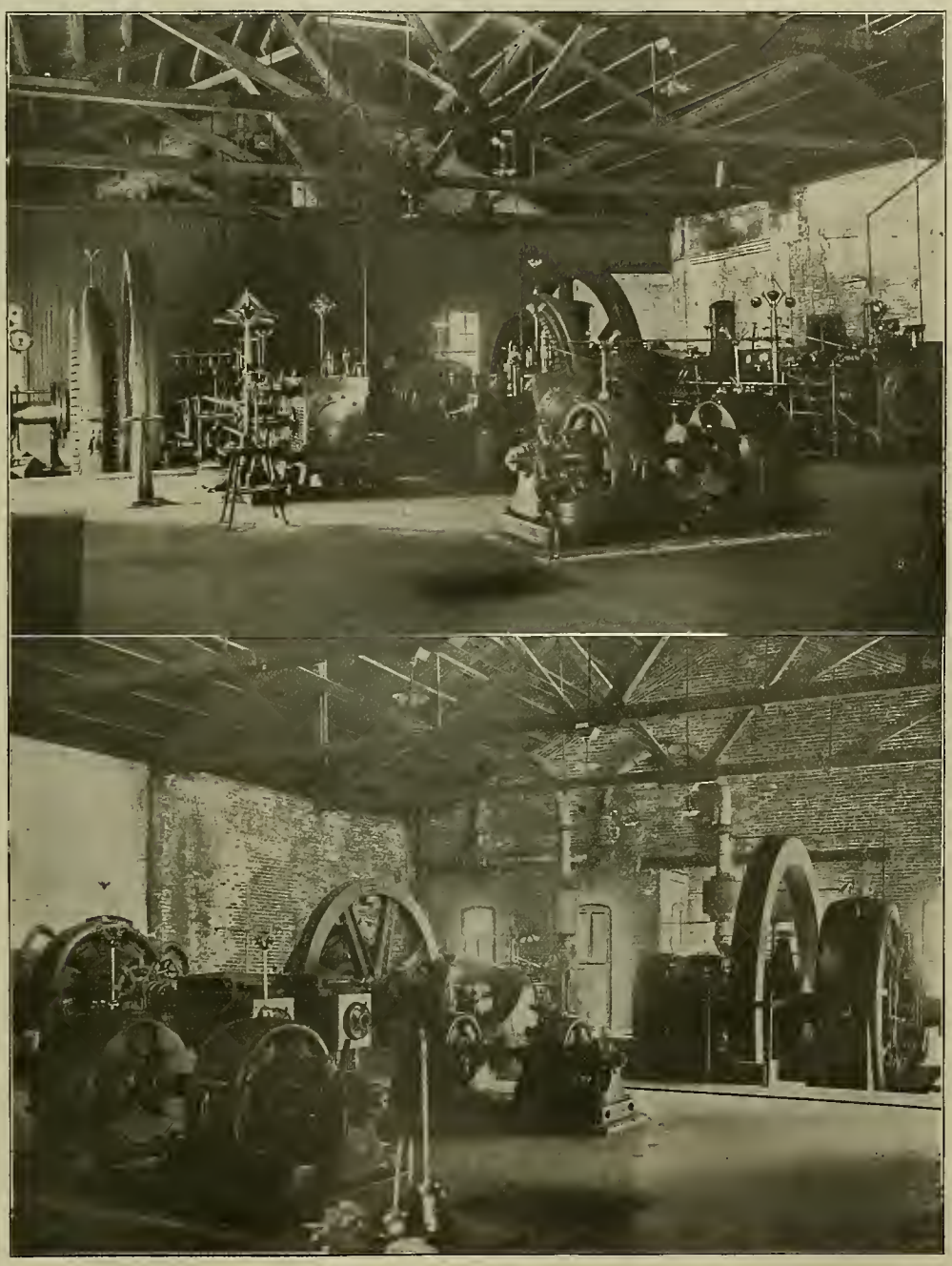


Fig. 1. Large Lighting Alternators and Induction-motor Exciting Set.
Fig. 2. Railway Generators, Rotary Converter and Exciter Sets.

ELECTRIC RAILWAY, LIGHTING AND HEATING PLANT IN BLOOMINGTON AND NORMAL, ILL.—VIEW IN ENGINE ROOM.

A 45-kilowatt exciter unit, shown in the foreground of Figs. 1 and 2 furnishes the necessary field current for the lighting machines and also for the railway generators. The generator of the exciting set is direct connected to a two-phase induction motor. In addition there is a reserve exciter of 22-kilowatt capacity direct connected to a 500-volt motor. This exciter is shown back of the first exciter in Fig. 2.

The two railway units are seen in Fig. 2. They are of 400 and 300-kilowatt capacity and are direct-connected to St. Louis engines and deliver direct current at 500 volts. As a connecting link between the lighting and railway systems a 170-kilowatt inverted rotary has been installed, which adds much to the flexibility of the station. This rotary is supplied with a double armature winding connected in the usual way with the direct and alternating-current circuits and operates in conjunction with two transformers shown in front of the rotary (Fig. 2).

At certain periods in the day it is found necessary to carry part of the railway load from the lighting generators. In that case alternating current at 2,200 volts is brought into the alternating-current side of the rotary and direct current is delivered to the railway system by the direct-current side of the rotary. The two transformers are used in that case to reduce the voltage of the alternating-current generators, which is 2,200, to the proper voltage for delivering to the rotary. When it is necessary at other times in the day to reverse this operation and assist the alternating-current machinery by the direct-current generators the direct-current side of the rotary is made to receive current from the railway generators, and the rotary then delivers alternating current through the transformers to the alternating-current system. The two transformers are of 75-kilowatt capacity each.

All cables from the generators are carried through conduits underneath the cement floor to the back of the switchboard. A front view of this board is shown in Fig. 3, and, as indicated in the picture, it is of an imposing appearance. The board was furnished by the R. Haas Electric and Manufacturing Company of Springfield, Ill., and is equipped with the latest design of instruments and switches. A view of the back of this board is shown in Fig. 4 and illustrates the neat and workmanlike manner in which the wiring has been done. Fig. 5 is a view of the side of the power house on which the cables leave the building for the pole lines.

Steam is generated by four Heine boilers, two of 400 and two of 300-horsepower capacity. They are hand-fired and there is storage capacity for 1,000 tons of coal. The stack is brick, octagonal in shape, 135 feet high, with an internal diameter of six feet six inches. Two feed-water heaters are installed in connection with the boilers of 400 and 600-horsepower capacity each.

Current generated by the station just described is used for three purposes, as already mentioned—that is, for the railway system, for power and for lighting. These three divisions of the load will be taken up separately.

The street-railway system includes in all 20 miles of track, which is located in Bloomington, Normal and between the two places. T-rail is used throughout in 30 and 60-foot lengths of three sizes—45, 60 and 70 pounds to the yard. The rails are bonded with solid copper bonds. Two sizes of trolley wire are used—No. 6 and No. 00 grooved. These are carried by white cedar, chestnut or steel poles as the conditions demand. Fourteen cars are regularly operated and 11 extras are ready for use at any time. There are also one rotary snowsweeper and one 3,000-gallon pneumatic steel street sprinkler.

Two 45-foot closed and two 14-bench open cars are used on the line running from Bloomington to Normal, according to the season. Besides these interurban cars there are two eight-bench open, 12 16-foot closed, six of miscellaneous styles and one 45-foot semi-convertible car, making up the total of 25.

The motor load carried by the station consists of 300 kilowatts in direct-current motors of 500 and 250 volts and 100 kilowatts in alternating-current motors. To obtain the 250-volt current, recourse is had to the inverted rotary already described. One of the features of this machine is that if a conductor be connected to the middle point of the secondary winding of the transformers which supply current to the rotary, it has been found that the difference of potential between this conductor and either of the direct-current brushes is equal to one-half of the difference of potential between the brushes. In this way 250 volts can be obtained from the 500-volt rotary.

Light is supplied for various purposes. There is a commercial lighting load of about 300 multiple arcs and 8,000 or 9,000 incandescent lamps, as previously mentioned. These are supplied from the alternating-current mains through pole transformers. Current for the incandescent lamps at Normal is transmitted at 2,200 volts and there stepped down to the voltage necessary at the lamps. Most of the distribution is done by pole lines, though the company owns a small amount of underground work in Bloomington. What few ducts there are are of tiling or creosoted wood.

The most interesting feature in connection with the lighting work is the 70-light, four-ampere, series-alternating-enclosed arc system of the Western Electric type at Normal, which supplies that town with street lights and also arc lights for the normal school. This system takes only four amperes of current and is one of the largest if not the largest of its kind in the West. The advantage of the four-ampere circuit is that for the same wattage a greater number of lamps may be burned, securing a more even distribution of lights.

Current for this system is transmitted from the power house to Normal over a transmission line which is three miles long. In a little transformer house at Normal, built in connection with the waterworks station, there are installed a 70-light, multi-circuit transformer, a switchboard and two 30-light regulators which are used for the series-alternating system. Fig. 6 is a view of the switchboard in this transformer house, showing also the ball and arm of one of the regulators. Fig. 7 is a diagram showing the connections of the system. The switchboard equipment includes primary and secondary fuses, two secondary snap switches for each circuit, two ammeters and a ground detector.

As indicated on the diagram, the two 35-light circuits are connected each with one limb to the regulator and one to the stab switches which are located on the board. The other terminals of the regulators are also connected to the switches. Lightning arresters are connected across each of the two lines. At a point between the regulators and the switches the two ammeters are connected through transformers. The connection of the transmission line to the board is shown at the top of the diagram. The ground detector consists of a potential transformer, in the secondary circuit of which is a detector lamp. One side of the primary circuit is grounded and the other side terminates in a movable point, which may be made to contact with any of four brass contacts which are connected, respectively, with the four wires of the two circuits leaving the station. If there is a ground on any line, of course, the lamp will light as soon as the contact point is moved into connection with the grounded line.

FIG. 5. CENTRAL STATION IN BLOOMINGTON, ILL., SHOWING WIRES LEAVING POWER HOUSE.

The lamps used on this system are supplied with one-half-inch carbons. This size was adopted because, although a three-eighth-inch carbon gives a little higher efficiency in the arc, the one-half-inch size lasts some longer, burning 100 hours. Two hundred and eighty watts is consumed at the terminals of the lamps and 245 in the arc. The voltage at the terminals is 80.

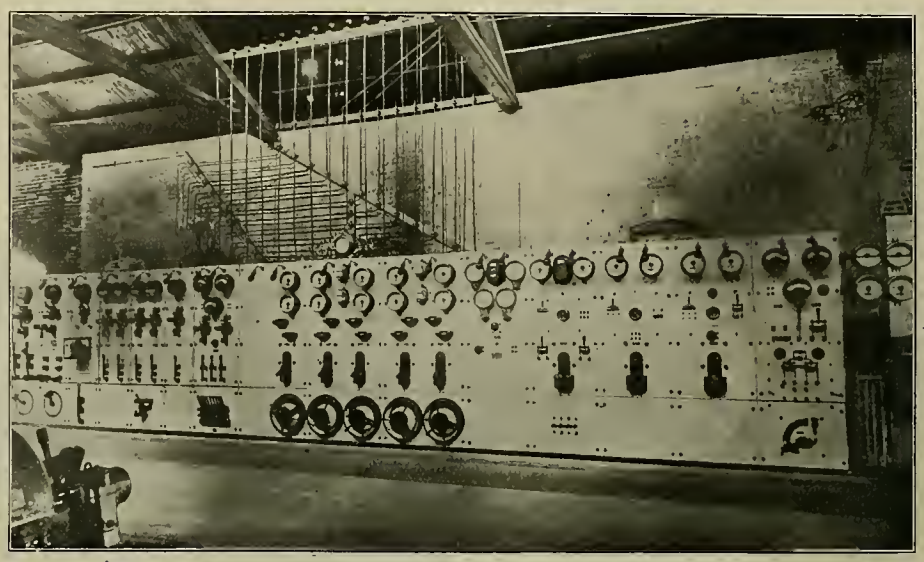


FIG. 3. FRONT VIEW OF SWITCHBOARD IN BLOOMINGTON CENTRAL STATION.

Heating forms an important item in the business of the company. The Yaryan hot-water system is used and now supplies 80,000 square feet of radiating surface. Eight heaters are necessary for this service—one large one containing within its casing 5,000 square feet of heating surface. Two duplex circulating pumps force the hot water out through

FIG. 4 BACK OF SWITCHBOARD IN BLOOMINGTON CENTRAL STATION.

the system. The main feeders from the heaters are 10 inches in diameter, and from this diminish in size down to seven inches and eight inches for the lateral mains. These iron pipes are laid in hemlock conduits. The bottom of these conduits is composed of three one-inch boards, with an air space of one inch between each board, which are held apart by side pieces of one inch thickness. The pipes are laid on this base and on each side are placed side pieces made up in the same manner, only not as wide; and over all is a top piece of the same construction. This method of laying the pipes has thus far proved satisfactory, as the amount of radiation loss in transmission has been found to be comparatively small.

Mr. A. E. De Mange is the president of the company and Mr. F. M. De Mange is manager of the heating and lighting departments. The superintendent of the power, lighting and heating departments is Mr. C. F. Snyder.

The electric fountain at Lincoln Park, Chicago, has been rebuilt and improved by the Chicago Union Traction Company and is again in use.

Influence of Electricity on Vegetation.

An interesting and at the same time an encouraging renaissance has lately been observed in various parts of Europe. This is the movement that has lately taken place—after many years of neglect—in favor of the application of electricity to agriculture, not only in the driving of all kinds of agricultural machinery, including the plow, but also in the influence brought to bear by electricity itself on vegetation and germination. In France quite recently the minister for agriculture sent to prefects and subprefects a circular instructing them to facilitate in every possible way the application of electricity to agricultural operations, and setting forth the advantages that agriculture and industry in general would derive therefrom. In Belgium still further progress has been made, as the interesting question of electricity in agriculture has been introduced into the university curriculum. The minister for agriculture has found the subject of sufficient interest for him to commission Mr. Guarini to devote to it at the Agricultural Institute at Gembloux a series of lectures on the questions we [says the London Electrical Review, from which this summary is taken] are about to enumerate.

We will not go into the description of the numerous experiments shown by the lecturer, nor into the contradictory results obtained by experimentalists in different countries. As to the latter, we will merely remark that the products obtained by electroculture are very abundant, very fine and very quickly matured. We will confine ourselves to the ideas put forward by Mr. Guarini, with special regard to his theories for the chemical and mechanical explanation of the satisfactory results obtained by the application of electricity to vegetation. For the last 40 years, particularly since the researches of the German scientist, Sachs (1865), our ideas with regard to vegetable physiology have been fairly definite. We can now easily explain to ourselves the function of each part of the plant, the raison d'être of each organ and of its form. Moreover, we know a great deal about the function of chlorophyll, in particular of what it consists, and what it requires to stimulate its production and to render it more active. But, on the other hand, we are completely in the dark as to how and by what means carbonic acid is decomposed in chlorophyll into carbon and oxygen.

Mr. Guarini asks whether in these days, where so many things are explained by electricity, we are not justified in thinking that plant life also is based on electrical phenomena; he asserts that this is so. In the first place, he remarks that contrary to what is believed and taught, it is not electricity that can be substituted for light in certain cases in the accomplishment of the function of chlorophyll, but the light of the sun and of arc lamps, with its electrical radiations, that can be substituted for purely electrical treatment. We have the best proof of this statement in the folowing experiment:

A plant placed in a pot which is enclosed in a metal cage (a Faraday cage) dies, although it is exposed to the sunlight. This, says Mr. Guarini, is because the plant is deprived of the indispensable influence of atmospheric electricity, and particularly of the electric radiations of the sun. On the other hand, if a plant is placed in absolute darkness it can produce much finer and more abundant fruit in less time than under natural conditions if judicious electrical treatment is applied to it. With regard to the experiment with the Faraday cage, for the plant to die it must be in a pot completely surrounded by the metal cage. When the plant is in the earth, although we suppress the influence of the solar radiations and of the current going from the atmosphere to the earth, we do not completely suppress that which passes from the earth to the atmosphere. Every time it rains, hails or snows, for instance, the potential of the earth changes from its usual negative nature to positive.

Mr. Guarini reminds us that in the Faraday cage

we have no charge inside if we have one outside, but we get one outside if we have one inside. When a plant is placed in the earth and surrounded by a metal cage it does not completely perish, but, as Messrs. Grandeau and Leclerc's experiments have shown, there is a diminution of 50 to 70 per cent. in the leaves and stalks, and 50 to 60 per cent. in the seeds and fruits, as compared to what it bears when there is no cage.

After this introduction, Mr. Guarini explains as follows the influence of electricity on the principal vital functions of the plant, i. e., nutrition, respiration and transpiration.

Nutrition.

1. Aerial Nutrition.—The current which passes through the plant from the atmosphere to the earth, or vice versa, decomposes the carbonic acid in the chlorophyll into carbon and oxygen. Mr. Guarini then performs the following experiment: He injects carbonic acid into a vessel of water from which proceed two electrodes connected with a current of 110 volts. There is at once a deposit of carbon on one of the electrodes. He announces, moreover, that he has obtained formic aldehyde in collaboration with Dr. Samarani of the Agricultural Institute at Gembloux. Special conditions of voltage and amperage are required for this. All this is perfectly in accordance with the experimental results obtained by the Russian, Walther, in his experiments on the synthesis of sugars by electrolysis, in which the original material consisted of carbonic acid.

2. Nutrition in the Earth.—The currents which pass through the earth whether natural (earth currents) or artificial (generated by batteries, accumulators, dynamos, etc.) decompose the chemical substances found in the earth or added to it in order to form nourishment more easily assimilated by plants.

3. Distribution of Aliments.—Mr. Guarini pointed out that in arc lamps on the one hand and electrolysis on the other, material was conveyed from the positive to the negative pole; he also referred to the experiments of Prof. Lemström of the University of Helsingfors, who was able to make water rise in a capillary tube immersed in a basin in which was placed the positive pole of a static machine, the negative pole of which was connected with a point touching the upper part of the capillary tube. When, therefor, the potential of the earth is positive or rendered so artificially, and the potential of the atmosphere is, above the plants, rendered negative, the current which goes from the earth to the atmosphere draws with it the water and alimentary substances, i .e., promotes the circulation of the sap.

Respiration.

This means the inhalation of oxygen through the pores of the capillary vessels. When there is a current passing from the atmosphere to the earth the oxygen is carried along in the direction of the current—i. e., downwards—and is driven out with more or less force through the pores, and thus respiration is kept up.

FIG. 6. SWITCHBOARD FOR SERIES-ALTERNATING ARC SYSTEM AT NORMAL, ILL.

Transpiration.

This consists in the plant giving off the products of combustion, carbonic acid and aqueous vapor. When there is a current passing through the plant in an upward direction the result is contrary to what takes place in respiration—i. e., the current drives the gases of combustion out of the pores.

To all these chemical and mechanical effects must be added another of considerable importance. Prof. Lemström shows that when a high-tension electric current is applied to plants there is produced ozone in large quantities, nitric acid, nitrous acid, and perhaps ammonia. Now, we know that the oxygen derived from the ozone is highly active, as is shown by the increased verdure of plants after a storm. From what Mr. Guarini says, it follows that for respiration the plant must be traversed by a current going toward the earth, whereas for transpiration the current must go toward the atmosphere, whilst in the case of nutrition the direction of the current is immaterial. As nutrition and respiration are the two most important functions of plant life (transpiration being a consequence of these two functions), it follows that the best result is obtained when the plant is traversed by a current going toward the earth, which would correspond to the normal electric condition of the atmosphere and the earth. Mr. Guarini, in order to prove that experiment agrees with theory, showed photographs obtained by Prof. Lemström during his experiments with a static machine of his own invention. With the aid of these photographs one can see and compare the results obtained from carrots, the layer of atmosphere surrounding them having been electrified (1) positively, (2) negatively, (3) positively and negatively, and (4) not electrified at all. When the atmosphere is electrified negatively, i. e., when there is a current towards the atmosphere, the carrots are better than when there is no electrical treatment.

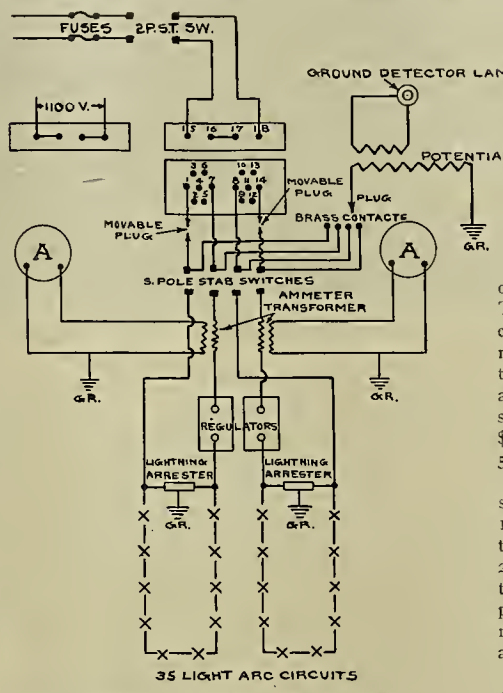


FIG. 7. DIAGRAM OF CONNECTIONS FOR SERIES-ALTERNATING ARC SYSTEM IN NORMAL, ILL.

In this case, as we have said, there is increased activity of nutrition and transpiration. The results are incomparably better when the atmosphere is electrified positively, i. e., when the current goes toward the earth. In this case we not only force respiration and nutrition into greater activity, but—and this is most important—we send into the plant a greater quantity of carbonic acid, i. e., a greater quantity of nourishment.

The illustration presented by the lecturer also showed that very deplorable results were obtained when currents of both kinds were applied.

Finally, the lecturer remarked that in order to derive the greatest benefit from electrical treatment it is necessary: (1) To place the plant in an environment where there is much more carbonic acid than in the atmosphere. This can easily be done in glass houses that are entirely closed; (2) to accustom the plants, perhaps, after a certain number of generations to forced alimentation, transpiration and respiration, and so to a much more rapid mode of life.

By these methods and by judicious electrical treatment, production can be pushed to extreme limits, and several crops a year obtained.

As to the sources required for the electrical treatment, Mr. Guarini mentions the three following:

1. Atmospheric electricity. None of the arrangements employed completely answer the purpose required. The sources of the atmospheric currents must be placed in much higher positions than they have yet been, so that there may be sufficiently high differences of potential between the top of the rods and the earth and sufficient to overcome the resistance of the plants and of the layer of air separating the lower part of the rods from the plants, that part of the air in which currents are produced and consequently ozone.

2. Static machines. He rejects these for the present as expensive and delicate toys, easily put out of order and incapable of producing the intense effects required.

3. High-tension continuous-current dynamos; these are both inexpensive and strong. By using them instead of atmospheric electricity, the electrical treatment can be regulated at will.

Mr. Guarini mentioned in this connection that the Société des Industries Electriques et Méeaniques of Geneva has recently brought out a continuous-current dynamo capable of giving one ampere at 23,000 volts, and that by coupling three of these machines in series the high figure of 69,000 volts is obtained, a value more than sufficient for electroculture.

Lastly, he concludes that plant life is an electrical phenomenon which can be regulated at will. The farmer will no longer be a mere machine, but a skilled and more or less intelligent electrician, who, like an engine driver, will direct from a board at the farm the germination and growth of his carrots, potatoes and cabbages.

Statistics of Street and Electric Railways.

The United States Census Office has issued a report covering all street and electric railways in the United States that operated during any part of the year ended June 30, 1902. A final report is now being prepared which will treat in detail the development of the modern street-railway system.

During the period covered by the present inquiry there was a total of 987 street and electric-railway companies—817 operating companies and 170 companies leased to and operated by other companies. The par value of capital stock and funded debt outstanding as reported amounted to $2,308,282,099. The total income and expenses of the operating companies amounted to $250,504,627 and $219,907,650, respectively. The companies gave employment on the average during the year to 133,641 wage-earners and paid $80,770,449 in wages. There were 7,128 salaried officials and clerks employed, to whom $7,439,716 was paid in salaries. The roads carried 5,871,957,830 passengers.

It appears from the items as reported that the single-track mileage increased from 8,123.02 miles in 1890 to 22,576.99 miles in 1903, or 177.9 per cent., and the number of fare passengers carried increased from 2,023,010,202 to 4,809,554,438, or 137.7 per cent. Of the total single-track mileage, 21,914.01 miles, or 97 per cent., was operated by electric power, 416.36 miles, or 1.9 per cent., by other mechanical traction, and only 259.10 miles by animal power.

From tables in the report it appears that the most extensive use of street and electric railways is in the North Atlantic states, where the average number of rides per inhabitant in 1902 was 124. The Western states come next with an average of 74.

Of the total number of operating companies, 252 reported that they generated electricity for sale for light and power purposes, and in addition a large number of companies had other permanent investments, such as in gas and water plants, bridges, etc.

Figures on electric-line construction show that 97.2 per cent. of the miles of single track operated by electric power obtain current by means of an overhead wire. It appears that 64.5 per cent. of this wire is supported by a span-wire construction, 32.9 per cent. by side brackets, and 2.6 per cent. by center poles. Wood poles are used by 80.3 per cent. of this mileage, and steel or iron poles for 19.6 per cent., the balance using buildings and other structures. There were 66,784 cars of all classes reported, 60,290 being passenger cars and 6,494 being used for express and other purposes.

There were 159 waterwheels used as prime movers for the generation of electric current, the average horsepower per wheel being 309. Of the total hydraulic capacity 69.6 per cent. was reported by 16 companies in the states of California, Georgia, Maine, Minnesota and New York. The largest plant of this character was shown for the Twin City Rapid Transit Company of Minneapolis, Minn., which company reported 12 wheels, 10 of which had 1,000 horsepower each.

The use of direct-current generators, having a capacity of 1,000 horsepower each or over, was reported by 59 companies. The use of small machines predominated, more than three-quarters of all the generators being rated at 500 horsepower or less, and their combined horsepower amounted to 43.5 per cent. of the total for all classes. A total of 231,924 horsepower was generated by 441 alternating-current generators reported. These machines were used by 163 companies, and of this number 127 reported that current was generated for sale for light and power.

The maximum speed within city limits is given approximately as varying from three to 40 miles an

hour, and outside city limits from three to 60 miles. The number of persons reported as killed is 1,218 and the injured 47,429.

Electrical Exports for May.

The electrical exports from the United States for the month of May last amounted to a total value of $810,958, an increase of $902 over the corresponding month of last year. Official figures show that for the month of May, 1904, the export of goods classified as electrical appliances, including telegraph and telephone instruments, fell off in the amount of $18,457 as compared with May, 1903, but the goods classified as electrical machinery gained $19,359 for the same period. The figures are: Electrical appliances—May, 1904, $292,997; May, 1903, $311,454. Electrical machinery—May, 1904, $517,961; May, 1903, $498,602.

For the 11 months ended with May, 1904, the exports of electrical appliances amounted to $4,486,647, while for the same period in 1903 they were $3,886,572. Electrical machinery shows a decrease for the 11 months ended with May from $5,362,907 in 1903 to $5,047,268 in 1904.

Classified according to destination the following were the principal buyers of electrical machinery from the United States during May, 1904: British North America, $138,170; Mexico, $91,777; Japan, $80,815; United Kingdom, $60,157; British East Indies, $32,043; Brazil, $27,143; British Africa, $24,511; France, $7,399; British Australasia, $7,351; Germany, $4,195; Philippine Islands, $3,550; Cuba, $3,378.

Interurban Rights in City Streets.

The Indiana Supreme Court has rendered a decision declaring that the construction and operation of an interurban railway in a city street does not necessarily entitle the abutting lot owners to damages. Henry Mordhurst of Fort Wayne sued the Fort Wayne and Southwestern Traction Company to enjoin it from building and operating its road past his residence. He admitted that the city had granted the company a franchise, but insisted that the company had no right to occupy the street without buying or condemning the privilege and compensating the lot owners. The court held that an interurban railroad with a franchise from the city to lay tracks in the streets with such rails as it sees fit and to operate thereon by electricity cars running to and from other towns and cities, carrying passengers, baggage, light express and mail matter and running not more than two cars in a train, is not an additional servitude which necessarily causes damage to an abutting owner and entitles him to enjoin the building and operating of such railroad in a street until his damages are assessed and paid or tendered. The owner can only have his action at law for actual damages suffered and proved.

The court said that interurban traffic does not create any resemblance between the interurban electric roads and a steam road carrying ordinary freight. A similar case was brought by Mrs. Kinsey against the Union Traction Company because of the use of College Avenue in Indianapolis, and was decided by Judge Carter on Saturday in favor of the company. The decisions are regarded as great victories for the interurban interests in Indiana.

Negotiations are in progress for the establishing of a large space-telegraph station on the big tower of the Hotel Rudolf at Atlantic City, N. J. The best facilities are offered for such a station in the hotel tower, and the details will be arranged at once.

Making Incandescent Lamps in the Palace of Electricity at St. Louis.

From the invention of the incandescent lamp up to the present time, manufacturers have taken every precaution to keep the various processes, apparatus, details, and all definite information pertaining to their manufacture from their competitors. The installation, in the Palace of Electricity at the St. Louis Exposition, of a model incandescent-lamp factory embodying the latest of apparatus and in constant daily operation is in contrast to this attitude, and gives those interested, as well as the public at large, a chance to become familiar with the manufacture of an article, the appearance and utility of which are matters of common knowledge.

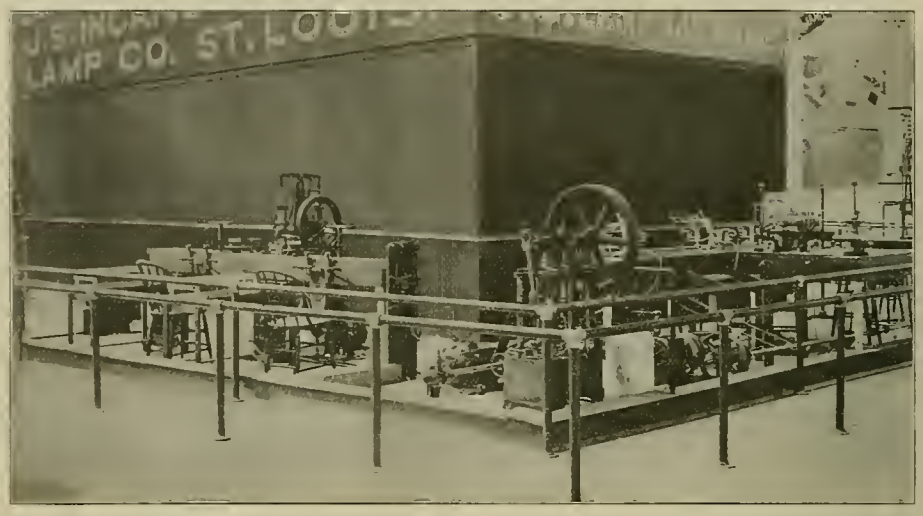


FIG. 1. MAKING INCANDESCENT LAMPS AT ST. LOUIS EXPOSITION.

This installation, is, therefore, of unusual value as a part of the educational scheme adopted by the exposition management, and is characteristic of the exhibits to be found in the various exhibit palaces, which are pre-eminently educational features. The efforts of Chief Goldsborough to bring together a series of working exhibits exemplifying the present status of the field of electrical industry have been most heartily supported by the U. S. Incandescent Lamp Company, with the result that one can now witness in the exhibit of this company the production, in its details, of a standard incandescent lamp.

The information to be gained from a study of this exhibit will be of value to all members of the electrical fraternity, in view of the important position which the incandescent lamp holds in all phases of electrical work. The exhibit is arranged in such a manner that the visitor, passing around the installation, views, at close range, the successive steps that transform the raw material into the finished lamp. Fig. 1 gives a good idea of a portion of the installation.

The accompanying illustrations show some of the most important operations of the 80 that are necessary to produce a high-grade lamp, and give a good conception of the interesting character of the process. The daily output is between 1,500 and 2,000 16-candle-power, 110-volt lamps, and 30 operators are required. The same thorough system of accounting is used as at the factory, and in this way the work of the different operators is made of record and various economical factors obtained.

From the general view it will be seen that the visitors are required to enter the exhibit at one corner and pass around the entire enclosure, during which journey any lamp may be followed through the various operations. Attention is first attracted by the operations which attend the production of the light-giving filament. Although many substances, such as paper, silk thread, bamboo, etc., have been used for this purpose, cellulose is now commonly used. This is the resultant when cotton-wool and zinc chloride are brought together, the application of heat aiding in the action. The cellulose, resembling in consistency molasses and of a pale straw color, is then placed in a hot-water bath, in vacuum, and the gases formed by the action are entirely extracted, the cellulose solidifying to a consistency of gelatine. Placed in a suitable vessel and subjected to pressure, it is then forced through a glass die, forming a slender thread 0.006 of an inch in diameter for a 16-candlepower, 110-volt lamp. This thread falls into a circular trav of alcohol, which revolves at such a speed that no strain is placed upon the filament. After several washings it is coiled upon a large drum and dried. The loss of moisture here reduces the thread about 0.001 of an inch in diameter, it then being approximately twice the size of the finished filament.

The cellulose is then wound on forms which vary with the size and shape of the filament desired. These are then placed in crucibles, which are packed with sawdust. The crucibles are subjected to a gradually increasing temperature, which reaches a maximum of approximately 3,000° F. in about eight hours, after which they are allowed to cool slowly. The now carbonized filaments are sorted and gauged for uniformity of size. A laboratory test is also made to determine the percentage of carbon; the filaments must not be less than 98 per cent. pure. The carbonization process reduces the size of the carbon and transforms all vegetable mat-

Fig. 2. Flanging Stem.

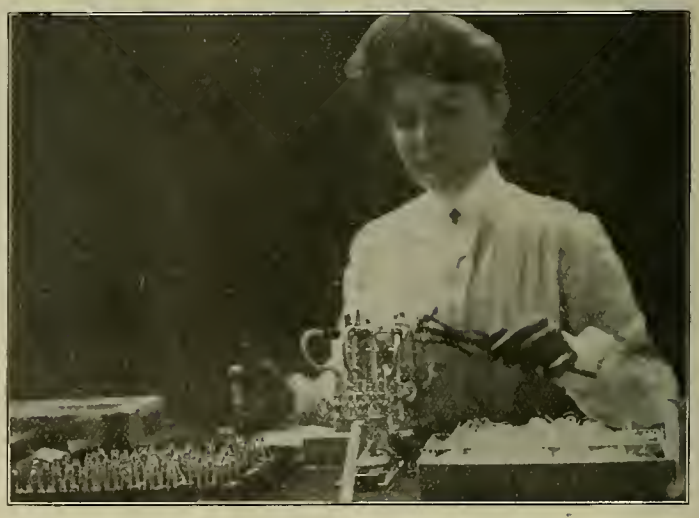


Fig. 3. Forming Stem and Inserting Leading-in Wires.

MAKING INCANDESCENT LAMPS AT ST. LOUIS EXPOSITION.

ter into practically pure carbon. It is interesting to note that French chemists have succeeded in making small diamonds from carbon by subjecting it to temperatures of from 6,000 to 7,000 degrees, or only about twice that required to produce suitable carbon from cellulose.

The carbon being completed, the next step is the "flashing" or treating of the carbon, the purpose of which is to give it a coating known as graphitic carbon, which is of the same class as that used in lead pencils. This is accomplished by hanging the carbons from contact clips in a vessel from which all air is removed, the carbons being brought to a dull red heat, while a hydro-carbon vapor is admitted to the vessel in such a manner as to circulate freely around the hot filament. The hydro-carbon, coming in contact with the carbon, deposits thereon, in a thin, uniform coating, graphitic carbon, the resistance of which is approximately 10 times that of the raw carbon. This effects an enlargement of the carbon, thereby reducing its resistance, allowing more current to flow, and this continues until a predetermined value is reached, at which point the current is automatically cut off. As a result of this treatment carbons are produced which are uniform in size, density and resistance.

An ingenious test is then applied to detect flaws in the deposition of the graphitic carbon, this being done by passing a current through the filament sufficient to bring it to a dull red. In case the carbon is not uniform in diameter this is indicated by bright spots at the points where the filament is smaller in cross-section. After being gauged and sorted in bunches of 1,000 each the carbons are ready to be attached to the glass stems or mounts.

The lamp manufacturer receives the glass tubing from which the stems are made in lengths of about five feet. These are cut into small pieces, varying in length with the style of lamp for which they are intended. A flange is formed on one end by placing the tube in a chuck, which rotates it in the flame of a glassblower's fire, a carbon pencil being used to flare out the heated end to a diameter a trifle smaller than that of the bulb neck for which it is designed. (Fig. 2.)

One of the most ingenious of the machines used by the lampmaker is that employed for closing the tube and placing therein at the same time the platinum "leading-in" wires, to which the carbon will be attached, and the anchor or pendant, which is a short length of German nickel wire, serving to support the filament at its middle point. One operator at this machine can turn out 2,500 stems a day, as against 600 by the usual manual method. The platinum tips of the "leading-in" wires are about 0.375 inch long and 0.008 inch in diameter. They are welded to the copper wires that connect with the brass base, and so fused into the glass stem that the weld point is just pressed into the glass where the tube is flattened.

Formerly the platinum and copper were connected by hand after having been cut to the proper lengths, but the most modern practice provides a coil of each wire, the ends of which are brought together, end to end. Current being supplied to the two wires, they are heated at the junction and a perfect butt weld is secured. The method of covering the weld with glass is protected by a patent, and where formerly five cents' worth of platinum was required, now the same result is obtained from the use of platinum costing less than one cent. Fig. 3 shows the old method of forming stems by hand.

When the stem has been thus prepared the carbon is attached by a paste composed, for the most part, of sugar and graphite. The operator takes a minute particle of paste on the point of a needle and touches it to one end of the carbon. The paste is sufficiently sticky to cause the filament to adhere, and it is deftly placed in contact with the platinum, a few strokes completing the joint. The other end is then joined and the middle of the carbon slipped into the loop in the end of the anchor wire and permanently fastened by a bit of paste. After being straightened and inspected the stems, with carbons attached, are baked in an oven to expel the moisture from the joints, when they are ready for the bulb.

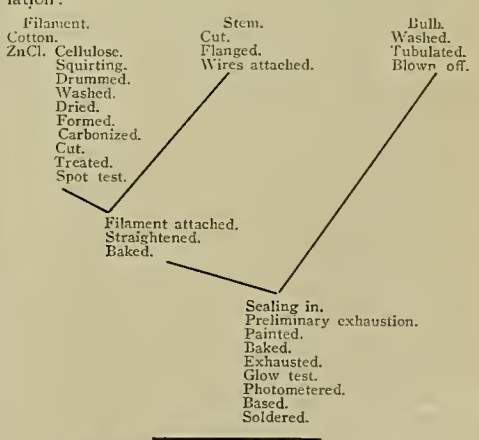
Almost all of the bulbs used by the different lamp manufacturers are supplied by one of the best-known makers of cut glass, the difficulties attending their manufacture having proved an effectual barrier to nearly all makers. Bulbs are blown of the best lead glass and come with a neck from two to three inches long. Formerly they were free-blown, but the practice is now to form them in a mold, resulting in a very uniform article. The bulb is blown without the tip, and the first operation is that known as "tubulating," which consists of opening the bulb at the end and fusing thereon a short length of small glass tubing, which later serves as a means for exhausting the lamp.

The bulb is now ready to receive the stem and filament, and this is the next operation. In Fig. 4 the operator can be seen finishing this step. The bulb is held in a sort of a chuck, and the stem, mounted on a spindle, is carefully held in the proper position, both revolving meanwhile. The flame from a glassblower's fire is now directed upon the bulb and flange of the stem, and in 10 or 15 seconds they are firmly united in an air-tight joint. After a preliminary exhaustion to remove the moisture resulting from the sealing-in process the now nearly completed lamps are "painted"—that is, a small portion of chemical is inserted in the exhaust tube and the bulbs are set away to dry. When ready for the final exhausting process the bulb is placed in a rack, with the tube inserted in a heavy rubber tube connected with the air pump. This is of English make, and by using it in connection with the chemical mentioned it is possible to secure a sufficiently high vacuum in less than one minute, although with the old process over an hour was required for each lamp. With the lamp in position current is supplied to its terminals, and the heat liberated causes the volitalization of the phosphorous, which combines with the residual gases in the bulb, and when the lamp is cooled a trace of fine solid matter is all that remains. The pressure applied in this process is about 50 per cent. higher than the normal voltage of the lamp.

The bulb is then sealed off by means of a hand blowpipe (Fig. 5), when it is ready for the "glow" test. This means simply the application of one terminal of an induction coil to the lamp. If the vacuum is correct the tube is filled with a blue haze. The lamp is then subjected to another "spot test," after which it is sent to the photometer, where, by well-known means, sufficient voltage is applied to its terminals to cause it to come up to candlepower, at which point the pressure and current are read.

The next and last step is the process of capping or basing. The base, which is a brass stamping, is placed over the upper end of the bulb, which is inserted in one of the cups shown in Fig. 6, and cemented to the glass. The wires are then soldered to the base and the surplus cut off, when the lamp is ready for the final inspection and packing. The entire process is not complicated, but there are so many difficult and delicate operations that no less than 40 inspections are made before the lamp is allowed to be packed for market. An ingenious lamp manufacturer has compiled a list showing 117 possible faults to be found in a lamp, which is an indication of the care necessary in their manufacture.

The following diagram shows clearly the different steps here described and is in the way of recapitulation:



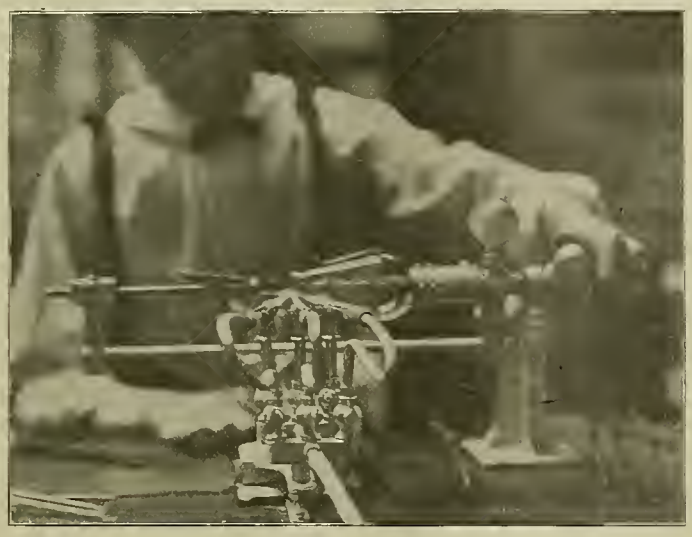


Fig. 4. Sealing in Stem.

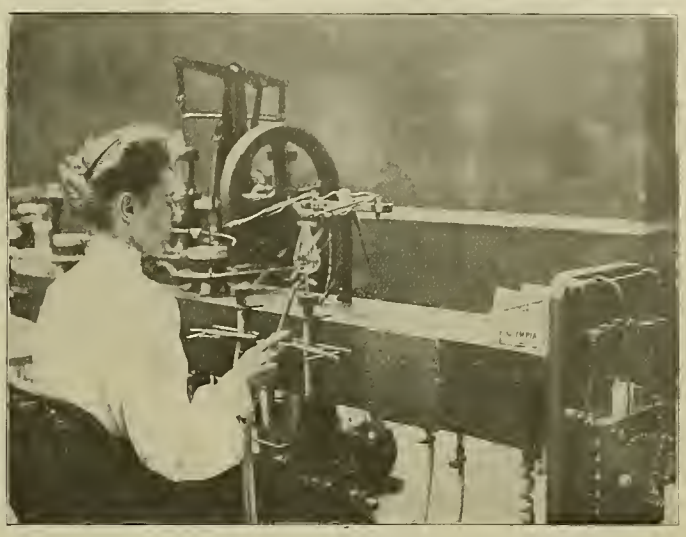


Fig. 5. Exhausting and Sealing.

MAKING INCANDESCENT LAMPS AT ST LOUIS EXPOSITION.

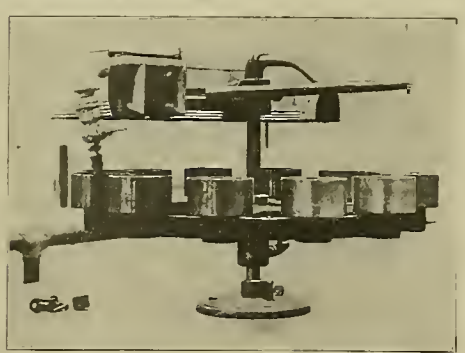


FIG. 6. MAKING INCANDESCENT LAMPS AT ST. LOUIS EXPOSITION.—MACHINE FOR ATTACHING BASE TO LAMP.

Society of Chemical Industry.

Visitors from many foreign countries are expected to be present at the first annual meeting of the Society of Chemical Industry ever held in America, which will be held in New York city on September 8th, 9th and 10th. Sir William Ramsay, the English scientist, heads the list of foreign visitors. On the general committee of arrangements are Professors Charles F. Chandler and Marston T. Bogart of Columbia University; Virgil Coblentz, professor of chemistry at the College of Pharmacy; Thomas A. Edison, Dr. Ernst J. Lederle, A. C. Humphreys, president of Stevens Institute; R. W. Moore, F. G. Zinsser, William J. Schieffelin, R. C. Woodcock, T. J. Parker and H. Schweitzer, chairman.

WESTERN ELECTRICIAN

EVERY SATURDAY.

PUBLICATION OFFICES:
510 Marquette Building, • CHICAGO.

TELEPHONE MAIN 1746.

Eastern Office, 193 Times Building, New York.
Telephone, 3806J Cortlandt.

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted. This paper is entered at the Chicago postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the **old address** as well as the new should be given.

CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—**the only general electrical paper published in the West**—thoroughly covers a territory *exclusively its own.* THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be furnished on application.

REMITTANCES.—All checks, drafts and other remittances should be made payable to the order of the publishers, the **Electrician Publishing Company,** and addressed to the offices of publication, Suite 510, Marquette Building, (204 Dearborn Street), Chicago, Illinois, U. S. A.

CONTENTS OF THIS NUMBER.

Electric Railway, Lighting and Heating Plant at Bloomington and Normal, Ill. Illustrated....21, 22, 23
Influence of Electricity on Vegetation....22, 23
Statistics of Street and Electric Railways....23, 24
Electrical Exports for May....24
Interurban Rights in City Streets....24
Making Incandescent Lamps in the Palace of Electricity at St. Louis. Illustrated....24, 25
Society of Chemical Industry....25
Editorial....26
Oil-film Receiver for Space Telegraphy. Illustrated....27
Improvements in the Stumpf Turbine. Illustrated....27
Chicago Street-railway Situation....27
Indiana Independent Mutual Telephone Association. (Convention at Lafayette, Ind., June 28 and 29, 1904)....28, 29
Members and Visitors....28, 29
Convention Notes....29
New Use for the Telephone....29
Telephone News from the Northwest....29
Telephone Progress on the Pacific Slope....29
Ohio Telephone Notes....29, 30
Indiana Telephone Items....30
General Telephone News....30
The Internal-combustion Engine as Applied to Central-station Service. By E. E. Arnold. With discussion. (National Electric Light Association)....30, 31, 32
Multiple-voltage Control for Variable-speed Motors. Illustrated....32
Mercury-vapor Lamp for Photographic Purposes. Illustrated....33
Westinghouse Railway Motor. Illustrated....33
Exposition Electrical Club....33
Elevated Trains to Run to Evanston....33

DEPARTMENTS.

Correspondence....34, 35, 36
Great Britain....34
New York....34
New England....34
Indiana....34
Ohio....34, 35
Michigan....35
Southeastern States....35
Northwestern States....35
Rocky Mountain States....35
Pacific Slope....35, 36
Personal....36
Electric Lighting....36
Electric Railways....36
Power Transmission....36
Societies and Schools....36
Miscellaneous....37
Trade News....37
Business....37
Illustrated Electrical Patent Record....37, 38

DATES AHEAD.

Ohio Electric Light Association (annual convention), Sandusky, August 16th to 18th.

International Electrical Congress, Hall of Congresses, St. Louis Exposition, September 12th to 17th.

International Association of Municipal Electricians (annual meeting), St. Louis, September 13th and 14th.

American Electrotherapeutic Association (annual convention), St. Louis, September 13th to 16th.

National Electrical Contractors' Association (annual convention), St. Louis, September 14th to 16th.

Colorado Electric Light, Power and Railway Association, Colorado Springs, September 21st to 23d.

American Street Railway Association (annual meeting), Festival Hall, World's Fair grounds, St. Louis, October 12th and 13th.

Kansas Gas, Water and Electric Light Association (annual meeting), Leavenworth, Kan., October 18th and 19th.

QUITE elaborate preparations are under way for the reception and entertainment of the foreign electrical engineers who shall visit this country at the time of the International Electrical Congress in September. Several European countries, notably Great Britain and Italy, will send delegations of some size, and the American Institute of Electrical Engineers has arranged a very complete itinerary. The foreign electrical engineers will be well repaid for their trip, we think, and they can rely on a cordial reception from local electrical men in all sections of the United States.

VISITORS to the Louisiana Purchase Exposition at St. Louis who are interested in electricity or electrical literature are cordially invited to call at the booth of the Western Electrician, which is in Block 1 (Section 13) of the Palace of Electricity, just west of the main northern entrance to the building. Here will be found copies of the current issue of the paper, bound volumes of the Western Electrician from the first number, a careful selection of electrical books exhibited by the Electrician Publishing Company, and other objects of electrical interest. Chairs are provided for weary sight-seers, and an attendant will extend a hearty welcome to all readers or friends of the paper.

THE ambitious project of telegraphing without wires from the United States to Japan and the eastern coast of Asia via the Aleutian Islands is again the subject of daily-newspaper conjecture, and it is even asserted that the United States government has entered into contract with one of the space-telegraph companies by the terms of which it will be "ultimately possible to send wireless messages between New York and Japan." The United States government has had experience with several space-telegraph systems, and it is perfectly safe to say that the naval officers and the Signal Service officers are well aware of the limitations of the art of wireless transmission as at present developed. The contract referred to is alleged to have been signed as late as June 28th, and if it exists at all it is probable that popular accounts of its purport have been greatly exaggerated. It will be well to establish regular wireless communication between Florida and Cuba or between New York and Washington or St. Louis and Chicago before attempting to go half way around the globe.

A PRACTICAL inquiry in the "Question Box" presented at the Boston convention of the National Electric Light Association was: "What is the relative cost of maintenance of induction motors and of direct-current motors in general city service?" Several answers were received, and considerable diversity of opinion was shown. The Boston Edison Company reported that "Two years' experience with a large capacity in induction motors in use in customers' premises has resulted in practically no repairs being required. Up to date a comparison of the repairs on both direct and alternating-current motors would be in the ratio of 100 to 1 in favor of the alternating-current motors." On the other hand, Mr. G. Wilbur Hubley said that the cost of maintenance of induction motors under average conditions would be about 25 per cent. less than of direct-current motors. Mr. W. F. Kingan was more favorable to the alternating-current motor, giving it as his opinion that the relative maintenance cost of induction motors having outside resistance to direct-current motors is as about four to one in favor of the former. The Malden Electric Company said that in three years' experience with 600 horsepower in induction motors it knew of no money being expended for repairs.

An anonymous contributor gave a valuable response. He showed that it is impossible to give actual figures on cost of maintenance of motors, since this item varies so much under different conditions. In general, it may be said that where proper care is taken of the motor practically the only cost of maintenance in induction motors with squirrel-cage armatures is a very occasional renewal of the bearings. In most motors having resistances in their armatures in starting an occasional renewal of contact pieces for the resistance short-circuiting switch is necessary. These contact pieces are used, however, only when the motor is being started, whereas with the direct-current motor the brush and commutator are in use not only during the process of starting, but all the time that the motor is running. For this reason, and also since there is always danger of dirt and moisture collecting in the armature winding, the potential of which is always greater than that of an induction motor, the cost of maintenance in direct-current motors is found to be several times that of induction motors.

ELECTRIC railways in England are said to be remarkably free from accident. The lines are conducted with so great an immunity from accident that the high degree of organization and the skill and care exercised by employes, which combine to produce the results, very rarely receive recognition. The best showing seems to be in Liverpool, where the percentage of fatalities to passengers is given as one in 28,000,000. The percentage of accidents to passengers, in no case high, has in some towns been reduced to almost nothing. Only a few years ago fears were frequently expressed of the danger that would follow the introduction of electric traction in England, and consequently the low maximum speed of eight miles an hour was enforced, and in many cases is still maintained. Last year, however, the Board of Trade granted a considerable increase in speed in Liverpool and the passenger traffic also increased 3.4 per cent. Nevertheless the number of accidents to persons decreased 11 per cent. The report of the general manager of Liverpool tramways says that of all methods of transportation, electric traction is undoubtedly the safest. It is urged that these records should suggest a greater relaxation on the restrictions on speed, placing greater reliance on the discretion of managers.

LIGHTNING, with its freakish phenomena, forms a subject of considerable importance to the fire underwriters, although, to be sure, the records of fires for the five years from 1898 to 1902 inclusive show that the percentage of the total number of fires due to lightning was only 4.4, while the proportion of losses was even less, being under three per cent. Nevertheless, the $3,759,980 of fire loss due to lightning in 1902 represents a sum well worth saving—if it could be done. The subject was considered in a report on "Protection of Buildings Against Lightning," presented to the National Fire Protection Association at its recent annual meeting. The committee believes that protection against lightning is advisable and proposes an elaborate set of specifications. It says that no generally accepted theory of thunderstorms has yet been formed. To what extent forests and trees act preventively is no more definitely known than the degree of protection afforded by lightning rods, although it seems to be established that trees surrounding a building, if not too near, are a source of protection, but if too near prove a menace. Oak trees are more susceptible to lightning than most trees, and beeches less so. It is well established that trees standing in temporary or permanently moist soil are much more likely to be struck than those in sandy or dry soil. It has been proved, the committee says, that lightning conductors, properly installed, are a protection, and, "notwithstanding that we are providing against an unknown quantity of current, we believe that there is a limitation which, if provided for by sufficient metallic surface area, properly arranged, may absorb and dissipate any charge likely to occur. At the same time, the protection afforded by a conductor will depend upon the relative positions of the electric discharge and the object it meets in its course." The more any object projects above the general level, the nearer to the cloud and the less resistance offered to the discharge. High objects are therefore more frequently struck, hence need more careful protection. A lightning conductor fulfills two functions—it facilitates the passage of the electricity to the earth, carrying it off harmlessly, and it tends to prevent disruptive discharge by neutralizing the conditions which determine such discharge in the vicinity of the conductor. To effect the first object, the path of the conductor should be of the least possible resistance, and much less than that of the structure it is designed to protect. The second object is accomplished by the conductor being surmounted by a point or points.

With the powerful underwriters' organizations as its friend, it will be seen that the lightning rod, the subject of so many spirited arguments between the eloquent agent and the doubtful farmer, is far from obsolete.

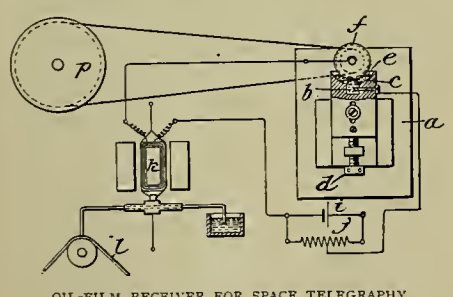
Oil-Film Receiver for Space Telegraphy.

Coherers for space-telegraph receivers have hitherto depended on the imperfect contact due to the natural film of oxide or other material which exists on most metals and which acts as the intervening layer, preventing full conduction between a pair of metal pieces brought into light contact in some random or unmetrical manner. Sometimes a contact between a spring pressing lightly on a point has been utilized. More usually, however, the accidental light and imperfect contact between the particles of a mass of metal filings has been employed. In each case the electrical disturbance due to the impact of ethereal waves has resulted in "coherence" and increased conductivity in the coherer, and "decoherence" has been occasioned by agitation or tapping. All coherers depending upon imperfect or light contact between bodies are subject to variation of sensitiveness and require frequent adjustment or renewal.

Dr. Oliver J. Lodge of Birmingham, Alexander Muirhead of Shortlands, and Edward E. Robinson of Birmingham, England, in a recent United States patent propose to dispense with the use of imperfect contacts in the construction of detectors or receivers and to use a thin film of some insulating material to separate the conducting masses which compose the detector or receiver and to obtain in a definite manner the light pressure desirable when the maximum sensitiveness is required. To this end they employ as the insulating film a thin layer of paraffin oil or similar insulating substance interposed between two metallic or conducting surfaces and frequently renewed, and for the pressure they depend on the hydrostatic pressure of a column of liquid, preferably employing mercury or other conducting fluid as one of the two conductors, the other one being solid and plunged to a given depth in the mercury.

To apply the film of oil, a layer of oil is placed upon the mercury, so that when the solid metal, preferably in the form of a platinum or iron point or a metallic wheel, is immersed to a small depth into the mercury it carries down with it a superficial film of oil. When the platinum or iron point or wheel is immersed into the mercury the depth of immersion must be slight, so that there may be as little capacity as possible between the two conductors, the insulating film employed acting as a perfect insulator or dielectric between the two. The smaller the capacity of the detector or receiver the more sensitive it will be to the ethereal waves. Although it is feasible to receive signals without actual immersion of the point or wheel into the mercury, yet the insulating film in such instance would necessarily be considerably thicker, requiring more battery power to break it down, which is correspondingly undesirable. For this reason it is preferable to obtain a thinner film by immersion, making use of the hydrostatic pressure of the mercury for that purpose and permitting the use of a much lower voltage.

It has been found that so long as a feeble voltage is applied (say three-tenths of a volt or less) the film is strong enough permanently to resist the passage of a current, but that whenever the electromotive force rises to, say, one volt or more, as it does at once, for an instant, if a spark has occurred in the neighborhood or if electric waves have been received from a distant station, then the film is



OIL-FILM RECEIVER FOR SPACE TELEGRAPHY.

broken down, easy conduction is caused, and a signal is recorded. To restore the continuity of the film again, motion is sufficient, and one of the simplest plans is to withdraw the metal point from the mercury into the supernatant layer of oil and immediately plunge it back again into the mercury. This withdrawal and reimmersion is very easily accomplished automatically, either by mechanical or electrical means or by the action of the current which the broken-down film itself transmits or otherwise, the reimmersion of the point following instantly on the cessation of the current by the restoration of the film. Obviously this motion may be effected in any appropriate manner, whether by rotation or translation or vibration. For instance, the immersed conductor might be the rim of a rotating wheel, or it might be supported on a vibrating body, such as the prong of a tuning fork, or it might be simply depressed into the mercury and withdrawn therefrom by attachment to the siphon-recorder coil or other moving part affected electromagnetically by the signaling current. The passage of a comparatively strong momentary current across the broken-down film is no detriment, since the film, being liquid, can be completely and certainly renewed. The metal used should be clean, free from any film of its own and not liable to amalgamate with mercury. One of these methods is illustrated herewith, showing the receiver attached to a moving wheel.

The conducting part (f) is shown in the form of a disk or wheel slightly immersed in the mercury (b). The constant rotation of the wheel, effected by such means as a clockwork train, represented diagrammatically at (p), brings about the restoration of the continuity of the oil film between the wheel and the mercury after the breaking-down action of ethereal waves received from a distance. The amount of pressure of the mercury upon the disk or wheel is regulated by means of the screw (d), fixed beneath the trough (c), which contains the mercury, so as to raise or lower it, and so regulate the immersion. The film or layer of paraffine oil acting as an insulator is shown at (e).

Improvements in the Stumpf Turbine.

In some types of steam turbines having more than one stage, difficulty is encountered in driving a generator from each of the shafts attached to the respective bucket wheels of the unit. The reason for this is that most of the energy is developed in the first stage of the turbine, making the coupling of the generators in series or parallel difficult or even impossible, owing to the difference in the useful effect of the turbine wheels. In the ordinary two-stage turbine about two-thirds of the energy is developed by the first set of buckets and one-third by the second set.

Johann Stumpf of Charlottenburg, Germany, has

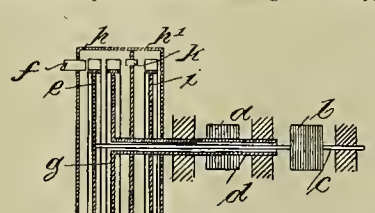


FIG. 1. IMPROVEMENTS IN THE STUMPF TURBINE.—SECTION SHOWING MOUNTING OF BUCKET WHEELS AND SHAFTS.

recently taken out a patent intended to overcome this difficulty and make possible the coupling of two generators to a single turbine, delivering to each about an equal amount of energy. The invention consists in arranging a third turbine wheel upon the shaft of the secondary wheel, which is impinged upon by the exhaust steam of the secondary wheel. A guide-shovel rim is provided for guiding this exhaust steam upon the third wheel. In this manner two systems rotated in opposite directions are obtained, the first system consisting only of the primary wheel and the second system consisting of the secondary turbine wheel and the third additional wheel, which rotates in the same direction as the secondary wheel. By this arrangement and by choosing suitable dimensions for the primary wheel the primary may be made to have about 50 per cent. of the total energy, the remaining 50 per cent. being developed by the secondary wheel and the third wheel.

Fig. 1 shows the device arranged to drive two generators of equal capacity. In the construction shown, (a) and (b) are armatures of generators. The armature (b) is fixed to the shaft (c). The armature (a) is fixed to the hollow shaft (d), situated around the shaft (c). The primary turbine wheel (e) is mounted upon the shaft (c). The nozzles through which the steam flows are represented by (f) upon the turbine wheel (e). A turbine wheel (g) is situated at the side of the turbine wheel (e), which wheel is fixed to the hollow shaft (d). It will be clear that the vanes of the wheel (g) must be situated in the opposite direction of the vanes of the turbine wheel (e), and that (g) consequently rotates in the opposite direction. The turbine wheels (e) and (g) are situated in a casing (h). To this casing a second casing (h') is fixed, in which is a third turbine wheel (i) fixed to the hollow shaft (d). This turbine wheel must naturally rotate in the same direction in which the turbine wheel (g) rotates. Nozzles represented by (k) connect the casing (h) with the casing (h').

The pressure of the steam in the casing (h) is by means of the nozzles transferred into velocity, which velocity acts upon the turbine wheel (i). If the turbine wheels are not to be rotated in such a way that the pressure of the steam is transferred step by step into velocity of flow, it is sufficient if a guide-vane rim for reversing the direction of the steam leaving the vanes of the turbine wheel (g) be provided. An arrangement, such as above described, enables two generators of the same capacity to be coupled to the same turbine, the amount of

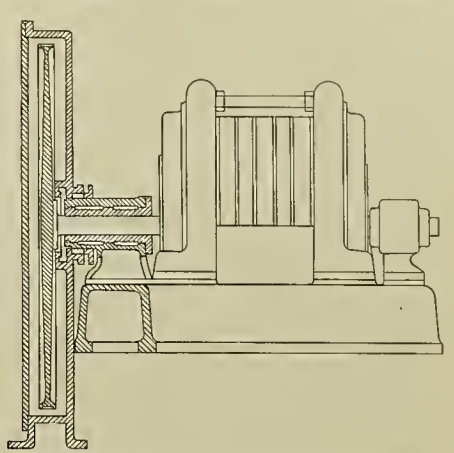


FIG. 2. IMPROVEMENTS IN THE STUMPF TURBINE.—TURBINE MOUNTED ON END OF SHAFT.

power delivered to each generator being approximately equal.

Fig. 2 shows a new method, also patented by Mr. Stumpf, of coupling the turbine to the generator shaft, in which the turbine is connected to the end of the shaft. This makes necessary only two bearings, which is a decided advantage, and furthermore, it prevents to a great extent the shambling or unsteady movement of the turbine wheel, which is one of the difficulties encountered in turbine operation. The reason for this is that the armature acts as a counterbalance to the turbine wheel.

Chicago Street-railway Situation.

If the present plans of the local transportation committee of the Chicago City Council are carried out the Chicago Union Traction Company may be compelled to vacate all streets not covered by the 99-year act as fast as the franchises expire. On certain streets, according to Judge Grosscup's decision, the traction companies of Chicago have indefeasible rights under the 99-year act till 1964. On other streets the companies have rights which will expire within a few years, and on still other streets their rights have expired already. To arrive at a settlement of the franchise-extension controversy the council transportation committee made what it considered a most reasonable offer to the traction companies. It was to commute their rights, or, in other words, average up all the long and short-term franchises of each company and grant an ordinance covering all the lines for the average time, which in the case of the Chicago City Railway Company would be 12 years, and probably in the same neighborhood for the Union Traction Company. The Chicago City company seems to favor the plan, and therefore the tentative ordinance for the extension of this company's franchise has been taken up, and it is believed a conclusion based on the offer will be reached soon. The Union Traction Company refused to consider any offer by which it would be expected to relinquish its claims under the 99-year act, and this attitude has apparently brought the company and the city to the parting of the ways.

The corporation counsel has been instructed to present to the local transportation committee a plan by which the Union Traction Company shall be notified to vacate the streets in which it operates on the franchise of the Chicago Passenger railway, which franchise has expired. A method is also to be furnished the council by which to supply transportation on the streets thus vacated. As a result the city may itself be forced to acquire these lines, which, together with lines covered by franchises which expire in the near future, comprise nearly 50 per cent. of the entire system. This would offer an opportunity to test the validity of Mueller bill certificates. Should the city acquire a section of the lines it is probable that they would be rented to the Chicago City company for operation or turned over to that company on a short-term franchise. In City Hall circles it is considered that the averaging idea will prove of value to the city in bringing about a solution of the problem, as the plan is considered a fair one.

Indiana Independent Mutual Telephone Association.

The seventh annual convention of the Indiana Independent Mutual Telephone Association was held in Thompson's Hall, Lafayette, Ind., on June 28th and 29th. The attendance was the largest, the enthusiasm the greatest and the entertainment features the most elaborate of any meeting in the history of the association. The headquarters were at the Hotel Lahr, where the supply men had converted about 20 parlors into veritable exhibit spaces for mechanical and electrical apparatus and demonstrations. An enjoyable programme for the entertainment of the members and guests was provided by the Chicago Telephone Supply Company of Elkhart and the Sterling Electric Company of Lafayette.

The association was organized in 1898 for the promotion and advancement of Independent telephony in Indiana. The membership is made up of active and associate members.

The forenoon of the first day was devoted to registration, distribution of badges and a parade in the downtown streets by 200 members, headed by a band escorted by Mr. W. E. Doolittle, the courteous and hospitable president of the Sterling Electric Company.

The first session of the convention was called to order on the afternoon of Tuesday, June 28th, by the president, Rome C. Stephenson of Rochester, who introduced Mayor R. B. Sample, who welcomed the delegates to Lafayette, and among other things said that the city felt honored in the association holding a second convention there. The mayor said that the people owed much to the telephone men of Indiana for affording such excellent means of communication and thus contributing to the conveniences and happiness of the people.

President Stephenson made the response for the convention and said: "I thank you, Mr. Mayor, in behalf of the convention for your hearty and courteous welcome to your beautiful city, which has been made the seat of the convention for the second time in our history. Seven years ago the Independent Telephone Association movement was begun, when a number of workers met in the southern part of the state and formed this association with a view of getting together and exchanging ideas for the betterment of the service over the country. We had at that time the strong, well-organized and well-equipped Bell Telephone Company to contend with; but we have received such support from the public that the venture has proved a success from the first. Now things have changed. The Independent system is the stronger, especially in Indiana, which has become the garden spot of the Independent work. We hold these meetings every year, not for the purpose of devising plans to increase the rates—God knows they are low enough now—but to get together and exchange ideas with one another for the betterment of the system."

The first paper was contributed by Professor J. C. Kelsey of the telephone engineering department of Purdue University. His subject was, "How to Make an Independent Telephone Man." Professor Kelsey dwelt upon the necessity of a thorough technical education and said the department of electrical engineering established two years ago by Purdue had been remarkably successful. He said: "If a business man should turn $50,000 over to some young man with no experience and tell him to go out and make the most of it, people would think him crazy. And yet that is exactly what many of the managers of the Independent companies over the country do. They turn over a station or exchange valued at $50,000 to a man with no experience, but with facts learned from a good school, and are seldom sorry for the trade. If you educate for the law you send your son to the law school; if for the medical profession to the medical college. It is equally necessary that the young electrician receive his training in a good technical school. Purdue affords unexcelled facilities for the training of the young telephone man. Every feature and requirement of the business, from installation to operation, are gone through thoroughly, and the young student on leaving the school is able to construct any terminal or take care of any branch of the work." Professor Kelsey's paper was well received and several delegates said that they could find no fault with it; that such a training was now universally recognized to be necessary to insure the success of the young engineer. President Stephenson said his experience with a student from the telephone engineering department of Purdue affirmed Professor Kelsey's theory. "A young man while still going to school completed the equipment of an office and exchange for me a few years ago, and soon after the work was completed an official of the Bell Telephone Company declared that there was not a better equipped or better arranged office in the country than the one finished by the Purdue student," said Mr. Stephenson.

Henry A. Barnhart of Rochester was the next speaker, the subject of his paper being, "The Part Played by the Press in the Development of the Independent Telephone Field." Mr. Barnhart is one of the brightest editors in Indiana and is often chosen to read papers before all sorts of conventions. He said that when the prophetic Noah wanted passengers for his ark he publicly advertised that he would sail on a certain day, and all who did not get aboard would get left. "You know what happened to the multitude, who said, 'It's only an advertisement,' and it has been happening to their kind in a commercial way ever since. Advertising has grown from year to year until the success of every undertaking which depends upon public interests must have judicious advertising for its basis. This is a busy age, and people are in the habit of going directly to the advertising columns of publications to find what they need and where to get it. I apprehend you are possessed with the mental query as to how a telephone company shall advertise and what good will it do. That depends upon surroundings. In the telephone manufacturing industry there are names of manufacturers and apparatus which have been made household words because we see and read most of them and the merits of their products, and the importance of making the general public familiar with the telephone service you give must be equally apparent. The wise telephone operator can well afford to cultivate the good will of the press in his community. He should give the newspapers all the favors he can without sacrificing business interests, and they will return publicity favors to recompense the operator for the good will; it will be 'bread cast upon the waters.' A direct system of advertising in the newspapers is very effective. For instance, if Mrs. Bedott, and Mrs. Slimer, and Mrs. Costrong have telephones put into their residences, see to it that the local news columns of your home paper tells it to the world and you will set a dozen angelic topknots to wig-wagging in that same neighborhood, and a dozen tactful and persuasive tongues will tell their husbands, 'we can have telephones as well as they,' and your orders for telephones will increase.

"If a business man sees it announced that his competitor has a telephone put in, a ginger-like sensation will come over him, and you get another order for a business telephone. You can also very profitably hand an occasional coupon book to your local newspaper to be used within your field of operation for news getting. You will lose nothing, for it will frequently be mentioned in the papers that this and that important news article came by telephone. That keeps the public advised that your toll lines reach surrounding points, and your toll receipts will increase as a result."

Mr. Barnhart concluded by saying that there were two important requisites for success in the telephone business. First, to give a meritorious service, and second, never to halt in judicious advertising endeavor.

A. L. Tetu, general manager of the Home Telephone Company of Louisville, Ky., was introduced next and gave a short talk. "Kentucky greets you," he said, "and it is a pleasure to come to this meeting, though I came to listen and not to talk. I learned the telephone business in Illinois and found competition in Indiana. I was long in the employment of the Bell company, but feel more satisfied in the ranks of the Independents. The most important thing in making a successful telephone company is the operator. The girls can make you or they can break you. We must have good telephone operators. A telephone man must have regard for the telephone girl—the barometer of his success. The girl is not there for pastime or pleasure, but because she has to work. Any subscriber who abuses a telephone girl at the other end of the line for no sufficient cause is a brute. And a telephone manager who will not rip out the telephone of that subscriber does not merit success. If I do no better than to aid the crusade for the demand for kind words for the telephone girl I will consider my visit well worth the while. Let us all get together and make the life of the telephone girl pleasant instead of full of misery."

Samuel G. McMeen of Chicago was introduced and declared to be the greatest acquisition to the Independents from the ranks of the Bell company. Mr. McMeen was given three cheers by the delegates. He said that he still claims Indiana as his home, having been born and reared in the Hoosier state. "I spent my early days as a telephone man in Indiana and attended Purdue University 19 years ago. After that time I was connected with the Bell company, but subsequently got out of the Bell system and found a healthier atmosphere and a heartier welcome with the Independent men," said he. He declared that the advancement of civilization had been caused by communication more than any other thing, and that if the telephones weren't the best way of communication he did not know what was.

On Wednesday forenoon the delegates and guests were taken to Purdue University, escorted by Professor Kelsey. They were greatly interested in the mechanical and electrical departments of that institution. They were then shown through the dairy, where ice-cold buttermilk was served in any quantity desired.

The Wednesday afternoon session was opened by the reading of a paper by the Hon. John F. McHugh of Lafayette on the subject of "An Attorney's Impressions of the Independent Telephone Field." Mr. McHugh said his first impressions were that the Independent companies are composed of earnest, true and loyal gentlemen—men with fixed purposes, men who respected their obligation to a community and who know the right and dare to do it; men who seek to serve the public efficiently. The Independents have had to contest the field and make its high mark inch by inch against the Bell company. The Independents do not want it all for the serving of the public. Rates are lower and this is an appreciative benefit to the public, and hence the people's generous support. Mr. McHugh's paper was well received by the convention.

R. B. Norton of Indianapolis read a short paper prepared by L. R. Sale of the Indianapolis Telephone Company. Mr. Sale did not confine his paper to the subject assigned him by the topic committee, but touched on the merits and needs of the Independent system. "We have been successful in obtaining the support of the public through merit," said he. "In Indiana the Independent development has been greater than in any state in the Union according to population. Flat rates have taught the people much, but it is apparent that we have established too low a rate for the residence service." Mr. Sale advocated co-operation. "Local ownership of exchanges is the only way to maintain local systems, but a standardized system should be adopted as soon as possible," he said. The speaker urged the adoption of uniform rules, uniform apparatus and the getting together oftener. He thinks that long-distance lines should be owned by one company in Indiana or in each state. The public is watching the progress of the Independents and will continue to support the system so long as that support is merited. Mr. Sale's paper brought out a generous discussion, Mr. Thorward of South Bend and Mr. Wright of Elkhart taking a leading part. Co-operation of local systems and toll-line systems was heartily indorsed, but the speakers intimated that there was a woeful lack of harmony or co-operation among the toll lines of Indiana. To illustrate, Mr. Thorward said South Bend had a toll line to Logansport and that Indianapolis had a toll line to Logansport, and yet the citizens of South Bend could not talk with Indianapolis. This condition ought not to exist.

The election of officers resulted as follows: President, Theodore Thorward of South Bend; vice-president, C. A. Reeves of Plymouth; secretary, J. K. Johnson of Elkhart.

Immediately after adjournment the members and guests marched to the steamer Tecumseh for a boat ride on the Wabash River to the German National Park, where a Dutch lunch and band concert were enjoyed. Mr. Doolittle was the toastmaster.

Members and Visitors.

The following is a nearly complete list of those in attendance:

Prof. J. C. Kelsey, Purdue University, Lafayette; E. R. Harding, Holtzer-Cabot Electric Company, Chicago; Walter E. Doolittle, W. R. Croffroth, Evan Shelby, H. W. Doolittle, H. T. Doolittle, S. B. Fowler, H. E. Denig, H. S. Bullock, F. M. Ross, G. W. Metcalfe; Sterling Electric Company, Lafayette; W. W. Kidney, Century Telephone Company, Buffalo; J. D. Downer, Western Electrician, Chicago; George W. Brown and G. A. Briggs, Chicago Telephone Supply Company, Elkhart; J. A. Russell, Swedish-American Telephone Company, Chicago; R. Schweitzer, Crawfordsville Wire and Nail Company, Crawfordsville; R. C. Stephenson, Rochester Telephone Company, Rochester; A. A. Adams, Whitley County Telephone Company; John C. Murray, International Telephone Manufacturing Company, Chicago; Gustav F. C. Bauer, Century Telephone Construction Company, Buffalo; Theodore Thorward, South Bend Telephone Company, South Bend; B. O. Wells, Charleston Telephone Company, Charleston, Ill.; Paul Latzke, American Telephone Journal, New York and Chicago; C. J. Arterburn, Kansas Telephone Company, Kansas, Ill.; H. S. Grant, Century Telephone Company, Buffalo; R. F. Blount and W. S. Stett, Home Telephone Company, Wabash; Fred G. Batz, Varney Electric Supply Company, Indianapolis; J. S. Engh, Automatic Electric Company, Chicago; P. J. Eubanks, American Electric Telephone Company, Chicago; A. E. Dunder, Holtzer-Cabot Electric Company, Chicago; J. H. Bell, Hoosier Telephone Company, Salem; J. M. Zion, Clark's Hill Co-operative Company, Clark's Hill; E. H. Blume, Indianapolis; L. A. Horney and J. H. Horney, Home Telephone Company, Clinton; C. L. Fisher, H. D. Ogden, J. F. Crook, Automatic Electric Company, Chicago; F. J. Goodwine, West Lebanon Telephone Company, West Lebanon; Alfred F. Potts, R. S. McOuat Supply Company, Indianapolis; George B. Pratt, North Electric Company, Cleveland; W. S. Bissell, F. Bissell Company, Toledo; A. E. Peterson, West Lebanon Telephone Company, West Lebanon; F. F. Sapp, North Electric Company, Cleveland; E. A. Williamson, North Electric Company, Cleveland; W. L. Harris, Delaware and Madison County Telephone Company, Elwood; H. Rosenow, Eureka Electric Company, Chicago; C. D. Boyd, North Electric Company, Cleveland; F. R. Parker, with Frank B. Cook, Chicago; C. M. McGregor, Posey County Telephone Company, Mt. Vernon; J. L. Arthur, Varney Electric Supply Company, Indianapolis; J. G. Brobeck, Simplex Electrical Company, Chicago; T. H. Harris and J. W. Mason, Central Electric Company, Chicago; F. O. Rusling, M. B. Austin Company, Chicago; William Pogue, Central Energy Telephone Company, Frankfort; A. J. Troxell, Mulberry Telephone Company, Mulberry; W. A. Cole, Mulberry; Le Grande Marvin, Central Energy Telephone Company, Frankfort; W. W. Rose, Rossville Home Telephone Company, Rossville; E. Walker, Carroll Telephone Company, Delphi; E. V. Fitzpatrick, Co-operative Telephone Company, Portland; F. W. Warner, Warner Electric Company, Muncie; W. W. Mendenhall, White Star Telephone Company, Westfield; R. Wickersham, Carmel Mutual Telephone Company, Carmel; William D. Baldwin, White Star Company, Westfield; H. F. Gallimore, Citizens' Telephone Company, Zionsville; G. E. Varney, Varney Electric Supply Company, Indianapolis; H. C. Moore, Varney Electric Supply Company, Indianapolis; George H. Miller, People's Telephone Company, Mulberry; John W. Kerlin, Rockfield Co-operative Telephone Company, Rockfield; W. C. Bogue, American Steel and Wire Company, Chicago; J. W. Stone, Arcadia Telephone Company, Arcadia; H. G. Lutz, Odell Telephone Company, Shadeland; Nathan Shute, Crouse-Hinds Company, Chicago; E. P. Shafer, Stromberg-Carlson company, Chicago; L. J. Patty and J. R. Collins, Carmel Mutual Telephone Company, Carmel; W. B. Foresman, Odell Telephone Company, Glen Hall; J. B. Magers, Indianapolis Arm, Bracket and Pin Company, Madison; W. Turpin, Roachdale Union Telephone Company, Roachdale; L. Nicely, Dayton; Joseph Heath, Oxford; Ezra Tripp, Boswell; F. W. Pardee, with F. B. Cook, Chicago; E. L. King, E. L. Draffen, Gould Storage Battery Company, Chicago; J. J. Keane, Chicago; F. R. Schalck, Western Electrician, Chicago; F. A. Franklin, Chicago; J. R. Collins, Indianapolis; S. G. McMeen, Chicago; H. B. McMeal, Telephony, Chicago; H. E. Babcock, Telephony, Chicago; J. E. Leach, Cheneyville Telephone Company; John A. White, Electric Storage Battery Company, Chicago; D. C. Plumb, Chicago; F. L. McGillan, Valentine-Clark Company, Chicago; W. H. Graffis, Sound Waves, Chicago; S. D. Messener, Williamsport Exchange; J. G. Ihmsen, American Electric Telephone Company, Chicago; E. L.

Hoffman, Sharpsville; John A. Hayes, Sharpsville; G. S. Van Deusen, Michigan City; Theodore Weinshank, mechanical engineer, Chicago; C. H. Macklin, Swedish-American Telephone Company, Chicago; R. D. Fisher, Indianapolis; W. H. Trimm, Chicago; John L. Osborn and J. H. Draper, Veedersburg; D. C. Shoaf, Wallace; W. A. Wright, Hillsboro; A. L. Tetu, Louisville, Ky.; A. E. Mailsbury, Francesville; Everett Harrold and D. B. Barnett, Flat Rock; C. H. Phelps, New Castle; W. H. Brown, New Market; Dr. J. W. Hedrick, Mulberry; E. E. Farley, Chicago; Henry A. Barnhart, Rochester; S. Y. Grove, Salina, L. E. Tokey, Markle; C. H. North, North Electric Company, Cleveland; G. H. Miller, Miller Anchor Company, Norwalk, O.; John E. Yarling, secretary and general manager Peru Home Telephone Company, Peru; R. G. Kendrick, W. G. Nagel Electric Company, Toledo, O.; J. C. Eckhart, Eckhart Telephone Company, Buck Creek; W. W. Smythe, Jr., Fibre Conduit Company, Chicago; T. E. Hanaway, Monticello; Byron Stratton, Citizens' Telephone Company, Cambridge City; S. Hebnsing, Cambridge City; M. H. Moffitt, National Carbon Company, Cleveland, O.; E. A. Phillips, Toledo, O.; L. H. Griswold, Francis Beidler Company, Chicago; J. Lenahan, U. S. E. Company, Rochester, N. Y.; Carl Carpenter, Perrysville Telephone Company, Perrysville; U. L. Early, S. Morrison Telephone Company, Greenfield; George H. Conker, S. Morrison Telephone Company, Greenfield; M. P. Boone, Peru Home Telephone Company, Peru; W. B. Coffing, Fountain Telephone Company, Covington; L. D. Carpenter, New Carlisle; O. Rex, North Manchester Telephone Company, North Manchester; D. E. Miller, Flora Telephone Company, Flora; M. J. Nagle, New Augusta Independent Telephone Company, New Augusta; A. W. Crouch, American Conduit Company, Chicago; H. H. Bass, Lake Charles, Ia.; Frank B. Cook, Chicago; G. H. Lutz, Kellogg Switchboard and Supply Company, Chicago; J. J. Brown, Consolidated Telephone Company, Danville; A. D. Pike, Clint Hall, Tippecanoe Telephone Company, Romney; Chas. Wilson, Romney; James Davis, Frankton Home Telephone Company; J. A. Wright, Williams-Abbott Electric Company, Cleveland, O.; F. M. Maddox, Otterbein Telephone Company, Otterbein; D. B. Wick, North Electric Company, Cleveland; L. G. Davis, Hoosier Telephone Company, Salem; LeRoy Patty, Union Telephone Company, Carmel; D. L. Thompson, Kirklin Telephone Company, Kirklin; C. E. Stinson, Toledo Home Telephone Company, Toledo, O.; L. H. Kratzen, Mulherry; John F. Dukes, Manson; Frank M. Boyd, Parke County Telephone Company, Rockville; Thomas Bromberg, Jr., Delaware and Madison County Telephone Company, Muncie; John C. Murray, International Telephone Manufacturing Company, Chicago; Robert J. Williamson, secretary and manager Montmorenci Telephone Company, Montmorenci; F. D. Rushing, Varney Electrical Supply Company, Indianapolis; R. E. Stone, Delaware and Madison County Telephone Company, Muncie; Charles S. Norton, Indianapolis; J. E. Switzer, Otterbein Telephone Company, Otterbein; J. Alex Navarre, Lindsley Bros. Company, Chicago; L. J. Burr, Anderson.

Convention Notes.

A. W. Crouch of the American Conduit Company was in attendance.

J. Alex. Navarre was present to talk poles for the Lindsley Brothers Company of Chicago.

The "Adjustaphone," was exhibited by the Chicago Writing Machine Company of Chicago.

C. H. Macklin and J. A. Russell were in charge of the Swedish-American Telephone Company's exhibit.

The Kellogg Switchboard and Supply Company had a representative present in the person of G. H. Lutz.

The F. Bissell Company of Toledo took occasion further to acquaint the trade with its telephone specialties.

The Monarch Electric and Wire Company of Chicago was among the firms to make an exhibit at the convention.

E. E. Yaxley and W. H. Trimm were in charge of the exhibit of the Monarch Telephone Manufacturing Company.

The Fiber Conduit Company exhibited a line of fiber conduit and was ably represented by Western Manager W. W. Smythe, Jr.

The F. B. Cook line of telephone accessories was attractively displayed and talked about by F. B. Cook, F. W. Pardee and F. R. Parker.

Professor Kelsey of Purdue increased his popularity, as well as his school's, by his genial and courteous attention to the visitors.

Pamphlets illustrating and describing the Hallett Iron Works specialties were distributed by the Central Electric Company of Chicago.

The Eureka Electric Company took advantage of the occasion and showed a fine line of apparatus, in charge of I. J. Kusel and H. Rosenow.

One-half of the expense and almost all of the work connected with the entertainment furnished was borne by the Sterling Electric Company.

Western Manager E. R. Harding of the Holtzer-Cabot Electric Company was, of course, present and showed a good line of his company's apparatus.

F. L. McGillan represented the Valentine-Clark Company and showed a number of photographs of this well-known company's product in the pole line.

The exhibit of the American Electric Telephone Company was in charge of General Manager J. G. Ihmsen, assisted by P. J. Enbanks and P. R. Hauptman.

One of the visitors from the southern end of the state was J. B. Magers, of the Indianapolis Arm, Bracket and Pin Company of Madison, Ind., who found the occasion not only an enjoyable but a profitable one.

The Chicago Telephone Supply Company showed (in charge of George A. Briggs, assisted by G. W. Brown) an excellent line of its apparatus. This company was one of the hosts of the occasion and furnished the entertainment, together with the Sterling Electric Company.

The display of the Stromberg-Carlson Telephone Manufacturing Company was in charge of E. P. Shafer, and occupied a prominent location on the exhibit floor.

E. L. Draffen, western manager of the Gould Storage Battery Company, attended the convention, for, of course, telephone companies are considerable buyers of batteries.

A tastefully displayed exhibit was that of the Century Telephone Construction Company of Buffalo, in charge of Will W. Kidney, assisted by G. F. C. Bauer and H. S. Grant.

A switchboard, with instruments and accessories, in charge of John C. Murray, was well displayed by the International Telephone Manufacturing Company of Chicago.

The Crouse-Hinds Electric Company had a number of its guy anchors about the hotel and was represented by Nathan Shute, who made numerous friends at the convention.

The North Electric Company made an extensive exhibit of its telephones and parts. C. H. North, F. F. Sapp, George B. Pratt and C. D. Boyd were present for this company.

Richard Schweitzer, the popular secretary of the Crawfordsville Wire and Nail Company, had on hand a display of telephone wire, and distributed canes made of this wire to the delegates.

R. G. Kendrick, the well-known representative of the W. G. Nagel Electric Company of Toledo, mingled with the delegates and looked after his firm's interests in a capable manner.

G. H. Miller, president of the Miller Anchor Company of Norwalk, Ohio, had a busy and profitable time showing his guy anchors to the many interested visitors. Mr. Miller reports a constantly increasing demand for his anchors.

The Automatic Electric Company showed and explained the workings of one of its automatic switchboards to the interested delegates. The company was represented by J. F. Crook, C. H. Fisher, H. D. Ogden and F. S. Engh.

Walter E. Doolittle, president of the Sterling Electric Company, was indefatigable in looking after the comfort and welfare of the visitors, and that his efforts were highly successful and fully appreciated can be attested to by all present.

The Sterling Electric Company's exhibit included a lamp-signal magneto switchboard, a sectional type switchboard, standard Bell type switchboard and the company's new type of farmers' switchboard. All of the different types of telephones were shown and a set of party-line telephones was in operation. The new No. 118 telephone attracted attention, and it was predicted that it would take the place of many of the present type of magneto telephones. There was also a complete line of the Sterling protectors. The exhibit included a telephone pole which had mounted upon it a new type of pole seat and pole house, with tubular fuse and carbon mounted on the inside of the pole box. All of the Sterling equipment was in full operation. The souvenirs were small miniature desk telephones. Walter E. Doolittle, president, was assisted in receiving by W. R. Coffroth, secretary and treasurer; Evan Shelby, sales manager; H. W. Doolittle, order department; H. T. Doolittle, purchasing agent; S. B. Fowler, electrical engineer; H. E. Denig, chemist; H. S. Bullock, superintendent; F. M. Ross and G. W. Metcalfe.

New Use for the Telephone.

A Cleveland (Ohio) man has started a business in that city which may mean a broadening of the use of the telephone. He calls his system "Telagirl," and it consists of a plan by which business men may dictate their correspondence to a stenographer in the office of the concern by telephone, and the work is done and sent back to the office of the subscriber. Private telephones are installed at the desk of each subscriber and enough stenographers are employed to take care of his work at any time he may call. In addition, a business man who has no one to leave in the office may have his telephone connected up with the "Telagirl" office when he steps out, inform the girls when he will be back and leave instructions for anyone who may call him up. In that way all inquiries will be answered and the new concern will take the place of an office girl. Arrangements will also be made to take care of business at night, on Sunday and at other odd times when employes of all offices are out. Graphophones will also be installed in the offices of those who desire and records of dictation will be called for by messenger. So far as known, this is the only system of the kind in this country. The charges will be moderate and it is probable that the service will be broadened from time to time to take in other branches.

Telephone News from The Northwest.

The Plainview Telephone Company will put in an exchange at Wabasha, Minn.

The Traill County Telephone Company is putting in a new exchange at Clifford, N. D.

The council of Watertown, S. D., has granted a renewal of franchise to the Dakota Central Telephone Company.

The Merton Rural Telephone Company has been organized to build a line from Owatonna, Minn., to Merton.

The Duluth Telephone Company has won the suit brought by the city of Duluth to compel the removal of wires to admit the moving of a building, on the ground that the ordinance as drawn was not valid.

C. W. Macomber is reported to have bought the local telephone system at Prentice, Wis.

It is reported that the Central Minnesota Telephone Company will rebuild the local exchange at Wadena, Minn.

The Winona (Minn.) office of the Northwestern Telephone Exchange Company is soon to have a new exchange building. Bids have been taken for the erection of a two-story building, 36 by 66 feet in size.

O. H. Freeman and others have incorporated the Cushing (Iowa) Independent Telephone Company, capitalized at $50,000.

The Hawarden (Iowa) Telephone Company has been granted a franchise at Rock Valley, Iowa.

The Hawkeye Telephone Company will install an exchange at Fort Des Moines, Iowa.

The Farmers' and Merchants' Mutual Telephone Company has been incorporated at Panama, Iowa, with a capital of $50,000. N. J. Roundy is president, and William E. Bliven, secretary.

Allen Cox has purchased the Chamberlain Telephone line from Stratford, Iowa, to Linnburg.

The Plainville and Rosemont (Iowa) Telephone Company has been incorporated with a capital of $1,000.

A rural telephone company has been formed at Lake Park, Iowa, with George Lenz as president and C. C. Gregory, secretary. R.

Telephone Progress on the Pacific Slope.

W. D. DeVarney of Kansas City has secured a franchise from the City Council of Albany, Ore., for the construction of a telephone line.

Construction has started and work will be rushed on the Independent telephone line from Corvalis to Philomath, Ore. The capital was supplied by Kansas City people.

The New Westminster (B. C.) and Burrard Inlet Telephone Company is changing the route of the telephone line to Blaine, Wash., bringing it around by Cloverdale.

The telephone line of the Babcock-Benson Company is nearly completed from Quincy, Wash., west to Wilson Creek City. A line north to Farmer, Wash., is also contemplated.

Levi Larrick and associates of Wilbur, Wash., have organized the Sans Poil Telephone Company and are rushing work on the construction of a line to Sans Poil, Idaho.

O. N. Campbell, A. L. Phelps and H. Sanders have organized a telephone company at Hatton, Wash. Construction on a line west of the town connecting with Line, Kaholotus, Ritzville and Sand Hills will be begun immediately.

The Bellingham Bay and British Columbia Railway Company is constructing a private telephone line from Hampton and Everson, Wash., to Lynden.

E. T. Talkington, Abe Shaw and W. L. Talkington are the promoters of a new telephone line from Harrington, Wash., to Moscow, Idaho. It will be the second telephone line in this section owned and operated by farmers.

The Yamhill County Telephone Company has been incorporated by R. N. Snell, F. R. Post, John Versleen, J. W. Marion and J. W. Mellinger. The capital stock of the incorporation is $3,000, and the general offices will be located at Dayton, Ore. The company proposes to carry on a telephone business and will string wires wherever there may be a demand for their services. P.

Ohio Telephone Notes.

The Independent Telephone Company, of which Sol P. Kineon is the principal owner, has been enjoined temporarily from erecting poles and stringing wires in Kenton County, Ky., at the instance of the Citizens' Telephone Company, which claims to have a franchise for the county. It is claimed that the company did cease work for a time but recently resumed.

The West Milgrove Telephone Company of Fostoria has been incorporated with a capital stock of $3,000 by W. W. Rosendale, J. P. DeWolfe, S. S. Ghaster, C. D. Stearns and J. C. Rhodes.

The Chatham Farmers' Mutual Telephone Company of Chatham has been incorporated by A. B. Horst, John Yoder, W. H. Ripley, D. A. Clapp and A. R. Clapp.

Another new corporation is the Wren Telephone Company of Van Wert County, which has an authorized capital stock of $10,000. J. L. Moses, L. M. Hassman, F. W. Lichtenslinger, O. J. Herman, B. O. Jones and E. L. Sheets are the incorporators.

The Queen City Telephone Company of Cincin-

nati is preparing to apply for a franchise in Covington, Ky. It has already made application in most of the suburban towns of Cincinnati.

The Tipp Interurban Telephone Company of Tippecanoe City has announced an increase of capital stock from $10,000 to $30,000. C.

Indiana Telephone Items.

The Idaville Telephone Company of Idaville has been incorporated with a capital stock of $0,000. T. B. Ginn, F. J. Royer and G. B. Tam are among the incorporators.

The Harristown Telephone Company has been incorporated with a capital stock of $4,000, to install an exchange in Harristown and lines in Washington County. A B. Creamer, E. P. Norris and J. W. Elrod are the directors.

The Eureka Telephone Company of Mauckport has increased its capital stock from $10,000 to $25,000. The company will install some new appliances and extend its lines.

The telephone girls employed by the Home Telephone Company at Crawfordsville have gone on a strike. For several days there has been a spirit of discontent among the girls, and the climax was reached on July 1st, when none of them reported for duty. An ultimatum signed by 19 of the girls was sent to A. F. Ramsey, president of the company, demanding an increase of wages of 10 cents an hour. The company immediately advertised for girls to take their places, and it was not long until they were filled, though the untrained help greatly crippled the service. One of the grievances is that the company had employed a young woman as monitor to investigate into the cause of many complaints recently that the girls were not prompt in answering calls.

The commissioners of Jackson County contemplate the building of a free telephone system over the county, and assert that it will be conducive to encouraging the youth to stay on the farm, instead of deserting it to go to the towns and cities to live. "Something must be done to bring this about," said Commissioner Murray. "We have free roads, free mail service and must next have free telephones." F.

GENERAL TELEPHONE NEWS.

W. Lee Travers of St. Louis, J. P. Phelan of Wellston, Mo., J. D. Houseman and C. R. Black are the incorporators of the Suburban Telephone Company of St. Louis, incorporated with a capital of $100,000.

The Battle Creek exchange of the Michigan State Telephone Company is being extended into the rural districts. The exchange has a list now of 82 rural telephones, and this branch of the service is expected to increase rapidly.

The law department of the General Council of Newport, Ky., has decided to recommend that a telephone franchise be advertised for sale and the successful bidder will be required, in addition to other things, to pay the cost of advertising the franchise.

Work on the new long-distance telephone line of the American Telegraph and Telephone Company in Connecticut is progressing steadily, the erection of poles in the vicinity of Rockville being now under way. The additional service will make a new long-distance line between Boston and New York.

Local business men of Council Bluffs, Iowa, are preparing for the organization of an Independent telephone company for that city. The new company will connect with other Independent exchanges in Southwestern Iowa, and will also serve trunk facilities to the principal cities in Wisconsin and Illinois.

The Michigan State Telephone Company has purchased and taken over the entire plant of the Chelsea (Mich.) Telephone Company. The Chelsea company was an Independent company, organized eight years ago and has had a long-distance working arrangement with the Michigan Telephone Company for the last three years.

It has been reported in Babylon, L. I., that control of the stock of the New York and Long Island Telephone Company has passed to the New York and New Jersey Telephone Company. The New York and Long Island Company has stations in every large village between Jamaica and Babylon, and was slowly extending its lines eastward to other villages.

C. C. Conroy of Beaumont Texas, late owner of the Beaumont and Northwestern Telephone Company, has practically disposed of his telephone property to H. E. Huntington, it is said. The Beaumont and Northwestern has 500 miles of toll lines, 16 exchanges and over 30 pay stations, covering the oil and lumber districts of East Texas. While in Galveston Mr. Conroy said that H. E. Huntington and associates are evidently seeking control of a telephone system that will encompass all Texas and perhaps other states. He said that the Commercial, which runs from Galveston to Houston and to Beaumont is one of the Huntington properties, and this connects with the Beaumont and Northwestern. The Lone Star and the Texas Northwestern lines are said to be other supposedly independent systems in the combination.

The Internal-combustion Engine as Applied to Central-station Service.[1]

By E. E. Arnold.

As in the evolution of all things, the development of the gas engine has again proved the law of the survival of the fittest, and we now find the battle being waged between the two modern forms of heat motor cycles, namely, the four-stroke and the two-stroke cycle. The latter has its advantages and its adherents, but the former is decidedly in favor by reason of its greater simplicity and certainty of action.

In an elementary single-acting, four-cycle, single-cylinder gas engine, starting with the piston just beginning its forward stroke, the mixture is ignited and the piston advances through the power stroke. Upon its return the exhaust valve opens and the burned gases are positively expelled. Upon its second forward stroke the cylinder draws in a mixture of gas and air, which upon its second return stroke is compressed to the desired degree. These operations may be followed out in the typical indicator card.

In this elementary construction piston-rod packing and cross-head may be dispensed with, and the cylinder is brought nearer to the shaft, thus securing the utmost simplicity and compactness. In some cases of power application, however, it is desirable to obtain a more uniform crank effort, which may be accomplished by using either multi-cylinder combinations of single-acting cylinders or the latest application of the double-acting principles to gas-engine designs.

In engines employing a two-stroke cycle it has been the endeavor of the designers to avoid the exhaust and suction stroke necessary in the four-cycle engine. This is accomplished in several ways, in one of which the piston at the end of its power stroke uncovers exhaust slots or ports in the sides of the cylinder. At the end of the expansion the exhaust gases are forcibly ejected through these ports, due to the remaining pressure. Whatever gases remain are at atmospheric pressure and are finally expelled by a puff of air previously compressed by an auxiliary air pump.

Immediately following this entrance of air a charge of gas compressed by another auxiliary pump is introduced into the cylinder and the whole is then compressed by the piston upon its return stroke. In this manner the functions of suction and exhaust strokes are delegated to auxiliary apparatus, although at the expense of considerable lost power and friction.

It is evident that the effect of more uniform crank effort will be progressively advantageous to the uniformity of rotation of the engine. So with the double-tandem arrangement with cranks at 90 degrees, the crank-effort diagram will be still further smoothed out, with a corresponding tendency toward uniform angular rotation. In each type flywheels would, of course, be used, proportioned so as to keep the cyclic variation in speed from uniform rotation within some predetermined limit. It is apparent, however, that the use of heavy flywheels should be considered as a last resource in obtaining low-cyclic speed variations, which should rather be secured through the use of multiple cylinders as furnishing the most practical means of obtaining the uniform crank effort desired.

It should be borne in mind that the thrust transmitted from the piston, due to the pressure generated by combustion, forms but one of the factors making up the sum total of crank effort, and it often occurs that the inertia of reciprocating parts, further influenced by the angularity of the connecting rod at certain points of the stroke, largely counterbalances the effect of the piston thrust, so that the pressures actually transmitted to the crankpins are greatly modified.

In this connection are involved the various methods of regulation. By far the simplest and most universally used is the plain throttling governor. By this method, with a given gas, a uniform quality of mixture is maintained at all loads which will give the maximum efficiency. Speed regulation is obtained by a governor of the centrifugal type actuating a valve that proportions the quantity of mixture admitted to the load upon the engine. It should be borne in mind that the term "throttling" is not here used with the same significance as in the steam engine, in which the throttling of steam results in largely decreased efficiency.

Another method that has received considerable attention from designers is that of "impoverishing the charge" of mixture. In this method a constant quantity of air is always admitted to the cylinder, with a varying quantity of gas according to the load. It is evident, therefore, that maximum efficiency may be obtained from the cycle at only one load, while at all other loads the mixture is either too lean or too rich.

In the majority of small engines up to 50 horsepower the "hit-and-miss" method of governing is used. This is accomplished in various ways, the end sought being to proportion the number of power strokes to the load upon the engine and not their intensity.

A method of governing, which now appears to be in the ascendancy for engines of large capacity for driving generators and other machinery requiring close regulation and high economy, is that employing a cut-off gear similar in many details to that used in various forms of poppet-valve steam engines.

Several distinct fuel gases suitable for gas-engine use are available. When reduced to calorific values per cubic foot of explosive mixture of proper constituency the calorific ratings are, however, nearly equal.

This is shown by the last column in the accompanying table, which gives the chemical constituents, thermal equivalents and air required for theoretical combustion of the various gases ordinarily available for gas-engine work:

TYPICAL ANALYSIS.*

	H_2	CH_4	CO	C_2H_2 Illuminants.	CO_2	N_2	O_2	B. T. U. Cubic Foot.	O_2 for Combustion.	Air for Combustion.	B. T. U. in 1 Cubic Foot Explosive Mixture.
Coal or bench gas	46.00	40.00	6.00	5.00	.50	2.00	.5	646	1.21	6.05	91.7
Water gas	48.00	2.00	38.00	.....	6.00	5.50	.5	295	.47	2.35	88.0
Producer gas; hard coal	20.00	.....	25.00	.....	5.00	49.50	.5	144	.225	1.12	68.0
Producer gas; soft coal	10.00	3.00	23.00	.50	5.00	58.00	.5	144	.24	1.20	65.5
Producer gas; coke	10.00	.....	29.00	.....	4.50	56.00	.5	125	.195	.98	63.0
Carburetted water gas	40.00	25.00	19.00	8.50	3.00	4.00	.5	575	1.05	5.25	92.0
Coke oven gas	50.00	36.00	6.00	1.00	1.50	2.00	.5	603	1.12	5.60	91.0
Blast furnace gas	1.00	.....	27.50	.....	11.50	60.00	.....	91	.143	.72	53.0
Natural gas; Pittsburg	3.00	92.00	.....	3.00	.....	2.00	.....	978	1.945	9.73	91.0
Oil gas	32.00	48.00	.....	16.00	.....	3.00	.5	846	1.615	8.07	93.0

*A. M. Gow, Electric Club Journal, March, 1904.

The power to be developed by an engine of given proportions does not, therefore, vary within appreciable limits, except on producer gas and blast-furnace gases, when larger engines are required, or larger cylinders on the same engine frame. The rate of combustion is, however, fortunately less rapid with these than with other gases, due to the large amount of inert gases such as N and CO_2 present in the mixture. The compression may therefore be carried much higher without risk of preignition or "back-firing," thus increasing the efficiency of the cycle. With water gas the high percentage of hydrogen occasions quicker combustion and higher flame temperatures with so considerable a tendency to preignition that this gas is not well adapted to gas-engine work.

Producer gas at present offers the greatest possibilities in the field of power for general utilization, due to its comparative cheapness, simplicity of generation and high efficiency. A comparison of the approximate thermal efficiencies of the various gas processes gives the following results:

Coal gas (without coke)	24 per cent.
Coal gas (coke included)	60 "
Water gas	60 "
Water gas (special quick-blast)	75 to 80 "
Producer gas	80 to 85 "

The ordinary producer-gas equipment comprises three elementary functions—a generator, resembling on a small scale the ordinary blast furnace; a scrubber for cooling and removing ash dust from the gas, and a small boiler, usually placed in the path of the heated gases leaving the producer. This boiler supplies steam, which is later dissociated in the producer into its elements O and H.

A recently introduced process, developed by Dr. Ludwig Mond, yields producer gas and sulphate of ammonia as a by-product. A considerable amount of special ammonia-recovery apparatus is necessary, but the returns, it is stated, from the sale of the by-product, often cover the cost of the fuel.

Several by-product coke processes are also being actively exploited in this country which seem to promise good results, the object being to secure a high grade of metallurgical coke as the main product and producer gas as a by-product for use in heating processes and for power purposes.

The actual performance of the modern gas engine does not, of course, even approximate the theoretical by reason of its inability to utilize the entire heat generated in combustion. As its upper limit of efficiency, however, is so much higher than in the case of the steam engine, its net efficiency, based on actual output, approaches the theoretical efficiency of the steam engine operating under ordinary conditions.

In order to show what average performance may be expected from the modern gas engine of reasonable size a table was prepared, giving as concisely as possible the results of a large number of carefully conducted shop tests at East Pittsburg and elsewhere upon Westinghouse gas engines, ranging in size from 100 to 600 brake-horsepower. These tests were selected at random from the test records of the company, comprising nearly a thousand complete gas-engine tests, the only care being to have them representative of several types and sizes of engines manufactured.

It is the usual custom of steam-engine builders

1. Abstract of a paper read before the National Electric Light Association at Boston, May 25, 1904.

to rate and express the economy of their engines in terms of indicated horsepower. In the gas engine, by reason of the higher pressures and temperatures dealt with, it is not such an easy matter to determine accurately the indicated horsepower. For this reason the results given in the table were based entirely upon brake or useful horsepower, thus eliminating all uncertainties incident to the indicated work. Indicator cards were of course taken at uniform intervals during the tests, but are used entirely to determine the accuracy of valve settings. In the majority of these tests Pittsburg natural gas was used, ranging in effective heat value from 850 to 1,050 B. T. U. per cubic foot. On account of fluctuations, occurring at various times, calorimetric tests are made at more or less regular intervals, and whenever especially important tests are being run the calorimeter determinations are made coincidently. The consumption of gas shown varies within certain limits, but when reduced to a basis of British thermal units per brake-horsepower the results are more uniform.

In the usual form of gas engine the expansion is not carried down to atmosphere, as this would necessitate entirely too bulky construction in proportion to the extra power to be derived. The terminal pressure usually reaches about 30 pounds, which reduces the limit of theoretical efficiency to about 50 per cent., over half of which is actually obtained at the engine shaft. The losses comprise mechanical friction, heat discharged into the exhaust and heat carried away in the cylinder-jacket water.

It is, however, possible to reclaim some of this lost heat, thus increasing the total efficiency of the outfit. In several instances the hot-jacket water is sent through radiators for heating the power building and offices; in others it is circulated through the water seal in gas holders to prevent freezing in winter; in still other plants, tubular boilers have been installed in the exhaust line from the engine through which the hot-water jacket water circulates, absorbing further heat from the exhaust gases, and is finally used as feed water in an auxiliary steam plant. Thus, in one case the total efficiency of the gas-engine equipment was increased from 25 to 65 per cent.[1] Again, steam may be raised to a suitable pressure for blowing the producers.

It may be held that the performance of engines tested under highly favorable conditions in the shop is not reproduced in actual practice where the machinery is obliged to operate under less favorable conditions, both as regards load and care received. As a matter of fact, however, the good performance on the testing floor is readily secured in actual service by properly designed engines unless they are subjected to gross misusage by careless attendants, as occasionally occurs.

The numerical coincidence of one pound of coal expended in producing one useful horsepower has been long looked upon as the probable limit of steam-engine efficiency. It is therefore of particular interest that this result has already been attained by high-grade internal-combustion engines. The average efficiency of a producer-gas plant may be taken at 80 per cent., which is a conservative figure; many producers reach a higher efficiency. Assuming the calorific value of medium-grade coal as 13,000 British thermal units per pound, the heat delivered to the engine in the form of gas is 10,400 B. T. U. This figure represents approximately the duty of the engines under consideration. It may therefore be expected that a gas-power plant properly designed and equipped will show a performance of about one pound of coal per brake-horsepower on full load.

At fractional loads the coal consumption would naturally increase, but not so rapidly as might be expected. Tests by different authorities upon gas-engine plants fully confirm the above.

Mr. H. A. Humphrey gives a 2½-hour test upon a 75-kilowatt gas-engine unit operating at full load upon Mond gas with a consumption of 0.92 pound of cheap slack coal per indicated horsepower-hour. During two years' continuous running of this power plant the average coal consumption at the switchboard was 1.82 pounds per kilowatt-hour, equivalent to 1.05 pounds per indicated horsepower-hour.

An interesting comparison between steam and gas equipments may be found in two electric-power stations operated by an American concern: One covers a steam station of 1,250 indicated horsepower capacity; the other a gas station of 685 boiler horsepower capacity. Both plants operate from 15 to 18 hours per day, and the steam plant runs condensing with a slightly higher load factor than the gas plant. Results obtained upon these two plants covering a period of five to six months' operation show that the heat consumption of the steam station was about 92,000 B. T. U. per kilowatt and the gas station 29,100 B. T. U. per kilowatt-hour, or approximately one-third that of the steam-engine equipment.

In another instance a 500-horsepower steam plant, equipped with non-condensing engines and boilers fired by natural gas, was superseded by an 800-horsepower gas-engine plant. During a 24-hour test at favorable load the steam equipment required 86 cubic feet and the gas-engine equipment 21.5 cubic feet of natural gas per kilowatt-hour at the switchboard.

It may be of interest to carry this comparison a little further into the domain of cost of equipment with a view of determining whether investment in a gas-power plant will ultimately prove more profitable than in a steam plant of corresponding capacity. In order to establish a legitimate basis of comparison it is necessary to consider two factors:

First, operating conditions and the cost of labor and supplies (except fuel) must be brought to a parity; second, the proper deductions for excess fixed charges, if any, must be made from the total saving recorded in the gas plant over the steam plant.

Assume, now, two plants, each of 2,000-kilowatt capacity—one a steam station running on four pounds of coal per kilowatt-hour and the other a gas station requiring two oounds of coal per kilowatt-hour, with an average output of 400 kilowatts or 20-per cent. load factor, fuel costing $3 per ton delivered for each plant. The saving in fuel cost due to the gas station throughout its life, which we assume as 15 years, amounts to $79 per kilowatt. This represents the gross difference in fuel cost with no fixed charges deducted. If, for instance, the two plants cost $100 and $125 per kilowatt, respectively, the difference in total fixed charges in 15 years of operation amounts to $51 per kilowatt. Deducting this from the total saving in fuel cost recorded in favor of the gas plant, we have $28 per kilowatt, which represents the net saving we have in favor of the gas-engine equipment in excess of the steam-engine equipment at the end of its life.

Consider another aspect of the case. A net saving of $28 per kilowatt at the end of the life of the equipment amounts to $56,000. Per year it amounts to $3,724, which may be regarded either as revenue for increasing dividends or as interest upon increased working capital. At five per cent. an increase of $74,350 would be warranted. This fact is rarely appreciated by purchasers of power machinery, with whom initial cost is often the most important item, so that equipments of inferior quality and decidedly inferior economy are often installed rather than apparatus that in the long run will net a handsome revenue.

The high cost of the gas-engine equipment as given above is mainly chargeable to holder capacity. Without holders the cost will be much more nearly equal. Although gas engines are rather more expensive to build than steam engines, owing to the higher pressures carried, the larger number of expensive auxiliaries required in the steam plant raise the total costs nearly to an equality with the gas plant.

Installations.

The results that have been obtained from the continued operation of gas-power plants may be of interest at this point as exemplifying the above facts regarding gas-engine economy. Its field of application has been extremely broad, embracing industrial works, central-station, electric-railway companies, high-pressure gas-distributing systems, pumping stations, etc., and although specific figures are in but few cases available the general results indicate the high character of the service rendered.

A notable lighting and power plant is located at Bradford, Pa., operated by the Bradford Electric Light and Power Company, which, in 1898, converted its steam-driven plant into a gas-engine plant, employing natural gas for fuel at a nominal cost of 10 cents per 1,000 cubic feet, with a minimum contract of $3,000 per year. The steam plant burned natural gas under the boilers and required 51 cubic feet per indicated horsepower-hour, or about 86 feet per kilowatt-hour. In the second year after the conversion from steam to gas engines, the cost for gas was reduced from over $9,000 to the $3,000 minimum, and at the end of four years after the conversion, although an increase of 30 per cent. was recorded, the gas consumption of the station was still $3,000 per year, and would have been less than $1,700 per year had it not been for the previous contract stipulations. Observations upon the gas-engine station for a period of six months show an average consumption of 21.5 cubic feet of gas per kilowatt-hour for all loads and conditions of operation. The gas is somewhat richer than Pittsburg natural gas, averaging about 1.175 B. T. U. per cubic foot. The cost of fuel, labor, supplies and repairs averaged $20,000 per year for the steam plant of 500-brake horsepower, and $12,000 per year for the gas-engine plant of 800-hrake horsepower.

The Madison Gas and Electric Company is operating at Madison, Wis., a 700-horsepower gas-engine station, supplying power to the city-railway system. The station is unique, in that fuel gas is furnished from the holders of an illuminating-gas works operated in conjunction with the electric plant. A 1,000-horsepower steam station also furnishes power for lighting and part of the railway system. Upon a basis of actual cost of gas in the holders, the gas-engine plant delivers a kilowatt-hour at the switchboard at a cost of fuel over one-third less than that required for running the steam plant. The cost of coal is the same for both plants; namely, $4 per ton.

Of more than ordinary interest to central-station engineers is the operation of alternating-current generators driven by gas engines in parallel upon a common bus bar. Until very recent years, this has been considered an impossibility, and, in fact, at the present time but few forms of gas engines are well adapted to do this work. Outside of the unquestionable success of several types of European engines in this service, it is of interest that a number of American plants are now in operation and are giving excellent daily service under these exacting conditions.

Discussion.

Ralph D. Mershon, New York: This paper by Mr. Arnold interested me very much, but surprised me more, because, from all the data I have been able to obtain in this country on the prices of gas engines and their auxiliary, I have not been able to get the results Mr. Arnold got on paper. I notice in the plant on which Mr. Arnold has been figuring that nothing is allowed for relay capacity, and if that is done it will mean a greater investment and will be, of course, against the gas engine. I ask him also whether or not the rated capacity of this plant is based on the ultimate capacity of the gas engine, or very nearly so, because, if it is, the comparison, it seems to me, is manifestly unfair. I found that most of the gas-engine builders rate the gas engine at or near the load at which the engine will lie down, whereas, with the steam engine, we have at the expense of efficiency, in the case of an emergency, considerable overload capacity. It is very clear, I think, that if, as will be the case with a good many loads, the load is subject to sudden fluctuations and swings, we must have enough capacity over the average load at which the engine is running to take care of these swings. In many cases the question of relay capacity and overload capacity will be taken care of by dividing up into a considerable number of small units. It is unfair, I think, if this method is to be adopted, to help the gas engine out, to compare such a gas-engine installation with a steam-engine installation divided up in the same way. So far as I can see, from the paper, Mr. Arnold assumes that the efficiency of the gas engine and steam engine with different load factors will be the same as the one figure he has taken—the relative efficiency will be the same. It seems to me, from what I know of gas-engine performances, that the gas engine should be figured as having less relative efficiency at the lighter loads. I would like to hear from Mr. Arnold on this subject. The relative course that Mr. Arnold has taken per kilowatt for steam and gas installations widely differs from prices I have been able to get—he gives the price per kilowatt for steam at $100 and for gas at $125. I should say that the figure for the gas engine should not be under $150, and nearer $175, judging from figures I have received lately in quotations. I should like very much if Mr. Arnold will kindly separate the elements which go toward making up that price of $125. That is, the engines and electrical equipment, with the gas generator in the one case, and with the steam generator in the other case. I should also like to hear from Mr. Arnold as to the question of relative skill required in the operation of the two plants.

As to the depreciation, of course, in these figures he has taken the percentage of depreciation and assumed that the depreciation in the case of two classes of prime mover will bear the same relation as their cost, approximately, which is correct; but I wonder whether Mr. Arnold has had any data covering engines which have been in operation for a number of years to support this. I should like to hear from him on this point also.

H. G. H. Tarr, Philadelphia: The greatest obstacle probably to gas-engine development has been that we have done nothing, practically, in this country toward the development of the producer for power purposes up to the last two years. This, of course, as you understand, is an expensive process. The net result is about $1 per ton in by-products. You get from a ton of coal about 70 pounds of sulphate of ammonia, worth three cents per pound. To produce the sulphuric acid and the labor necessary to extract it amounts to one cent per pound. If the coal is worth $2.50 per ton, it reduces the cost to about $1.50 per ton. This is only applicable to the larger plants, say, plants of 50 tons capacity in 24 hours, and above. In the smaller installations, where the ordinary producer is used, or what is known as a tailer producer, the difficulty has been, and I think the general impression is you can only use coke or anthracite coal. We have now perfected this producer, so that we are running our own shops on this form of producer in connection with gas engines with most excellent results in the use of bituminous coal, so that we are now prepared to make estimates, plans and installations of the ordinary form of producer which costs us $17 to $20 a horsepower, using bituminous coal. In addition to our own plant, there is one at Vincennes, Ind., producing excellent results.

William R. Gardener, Pittsfield, Mass.: In Mr. Arnold's paper he mentions several kinds of fuel that can be, and are being, used for this purpose. I see nothing in the paper in regard to peat as a fuel. I understand these swamps, located all about us, all over the world, in fact, are simply coal in what may be called its earlier stages, upon which nature has worked only a few thousand years, or possibly a few million years, and in time will become coal. As I understand it, this fuel taken from the bogs, put through a machine and properly dried and broken up, makes a very good producer gas, and I hope that some of these gentlemen who are posted on the gas engine will give me some enlightenment on the value of this bog fuel or peat, for the purposes of comparison.

Henry L. Doherty, New York: There are a few points in connection with this discussion I hope will not be lost sight of. I think that the present development of the gas engine and the present development of the steam turbine probably gives them a field of their own. A few years ago I had occasion to install some large gas engines, some of the first turned out by the Westinghouse company, and I was

1. C. H. Williams, Madison Gas and Electric Company.

almost universally condemned for my part in that installation. There was a pronounced prejudice against the internal-combustion engine. I believe today that practically every authority on thermodynamics believes that the ultimate prime mover will be the internal-combustion engine. I will let the persons interested in these engines believe that, but I do not want to go on record as believing that myself. I do not believe it will be the steam turbine, and in my opinion if it is a question between the steam-turbine engine and the internal-combustion engine, I think the internal-combustion engine will unquestionably be the eventual prime mover. The characteristics of the steam turbine and the gas engine are very different. A gas engine is very efficient, as far as heat used for useful work is concerned, but to get efficiency from the gas engine you will find generally that you get best results at the absolute maximum capacity of the gas engine, principally because you have certain constant losses which are there in the aggregate in the same quantity, regardless of the load on the engine, and these losses even amount to 25 per cent. of the capacity of the engine. No matter what the load on the engine may be, the losses are 25 per cent. of the capacity, and therefore if you have only half load on the engine the losses become 50 per cent. At Madison, Wis., we have a gas-engine station, and are now putting into the gas-engine station a steam turbine. The ability to operate steam turbines and gas engines together, and operate them economically, and perhaps more economically than either alone would permit, is a matter which I believe to be of considerable importance. Your gas engine costs much more per horsepower at the start, and your fixed charges are therefore heavier. Now, then, if you can save a certain amount on the operating cost of a gas engine, you must be able to operate that gas engine a sufficient number of hours during the year to make that operating cost more than balance your increased fixed cost. With a low-load factor, you cannot do that, but if you already have steam engines in, I think the ideal arrangement for the use of a gas engine would be to put in an installation that would take care of a portion of your load, a portion only, and that portion which operates 24 hours a day. Instead of operating your engine to give you constant potential on the machine, if you will operate that engine so that it runs at a uniform speed, and its maximum load, and the fluctuations of the load are taken up with the present steam engines, you will secure very high economy from the gas engine. Your present steam engines, we know, are not efficient on a variable load, but a steam turbine has the characteristics of any rotary prime mover and has some peculiar characteristics of its own, chiefly the one that each part is working at the same temperature and enables you to get away from the bad effects of fluctuations of temoerature and what would be the cylinder condensation of your steam engine; and therefore by using gas engines running at maximum load and arranging the government so that the steam turbine will take up the fluctuation, you can work out a condition where you will get a higher efficiency than with either one alone.

In one plant with which I am connected we have a peculiar load—it is at a summer resort, and we recently had occasion to consider the advisability of renewing our generator equipment. We found there was one portion of our load that ran for 391 hours per year, and it was absolutely impossible to save the fixed cost on a new installation to supersede the present installation, even though the present installation is brutal in its consumption of fuel; but it was run for such a short period of time during each year that there was no opportunity to save these fixed costs.

Mr. Arnold: Replying to Mr. Mershon's remarks in regard to the relay capacity and rating of the engine, you will notice that we took into consideration a lighting plant rated at 2,000-kilowatt capacity, with a 20 per cent. load factor. A gas engine is ordinarily rated on its brake horsepower at about 15 to 20 per cent. under its maximum capacity, while the steam engines are rated on their indicated horsepower, and have, say, 50 per cent. overload on that. The difference betwen indicated and brake horsepower amounts to considerable, and the rated capacity of the two engines approach more closely than would ordinarily be supposed. The fact that this is a lighting station and had an ordinary 20 per cent. load factor, the relay capacity is well taken care of by the way the units are laid out. You can have any combination of gas-engine units or any combination of steam-engine units to fit the best load curve, and the engine blocked in in the manner which will best take care of it. In that manner it takes care of the relay capacity. You can run very small gas-engine units with aporoximately the same efficiency that you can run large gas-engine units, and the small gas-engine units are notably more efficient throughout their range of load than in the steam engine. Another point that comes right in there is the relative efficiency of the gas engine, which is spoken of as having a lower relative efficiency at light loads. I think that, while its efficiency does decrease, as does the steam engine, you will find at half load the brake kinetic efficiency of the engine is 21 per cent., that is, heat input to the heat equivalent of the work done.

In regard to the relative skill required to operate the different engines and the amount of attendance necessary, the large stations can be taken care of with much less attendance and also with less relative skill than is required in the boiler equipment of a small plant; and it has been our experience that the engineering skill, operating engineer, attendant upon the engine for the same size of engine and the same importance of the plant, is about equal.

As to the matter of the depreciation of the gas engine and its life, relative to that of the steam engine, of course, we have not had as much experience with the depreciation of gas-engine machinery as we have had with steam-engine machinery, but all the experience we have had points to the fact that the gas engine quite holds its own with the steam engine, so far as depreciation is concerned; that is, the ultimate life of the machinery. Owing to the high pressures dealt with and some of the more intricate valve mechanism employed, it perhaps will be found to cost slightly more per horsepower for repairs than a steam-engine equipment, but I do not think it will when compared to the more intricate designs of the higher types of multiple-cylinder, releasing-gear steam engines, using superheated steam and other refinements that go to make up the engine.

I would like to state a figure for a plant I have in mind for such a gas engine, a lighting station doing 24 hours' service, 800-horsepower rated capacity in five units whose complete repairs for the year 1903, including repointing of igniters and everything connected with the gas engines was $102, or something less than 13 cents per horsepower a year.

Multiple-voltage Control for Variable-speed Motors.

In all variable-speed systems of electric drive for factories where constant horsepower is required, whether it is multiple-voltage, shunt-field control or armature-resistance, the motor is always larger than would be required if a constant-speed motor were used with mechanical speed-changing devices. This is because the motor must be large enough to give the maximum power required either at the highest or lowest speed, and thus, under normal conditions of full voltage and full field, will have a capacity in excess of that necessary to do the required work. The most economical arrangement involving the use of the minimum-size motor is that in which the motor is worked up to its maximum capacity at both the highest and lowest speeds.

In straight multiple-voltage work alone, without field control, the motors are only worked up to their limit on the lowest speed. By using shunt-field control alone, the motors are limited by their capacity at the highest speeds. Therefore, by properly combining multiple voltage and field control, the advantages of both systems are obtained, and a smaller size motor for the same speed range is required. Consequently, by the proper use of field resistance to weaken the field of the motor to a point where the capacity is just equal to the capacity obtained on the lowest voltage, a system is obtained which requires the minimum size motor, and which will work this motor over the maximum range of speed. These are the features of the Bullock Electric Manufacturing Company's multiple-voltage system.

The apparatus required in the three-wire system

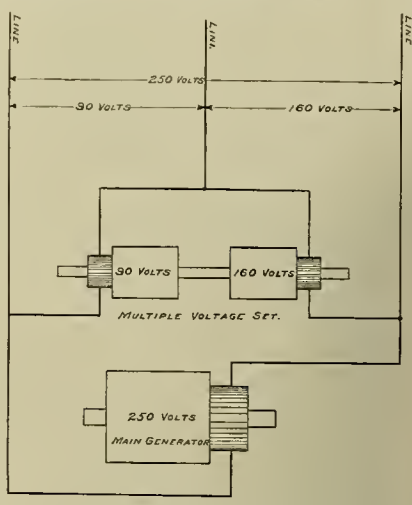


FIG. 1. MULTIPLE-VOLTAGE CONTROL.—CONNECTIONS FOR THREE-WIRE SET

includes a generator wound, preferably, for 250 volts, a balancer, consisting of two comparatively small machines, a third wire running from the balancer to the point where the motors are placed, and a controller for each motor. The balancer consists of two similar machines coupled together, the armatures of which are connected in series across the 250-volt mains, the armature for one being wound for 90 volts and the other for 160 volts. The distributing system is shown diagrammatically in Fig. 1. This gives three voltages available at the motor—90, 160 and 250. The controller connects the armature terminals to these three different voltages, whereby motor speeds are obtained proportional to these voltages. The fields of the motor are constantly connected to the 250-volt circuit. The controller is so arranged as to introduce several steps of resistance into this circuit at the proper points, and by this means 12 speeds are obtained in the forward direction and nine in the reverse, the last three steps of resistance being omitted in reversing. These speeds are so chosen that each one is approximately 20 per cent. higher than the preceding one. An external resistance is introduced into the motor armature when starting, and also when passing from one voltage to the next. This resistance is merely for the purpose of easing the transition from one speed to another, and is automatically cut out by a solenoid switch as soon as its purpose has been accomplished. A diagram of connections for a three-wire system is shown in Fig. 2.

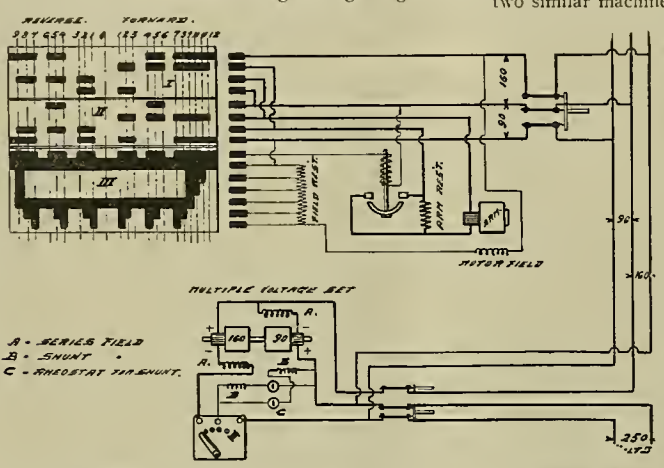


FIG. 2. MULTIPLE-VOLTAGE CONTROL.—CONNECTION DIAGRAM FOR THREE-WIRE SET.

The four-wire system is similar to the three-wire, but requires a balancer, consisting of three similar machines coupled together. Four wires are necessary, from which six different voltages are available, as shown in Fig. 3. By reference to this figure it will be seen that if the armature terminals of a motor are connected across (A) and (B), the armature will receive 60 volts; if across (B) and (C), 80 volts, and if across (C) and (D), 110 volts; if across (A) and (C), 140 volts; if across (B) and (D), 190, and if across (A) and (D), 250 volts. The same arrangement of generator, balancer mains and controller is used in this as in the three-wire system.

The arrangement of the three-wire controller is such that 26 speeds may be obtained in the forward direction and six in the reverse. The four-wire controller gives finer gradations, each speed being only seven per cent. higher than the preceding one.

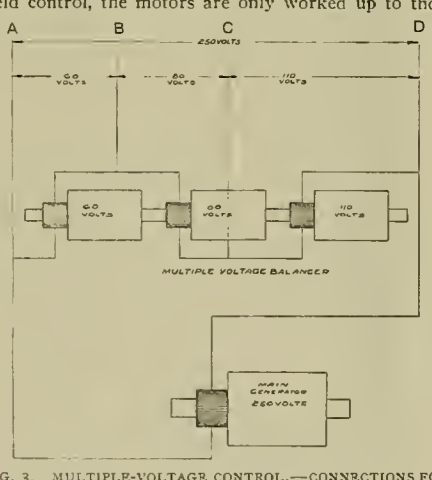


FIG. 3. MULTIPLE-VOLTAGE CONTROL.—CONNECTIONS FOR FOUR-WIRE SET.

An Associated Press dispatch from St. Petersburg relating more particularly to the use of space telegraphy by Russia in the present war with Japan, says that the question of wireless communication with Port Arthur promises to raise an interesting international problem. Some of the authorities who have been examining the question are inclined to hold that if a blockaded port communicates by space telegraphy with a shore station in neutral territory it does not necessarily constitute a breach of neutrality any more than communication over an unsevered cable, the enemy having the remedy in one case of cutting the cable and in the other of stationing a vessel rigged with wireless apparatus between the sending and receiving stations, thus interfering with communication.

Mercury-vapor Lamps for Photographic Purposes.

Mercury-vapor lamps are fast coming into favor with photographers, not only for printing work but for exposure as well. The accompanying illustrations show two applications of a photographer's outfit of this kind now in use in the studio of Edmund C. Pratt of Aurora, Ill.

Fig. 1 is a view showing the method of hanging

FIG. 1. MERCURY-VAPOR LAMPS FOR PHOTOGRAPHIC PURPOSES —LAMPS HUNG FOR EXPOSURE.

the lamps for making an exposure. Five of the lamps are mounted in a frame four by five feet in dimensions, which is hung from the ceiling by ropes and pulleys, allowing the frame to be run up and down and tilted at an angle. The lamps themselves are arranged to be tilted within the frame for starting; each requires 3½ amperes at 110 volts (direct current).

An outfit of this capacity will give a light equal to an 18 by 20-foot skylight, and by starting with one or two lamps late in the afternoon or on dark days the number may be increased as the daylight wanes, giving a light during both day and night that is practically of constant power. Sittings are made under this light with a portrait lens with from one-half to 1½ seconds' exposure.

Fig. 2 is a picture of the same outfit lowered to

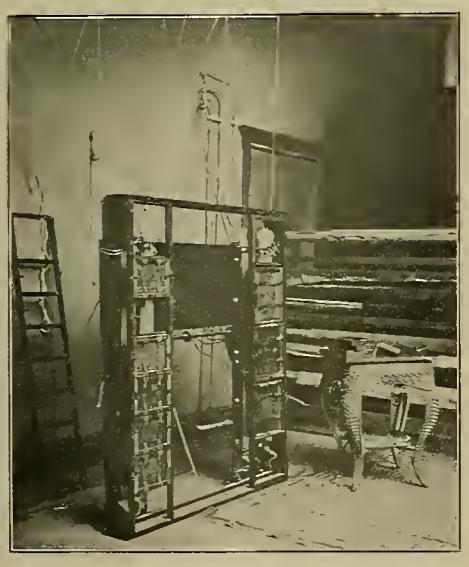


FIG. 2. MERCURY-VAPOR LAMPS FOR PHOTOGRAPHIC PURPOSES.—LAMPS LET DOWN FOR PRINTING.

the floor for printing purposes. The tubes are pushed together in two groups and the printing racks fastened to the frame immediately in front. Photographic prints can be made by this means on any printing-out or developing paper, and the light has the advantage of being practically constant, so that after one print is made from a certain plate it is known exactly how long to time each succeeding print from that plate.

The recent annual meeting of the Photographers' Association of Illinois was held in Aurora. Mr. Pratt is secretary of that association, and members were taken to his studio to inspect the apparatus which, when first installed, was the only one of its kind in the West.

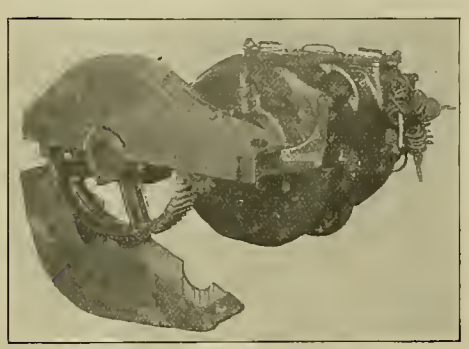
Westinghouse Railway Motor.

The Westinghouse No. 101 railway motor, illustrated herewith, embodies many late modifications and improvements and represents advanced practice in design and construction. Under usual conditions of operation a double equipment of these motors is suitable for single-truck cars, weighing from 16,000 to 18,000 pounds, without equipment or load, and for double-truck cars of equal or slightly greater weight. A quadruple equipment will, under similar conditions, successfully operate a double-truck car weighing approximately 30,000 pounds exclusive of equipment and load.

The motor has a nominal rating at 500 volts of 40 horsepower for one hour. This rating is but a comparative estimate of capacity under certain assumed conditions. It also has a continuous capacity of 35 amperes at 300 volts, or 33 amperes at 400 volts.

At the close of a shop-run of 24 hours' duration at either of these loads the rise in temperature of the motor windings, as measured by thermometer, will not exceed 75° C. When operated under a running car better ventilation is usually secured and the rise in temperature should not exceed 55° C.

The motor frame consists of two castings of high-grade steel, divided along a horizontal plane and held together by bolts. The two parts are hinged together in such a way that on the removal of the bolts the lower field may be opened down either with or without the armature and access obtained to any part for inspection or repair. The closed frame is approximately cylindrical in shape, somewhat flattened on the top. An opening over the commutator extends across the frame and is closed by a dustproof lid held in place by toggle latches. Hand-



WESTINGHOUSE RAILWAY MOTOR.

holes, closed water-tight, are located at convenient points. All covers are made of malleable iron.

Four poles of laminated steel are bolted to the frames and project inward at angles of 45° with the horizontal. The pole pieces are built up of soft-steel punchings riveted together between end plates of wrought iron. The holding bolts pass through the frame from the outside and terminate in heavy rivets provided for the purpose. The pole faces are thus left smooth and with unbroken surface. The pole tips are extended and serve to hold the field coils in place.

The coils are wound with copper strap, insulated with asbestos and mica and protected by heavy wrappings of tape. They are therefore practically moisture and fire proof. These coils are straight and interchangeable and are fitted on the poles and held in place by the spreading tips of the pole faces. Flat steel springs between the coils and frame prevent looseness due to shrinkage. Protection against mechanical injury is provided by leatheroid washers and oiled duck.

Field connections are made to terminals slotted to receive the copper strap of the coil winding, which is securely bound to the coil on each side of the terminal. By the use of terminals the wiring within the motor frame is considerably reduced.

Circular punchings of soft steel form the armature core and are built up on a cast-iron spider and secured between end plates of cast iron. The spider is pressed on the motor shaft and keyed in place. As the commutator is also mounted on this spider the shaft may be taken out and renewed, should this become necessary, without replacing any other part. The armature coils are machine-wound and carefully insulated with special material of the highest quality. They are embedded in rectangular slots in the core and held in place by retaining wedges of hard fiber. There are no band wires over the core. The retaining wedges slide in grooves punched in the armature teeth, and may be easily withdrawn should it become necessary to replace a coil.

The commutator is formed of 111 hard-drawn copper bars, separated by mica segments, built up together upon a cast-steel bushing and clamped between two V-shaped surfaces, from which they are insulated by rings of molded mica.

Two cast brass arms for the brush holders are independently supported from the upper frame and held secure by large washers of prepared fullerboard, fiber blocks and insulated bolts, which permit a radial adjustment to compensate for wear of the commutator. The holders are of the sliding type, with shunts.

Solid shells of cast iron, lined with babbitt metal and pressed in circular housings of cast iron form bearings for the armature shaft. The bearing housings are securely held between the upper and lower motor frames and retained in place by finished flanges on the inner ends, which fit finished surfaces on the frame. Screw taps are provided so the housings may be bolted to either frame and the armature, therefore, retained in either the upper or lower field when the motor is opened for inspection or repair. This arrangement also provides a safe method of handling the armature, as eyebolts may be inserted and armature and bearings removed together, without danger to commutator or winding.

Lugs cast solid with the upper frame provide for suspension from the trucks by means of bars set parallel with the motor shaft. A forged steel pinion with machine-cut teeth is keyed to the shaft and held upon a taper seat by a nut and lock washer. The gear is made of cast steel, in two parts, which are bolted together and keyed to the axle. The gear case is made of malleable iron, in two castings, separated in a plane through the center of the armature shaft and the center of the axle. The two parts are secured at front and back to the upper half of the motor frame by bolts, which pass through lugs on each half of the gear case, and the extension from the motor frame shown in the illustration.

Exposition Electrical Club.

At the second meeting of the Exposition Electrical Club, held recently in the Palace of Electricity, St. Louis, over 60 new members were admitted, including President D. R. Francis, Director of Exhibits F. J. V. Skiff, Professor W. E. Goldsborough, R. H. Pierce, chief engineer of the exhibitors' power plant; Henry Rustin, formerly chief of the electrical and mechanical department; Charles F. Foster, operating chief engineer, and the members of the street-railway test commission.

The object of the club is purely social. Active members are taken from among the exhibitors and representatives of exhibitors in the Palace of Electricity, representatives of the Electricity Exhibit Department, representatives of the electrical bureau of the Department of Works, representatives of the technical press, and all representatives at the exposition associated with the electrical industry. It is the plan to hold regular meetings every Tuesday at five o'clock p. m.

The officers elected for the term of the exposition are as follows: President, Frank H. Gale, General Electric Company; vice-presidents, W. K. Dunlop, Westinghouse Companies; H. W. Pope, American Telephone and Telegraph Company; J. W. Dunfield, Allis-Chalmers-Bullock interests; secretary, J. S. Hamlin, National Electric Company; treasurer, F. V. L. Turner, Kellogg Switchboard and Supply Company; executive committee, the officers and W. A. Layman, Wagner Electric Company; Edw. Dixon, British Electrical Section; Cloyd Marshall, Department of Electricity; C. B. Fairchild, Jr., Street Railway Review; O. A. Mygatt, Holophane Glass Company.

Elevated Trains to Run to Evanston.

An ordinance providing for the extension of the Northwestern elevated electric railway north to Evanston, Ill., is before the City Council of Chicago. It is the outcome of an agreement for the operation of the Evanston branch of the Chicago, Milwaukee and St. Paul surface steam railroad by the Northwestern Elevated whereby the Northwestern will take charge of the road and extend its service over it, provided the council adopts the ordinance permitting the operation of the road by electric power.

In consideration of the grant the company offers a five-cent fare from the northern city limits of Chicago into the city around the loop. The Northwestern Elevated is to run all its trains through to Evanston, and also will handle by electric power the freight business of the line for the Milwaukee and St. Paul, thus removing all steam power from the road. An incline from the elevated structure to the surface will be built at a point north of Montrose Boulevard. A number of the aldermen are demanding a clause in the ordinance for universal transfer on all elevated roads, and on this point the grant now seems to hinge.

Electric coin-controlled turnstiles have been installed at the St. Louis Exposition, which obviate the necessity of purchasing tickets by visitors and result in saving much time when crowds are entering the grounds. Seventy-five machines have been put in operation and are said to work admirably. It is probable that the scheme will be adopted at concessions where a fixed fee is charged for admission. Money changers occupy the booths hitherto used at the entrance for ticket sellers, but the exposition officials say that the turnstiles will save much in the way of salaries.

CORRESPONDENCE.

Great Britain.

London, June 25.—The gas companies still continue their opposition to the municipal electric-light undertakings in the Houses of Parliament. One of the biggest attacks ever made came to a conclusion yesterday, with something like a victory for the municipalities. A House of Lords' committee was called upon to confirm a large number of provisional orders conferring powers upon local authorities to supply electrical energy. In every case the local gas company opposed the orders and sought for the insertion of a clause which made it incumbent upon the municipalities to so adjust their charges at the commencement of every year as to insure, as far as possible, that the expenditures should not exceed the revenue. The gas companies argue that, as large taxpayers, they should be protected against having to pay increased rates should a loss occur upon the electric-lighting undertaking. On the face of it the clause seems reasonable, but the effect of it will be apparent when it is stated that all estimates for municipal electricity works in England are based upon a loss during the first year, and sometimes two years. Obviously, then, if such a clause were to be put upon the undertakings it would mean the raising of the price to such an extent that no one would take the current. Naturally, this has been the object of the gas companies, but the House of Lords' committee in question has put the matter upon a more firmly established basis than it has ever been before. They give new undertakings five years within which to work as they please, and then every three years the charges have to be so adjusted that no loss falls upon the taxpayers. Practically speaking, therefore, the gas companies, by their persistence, have created a precedent against themselves which will not be of much value to them.

The engineering standards committee recently convened a meeting of makers of tramway poles, with the object of arriving at some definite standards for tramway-pole construction. A sub-committee of the standards committee has in hand a standard specification for a three-section tramway pole, but before finally drafting it, it was deemed that a friendly discussion by those concerned would facilitate the work which the sub-committee has in hand. During the discussion many differences of opinion arose, but finally definite proposals were made as to the diameter of the poles. Many other matters were carefully gone into, such as the length of the sections, tests, etc., and the publication of the report of the sub-committee should make interesting reading as well as being of great practical value.

A new class of technical officer in the engineering department of the General Postoffice has been created, viz., second-class engineer. The limits of age are 22 and 24 years, and the details of the competitive examination have been published. Before a candidate will be allowed to sit for the examination, however, he must satisfy the authorities that he has had at least two years training either in a suitable workshop attached to a college or university, or under a firm of electrical or mechanical engineers of good standing. Besides the ordinary commercial subjects, the examination includes also electrical engineering.

Two more accidents have occurred to persons stepping upon the live rail of the Northeastern railway and the Lancashire and Yorkshire railway. The victims had been trespassing, yet the matter is attracting considerable attention. An inquiry has been ordered, and until that has been made no official opinion can be obtained upon the matter. The live rails are already being referred to as mantraps, setting of which is illegal here. At any rate, it may be assumed that the railway companies will give every possible attention to the matter, and with this hope many suggestions of how to avoid these accidents are being made.

A definite statement was made in the House of Commons a day or two ago as to the course which the government will pursue as to the acquisition of the National Telephone Company's undertaking. By giving six months notice from June 30th, the company's undertaking could be taken over on January 1, 1905, and this course is one which many people would wish to see adopted. But, as was foreshadowed last week, the government has decided not to do this, as being against public interest. Negotiations are in progress for a voluntary sale of the company's business, and the postmaster-general says he hopes they will be satisfactory.

The Dolter surface-contact system of electric traction is now definitely authorized to be adopted in Torquay, and it is to be hoped that the results will not lead to such recriminations in the Town Council as was the case at Wolverhampton in connection with the Lorain system there. There was a large amount of opposition to the Dolter system, but it was not of a very technical character, and failed to carry much weight. At present there are no tramways of any description, but, judging by the hilly nature of the district, the visitors to this seaside watering place would welcome some such means of conveyance. G.

New York.

New York, July 2.—The underground subway cars will commence running on September 1st. The section to be opened has been constructed at a total cost to date of $37,750,000, the money having been advanced by the city. Mayor McClellan, Mr. Belmont and all of the members of the Rapid Transit Commission are heartily in favor of the project to start off the subway with a great celebration.

August Belmont, president of the Interborough Rapid Transit Company, and currently rumored to be the leading financial supporter of Tammany Hall, left here for St. Louis on Wednesday night to open the Parker headquarters at the Democratic convention.

A rumor is both affirmed and denied that the Metropolitan street-railway system is to be controlled by the Interborough Rapid Transit Company. The price paid for the Metropolitan stock is said to be 130.

The New York Transportation Company of Eighth Avenue and Forty-ninth Street is extending its business, and now asserts that its electric cab service is cheaper than the cost of horse-drawn carriages.

The firm of which Sir Weetman Pearson, the British government contractor, is the head has been incorporated under the laws of the state of New York, with a capital of $1,000,000. This has been done in order to secure a legal status to carry out the contract for the Pennsylvania railroad tunnel.

The Hall Signal Company has secured enough contracts, it is said, to keep its works busy for several months to come. The company will equip the Lake Shore and Michigan Southern railway and also the Illinois Central railroad between Fulton, Ky., and Memphis, Tenn.

A number of cars of the Brooklyn Rapid Transit Company has been recently reconstructed and provided with a sheeting of asbestos under the flooring as a precaution against fire. All wires also are covered with asbestos. It is expected to have these cars on the tracks in December next.

At least 400 suits are said to be pending against the Brooklyn Rapid Transit Company for damages for refusal to grant transfers or a continuous five-cent fare to Coney Island. The courts last week awarded $50 damages in a test case, and the company has not up to this Saturday acted upon the judgment. The leader in the struggle is Luke O'Reilly of 44 Court Street, Brooklyn.

Nearly every week something goes wrong with the contact-shoes on the Brooklyn elevated system. Last Sunday morning on the Fifth Avenue line a loose shoe ripped up the third rail and caused the traffic to be suspended for three hours.

For reasons not made public the Brooklyn Rapid Transit Company has terminated its lease of the lines of the Nassau Electric Railroad Company, which will hereafter be worked independently. Transfers, however, will continue to be granted as heretofore.

The Degnon Company has completed tunnel section No. 3 of the Atlantic Avenue improvement, Brooklyn, and it is expected that section No. 1 will be finished in November. These tunnels are for the Long Island railroad traffic and form part of that corporation's electrification scheme.

The supervisors of Nassau County have extended the terms of two traction franchises, viz., that of the New York and Long Island Traction Company for a trolley line from Mineola to Queens, and that of the Glen Cove Railroad Company, which is also allowed to eliminate a portion of its route.

Bids for the public lighting of Merrick, L. I., will be received up to July 13th. So far the Nassau Light and Power Company has offered to furnish 30-candlepower electric lamps at the rate of $18 each for the first year, $21 for the second and $25 for the third.

A private space-telegraph installation is being put in position on the grounds of W. Gould Brokaw at Great Neck, L. I. Mr. Brokaw will utilize the system to keep in touch with his business office in New York and with his yacht at Newport. D. W. W.

New England.

Boston, July 2.—During the last week a noteworthy instance of the increasing value of the application of space telegraphy to the shipping requirements of the port of Boston was given by the signaling of the incoming steamship Ivernia of the Cunard line The following message was received from the ship at the station in South Wellfleet, Mass.: "6:30 p. m., Boston time, 75 miles east of Boston: thick fog, light breeze, slow progress. Time of arrival uncertain. How is weather at Boston light? Captain Jeffries, Ivernia." This is the first time such a message coming so long a distance has been received here from an inbound ship, and all concerned, especially the local Cunard people, are much gratified at the realization of this desired result from the experiments that have been under way here looking to this end.

The Old Colony and the Boston and Northern Electric Street Railway companies have thus far disposed of $1,000,000 par value of the new four per cent. bonds recently authorized by the Massachusetts railroad commissioners, the deals being effected at private sale.

The New York, New Haven and Hartford Railroad Company, in the furtherance of its plans for an extended use of electricity on its system, where practicable, has purchased land in Fall River as a site for a power house, it is announced, and will operate by electricity between that city and Newport, R. I., with connections and transfer arrangements at Fall River for the conveyance of passengers to Providence.

The street-railway service of Gloucester has been in a crippled condition during the last week. Lightning struck the power house of the Boston and Northern company in that city during a severe shower and circulated through the big new generator, burning out coils and tying traffic up for a few hours completely. Superintendent Roberts has been able to keep about a dozen cars in commission by utilizing the old machinery while repairs are in progress.

At New Haven, Conn., the New York, New Haven and Hartford railroad has planned to construct a train station for both steam and electric service, now that the company has acquired the street-railway system of that city and its environs. Under the proposed arrangement, passengers arriving in New Haven will find street-railway cars in waiting at the train platform to convey them to any point in the city or suburbs. The Derby branch from New Haven is to be equipped with electric instead of steam power, and negotiations are pending for the acquisition of the independent electric street-car lines in Hartford, Middletown and Danbury, it is stated, with a view to connections there similar to those made in New Haven. The new station in New Haven is to cost $1,000,000. B.

Indiana.

Indianapolis, July 4.—Three new traction lines or divisions were opened last week. The first cars of the Indianapolis Northern electric line began running between Kokomo and Peru on July 2d. A two-hour service is maintained. The new electric line connecting Angolia and Lake James and extending into the beautiful lake country of the northeastern part of the state for the accommodation of fishermen and pleasure seekers was opened on July 1st, and the Crawfordsville division of the Northwestern Traction Company connecting Crawfordsville with Indianapolis via Lebanon was opened on the same day. Cars left Crawfordsville and Lebanon containing the city officials and invited citizens simultaneously and met half way, where the Lebanon people entered the Crawfordville car and proceeded to Crawfordsville for a jollification meeting. Mayor Russell of Crawfordsville gave an address.

It is announced that John D. Rockefeller, H. J. Heintz, John Wanamaker and J. M. Studebaker have made arrangements to build a traction road from Winona Lake and Warsaw to Goshen. They propose to take only the five-per cent. gold interest-bearing bonds of the company and let all other earnings go to the benefit of the Winona Assembly, which will hold the stock.

From a source regarded as reliable comes the statement that the transfer of the Fort Wayne and Southwestern Traction Company to the McCulloch syndicate, which has the Wabash-Logansport line, was concluded last Thursday, although the signed-up papers have not yet been delivered. The two lines will now be amalgamated and will be operated as a single road from Fort Wayne to Peru and Logansport and ultimately to Lafayette, to which point the road will be extended next year. This acquisition affords the syndicate a through line between Indianapolis and Fort Wayne via Peru.

The Pennsylvania Railroad has taken off its local train between Richmond and Indianapolis. Officers of the road admit that poor business, due to the inauguration of interurban service, put the train out of commission. Before the interurbans came three accommodation trains were run between these points.

The Indiana Appellate Court has decided that the strict rule of law that a person about to cross a steam-railroad track at a highway crossing must look and listen for approaching trains does not apply to one about to cross a much-traveled street along which an electric railway is operated. F

Ohio.

Cleveland, July 2.—It is reported that the Toledo and Northwestern and the Ohio and Michigan electric roads have been consolidated under the name of the Toledo, Ann Arbor and Detroit. J. O. Zabel of Monroe is authority for the statement that the cars of the Toledo and Jackson line will be run over the tracks of the new company to Petersburg, whence a branch will run to Jackson.

J. M. Cummins is promoting an electric railway through Defiance and Williams Counties to Coldwater, Mich. It will touch both Defiance and Bryan as well as some other towns.

The report that the American Railways Company had secured control of the Dayton and Xenia and the Springfield and Xenia roads has been denied, but at the same time it is said that plans are being formulated by which a through service will be inaugurated between Dayton and Springfield and that the cars will pass over these two lines.

C. V. Wagner, G. W. Acker and P. S. Willis of Toledo are arranging to incorporate a construction company for the purpose of building an electric railway from the heart of Toledo out through Washington and Sylvania Townships to provide for an entrance for three interurban roads into the city.

The Rocky River Water, Light and Power Com-

pany of Rocky River, a suburb of Cleveland, has been incorporated with a capital stock of $75,000. Christian Burkhardt and Charles P. Corlett are among the incorporators.

Ten thousand people attended the first consolidated picnic given by the Cleveland Street Railway Employes' Association at Manhattan Beach Park last Wednesday.

John E. Monnot of Canton is projecting an electric railway to connect that city with Youngstown. The proposed line would also connect with the Canton and Akron, Canton and Massillon and the New Philadelphia line.

The Dayton and Northern Traction Company will shortly increase its passenger rates, as they have been too low, in the opinion of the management, to justify the service that has been given and meet the necessary expenses.

Warren Kahley, electrician at the plant of the Kenton Gas and Electric Company, Kenton, was killed a few days ago while switching current from one dynamo to another. His fingers came in contact with the metal on the switch plug.

John J. Lentz, ex-congressman from Ohio, is working on a plank for government ownership of the telegraph for the Democratic platform. He wants the telegraph made a part of the postal system of the country.

The Ohmer Fare Register Company, incorporated in New York, has been admitted to Ohio to transact business. The stockholders are Dayton and Cincinnati men. John F. Ohmer of Dayton will be the Ohio representative of the company and the factory will probably be located in that city.

J. Richards of Lebanon has been granted a franchise to build an electric railway through Xenia. Mr. Richards is planning a road from Xenia to Lebanon paralleling the Pennsylvania steam road.

The Urbana, Bellefontaine and Northern tracks are built over a peculiar sinkhole near Round Prairie that has given much trouble. The ground sinks with the weight of the tracks and has defied all attempts to fill it. Carloads of stone and other material disappear within a short time and the tracks are as low as ever.

The consolidation of interurban roads centering in Cleveland has been discussed of late by some of the men interested. It is said the plan has a number of friends, but that others object. O. M. C.

Michigan.

Detroit, July 2.—E. R. Phinney of Detroit has secured the right-of-way for the new electric line from Ionia to Owosso. A great many farmers are willing to give the right-of-way free, in order to get the road, which will be called the Ionia and Owosso electric railway. The work of grading on the road will begin on September 1st.

The city attorney of Monroe has been authorized by the council to start proceedings against the Detroit, Monroe and Toledo Short Line (electric) to ascertain the company's right to haul freight through the streets while it is organized under the general steam-railway act.

A new electric-railway company has been incorporated which will be known as the Flint and Saginaw Traction Company. The company will build an electric line from Flint to Saginaw, via Mt. Morris and Clio, and it is intimated that those behind this project will work in conjunction with the promoters of the Detroit, Flint and Saginaw road and that there will be a merger of the interests of the two companies.

The city of Ithaca is bonding itself for $13,000, the money to be used for building a municipal electric-lighting plant.

The water and electric-light plant at St. Ignace was destroyed by fire last week, entailing a loss of $5,000. The city is left entirely without lights and without fire protection.

The Grand Rapids Street Railway Company has issued a very attractive handbook on points of interest in and about the city and its outskirts. It is illustrated with sketches and half-tones and comprises 36 pages, with two colored plates.

A $375,000 block of Detroit Edison Company bonds has been sold in Boston, the proceeds of which will be used in completing the new Delray plant.

The Detroit United Railway, in connection with merchants of Detroit, has inaugurated what is known as "Trolley Day," a holiday, in which shoppers all over the territory of suburban lines reaching Detroit are given an excursion every Tuesday to Detroit. Announcements giving the names of merchants, their places of business, how to reach them and a list of the excursion rates in effect, have been printed. The rates of fare are a little out of the ordinary, as, instead of offering a flat rate, each merchant gives a reduction in the fare in proportion to the amount purchased.

The Eureka Manufacturing Company has been incorporated with a capital of $5,000. The company will make automobile machinery.

The Grand Ledge Electric Power Company has been incorporated, and is capitalized at $5,000.

The McHardy-Peterson Motor Car Works of Detroit has been organized. The capital is $100,000. J. H. McHardy is at the head of the company.

A new company has been organized to construct an electric railway from Battle Creek to Gull Lake, Gunn Lake and other points between Battle Creek and Grand Rapids, a distance of 65 miles. The name of the company is the Battle Creek and Grand Rapids Inland Lakes Traction Company, capitalized at $520,000.

Bids are now being received for the construction of the new municipal electric-lighting plant at Bay City. It is stated that the electric-lighting committee will have the lighting plant combined with the commercial plant and installed in a new building adjoining the waterworks property. West Bay City has a proposition to occupy the old waterworks in view of the fact that the two cities will be consolidated in 1905.

The merger of the Consolidated Traction Company which operates the Jackson city lines with the Detroit, Ypsilanti, Ann Arbor and Jackson Railway is denied. It is stated that arrangements have been entered into between the two companies whereby the Detroit, Ypsilanti, Ann Arbor and Jackson line will rent power from its Michigan Center power house to the Consolidated Traction Company when the latter company's power houses are taxed beyond their limit or a breakdown should occur.

The Detroit Motor Car Company is seeking a site in Wyandotte and has asked for free water and exemption from taxes for a period of 10 years. It also asks that $50,000 worth of stock be subscribed for in Wyandotte.

The city of Buchanan, after being in darkness for 10 months, is now being lighted by electric lights.

The J. F. Esley Milling Company of Plainwell will soon have an electric-power plant. The old mill property has been purchased and an up-to-date electric power house will be equipped with water power. C. G. W.

Southeastern States.

Charlotte, N. C., July 2.—A number of cotton mills at Rock Hill, S. C., are contemplating installing electrical machinery to operate the mills. Power will be obtained from the Catawba Electric Power Company's plant at Fort Mill, S. C.

Citizens of Memphis, Tenn., are agitating the question of a cross-town car line to shorten the present routes. The proposed line is suggested largely with a view to operating with the present system of the Memphis Street Railway Company.

The State Corporation Commission of Virginia has decided that the labor tickets and transfers between the Seven Pines line of the Virginia Passenger and Power Company and the intersecting line of the Richmond Passenger and Power Company in the city of Richmond should be continued as heretofore, and the advance in rates which would follow from granting the petition of the two companies is not permitted.

E. E. Mendenhall of High Point, N. C., is at the head of the Yadkin River Power Company of Spencer, N. C., which proposes to operate an automobile line. The capital will be $10,000.

A temporary restraining order has been granted the Western Union Telegraph Company to prohibit the city of Richmond, Va., from interfering with its poles, wires, etc. The injunction is the result of the undergound-wire ordinance passed by the city some time ago. L.

Northwestern States.

Minneapolis, July 2.—The Mahaska Construction Company has been incorporated at Oskaloosa, Iowa, with a capital of $10,000, for the purpose of building an electric power plant.

The Grand Forks (N. D.) Gas and Electric Company will spend $20,000 in improving its gas and electric-light plant. A new fireproof building will be erected and new machinery installed.

The Fox River Electric Railway and Power Company has installed the machinery in its new power plant at Green Bay, Wis.

James Bradbury has resigned as superintendent of the street-railway system at Winona, Minn.

The construction by the Des Moines Interurban Railway Company of a line to Perry, Iowa, is assured.

The franchise of the Electric Gas and Power Company at Albert Lea, Minn., has been extended to 25 years. R.

Rocky Mountain States.

Reno, Nevada, July 1.—The La Brisca Company will put in a large electric plant to light and run its works near Magadalena, Ariz.

Simon Bamburger of Salt Lake City has interested a syndicate of California capitalists in his project of converting the Salt Lake and Ogden railroad into an electric system. The intention is to extend the road to Ogden.

The Utah Construction Company is to erect a power plant in Weber Canyon, near Ogden, for the generation of 2,000 horsepower. The plan is to take the water out of the Weber River, near Strawberry Creek, and convey it by means of a pipe line around the wall of the canyon on the north.

The citizens of Reno, Nev., have subscribed over $20,000 toward the construction of an electric street railway in Reno, which will connect with Sparks. Dr. H. E. Reid and H. J. Darling, members of the committee which has the matter in hand, have petitioned the City Council of Reno for a 50-year franchise.

Articles of incorporation have been filed at Boise, Idaho, by the Crane Falls Power and Transportation Company, with headquarters at Boise. The incorporators are W. D. Bean, A. J. Nothacher and J. O'Neill of New York. The company is organized for the purpose of generating electric power to operate the company's plants.

The J. R. Wright Gravity Motor Company has been incorporated at Reno, Nev., for the purpose of manufacturing and generating power. The incorporators are J. R. Wright of Trenton, Mo.; J. J. Moore, G. A. Hoffman, Chillicothe, Mo., and others. The capital stock is placed at $1,000,000.

The Idaho Consolidated Power Company has just incorporated at Cheyenne with a capital stock of $2,000,000. The new company takes in all the existing power plants of Southeastern Idaho and controls all the properties and franchises of the American Falls Power and Light Company, the Bozeman Light and Power Company, the Blackfoot Light and Power Company, and the Rexburg Light and Power Company, also the water rights of A. H. Tarbit on the Snake River. It is the purpose of the new company to merge the three existing plants at American Falls into one plant, and the capacity of 4,000 horsepower will be increased to 25,000. The old companies are now supplying power to Pocatello, Blackfoot, Ross Fork and Rexburg, Idaho. The new company intends to extend the field, eventually reaching the mines near Butte. The officers of the new company are A. H. Tarbit, president; J. H. Brady, vice-president and general manager; G. W. Standrod, treasurer, and W. S. Chaney, secretary. A.

Salt Lake City, July 1.—A project has assumed definite form among promoters at Lewiston, Idaho, who have interested eastern capital for the installation of an electric power plant on the Grand Ronde River about 25 miles from that city. The plant will have a capacity of from 5,000 to 10,000 horsepower, and it is estimated that the total cost of the enterprise, including tunneling and the construction of transmission lines, will be about $500,000. It is the design to supply Lewiston and all the cities of the Palouse country with electrical energy and for street railways in the larger cities. The local representative of the project is E. H. Libby of Lewiston.

A franchise has been granted to A. B. Johnson of Libby, Mont., for the construction of a power plant and the operation of a telephone system in Flathead County.

A postponement in the foreclosure case of the Salt Lake Water and Electrical Power Company at Salt Lake City, Utah, has been secured by M. H. Boutelle and others representing an eastern syndicate, who propose purchasing the holdings of the company. The plant is located on the Jordan Narrows and was established at a cost of about $100,000. The establishment of a second plant of a large capacity is contemplated by the prospective purchasers.

The Boise (Idaho) Traction Company has entered into a contract with the Boise-Payette Power Company for a supply of electrical energy for its system. For this purpose a new generator has been ordered by the power company of 300-horsepower capacity. Additional cars will be operated when the generator arrives. G.

Pacific Slope.

San Francisco, July 1.—The San Francisco, Oakland and San Jose railway has received 12 more cars for its interurban electric road from the St. Louis Car Company. These were brought overland on their own trucks and made up a complete train in themselves.

The Northern Mountain Power Company has commenced suit in the Superior Court at Redding, Cal., to condemn a site for a power plant on the banks of Trinity River about two miles below Junction City.

James Smith of New York has sold the electric-railway system in Santa Cruz, Cal., to F. S. Granger, who will improve the roadbed of the old line and lay heavier rails at once. The change does not include the Capitola line.

The city of Healdsburg, Cal., invites proposals for furnishing a 200-horsepower Corliss engine, boilers, etc., a 150-kilowatt generator, 66 cycles, 2,300 volts, belted type, with exciter, synchronizer and other appliances necessary to connect in parallel with the machine now in operation.

It is reported that the California Gas and Electric Corporation contemplates making some extensive improvements and additions to the electric plant at Electra, Cal.

The Board of Trustees of Alameda, Cal., will soon advertise for bids for a 150-kilowatt generator to replace the 90-kilowatt generator now in commission at the municipal electric-light works.

The towns of San Jose and Palo Alto, Cal., are to be joined by an electric road. C. B. Good, representing a syndicate of Boston capitalists, is attending to the preliminary details.

The Corona Gas and Electric Company is to enlarge the plant at Corona, Cal., and has created a bonded indebtedness of $40,000 for this purpose.

The Key Route, operating an electric line in Berkeley and Oakland, is to install an interlocking block system with semaphore signals. A.

Seattle, Wash., July 1.—The Consolidated Electric Light Company has been incorporated at Portland, Ore., by H. M. Basford, C. P. Johnson and Clarence Johnson. The capital stock is placed at $10,000, with principal place of business at John Day, Grant County, Ore.

Upon the assurance of J. J. Bonevan that work

would be resumed at once upon the Nooksack Falls plant, near Bellingham, Wash., the council extended the company's franchise, which had expired 18 months ago. The company has expended $110,000 in the work, and to complete it will cost about that much more.

The Elk River Power and Light Company has started work at Elk River Falls, B. C., and will erect a large power house, the power to be used by various industries in the Crows Nest Pass.

D. L. Huntington of the Washington Water Power Company is selecting a route for a high-voltage transmission system to a number of mines near his line.

The Chilliwack Electric Light and Power Company of Chilliwack, B. C., of which J. B. Morgan is the head, expects to install a new electric-lighting system.

Some extensive improvements are planned for the Oregon Agricultural College. A new dynamo is to be installed, also a switchboard to cost about $1,000.

The Prossner Falls Electric Company is contemplating installing electric lights and power in Nabton and Sunnyside, Wash.

The British Columbia Copper Company is installing a large amount of electrical machinery in its smelter at Greenwood, B. C.

The La Grand (Oregon) Light and Power Company has sold out to J. A. Thornson, C. J. Thornson, T. Thornson and C. J. Broughton of Dayton, Wash.

The Nanaimo Electric Light Company will install a power plant near New Westminster, B. C.

The citizens of Elma, Wash., are contemplating the construction of an electric-light plant.

H. W. Fellows of Spokane, Wash., is contemplating the construction of an electric-light plant in Harrington, Wash.

Robert Houston has been granted a franchise in Snohomish County, Wash., to build and operate a trolley line over the county road to Arlington. This franchise is part of the big system which begins at Seattle.

The Ballard Electric Company of Ballard, Wash., has made good progress with the installation of its new power plant. The buildings that were burned last winter have been rebuilt and some of the new machinery installed.

A. Welch, A. Hoff, Carl Delischiemer and L. Sommer of Baker City, Ore., and L. Lowengart of Portland have purchased the Citizen's Light and Traction Company's property at Salem, Ore., for $100,000. Mr. Welch has for the last two years been the general manager of the Baker City Electric Light and Power Company. Under his direction the company has just completed a large waterpower electric plant on Rock Creek. He has disposed of his interest in that company to become manager of the Salem property. P.

PERSONAL.

R. S. Mueller of Chicago has been appointed manager of the Cleveland branch of the Kellogg Switchboard and Supply Company, to succeed A. B. Kartz, who recently tendered his resignation. A. J. Roberts will be the assistant manager.

C. B. Humphrey, for some time manager for the Westinghouse Electric and Manufacturing Company at Cincinnati, has been made manager of the company's Detail and Supply Department in Pittsburg. This is in the nature of a deserved promotion.

William J. Hammer, consulting electrical engineer of New York city, is in St. Louis, where he will place on exhibition his unique collection of incandescent lamps, which includes specimens of every kind of filament lamp ever manufactured either experimentally or commercially.

F. W. Pardee recently resigned his position as corresponding secretary of the Chicago Writing Machine Company, to become the general manager for Frank B. Cook of Chicago. Mr. Pardee is well known among electrical men and should prove a valuable man in his new capacity.

Secretary and Treasurer R. P. Tell and Advertising Agent Harry M. Klingenfeld of the National Electric Company, Milwaukee, were visitors to Chicago last week. Mr. Tell and Mr. Klingenfeld only spent a day in Chicago, and the latter left in the evening for St. Louis to visit the World's Fair.

Harry R. King, designing electrical engineer of the Western Electric Company of Chicago, was married on June 21st at Leadville, Colo., to Miss Irene Baker. Mr. and Mrs. King will remain in Colorado for their honeymoon, spending the next few weeks in the mountains near Rifle. Mr. King has been connected with the engineering department of the Western Electric Company for several years, during which time he has formed a wide acquaintance among the electrical men of Chicago.

John Reed Bowen, formerly of Chicago, died at his summer residence in Sedgewick, Pa., on July 2d after a long illness. He was an electrical and mechanical engineer, employed by Robert W. Hunt & Co., at their Pittsburg office. He was born in Chicago in 1873 and was a graduate of the Chicago Manual Training School and of Cornell University. While in Chicago he was a member of the Chicago Athletic and the River Forest Golf clubs. During the last four years Mr. Bowen has resided in Pittsburg. Three years ago he married Miss Florence Talbot of Chicago. Mrs. Bowen and two children are living.

A. L. Spitzer of Toledo, Ohio, vice-president of the Jackson and Battle Creek (Mich.) Electric Railway Company, had both his legs broken in an accident on his road near Marshall, Mich., last week. The motor in a local car gave out, it is said, and a limited car running at 50 miles an hour collided with the disabled car.

S. P. Grace, chief engineer of the Central District and Printing Telegraph Company of Pittsburg, has earned and received the degree of electrical engineer from the University of Michigan, having previously taken the degree of bachelor of science in civil engineering from the same institution. Mr. Grace fulfilled all the requirements for the degree of electrical engineer, and was not the recipient of the honorary degree of master of engineering, as erroneously stated in the Western Electrician last week.

Herman F. Witte, general superintendent of the Otis Elevator Works, died of apoplexy at his home in Yonkers, N. Y., on June 26th. Mr. Witte was born at Blue Island, Ill., in 1860. He was formerly superintendent of the Crane Elevator Works of Chicago, but upon the consolidation of the companies he was made the general superintendent. He had been in poor health for some time. Three weeks ago he was summoned to Chicago by the death of his father, and since then he failed rapidly.

About 50 members of the General Electric Company, chiefly from the New York office, met on Thursday, June 23d, to present to Mr. Ralph Beach a handsome silver punch bowl, on the occasion of his leaving the company to take up a new and important post as president of a steel and iron company in Mexico. Regrets were expressed at Mr. Beach's departure and hearty good wishes for his success were given by those present. Mr. Beach has been connected with the General Electric and Thomson-Houston companies for the last 17 years.

A sad accident befell Professor D. C. Jackson, head of the department of electrical engineering of the University of Wisconsin on the afternoon of July 1st, in which his mother was killed and he himself was severely injured, as was also his wife and Mrs. Erastus Milo, wife of the former president of Fisk University, who was visiting them. While driving on University Drive, Madison, Wis., Professor Jackson was overcome with a sudden weakness and fainted. Lack of control caused the team to run away. As the result, Professor Jackson and his wife each had an arm broken. Mrs. Jackson, who was killed, resided at Pittsfield, Mass. In this peculiar chapter of accidents Professor Jackson will have the sympathy of many friends.

ELECTRIC LIGHTING.

About $8,000 will be expended by the town of Aberdeen, Md., for purchasing or establishing an electric-light plant.

The city of Louisville, Ga., has voted $10,000 bonds for the improvement of the electric-light plant and waterworks system.

Bids for a complete outfit for an electric-light plant will soon be asked by the city of McKinney, Texas, the city having decided to erect a plant.

The City Gas and Electric Company of Paris, Ill., has been incorporated with a capital of $150,000 to operate a gas and electric plant. A. J. Baber, W. J. Hunter and J. E. Parrish are interested.

A company to be known as the American Electric Lighting Company has been formed at Oakdale, Ky., by Charles Hess and associates of Louisville. The company has been incorporated with a capital of $10,000.

The Gillespie Electric Light Company of Gillespie, Ill., has been incorporated to maintain and operate an electric-light and power plant. The incorporators are C. W. Smith, G. W. Schmidt, Jr., and others. The capital of the company is $15,000.

At Hillsboro, Ill., the board of supervisors has granted the privilege to the Hillsboro Electric Light and Power Company to erect and maintain electric-light wires over the highways of the county, so as to connect Hillsboro with Butler, Coffeen, Irving and Raymond.

ELECTRIC RAILWAYS.

John S. Crump of Columbus, Ind., has been in Paducah, Ky., for some time looking after the proposed electric road from that place to Cairo, Ill. An attempt is being made to finance a company in the East to build the line. The idea is to build the road to Cairo and then extend it into Indiana.

Earnings of the St. Louis Transit Company since the opening of the exposition show a decided increase. The gross earnings for May last were $838,000, as compared with $642,000 for May last year, an increase of $196,000. The first 23 days of June show an increase of $203,000 in gross earnings over the corresponding period last year. It is reported that the banking syndicate which purchased the $8,000,000 bonds will await the expected profitable results of the exposition business before making an effort to resell the bonds.

The Boston and Worcester street railroad has made a successful trial of running a two-car train from Worcester to Brookline village. The cars were run in multiple control, one motorman having complete control of the motors on both cars. It was the first experiment that the road has made of this kind.

Work is about to be commenced on the East St. Louis, Waterloo and Chester interurban electric railway. The first strip of track will be from East St. Louis to Falling Springs, passing through East Carondelet and Columbia, Ill. The company is composed of wealthy residents of East St. Louis, Columbia, Waterloo and other towns in St. Clair and Monroe counties.

The Metropolitan West Side Elevated Railroad Company has secured permission from the Chicago City Council to construct a line in Fifth Avenue, from its own line in Van Buren Street to the new terminal, located on Fifth Avenue, between Jackson and Van Buren Streets. With these lines connected up the company will have an independent loop, capable of handling and turning around the trains coming into its new terminal, including those of the Aurora, Elgin and Chicago electric railroad.

F. G. Dunn and Captain Ward of San Francisco, associated with capitalists from San Jose, have been granted a franchise by the secretary of the interior to build an electric railway into Yosemite National Park. Associated with these in obtaining the franchise was W. C. Ray, a well-known promoter. This is the first franchise ever granted by the government for an electric road into any government reservation in any state. The road will commence at Merced and, running north to the Merced River, will follow its windings into the valley. The terms of the franchise require that stations be constructed every 10 miles. It is definitely announced that work will be begun this summer.

In the traffic reports for June both the South Side and Metropolitan elevated roads in Chicago show a falling off compared with June a year ago, while the Northwestern Elevated shows a gain of 1,651 passengers a day. The Metropolitan carried an average of 110,923 passengers daily during June this year as against 111,613 last year; the lack of ball games on the West Side being given as the cause. The closing of the Washington Park racetrack is probably the cause of the falling off of the South Side business; the company having carried daily in June, 1903, 85,265 passengers and only an average of 81,405 in June this year.

POWER TRANSMISSION.

The shareholders of the Niagara, Lockport and Ontario Power Company have voted to increase the capital of the company from $1,000,000 to $10,000,000.

The city of Covington, Ky., contemplates building and installing an electric power plant at a cost of about $75,000. The plant is to have a capacity for supplying 350 arc lights and 150 32-candlepower incandescent lights.

The Glencove Power, Manufacturing and Supply Company of Belair, Md., recently incorporated for the development of waterpower and transmission of electricity, has been organized, with C. A. Andrew as president.

Thirty-three men are reported to have been killed in the new main pipe line operating the turbines of the West India Electric Company, near Spanish Town, 10 miles from Kingston, Jamaica. About 150 men were at work in the pipe line removing sand and debris which had accumulated, owing to recent heavy rains, when water was turned on without warning and a desperate fight for life is said to have ensued. Those who were saved escaped through manholes. The company operates the street cars at Kingston.

SOCIETIES AND SCHOOLS.

The Canadian Electrical Association now has a membership of 375, compared with 344 a year ago. The 1905 convention of the association will be held in Montreal.

On June 30th the land and building fund of the American Institute of Electrical Engineers amounted to $62,752. Recent contributors of $1,000 and over were Thomas A. Edison, $5,000; Peter Cooper Hewitt, $1,000; M. I. Pupin, $5,000; Elmer A. Sperry, $1,000.

At the annual meeting of the Philadelphia branch of the American Institute of Electrical Engineers Horatio A. Foster was elected chairman, H. F. Sanville, secretary and treasurer, and J. F. Stevens, C. W. Pike and Paul Spencer were chosen as the board of managers.

It will be unnecessary this year to secure special rates on the certificate plan for the benefit of delegates and visitors to the conventions of many of the electrical associations which convene in St. Louis during September on account of the low rates issued by the several passenger associations between St. Louis and other points.

MISCELLANEOUS.

B. S. Rairden, United States consul at Batavia, Java, says that magnetic-iron sand has recently been discovered on the south coast of Java, and it is reported to be very valuable. The persons who made this discovery have obtained concessions from the government, but, it is said, have no capital to work them, and are ready to accept any fair offer in order to form a company for the establishment of an iron and steel plant. Mr. Rairden says he will gladly give further information.

The "grave and reverend seigneurs" who control the advertising department of the New York Edison Company have broken into verse:

There was an old Turk of Jahore
Who rushed to the summer seashore;
But the up-to-date man
Just started his fan
And brought the sea breeze to his door.

Some permeability tests recently made by Prof. Benjamin F. Bailey of the University of Michigan upon specimens of steel from the Detroit Steel Casting Company, show very good results. A rough steel ring had a permeability much higher than that usually obtained in practice. The permeability ranged from 1,720 at 5,500 lines per square inch to 782 at 100,000 lines per square inch, and it required only a magnetizing force of 40 ampere-turns per inch to produce this number of lines. To produce 85,000 lines of force per square inch required 22 ampere-turns per inch length. With ordinary steel, according to "Weiner's Practical Calculation of Dynamo-electric Machines" it would require 43 ampere-turns per inch. With this steel it would be possible to take 100,000 lines per square inch as the working magnetization instead of the usual 85,000, effecting a saving of 15 per cent. in the size and weight of the magnet. The results of tests upon a machined ring, after annealing, showed up even better than with the rough ring. The results of the latter tests showed that at the maximum usually employed, 100,000 lines per square inch, the annealed ring required 31 ampere-turns, the rough ring 39, wrought iron 91, and ordinary cast steel 100.

TRADE NEWS.

James Wilkinson, it is reported, will establish a plant at Birmingham, Ala., for the manufacturing of the Wilkinson steam turbine which he has invented.

Gilbert W. Mullikin, who has been doing business as the Stewart Electrical Company in Cincinnati, has made an assignment to Alfred G. Allen. He named his assets as $3,000 and liabilities at $14,500.

The Ministry of Public Works in Cairo, Egypt, will purchase a large quantity of telegraph materials to be delivered at Suakim from October 1st to December 1st next. Among the supplies required are 220 miles of insulated wire, 6,000 insulators, wooden telegraph poles, etc.

The Interstate Electric Company of New Orleans has been awarded the contract to wire and light the town of Woodville, Miss. Isaac G. Marks, manager of the contracting department of the company, said that the task would be a large one, and the whole city would be wired and lighted and a power house built.

The F. Bissell Company of Toledo, Ohio, announces that to avoid litigation an arrangement has been made by which the W. G. Nagel Electric Company has sold to the F. Bissell Company its patent on cable trolleys and all merchandise and good-will in connection therewith. This makes the F. Bissell Company the exclusive manufacturers of cable trolleys, it is said.

BUSINESS.

The Kuhlman Electric Company of Elkhart, Ind., says that calls for its transformers are exceptionally good and that it is rushed to keep up with orders.

The J. W. Morrison Lumber Company, successor to the Fay & Morrison Company of Minneapolis, wholesaler and dealer in cedar products, reports a very satisfactory business. The company says that it handles carefully inspected poles for use on telephone lines, etc., and that it has large stocks and can make prompt shipments. The company has a number of yards conveniently located in the heart of the cedar country.

The International Telephone Manufacturing Company of Chicago has completed delivery of the new exchange equipment for the Portage Telephone Company, Portage, Wis. It consists of the company's latest type lamp-line central-energy switchboard arranged for an ultimate capacity of 1,200 lines and equipped for the immediate operation of 500 lines, together with complete power-plant equipment, consisting of storage batteries, charging machines, power board, battery cabinet, etc. The Portage exchange has also placed an order for 400 central-energy telephones, and after the work of installation is completed will have a thoroughly up-to-date exchange. It has entirely rebuilt the outside construction, placing all of the wires in the business portion of the city underground.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued (United States Patent Office) June 28, 1904.

763,350. Lightning Arrester. Garrison Babcock, Chicago, Ill. Application filed September 20, 1902. Renewed April 18, 1904.

Line and ground carbon plates have continuous surfaces provided with transverse ribs or corrugations. A retardation fuse wire is pressed into the corrugations between the plates and insulated therefrom.

763,351. Selective Signaling System. Garrison Babcock, Chicago, Ill., assignor to the Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y. Application filed May 18, 1903.

A series of sub-stations each equipped with a magnetic selective apparatus are connected by an electrical circuit. Automatic means cause electric-current impulses to traverse the circuit to cause the actuation of the selective apparatus, and automatic means short-circuit the circuit between succeeding current impulses.

763,355. Electric-fixture Support for Outlet Boxes. William F. Bossert, Utica, N. Y., assignor to the Bossert Electric Construction Company, Utica, N. Y. Application filed January 9, 1904.

An independent and detachable insulating piece between the inner end of the fixture support and the wall of the box has a stationary spherical surface engaging a movable spherical surface on the inner end of the support. Adjustable means hold the surfaces to each other and to the wall.

763,364. Third Rail for Electric Railways. Jacob Caesar, New York, N. Y. Application filed March 2, 1903.

The rail is placed on the under side of flaring flanges, which serve to protect it. Contact is made on the under side.

763,366. Lock for Levers in Interlocking Machines. John P. Coleman, Edgewood, Pa., assignor to the Union Switch and Signal Company, Swissvale, Pa. Application filed October 8, 1903.

A lever of an interlocking machine has an arm suitably connected. A lock in its set position limits the movement of the arm. Means operate the lock from its set position, and detents carried by the arm prevent the lock returning to its set position until after a movement of the arm.

763,368. Electric Coke Oven. Michael R. Conley, New York, N. Y. Application filed September 8, 1903.

The coke oven is comprised of a body of non-conducting material and electric-resistance plates arranged in the inner wall of the body, the plates being in opposed pairs and the several pairs being on different horizontal planes, whereby a series of heating zones are produced.

763,369. Process of Making Coke. Michael R. Conley, New York, N. Y. Application filed September 8, 1903.

Electrical resistances are used to heat the interior walls of the coke oven to incandescence.

763,374. Telephone System. William M. Davis, Chicago, Ill., assignor to the Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y. Application filed March 2, 1903.

Besides the usual apparatus there are a test contact associated with the cord-connecting apparatus, an auxiliary source of current, and a test relay adapted when testing to be energized by the auxiliary source of current to close a local circuit through a test winding and the common source of current. (See cut.)

763,379. Alternating-current Induction Motor. George B. Dusinberre, Edgewood Park, Pa., assignor to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Application filed December 29, 1902. Renewed August 8, 1903.

In an induction motor having a rotary secondary member there are provided windings adapted to polyphase currents. Interleaved resistance coils having exposed inner surfaces are rigidly mounted upon the shaft of the rotary member. A short-circuiting contact device and means for moving it along the coils longitudinally of the shaft is also provided.

763,386. Alarm Device. Elbert L. Fitch, Highland Mills, N. Y. Application filed December 12, 1903.

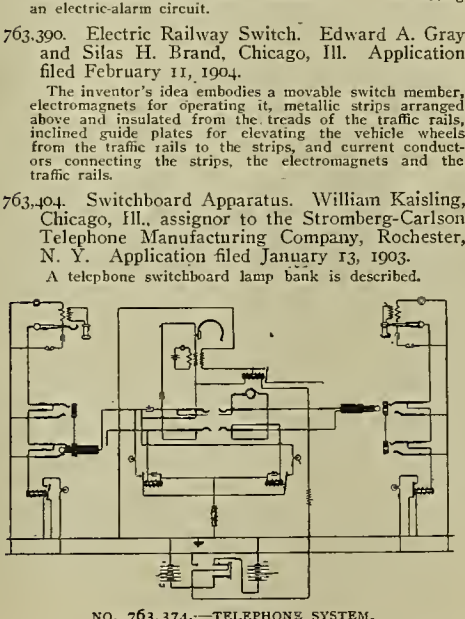
A window protecting device consists of wires interlaced across the window and connected to a lever closing an electric-alarm circuit.

763,390. Electric Railway Switch. Edward A. Gray and Silas H. Brand, Chicago, Ill. Application filed February 11, 1904.

The inventor's idea embodies a movable switch member, electromagnets for operating it, metallic strips arranged above and insulated from the treads of the traffic rails, inclined guide plates for elevating the vehicle wheels from the traffic rails to the strips, and current conductors connecting the strips, the electromagnets and the traffic rails.

763,404. Switchboard Apparatus. William Kaisling, Chicago, Ill., assignor to the Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y. Application filed January 13, 1903.

A telephone switchboard lamp bank is described.



NO. 763,374.—TELEPHONE SYSTEM.

763,411. Automatic Electric Block Signal. William A. Luby, Kalamazoo, Mich. Application filed June 25, 1903.

The signal circuit has a source of electric energy, an electromagnet and a circuit interrupter; a differential electromagnet is arranged to actuate the interrupter. The track circuits of two abutting signaling blocks control the differential magnet.

763,412. Automatic Electrical Exchange. Frank A. Lundquist, John Erickson and Charles J. Erickson, Chicago, Ill., assignors to themselves, John Anderson, Salina, Kan., and the Globe Automatic Telephone Company, Chicago, Ill. Application filed December 2, 1893.

An automatic electrical switch has a series of contact points arranged in groups, the groups being arranged in two rows. Circuit-closing devices—one for each of the groups—are movable into contact with the different contact points in their respective groups. Means are supplied whereby the circuit may be closed alternately through the groups of contact points in different rows.

763,429. Automatic Signaling System for Railways. William N. Owen, Conway, Ark. Application filed October 7, 1903.

In a railway-signaling system are an alarm circuit, including a switch and an operating circuit independent of the switch, including a polarized relay for opening or closing the switch. Means on the moving vehicle complete the operating circuit to render the alarm circuit effective.

763,434. Insulating Support for Electric Third Rails. Frederick R. Slater, New York, N. Y., assignor to Robert W. Lyle, New York, N. Y. Application filed May 28, 1903.

An insulating support for electric conductor rails comprises an insulating base, a sectional rail chair mounted transversely upon the top of the base and having at its top means for supporting and clamping the rail, and a transverse bolt passing through the sectional chair and clamp structure below the rail support.

763,435. Contact Device for Under-contact Third Rails. Frederick R. Slater, New York, N. Y., assignor of one-half to Robert W. Lyle, New York, N. Y. Application filed June 20, 1903.

A contact device for under-contact third-rails comprises an upwardly bearing gravity contact shoe, and anti-jarring means for maintaining the normal gravity action.

763,464. Circuit-closing Device. Albert B. Chance, Centralia, Mo. Application filed April 6, 1903.

A hook switch for telephones is described.

763,479. Process of Electrolytic Manufacture of Aluminum. Gustave Gin, Paris, France. Application filed May 14, 1903.

Aluminum may be manufactured by decomposing by an electric current an electrolyte formed by a molten mixture in definite proportions of fluoride of aluminum and sulphide of sodium in which one molecule of fluoride of aluminum and three molecules of sulphide of sodium are present.

763,495. Electric-lighting System for Vehicles. John A. Little, St. Louis Mo., assignor to the Globe Electric Company, St. Louis, Mo. Application filed October 3, 1903.

Located upon the vehicle is a dynamo, the armature of which comprises a number of circuits. A battery is energized from one of the circuits, and electromagnetic means from another of the circuits, for controlling the flow of current through the battery.

763,501. Electric Transmitter. Arthur J. Mundy, Boston, and Albert E. Smith, Waltham, Mass., assignors to the Submarine Signal Company, Waterville, Me. Application filed September 8, 1903.

One of a pair of carbon plates having opposed relation to each other contains a number of recesses. Independent elongated pieces vary electrical resistance lengthwise in the recesses in contact with both plates but in separated relation from each other.

763,509. Trolley Guard and Finder. William F. Reichenbach, Rochester, N. Y. Application filed October 15, 1903.

A pair of guide arms are hinged to the trolley axle and are controllable from the car by a cord.

763,510. Magneto-electric Generator. Benjamin P. Remy and Frank I. Remy, Anderson, Ind. Application filed March 14, 1903.

An igniting generator is described.

763,515. Train-operated Time-signal System for Railways. William B. Severance, Auburn, N. H. Application filed November 10, 1902.

Combined with an electrically operated signaling device are normally open electric circuits, a time mechanism having a closer for one of the circuits, a controller for the time mechanism, electrically operated means in the circuits to actuate the controller and train-operated means to close and reopen the circuits.

763,516. Apparatus for Demonstrating the Efficiency of Lightning Rods. Harvey Simpson, Burlington, Wis. Application filed February 29, 1904.

Upon a portable model building is an electrical-conducting rod, provided with upwardly projecting points. A source of electrical current supply has one pole connected with the rod. A movable device constitutes a terminal of opposite polarity for the current supply and is adjustable into and out of proximity to the points.

763,520. Electric Switch. Walter S. Tobie, Augusta, Ill. Application filed February 10, 1904.

The switch blade is pivoted in a housing and is normally held closed with the line wire contact by a spring. A cord is connected to the blade for opening the switch

and a catch holds it when once opened. Another cord is attached to the catch for releasing it and allowing the blade to fly closed.

763,540. Railway Signal. John P. Coleman, Edgewood, Pa., assignor to the Union Switch and Signal Company, Swissvale, Pa. Application filed February 2, 1903.

The signal is operated pneumatically, the valves being opened and closed by electromagnetic means.

763,547. Alternating-current Induction Motor. George B. Dusinberre, Edgewood Park, Pa., assignor to the Westinghouse Electric and Manufacturing Company. Application filed February 27, 1904.

The rotatable secondary member is associated with spiral resistance coils having exposed edge surfaces and mounted to rotate with the secondary member. A contact device is so constructed and disposed as to be movable by centrifugal force to gradually cut the resistance coils out of circuit as the motor speeds up.

763,565. Secondary Battery. Jacob W. Madigin, Toronto, Canada. Application filed January 10, 1903.

The electrode comprises a perforated horizontally corrugated plate having the perforations extending through the corrugations and finished free from projecting lips around the perforations. A solid reinforcing bounding rim cast around the plate is burned to the edge, and active material extends from bounding rim to bounding rim all over the plate and is locked to the plate through the perforations and covers the entire surface on each side of the plate within the rim.

763,613. Automatic Signal. Thomas F. Keating, New York, N. Y. Application filed January 14, 1903.

In a signal for railway cars are two or more electric circuits with signal lamps in the circuits. One or more circuit-breakers have connections between the circuit-breakers and the brake mechanism, whereby one or more circuits are made when the brakes are applied and broken when they are released, depending upon the space through which the brakes move.

763,615. Potential-varying and Current-reversing Apparatus. Maurice Laur, New York, N. Y. Application filed September 4, 1903.

The apparatus comprises a screw, a motor to rotate the screw, and a pole changer for reversing the current in the motor circuit.

763,657. Electrical Apparatus for Therapeutical Purposes. John P. Brown, Rogers, Ark. Application filed April 20, 1904.

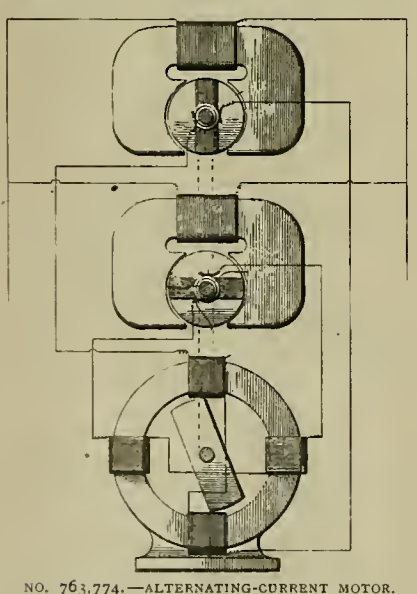
The electrode comprises the contact element. A supporting post carries the contact element, while a belt-engaging device is carried by the outer end of the post.

763,658. Control of Dynamo-electric Machinery. Eugene R. Carichoff, East Orange, N. J., assignor to the Sprague Electric Company. Application filed August 1, 1901.

Combined with an electrically operated controller are a series of consecutively acting magnets. Circuits are provided for the magnets, and a switch for the circuit of each magnet, except the magnet first operated, which is closed by the magnet which precedes in operation.

763,674. Electric Battery. Pierre J. Kamperdyk, New York, N. Y. Application filed October 14, 1903.

Beadlike masses of carbon compose the electrode, and a metallic conductor, proof against corrosion, is inclosed in the masses.



NO. 763,774.—ALTERNATING-CURRENT MOTOR.

763,741. Pump-controlling Apparatus. George V. Ellis, New York, N. Y., assignor to the Ellis Company, New York, N. Y. Application filed January 18, 1904.

A pump driven by a motor is stopped when the water is lowered to a predetermined level by a float, which, falling, breaks the motor circuit.

763,755. Combined Telephone Receiver and Transmitter. Johan G. Holmström, Stockholm, Sweden, assignor to the Elektromilitära Aktiebolaget, Stockholm, Sweden. Application filed August 14, 1903.

A telephoning instrument consists of a casing, a receiver and a transmitter mounted in the casing. A partition of sound-deadening material is situated within the casing between the diaphragms of the receiver and transmitter and separates them.

763,759. Trolley. George A. Hunsinger and Edward A. Dewald, Allegheny, Pa. Application filed January 20, 1904.

Pivoted arms are carried on the trolley harp to guide the wheel upon the wire.

763,766. Signaling Means for Railroads. Horatio A. Johnson, St. Paul, Minn. Application filed November 9, 1903.

Magnets are arranged in the master circuit and an armature connects with each of the magnets. A lamp circuit contains a source of energy arranged in connection with the armature.

763,772. Apparatus for Wireless Telegraphy. Guglielmo Marconi, London, England, assignor to Marconi's Wireless Telegraph Company, London, England. Application filed November 10, 1900.

A signaling instrument comprises an induction coil, the secondary circuit of which includes a condenser discharging through a means which automatically causes oscillations of the desired frequency. An open circuit is electrically connected with the oscillation producer and a variable inductance is included in the open circuit.

763,774. Alternating-current Motor. Mitford C. Massie, Washington, D. C., assignor of one-half to Max Georgii, Washington, D. C. Application filed February 12, 1904.

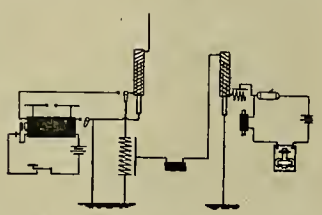
Alternating current is passed into means for changing the current into a number of periodic currents, each of which has the amplitude of its successive waves varying periodically. The periodical variation of the amplitude of the waves of one current is out of phase with the periodical variation of the amplitude of the waves of the other current. (See cut.)

763,803. Signaling System for Telephone Exchanges. Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Company, Chicago, Ill. Application filed October 26, 1901.

A combined ringing key and supervisory signal for switchboard-cord circuits comprises circuit-changing switch contacts, an actuating device, a detent adapted to engage the actuating device and an electromagnet. A movable armature of the magnet is mechanically connected with the detent to withdraw it and release the actuating device of the switch.

763,812. Resistance for Electrical Uses. James F. Tracy, Sheridanville, Pa., assignor of one-half to William H. McFadden, Pittsburg, Pa. Application filed December 12, 1903.

Embodied in the starting box is a non-conducting tubular holder or shell, a core formed of comminuted conducting material, a series of contacts arranged in the shell or holder and electrically connected to the core, and a contact movable along the stationary contacts.



NO. 763,893.—SPACE-TELEGRAPH INTENSIFIER.

763,820. Trolley Pole. Andrus S. Weaver, Joy, N. Y. Application filed August 19, 1903.

The trolley pole is provided with an automatic folding head.

763,845. Means for Securing the Stators and Rotors of Electrical Machines in Adjustable Relation. Hans Böhmländer and Rudolph Pfeifer, Charlottenburg, near Berlin, Germany. Application filed February 24, 1902.

The machine is made up of a stator core, a series of screw bolts arranged at intervals and securing the core to the frame, and other adjustable screw bolts alternating with the securing bolts and serving to regulate the distance intervening between the core and frame.

763,861. Electric Regulating Switch. Henry W. W. Dix and John Sandford, Birmingham, England. Application filed December 21, 1903.

Stationary contacts, a rotatable shaft arranged parallel to them, a helical movable contact slidably, but non-rotatably, held on the shaft, and a stationary rack engaged by the helical contact, are the essential parts.

763,890. Safety Grating. Gustav T. E. Henriksen, Milwaukee, Wis. Application filed December 2, 1903.

A grating is composed of crossbars and vertical tubes secured in the bars and of rods revoluble and movable endwise in the tubes. An electric alarm is adapted to be operated by the release of any of the rods, and means normally support the rods out of operative relation to the alarm, and release them when they are turned in the tubes.

763,893. Wireless Telegraphy. William S. Hogg, Washington, D. C., assignor of one-half to the Greater New York Security Company, New York, N. Y. Application filed September 22, 1902.

An intensifier is made up of a thin metallic plate folded to form a number of points, and is covered with insulation. A collector plate is located near the points and in inductive relation thereto, while a case incloses both of the plates with means for effecting electrical connection through the core with each of the plates. (See cut.)

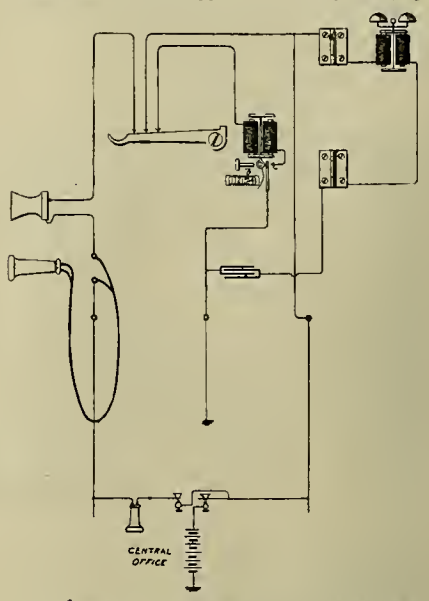
763,894. Coherer. William S. Hogg, Washington, D. C. Application filed February 9, 1903.

Receiving apparatus comprises two coacting wave-responsive devices, one of which is self-restoring, and the other of which is non-self-restoring. A circuit common to both devices and a translating device are connected in the circuit.

763,908. Submarine Telegraphy. Isidor Kitsee, Philadelphia, Pa. Application filed October 28, 1899. Renewed December 22, 1903.

In long-distance telegraphy the method of overcoming the shifting of the zero consists in causing, through the varying movements of the receiving device, a normally mechanically and electrically independent second device to move in unison with the shifting of the zero, thereby electrically connecting with the receiving device and actuating a local circuit.

763,911. Call Register for Telephone Systems. Jacob W. Lattig, West Bethlehem, and Charles L. Goodrum, Philadelphia, Pa., assignors to the Eastern Telephone Manufacturing Company, Westchester, Pa. Application filed June 6, 1903.



NO. 763,911.—CALL REGISTER FOR TELEPHONES.

A service meter comprises a register and a plunger adapted to operate it. An electromagnet controls the lock of the plunger. A circuit-closer is operated in the initial movement of the plunger, connects the electromagnet to the circuit terminals, together with means to determine the flow of current in the circuit, whereby the plunger may be released and permitted to operate the register under some circuit conditions and not others. (See cut.)

763,921. Electrically Controlled Automatic Block System for Operating Railway Signals. Alfred Oesterreicher, Vienna, Austria-Hungary, assignor of one-half to Lorenz Nemelka, Vienna XI, Austria-Hungary. Application filed October 4, 1902.

An automatic block-signal system embodies short lengths of a locally arranged overhead line. A contact establishes communication between the line and is operated by the starting lever of the locomotive into and out of operative position. A motor is arranged at the block and operating signal devices, together with means for establishing communication between the line and the motor.

763,939. Automatic Train-signaling and Recording System. Frank R. Wood and Daniel F. Shamberger, Sparrows Point, Md. Application filed August 24, 1903.

Transmitter mechanism is common to all of the circuits of the system and includes means for grounding a portion of one of the main-line circuits and cutting out the remaining portion to permit sending in a signal through the grounded portion and prevent signaling through the cut-out portion of the main-line circuit.

EXPIRING PATENTS.

Following is a list of electrical patents (issued by the United States Patent Office) that expired on July 5, 1904:

365,776. 365,777. 365,778. 365,779. 365,780. 365,781. Telephone Transmitters. James A. Ponta, Philadelphia, Pa.

365,787. Electric Clock System for Pneumatic Dispatch. Andrew Bryson, Jr., and Henry S. Mudge, Brooklyn, N. Y.

365,842. Electric Cartridge. 365,843. Electrical Breech-loading Firearm. Edgar A. Monfort, New York, N. Y.

365,911. Police Telephone System. William H. Eckert and John A. Seely, New York, N. Y.

365,935. Electromagnetic Annunciator Drop. Joseph J. O'Connell, Chicago, Ill.

365,978. System of Electrical Distribution. Thomas A. Edison, Llewellyn Park, N. J.

365,982. Transmitter for Printing Telegraphs. Stephen D. Field, New York, N. Y.

365,994. Printing Telegraph. Clarence L. Healy, Brooklyn, N. Y.

366,021. Electromagnetic Motor. Henry M. Paine, Newark, N. J.

366,034. Galvanic Battery. Carl Seiler, Philadelphia, Pa.

366,058. Electric Belt. Robert F. Williams, Dallas, Tex., and Turner G. Hammer, New Orleans, La.

366,124. System of Electric Distribution. James F. McElroy, Lansing, Mich.

366,166. Printing-telegraph Transmitter. Clarence L. Healy, Brooklyn, N. Y.

366,173. Junction Box for Electric Conductors. John Kruesl, Brooklyn, N. Y.

366,174. Electrical Conductor. John Kruesl, Brooklyn, N. Y.

366,176. Thermotic Circuit Closer. John C. Mackey, Phœnix, N. Y.

366,178. Printing Telegraph Receiver. Henry Mahnken and Clarence L. Healy, Brooklyn, N. Y.

366,190. Electric Telephony. Alfred G. Safford, Washington, D. C.

366,192. Polarized Relay. Granville T. Woods, Cincinnati, Ohio.

366,184. Electric Rock Drill. Lucius J. Phelps, New York, N. Y.

366,164. Electrolytic Vaporizer for Medicinal Purposes. Manly M. Gillam, Philadelphia, Pa.

WESTERN ELECTRICIAN

EVERY SATURDAY

Vol. XXXV. CHICAGO, JULY 16, 1904 No. 3

Electropneumatic Control for Metropolitan Elevated Railway in Chicago.

Extensive improvements are being made in the train equipment of the Metropolitan West Side Elevated Railway Company in Chicago, which involve changing from the present single-motor-car or (electric) locomotive system of operation to the Westinghouse electropneumatic system of multiple train control. It will be seen that this is an undertaking of no small magnitude when it is remembered that the company owns 350 cars which must be overhauled and re-equipped. Of this number 87 are motor cars, and besides these 69 new motor cars will be added, which are now building. To make these changes and at the same time keep up the regular schedule of trains which carry from 110,000 to 120,000 passengers a day entails a great expenditure of time and labor. Added to this is the fact that the newly equipped cars are raised three inches higher on the trucks, making it impossible to run them in the same trains with cars not yet changed, since the air-brake connections could not be made and the couplers would not connect unless one or the other were offset, which would be impracticable.

The cars when equipped will embody what is regarded as all the latest improvements in the electropneumatic system of control and also the latest air-brake mechanism. Thus far one five-car train has been completed and is now in operation while other cars are in various stages of completion. The equipment of the first train naturally involved more or less experimentation in order to ascertain the best and quickest method of installing the apparatus upon the cars, so that in the succeeding trains this system might be followed with no loss of time, using standard lengths of conductors and templates for the construction of the various parts that must be built in the shop.

Fig. 1 is a view of the first train to be operated by the new system, and was taken a few hours before the train was first run out upon the line for actual service. The picture is of a five-car train with one motor car at each end. It is now the intention of the company to operate each five-car train with a motor car at each end and three-car trains with one motor car in front. Whether this plan will be adhered to in actual operation remains to be seen. The system, however, is such that any combination of motor cars and trailers may be made as desired.

In general the electropneumatic system consists of devices so arranged as to utilize compressed air from the air-brake system for the operation of the main switches in the motor circuits. Electromagnetic valves govern the admission of air to the operating devices, the electromagnets of these valves being in a separate low-voltage circuit entirely distinct from the motor circuit. This low-voltage circuit is the only one which it is necessary to establish from car to car, and is also the only one brought above the floor of the car. The complete equipment of a single car consists of a switch group, a reverse switch, two controllers and the necessary resistances. This apparatus is all very compactly arranged beneath the floor of the car, as is shown in Fig. 2, which is a reproduction of a photograph taken beneath the car. The arrangement as shown requires the minimum amount of space and is such that the leads may be carried directly back to the motors from the switch turret.

The switch group consists of a number of independent or unit switches, grouped together radially around an air reservoir, as shown in Fig. 2, and operated by means of small air cylinders controlled by electromagnetic valves. Referring to Fig. 3, which is a drawing showing one of the turrets in section, it will be seen that in the center below the air reservoir there is a single blow-out coil which gives a powerful field at the point of switch contacts.

A switch group for two 200-horsepower motors is made up with 13 unit switches to effect the necessary motor and resistance combinations. The switch-arm rotates upon a support by motion of a piston, as shown. Upon the switch-arm are carried the contact fingers, which have independent motion upon a contact-arm, which is in turn affected by springs. The operation of these secures the initial contact at the point of the removable contact tip and the final or resting position at the surface. The wiping or rocking motion of the fingers maintains positive contact, upon which the deterioration is a minimum. The piston of each cylinder is connected to the insulated switch-arm and carries at its other end an interlock switch which follows the movement of the piston.

FIG. 1. ELECTROPNEUMATIC CONTROL FOR METROPOLITAN ELEVATED RAILWAY IN CHICAGO.—FIRST FIVE-CAR TRAIN WITH NEW EQUIPMENT.

Upon the outer edge of the cylinder casting are bolted eight magnet valves. These are ironclad and thoroughly protected. To the cylinder casting is also bolted the supporting plate, which forms the top spider for the magnetic blowout. Supported by this plate, but insulated from it, are switch-contact studs serving as connection points for the various motor leads. These studs and connecting wires are enclosed in a tight insulating box, protecting them from dust and moisture, with sealed outlets for connection to the car wiring.

The interlock switches are electrically connected with the magnet valves in such manner that the closing of one switch energizes the magnet of the next succeeding one, thus producing an automatic progressive action. When the magnet is energized its armature is attracted, opening a valve affording passage from the air chamber to the cylinder, supplied with air from the auxiliary control reservoir at 70 pounds per square inch. The piston makes its downward stroke, compressing the piston spring and operating the switch, which closes or opens the contacts on the interlock. When the magnet circuit is opened the armature is released, exhausting the cylinder to atmosphere and cutting off the supply to the air reservoir. It will be noted that the normal position of the switches is open, and that failure of the

air supply or interruption of the operating circuit opens all the unit switches.

A reversing switch is supplied and is enclosed in the sheet-iron casing shown at the left in Fig. 2. The function of the switch is to interchange the armature polarities of the motors with respect to the field. It consists essentially of an insulating block provided with two sets of contact strips and arranged to make contact with stationary fingers by simple straight-line motion. The block is moved in one direction or the other by means of two pneumatic cylinders, the admission of air being controlled by electromagnetic valves similar to those on the switch group and likewise energized from the controller. An electrical interlock is provided on the reverse switch so that the switch group cannot be operated unless the reverse switch is fully thrown in the direction indicated by the controller.

The controller, which governs the action of the switch groups throughout the train, is located in the motorman's cab. It is of simple and compact construction, measuring approximately seven inches high, six inches wide and four inches deep. It consists of a revolvable drum and stationary contact fingers, which are electrically connected to the various magnet valves. On the exterior is an operating handle and a dial indicating three positions for each direction of the car, the "off" position being in the center. The operating circuit is supplied from a 14-volt storage battery and includes the controller as the operating device and the armatures of the magnet valves on the switch groups as the parts actuated.

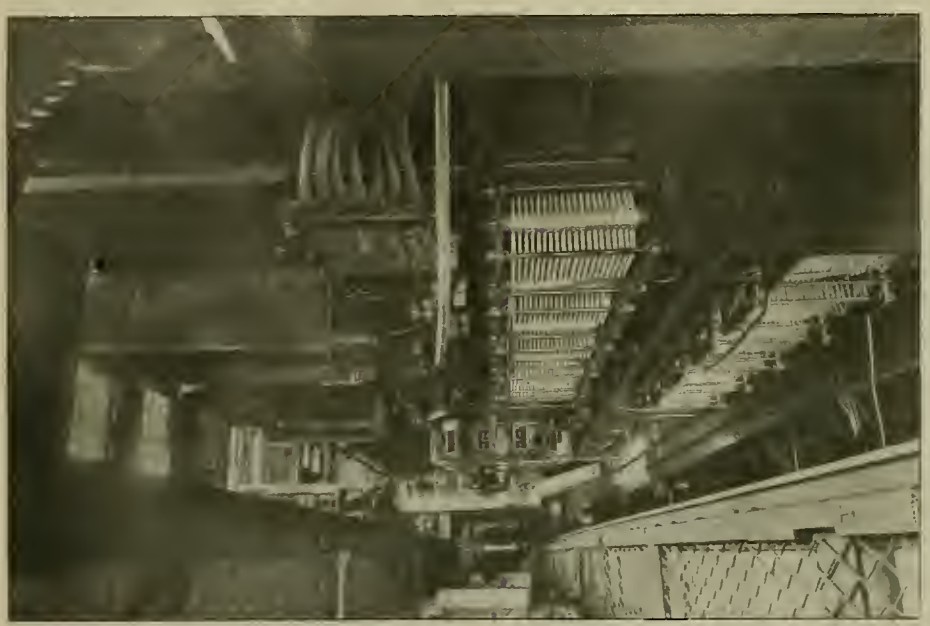


FIG. 2. VIEW SHOWING APPARATUS FOR ELECTROPNEUMATIC CONTROL ON UNDER SIDE OF ONE OF THE NEWLY EQUIPPED METROPOLITAN CARS.

By examining Fig. 4, which is a diagram of motor connections, and Fig. 5, a diagram of motor and resistance connections, the following explanation will be made clear: In the "off" position of the controller all unit switches are open. The first position throws the reverse switch forward or reverse, according to which side of the center the operating handle is moved, and connects the motors in series with four steps of resistance, giving a position for shifting or slow-speed running. The second position closes the unit switches in such a manner that the four steps of resistance are successively cut out by means of the automatic action of the interlock until the motors are in series with no resistance. No further changes will take place until the handle is moved to the third position, when the change from series to multiple connection of the motors with three steps of resistance in series is smoothly made by the closing of the appropriate unit switches. These steps are then successively cut out, leaving the motors finally in multiple with no resistance. Switches will remain in this condition until the handle is thrown to the "off" position.

The rate at which the resistance is cut out of circuit is such as to give a practically uniform accelerating current, and this is effected by means of the limit switch. This feature is a valuable one, as it gives a smooth, uniform acceleration and prevents the motorman from throwing on the power in excess of a predetermined rate. This also relieves the motorman of the nervous strain entailed in concentrating his mind for hours at a time upon the proper acceleration of his train.

The limit switch consists of a small solenoid, through the coil of which current from one motor passes. When this current exceeds a predetermined limit its armature is attracted against gravity, opening a pair of contacts in the operating circuit and holding these open so that no further switches can close (those already closed, however, being suitably retained) until the accelerating current falls below the predetermined limit. The armature drops, completing the operating circuit again, which allows the unit switches to continue their progression of closing. They are thus interrupted at each step of resistance.

It will be seen that the handle of the master switch may be thrown to the extreme advance position (and this will be the ordinary service condition) with the car at a standstill, when the car will accelerate at constant current until all resistance is cut out and the full voltage applied to motors.

The progressive action of the unit switches can be arrested and held at any point by moving the controller handle back to the first position.

Current for the operation of the magnet valves is secured by a storage battery of seven cells having a capacity of 40 ampere-hours. Two batteries are provided in each car, one being on charge in series with pump-motor circuit, while the other is on the operating circuit.

The positive side of the battery is connected to the controller and is carried through the entire train as one of the seven wires of the train line. The negative is connected on each car to the negative side of the magnet valves. This arrangement localizes the current demand from a battery to its own car.

The use of a low-voltage battery to operate the electromagnetic valves is of advantage, obviating the necessity of running high-voltage circuits through the train and making the operation of the control independent of fluctuations of the line voltage. The capacity of either of the batteries is more than sufficient to operate the brake mechanism during a single day's run, so that the motorman is not required to attend to the switching of the batteries on to the charging or operating circuits, this being done in the barn before the car is taken out.

Connecters employed to establish the electrical connection between the cars in one train consist essentially of two sockets and a pair of plugs connected by a short cable. The sockets, which are mounted on the end of the motor car, are provided with seven split pins mounted on insulating bases, the pins being located in the interior of the socket, and effectually protected from injury.

The plugs consist of a cast-iron shell surrounded by a piece of insulating material, in which are set seven small brass sockets corresponding to the split pins in the main sockets mounted on the car.

There is also provided a line relay to open all unit switches should the current supply fail. It consists of a magnet connected across the current-supply mains with resistance in series, the armature of which holds two contacts in the operating circuit closed against the tension of a spring. This device is a decided advantage where there is any considerable break in the continuity of the third rail, such as often occurs at switching points, and has been used with good results on interurban roads where the third rail is interrupted at crossings.

Heavy Electric Traction by Alternating Currents.[1]

By F. M. Lincoln.

Again and again the prophecy has been made that the steam locomotive is doomed to extinction—that electricity will take the place of the steam locomotive in through service on trunk lines just as it has replaced the horse as a motive power for local service on urban and suburban lines. The displacement of the horse as a motive power has been complete. Not only that, but the field previously occupied by the horse has been broadened and extended until the service rendered has approacned both in weight of vehicles, speed and distance traveled, the service rendered by steam trunk lines. In view of the extremely rapid growth of electric traction in extent as well as in weights of the cars and speeds, the prophecy that the steam locomotive is about to pass is not a surprising one.

With this prediction in mind, therefore, the writer recently undertook to look up the records of one of the large electric manufacturing companies to find the extent in which electricity has been substituted for steam. The writer had in mind such well-known examples as the equipment of the Baltimore and Ohio tunnel in Baltimore, the New York elevated lines and the proposed electrification of Pennsylvania and New York Central systems in and around New York. Recalling these he expected to find many typical examples where electricity had displaced steam for various kinds of traffic. It was surprising to find, therefore, that the examples above mentioned are practically the only ones where such substitution has been made or actively undertaken in this country. There are a number of examples where the service rendered by electricity is comparable in many respects to that rendered on trunk lines, but such service almost invariably has been due to the expansion of an urban or suburban-electric system, and does not indicate any tendency on the part of the trunk-line managers to adopt electricity as a motive power. Even in the cases cited above where electricity has been substituted for steam, the change from steam to electricty can hardly be said to have been made voluntarily. The New York Central decided to make the change only after an appalling accident due to the obscuring of signals by the smoke of locomotives. In the case of the Pennsylvania railroad the use of long tunnels which would be fouled by locomotive smoke and gases, certainly beyond the point of comfort for passengers and possibly beyond the point of endurance, practically forced the adoption of electricity. The class of service represented by the Manhattan Elevated had been successfully performed by electricity for years in other places before a realization on the part of its management that electricity as a motive power was cheaper as well as the public indignation against the smoke nuisance in New York finally forced the adoption of electricity as a motive power. In the case of the Baltimore tunnel it required an edict of the courts before the change to electricity was made.

There seem to be two reasons for this surprising lack of progress which electricity has made in displacing the steam locomotive, one a technical and the other a psychological reason.

First, to take up the technical reason. Up to within comparatively recently the only thing that the electrical engineer had to offer for trunk-line operation was the well-known direct-current motor with a maximum voltage of, say, 700, and the necessary rotary-converter equipment that normally goes with such a system. To this system there are admittedly a number of valid objections. In spite of these objections, however, there has been no time within the last five years when the electric companies would not have undertaken to equip any trunk line on this continent, and, furthermore, they would have guaranteed to render at least the same service as is rendered by steam. As to the relative cost of such service by the direct-current system compared to steam there comes in a question as to the character and density of the traffic. In many instances it could be shown that the trunk-line traffic could be done more cheaply by electricity than by steam, even when the direct-current system was used. With heavy trains at long intervals, however, the handicap against electric traction increased until the point arrived where practically no saving could be shown. The advent of the alternating-current motor changed all this. This point will be returned to later.

Perhaps of still greater import is the second reason offered to explain the lack of progress by electricity in displacing steam—the psychological one. The electrical engineer must not only develop a system which is capable of handling the traffic of a trunk line, but he must also convince the trunk-line managers that he can successfully handle their traffic. Until the writer made the investigation referred to above he had remained under the impression that the trunk lines were installing electricity on such branch lines as were unquestionably suited to electric operation, and were, in short, becoming educated to appreciate the advantages of electric drive. That investigation, however, dispelled such ideas. It is not the trunk lines that are putting in the many high-speed and heavy-service electric roads latterly so common, but a new-type transportation engineer, and one that is not bound by the traditions of the steam railroads. That this new method of transportation

1. A paper read before the Canadian Electrical Association at Hamilton, Ont., June 16, 1904.

is a serious rival to the trunk line in many fields, and, further, that it is bound to become a still more serious rival is unquestionable.

It is appreciated that there is reason why the trunk lines should hesitate to adopt on their main lines at once so radical a change as that of electricity as a motive power instead of steam. The steam locomotive is doing its work and is doing it well. The first essential of the trunk-line manager is to move his freight and passengers, and to move them promptly, and that is what his steam locomotive is doing. Electricity, therefore, is not a necessity, he

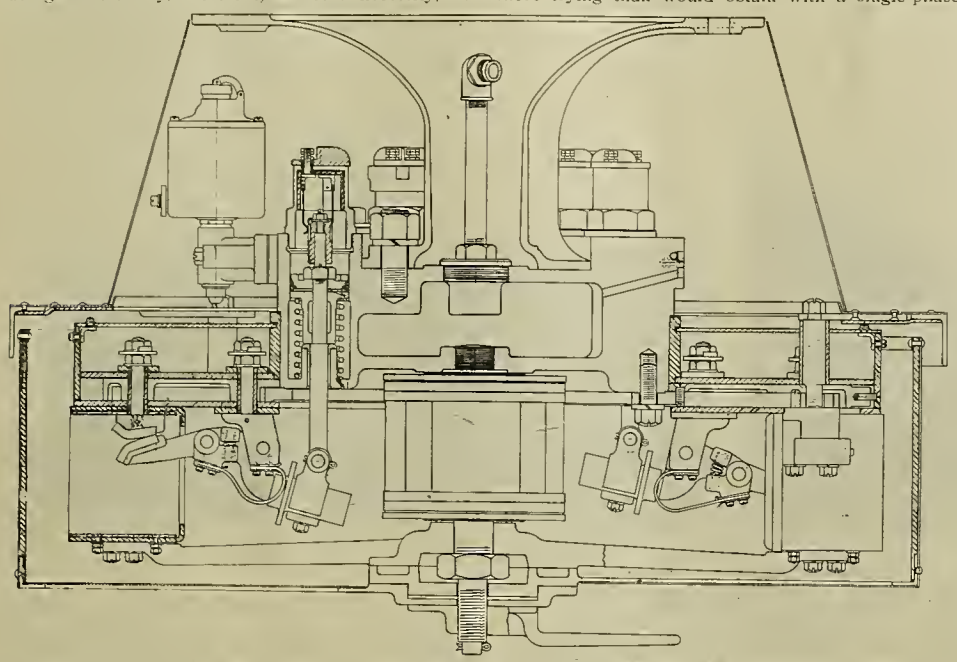


FIG. 3. VERTICAL SECTION OF SWITCH TURRET ON METROPOLITAN CAR SHOWING ELECTROPNEUMATIC SWITCH-OPERATING DEVICES.

reasons: it is only an improvement—and of that proposition he is by no means convinced, and apparently does not desire to be convinced. All the electrical engineer asks is an opportunity to prove that he is prepared to do successfully the work that is now being done by steam. That such an opportunity has not been given is evident from the record referred to above, showing the remarkably few number of substitutions of electricity for steam.

But now to return to the technical question. Briefly, the question is, Can trunk-line traffic be handled economically by electricity? Since the advent of the single-phase, alternating-current motor our answer is an emphatic yes. With the direct-current system there was, perhaps, some doubt, but that is entirely removed by the single-phase motor.

The advantages of the alternating over the direct-current systems are apparent. Those which pertain particularly to heavy traffic are:

First—Elimination of the trolley voltage limit, resulting in:

(a) Reduction of the current to be collected by use of higher trolley voltages.

(b) Ability to use overhead-contact conductors rather than third rail.

(c) Increased economy both in copper and power.

Second—Elimination of the rotary converter.

It is in the elimination of the trolley voltage limit set by the maximum allowable voltage that can be put on a direct-current motor that the principal advantage accrues to the alternating-current system. To do the work that is now done by the steam locomotive requires the application of an enormous power. To get this power at even the maximum voltages allowable in direct-current work involves currents which would often run from 4,000 to 8,000 amperes for the operation of a single train. The delivery of this amount of power from the sub-stations to the trains means both expensive conductors and large losses. But the expense and the loss are perhaps not the greatest problems. These currents must be taken from the conductors into the trains through a moving contact. This requirement in turn demands a working conductor with a large surface, and even under the most favorable conditions, is a problem that demands the most careful consideration. The usual solution is the installation of the third rail. This furnishes a working conductor with both a large surface and large current-carrying capacity. But the expediency of equipping trunk-line railway systems with third rail is, to say the least, doubtful. An overhead conductor is preferable for many reasons. Raising the voltage of the working conductor cuts this Gordian knot at once. For trunk lines a trolley voltage of 3,000 might be considered as a minimum and 10,000 volts would be proposed without hesitation. In fact, this latter voltage has been successfully used abroad under circumstances much more trying than would obtain with a single-phase system, in that all three conductors of a three-phase system with 10,000 volts between any two were used as working conductors. In the single-phase system only a single overhead conductor need be used.

Since the cost of conductors to take power from the sub-stations to the trains is the greatest single item in the direct-current system, it is evident that this raising of the trolley voltage is a large factor in cutting down the cost of the alternating-current relative to the direct-current system.

The elimination of the rotary converter is probably the next difference in order of importance. Not only does the use of alternating current eliminate a large element of first cost and an element of loss averaging probably 10 per cent., but by making available higher trolley voltages it also makes the total number of sub-stations smaller and eliminates the necessity of skilled attendance at the sub-stations that are used.

There are a number of other points of advantage, but those mentioned above are the principal ones.

When we come to consider trunk-line traffic with electricity as a motive power, there are two distinct problems to discuss:

First—Electricity vs steam, and,

Second—Direct current vs. alternating current.

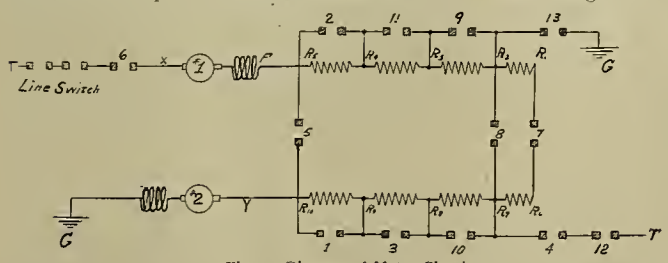


Fig. 4. Diagram of Motor Circuit.

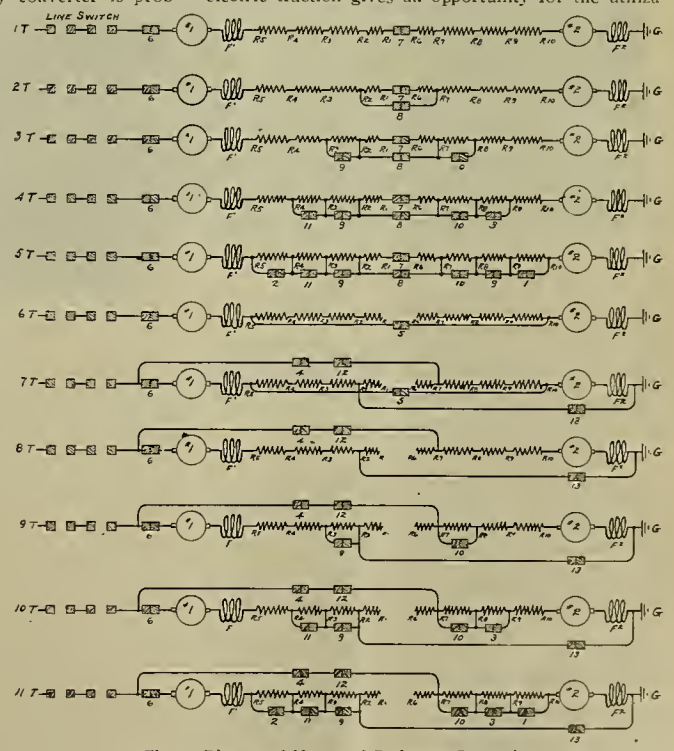


Fig. 5. Diagram of Motor and Resistance Connections.

ELECTROPNEUMATIC CONTROL FOR METROPOLITAN ELEVATED RAILWAY IN CHICAGO.

As to the latter question there is no doubt. The alternating-current system is the better in practically every particular. The main reasons are given above.

As to the first question there is perhaps cause for greater discussion than on the second, but to my mind there is no greater cause for doubt.

Advantages of Electricity.

The following points of advantage in electric drive for trunk lines may be offered:

First—Reduced Weight of Locomotives.—Forty-five per cent. of the weight of a steam locomotive and tender available for traction is about the average obtained at present. In the electric locomotive every pound of weight is available for traction. The weight of an electric locomotive to do a given service may therefore, so far as tractive effort is concerned, be cut down to at least one-half that required by steam. In ordinary practice, too, the weight of the locomotive and tender constitutes from five per cent. to 25 per cent. of weight of the train. Electric traction can, therefore, by this one consideration, save from 2½ to 12½ per cent. of the power now required under steam service. Or, to put it in another way, the live freight per train may be increased with electric traction—considering tractive effort alone—from 2½ per cent. to 12 per cent. over steam.

Second—Uniform Torque.—Another condition that will serve to enhance still further the difference in weight is the uneven torque exerted by the steam locomotive within a single revolution of the drivers as compared with the perfectly even torque as exerted by the electric locomotive. A given weight on drivers is therefore more effective in the electric than in the steam locomotive, or, in other words, for a given useful tractive effort less weight is required on the drivers of an electric than a steam locomotive.

Third—Perfectly Balanced Drivers.—The electric locomotive not only has a perfectly even torque at all points in the revolution of the drivers, but the drivers are always in perfect balance. In this respect it is decidedly superior to the steam locomotive, where a perfect balance is an impossibility. At high speeds, therefore, the pounding of the steam locomotive on the track is one of the greatest elements in the deterioration of the permanent way. This element of deterioration of track would be entirely avoided by the use of electric drive.

Fourth—Fewer Repairs.—Compared to the electric motor, the steam locomotive is an extremely delicate and complicated piece of apparatus. Imagine, for an instant, if you can, a steam boiler and an engine operating under the conditions met and successfully met by the street-railway motor in everyday practice. Railway motors have been known to make a mileage of as much as 450,000, requiring renewal of bearings only. Such a record with a steam engine and boiler under such conditions is unthinkable, as well as unreasonable to expect in view of the greater number of parts and the reciprocating motion.

On account of this greater sturdiness and less liability to damage on the part of the electric locomotive, it follows that to render a given service fewer electric than steam locomotives will be required because the proportionate number in the roundhouse will not be so great. The result, therefore, is not only a smaller repair bill but also a smaller number of machines to provide, house and care for.

Fifth—Utilization of Waterpower.—The use of electric traction gives an opportunity for the utilization of waterpower that is impossible with steam. This point is of particular interest to Canadians, both because of the scarcity of coal and the abundance of waterpower. The same reason for the consideration of electric drive holds true for a large part of the western United States. This same consideration has caused the Swedish government to determine upon a change on all the railroads of Sweden from steam to electric drive, and the first

active steps looking toward this change have already been taken.

Sixth—Multiple Control.—The electric drive lends itself easily to distant control. It is not necessary, therefore, with electric drive to have the point of application of power and the intelligence that governs the application of that power at the same place. It is possible to subdivide the electric drive into relatively small units and place them at intervals through the train, still retaining control over the individual units at a central point. This avoids both the necessity of concentration of weight at the front of the train as well as the excessive drawbar pulls, both of which problems are of no small dimensions in steam practice.

Seventh—Smoke and Cinders.—The abolition of the smoke and cinders of the present steam locomotives, although, perhaps, it does not add to the economy of the electric system, still it is an advantage in its favor that would be vastly appreciated by the traveling public.

Eighth—Economy.—Practically all the points above mentioned are in the direction of increased economy. In addition, however, we have, in case steam power is used, the vast difference between the economy that can be obtained from relatively large stationary engines operated in conjunction with condensers on the one hand, as against the locomotive on the other, which must necessarily run non-condensing and in which the losses by radiation, relatively small grate area and enormous changes in load are necessarily severe. The question of relative economy between steam and electric motive power on trunk lines was considered by Mr. A. H. Armstrong, in a paper read by him before the Canadian Society of Civil Engineers, November 19, 1903. From his analysis and conclusions it is safe to assert that nine-tenths of the trunk-line traffic of this continent can be operated more economically by electricity than by steam. This showing is made, too, on the basis of using steam-generated power. The showing is bound to be much better where waterpower is available, as is the case practically throughout the whole of Canada.

The foregoing remarks have only touched the surface of this question, and this discussion is not intended to be exhaustive. A complete discussion would take up vastly more time than has been allotted to this paper. If those to whose attention these words come would carry away two ideas the writer would be satisfied. These are:

First—That there is some merit in the proposition to operate trunk lines by electricity; that it is at least worth investigation.

Second—That the electric companies are not only prepared to build equipments for trunk lines, but also are prepared to guarantee their successful operation.

Chicago Street-railway Situation.

By the action of the City Council on July 11th the Chicago Union Traction Company is ordered to vacate within 90 days Adams, Harrison, Desplaines and other streets in which it has been operating as the lessee of the Chicago Passenger Railway Company and on which the franchise has expired. The right to operate in these streets is to be offered to the highest bidder, and sealed bids are to be received on several plans, for which terms, conditions and specifications are to be furnished by the city. It was further ordered that the commissioner of public works be instructed not to issue any further permits to the Union Traction Company for the purpose of reconstructing any part of its new system without first referring the requests to the council for consideration.

The negotiations between the local transportation committee and the Chicago City Railway Company have been delayed by disagreement on the universal transfer question. Several experts, however, will be consulted on this point, and it is thought a tentative ordinance will be ready for presentation to the City Council before the summer vacation of that body.

Track Repairing in New York City.

The accompanying pictures are reproductions of photographs taken by the New York correspondent of the Western Electrician and illustrate the method of repairing and relaying tracks in New York city without suspending the traffic of surface cars.

Fig. 1 was taken just below the Cooper Union Building on Third Avenue and Eighth Street and shows a crossing temporarily deposited at the side of the roadway. This construction is all of one piece, made up before it is brought from the shops and needing but little work upon it to fit it for its final position on the tracks. When the worn-out crossing has been prepared for removal the new rails are moved over on rollers and the work of bolting it down occupies only a few minutes and necessitates a minimum of interference with the traffic.

Fig. 1. Crossing Third Avenue.

Fig. 2. Fourth Avenue and Fourteenth Street.

TRACK REPAIRING IN NEW YORK CITY.

The next photograph (Fig. 2) represents the intersection of Fourth Avenue and Fourteenth Street. The work at this point was particularly complicated on account of the Fourth Avenue conduits having to be entirely relaid over the subway excavation, and added difficulties were encountered when the new conduits were placed along Fourteenth Street to take the place of the old horse-car line. The street was in the condition depicted for several weeks and gangs of men were working on it night and day, the ordinary vehicular traffic being accommodated on the right or left of the tracks according to circumstances. On the right is seen the flagman, who regulated the traffic, and a second man provided with a whistle warned the workmen of the approach of the cars. Between the tracks is seen a man, who, as a general rule, would duck beneath the track itself as a car went by, and as the cars pass at this point at the rate of at least three a minute, men working in such positions had to display unusual agility. In spite of the unusual danger of the work, accidents are very rare, and the men get so accustomed to the approach of cars and to the foreman's whistle that they keep hold of their tools and duck their heads almost automatically. At the extreme left is shown one of the portable lamp standards used to illuminate the tracks at night.

FIG. 3. TRACK REPAIRING NEAR BOROUGH HALL, BROOKLYN.

The picture in Fig. 3 shows an entirely different method of replacing tracks, and was taken outside the Borough Hall, Brooklyn. In this case, owing to the variety of alternate routes, the entire traffic was suspended from midnight Saturday until six a. m. on the following Monday, and the photograph, taken at noon on Sunday, shows a section of newly laid track on which a specially trained gang of about 100 men had worked continuously for 12 hours. In this case a crossing and about 100 yards of new track were relaid between Saturday night and Monday morning, when the ordinary traffic was resumed.

Lord Kelvin, the Nestor of electrical engineers, celebrated his eightieth birthday on June 26th last.

Application of Salts of Radium to the Study of Atmospheric Electricity.[1]

By Th. Moureaux.

In current observations of atmospheric electricity, the value of the potential of the air is generally obtained by means of dropping water. This method, perfect in warm countries, is impracticable in our climate on account of the freezing of the water, the receiver, in many cases, being installed under the eaves of elevated buildings, in a place devoid of means of heating. Attempts have been made to protect the stem of the dropper from freezing, chiefly by means of a covering of wool, or by adding to the water a certain quantity of alcohol or glycerine; but these means present rather serious difficulties in practice. In fact, the registering of variations of the potential is frequently interrupted in winter, at least during severe cold.

The discovery of the salts of radium by Professor and Mrs. Curie places in the hands of physicists a new method, applicable to all places and in all seasons. Professor Curie having had the kindness to place at our disposal some samples of salts of radium of different degrees of activity, we have successively executed a comparison between them and the water dropper now in use. The method adopted for these experiments is as follows: In a copper disk about four centimeters in diameter and two millimeters in thickness, Professor Curie hollowed out to a depth of half the disk's thickness a cavity 15 millimeters in diameter; at the bottom of this cavity he placed a thin sheet of asbestos, on which was placed a decigram of radium-bearing chloride of barium. A plate of aluminum about 0.1 millimeter in thickness was then carefully soldered to the copper disk, in such a manner as to hermetically seal the capsule thus formed. On the face of the disk opposite the aluminum plate was soldered a copper tube which fitted exactly the ordinary tube of the water reservoir at its free extremity. The value of the potential can then be ascertained as one wishes, either by means of radium or by means of the water dropper at two points as near as possible to each other.

Experiments were made at the observatory of Parc Saint-Maur during the months of March and April, 1903, with this apparatus. Three capsules were studied successively. In one, one of the first samples of radium obtained from Professor and Mrs. Curie in 1899, was used. Its radio-activity was not determined, but the experiment showed that the activity of this salt was not sufficient. In fact, the needle of the electrometer established equilibrium very slowly with the atmospheric potential. Rapid variations, for example, were considerably weakened; moreover, the portions of the registered curve indicated constantly a potential clearly less than that indicated by the water dropper; and, finally, the return to zero was extremely slow. The second capsule contained radium-bearing chloride of barium, of activity 5,000 times that of uranium. The curves obtained from this second sample did not differ materially from the preceding; they showed that here also the radio-activity was insufficient to guarantee that the registered values were equal to the real value of the potential near the capsule, and, on account of the slowness of the movement of the needle of the electrometer, the details of the variations were equally reduced or altogether suppressed. Finally, the third capsule contained a decigram of radium-bearing chloride of barium 30,000 times that of uranium. This radio-active power gave to the observed variations of the potential a sensitiveness as great as did the water dropper.

This third capsule was placed at the extremity of the tube, and the potential was taken alternately, during regular intervals, with the radium and the water dropper. In both cases the state of equilibrium and the return to zero were reached with equal rapidity; the same details were obtained with radium and with the water dropper, and at the moment when either apparatus was substituted for the other the agreement of the curves was perfect. The experiment was prolonged during several days, and gave constantly the same results; the capsule has

1. From the Annuaire de la Société Météorologique de France. The author is director of the observatory at Parc St. Maur. The article was translated by Miss R. A. Edwards for the United States Monthly Weather Review.

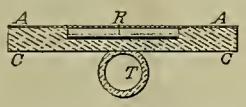
consequently been put into active use; tests made from time to time have shown that the radium-bearing salt loses none of its energy. But after eight months of exposure to the air, it has been ascertained that the aluminum plate alters with the weather, under the influence of the radiation from the radium, and does not sufficiently protect the salt from changes of humidity. Professor Curie thought that a good varnish would probably suffice to protect the contents of the capsule from variations of atmospheric humidity; the experiment was made by spreading over the capsule several thicknesses of special varnish used at carriage factories for fine carriages. This varnish, almost impervious to changes of weather, assures a perfect and durable protection. Moreover, it has the advantage of offering less resistance than the aluminum plate to the radiations of radium, so that by doing away with this plate, in some form of capsule that may be finally adopted, a salt of less radio-activity, obtainable at a more reasonable price, could probably be used. Experiments are continuing in this line under the direction of Professor Curie.

This process possesses then all the requirements for efficiency, providing the salt is endowed with proper radio-activity and that it is perfectly protected from the influence of humidity.

The advantages in using salts of radium in observations of atmospheric electricity are numerous. We will cite the principal ones: The constancy of the height above ground of the point where the potential is taken; facility in raising this point so as to be above buildings, trees, and, in a word, above all kinds of obstacles that by modifying the shape of equipotential curves greatly impair their value as useful observations; the total suppression of breaks resulting from stoppage in dropping, due to impurities in the water or to freezing temperature; less frequent personal attention; the abolishing of the water reservoir and, consequently, considerable diminution in the expense of installation and of maintenance; extension of the method to the polar regions, where the study of these phenomena is particularly interesting.

In a letter describing his apparatus more fully, Mr. Moureaux says:

"The apparatus with which I made these observations, and which was constructed for me by Professor Curie himself, is described briefly in the Annuaire of the Meteorological Society of France. The capsule, as it is called therein, is represented in section in the accompanying figure.



"(CC) is a disk 32 millimeters in diameter and three millimeters in thickness. It is cut away to a depth of one-half its thickness at (R), leaving a circular cavity 15 millimeters in diameter. On the opposite side of (T) there is soldered a tube of copper, which is held in place by friction at any point along the tube that carries the water used in the water-dropping collector. At the base of the cavity there is placed a thin sheet of the finest sort of asbestos, known as amianthus or earth flax, which is represented by the heavy black line. This is intended to keep the radium salt in place, since on this sheet of amianthus there is placed one decigram of the radio-active chloride of barium, having a strength of 30,000, and represented on the diagram by the dots at (R). Finally, the salt of radium was at first covered with a plate of aluminum 0.1 millimeter in thickness, and represented by the sectional line (AA), which was soldered to the copper. But, after some months of exposure, this plate of aluminum was attacked by the emanations from the radium and pierced by numerous holes, through which the atmospheric moisture could penetrate. In order to remedy this inconvenience, and with the advice of Professor Curie, after having completely dried the capsule, I covered the perforated plate of aluminum with several layers of an excellent varnish, resisting all bad weather.

"This operation was performed in December, and since that epoch the apparatus has operated with the greatest regularity. It is, therefore, probable that the plate of aluminum ought to be suppressed in the construction of a new apparatus. You will find the reproduction of two of my daily curves in the Comptes Rendus of the Southport meeting of the International Meteorological Committee, pp. 64 and 65 of the French edition."

The application of radium to the determination of the electric potential at any point in the atmosphere was independently made by several persons; possibly it was first suggested by Professor F. Exner of Vienna. It undoubtedly constitutes a most convenient substitute for the water dropper, the flame of burning gas, or the various forms of induction apparatus, and it will be worth while for those interested in the subject to look up its earlier bibliography and to ascertain the relative reliability of different methods.

Under date of April 9th, Professor Rutherford suggests an improvement on Moureaux's method of exposing the radium and securing it from the influence of the weather, namely, "by enclosing the radium preparation hermetically in a very small thin-walled bulb which allows most of the β-rays to escape. If the outside of the bulb is silvered and connected with the electrometer, it would act rapidly and should be quite independent of all atmospheric troubles."

As to the relative reliability of various collectors, Linke has shown that the water dropper gives different results or varies in its sensitiveness in proportion to the pressure under which the stream of water is flowing; the greater the pressure the greater the number of small drops formed per second, and therefore the greater the sensitiveness. He has also shown that in using a radio-active substance as collector the sensitiveness increases with the increase in the velocity of the wind and the consequent convection of the emanations.

Electrical Decorations at a Lawn Party.

The art of decorative lighting was beautifully displayed at a recent lawn party given by Mrs. Harold F. McCormick to her friends on the grounds of her beautiful Lake Shore Drive residence in Chicago. The accompanying illustration, although taken by daylight, and therefore not showing advantageously the electric-lighting devices used in producing the very brilliant effect achieved, gives an idea of the beauty of the surroundings.

More than 1,500 electric lights were used on the large lawn, and these were tastefully arranged amid trees and foliage plants transplanted from the North Shore woods, which furnished the forest feature. The natural beauty of the lawn, with its velvet sod dotted with vines, flowers and shrubbery, furnished the groundwork for the artists. The guests on entering were at once attracted by the harmonious blending of white, red, green and yellow electric lamps. These took the form of fruit, flowers and other adaptations. Along the paths were rose bushes bearing their burden of wax and glass roses, the former done in yellow and the latter in red, illuminated by electric light. The grapevines contributed large, tempting bunches of electric grapes and the trees throughout the grounds bore fruit made of four and eight-candlepower electric bulbs.

ELECTRICAL DECORATIONS AT A LAWN PARTY.

In the center of the grounds was the large dancing pavilion, illuminated with miniature electric bulbs, with an occasional electrolier of artistic design. The stand occupied by the Hungarian band and the booth occupied by the Hindoo juggler were decorated with costly lighting designs. A striking feature was the lily pond, in which floated water lilies done in a perfect blend of colors, no wires being visible. Two vaudeville performances were conducted in different parts of the grounds, and at these the lighting was done by small bulbs arranged in novel design.

Everywhere throughout the garden there were cosy nooks and corners in which had been placed tables on which an elaborate repast was served later. There were 50 of these tables, the larger ones having beautiful lamps or candelabra and the smaller ones lighted with miniature electric candles. Several of these lamps are shown in the picture. The large pillars of the fence surrounding the grounds were crowned with prominent electric balls which shed their light upon the gaily gowned women, the soberly dressed men, the trees, shrubbery, flowers, walks, booths and objects of art that constituted the brilliant scene.

The whole affair was probably the most elaborate and successful of its kind ever seen in Chicago, and was due to a combination of good taste and lavish expenditure. Many of the art lamps and designs were very costly. The work was done by Mr. Willy H. Lau of Chicago, an expert in decorative effects. Current was obtained from the mains of the Chicago Edison Company. A concealed cable was suspended along the fence, and from it the wires were conducted beneath the sod to the tables and other outlets, so that no wires were visible. Most of the 1,500 lights were of four and eight candlepower. An unusually large number of cut-out boxes were placed throughout the grounds as a precaution against accident.

Operating Expenses of Waterpower Plants.

[From the Question Box of the National Electric Light Association.]

QUESTION.

What are average operating expenses per horsepower-year of waterpower plants of different sizes?

ANSWERS.

Herbert McNulta, electric-lighting and railway department, Anaconda Copper Mining Company, Anaconda, Mont.: Our waterpower plant consists of two 150-kilowatt alternating-current generators, each connected to turbine; two 60-kilowatt arc-light machines on one wheel; two 100-kilowatt, 500-volt generators on one wheel. Total capacity of electrical machinery, 620 kilowatts. Flume of wood, three miles long, supplying, at maximum, water enough to develop 500 kilowatts at switchboard. This plant feeds into trunk lines connecting to two steam plants. The average annual output of waterpower plant for two years was 1,700,000 kilowatt-hours; average electrical load, 194 kilowatts. The flume had been in service 10 years, the waterwheels and generators six years, and the repairs to flume and machinery were unusually high for these reasons. The following are, in round figures, the operating expenses per kilowatt-hour, not including any depreciation, superintendence, taxes or general expenses:

Repairs to building	0.007 cents
Repairs to dams and conduits	0.097 "
Repairs to turbine and electrical machinery	0.102 "
Labor, dynamo tenders	0.242 "
Labor, flume tender	0.053 "
Sundry supplies	0.014 "
Total	0.515 cents

The flume was practically gone in 12 years.

E. H. Mather, Portland, Me.: A modern waterpower plant of about 1,500-horsepower capacity can be operated for $3 to $4 per horsepower-year, which includes only labor and material used at the power station.

More than half of the world's output of copper is produced in the United States. The total production in 1903 was 565,820 long tons, of which the United States contributed 298,650 tons; Spain and Portugal, 49,740; Mexico, 45,315; Japan, 31,360; Chile, 30,930; Australasia, 29,000; Germany, 21,205, and other countries smaller amounts.

WESTERN ELECTRICIAN

EVERY SATURDAY.

PUBLICATION OFFICES:
510 Marquette Building, • CHICAGO.

TELEPHONE MAIN 1746.

Eastern Office, 193 Times Building, New York.
Telephone, 3806J Cortlandt.

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted. This paper is entered at the Chicago postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the **old address** as well as the new should be given.

CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—**the only general electrical paper published in the West**—thoroughly covers a territory *exclusively its own.* THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be furnished on application.

REMITTANCES.—All checks, drafts and other remittances should be made payable to the order of the publishers, the **Electrician Publishing Company,** and addressed to the offices of publication, Suite 510, Marquette Building, (204 Dearborn Street), Chicago, Illinois, U. S. A.

CONTENTS OF THIS NUMBER.

Electropneumatic Control for Metropolitan Elevated Railway in Chicago. Illustrated.....39, 40, 41
Heavy Electric Traction by Alternating Currents. By P. M. Lincoln. (Canadian Electrical Association).....40, 41, 42
Chicago Street-railway Situation..... 42
Track Repairing in New York City. Illustrated..... 42
Application of Salts of Radium to the Study of Atmospheric Electricity. By T. Moureaux. Illustrated. (Société Météorologique de France).....42, 43
Electrical Decorations at a Lawn Party. Illustrated..... 43
Operating Expenses of Waterpower Plants. (National Electric Light Association) 43
Editorial 44
Fighting Ice in Waterpower Plants. Illustrated. (National Electric Light Association)..... 45
Engineers Inspect New Interlocking Steel Sheeting.... 45
Electric Heating and the Field It Offers Central Stations. By James I. Ayer. With discussion. (National Electric Light Association) 46, 47
Death of E. T. Bubier 47
Michigan Electric Light Association..... 47
Taking Moving Pictures by the Use of Vapor Lamps... 47
Automatic Pumping Plant for Residences..... 47
Purchase of Allis-Chalmers Company by General Electric Denied 47
Corporation Telephones. By A. R. Bennett. (Institution of Electrical Engineers) 48, 49
Telephone News from the Northwest..... 49
Ohio Telephone Notes 49
Michigan Telephone Matters 49
Southern New England Telephone Company..... 49
Extensions and Improvements 49
General Telephone News 50
Engineers Should Have a Good Knowledge of English.... 50
Book Table 50
Stevens' "Copper Handbook" 50
American Street Railway Investments 50
Bowker's "Dynamo, Motor and Switchboard Circuits". 50
Electric Equilibrium of the Sun..... 50
Electric Fire-alarm and Police-patrol Systems..... 50

DEPARTMENTS.

Correspondence 51, 52, 53
Great Britain 51
Dominion of Canada 51
New York 51
New England 51
Michigan 51, 52
Southeastern States 52
Ohio 52
Indiana 52
Northwestern States 52
Pacific Slope 52, 53
Personal 53
Electric Lighting 53
Electric Railways 53, 54
Power Transmission 54
Societies and Schools 54
Publications 54
Space Telegraphy 54
Miscellaneous 54
Trade News 54
Business 54
Illustrated Electrical Patent Record.....55, 56

DATES AHEAD.

Ohio Electric Light Association (annual convention), Sandusky, August 16th to 18th.

International Electrical Congress, Hall of Congresses, St. Louis Exposition, September 12th to 17th.

International Association of Municipal Electricians (annual meeting), St. Louis, September 13th and 14th.

American Electrotherapeutic Association (annual convention), St. Louis, September 13th to 16th.

National Electrical Contractors' Association (annual convention), St. Louis, September 14th to 16th.

Colorado Electric Light, Power and Railway Association, Colorado Springs, September 21st to 23d.

American Street Railway Association (annual meeting), Festival Hall, World's Fair grounds, St. Louis, October 12th and 13th.

Kansas Gas, Water and Electric Light Association (annual meeting), Leavenworth, Kan., October 18th and 19th.

"IN TIME of peace prepare for war." That's what the Japs appear to have done, and with good results. Similarly, the central-station man, in these long summer days, may well lay his plans for next winter's campaign. He should overhaul his equipment for melting ice in water pipes, and, if he has a waterpower plant, ice at the intake rack should not find him unprepared. Some valuable hints on methods of fighting ice in hydro-electric plants, taken from the Question Box of the National Electric Light Association, are therefore given in this issue

RENEWED utterance of an old complaint was made by a recent speaker before the St. Louis Railway Club. "While the railroads are spending millions for various equipment, to reduce expenses and improve operation, not one cent, nor one moment's time, is devoted to procuring and carefully training the telegraph operators they place in charge of their most valuable property. When an operator is to be employed it is a fish-net proposition, and whatever is caught is pressed into the service, his habits and qualifications not fully known for some time afterward. One appropriate remedy for this condition would be the establishment of a telegraph school by as many as five or six large railroads, the only obligation required of each road being to furnish transportation for the student to school and employ such students as become operators, the school to be made thorough, teaching every branch of the work." Various suggestions, including government supervision through the Interstate Commerce Commission, have been made with the idea of raising the grade of railroad telegraphers. The low rate of wages paid to railroad telegraph operators is of course mainly responsible for the existing condition of affairs, and the railroad companies have, of course, the remedy in their own hands. The school idea is all right, but it should be supplemented by the very practical inducement of increased remuneration for better service.

A CHICAGO daily newspaper declares that the wastage of water pumped from Lake Michigan by the municipal waterworks represents a sum of "something like $636,000 a year." It goes on to say that "Our waterworks are an object lesson in municipal ownership. Whenever the socialist yawpers wish to commend the municipal ownership of public utilities they say: 'Look at the waterworks.' Well, look at them, and what do you see? You see the worst managed public utility in the universe. It is safe to say that nowhere else on the globe are there waterworks which, at heavy expense, pump four times as much water as is needed, and all on account of bad management. Does anybody believe that a private company that owned the waterworks would put up with a waste of 75 per cent. for 20 years? Private parties are accustomed to keep a close watch on the annual depreciation of properties from wear and tear and to guard against it as far as possible. A private company could take the waterworks of this city and make them economical and profitable within a year."

It is but fair to add that this criticism comes from a bitter opponent of the city administration and represents an extreme view. Probably few responsible persons could be found who would seriously propose to take the control of the waterworks from the city authorities and place it in the hands of a private corporation. Every person in the community is concerned in the supply of water, liberal in amount to diminish the fire risk and wholesome in quality to insure good health. But the case of electric-lighting, street-railway and telephone utilities is quite different. These conveniences are not universal in their application. In view of the laxity in the operation of the waterworks, it is not wise to extend municipal administration, entangled with political ambitions and extravagances, to enterprises where such control is not imperative.

PHYSICAL research leads the investigator into channels of curious interest. It would seem to be a far cry from the phenomena of radio-activity to the action of anæsthetics such as are used in medicine, yet as the result of the work of J. Chunder Bose, the distinguished physicist of Calcutta, it is known that anæsthetics diminish the "electric response of matter," or the return to equilibrium after an excitation, either because they increase the viscosity or diminish the elasticity of the material. If that is so, it is intelligible that the matter affected should be unable to follow the extremely rapid vibrations which give rise to N-rays. J. Becquerel, following this line of research, as we learn from a contribution in Comptes Rendus abstracted by an English contemporary, has examined the action of anæsthetics in diminishing the transmission of N-rays and the response to their impact. He used a hollow cone of aluminium or copper, and placed the source of N-rays under its base. The sensitive screen was placed at the apex, and the whole enclosed in a vessel which could be filled with air or with the vapor of chloroform or other anæsthetic. It was then found that if the base was protected against the immediate action of the chloroform, by means of a plate of thin glass, the rays passed in spite of the presence of the vapor if the source was enclosed in a box of glass, wood or cardboard; but all action ceased if the box was made of aluminum or copper. The author concludes that aluminum and copper lose their transparency for N-rays when the surface which receives the radiation (in this case the base of the cone) or the surface from which the rays proceed (in this case the box containing the source) is exposed to the action of an anæsthetic. Glass, wood and cardboard, on the other hand, always allow the radiation to pass. The author is inclined to believe that the N-rays consist of two different radiations, one of them traversing glass and other substances with the velocity of light, or nearly so, as shown by the index of refraction, and a form of energy which is only propagated slowly and which stops at the surface of chloroformed metals.

These results are very interesting and seem to indicate, dimly, some confirmation of the daring theory that the forces of protoplasm are electrical, in large part at least, and that they give rise, under special conditions, to the phenomena which constitute life and which may be in part arrested or altogether stopped by the administration of anæsthetics.

IN a recently published report on the municipal tramways of Hull, England, Mr. W. C. Hamm, the United States consul in that city, expresses surprise that the double-deck car is not more extensively used in the United States. He says that the double-deck cars are popular in Hull, and that all the cars in use are of that pattern. Smoking is permitted anywhere on the upper level, and the outlook from this elevation is pleasant. Ladies prefer not to climb the stairs usually, although the ascent is easy. The upper deck is particularly selected by the men, and seldom is either section uncomfortably crowded.

The picture drawn is a pleasant one, but the conditions are those of a medium-sized English city, where life is taken easily and tranquilly. In the rush and hurry of large American cities the double-deck cars would not do at all. Two conductors would be needed—one for each deck—during the rush hours and perhaps for every trip. The cars are heavy and cumbersome, and the danger of accidents in crowded city streets would be increased. Despite Mr. Hamm's contrary belief, it is also practically certain that under such "step-lively" conditions as obtain in New York, Chicago or Boston, no double-deck car could load and unload passengers as quickly as a single-decker. Again, in many American cities the cars pass under elevated tracks or bridge structures, and the headway required for the towering double-deck car would be prohibitive. Then, too, there is an increasing tendency toward street-railway subways or tunnels under the congested streets of large cities, and the two-decker does not lend itself to this service. Climatic conditions, furthermore, are unfavorable to the double-deck car in the United States.

For the reasons given and for others which might be mentioned, there seems to be no place for the double-deck car in large American cities, and it is doubtful if they are practicable in smaller cities either, owing to their size, cost and lack of flexibility in operation. For pleasure riding in summer the upper platform of this type of car has decided advantages, but as an all-around car the double-decker is not adapted to the conditions of American street railroading.

Fighting Ice in Waterpower Plants.

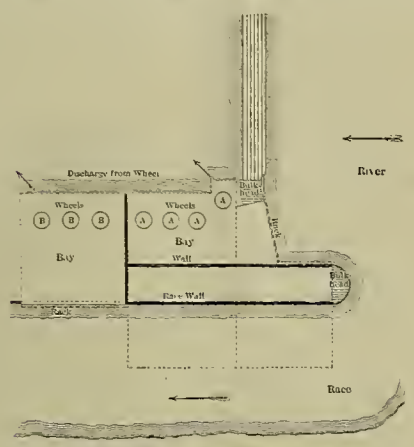
[From the Question Box of the National Electric Light Association.]

QUESTION.

How is ice handled in waterpower plants, and what method is used to prevent it from interfering with the power service? Is the ice worked through the racks, removed from the river entirely, or passed over the dam?

ANSWERS.

E. P. Maxwell, superintendent Dixon Power and Lighting Company, Dixon, Ill.: We have four wheels (see diagram), marked (A), that take water direct from the end of the dam and three wheels, marked (B), that take water from the race. If we wish to clean rack No. 1, we shut down the wheels marked (A) and open and carry the load with wheels (BBB). As soon as the wheels are closed the suction stops and the ice or drift comes up to the surface of the water and is carried over the dam. If we wish to clean rack No. 2, we close wheels (BBB), and open and carry the load with wheels (AAA); then we push the ice down below up in the race, and the drift



ARRANGEMENT OF WATERWEELS AT DIXON, ILL.

we fish out. Working it in this way, we clean them very easily and quickly.

Union Electric Light and Power Company, Unionville, Conn.: We consider it best to leave the ice in the dam and river, both on account of the expense and for the prevention of anchor ice, letting it freeze up as close to the rack as it will, and leaving only room for a rake to work up and down on the rack to remove any small particles of ice or other material that may clog there. A river, pond or canal, once solidly frozen over, prevents any further trouble from anchor ice.

L. E. Watson, Kearney, Neb.: We endeavor to keep floating ice out of our canal until it becomes rotten, when we throw it over our waste weir. Our aim is, however, to keep our canal covered with ice as long as possible, thereby getting rid of slush. We consider it very bad practice to work it through the racks.

Calvin W. Rice, New York city: A convenient way of preventing floating ice, sticks, etc., from interfering with the service is to string a boom across the flume or forebay, some distance above the racks. Preferably, the boom should be at an angle with the direction of the flow of the stream, so that the ice and brush go automatically toward the spillway. It is preferable to remove all debris entirely.

C. H. Hollingsworth, Cheboygan, Mich.: The floating ice is usually passed over the dam, but if it is not possible to do this, and the ice is present in large quantities, it must be taken from the water and removed entirely from the plant. It is not possible to work the ice through the racks unless it is reduced to slush, and even then it will seriously interfere with the operation of the turbines, often stopping them entirely. This difficulty is more easily prevented than cured, by arranging headgates outside the racks, and placing the entire gate openings under water. The bulkhead in which the gates are located will then act as a skimmer, and all floating matter can be floated over the dam or through an ice sluice. If this arrangement is not possible, a cheap substitute is found in a glance boom of the pattern known as a stiff boom. This can be built either of logs or square timber and set across in front of the headgates at an angle with the current; the smaller the angle the more efficient will be the boom. It is advisable to have the boom two tiers high, so that it will float low in the water.

C. L. Hoon, Georgetown, Colo.: We have about one mile of steel pipe line ranging in size from 18 inches at the lower end to 36 inches at the intake, with a total head of 700 feet, or 303 pounds pressure. We run continually, 23 hours per day, and at no time is there less than 250 cubic feet per minute pouring through the pipe. In January the ice began to gather upon the inside of the pipe, and it continued to grow thicker each day until the head was reduced 65 or 70 pounds by friction. Other pipes in the county had frozen solid and the plants closed down. We could not afford to close down, and as a last resort we put a 25-horsepower steam boiler about 20 feet from the intake and put steam in the water at that point just as fast as that boiler could make it. The temperature of the water in the tail-race before we began using the steam was 30 degrees. After a continual flow of steam in the pipe line for five days and a half, we raised the temperature to 32 degrees, which soon cut the ice from the pipe.

E. H. Mather, Portland, Me.: The only satisfactory way to prevent difficulty from anchor ice is to prevent its formation by arranging a large millpond or forebay so that the water will remain comparatively quiet and readily freeze over.

Easton (Pa.) Power Company: For a 1,500-horsepower plant fed by a power canal, we use a number of booms placed 50 feet apart for a distance of a quarter of a mile above the intake. This arrangement calms the water and facilitates freezing. Our greatest trouble is with thin ice that forms in patches on the canal surface and gradually thickens while floating down the two-mile level. The booms hold this back for some time till it works under and crowds down along the racks. It is then necessary to employ men with rakes to keep the racks clear. Part is worked through and part is removed entirely—an operation of considerable difficulty and expense.

Augusta (Ga.) Railway and Electric Company: Ice may sometimes be removed from forebay before getting into wheels by having side outlet to drain surface water from the forebay.

Fred B. Hubbell, Westport, Conn.: We find the cheapest and most effective method of dealing with anchor ice to consist in the maintenance of a boom of logs across the head-race and, at exceptional times, a continual raking of the racks. This last winter we have had no trouble, as the river and raceways have been frozen solid continuously.

Franz Köster, New York city: European practice in disposing of ice is to build in the intake canal special ice-breakers or deflectors and to provide a collecting basin at the end of the canal in which such ice as passes the deflector and the breaker is collected and discharged to the river by means of a sluicegate or icetrap, which is lowered, allowing the ice to pass over it. The deflector for floating ice is triangular in plan, located at one side of the intake canal and built so as to extend above the water level, so that the ice, traveling at a high velocity, is forced against it, its direction of flow is changed, and it is shot over the overflow dam.

QUESTION.

What methods have been successfully employed to obtain relief from slush or anchor ice?

ANSWERS.

Union Electric Light and Power Company, Unionville, Conn.: There are different kinds of anchor ice—one kind that will go readily through the racks and will clog in the wheels and stop them, and another kind that will gather at the racks and clog, but by means of vigorous raking can be worked through any ordinary rack, and once through the rack will pass readily through the wheel. In the former case the very best thing to do is to shut down until the ice stops running, for when it gets clogged in the wheels it takes a long time to thaw out. In the latter case it is usually advisable to keep running and keep the racks clear by raking. However, as anchor ice usually comes on the first cold nights of the season, we find it best to shut down completely and allow the canal to freeze over solidly, which it will do faster than if the current were running swiftly, and when once frozen over there is no further trouble from anchor ice.

L. E. Watson, Kearney, Neb.: Thus far we have not been able to do away with slush ice entirely, but we are not troubled now nearly as much as we have been heretofore. Our main desire is to keep our still bay frozen as long as possible. To this end we have put in boom logs, which quiet the water and allow early freezing. At times when slush is expected we endeavor to have at least three inches going over our waste weir. We have a long boom placed at an angle with the weir, so that it tends to throw over all floating slush. We find that it is necessary at such times to keep a man cleaning this weir from the adhering slush. We have also lowered our racks so that the upper end is below the surface of the water. This tends to keep the iron at the same temperature as the lower water.

Calvin W. Rice, New York city: I know of no method of successfully obtaining relief from anchor ice, but recommend that provision be made for an inclosed flume for a considerable distance previous to entering the penstock, and where this is impossible to have a wide and smooth channel to keep down the rate of flow. This works in two ways—first, there are no sharp points at which the anchor ice seems to form; and, second, the choking of the stream is prevented.

C. H. Hollingsworth, Cheboygan, Mich.: The only positive method of obtaining relief from slush or anchor ice is having a sufficiently large millpond above the power plant to allow such ice either to melt or come to the surface. This ice is formed in rapids, and if the approach to the turbines is swift water, it is a difficult matter to get rid of it. The length of still water required to dispose of it is governed by the character of the stream above the penstock and the velocity of the current, and may be a distance of two miles or more.

Little Falls (Minn.) Waterpower Company: With an experience of 17 years in the operation of waterpower plants, we have not yet been able to find a method for getting rid of anchor ice. There is a vast difference on this river (the Mississippi) between slush and anchor ice. The slush ice is on top of the water and can be taken care of by men at the headgates by either removing it entirely from the water with scoops or by breaking it up and letting it pass through the wheels. The anchor ice, with which we are occasionally troubled, is a very small, diamond-shaped icicle, which is usually carried down by the current from three to five feet below the surface of the water and in such a mass that it clogs up the head-racks, and with three men on the 10-foot rack we have been unable to keep the rack clean. When we have been troubled with anchor ice it has come down the river immediately after the first freeze-up and interferes with our operation for not over 24 hours; after the river is once frozen over the trouble ceases.

Easton (Pa.) Power Company: Slush or anchor ice will usually go through the wheels without difficulty, except in the most severe weather. We have had only one instance of a waterwheel clogging and freezing while running—a 51-inch McCormick turbine, which was afterward thawed out by fires built inside the turbine chamber.

E. H. Mather, Portland, Me.: With a plant where the anchor ice floats near the surface, relief can sometimes be obtained by constructing floating guides in front of the rack, leading diagonally to a side sluiceway through which the anchor ice will run off and not pass through the rack. In a plant where the water passes through the rack with much force it is doubtful if there is a device that will give any more relief than the common hand rake.

Franz Köster, New York city: For disposing of anchor or slush ice, a barrier a few feet high is built across the bottom of the intake canal before it reaches the collecting basin. This barrier is curved, and one end terminates at a sluice-gate built in the overflow wall of the canal. To discharge the ice this gate is operated from above, either electrically or by hand. It is also common practice to deepen the intake canal before reaching the barrier, and thus reduce the speed of the water and collect all the ice at this point.

E. S. King, Merrill, Wis.: I believe rafts placed in the forebay or pond so that the water will pass under cover for some distance before reaching the racks will cure the trouble in many cases. We ran for nine years in connection with a sawmill. During this time the pond for a distance of 500 feet above our racks was covered with logs, and we never experienced any trouble with ice. For the last four years we have had trouble every year until a coating of ice is formed over the pond, when it ceases, but frequently troubles us again in the spring during cold snaps after the ice has gone out.

Engineers Inspect New Interlocking Steel Sheeting.

About 50 engineers and other guests were given an opportunity on July 8th to inspect the new interlocking steel sheeting used by the Jackson & Corbett Company in construction work where casings or cofferdams are required. The party was taken out in two large tally-hos and was in charge of George W. Jackson and John J. Corbett. At the foot of Harrison Street an inspection was made of the incline being constructed for the outlet of the Illinois Tunnel Company to Grant Park. Here the steel sheeting used to support the adjoining property is driven to a depth of from eight to 35 feet. The advantage over the old method of pile-driving and wood-casing is evident from the fact that sections of the interlocking casing were easily driven through a variety of obstructions. At one place the steel sheeting was driven through an obstruction which proved later after excavation to be a section of the old dock said to have been laid in 1840.

The party was next taken to the North Side pumping station to see the steel sheeting which had been driven there to enable the construction of the foundations for new pumps. The interlocking steel sheeting has been patented by George W. Jackson and August Simon and is used for cofferdams, piles, water-tight casings, bridge foundations, water-tight bulkheads, etc. The new method was successfully employed in the construction of the foundations of the new Randolph Street bridge in Chicago. A cofferdam 75 feet wide and 85 feet long was constructed and the interlocking sheeting was driven to a depth of 31 feet below datum without any damage to the foundations of adjoining buildings. A four-inch centrifugal pump controlled the water after the sheeting was driven and the channels filled with clay. The sections are made in all lengths and can be used repeatedly, an advantage being the ease with which the steel is pulled after the work is completed.

The trio was concluded by a very interesting ride through the tunnels of the Illinois Tunnel Company. A train of five steel cars drawn by a small electric locomotive carried the party through a part of the 20-mile system at a speed of 18 miles an hour. Stops were made at the corner of Franklin and Washington Streets and at Fifth Avenue and Jackson Street. The members of the party were well pleased with what they had seen.

Electric Heating and the Field It Offers Central Stations.[1]

By James I. Ayer.

There are many convenient electric heaters of small current consumption that are effective in supplying wants that gas cannot meet, or when possible with gas, the contrast is even more marked in their favor than a comparison of the two methods of illumination, and I will mention some of them.

Electric curling-iron heaters use 50 watts and are never in service but a few minutes at a time. The electric heating pad, or substitute for a hot-water bottle, is an invaluable device when required, and uses but 50 watts. Electric flatirons are made for sewing-room use of 200 or 300-watt capacity, and though frequently in commission, the period of operation is short, so that the monthly consumption of current is small. They save many weary trips to the kitchen for a hot iron to press a seam, a bit of lace, and, not infrequently, Johnny's trousers.

An electric teakettle or stove using 200 watts, or a small cup with heater, will produce afternoon tea for two, heat the baby's milk night or day, heat shaving water, and is of much value in the sick-room. With two small stoves, a breakfast of eggs, toast and coffee can be prepared on the dining table while you wait, and you will not wait as long as usual.

A chafing-dish, of course, is more useful for general cooking in the dining-room, and until one has "lived with an electric chafing-dish," he does not know its possibilities. These require 200 or 500 watts, according to the size, and are cheaper to operate at lighting rates than the alcohol kind.

An automatic coffee-urn for the breakfast table does its work perfectly in from 10 to 20 minutes, using 200 to 400 watts, according to size.

For the man of the house inclined to tinker an electric soldering iron, using from 100 to 200 watts, is useful, as well as a small glue pot.

All of the above-mentioned articles are usually supplied with lamp-socket plugs, and are sold ready to connect. There is nothing in the way of special work required to put them into service; their operation is quickly understood, and most are of such low price as to be easy to introduce. Such articles are the best possible advocates for the more extended use of the electric service in the household, and will do much to make a satisfied customer. The fact that, except the heating pad, none of the articles is at work for more than from 10 to 30 minutes at a time makes the aggregate for the month but a small addition to the total bill, yet a material gain to the station, for it is added output on existing service wires, and the articles serve as missionaries.

Every residence customer on your lines should be systematically informed of the advantages of these small items, their introduction urged, and a record kept of the purchases. The use of the above leads to a demand for electric cooking appliances for the kitchen, and irons for the laundry.

How does the cost of electric cooking compare with gas? Here we have a burning question.

If electricity and gas could be used at equal efficiencies for the various cooking operations, this topic would have been omitted, but fortunately that is not the case. Electric cooking apparatus easily operates at an average efficiency of about 70 per cent. and gas at about 15 per cent. in ordinary practice in domestic kitchens. I am aware that some gas operations show a much higher value and others less, and in the hands of experts better average results may be obtained, but this is equally true of electric apparatus. Jane may turn on the oven of either system a half hour in advance of the time required. She can run the burners under the kettles wide open and waste at a greater rate than by treating the electric heaters in the same manner, for they have a fixed maximum, and it is all heat; but whether gas or electric cooking is reasonable in cost depends much on Jane. I trust you will pardon me if I say gas varies in quality. It is credited with having from 600 to 800 heat units per cubic foot, and it depends on the pressure, location, kind and condition of burners as to whether complete combustion occurs to develop all these heat units. Assuming that under average conditions 700 heat units are available for every cubic foot of gas, we have 700,000 heat units for a thousand feet. One thousand heat units equal 0.2909 kilowatt-hours. Allow a drop of one per cent. between meter and heater gives us 0.2938 kilowatt-hours for 1,000 heat units. On a basis of 15 per cent. average efficiency for gas ranges, we have effective 105,000 B. T. U. in each 1,000 feet of gas.

Electric heat at an average efficiency of 70 per cent. equals 0.4197 kilowatt-hour per 1,000 effective heat units, and for 105,000 effective there would be required 44.065 kilowatt-hours to give the same results. To compete with gas at equal rates electricity will have to be sold—

at 5.67 cents per K. W. H. where gas is at $2.50 per 1,000 feet,
at 4.54 cents per K. W. H. where gas is at 2.00 per 1,000 feet,
at 3.40 cents per K. W. H. where gas is at 1.50 per 1,000 feet,
at 2.83 cents per K. W. H. where gas is at 1.25 per 1,000 feet,
at 2.27 cents per K. W. H. where gas is at 1.00 per 1,000 feet,

The above is, I believe, as fair a comparison as can be made where exact comparisons cannot well be secured. The results above quoted have been checked by records made in the same family, alternately using gas and electricity each week for considerable periods in a number of cases, and from a variety of records obtained otherwise. It is assumed that suitable equipments, both of electric and gas appliances, are used.

It is a fair statement that in a family of four or more, with a suitable equipment and ordinary care, it will require from one to 1½ kilowatt-hours per day per person. Taking the higher value, this at three cents a kilowatt-hour is 4½ cents per day, or $1.35 per month per person, and for a family of four equals 18 cents per day, or $5.40 per month; at five cents per kilowatt-hour, it is 7½ cents per day, or $2.25 per month per person, and for four, 30 cents per day, or $9 per month. If economy is practiced, these amounts, at the respective rates, can be reduced about one-third. Our recorded data show an average of about 20 per cent. less than the highest value quoted.

A variety of cooking devices, each perfectly adapted to its work, entirely independent of each other, separately controlled, having fixed temperature limits, so that successive operations may be performed under exactly the same conditions, all operating with no measurable effect on the room temperature, constitute in brief the electrical method. When it is realized that the principal reason for the failure of the cook to reproduce her best results is because the heat supply fluctuates between such wide limits, due to improper care, we can see what opposition we shall meet from the doctors when they realize this personal equation is being eliminated from cooking operations. Exact methods are the only ones that will yield uniform results. Imagine your central-station service with the boilers controlled in the manner of the average kitchen range.

In arranging electric cooking apparatus, we have departed from the conventional form of fuel stove or gas ranges, because electric heat permits of more convenient arrangement, and an electrical outfit can be extended to meet increasing demands without affecting the usefulness or efficiency of the original equipment. A panel board on the wall, with a number of plug-switch receptacles and an ordinary kitchen table constitute all of the necessary fixtures, the heating devices consisting of ovens, disk-heaters or stoves. Broilers, griddles, or the two in combination, waffle irons and water heaters, all of which are light and portable, permit the selection of a more or less elaborate outfit for a family of four, which on occasion may be expanded to meet the requirements of 10 times that number without changing the effective value of the first selection. One can start with one or two articles and gradually add to the equipment as may be desired.

All cooking utensiles for the kitchen are preferably made without heaters, so that a variety for different operations may be used on a single heater. More utensils than heaters are always necessary for general cooking, and vessels without heaters are much lighter, more convenient, more easily cleaned, and, of course, cheaper.

In all cases, utensils made specially for electric stoves should be used with them, as they are designed to fit and temporarily become a part of it while in position. Dissatisfaction with disk heaters is the result of operating them with improper vessels. Besides the above, there is a demand in residences for electric plate warmers, electric water heaters for bathrooms, laundry irons and electric radiators.

Electric plate warmers are usually placed in the pantry, and supply a want but imperfectly met heretofore. They are not expensive to operate for those who demand them, and they should be suggested when arrangements are made for installing wires. The large heat capacity of water makes heating it by electric heat in quantity expensive, yet for bathrooms it is becoming more and more in demand. Five gallons of water heated to 190°, when added to 10 gallons of water at hydrant temperature in a small bathtub, will provide one with a warm bath, while eight gallons at 190°, added to 15 gallons at the hydrant temperature, would be more desirable.

The former would require 1,750 watt-hours, which at five cents per kilowatt-hour, is 8.75 cents, and the latter 2,800 watt-hours, costing, at the same rate, 14 cents. This cost is not excessive, but it means heaters of 1,750 and 2,800 watts capacity, respectively, which must be turned on an hour before the water is needed. If the work is to be done quicker, then correspondingly larger heaters and service wires are necessary. We frequently supply pressure boilers connected to the water mains, containing heaters of smaller capacity, which are arranged with subdivisions of heat, which may be kept on continuously at low heat, and at low rates they are not prohibitive.

Small heaters for washstands, that may be connected to the supply pipe, are being developed, but for such use a small cup that will quickly heat to the boiling point a pint of water (requiring for this about 850 watts for three minutes) is useful, and current is not so likely to be wasted. The cost for heating one gallon of water to different temperatures at different rates is here given, which best tells what is required in current supply for a given result in quantity, temperature and time as well.

Total Temperature.	—Watts used for— 5m.	10m.	20m.	1 hour.	Cost in cents with current at 3c.	5c.	10c.	20c.
100° F...	1296	648	324	108	.32	.844	1.088	2.17
150°	2976	1488	744	248	.74	1.24	2.48	4.96
175°	3744	1872	936	312	.94	1.56	3.12	6.24
200°	4608	2304	1152	384	1.15	1.92	3.84	7.68
212°	4992	2496	1248	416	1.25	2.08	4.16	8.32

The equipment of domestic laundries will be found a profitable field. The family requiring but one iron will need a size using about 500 watts, and it will be in demand from five to 10 hours per week, according to the size of the family. This means from 2,500 to 5,000 watt-hours per week.

Radiators are in demand, and are used to advantage, but it is not possible to do usual office or house heating unless current may be obtained at exceptionally low rates. An application that is reasonable is the use of one in a bathroom for taking off the chill during the morning bath. For such work a radiator of less than 1,500-watt capacity is not to be recommended, and one of 2,000 watts is better. The latter, operating for 15 to 20 minutes, will usually answer requirements, making a total consumption of from 500 to 800 watt-hours. There are other special conditions where they are sometimes used to advantage. Being easily portable, they are valuable about the house for occasional use for short periods.

For electric cooking and electric laundry work in the home, it is clear that special rates, lower than can be made for lighting, are essential to success. The load being principally a summer day load, makes special low rates possible, and the business desirable.

One method that has been practiced is to install a separate meter, making no restrictions as to the amount to be used, thereby offering all possible encouragement to the customer. Another plan is to use two-rate meters. Rates on either plan, in most communities, may be made with profit as low as five, and in many cases as low as three, cents per kilowatt-hour for day service.

Electric laundry and tailors' irons have the widest use of any single line of electrically heated devices, and today offer the broadest single field for development. Being best known, perhaps, of all electric heating devices, it is perhaps worth while to examine them in detail, in relation to the requirements and how well the demands are met. The home needs and how they are met has received attention. Hotel and commercial laundries demand irons for constant and rapid work. In the majority of cases these are heated over gas burners. The rooms are usually small, and when the gas stoves have done their best it is a place to avoid; yet here we send our linen to be cleaned. Though this is generally so, the improvement in the financial condition of laundry owners in the last few years is such that they are seeking better methods, and are in many cases looking to you for help in improving the efficiency and sanitary condition of their establishments. The same is true of many clothing and similar factories.

The electric iron, while working, is passed rapidly over damp and frequently wet fabrics, with pressure constantly applied. This treatment demands a rapid supply of heat for the work and for the constant loss by radiation, which, though not a large element in the normal working temperature, still is a constant loss. Irons are made with a given generator capacity for the different classes of work, and if they are continuously employed in the regular manner their temperature is fairly uniform and results are satisfactory. When, for any reason, the irons are left with the current on idle for even five minutes, their temperature rises to about double the normal working value, and, according to their construction, the generator or winding within the iron goes much higher; in 15 or 20 minutes the temperature is still higher, which submits the heater to strains that finally become destructive. It is because of this treatment that, until improvements were made to enable them to better withstand this treatment, the product was unreliable.

Today it is still difficult to construct irons for rapid work that will give good service without some arrangement to prevent the overheating when idle. One device which accomplishes this operates automatically to reduce the current supply whenever the iron is placed on its stand, and this incidentally effects a saving of 25 per cent. or more during such periods. One other fault incident to overheating, not confined to electric irons, is their liability to burn the garment on which they are first placed when in this condition. Complaint is sometimes made about the breaking of flexible conductors, and this is always a serious fault in improper installations. Cords should be no longer than necessary to permit the free use of the iron. If they are connected to the circuit by a plug switch, placed 20 inches above the table on the wall back of the bench and suspended by an elastic cord, and strung from the ceiling so there is not more than two inches of slack between the point of support and the iron when placed in the center of the bench, there will be no complaint of the cords.

All irons should be provided with a suitable ventilated stand and no other kind.

The advantages of the irons are conspicuous; they are always clean; heat in from four to five minutes; will operate continuously, and may be kept at practically uniform temperature under all conditions of service, and when controlled have long life and, in the best products, in common with other types of electric heaters, do not change their resistance with continued service.

The cost for operation per hour varies with the size. For the all-around use for domestic requirements, without a regulator, the most efficient use from 500 to 550 watts. The regulators effect a saving in such service of from 15 to 20 per cent.

In laundry work in hotels and commercial laundries, the irons vary in size, and their consumption is from 350 to 600 watts per iron, and the regulators effect fully 20 per cent. saving.

In clothing and similar manufacturing establish-

1. Abstract of a paper read before the National Electric Light Association, at Boston, May 24, 1904.

ments, the tailors' irons are larger and require from 600 to 1,000 watts per iron, and the average is perhaps 750 watts. Except where electric irons are used, gas irons, with burners within them, connected to the supply with rubber tubing, are almost invariably used. They have no end of trouble with leaky tubes, which frequently burn off, break or slip off the connection; combustion is more or less imperfect, and they are dirty. All of this makes a bad sanitary condition and a constant source of trouble.

As to the durability of apparatus, it can be asserted that the general product of experienced manufacturers will give quite satisfactory results, if customers are thoroughly and carefully acquainted with what is necessary for fair treatment. Perhaps a statement of performance will give a better answer regarding durability than in any other manner. In the winter of 1902-3, about a year and a half ago, the Natural Food Company of Niagara Falls, N. Y., began the manufacture of a new product they call Triscuit, it being a cracker of shredded wheat baked or toasted by having heat applied to both sides at the same time. The operation consists of passing the product through a machine between two endless link belts enclosed except at one end. The links of the belts are electric stoves, and are so arranged that the Triscuit is fed in and held pressed between the faces of two stoves throughout the complete circuit of the machine. The operation is continuous. Each machine has about 2,500 stoves and has a product of 17,500 triscuits an hour. They are operating about 10,000 of these stoves, and their failures up to date have been less than one per cent. from all causes. This is the largest development of electric cooking in the world, and is successful in every way; the cost for baking, including labor, being less for the same amount of product of triscuits than for shredded wheat biscuit using coal.

DISCUSSION.

Alex Dow, Detroit: I have been footing the bills for an electric kitchen. I have arrived at several conclusions which I will pass out to you, but if anyone wants to get into a corner and argue the matter with me I want him to give me notice so that I can bring Mrs. Dow to help me out. She is responsible rather than myself. We have four or five kitchens where electricity is used in a line of houses, but only one of them is under my personal observation. My conclusions are as follows: The peak load is in advance of the usual maximum lighting in the residence district. That, in our town, coincides with the downtown peak. The heating will require no additional sub-station machinery, but it will add to the main-station load for winter service only. The next conclusion is that the cooking load is about two hours per day through the year, say 700 hours of the demand on the district, not the demand of the individual customer but the demand on the district. The next conclusion is that it does not do to sell cooking discs, etc., unless you look after the kettles. You can waste about half the current by having the wrong sort of vessels to put on the discs. An absolutely clean, smooth vessel is better than the ordinary cooking utensil, and the best one is the type of vessel which clamps solidly on the disc. The next conclusion is that the cords are a nuisance and are constantly causing trouble; they get greased and grease the food and apparatus, and should be cut off as short as possible. While we are waiting for some method of wireless connection for cooking utensils I have adopted the plan of putting the cord through a hole in the table and letting it drop through there, as in the case of a telephone switchboard. It works nicely and gets it out of the way. The next conclusion is that the devices furnished by various makers for varying the heats are bad things in the hands of the ordinary kitchen mechanic. They are mismanaged and broken. I believe that two heats, in practice, are sufficient—one quick heat and one simmering heat—and these can be obtained by a double-throw switch, which, when open, cuts the heat off altogether. In my opinion the best method of wiring is the double-throw switch, with the wires running down through the table and only two heats available.

My last conclusion is gathered from the experience of my neighbors and myself with a number of different makes of apparatus and utensils for electric cooking, and that is that the worst fault to be found with the electric cooking today is the repair bill. The load is a desirable one, I think. The rate might be cut down to a point where there would be considerable business, particularly in apartment houses, and particularly with the large class of people where the mother does the work. But the repair bill is very serious. I want to say that that is a statement not based on experience with any one class of apparatus, but from an average of a number of makes of apparatus, and there seems to be a lot of difference, not merely between the makers, but between different productions of the same maker.

Arthur Williams, New York: Our company has constant applications for just such data as this from contractors and engineers and other people who want to consider electric heating and cooking. Not long ago our company—the New York Edison Company—issued a circular, the first edition of which was over 30,000 copies, covering this subject as far as we could in the limits of a small circular, giving the approximate sizes of the utensils, their cost and hourly cost of burning. This and another circular which has recently been issued by our company have been called for so generally that it is evident there is a well-sustained and a very widespread public interest in this subject of electric heating and cooking. I think it will be admitted that electric cooking apparatus will never return to the companies a large revenue, as its use is confined to short periods of the day, but apart from the cooking of the late afternoon dinner hour in the winter months, whatever revenue comes from this apparatus is additional revenue per kilowatt of installation. I think in itself that will encourage us in making efforts to install electric-heating and cooking apparatus.

In addition it is one of those factors of convenience and necessity in the supply of electric current for commercial purposes. If you take June, July, August and September, any cooking apparatus used in those months cannot come on the peak of the system or of the converters, and it has occurred to me that as residence lighting in these months is very low, why would it not be possible to adopt the English method? A recent English schedule of which I have heard provides a half rate for all current consumed below the stret level. If the usual rate is 12 cents per kilowatt-hour, the rate for installation below the street level is six cents, and the suggestion occurs to me why we could not in the summer months, for residence lighting, cut the usual rates in two. That might be a way out of the difficulty, because I can see that the installation of the parallel system of wiring and a second system of meters, or a two-rate meter, would be an application many companies would not care to indulge in. I know of a number of instances where small stoves, French coffee-pot heating pads (than which there is no greater convenience in household arrangements—a substitute for the hot-water bottle), chafing dishes and small heaters have been used without any apparent change whatever on the bill. The cost is generally too insignificant to consider, and these costs should be published very generally by the electric-lighting companies.

We had recently an instance, however, of a customer who had an electric heater on his meter, which he left connected at the time of cutting off the current in the summer, and it was still connected when he returned to his house in the fall. The connection was not known until after the bill for the month was rendered, and then it was very much known. A great deal of trouble has been experienced through the absence of any indicating device as to when the current is or is not on. Servants are universally careless about such matters. Every large device connected with electric cooking, such as plate warmers, etc., should have an indicator which cannot be removed. I know of cases in which the butlers have turned the colored lamps out, and there was no indication as to whether the device was in use or not, and when the bills have come in they have caused great dissatisfaction. It does not seem to me that the kilowatt price is at all important. I have in mind an instance of a large factory where electric irons are used for making hats, where the price is eight of nine cents per kilowatt-hour, and the cost of this service is almost identically the same as the corresponding service rendered by gas. They were special irons made for making hats. These were the advantages of the use of electric-heating apparatus as given by the proprietor—the men worked faster, thus increasing the output of the factory; the factory itself and the surroundings among the men who were working there were cleaner; the atmosphere was cooler, and the work in the use of the electric irons much less fatiguing on the employes.

Death of E. T. Bubier.

Edward T. Bubier, author and publisher, passed away on July 4, 1904, at his home in Lynn, Mass., in which city he was born and educated. In early manhood he was attracted to the electrical field and began the preparation of works of a semi-technical nature. Through the Bubier Publishing Company, with which he was identified, many books and pamphlets were printed, and for a series of years his compilations on various electrical and other subjects followed each other in rapid succession. These books were issued under the pen name of "Edward Trevert" as author. Perhaps Mr. Bubier took a fancy to the use of his middle name on account of its spelling being the same backward or forward. His books were of an elementary nature. Mr. Bubier was 46 years of age and leaves a wife but no children.

Michigan Electric Light Association.

The association of electric-light managers and superintendents of the state of Michigan, temporarily organized at Detroit on June 8th, will meet at the Pantlind Hotel in Grand Rapids on July 20th for the purpose of forming a permanent organization. The business session will be begun at 2 o'clock p. m., and will be followed by a dinner and social session in the evening. The committee appointed to draft a constitution and by-laws will report, and it is urged that every electric-light manager and superintendent in the state be present, as it is believed much good will result from such an organization. F. S. Hubbell of Milford, Mich., is chairman of the committee.

Taking Moving Pictures by the Use of Vapor Lamps.

The different Westinghouse Companies in the Pittsburg district recently gave a display at Carnegie Hall, Pittsburg, of moving pictures of scenes in and about the Westinghouse works, which was attended by 2,500 Westinghouse employes. The pictures were taken for exhibition in St. Louis in the private Westinghouse Auditorium on the fair grounds and are interesting not only as one evidence of the active preparations being made by big exhibitors for the entertaining of visitors to the World's Fair but as a revelation of an important use of the Cooper Hewitt mercury vapor lamps in connection with interior photographs. The secret of the success attained in the remarkable photographs of shop interiors is ascribed to the possibilities of artificial lighting by means of the Cooper Hewitt lamp.

Although the greater number of the pictures are interiors, the panoramic scenes along the route of the Pennsylvania railroad from Pittsburg 20 miles east to Stewart and Trafford City, with views of stations along the way and of the Westinghouse works at Swissvale, East Pittsburg, Wilmerding and Trafford City, will be of special interest to Pennsylvanians at the exposition. To secure this series a special train was run for two days back and forth along the Pitcairn branch.

The interior views, however, are the features of the Westinghouse display which will attract most attention at St. Louis. Several of them are mutoscope pictures, in which the camera was placed about 15 feet above the ground on a platform suspended from an electric traveling crane and moved slowly down along the aisle about 50 feet in the rear of the Copper Hewitt lamps, the latter also suspended from a traveling crane moving at an equal speed. On the first giant crane, with the lamps, was mounted a 500-volt motor connected to a 27-kilowatt generator of 125 volts, direct current. The 64 lamp tubes themselves were hung in sets of eight, in eight frames, each about five feet high, three feet wide and four inches deep, and fitted with resistance coils, each board taking 35 amperes at 110 volts, the entire set of lamps requiring only from 30 to 40 kilowatts, or about one-fifth the energy consumed by the 400 arc lamps.

The pictures include, besides the railway scenes, many every-day scenes at the plants of the Westinghouse Machine Company and the Westinghouse Electric and Manufacturing Company, East Pittsburg; the Westinghouse Air Brake Company, Wilmerding, and the Westinghouse Machine Company Foundry, Trafford City.

Automatic Pumping Plant for Residences.

Country residences as a rule present difficulties in the endeavor to supply them with the modern conveniences of a city home. To supply running water where the house is outside of a district supplied with water service a pumping plant has been invented by Francis L. Orr of Thurman, Iowa. The device automatically keeps the water in a supply tank at a given level. Electricity is utilized to operate the pump, which is only put in motion whenever the water falls low enough in the reservoir to connect the switch through which the current passes to the pump. The pump piston extends inside an electromagnet and is operated directly by the current with a reciprocal motion instead of being driven by a rotary movement as with the ordinary motor. The solenoid winding is connected directly with the supply circuit and a simple device on the piston reverses the current at the proper time.

Purchase of Allis-Chalmers Company by General Electric Denied.

The Chicago Inter Ocean of Saturday last contained a New York dispatch dated July 8th saying that the General Electric Company had bought the Allis-Chalmers Company and that an official announcement would be made in a few days. Inquiries made by the Western Electrician at the New York office of the General Electric Company were met by a categorical denial of the story.

The Inter Ocean dispatch also contained the statement that the General Electric Company "is also negotiating for the purchase of the National Electric Company of Milwaukee." This is a broader statement, but there is excellent authority for the assertion that if there have been negotiations between these companies they have amounted to nothing tangible.

The Denver-Boulder Interurban Railway Company announces that it has secured all the right-of-way on private property between Broomfield and Louisville, Colo., and that it expects soon to be able to announce that the entire right-of-way between Denver and Boulder has been secured. That portion of it from Broomfield to Boulder is exclusively over private property. Traffic arrangements with the Denver Tramway and the Boulder Electric Light and Power Company give the company terminal facilities in both towns.

Corporation Telephones.[1]

By A. R. Bennett.

The first independent telephone exchange constructed by any local authority was that of the states of Guernsey, which was established in July, 1898, and which is consequently in its seventh year of working. From a small beginning, it has developed until at the present moment there are 1,230 telephones at work in the island. As the population is only 40,300, this gives one telephone to every 33 souls, and makes Guernsey the best telephoned area in the United Kingdom. The rates charged are very low, but the financial results have been satisfactory.

The second exchange to be established was that of the corporation of Glasgow, which commenced to work in March, 1901. That has also been extremely successful, as, beginning with promises for 3,000 instruments, it has now 11,200 actually working with a stream of new orders always flowing.

The third corporation exchange was that of Tunbridge Wells. The scheme was a very small one, providing only for 300 lines, as it appeared quite unlikely to the authorities, notwithstanding strong advice to the contrary, that that number could be exceeded for at least a very considerable time; but the success of the service was so great, that 300 instruments were working within a few weeks of the opening, and in the course of a few months the number had reached nearly 900, which had to be grafted on a system which was originally far too small.

The next exchange to be started was that of the corporation of Portsmouth, which was opened in March, 1903. From a small beginning, the exchange has prospered mightily, and has at present some 1,700 telephones speaking, with many others to join up, augmented daily by new orders.

The fifth exchange to get into operation was that of the corporation of Swansea, which was opened in August, 1903, and has at present nearly 800 telephones joined up and many more to follow. Being of such recent erection, no accounts are, of course, available, but a good surplus on the first year's working is confidently expected.

The sixth exchange was that of the corporation of Brighton, which was opened in November, 1903, and has now 900 telephones working, with about 1,000 more to join up. In this case also no accounts are, so far, available.

The system in Guernsey was at first nearly exclusively overhead, as it was felt desirable to have the routes well defined before undertaking underground work. The poles used are creosoted Norway fir, of the usual sizes. A few standards have been erected on the roofs, but only where absolutely unavoidable. These standards are exactly the same as I designed for use in Glasgow in 1881, built up and spliced in the same fashion, and are fitted with the channel-iron arms which I designed about the same period. The insulators used throughout are of the pattern known by my name, which also dates from 1881. These insulators, while being effective as such, resist the effects of stone-throwing much better than any other form, and are consequently well suited for country roads and districts. As the island is small, and no chance exists of long-distance trunk communications, it was decided to employ silicium bronze wire of an unusually small gauge, namely No. 19, which, electrically, is quite sufficient for such a restricted area. It has a breaking strain of 153 pounds and a resistance of 94 ohms per mile. It was said when the exchange was first opened that such small wire would not stand the storms to which the island is subject, and would soon be eaten away by the salt air. These predictions have been completely falsified by results. The original wire, put up seven years ago, is still intact, and shows little signs of wear. It has withstood many gales with great success; interruptions to service through storms, even the most severe, are extremely rare. As the routes filled up and the subscribers increased markedly, it was deemed desirable to lay underground cables, and this policy has been followed, until the mileage of underground wire in the island is more than one-third that of the overhead, the respective mileages of metallic circuit on December 31st last being 318 miles underground and 827 miles overhead. The type of underground cable used throughout is air-space paper insulated, the gauge of the conductors being No. 22. The cable is sheathed with lead in the usual way, and then armored with steel tape, finished over all with a serving of jute. I believe that these were the first armored cables ever used for telephone work, and the new departure, like most innovations, caused comment and adverse criticism; but the venture has been fully justified by results. It is nearly seven years since the first cable was laid, and although the mileage is now, as I have said, very considerable, not a single fault has occurred in any of the cables from first to last, and when uncovered the cables look as good as new, so that they have evidently a long life before them. The switching system used in Guernsey is that known as the Bennett ring-through. In the Guernsey system one subscriber can ring through to the other without making any signal at the exchange, the ring-off being unaffected until he makes the proper movement. This result is brought about by bridging the conductors in the connecting cords by two coils of equal resistance and taking off from between them a branch to earth through a battery. The ring-off signal may either be worked by the resistance coils arranged as electromagnets or by a special indicator included in the battery circuit. It will be seen that the ring-off battery is always charging the lines connected by the cords, although no current flows until one or both of the subscribers touches his ring-off button, which has the effect of making a momentary earth at his end of the line. The current then flows from the ring-off battery and accentuates the drop. This system requires well-constructed and well-insulated lines, because no earth or leakage is admissible, such, when it occurs, being indicated by the ring-off drop persistently keeping down. The system is, therefore, always under test, a fact which worked out to the great grief and dismay of the earlier linemen, who were accustomed, with great light-heartedness, to run wires in contact with trees and buildings; that cannot be suffered with this plan, so that a well-insulated and well-maintained system is a necessity.

In Glasgow there are 19 switch rooms. In 14 of these the ring-through system, practically the same as in Guernsey, is fitted, but in the remaining five switch rooms, those in the central parts of the city, namely, Renfield Street, Hillhead, Bridgeton, Kinning Park and Queen's Park, the five chief exchanges, were constructed on the call-wire principle, in deference to the wish of the telephone committee, which, before a start was made, considered the question carefully. On three of these central exchanges, however—Hillhead, Kinning Park and Queen's Park—ring-off drops on the ring-through system have been fitted so as to render it unnecessary for subscribers on those exchanges to call-off after a connection; they simply press a button, establish an earth connection at their instrument, and cause the central ring-off battery to work the indicator. This saves much time on the call wire, and leaves it clearer for those calling for connections.

The construction work in Glasgow is to a very large extent underground. After the recently constructed Postoffice system in London, the Glasgow corporation is the largest underground system in the United Kingdom, and that by a very long way. The form of duct employed is cast-iron socket-and-spigot pipes of three inches internal diameter, jointed by means of spun yarn and lead, and laid so as to be water and gas tight. At frequent intervals brick manholes have been built, and in many other places split cast-iron pipes, with the flanged halves bolted together, are put in for the purpose of taking off branches. In the suburbs cast-iron pillar boxes, containing air-tight joint boxes, are used instead of manholes. These, being painted red, are occasionally mistaken for letter boxes, and it is an amusing sight in Pollokshields sometimes to see servant girls walking round them, vainly endeavoring to post letters in slots which do not exist.

The cables used in Glasgow are of two kinds, armored and unarmored. They are all air-space, that is to say, the conductors are insulated by loose paper wrappings, each pair of conductors being twisted together to form a metallic circuit. These metallic circuits are then laid spirally in layers, each successive layer being reversed, the number of layers varying with the number of pairs contained in the cable. This number varies from two pairs to 312 pairs, the last being contained in a diameter of 2.75 inches. The core thus built up is covered with lead, which varies in thickness from 0.1 to 0.16 of an inch, according to the size of the cable. The insulation resistance required at the factory is 7,500 megohms per mile, and the insulation required after laying and jointing is 500 megohms. Number 22 conductors are used within a half-mile radius of an exchange, and these give a capacity of 0.07 of a microfarad per mile. Beyond a half-mile distance No. 20 conductors are used, and these give 0.08 of a microfarad. The greatest number of pairs that can be got into a cable of 2.75 inches diameter when No. 20 gauge is used is 217. For the purpose of facilitating testing and jointing, the different layers in a cable are marked by differently colored threads wound spirally round them, always starting with the same color at the core, the seventh layer being of the same color as the first. Each layer also contains one pair done up in differently colored paper from the rest. These cables are drawn into the three-inch iron pipes and are sometimes joined in the manholes direct to one or more branch cables, but in Glasgow are generally taken into joint boxes fitted with air-tight covers to facilitate distribution. The cables in the manholes are fitted with nozzles, through which air pressure can be applied by means of a hand pump; all joints are tested in this way before being passed as satisfactory, and the joint boxes are also frequently subjected to air-pressure tests. At the central exchange air pumps, driven by electromotors, are provided, by means of which air pressure can be put on any of the cables at will, the air being first passed through drying pipes containing chloride of calcium. The air under pressure finds its way through the loose paper insulation, and being dry absorbs any moisture that may be present and discharges it at a distance, where an opening is purposely made to allow its egress. The air pressure is felt at very considerable distances, as far, for instance, from the central as Maryhill. If a puncture exists on a cable, the application of constant pressure inside prevents any moisture entering through the fault, and so keeps the cable working under circumstances which, without pressure, would speedily prove fatal.

In Glasgow, to a very large extent, the underground cables are taken into subscribers' premises in the same way as gas and water. This is a more expensive method than was contemplated in the original estimate, but when once done is much freer from disturbances than the ordinary overhead wires. Away from the center of the city such a method of distribution would prove extremely costly, and the usual method followed is to lead the underground cable up a distributing pole, or to a distributing standard on a roof, there making what is called a pot-head joint, and connecting the underground metallic circuits to overhead distributing wires by an intervening link of wire insulated with vulcanized india rubber, protected by waterproofed braiding.

The insulators used in Glasgow are of the same type as in Guernsey, except that on the longer lines double-shed insulators are employed. Bronze wire is used for distributing purposes, but the gauge is No. 18, weighing 40 pounds to the mile. The poles used for distributing are generally of creosoted wood, but sometimes they are of square pitch pine, and more rarely of steel tubes.

At terminal poles, where all the pull is on one side of the insulator, what are known as J-bolts are employed, which prevent a twisting strain being thrown on the wooden arm. These wooden arms are usually of oak, but recently we have tried karri wood, which promises to be very successful. Sometimes an effort is made to give an ornamental appearance to the pole by means of wrought-iron brackets. Where roof standards are employed, they, with their fittings, are all of the same type as in Guernsey. Recently an ornamental iron finial has been adopted for the poles and standards; this also acts as a lightning discharger, as the earth wire, with which all poles are fitted, is fixed in direct metallic connection with it. Wherever possible, the hanging of overhead wires above the tramway trolley lines is avoided.

At the exchange the underground cables are first taken to a room fitted for air-pressure tests, as already described, and are thence continued to the cross-connecting room. Here the cables are terminated in pot-head joints, and the wires are distributed to test jacks, mounted on one side of an iron frame, to which they are permanently fixed. To the other side of the frame are attached the lightning and high-tension guards, to which the cables from the switchboard are permanently connected. The test jacks and the guards are joined by single pairs, which can be shifted in the event of any alteration taking place in the subscribers' numbers, all transpositions being effected between the test jacks and the guards so as to leave the cable wiring permanent on both sides.

The switchboard used at the central exchange is designed for 10,000 subscribers. At the present moment nearly 7,000 stations are served from it. It is of simple design, because the call-wire system renders it possible to make everything in the exchange of much greater simplicity than is practicable with any other system. The switchboard is flat, so that operators may sit on both sides, an arrangement which saves a large amount of floor space, a material consideration in the center of Glasgow. The jacks are two-point only, with a third connection for the test circuit. They are arranged vertically, but no trouble is experienced from the accumulation of dust, the danger of which is sometimes urged as a strong objection to vertical jacks. The cords and plugs are hung from a canopy suspended from the roof so as to leave a clear space for the operators' hands. The cords contain three conductors, two for the metallic circuits and one for the test circuit. At the sections of the board devoted to junction-line working the cords are single for the service of the incoming junction lines. The outgoing junction lines are distributed among the operators, who are provided with speaking keys, by means of which they can ask connections from the various outlying switch rooms.

The method of disposing of the multiple cables is, I believe, unique. One objection to the usual type of flat switchboard is the difficulty of stowing the multiple cables, which are generally contained in the table itself, and are consequently inaccessible. At the central exchange the multiple cables are laid on either side of the switch table, under movable flooring, in guides which are so arranged that any particular cable can be located without difficulty. All trouble as regards accessibility is consequently prevented. The connections to the spring jacks are taken off at the proper intervals and led under the flooring into the body of the table, and thence up to the spring jacks, sufficient spare cable being provided to enable the spring-jack strips to be taken out, examined, and readily repaired. The spring-jack strips are very accessible, as they can be readily slid sideways and opened out for inspection. As a matter of fact, however, the faults are extremely few, and it is not often necessary to meddle either with the jacks or the cables.

The same type of switchboard is used at the Bridgeton, Hillhead, Kinning Park and Queen's Park switch rooms, but these switch rooms, being on a much smaller scale, it has not been necessary to make any special provision for the cabling, which is readily contained in the bodies of the tables. These branch switch rooms, however, differ from the central in having the ring-off indicators fixed to the canopies, the ring-off drops coinciding with the pairs of cords. At all other switch rooms, vertical boards are employed, on the ring-through system, as already described. The largest of these is at Govan, which serves 232 stations.

The subscribers' instruments, which have been

1. Abstract of paper read before the Glasgow Local Section of the Institution of Electrical Engineers, on April 12, 1904. Mr. Bennett is general manager of the Glasgow Municipal Telephones.

chiefly supplied by the Ericsson-Bell Telephone Company, although there are a good many by L. M. Ericsson of Stockholm, and a few by the General Electric Company of London, are provided with an unusually powerful magneto-generator, which contains four permanent magnets, and is capable of ringing a bell audibly through a resistance of 25,000 ohms. The speaking set is invariably of the hand micro-telephone description. It has been found advisable to omit the finger battery key, which is frequently a feature of these sets, owing to trouble arising from domestic servants and others not well acquainted with telephone working, omitting to press the switch when using the instrument or only pressing it intermittently. Any subscriber, however, who desires it is furnished with a finger key. The ringing of subscribers' bell, when necessary, is effected by means of magneto-generators driven off the electric-lighting mains. One generator is used for the central and another supplies current to the principal branch exchanges by means of metallic circuits specially reserved for that purpose.

Turning now to the Portsmouth corporation telephone exchange, there is little to differentiate it from Glasgow, except as regards the switching system. Cast-iron pipes are used for the ducts; the cables and manholes are to the same specification; the distributing poles are similar, and the bronze wire employed for distributing is No. 18, of the same specification as in Glasgow. Hard-drawn copper wire is used for the junctions, and Portsmouth possesses probably the longest junction route in the country, as, in order to reach Gosport, which is only distant half a mile across the harbor, a circuit of nearly 20 miles has to be made. This is owing to the inadaptability of the bottom of the harbor for submarine cables.

The Portsmouth switching system is the same as in Guernsey and the branch exchanges in Glasgow, except that the calling is not done by a magneto-generator, but by a central battery at the exchange, which is brought into operation by putting an earth, by means of a finger key, on to one leg of the subscriber's line. This causes the subscriber's line indicator to be operated until the operator plugs into the answering jack, when it is automatically restored to its neutral position. The wiring of the multiple jacks on the Portsmouth board is somewhat of an innovation. The spring jacks consist of two pairs of springs, an inner pair and an outer pair. The outer pair of springs is in parallel circuit with the subscriber's line, and all speaking is done through this outer pair of springs. The inner pair of springs of the several jacks are connected in series, and the last spring is permanently earthed through the indicator and the central battery. The insertion of a plug in any of the jacks on a subscriber's line connects the operator's set to the line and at the same time causes the inner pair of springs to open and to interrupt the indicator circuit, so that the indicator is cut out wherever an operator plugs in or two subscribers are connected.

The central battery consists of a duplcate set of Hart accumulators, from which not only the calling, but the speaking, circuits are worked. These are charged by a motor-generator driven off the electric-lighting mains. A seoarate generator is used for ringing purposes during the day, but during the night the alternating electric-lighting current which is used in Portsmouth is employed for ringing the alternating bells, being transformed down by an ordinary translator.

The Swansea corporation telephone system is exactly the same as at Portsmouth, except that glow lamps are added to each operator's position, which indicate when an unusual flow of current is passing over the lines joined to that position.

At Brighton several deviations were made from previous practice. The underground ducts in the central district consist of four-inch octagonal stoneware pipes laid in cement concrete, the joints first having been covered with adhesive tape. The laying, jointing and alignment of these octagonal ducts require much greater care than the laving of iron pipes, but when once finished satisfactorily they make an extremely good job. In the outlying districts in Brighton, where only one duct is employed, a three-inch cast-iron pipe is laid. Apart from this, the outside work is the same as in the other places.

The switching system employed, however, although essentially on the same plan as at Portsmouth and Swansea, differs in an important detail. In those places the exchange is called by pressing a button. At Brighton the exchange is called by the act of lifting the telephone from its rest.

The only other system remaining to be referred to is that of the corporation of Hull, which is now in course of construction, and is expected to be in operation in June or July. The ducts used there are of the Albion Clay Company's socket-and-spigot type, with Stanford joints, a pattern which has been successfully used in Hull both for the electric-light and tramway systems. They are four inches in diameter within half a mile of the exchange, where the largest sized cables will prevail, and three inches in diameter beyond that distance. The switching system will be identical with that employed at Brighton, and the other details, both outside and in, will be the same as in the other centers.

[An interesting and protracted discussion followed the reading of this paper. An abstract of this discussion will be given in the Western Electrician next week.]

Telephone News from the Northwest.

The directors of the Interurban telephone exchange of Alexandria, Minn., have concluded to allow the old rates to stand.

The Wrightstown (Minn.) telephone line will be extended into Staples, Minn.

The local exchange at Wells, Minn., is to be rebuilt.

The Dakota Central Telephone Company has refused the franchise voted by the council of Watertown, S. D., owing to the conditions which are imposed. The council is empowered to revise the rates of the company after 10 years.

The council of Janesville, Wis., has ordered telephone and electric-light wires to be placed underground.

The council of Alexandria, Minn., has granted a franchise to J. B. Cowing and G. G. S. Campbell for a competing local telephone system.

The Tri-state Telephone Company is building a toll line toward Winona, Minn., from the Twin Cities and expects to reach there about July 18th. The line will be continued on to La Crosse.

The Dassel and Collinwood Telephone Exchange Company has been incorporated at Dassel, Minn., with $25,000 capital.

The Lake Valley Co-operative Local Telephone Company has been incorporated to operate in Lake Valley and in Traverse and Grant counties. The capital is $10,000.

The Clarkfield (Minn.) Telephone Company has been incorporated with $3,000 capital.

W. C. Stickney has sold the telephone exchange at Moulton, Iowa, to Clyde A. Mann of Woodbury County, Iowa.

O. G. Potter of Pepin, Wis., has bought the Pierce County telephone lines operating in the eastern portion of Pierce County, Wis.

The Hawkeye Telephone Company will erect a new telephone exchange building in Winterset, Iowa. It will be two stories high.

The Grant and Audubon Township Mutual Telephone Company has been incornorated, with headquarters at Adair, Iowa. F. G. Long is secretary.

The Hamilton County Telephone Company of Webster City, Iowa, is completing a new exchange which will be ready for operation about August 1st. The switchboard has 400 connections and an ultimate capacity for 1,000. It is a central-energy system.

The Hastings Independent Telephone Company has been granted a franchise for a local exchange at Hasting, Neb., after a long deliberation by the City Council. R.

Ohio Telephone Notes.

The United States Telephone Company is now at work on its line to connect up the system with the western companies at Richmond, Ind. Several other lines are being constructed also, to make it possible to handle the business that is offered. It is the intention to spend perhaps $200,000 on new lines and extensions this summer. A large amount of new business will be secured through connections with other long-distance companies. The report for May shows an increase of about $900 in surplus over the same month last year.

The June earnings of the Cuyahoga Telephone Company show an increase of $1,000 over May and a big increase over the same month last year. This is due in a large measure to the new equipment that has been installed. New contracts are now being made at the rate of about 275 per week, which will shortly bring the service up to handsome proportions. Last week the officers held a reception, and a large number of people inspected the plant. This was primarily for the purpose of acquainting the stockholders with the extent and condition of the plant, but the public also showed much interest in it.

The Portage County Telephone Company of Ravenna is at work on the extension of its lines to Rootstown, New Milford, Edinburg, Randolph and some other points. In all about 25 miles of new line will be built, at a cost of $5,000.

The Salem Township Rural Telephone Company of Salem has been incorporated with a capital stock of $2,000 by H. A. Halverstadt and others.

O. B. Brandt, J. P. Gundy and others have incorporated the Carroll Telephone Company of Carroll with a capital stock of $5,000. C.

Michigan Telephone Matters.

M. Saunders of Bay City has been appointed manager of the Valley Telephone Company to succeed E. G. Pike, who has accepted the position of district superintendent of the Southwestern Telegraph and Telephone Company, with headquarters at Houston, Texas.

The Michigan State Telephone Company is building a new line from Hartford to Benton Harbor upon which there will be four circuits. Two additional circuits will be added between Hartford, South Haven and Kalamazoo.

The Citizens' Telephone Company of Lansing has advised its subscribers that, beginning July 1st, the rate of residence telephones will be increased from $12 to $18 a year.

A new telephone company which was refused a franchise by the Ypsilanti council has received poles and wire and will begin to establish the new line this week. The company is taking a lease of a building in which to install the exchange. It is presumed that this company will operate under the state law, in view of its being refused a franchise.

The Union Telephone Company (Independent) has just sent out checks to over 400 stockholders for the amount of the semiannual dividend of four per cent. on all stock issued prior to June, 1904. The capital stock represented by over 400 stockholders is $400,000. The headquarters of this company is located at Alma. The company does business in the counties of Gratiot, Montcalm, Isabella, Claire, Washtenaw and Clinton. W.

Southern New England Telephone Company.

At a recent meeting of the directors of the Southern New England Telephone Company it was voted to increase the capital stock by issuing 5,000 new shares, par value $500,000. This will bring the company's capitalization up to $4,500,000, which is within $500,000 of its total charter authorization. President Morris F. Tyler's annual report submitted some interesting statistics. Last year the net increase was 5,509 stations, the total now being nearly 27,000. Earnings were $1,114,214, against $935,237 in the previous year. The company operates mainly in the state of Connecticut, and improvements in the battery systems have resulted in an almost entirely new equipment in this respect throughout the service. Special work has been accomplished in New Haven, Waterbury, Bridgeport, Hartford and Meriden. In the latter city an entire new plant was opened within the year, and a new outfit and building for New Britain is contemplated for next year.

EXTENSIONS AND IMPROVEMENTS.

The Southern Bell Telephone Company has about completed its new office at Rutledge, Ga.

The Cumberland Telephone Company, it is said, will soon establish an exchange at Greenbrier, Tenn.

The Corvalis (Oregon) Independent Telephone Company is considering the extension of its line from Corvalis to Philomath.

The Interstate Telephone Company has laid a subaqueous cable across the St. Joe River at St. Maries, Idaho, to prevent having the wires pulled down by steamers.

The Galesburg Union Telephone Company of Galesburg, Ill., is installing a new tollboard and contemplates the erection of another line between Galesburg and Knoxville.

Toll stations of the Rocky Mountain Bell Telephone Company have been completed at Standpoint, Idaho, which gives that city telephonic communication with Spokane, Wash., and other distant points.

The Home Telephone Company has begun the work of cutting in at Hopkinsville, Ky., and the Cumberland company is also cutting over to a new system. Both systems are up-to-date in every respect.

The factory building and site at 523 Jackson Street, Topeka, Kan., have been purchased by the Independent Telephone Company of that city for $18,000. The building will be remodeled and used as the permanent home of the company.

The Southern Bell Telephone Company is preparing to reconstruct the exchanges recently bought at Cheraw, Dillon, Marion and Mullins, S. C. The long-distance service, it is said, will also be improved through the Pee Dee section giving extensive connections out from Columbia.

No contract will be awarded for the construction of the new building of the Mutual Telephone Company of Des Moines, Iowa, as the company has decided to erect the building under its own supervision. James Leighton will superintend the work, and it is hoped to have the structure completed within a few months.

New telephone lines are to be constructed from Madrid, Spain, to the French border; from Madrid to Galicia via Santander; from Madrid to Malaga and Cadiz; from Vich to Manlleu; from San Vincent de Torello to Ripoll, and from Elche and Noveldo to Pinoso and Crevillente. These lines are in charge of the director-general of telegraphs at Madrid.

The Kinloch Telephone Company of St. Louis has now purchased a site and will proceed at once to erect the proposed 15-story building recently mentioned. The building is to cost about $850,000, and the four top floors will be retained as the company's home. Financial arrangements, it is said, in which the Kinloch company and a number of other Independent companies are interested, are being perfected for the proposed transcontinental long-distance system.

By the terms of a contract with the Rocky Mountain Bell Telephone Company the Postal Telegraph-cable Company is permitted to use the poles of the telephone company from Cheyenne to Laramie, Wyo., from Fort Steele, Wyo., to Salt Lake City and from Salt Lake City to Butte, Mont. It is officially announced that the Postal company will be doing business in Salt Lake City by September 1st, which will place Salt Lake City on a continental line, besides giving a connection with the Pacific cable to the Orient.

GENERAL TELEPHONE NEWS.

The Bell Telephone Company announces that it has now 16,800 subscribers in the city of Buffalo, N. Y.

The Big Leatherwood Telephone Company of Perry, Ky., has been incorporated with a capital stock of $2,500.

The Tate County Telephone Company of Senatobia, Miss., has been incorporated by J. F. Brewer, F. M. Bizzell and others.

A telephone company organized at Bellair, Ill., by L. M. Biggs, J. C. Farley and E. M. Wiman, has been incorporated with a capital of $5,000.

The Home Telephone Company, through William J. G. Lambert, has acquired the franchise of J. U. Street for a telephone system in Riverside, Cal., and will expend about $100,000 in construction work.

The Rose Township Mutual Telephone Company, with headquarters at Shelbyville, Ill., has been incorporated for the purpose of operating a telephone system. The incorporators are Philip Roessler, George Ruff and Jacob Kull.

A movement is on foot to organize a new telephone company at Salisbury (N. C.), which would compete with the Bell Telephone Company. Part of the stock for the new company has been subscribed.

The Utah Independent Telephone Company began the operation of its system in Salt Lake City, Utah, last week. The system will compete with the Rocky Mountain Bell Telephone Company. The equipment throughout is of the most modern type.

A bill has been introduced in the Legislature of the state of Georgia to place telephone companies under the supervision of the State Railroad Commission. About all of the other public-utility corporations are already under this commission.

An increase of 1,838 instruments for the month is shown by the June statement of the Chicago Telephone Company. Of this number, 1,304 were in the city and 534 in outlying territory. The company now reports a total of 110,712 instruments in operation.

An attempt was made recently to steal copper wire from the poles of the Delaware and Atlantic Telephone Company near Ambler, Pa. Several men with a team cut two of the 18 wires from the poles for 300 yards and escaped with 500 pounds of wire before officers arrived.

The Interstate Independent Telephone and Telegraph Company, with headquarters at Aurora, Ill., is pushing its plan for the building up of a large Independent telephone system, including Illinois and Wisconsin. Charles B. Cheadle of Aurora has spent some time in Wisconsin recently in the interest of the company.

In the case of the Cumberland Telephone and Telegraph Company vs. Martin, a telephone company which negligently stretches a wire over the roof of a store porch without adequate insulation is held to owe no duty to a passerby who takes refuge under the roof from a rainstorm, and therefore not to be liable for his death in case lightning is conducted by the wire to the roof and kills him in reaching the ground.

The Consolidated Telephone, Telegraph and Electric Company has been incorporated at Phœnix, Ariz., with a capital of $2,500,000. The intention is to improve and extend the telephone and transmission lines to Old Mexico and to furnish electric light and power to that district. The officers of the company are: President, E. Randolph; secretary, F. S. Ives; general manager, C. W. Hincheliffe. The headquarters of the company is at Tucson, Ariz.

The Northwest Iowa Independent Telephone Association will meet at Arnold's Park, West Okoboji, Iowa, on July 20th. President G. W. Greaves will lead the discussion on "The Present Condition of Our Farm Line Situation;" J. M. Plaister of the Fort Dodge Telephone Company will present the clearing-house proposition to the association, and E. H. Martin will talk on "How Can We Strengthen Our Independent Toll Lines?" Several days will be spent in the beautiful lake region.

Engineers Should Have a Good Knowledge of English.

Within a few weeks I was presiding at a conference of engineers in which the subject of consideration was the development of a special course of instruction to meet the needs of a certain business. Every man in the room stated that in his opinion the teaching of English was of more consequence than the teaching of any other subject. Each man had come to the conference with the intention of expressing this opinion, expecting to have all the others disagree with him. As one man put it: "I prefer to have my assistants know little and be able to clearly show how little they know than to leave me in doubt as to what they do know and what they do not know."—Alexander C. Humphreys, president of Stevens Institute, in an address to the students of Sibley College, Cornell University.

BOOK TABLE.

The Copper Handbook. Vol. IV. Houghton, Mich.: Horace J. Stevens. 1904. Pp. (5¾ by 8½ inches), 778. Price, $5.

The present issue of the Copper Handbook, covering the year 1903, is the fourth annual edition, and the book has grown from 328 pages in 1901 to more than twice that size. This volume lists and describes 3,311 copper mines and properties in all parts of the world, the descriptions ranging from a few lines in several pages. Noteworthy features of the book are 15 miscellaneous chapters devoted to the history, uses, geology, geography, mineralogy, chemistry, metallurgy and statistics of copper, with a glossary of mining terms. The book is substantially bound in buckram. The properties listed are arranged in alphabetical order, and the whole forms a valuable work of reference.

American Street-railway Investments (Vol. 11). New York: McGraw Publishing Company. 1904. Pp. (9¼ by 13 inches), 362, with 30 illustrations. Price, $5.

This year's "Street Railway Red Book" is larger than usual and contains reports of a number of companies which hitherto declined to present financial statements. Maps are given of the principal street-railway systems in the country, some being done in colors. There are also maps of the interurban systems of New Jersey, Ohio, Indiana and Illinois. The location of the power stations, repair shops, parks and pleasure resorts of each of the properties described is a good feature of the work, the pleasure resorts being always an important factor in increasing the traffic of a line which passes through them. The book does not purport to give information about all the surface and elevated street-railway companies in the United States, but it appears to cover nearly all of them, and probably all of the principal ones. The data presented are arranged alphabetically by states and towns, and the whole constitutes a valuable work of reference.

Dynamo, Motor and Switchboard Circuits for Electrical Engineers. By William R. Bowker. New York: D. Van Nostrand Company. (London: Crosby, Lockwood & Son). 1903. Pp. (six by nine inches), 120, with 109 illustrations. Price, $2.25.

This work might well be termed a book of amplified definitions. It is quite original in character and style, and although it contains no detailed information on the subjects treated it should find a considerable field of usefulness for what it purports to be—a hand-book for engineers and artisans. No attempt has been made at a theoretical treatment, but, on the contrary, the aim is to condense in a paragraph or a page such information on some one subject as will aid the practical man in his everyday work. For example, under the chapter headed "Alternating and Polyphase Currents" about a page is devoted to the paralleling of alternators, telling in a few simple words what is meant by paralleling, and, by the aid of a diagram, explaining how it is done. Again, in the same chapter, are explained in brief what is meant in three-phase transmission by "star" connection with three wires, "star" connection with four wires, "mesh" or "delta" connection with three wires, etc. The diagrams throughout the book are exceptionally good and aid very materially in making clear the explanations, which is important, owing to the limited space allotted to each subject. The subject matter is of such an elementary nature that perhaps the engineer will not find the book so valuable as will the man whose technical training along electrical lines has been limited and who finds that everyday questions are coming up in his work which he cannot answer from his own knowledge, and information on which he would like to find in a condensed and easily understandable form in some book of ready reference.

Electric Equilibrium of the Sun.

Svante Arrhenius frames a theory of the process by virtue of which the sun is able to give out a continuous supply of negative electricity without its positive electrification being raised to such a high point as to retain the negative electrons in the sun. This process necessitates some form of circulation or renewal of the negative electricity in the sun, and the author makes such a circulation very plausible. We know that negative ions condense vapors more easily than positive ions. The gases in the atmosphere of the sun are ionized by the ultra-violet radiation. Therefore, we have to suppose that among the little drops formed by condensation in the sun's atmosphere far more are negatively charged than are positively charged. As these drops are driven away by the pressure of radiation, they charge with negative electricity the atmosphere of celestial bodies, such as the earth, till the charge is so great that discharges occur, and cathode rays are formed, which carry the charge back to the universe. The author makes an interesting calculation of the speed with which the drops will be driven from the sun, assuming that the radiation pressure is twice their weight. A drop which partly reflects the light will arrive at the earth in about 46 hours. Now, according to Ellis, the interval elapsing between the passage of a sun spot across the meridian and the maximum of the consequent magnetic storm upon the earth is 42.5 hours. This agreement renders the base of the calculation reasonably probable. The author then goes on to show that the charge of the sun is sufficient to attract and absorb negative electrons traveling with observed velocities anywhere within 1.25 light-years of the sun. Since the nearest star is four-light years away, and there are other stars about 10 light-years off, not many electrons can traverse interstellar space without being attracted by some star or other. Thus the suns recover from space as much negative electricity as they lose. The electric charges of the suns are very effective regulators. If the charge is quadrupled the mean distance of the caught electrons is doubled, or, in other words, as they are uniformly disseminated in space, their quantity is quadrupled. Therefore, the supply of negative electricity to the suns is proportional to their defect thereof.—From Proceedings of the Royal Society, abstracted by E. E. Fournier d'Albe.

Electric Fire-alarm and Police-patrol Systems.

A bulletin covering statistics of municipal electric fire-alarm systems and police-patrol systems, which are frequently worked together, has been issued by the Bureau of the Census of the United States government. The statistics cover the systems in operation during any part of the year 1903. The bulletin shows a total of 764 municipal electric fire-alarm systems. These systems had in the aggregate a total overhead wire mileage of 28,202 miles, besides 11,433 miles of wire in underground conduits. The earliest records dealing with the subject show that fire alarms and fire extinction were matters which until the last century were left largely to private or volunteer effort; now, however, the 764 systems included in the statistics are under the supervision of some department of the various city administrations.

From 1852 to 1862 only four systems of fire-alarm telegraph were installed. In the next 10 years 40 systems were put in. From 1872 to 1882 the increased appreciation and demand on the part of the public were shown by the installation of 62 systems. The rate of increase was well maintained from 1882 to 1892, during which period 299 systems were installed. In the 11 years from 1892 to 1902 inclusive the number of new systems was proportionately greater, reaching 359. In view of the fact that all the larger cities had already been equipped, the swelling number would indicate that as time has gone by the improvements of the system and the increasing introduction of automatic features have rendered the service available for many of the smaller communities.

Distributed along the circuits of the 764 systems in the United States there were reported 37,739 signaling boxes or stations. To this number might be added 1900 special telephones and 93 annunciating boxes. Over this apparatus 85,070 fire alarms are reported to have been sent or received during the year 1902.

For the operation of fire-alarm systems reported a large variety of apparatus and methods are in use, although battery current is the main reliance and chief source of energy supply. The central-office power or current equipment in 1902 comprised 57,010 primary and 49,327 storage-battery cells. Of the total number of systems there were reported only 19 dynamos generating current, seven steam or gas engines and 81 motor-generators or dynamotors. In connection with telephones for use in fire alarms it is noted in the report that the chief of police of a large city has recently requested the telephone company to omit from its telephone directory the suggestion that patrons send fire alarms over the telephone, for the reason that it frequently takes too long to notify fire headquarters by telephone.

Electric police-patrol systems are of much more recent date than the fire-alarm systems. Reports were received from 148 of these systems. Of this number only eight had been installed prior to 1882.

The bulletin just issued is very exhaustive on the subjects treated and is descriptive of every detail, both physical and historical. The great progress made in the use of the electric current is brought strikingly forward. The electric telegraph was not utilized for fire-alarm purposes until the beginning of the nineteenth century, and even today there are a great many communities in America which retain the inadequate method of notifying the community by ringing a bell in some high tower. The utilization of the telegraph, in a systematic way, as an aid in the detection and suppression of crime was resorted to by the police departments of various large cities as early as 1858, according to the report.

The Green Bay (Wis.) Traction Company, known until recently as the Knox Construction Company, has begun to operate regular cars between Green Bay and Depere on the Green Bay-Kaukauna interurban route. The company has not yet been granted a franchise.

CORRESPONDENCE.

Great Britain.

London, July 1.—The prophecy made some years ago that with the advent of the large electric power-distributing companies, the number of smaller generating stations would rapidly diminish, or, rather the number of local authorities and others intending to erect comparatively small works would yearly grow less, has been amply fulfilled. Already in the provinces numerous small local authorities have entered into agreements with the power companies and are now awaiting a supply, and in some cases a supply is being given from temporary plant. Quite recently one of the London borough councils decided to take current in this way from a power company. The district of the authority in question is much more adapted to a successful municipal scheme than many that are in existence, and the power company must have offered favorable terms to have overcome the general enthusiasm among councilors of comparatively small districts, for running their own works.

On this point of electric power supply by large companies, it is interesting to note the determination with which Parliament this session has refused local authorities permission to go outside their areas in order to supply in competition with the company. It is well established nowadays that local authorities may do almost what they please with the taxpayers' money so long as their operations are confined to their own boundaries, but it steadfastly refuses, except under exceptional circumstances, to allow municipal trading to be carried on outside the boroughs where no rate can be levied. Consequently, if a loss be incurred, it has to be made good by the taxpayers in the other district, who get no advantage from the supply.

Quite an outcry is being made by members of Parliament in connection with the accidents that have happened upon the Northeastern and Lancashire and Yorkshire railways through persons coming into contact with the third rail. A general request is being made that the live rail should be protected, but until the report which is being prepared by the officers of the Board of Trade has been presented nothing official will be made known.

The telephone committee of the Brighton Town Council anticipates that the revenue this year will cover the interest and sinking-fund charges. There are now 1,200 lines connected. Last year, the first year of working of the undertaking, there was a loss of nearly $10,000.

The Marylebone Borough Council is now arranging to borrow the necessary money, authorized by its bill this year, to pay the Metropolitan Electric Supply Company. Of the amount necessary, $2,500,000 will be borrowed from a bank temporarily and the remainder from private individuals. In October the London County Council will advance the money to redeem these loans.

A slight scare was caused last week by what appeared to be a fire in the new Great Northern and City tube railway. A short-circuit occurred in a signal box and filled one of the stations with smoke. But it was soon cleared. G.

Dominion of Canada.

Ottawa, Ont., July 7.—The electric railway at Levis, Que., has ceased to operate as the result of a dispute with the Chaudiere Electric Power Company. The directors of the railway intend to install an electric power plant of their own.

The township of Ernestown, Ont., has voted favorably on the by-law of the Ontario Electric Railway Company, which provided for the appropriation of the sum of $20,000 to purchase the first-mortgage bonds of the railway.

The council of the town of St. Louis, Que., has adopted a new contract with the Montreal Light, Heat and Power Company, which places the rental on street lamps at $75 a year. The town's contracts with the Royal Electric Company and the Citizens' Light and Power Company were annulled. The contract runs for 28 years.

The Cataract Power Company of Hamilton, Ont., owns and operates the following concerns: The Hamilton Light and Cataract Power Company, the Cataract Power Company, the Hamilton Electric Light and Power Company, the Electric Power and Manufacturing Company, the Dundas Electric Company, the Hamilton street railway, the Hamilton Radial electric railway and the Hamilton and Dundas street railway. The Cataract company generates at present about 8,000 horsepower at DeCew Falls, and is putting in a plant that will give it 40,000 horsepower in the course of two years. By next fall upward of 26,000 horsepower will be available.

In pursuance of an agreement with the Kingston Light, Heat and Power Company, the city of Kingston, Ont., will take over the lighting plant of the company on August 1st. The city guarantees the interest on the bonds of the company until the bonds, which amount to $99,975, mature in 1917; the street-railway company is given power at its present rates for the next six months; Lake Ontario Park is to be supplied at a reasonable rate, and the city comes into its own in August. All legal proceedings have been withdrawn.

A short time ago it was announced that the Dominion government intended to install at once several Marconi stations on the St. Lawrence route to the sea. Four were to be installed this season, the points selected being Fame Point, Heath Point, Point Amour and Belle Isle. The station at Fame Point is now ready for business, and the remainder will be completed by August next. For the first time in the history of St. Lawrence navigation, telegraphic communication between a steamship on her voyage and land was established.

The Canadian Pacific Railway Company will construct over 2,000 miles of new wires and pole lines before the close of the present year. General repairs to existing lines are being made all over the system. A new copper wire has been put in between Regina and Winnipeg. Other new lines that have been built during the last few months are between Toronto and Detroit; Toronto and Peterboro, and Fort William and Ignace. W.

Winnipeg, Man., July 8.—The Winnipeg Electric Street Railway Company has decided to extend its line, by request of the City Council, along Logan Avenue to McPhillips Avenue, instead of along Elgin Avenue, and the city will repave the street to McPhillips Avenue to enable the street-railway company to lay tracks. The Ottawa Car Company is building six more new cars for this company. The street-car company will also place in position in its power station in Winnipeg a 15-horsepower engine, to be built by Burrige & Cooper of Winnipeg.

The Robb Engineering Company of Amherst, N. S., has been awarded the contract to supply one of the Porto Rico sugar plantations with a large-sized Robb-Armstrong engine for furnishing electric light and power.

The Mexican Light and Power Company of Montreal, of which James Ross is president, has placed a large order for copper cable in the United States. The order calls for 1,500 miles of cable, weighing upward of 2,000 tons. The cable line is to be built from the company's Necaxa power plant to Mexico City and from there on to the El Oro mining district, a distance of 125 miles. The lines will be supported on steel towers in spans of 500 feet. The contract for the cable was let to the Ansonia Brass and Copper Company of Ansonia, Conn.

The Vulcan Iron Works of Winnipeg will install an electric crane capable of sustaining and carrying a weight of 20,000 pounds in its new boiler factory and blacksmith shop, now building. The crane will be similar in design and operation to the one in the foundry department; the latter has a capacity of 30,000 pounds and runs the length of the shop. Two electric motors furnish the power, one being used to control the crane as it moves on the tracks and the other furnishes the lifting power. H.

New York.

New York, July 9.—On the Coney Island trolley lines, last Saturday, Sunday and Monday, more than a thousand passengers refused to pay a double fare on the cars. Nearly all those protesting were ejected from the cars at the point where the second fare is collected, and in a number of cases women and children are alleged to have been treated with undue violence. Statements and counter statements have been issued every day on the legal point involved, the chief claims being made over the signature of President Winter of the Brooklyn Rapid Transit Company, who states that the company has a legal decision which would enable it to charge as much as 30 cents for the trip to Coney Island. Deputy Police Commissioner Farrel is investigating the cases of alleged violent treatment and hundreds of citizens are threatening suits against the company. The company's most effective retaliation to the public agitation are the steps now being taken to bring back the various subsidiary corporations to their original position of independent companies, as stated in this column last week. The Brooklyn Rapid Transit has also announced that it will grant no more passes to police officers and detectives not in uniform.

The Board of Aldermen has deferred final action on the application for a franchise from the New York, Westchester and Boston Railway Company until July 26th.

The first quarterly dividend (being 1¼ per cent.) will be paid to the stockholders of the Third Avenue Railway Company. The company was purchased four years ago by what is now the New York City Railway Company, and although it was promised that the dividend should be five per cent. from 1900 to 1904, and thereafter six per cent., this is the first time that any dividend has been announced for distribution.

On Friday Charles H. Werner, as president, and Ashley P. Cole, as secretary, signed a certificate which merges the Kings County Lighting Company with the Kings County Gas and Illuminating Company. The first-named corporation owned all the stock of the latter and is quite a new organization. It promises to enter into competition with the older local lighting companies.

O. Wagner, W. D. Bickford and H. E. Spooner are the directors of the newly incorporated electrical firm, to be known as Richmond & Co., with a capital of $20,000, and works in New York city.

In the course of extensive alterations to be made at the City Hall, the existent gas chandeliers in the governor's room are to be wired for clusters of incandescent lamps, to the total of 72 lights.

The rapid-transit subway is so near completed that it may be traversed on wheels from City Hall to the Harlem River on a permanent way of 100-pound steel rails, stone ballasted and comparable throughout to the best division of the Pennsylvania railroad. Only those who have made this trip in an observation car are likely to have an adequate conception of the magnitude of the work or the thoroughness and intelligence with which it has been carried out from inception to finish. There is still some work to be done in finishing the stations, but the delay of this will not interfere with the use of the tunnel nor involve inconvenience to the public. The electrical installation is so far advanced that by the end of the present month it can be subjected to every test needed to show its efficiency and the perfection of its operation. Contrary to what seems to be the popular impression, the work on the power house and its plant is ahead of the schedule. By September 1st the current required for moving 450 to 500 cars, for operating all electrically actuated mechanism, and for lighting cars, stations and tunnel, will be in operation. This installation is in some respects epoch making in the history of electrical science, less because it ventures new and untried experiments than because it brings together what is best in experience up to this time and establishes new standards of excellence in principles and details. The provision of rolling stock available by September 1st or earlier will be ample for the immediate requirements of traffic. With the exception of the first order it will consist of steel cars of the type evolved by investigation and experiment which is now regarded as the best, although among those whose judgment is entitled to consideration by no means unanimously agreed to be the best. D. W. W.

New England.

Boston, July 9.—The Adams Trust Company of this city takes the Boston and Northern Street Railway Company mortgage authorized by the last Legislature. The Old Colony Trust Company, also of Boston, takes the Old Colony Street Railway Company mortgage, $15,000,000 being involved in the transactions.

The Massachusetts railroad commissioners, in passing upon an appeal in the matter of increased fares at Haverhill and vicinity, ordered by the Haverhill and Southern New Hampshire Street Railway Company have disapproved the change of rate, which was revised on a mileage basis in part. This decision has raised the hopes of electric-railway patrons in other places where similar conditions have lately arisen.

A severe electrical storm swept over the coast section on July 5th. A million-dollar fire in the Bunker Hill district in Boston resulted from one flash of lightning, which set fire to wharf property, the flames spreading to an Allan Line ocean steamship and to a Boston and Maine railroad grain elevator. In Lynn the street-car service was disturbed seriously, the main office of the Boston and Northern Company being struck, and several employes were injured. Some of the trolley wires were also damaged. In West Quincy the electricity struck a car and set it on fire. One passenger was overcome temporarily by the shock.

The city of Boston Wire Department reports further progress in the heart of the city, during the statistical year just closed, in the matter of removal of poles and overhead wires. Nearly 250 poles have been eliminated and upward of 50 miles of wire. Most of the permits for new poles and overhead construction have been granted for outlying districts, 761 being the number for the year, but these do not begin to offset the miles of wire taken down. There are now a little over 15,000 poles standing within the city limits, but the downtown district is almost free from them. B.

Michigan.

Detroit, July 9.—Grand Ledge is to have an electric-light and power plant which will be constructed by S. E. Jaris, who has purchased the mill property and water rights of E. J. Hixon. A large dam will be built in the Grand River from which power will be secured for generating current for light and power in Grand Ledge and Lansing.

It is understood that an agreement has been signed whereby the two electric lines between Detroit and Jackson have been done away with, and the Detroit, Ypsilanti, Ann Arbor and Jackson, the Jackson city lines and the lines to Wolf Lake and Grass Lake will be operated as one system. It is understood that the owners of the Jackson Consolidated Traction Company and Messrs. Hawks and Angus of Detroit have come together and consummated arrangements which will enable both companies to operate their systems more economically.

A bad accident occurred on the Jackson and Battle Creek electric road about two miles and a half west of Marshall last week in which three persons were fatally injured and 20 badly hurt. This line is operated on the third-rail system. A local car from Battle Creek burned out a motor, after going a few miles, and on reaching a crossing on a sharp curve had not sufficient speed to drift over the crossing and became stranded. Limited car No. 47 was due at this time and collided with the local, badly damaging both cars. Among the injured was C. H. Frisbie of Jackson, president of the Kalamazoo Valley Electric Company, who had his head badly cut.

The village of Charlevoix has accepted a proposition from a new power company at Bellaire for the lighting of its streets. The contract calls for the construction of the plant and the turning on of the

light at Charlevoix by June 1, 1905. It is proposed to build a dam and erect a plant capable of furnishing 1,000 horsepower.

The Bessemer and Ironwood Interurban Railway Company, capitalized at $25,000, has been incorporated.

The trouble between the City Council and the street-car company at Manistee has now been settled. The laying of the street-car track, which has been held up since last fall, will now proceed. C. G. W.

Southeastern States.

Charlotte, N. C., July 9.—There is a movement on foot to construct an electric railway from Clarksville, Tenn., through New Providence.

The Norfolk and Southern railway is to be electrically operated by the Chesapeake Transit Company, thereby developing an important suburb of Norfolk, Va. Several electric cars have already been purchased.

The Central Traction Company has engaged an engineer to make estimates for a proposed electric line from Jerseyville to Hardin, Calhoun County, Mo.

Architects Hook & Sawyer have about finished plans for the sub-station of the Catawba Power Company at Charlotte, N. C. The building will be small, however.

The council of Newberry, S. C., has authorized the mayor to execute notes to pay for a modern electric-light plant. The council also voted to sell the present plant.

The D. A. Tompkins Company of Charlotte is constructing a central-station electric-lighting plant at Davidson College, N. C. An arrangement may be made by which the town of Davidson may be lighted.

The new $75,000 dam of the Crown Mountain Mining and Milling Company near Dahlonega, Ga., has been completed and will furnish electric power to the plant and possibly to the town for lighting.

The Jasper (Ala.) Water, Light and Power Company has been incorporated with a capital of $50,000, with $30,000 paid in. J. M. Cranford, D. K. Carter and others are interested. L.

Ohio.

Cleveland, July 9.—Traction roads generally show a satisfactory increase in earnings for the first half of the year over the corresponding period in 1903. The Cleveland and Southwestern shows a gain of $8,000 in gross earnings, and June alone made an increase of more than $3,500. The Lake Shore Electric shows an increase of almost $11,000 over the first six months of 1903.

The tax valuation of the city tracks of the Columbus Railway and Light Company has been fixed at $8,500 a mile, while that outside the corporation limits is placed at $4,000. The rolling stock is valued at $337,000 in the city and $2,000 outside. Moneys and credits are given as $120,000.

Considerable damage was done on the Columbus, Newark and Zanesville road by floods this week There were several washouts and operations were suspended for some time. The Columbus, Delaware and Marion suffered quite a little from the same cause and some of its cars were delayed several hours.

The organization of the Geneva Electric Company, which will build an electric railway from Geneva to the lake shore, has been completed by the election of Marcus Westerman of Youngstown as president and Homer Hood of Toledo, secretary. In addition to these A. G. Webb of Cleveland, H. B. Gregory of Geneva and L. H. Young of Youngstown are members of the board of directors.

The Dayton and Troy road is receiving extensive improvements to make it equal to the service that is being maintained on it in connection with the Western Ohio, a limited service having been established some time ago from Lima to Dayton. The regular dividend of five per cent. was paid on the preferred stock a few days ago and the money has been earned for a dividend on common stock, but this will not be paid until the improvements are completed.

Engineers are at work on a route for the extension of the Ohio River and Western electric railway from Zanesville to Cumberland and Powhattan Point on the Ohio River.

The holiday business of the electric roads centering in Cleveland was the largest ever known. The number of tickets sold in Cleveland alone over the interurban lines was more than twice as large as last year.

President M. S. Hart of the Commercial Electric Company of New Orleans was in Cincinnati a few days ago to purchase equipment for the new plant which the company is building. The stockholders of the company are largely consumers.

The City Council at Columbus has passed an ordinance fixing the price of current for commercial lighting at five cents per kilowatt-hour. The Columbus Railway and Light Company has maintained that it cannot furnish current at that price and may go to the courts to determine the right of the council to fix the price at so low a figure. The ordinance is for two years. An ordinance has also been passed providing for rental of poles for municipal wires.

Reports from Cincinnati indicate that the Toledo Urban and Interurban Company will shortly be capitalized as a holding company for the Toledo, Bowling Green and Southern. The capital stock will be fixed at $1,000,000. The indebtedness of the original company will be paid by the holding company and the road will be completed into Toledo under plans that are now being carried out. George B. Kerper, Charles H. Kilgour, John Kilgour and other Cincinnati capitalists are interested in the Toledo, Bowling Green and Southern and will hold the majority of stock in the new company. About 60 miles of track is now in operation, and the portion between Findlay and Lima will likely be completed within a short time. A large central power house may also be built.

Clifford W. Fuller has been appointed by Judge Dissette of the Cuyahoga Common Pleas Court as referee to take testimony in the contentions of the creditors of the Miami and Erie Canal Transportation Company and make an investigation of the organization and financing of the company.

English investors have taken the remainder of the Detroit and Toledo Short Line bonds held by the Everett-Moore syndicate, and as a result the Cleveland men have taken a long step toward straightening out the financial tangle. The bonds aggregated $1,900,000 and are guaranteed by the Grand Trunk and Clover Leaf roads. The last block sold amounted to $250,000.

Traction men from Erie, Pa., and other points between Cleveland and Erie will come to Cleveland over the various roads on July 18th in order to make an investigation with a view to introducing a through service and possibly through cars. H. A. Everett and other Cleveland men went over the line some time ago and are of the opinion that such a plan is entirely feasible.

Reports indicate that the Toledo Railways and Light Company will probably get an extension of franchise for 25 years within the next three months. In return the road will give lower fares and universal transfers.

The June report of the Toledo and Western shows that 223 freight cars were handled in comparison with 139 for the same month last year. It also shows to what an extent an electric road may be used for handling freight in addition to the regular passenger business.

It is probable that the Springfield and Xenia will be sold by the receiver within a short time. It will probably be knocked down to the bondholders' committee and the company at once reorganized. In that case bonds enough will be issued to take care of the old bonds and furnish money enough to make some needed improvements.

The annual report of the Steubenville Traction and Light Company, Steubenville, shows an increase of $7,360 in gross traction earnings over 1903. O. M. C.

Indiana.

Indianapolis, July 11.—William Clark, W. C. Dorsey and James Soules, who got a franchise about a month ago for an electric interurban railway to Sullivan, have succeeded in getting a right-of-way through the greater portion of Vigo County and will soon begin work in Sullivan County. The projectors intend to run a branch line to Linton and Jasonville.

Two suits were filed in the Superior Court today asking for the appointment of a receiver for the Indiana Union Traction Company. Robert C. Light and A. W. Thomson are the plaintiffs. Light charges that the Indiana Union Traction Company failed to carry out its part of an agreement in a lease—namely, to build new lines. His petition to the court is that a receiver be appointed, that all books be examined, that the present officers be removed, and that the stockholders be permitted to elect new officers: that the present officers be restrained from disposing of any holdings in the three corporations, that the lease given to the Indiana Union Traction Company by the Union Traction of Indiana be canceled.

A survey is being made of the proposed electric line to run from Richmond to Anderson by way of Greensfork and Hagertown. The steps taken thus far indicate that while there is little publicity given the project at this time, there is really much being done and the hopes of the people along the route have been restored.

The name of the Evansville and Princeton Traction Company has been changed to the Evansville, Princeton and Indianapolis Traction Company. The company has been reorganized with the same officers. The company will extend a branch line from Fort Branch to Owensville and New Harmony and a branch line from Patoka to Union and Petersburg in Pike County. Later the line will be extended on to Hazelton and Vincennes and connect into Indianapolis.

Gus Wing, superintendent of the city lighting plant at Peru, met with a serious accident while working with an arc light in a store a few nights ago. In some manner the wires got crossed and he received a severe shock. He was upon a 16-foot ladder, and when the shock came he was thrown backward to the floor, alighting in a sitting position. His right hand was severely burned, and it was several minutes before he regained consciousness.

The Indianapolis News contained the following item recently: "Hugh McGowan, boss of the Indianapolis street-car lines, and Crawford Fairbanks, boss of the Terre Haute brewery, are two old cronies. They are together most of their time, and neither will tell a funny story unless the other is present."

The question of the route of the Rushville traction line into Indianapolis, which has been a matter of interest to property owners in Irvington and east of the city, has been settled. The tracks will form a junction with the Shelbyville line at Prospect Street and Southeastern Avenue, making an entrance to the heart of the city over this line, which is now owned by the same company. The line is to have double tracks all the way from Cincinnati to Indianapolis. In Rushville, the home of Capt. Mauzy has been bought for offices and the city station of the company. The road will be in operation about October 1st.

L. C. Walker and W. H. H. Miller, attorneys for the Marion Trust Company, receiver for the Home Heating and Lighting Company, have presented a petition to Judge Carter, of the Superior Court, asking for instructions concerning the operation of the plant this winter. In case it is desired to operate the plant next season, it is set out, it will be necessary to purchase coal now and to put the machinery in a better state of repair. T. N. C.

Northwestern States.

Minneapolis, July 9.—The Omaha, Lincoln and Beatrice railway will build a power house either at Ashland or Springfield, Neb.

The electric-light plant at Waverly, Iowa, may be purchased by the city.

Wausau, Wis., is considering the project of municipal lighting. It would cost about $24,000 for a plant, it is estimated.

The council of Rushford, Minn., has awarded a contract to the Triumph Electric Company to furnish a generator, switchboard, etc., for an addition to the electric-light plant.

The Citizens' Light and Power Company of Milwaukee has filed a formal acceptance of the franchise granted it by the council of Fond du Lac, Wis., in April. A bond of $200 has been filed to secure the fulfillment of the conditions of the franchise.

August Brandt, a street-railway lineman in Minneapolis, was killed by accidentally bringing the trolley wire on which he was working in contact with a live lighting wire. He received 2,300 volts, and died after six hours.

The street-railway company at Des Moines, Iowa, will extend the Fourth Street Line to the North Side. R.

Pacific Slope.

San Francisco, July 7.—The San Francisco Gas and Electric Company has been awarded the contract for furnishing the city with lights for streets and public buildings during the coming fiscal year. According to the contract 100 new arc lights are to be installed and the dome of the City Hall illuminated on any 12 nights of the year. For lights not burning, an allowance is to be made to the city of 35 cents per night each. The entire cost of lighting, including gas lamps, is to be $320,000.

The Soldiers' Home near Los Angeles is to have an arc-light system, and proposals are being invited for the necessary supplies.

The Century Electric Company has been reincorporated under the name of the Century Electric Corporation. F. M. Greenwood, who for over 20 years has been connected with the California Electrical Works of San Francisco, has been elected president; C. M. Wood, vice-president and manager; E. F. Weihe, secretary and treasurer, and L. D. Hitzeroth, electrical engineer. The new corporation has completed negotiations for a six-story building and basement on Second Street, near the present quarters of the firm, and will soon occupy it. Here a large stock of electrical machinery will be carried, as well as lighting supplies, telephone apparatus and construction material.

The California Electrical Works had an interesting exhibit of its various specialties at the recent meeting of the Electrical Transmission Association at Monterey, Cal. This included a 25-light series alternating arc-lamp outfit, with step-up transformer and automatic current regulator in operation. Also in operation were samples of multiple alternating arc lamps, Emerson alternating-current fan motors and 500-volt direct-current fan motors.

The council of Port Angeles, Wash., has passed a resolution providing for the issuance of $14,000 bonds to continue the work of constructing the electric-light system in that city.

The county commissioners of Pierce County, Wash., have sold the electric plant in the county courthouse at Tacoma to the Syndicate Light and Power Company for $800.

The Humboldt County Water and Power Company has been incorporated at Eureka, Cal., by Congressman Gillett, N. H. Hine, F. B. Hink and others, with a capital stock of $1,000,000. The company intends to take water and power from Mad River, and proposes to install at once a power plant to supply the immediate market in Eureka.

General Manager Kennedy of the Edison Electric Light and Power Company of Los Angeles will make investigations looking to the installation of an electric power and lighting system at San Diego, Cal.

J. G. Van Orsdel, the new proprietor of the Dallas electric-light plant at Dallas, Ore., is replacing the old machinery with new. A new dynamo will be installed.

The council of Ladysmith, B. C., is considering the matter of installing an electric-light plant and introducing a telephone system in that city.

F. M. Friedberg has sold the Marshfield (Ore.)

lighting plant to C. F. MacKenzie of Colfax, Wash. It is the intention of the owner to double the capacity of the plant and make other improvements.

The Union Light and Power Company will spend $50,000 in improvements to its power plant at Silverton, Ore. Mr. Cummings of Seattle, Wash., has charge of the work.

It is announced that the East Shore and Suburban Company, which is now constructing the electric road in Richmond, Cal., will extend its road and form a junction with the Oakland Transit system on San Pablo Avenue, at the Alameda County line. A.

Seattle, Wash., July 7.—Myron B. Haywood has applied to the Pierce County (Wash.) commissioners for a 25-year franchise to erect poles for wires for the transmission of electricity to and from the town of Wilkeson, Wash.

The county commissioners of Snohomish County, Wash., have granted a franchise to Robert Houston, as trustee, authorizing him to construct an electric railway from the southern lines of the city of Everett to the King County line. The exact route is not specified.

Langford Spofford, president, and R. E. Randolph, secretary of the Southeastern Railway Company, have gone East to raise money for the construction of the proposed electric railway from Lewiston, Idaho, to Grangeville and Pierce City. The length of the line will be about 108 miles.

The Preston-Parr Milling Company, one of the largest in the state of Washington, with headquarters at Waitsburg, has petitioned the city of Weston for an electric power franchise.

Harry West, the present lessee of the Chehalis electric-light plant at Chehalis, Wash., has secured the plant and a franchise for a term of 15 years, beginning December 1st of this year.

Articles of incorporation of the Lewiston-Clarkston Company have been filed by Edgar H. Libby and G. W. Bailey. The capital stock is $2,000,000. The new company will take over the holdings of the Lewiston (Idaho) Water Company, the Vinland Company, the Lewiston Light Company and the Clarkston Water Company. Improvements will be made, including the development of an extension of electric-light and power lines to the territory north of the Snake River. An electric line will be constructed at once from Lewiston to Uniontown, Genesee, Moscow and Clarkston. P.

PERSONAL.

Robert Ferris, treasurer of the Edison Illuminating Company of Monmouth, Ill., and the Eldora Electric Light Company of Eldora, Iowa, was a Chicago visitor last week.

The City Council of Lincoln, Neb., has contracted with Professor C. R. Richards and G. H. Morse of the State University to be consulting engineers for the installation of the new lighting system.

A. L. Waterbury, who was at one time first vice-president and general manager of the Citizens' Telephone Company of Houston, Tex., has accepted a position as general manager of the sales department of the American Conduit Company. Mr. Waterbury will have his headquarters at the Chicago office of this company.

David Marchant of Chicago, at one time a partner in the business of Fraser & Chalmers, died on July 7th at the age of 81 years. Mr. Marchant devoted much of his time to the perfection of stone crushing and handling machinery. He revolutionized the handling of limestone by building a stone crusher with a capacity of three tons of stone a minute.

E. G. Pike, who has for 10 years been manager of the Bay City exchange of the Michigan State Telephone Company, has accepted a position at Houston, Texas, as district superintendent for another Bell company. The change is a decided promotion. The Bay City exchange has grown under Mr. Pike's management from about 600 telephones when he came to its present system of 1,800 instruments, with a well-equipped plant.

F. B. Behr of London, England, inventor of the monorail electric railway, is at present in St. Louis, where a model of his car is being exhibited by the British government. Mr. Behr's system is being installed between Manchester and Liverpool, England, where he is under contract to maintain a speed of 100 miles an hour. The scheme upon which the road is being built makes it impossible for a car to leave the track, it is said, and any speed desired may be attained without danger to the passengers. Associated with Mr. Behr in the construction of the road are R. Elliott Cooper, Lord Kelvin and Sir William Preece. On leaving St. Louis Mr. Behr will go to Alaska, where he has large mining interests.

F. H. Shepard, chief engineer of the detail engineering department of the Westinghouse Electric and Manufacturing Company, was in Chicago a few days this week superintending some of the details of the installation of the car equipment of the Metropolitan elevated railway, which is described in this issue. Mr. Shepard is thoroughly familiar with multiple-unit-control systems, having been for four years associated with Frank J. Sprague at the time the Sprague system was being developed. He spent several months in Chicago with Mr. Sprague when the South Side elevated road was changed to electrical equipment. His headquarters are in New York city, but his work takes him about the country a great deal, and much of his time is also spent in Pittsburg.

The friends of Mr. Otto M. Rau, chief electrician of the Milwaukee Electric Railway and Light Company, will sympathize with him in the death of his wife, which occurred on July 8th, after a brief illness. Three young children, besides the husband, are left to mourn a great loss. Mrs. Rau possessed a winning personality. She attended the recent Boston electric-light convention with Mr. Rau and made friends of all who had the pleasure of meeting her.

B. L. Freedy, for a number of years manager of the Northwestern Telephone Exchange Company in St. Paul, has been promoted to be superintendent of the company, with headquarters in Minneapolis. Mr. Freedy will assume the duties of the late W. A. Vail, although he has the title of superintendent—a new office—in place of assistant general manager, which title has been abolished. R. H. Woolfolk, manager of the company at Stillwater, Minn., has been advanced to succeed Mr. Freedy in St. Paul. C. P. Donnellan of St. Paul will be placed in charge of the Stillwater office.

The many friends throughout the West of C. D. Knight, so well known through his skillful designing of direct-current machinery for several large concerns and especially for the National Electric Company of Milwaukee, will be interested to know that he has recently resigned his position as chief engineer of the direct-current department of the National Electric Company and has accepted a position in the engineering department of the Cutler-Hammer Company of the same city. While with the National company Mr. Knight had charge chiefly of matters appertaining to the mechanical design of the National company's electrical machinery.

ELECTRIC LIGHTING.

A bond issue of $20,000 is contemplated by the city of Kissimmee, Fla., for enlarging and improving the electric-light plant.

The business men in Gibson City, Ill., are being solicited for steam-heating contracts by the new Gibson Electric Light and Power Company.

The city of La Grange, Ga., has voted in favor of the $25,000 bond issue for the construction of an electric-light plant and system of waterworks.

W. R. DeWitt has been granted a franchise by the City Council of Slater, Mo., for the construction and operation of an electric-light plant in that city.

The plant of the Eureka Lighting Company of Eureka, Cal., was destroyed by fire recently. The loss is variously estimated at from $60,000 to $100,000.

It is reported that the El Paso Brewing Company of El Paso, Texas, contemplates the construction of an electric plant and system of waterworks in East El Paso.

O. G. Bamntly, W. P. Simpson, C. W. Rubey and associates have incorporated the Lebanon Electric and Power Company at Lebanon, Mo. The company is capitalized at $2,000.

A committee of the City Council of Sioux Rapids is investigating the advisability of purchasing the electric-light plant in that city and also looking up the cost of building a new plant.

The City Council of Joplin, Mo., at its last meeting voted again to place the proposition to issue city bonds to improve the electric-light plant before the voters of the city. Bonds to the amount of $30,000 are proposed.

Despatch, N. Y., now has a local heat, light and power company, with a capital of half a million dollars. The directors of the new concern are A. H. Brown and W. R. Brown of Penfield, and W. P. Thistlewaite of Macedon.

A. G. Fields, the popular minstrel man of Columbus, Ohio, is at the head of a company which proposes to put in an electric-light plant in Pataskala, Ohio, to furnish illumination for Pataskala, Jersey, Summit Station, Etna, Kirkersville and Outville. Such a plant would cost something like $200,000.

Extensive improvements in the University of Chicago's heating and lighting plant, costing $60,000, are to be made, it is said. The completion of the Emmons Blaine School of Education Building, the Tower group of four buildings, and the Law School Building has necessitated increasing the capacity of the power plant. The improvements, which will be completed this summer, will bring the total cost of the plant up to around $360,000, of which nearly $100,000, it is said, has been expended on smoke-consuming devices.

ELECTRIC RAILWAYS.

The election at St. Louis of Joseph Dickson as director and R. W. Gray as manager of the St. Louis, St. Charles and Western Electric Railway Company is thought to be the preliminary step toward the probable ultimate merger of the line with the St. Louis Transit system. Both Mr. Gray and Mr. Dickson are said to be closely allied with interests intimately identified with the Transit company. James D. Houseman was former manager of the road, his resignation being due to other private interest which demand his attention.

The new electric railway connecting Florence, Sheffield and Tuscumbia, Ala., was formally inaugurated recently with pomp and enthusiasm. The new line has a trackage of 11 miles winding about the three towns.

The Mattoon-Charleston (Ill.) interurban electric railway has been turned over by the McCulloch Construction Company, the contractor, to the Illinois Central Traction Company, the work of the contractor having been completed.

The Brazilian government has approved the draft of a contract to be made with Eugenio de Andrade for the construction and working for 70 years of a standard-gauge electric railway from Rio de Janeiro to Petropolis.

It is said that the Schenectady (N. Y.) Railway Company's trolley system has been purchased jointly by the New York Central and the Delaware and Hudson railroads. No details of the reported transfer are at hand.

The Saginaw Valley Traction Company is making improvements to its system in Saginaw, Mich. The new continuous rails are being laid in some of the streets, the idea being to do away with joints and thereby have the cars run more smoothly.

The Chicago City Council at its meeting on July 11th sent the Union Loop ordinance back to the committee on local transportation with instructions to employ an expert to report on the possibility of through rates from one line to another, and also on the abatement of elevated-road noise.

Traffic on the Chicago and Oak Park elevated railway for June shows a falling off as compared with June last year. The daily average of cash fares on the main line was 41,200 for June, 1904, and 42,162 for the corresponding period a year ago. With transfers the figures were 43,856 and 44,875, respectively.

The new trolley line in Rochester, N. Y., to Genesee Valley Park is now completed, but passengers cannot be conveyed thereon on account of the delay in making proper arrangement for the crossing of the Lehigh and Erie tracks at the Park terminus. The railroad companies have promised to construct a subway at the point.

Tokio, Japan, is to have a steam-turbine railway plant. The Tokio-Shigai Railway Company has ordered four 1,500-horsepower Curtis turbines to install in its main generating station. The company is constructing 30 miles of double track, and the cars that are now running take current from the plant of the Tokio Electric Light Company.

Railroad men in Tacoma, Wash., are inclined to believe that there is a community of interest between the Tacoma-Eastern and the Seattle-Tacoma Interurban electric railway. Recently plans were under consideration for connecting the two lines at their terminals in Tacoma in order to handle freight between the points on the Tacoma-Eastern and Seattle.

The Stone & Webster syndicate, owner of the various lines of street railway operating in Dallas, are making active preparations, it is said, for the commencement of the work of construction of an interurban electric railway to run between Dallas and Waxahachie, Texas. It is proposed to construct a thoroughly modern and first-class line of heavy steel, ballasted with rock.

The Schenectady (N. Y.) Electric Railway Company's branch line to Ballston, N. Y., 16 miles in length, has been opened for traffic. The schedule provides for cars to leave each terminus every half hour and connect at Ballston with the Hudson Valley company's line to Saratoga and Round Lake. The line connects with the trolley roads running between Albany and Lake George.

The ordinance granting the Northwestern Elevated Railroad Company of Chicago permission to extend its line to Ravenswood (a northern suburban district within the city limits) has been passed by the City Council. This makes possible a rapid transportation service for the people of the northwestern part of the city. Features of the ordinance are universal transfers, half fares for children and a station at Oak Street. The universal-transfer provision will not become operative until an ordinance covering all the elevated roads is passed.

The board of directors of the Bloomington, Dwight and Joliet Interurban Railway Company met in Peoria, Ill., recently and decided to commence work of construction between Pontiac and Dwight within 20 days. W. F. Van Buskirk will have charge of the work and will personally supervise it, assisted by John S. Murphy and C. E. Legg. B. J. Arnold of the Arnold Electric Power Station Company of Chicago, will be the chief engineer. The directors also decided to increase the capital stock of the company from $100,000 to $300,000.

Residents of Springfield, Ill., believe that that city is destined to be the center of an extensive system of electric railways. The interurban cars of the Illinois Central Traction Company are now running into the city on an hourly schedule, having completed an agreement with the Consolidated Railway

Company for the use of its tracks in the city. The Peoria, Pekin, Bloomington and Lincoln Electric Railway Company is also seeking an entrance into the city, and a majority of those owning frontage on the route to the terminus are said to be in favor of admitting the company.

Assurances from officials of the Fond du Lac (Wis.) and Northeastern Railway Company indicate that every obstacle to the building of the road is now removed. The City Council of Manitowoc, after holding out for months, has at last granted a franchise, giving the company a clear right-of-way from Fond du Lac to Manitowoc, the terminal.

POWER TRANSMISSION.

At Fort Frances, Man., the Rainy River flows over a natural dam and provides the raw material for about 15,000 horsepower. The International Power Company proposes to utilize this power. Work is to begin at once, and it is said that $1,500,000 will be expended.

A report says that the Cherokee (Ala.) Development and Manufacturing Company, organized several years ago by Henry C. Jones of Montgomery, Ala., and associates, has completed surveys for the erection of an electric plant at Cherokee Bluff, on the Tallapoosa River. A dam of granite 100 feet high will be constructed, it is said, and 25,000 horsepower will be transmitted electrically to Birmingham, 85 miles distant. About $2,000,000 will be invested.

The appropriation of $1,500 recently made by the New York state Legislature for co-operative hydrographic work with the United States Geological Survey will be used in maintaining records of the rise and fall, the ordinary outflow, floods and droughts of many streams in the state. By means of these records it is possible to determine, in specific cases, the water supply available for canals, public water systems and waterpower. The condition of streams in more than 50 places in the state is regularly reported. The work has gradually grown until there is at present hardly a section of the state in which some river is not systematically measured. Robert E. Horton, hydrographer, of Utica, N. Y., has charge of the work.

SOCIETIES AND SCHOOLS.

The proceedings of the eighth annual meeting of the National Fire Protection Association, which was held in New York, May 24th to 26th, have been issued in book form, ready for distribution to members only. The book contains 271 pages and embodies the complete proceedings of the meeting with the discussions which took place.

An interesting paper descriptive of the Alabama Polytechnic Institute at Auburn, Ala., was recently written by Charles C. Trach, M. A., president of the institution. The school was organized in 1872 and has been successful, the enrollment for 1903-04 having been 480 students. Instruction is given in 15 well-equipped laboratories and in the seven regular degree courses is included a thorough course in electrical engineering.

The last quarterly bulletin of the Lowell Textile School of Lowell, Mass., briefly reviews the history of the institution and sets forth the advantages of a course in the theory and practical art of manufacturing all commercial fibers. In the engineering department is offered a course in electricity, embodying instruction in elementary electricity, magnetism, electrical measuring instruments, dynamo-electric machines, electric lighting, principles of alternating currents, electrical power transmission and electrical testing. Charles H. Eames, S. B., is the instructor in electrical engineering.

An interesting programme was carried out at the recent second annual commencement of the Electrical and Mechanical College of St. Joseph, Mo. Many prominent men were present. President Ligori of St. Joseph Commercial College addressed the class and Congressman C. F. Cochran also spoke on "The Advantages of Education." The following-named received certificates: Electrical engineering—Bertram C. Donnelly, John H. Rice, Colemore N. Barnes, James I. Dolton, Percy L. Baldwin, Frederick Letts, William L. Fuller, all of St. Joseph; Edward MacDonald, Leavenworth, Kan. Steam engineering—William Sampson, Daniel Spoundle and Archie E. Edgar, St. Joseph. Telephone engineering—James Burrows, Jr., St. Joseph. Drawing and plumbing—Albert C. Fouts, Boise City, Idaho.

PUBLICATIONS.

Flake graphite for the lubrication of air compressors is highly recommended in a mailing card issued by the Joseph Dixon Crucible Company of Jersey City, N. J.

The F. Bissell Company of Toledo, Ohio, is distributing its large new price list of 466 pages. It is asserted that this list is the largest and most complete of its kind ever published and that it is absolutely complete in itself.

Bulletin No. 2, illustrating and describing Duncan direct-current wattmeters, has just been issued by the Duncan Electric Manufacturing Company of Lafayette, Ind. The company continues to find a good demand for its product.

The H. W. Johns-Manville Company of New York city has issued a new price list of its insulating materials. The company states that it is in a position to supply the requirements of its customers in India or amber mica, which it buys direct from the mines.

The Electric Storage Battery Company's latest bulletin is devoted to installations of Chloride accumulators in residential lighting and power plants. It is especially interesting in that it shows pictures of some of the finest residences in the country with views taken in the battery room of each.

The Artesian Electric Company of Chicago presents to the trade an illustrated catalogue of its electrical novelties and supplies, including small motors, electric alarm clocks, pocket searchlights, medical coils and such apparatus. Each device is illustrated and described in the catalogue.

A quantity of literature folded in an enclosure bearing a "cracker-jack" Fourth of July design, has been sent out by the Sterling Electrical Manufacturing Company of Warren, Ohio. Considerable incandescent-lamp data is given, also an answer to the question, "At what Voltage Are Incandescent Lamps Really Burned?"

A supplement to the 1903 edition of the National Electrical Code has been issued containing rules on car wiring formulated by the conference committee of the Underwriters' National Electric Association. It has been adopted by the National Board of Fire Underwriters for the government of the electrical wiring and equipment of street-railway cars. The first edition has been limited to 10,000 copies.

A leaflet from the Pittsburg Transformer Company calls attention to the two most important things in a transformer, the insulation between the primary and secondary and the coils themselves. The coils of these transformers are wound directly upon the core. The company's monthly calendar for July is also out, and the pretty girl whose picture appears this month adds to the well-established reputation of the series.

The annual report of the Wire Department of Boston has appeared, covering the period from February 1, 1903, to February 1, 1904. The report is a comprehensive one and contains among other things maps of "underground" districts and pictures of streets before and after the wires were removed. The L-street station of the Boston Edison Company is also described. The creditable showing made by this report is largely due to Mr. Patrick J. Kennedy, commissioner of wires.

The Engineers' Club of St. Louis has published a World's Fair souvenir, which is prepared for the use of visiting engineers who may come to St. Louis during the fair as well as for the information of its own members. The book contains four divisions. The first division is given up to the exposition—historical and descriptive. The second division is an engineering guide to the city of St. Louis, describing all the points of engineering interest in St. Louis. The last two sections are devoted to local engineering data for St. Louis and vicinity and to the annual bulletin of the club.

SPACE TELEGRAPHY.

Dr. Tyndall of New York city recently delivered a lecture on the latest developments in space telegraphy before a large gathering of the Chamber of Commerce of Liverpool. The lecture, which dealt with the physical rather than with the commercial application of space telegraphy, was fully illustrated and created much interest. A hearty vote of thanks was accorded to the lecturer.

The first space-telegraph message sent to the New York navy yard from the wireless station at Navesink, announcing the arrival of a vessel, was when the supply ship Culgoa arrived off Sandy Hook a few days ago. The vessel arrived from southern ports, and a message was sent to the navy yard announcing her location and the probable time of arrival. The question of absolute government control of space telegraphy, so far as the location within zones of interference along the coast is concerned, is still attracting much discussion in the navy. It is said that the Bureau of Equipment of the Navy Department has on file applications from the following space-telegraph companies to test their systems: The Marconi, the De Forest, the Bull, the Piggott, the Fessenden, the Pacific, the Lodge-Muirhead, the Clark, the Telefunken and the Rochefort.

MISCELLANEOUS.

The recent visit of the Institute of Mechanical Engineers of Great Britain to Milwaukee in response to an invitation from the president of the Allis-Chalmers Company was described by President Wicksteed of the institution in his speech at West Allis as "one of the pleasantest experiences that had come to the members during their American visit." "I do not know how these things are done," said he, "but this excursion has been perfectly managed. Two or three days ago in Chicago I met the president of this great company and incidentally remarked to him that I had long desired, as I knew many of my fellow members had, to visit the famous engine works in Milwaukee. President Warren asked, 'When will it be convenient for you and your fellow members to come?' and I replied 'the day after tomorrow,' and here we are, transported in some sort of a magical way, quietly, comfortably, without any apparent effort, by arrangements which can only have been made over night, and yet are so admirably planned and carried out that they could not have been excelled had they been a long time in preparation."

A loss of nearly $400,000 resulted last week from a fire which destroyed the Electrical Vehicle Equipment Company's factory in Brooklyn, N. Y. The building covered nearly two acres and was owned by the Edison Company.

High water during last week again caused considerable trouble and damage in Kansas City and suburbs. In some localities houses and factories were many feet in water. Parts of the big buildings of the Nelson Morris Packing Company in Riverside were washed away and about a hundred men were kept hard at work trying to keep a small island intact around the Riverside electric power house of the Metropolitan Street Railway Company.

TRADE NEWS.

W. D. Harris, clerk of the town of Wilton Junction, Iowa, will receive bids until July 22d for improvements in the municipal electric-light plant at that place, following plans and specifications now on file with the town clerk.

About 70,000 horsepower of water turbines will soon be purchased, it is said, for installation in the hydraulic plant of the Toronto and Niagara Falls Power Company on the Canadian side of the cataract. W. P. Plummer of 29 Broadway, N. Y., is acting as the company's purchasing agent. He recently awarded a contract to the Canadian General Electric Company for the generating apparatus.

The Weatherproof Sectional Pole Company of Little Rock, Ark., will erect a factory in Little Rock for the manufacture of telegraph and telephone poles. For the present the poles will be creosoted at Texarkana, but later a creosoting plant will be built in connection with the new factory. The company was recently organized with a capital of $100,000. W. B. Crossland is president and general manager.

One of the largest boat orders ever placed was recently secured by the Electric Launch Company, Bayonne, N. J. The United States Navy Department has need of 120 electric boats for the use of the artillery corps in the operation of planting submarine mines for harbor defense. This fleet will be capable of handling 500 mines, and will also be used as tenders to the new submarines. The contract date of completion is June 30, 1905.

The Crocker-Wheeler Company makes the important announcement that by arrangement with the well-known electrical engineers, Brown, Boveri & Co. of Baden, Switzerland, it has secured the latter's alternating-current designs, patents and rights to manufacture in America and has retained them as consulting engineers. The Crocker-Wheeler Company is now putting on the market alternating-current generators, transformers and accessories adapted to American practice.

Cleveland, Chicago and St. Louis men met in Cleveland, Ohio, recently and formed a national trades union of insulator and asbestos workers. It will be known as the National Insulator and General Asbestos Workers of America. Unions of steam-pipe and boiler coverers in the various cities will be asked to affiliate with this organization. In all there are probably 7,000 or 8,000 men engaged in this work. The originators desire to make an important organization of it.

Various supplemental changes have been made in the Australian tariff during the last year. Among the articles placed on the free list are rubber tape; electrical bolts, unattached and being parts of insulators which accompany them; incandescent-lamp caps, being parts thereof and not otherwise usable; electric-discharge keys, and porcelain electric tubes. Zinc plates, cut to sizes for electrical purposes, and electric searchlights have been placed in the classification upon which 12½ per cent. ad valorem is paid. Glass insulators and glass rod separators for accumulators, and glass shades for arc lamps must pay a duty of 20 per cent. ad valorem.

BUSINESS.

The Central Electric Company of Chicago is sending out circulars quoting prices on porcelain tubes and insulators. The company is prepared to make prompt shipment and especially requests that all those who have not received quotations write for them.

M. Krell, manager of the foreign department of the Commercial National Bank of Chicago, speaking of conditions in Germany on his return from a two-month stay in Europe, said that German industries had been reorganized and were doing an enlarged business when the Russo-Japanese war broke out, but that event had checked temporarily the development. "The electrical industries," he said, "which were in a particularly bad way and caused the industrial depression, have all been thoroughly reorganized and are on a perfectly sound basis. The output of this industry is up to date, and when there is a resumption of activity the German demand for copper should be great."

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued (United States Patent Office) July 5, 1904.

763,964. Safety Train-controlling System. George W. Cohen, Allegheny, Pa., assignor to the Cohen Automatic Electric Block Signal Company. Application filed October 1, 1903.

The railway track is divided into blocks insulated from each other. A contact strip in each block is connected in a normally open circuit with the rails, which is adapted to be closed by a relay in the next block when the latter becomes short-circuited. The steam valves on the engine are arranged to be closed automatically by a relay in the engineer's cab, which is actuated by a circuit forming part of the contact-strip circuit.

763,970. Party-line Telephone System. Thomas C. Drake, Malta, Ohio. Application filed February 13, 1903.

In a party-line telephone system there are two polarized call-bells biased in opposition to each other and connected with a line circuit for signaling. One of the bells is organized to operate with a heavy positive alternation of current to actuate its biased armature in opposition to the biasing force exerted thereon. A light negative alternation of current assists the biasing force in the operation of its armature in the direction of its normally biased trend. The other call bell is organized to operate with a heavy negative alternation of current to actuate its biased armature in opposition to the biasing force exerted thereon.

763,971. Ringer System for Telephone Exchanges. Thomas C. Drake, Malta, Ohio. Application filed April 14, 1903.

Bridged with the line is a call bell and means in the call-bell circuit to prevent excessive current from interfering with the bell's operation. A direct-current type of relay is bridged with the line and in multiple with the call bell, a source of alternating current is bridged with the line to actuate the call bell and relay in multiple in the use of the line, and a source of direct current in series with the alternating current energizes the relay while the alternating current is reversing.

763,972. Automatic Selecting Apparatus and System. Joshua T. Fisk, Adrian, Mich., assignor to George P. Fisher, Jr., trustee, Chicago, Ill. Application filed January 8, 1902.

Selective apparatus for telephones, includes an automatic switch for telephone circuits, an electric signal, a lock for the switch and a step-by-step selecting device arranged to hold the lock in an inoperative position and to close the circuit through the signal after a movement to any one of a limited number of adjacent predetermined positions.

764,005. Glower Support for Second-class Conductor Lamps. Henry N. Potter, New Rochelle, N. Y., assignor to George Westinghouse, Pittsburg, Pa. Application filed October 9, 1902.

A lead wire is attached to the glower at each end, and conducting supports hold the lead wires. At least one of the supports is a conducting sleeve so disposed with relation to the glower that the effect of expansion upon the glower will cause the lead wire to be pushed farther into the sleeve, the latter being of a material which is not deleteriously oxidized at the operating temperature of the lamp. (See cut.)

764,006. Heater Support for Nernst Lamps. Henry N. Potter, New Rochelle, N. Y., assignor to George Westinghouse, Pittsburg, Pa. Application filed October 9, 1902.

A heater, one end of which rests against an insulating base or support, is associated with an adjustable piece and means for pressing the adjustable piece against the opposite end of the heater body. The base and the adjustable piece are provided with means for supporting the heater ends.

764,020. Electrically Propelled Vehicle. Russell Thayer, Philadelphia, Pa. Application filed April 11, 1904.

An automobile provided with an electric motor and a storage battery, has wheels constructed to traverse the tracks of a railway supply system, with the motor in operative connection with the system. It is also arranged to traverse a trackless roadbed, independently of the system, with the motor in connection with the battery.

764,027. Sounder Frame. Gustave A. Zundel, New York, N. Y. Application filed March 18, 1903.

The mounting of the armature of a telegraph sounder is described.

764,039. Overhead Trolley. Clide C. Chambers, Everson, Pa. Application filed February 25, 1904.

A rearward, horizontally disposed extension on the trolley pole carries the wheel.

764,055. Telephone Transmitter. Dugald C. Jackson, Madison, Wis. Application filed September 26, 1902.

A front wall carries a diaphragm clamped thereto and a supporting bracket bridges the wall at the rear. A stem is adjustably secured in the bracket and extends forwardly. A flange at the front end of the stem, an electrode chamber adjustably engaging the flange and freely suspended therefrom, a rear electrode secured to the flange, a front electrode secured to the diaphragm and extending within the chamber, and a ring of cellular material disposed between the interior walls of the chamber and the periphery of the front electrode are the other features.

764,093. Wireless Telegraphy. Leonard D. Wildman, United States Army. Application filed June 10, 1904.

In a wireless-telegraph system is a radiating system consisting of a number of elevated conductors, an inductance coil, and connections from each of the elevated conductors to different points of the inductance coil. By this means the natural periods of the elevated conductors are made equal.

764,094. Wireless Telegraphy. Leonard D. Wildman, United States Army. Application filed June 10, 1904.

Alternating-current energy is employed with means for protecting the armature of the generator from excessive potential discharges. The means convey the discharges to earth.

764,105. Electric Arc Lamp. André Blondel, Paris, France. Application filed December 22, 1903.

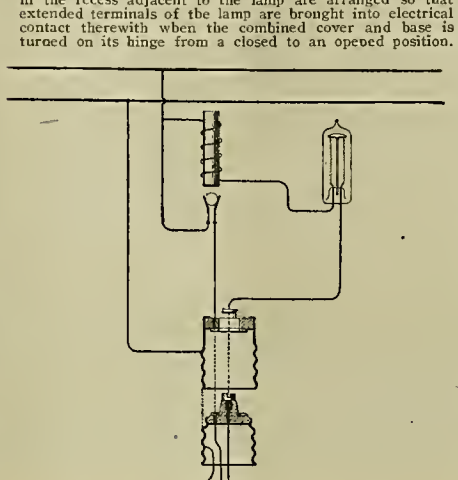
In an arc lamp are combined a reflector having an opening, a mineralized movable electrode projecting through the opening, and a protective envelope extending into the opening and surrounding the mineralized electrode.

764,112. Electricity Meter. Carlo Clerici, Milan, Italy. Application filed November 30, 1903.

A maximum-demand indicator consists of a bulb connected with a thin tube open at its lower end, the whole being sealed to a glass receptacle containing a suitable liquid, into which the orifice of the tube dips. The bulb is surrounded by a coil through which the current to be measured is caused to flow and the tube, open at its lower end, is fitted with a scale allowing of readily ascertaining the height of the liquid column. Under the action of the current the column rises within the tube in the form of a continuous undivided body, and does not sink upon the current being turned off.

764,135. Electric-light Hanger for Walls. Willy H. Lau, Chicago, Ill. Application filed April 23, 1904.

A base provided with means to attach to a wall is provided with a recess. A combined cover and base is hinged to the first-named base and carries an electric lamp attached to the under side. Spring terminals in the recess adjacent to the lamp are arranged so that extended terminals of the lamp are brought into electrical contact therewith when the combined cover and base is turned on its hinge from a closed to an opened position.



NO. 764,005.—GLOWER SUPPORT.

764,139. Telephone. John W. Mead, Harry A. Mackie and Martin Van Buren, Amsterdam, N. Y., assignors to Van Buren and John J. Turner, Amsterdam, N. Y. Application filed October 19, 1903.

Combined with a talking circuit are a receiver and a movable support for the receiver. The subscriber's signaling circuit contains a switch, one member of which is carried by the receiver support whereby the circuit is controlled by the movements of the support. An induction coil independent of the talking circuit has its primary included in the signaling circuit and its secondary connected with the main line. An automatic make-and-break device independent of the switch is arranged in the primary circuit of the coil.

764,143. Circuit-changer for Telephone Switchboards. William E. McCormick, Chicago, Ill., assignor to the International Telephone Manufacturing Company, Chicago, Ill. Application filed August 26, 1901.

The circuit changer is composed of a plate, a pivoted key and an insulating base carrying ringing and listening terminals supported in banks, having a common median line. The key is forked, one of the branches being at the front of the ends of the terminals of one bank and the other branch being between the terminals of the other bank.

764,148. Third-rail Guard for Electric Roads. John S. Payne, Midlandpark, and James S. Payne, Wortendyke, N. J. Application filed July 23, 1903.

Rail blocks secured to the third rail have a parallel rail guard secured to the rail blocks having its upper edge coming above the third rail. A series of cover plates are pivotally connected adjacent to the base of the third rail and have their edges normally resting against the rail guard to completely cover over the third rail.

764,169. Insulated Rail Joint. George A. Weber, New York, N. Y., assignor to the Weber Railway Joint Manufacturing Company, New York, N. Y. Application filed March 25, 1904.

Insulating filling blocks are arranged at each side of the rail webs and metallic bolt plates extend across the joint on the outside of the filling blocks, the bolt plates being wholly beyond the under portions of the base flanges of the rails.

764,174. Thermo-electric Element. William H. Bristol, Hoboken, N. J. Application filed February 18, 1904.

One element of a thermo-electric couple consists of tungsten or wolfram steel.

764,175. Thermoelectric Couple. William H. Bristol, Hoboken, N. J. Application filed March 5, 1904.

A thermo-electric couple has its elements reduced in cross-section at and near their junction and has its shanks of large conducting area. Means for establishing a fluid circulation about the cold ends of the elements are provided.

764,176. Thermoelectric Couple. William H. Bristol, Hoboken, N. J. Application filed April 4, 1904.

Two separated elements, an electrical measuring instrument in connection with the hot or cold ends of the elements, and a liquid bath connecting the opposite ends and forming an electrical connection between elements compose the couple.

764,177. Thermoelectric Couple. William H. Bristol, Hoboken, N. J. Application filed March 5, 1904.

Conductors of different material from the primary couple are joined to the latter at different distances from the juncture of the primary couple.

764,178. Thermoelectric Apparatus. William H. Bristol, Hoboken, N. J. Application filed May 5, 1904.

Thermo-electric apparatus comprises two separate elements, one of which is constituted in whole or part by the article to be treated. An electrical measuring instrument is placed in connection with one end of the couple and a bath connects the opposite end of the couple.

764,181. Starter for Vapor Electric Apparatus. Charles W. Denny, New York, N. Y., assignor to the Cooper Hewitt Electric Company. Application filed January 27, 1904.

Vapor electric apparatus starting devices consist of a suitable chamber and a solid electrode supported therein, the solid electrode being provided with a lip or finger bent outward into proximity to the wall of the chamber.

764,189. Electric Switch. James F. Hardy, New York, N. Y., assignor to the Consolidated Dental Manufacturing Company, New York, N. Y. Application filed March 4, 1903.

Combined with a movable part is an electric motor for operating it, a switch for controlling the motor and means for operating the switch to stop the motor. The latter comprise a sliding plate arranged to be engaged by the movable part when the part reaches a predetermined point and a connection between the plate and switch consisting of a cross shaft having a pinion-and-rack engagement with the switch and sliding plate whereby the movement of the plate is imparted to the switch.

764,194. Trolley Pole. Caleb Jones, London, Ky. Application filed December 17, 1903.

Spring-pressed telescopic sections make up the pole, a sleeve or collar being carried by one of the sections. A trolley rope is secured to the sleeve or collar and a spring-actuated roller regulates the tension of the rope.

764,199. Alarm-system Apparatus. Felix McGloin, Brooklyn, N. Y. Application filed May 23, 1903.

Two main-circuit terminals, an instrument terminal, a spring-retracted switch for disconnecting the main-circuit terminals and connecting one of the terminals with the instrument terminal are provided. A pawl engages directly with the moving portion of the switch when in unretracted position, while means automatically disconnect the pawl at the end of a definite mechanical operation of the signal.

764,213. System of Electrical Distribution. Charles P. Steinmetz, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed January 23, 1895.

A method of phase transformation consists in generating two-phase currents, combining component magnetomotive forces due to the two-phase currents, deriving three-phase fluxes as the result of the combination, and inducing three-phase electromotive forces by the action of the fluxes.

764,218. Electric Circuit-controlling Apparatus. Jacob P. Tirrell, Boston, Mass., assignor to Jay B. Crawford, Boston, Mass. Application filed October 10, 1903.

Stationary contacts are associated with a revolving contact intermittently stopped by the stationary contacts, the stationary and revolving contacts being relatively movable to bring the stationary contacts into and out of the path of the revolving contact. A continuously-revolving tripping device releases the revolving contact from the stationary contacts, and means accelerate the revolving contact from one position to the next.

764,224. Trolley. John Q. Brown, Oakland, Cal. Application filed April 12, 1904.

The trolley comprises a double diamond-shape spring-actuated structure made up of a series of conjoined upper and lower rectangular frames, each of substantially uniform width transversely, whereby the sides of the lower frames are disposed vertically in line with the sides of the upper frame. A long trolley roller is supported between the ends of the opposite side bars of the uppermost frame.

764,240. Electrohydraulic Valve Mechanism for Elevators. Herbert F. Hinman, New York, N. Y. Application filed April 26, 1902. Renewed June 3, 1904.

In an elevator apparatus are a hydraulic cylinder, a pressure pipe and a second pipe leading directly to the cylinder. Independent branch openings are situated between the two pipes, a valve controlling each branch. An electromagnetic operating device is provided for each valve and a switch controls one or all of the valves at will.

764,244. Third-rail System for Electric Railways. Washington H. Kilbourn, Greenfield, Mass. Application filed October 1, 1903.

The third rail comprises a conductor and guard rails secured at opposite sides of and projecting above the conductor. The guard rails are separated from each other above the conductor by an arm-receiving slot, being composed of sections insulated from each other.

764,253. Electric Meter. Albert Peloux, Geneva, Switzerland, assignor to the Société Anonyme des Ateliers de Mecanique de Precision de Territet, Territet, Switzerland. Application filed April 13, 1903.

Combined with a disc armature are a core, closed circuited windings on the core, and a series coil all on one side of the disc armature. Another core, shunt coils on the core, and a separate core extending between the poles of the last core on the other side of the disc armature make up the apparatus.

764,282. Battery Cell. William O. Duntley, Chicago, Ill. Application filed February 15, 1904.

A battery cell has a bottom opening, a closure therefor independent of the battery elements, and means for pass-

ing a cleansing fluid through the cell to wash it out through the opening.

764,293. Electric Circuit Cut-out. Charles Johnston and Claude Johnston, Memphis, Tenn. Application filed August 20, 1903.

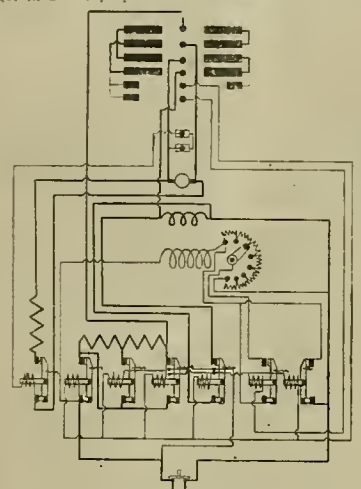
A wheel having alternate contact and insulated pins is supplied with an arm to advance the pins. A check pawl carried by the arm limits the motion of the pins, an electromagnet operates the arms and means shut the current on or off from the magnet to operate the arm.

764,349. Electromassage Device. Lee J. Chapman, Columbus, Ohio. Application filed March 12, 1904.

A cell acting as a handle is provided with a non-conducting covering and an electrode or shoe is carried upon one end of the cell. Means for producing a variable interrupted current are carried by the casing.

764,367. Target Apparatus. John L. McCullough, Brooklyn, N. Y., assignor to the Automatic Target Machine Company of New York. Original application filed December 31, 1901. Divided and this application filed March 31, 1902.

A target device comprises a stationary penetrable target, a pointed indicator back of the target, means for moving the indicator across the field back of the target, and means for moving the indicator into contact with the target in a line perpendicular to the same.



NO. 764,439 —MOTOR CONTROL.

764,371. Trolley-wire Replacer. John D. Ratliff, Muncie, Ind. Application filed February 15, 1904.

The trolley-wheel face is broad and has grooves upon its surface to direct the trolley wire toward the center.

764,372. Thermal Cut-out. Robert H. Read, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed October 23, 1902.

A thermal cut-out embodies a secondary break point in the circuit exterior to the fusible element and in series therewith. Means for opening the circuit at the break point on extreme overloads are supplied, being dependent on the failure of the fuse to open the circuit.

764,384. Insulating Support for Electric Third Rails. Frederick R. Slater, New York, N. Y., assignor to Bleecker S. Barnard, New York, N. Y. Application filed May 28, 1903.

Electric conductor rails comprise a base having a downwardly extending recess in its top, an insulating block is formed in one piece and comprises an upper body portion having a solid spindle on its bottom projecting downwardly therefrom and inwardly into the recess in the base.

764,388. Electric Railway. Henry N. Sporborg, Rugby, England, assignor to the General Electric Company, Schenectady, N. Y. Application filed December 9, 1902.

An electric railway has a number of conductors paralleling the service or track rails, means for connecting the conductors together at intervals along the way and means for opening the connections simultaneously.

764,391. Electrical Connection. Ernest A. G. Street, Courbevoie, France, assignor to la Société Anonyme le Carbone Levallois-Perret, near Paris, France. Application filed July 15, 1903.

In the apparatus are embodied a carbon brush, a conductor and a conducting body, channels formed in the body and clamping means applied to the opened-out strands of the conductor at the channel extremities.

764,392. Trolley. Bernard E. Sunny, Chicago, Ill., assignor to the General Electric Company, Schenectady, N. Y. Application filed December 10, 1903.

Multiple-conductor current collectors comprise two members mounted in relatively fixed relation to each other, one member having a shifting position of contact with one conductor and the other member having a relatively constant position of contact with the other conductor.

764,400. Cut-out for Trolley Conductors. Pendleton G. Watmough, Jr., Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed November 1, 1901.

Guide brackets for leading off a lateral branch of the section are provided with a movable trip device connected to the conductor. A switch is interposed between the feeder and trolley wire, and an operating device is provided for the switch in the path of movement of the tripping device.

764,402. Controller. Elmer B. Wharton, Columbus, Ohio, assignor to the Case Manufacturing Company, Columbus, Ohio. Application filed November 13, 1903.

A pivotally-mounted switcharm caries a series of contact fingers and a rotary disc contact. Suitably-mounted contact plates receive the contact fingers and a series of knife-switch contacts are connected with a suitable resistance medium and adapted to engage the rotary disc contact.

764,407. Means for Controlling the Division of Load Between Synchronous Motor-generator Sets. Jonathan E. Woodbridge, Albany, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed January 9, 1903.

Means for supplying alternating current to an alternating-current circuit, embody a motor generator set, consisting of a synchronous motor and an alternating-current generator mechanically coupled together. Leads supply alternating current to the synchronous motor, and means also produce a reactive drop of voltage in the leads.

764,418. Multiple Trolley. John S. Briggs, Los Angeles, Cal. Application filed June 1, 1903.

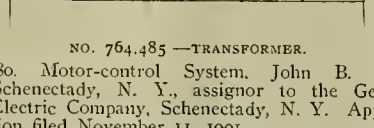
The trolley pole carries two wheels.

764,439. Controlling System for Electric Motors. Arthur C. Eastwood, Cleveland, Ohio. Application filed March 21, 1904.

A reversing controller is actuated by an electric motor with switches operatively independent of the controller for governing the application of current to the motor after the controller has been operated. (See cut.)

764,469. Telpherage System. John H. Johnson, Dodgeville, Wis., assignor of two-thirds to George A. Lee and Anton Dyreson, Dodgeville, Wis. Application filed July 18, 1903.

An electric motor traveling on a suspended wire carries a load from one place to another.



NO. 764,485 —TRANSFORMER.

764,480. Motor-control System. John B. Linn, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed November 11, 1901.

Separate electromagnetically actuated switches have their actuating windings connected in series. Circuit connections intermediate the windings, or certain of them, lead to one side of the supply circuit, and contacts controlled in their operation by the current in the motor circuit are included in the intermediate circuit connections.

764,481. Field Coil and Method of Making Same. Walter D. Litchfield, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed October 10, 1902.

A coil for a generator is composed of wound sections of copper conductor coated with a flexible enamel, a wrapping of tape, insulating compound filling the interstices, and an outer wrapping.

764,485. Transformer. Walter S. Moody, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed December 14, 1903.

Two inductively related windings are each made up of coils, the coils of one winding being connected in series with each other and the coils of the other winding in multiple with each other. Proper connections are provided for utilizing less than the whole number of the series-connected coils. (See cut.)

764,499. Brush Holder. Henry G. Reist, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed November 25, 1898.

A brush holder for an electric motor or generator, comprises a brush support, a sheet metal frame secured thereto formed of a single blank of sheet metal, provided with ears for connecting it with the support, ears for a pivot pin, and a brush follower mounted on the pivot pin.

764,505. Electric Switch. John L. Steeb, Butler, Pa., assignor of two-thirds to William M. Carnahan and Frank M. Megogney, Pittsburg, Pa. Application filed September 29, 1903.

Details are described.

764,518. Electrical Heat Motor. Hugo Bremer, Neheim, Germany. Application filed Aug. 15, 1903. Renewed May 7, 1904.

In an electrical heat motor having a magnetizable armature is a field-producing magnet, and means for partially demagnetizing the armature so as to cause it to move in the field. A coil is adapted to excite as well as to heat the active end of the magnet, the end being in close proximity to the armature.

764,533. Automatic Electric Block Signaling. William A. Luby, Kalamazoo, Mich. Application filed May 9, 1903.

Alternating current is used in the signaling system.

764,539. Automatic Electrical Display Apparatus. Bernard A. Gilbert, Philadelphia, Pa., assignor to Lillian T. Gilbert, Philadelphia, Pa. Application filed June 10, 1903.

A motor advances the curtain carrying the sign. Contacts on the curtain are movable along different paths, and a reversing relay is controlled by each contact for reversing the motor.

EXPIRING PATENTS.

Following is a list of electrical patents (issued by the United States Patent Office) that expired on July 12, 1904:

366,195. Underground Way or Conduit. S. W. Arnold and William C. Cramer, Philadelphia, Pa.
366,202. Apparatus for Measuring Electricity. Jules Cauderay, Paris, France.
366,209. Electrical Conductor for Railway Trains. A. L. Duwelius, Cincinnati, Ohio.
366,212. Electrical Alarm. James A. Galvin, Steelton, Pa.
366,229. Telegraphy. L. Maiche, Paris, France.
366,263. Underground Cable for Telegraph Wires. R. F. Silliman, Troy, N. Y.
366,267. Automatic Regulator for Electric Motors. W. Stanley, Jr., Great Barrington, Mass.
366,268. Electric Meter. W. Stanley, Jr., Great Barrington, Mass.
366,305. Galvanometer. Harry B. Cox, Cincinnati, Ohio.
366,324. Automatic Electric Temperature Regulator. Warren S. Johnson, Milwaukee, Wis.
366,337. Semi-elastic Compound for Covering Electric Wires, etc. H. W. Somerville.
366,347. Electrical Converter. Albert Schmid, Allegheny, Pa.
366,349. Regulator for Self-exciting Alternate-current Electric Generators. O. B. Shallenberger, Rochester, Pa.
366,350. Safety Strip for Electric Circuits. O. B. Shallenberger, Rochester, Pa.
366,352. Incandescent Electric Lamp. Edward P. Thompson, Elizabeth, N. J.
366,353. Process of Making Incandescents. Edward P. Thompson, Elizabeth, N. J.
366,361. Electric Conductor. George Westinghouse, Jr., Pittsburg, Pa.
366,362. Electrical Converter. George Westinghouse, Jr., Pittsburg, Pa.
366,374. Circuit Controller for Electric Circuits. Henry M. Byllesby and P. Lange, Pittsburg, Pa.
366,375. Electric Converter. H. M. Byllesby, Pittsburg, Pa.
366,376. System or Circuit for Electrical Distribution. Henry M. Byllesby and O. B. Shallenberger, Pittsburg and Rochester, Pa.
366,400. Telegraph Key. Alphonso S. Keating, Corry, Pa.
366,407. Electric Switch. Philip Lange, Pittsburg, Pa.
366,408. Core for Electromagnets and Method of Forming the Same. Philip Lange, Pittsburg, Pa.
366,409. Electric Galvanometer. Philip Lange, Pittsburg, Pa.
366,410. Electric Galvanometer. Philip Lange, Pittsburg, Pa.
366,457. Laying Continuous-electrical Conduits. Alexander C. Chenoweth, New York, N. Y.
366,513. Electric Controlling and Regulating Device for Pendulums. W. S. Scales, Somerville, Mass.
366,523. Automatic Regulator for Electric Distribution. W. Stanley, Jr., Great Barrington, Mass.
366,544. Electrical Converter. George Westinghouse, Jr., Pittsburg, Pa.
366,603. Mast Arm for Electric Lights. Frank H. Parker, Burlington, Vt.
366,606. Key Socket for Incandescent Electric Lights. F. L. Pope, Elmoro, N. J., and H. M. Byllesby and P. Lange, Pittsburg, Pa.
366,613-366,614. Electric Arc Lamps. Addison G. Waterhouse, Hartford, Conn.
366,634. Electric Switch. R. Macrae, Baltimore, Md., and C. F. Tavener, Boston, Mass.

SPECIAL MENTION.

Electrical people will be interested in knowing of the excellent service that is being furnished by the Pere Marquette Railroad Company among the many delightful Michigan resorts. Since the entrance of this well-known road into Chicago it has been constantly improving its service. Chicago can be left at noon, and in a few hours the heat and dirt of the city are forgotten and the traveler is in the cool breezes and beautiful surroundings of Michigan's delightful and health-giving lake resorts. The Pere Marquette, too, is building up rapid, comfortable travel throughout all parts of its system. Of interest also to electrical manufacturers are the many fine sites for the locating of factories reached by its lines. The energetic passenger agent of the road, Mr. H. F. Moeller of Detroit, is always pleased to furnish information in regard to its train service and the points it reaches, where vacations may be spent and the recreation of good fishing, sailing and boating found.

The Eureka Electric Company of Chicago is now placing on the market for use in both its own switchboards and other makes a four-party selective key, which contains some commendable features. The usual difficulty of constructing this type of key on a rubber base has been obviated, it is said, and there is no tendency to warp in service. The key is constructed on solid metal frame, and is adaptable for companies employing four-party lines in their exchanges.

Incorporation papers for the Electric Filter Company of Youngstown, Ohio, have been filed. The incorporators are V. M. George, S. W. Carroll, John Goeppinger, Michael and Abe Livingstone. The capital stock is fixed at $10,000. The company was formed for the purpose of manufacturing and placing on the market a new water filter invented by Mr. George. The invention purifies water by means of electrolysis. As soon as the incorporation is effected the new company will organize and begin the manufacture of filters.

The Eastern Wisconsin Railway and Light Company, which operates the up-to-date interurban line between Oshkosh and Fond du Lac, Wis., has issued a handsome hanger, entitled "Take the Yellow Car." The hanger bears the picture of a man carrying under his arm a model interurban car and contains besides a schedule of the cars running between the two points. When hung up in an office it saves time in looking up schedules and serves also as a reminder of the modern advertising methods of the company.

The Erie Railroad Company has just issued an industrial map of its system, which shows the advantages of the Erie railroad between New York and Chicago in relation to manufacturing, fuel, markets and route. The territory traversed by the railroad is districted by the industrial department of the company according to the resources, markets and advantages for manufacturing, and advice will be given manufacturers regarding suitable locations. The bituminous and anthracite coal areas, the area in which oil or gas is produced, and the area in which coal, oil and gas are produced, are shown in colors on the map.

WESTERN ELECTRICIAN

EVERY SATURDAY

Vol. XXXV. CHICAGO, JULY 23, 1904 No. 4

LIBRARY OF ELECTRICAL ENGR.

Portable Space-telegraph Stations for Military Purposes.

The Gesellschaft für Drahtlose Telegraphie (Wireless Telegraph Company), Berlin, which was started some time ago as a consequence of an understanding brought about between two leading German electrical companies—the Siemens Company and the Allgemeine—has since the beginning paid especial attention to the use of space telegraphy both for naval and military purposes. According to the results so far obtained a safe communication up to more than four days' marching is possible when working with the Morse recording apparatus, while in the case of an audible record of the signals the distance susceptible of being covered may even be double.

Herewith a short description is given of this company's latest form of portable station for military purposes.

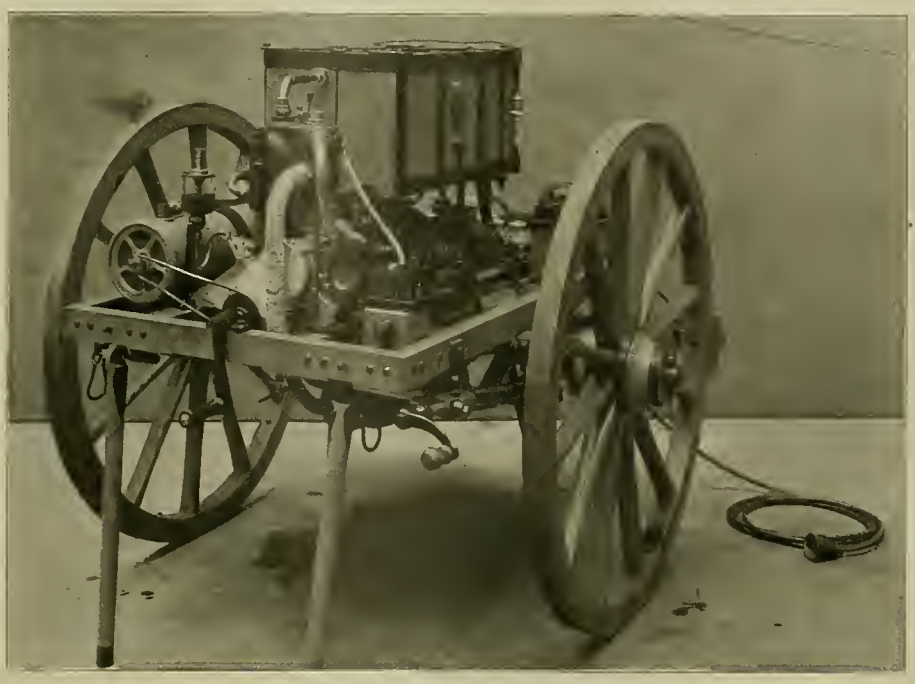
The stations are arranged for two wave-lengths—that is, a short wave of 0.350 meter and a long wave of 1.050 meters, the antenna remaining the same for both. In the case of the short wave, the antenna will oscillate in three-quarters of a wave, and with the long wave in one-quarter of a wave. The antenna is overbalanced in the first case by a counterweight constituted by about six square meters of copper gauze stretched out at a height of about one meter from the ground, while the amount necessary in the second case is as high as 24 square meters. The antenna is supported either by kite balloons or by linen kites; the former have a volume of 10 cubic meters and a pull of about three kilograms, while the effective wind surface of the latter is 1.1 square meters, so as to be used even in the case of small wind strengths to save the gas needed for the balloons.

Each station comprises three two-wheel carts—first, the power cart; second, the apparatus cart, and third, the utensil cart. The power cart and the apparatus cart are shown in the accompanying pictures.

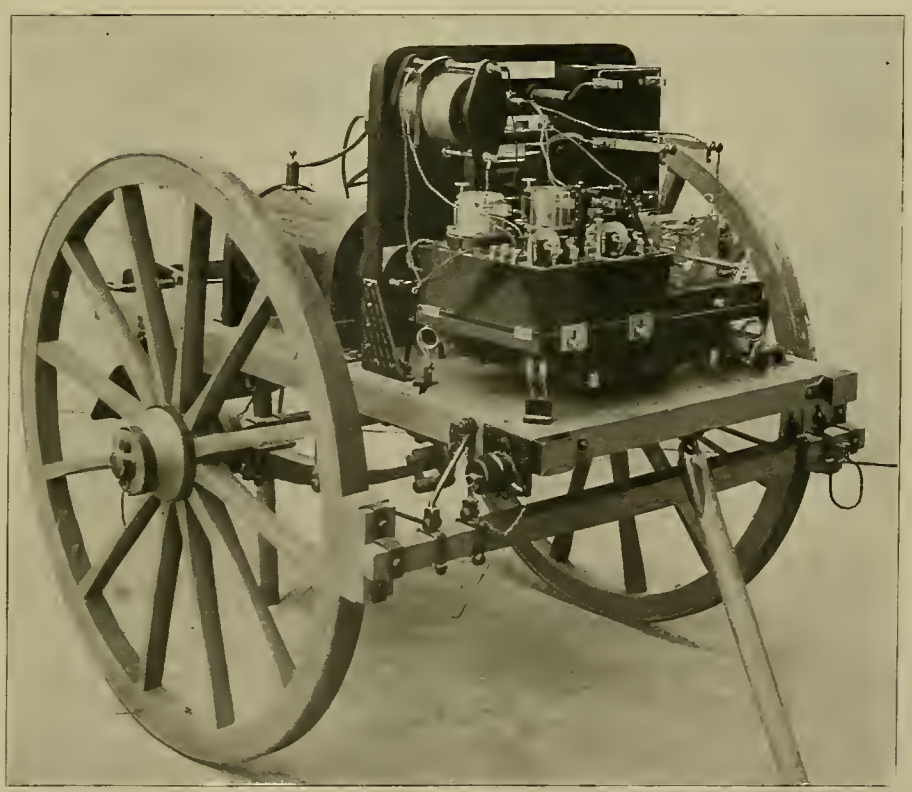
The power cart contains the current source, consisting of a benzine motor of about four horsepower direct-coupled to an alternating-current generator of an effective output of about one kilowatt and the exciting machine. The cooling of the motor is effected by water, carried along in a reservoir located above the machinery, as plainly shown in the illustration. The circulation of the water is effected automatically by means of a small pump, the water being cooled by a tube system and by a ventilator. The benzine necessary for the operation of the motor is carried in a reservoir of about 30 liters in capacity, located beside the water recipient, this capacity being sufficient for a continuous telegraphic service of about 30 hours.

The igniting device of the motor is electrical and operated by accumulators charged automatically from the exciting dynamo of the alternator.

The balloon is pulled in by means of a conical friction coupling, easily engaging and disengaging, and causing, by means of a chain transmission, a cable drum on the external side of the protective casing to rotate. A full supply of accessories and reserve parts is located in the tool box fixed outside of the cart, the side walls of which contain in addition the two counterweights as well as bars supporting the latter.



Power Cart.



Apparatus Cart.

PORTABLE SPACE-TELEGRAPH STATION FOR MILITARY PURPOSES.

The apparatus cart, separated into two compartments by a frame, contains both the sending and receiving apparatus. In the front part, protected against contacts, are located the high-tension instruments, comprising the induction coil, a battery of Leyden jars with adjustable spark gaps and the high-tension transformer. By means of a removable trap on the side wall an easy access is secured so as to allow of the Leyden jars being exchanged and the spark-gap regulated readily. In the back part is placed on the wagon platform the Morse key. On a board supported by strong springs, as shown, there are two receiving apparatus and a Morse recorder, while on the table of the latter the smaller receiving transformer is located. On the frame separating the two parts of the car are arranged the large receiving transformer, the receiving plug as well as a counterweight switch with two levers. On one of the side walls there is the acoustic apparatus, comprising an electrolytic detector and a telephone, while on the door an easily removable alarm bell has been placed. These instruments have been so installed as to allow of the upper part being removed without withdrawing any connection. The accumulator necessary for lighting purposes is placed in a protecting box installed at the left-hand outer side.

The utensil car contains the gas reservoir and the necessary trenching tools as well as the balloon and a reserve benzine reservoir. The gas recipients are built direct into the car and have each a capacity of about five cubic meters at a pressure of 120 atmospheres, two reservoirs being sufficient for filling the balloon.

The same outfit has been used in connection with the Gordon Bennett cup races for signaling the progress of the automobiles from one point of the racecourse to another. A. G.

Utilization of Electric Power in Italy.

In a recent report on the industrial development of Italy, Mr. A. Percy Bennett, commercial attache to the British embassy at Rome, points out the remarkable increase in the utilization of electric power in Italy since 1890. Today, he says, electricity in Italy provides a total motive force of over 200,000 horsepower, while in 1890 (although there were no statistics of small plants at that date) it is improbable that the total electrical energy available exceeded 20,000 horsepower.

Milan alone disposes of 20,000 horsepower, and the large new hydro-electric station at Vizzola, near Milan, distributes 18,000 horsepower to various points in the provinces of Milan and Como. Other stations of importance in Lombardy are those of Calvagese, Varese and Campodolcino. In Piedmont four plants belonging to the Societa Alta Italia were erected between 1890 and 1901 at Lanzo, Bussoleno, Stambinello and Germagnano, generating a total force of 12,000 horsepower. Other important plants erected since 1890

are those of Cossogno, in the province of Novara and of the Company Casalese in the province of Alessandria. Further, in Lombardy and Piedmont, especially in the provinces of Turin, Novara, Bergamo, Brescia and Como numerous plants have been erected which distribute a total motive force of over 5,000 horsepower. The central station at Genoa generates and distributes over 8,000, and those of Rome and Naples over 10,000 horsepower, respectively. The new plant at Cellina will shortly be in a position to distribute a motive force of about 18,000 horsepower to the provinces of Udine, Treviso and Venice. In Umbria there are two big plants utilized by local factories distributing over 15,000 horsepower.

In 1890 electric traction was only utilized on the Florence-Fiesole line; today, in addition to the complete urban and suburban lines at Milan, Naples, Rome, Genoa, Florence, Leghorn, Palermo, Perugia and Varese there are the electric lines of Milan-Monza, Milan-Gallarate-Varese, Lecce-Colico, Terni-Collestatte, Lecce-San Cataldo, and some few lines on the Italian Riviera. In the aggregate there are over 500 kilometers of railway in Italy served by electricity. In 1890 there were about 400 communes in Italy either partially or totally lighted by electricity. Today electric light is general in at least 600 communes. The development of the application of electricity to industrial purposes in Italy is very marked, and with a continued adaptation of the waterpower with which the country is so richly provided, greater progress in this direction may be confidently anticipated.

Steinmetz's Phase Transformer.

A method for transforming an alternating-current system comprising polyphase electromotive forces of any given number and phase relation into a different system where the phase relation of the electromotive forces corresponds to that desired has been patented by Charles P. Steinmetz. There is an almost endless variety of phase transformations rendered practicable by the invention, but two-phase and three-phase translating devices are the ones most commonly employed, the transformation from quarter-phase to three-phaze, or vice versa, presents the greatest practical importance.

Figs. 1 and 2 are diagrams illustrating the conversion of three forces 120 degrees apart into two forces 90 degrees apart, or vice versa.

Let (a) (b) (c) Fig. 1 represent the three electromotive forces of such a system displaced 120 degrees in phase and of equal voltage and further assume that it is desired to transform these electromotive forces into other forces corresponding in angular relation to the vertical and horizontal lines (x x) (x' x'). On the diagram the vertical and horizontal vectors (a') (a^2) (b') (b^2) are drawn, into which the forces (a) (b), respectively, may be resolved, while (c) may in like manner be regarded as the resultant or equivalent of a vertical vector equal in length to the line (c) and a zero horizontal vector. Now combine the forces (a) (b) (c) in values and directions corresponding to the vertical vectors and the resultant will be found to be an electromotive force in the direction of (x x). To represent this, there are laid off on lines (a) (b) lengths equal, respectively, to (a') (b'), and by completing the parallelogram a resultant (e) is secured. When (c) and (c) are then combined, after reversing one of them—for example (c)—to correspond with the different directions of the vectors (a') (b'), a resultant (c) is obtained in the direction of line (x x) equal in value to the sum of (e) and (c). This is one of the electromotive forces of the required quarter-phase system, and, as already pointed out, has been secured by combining the forces in values and directions proportional to the vertical vectors. To secure the second electromotive force of the desired quarter-phase system, lay off on line (a) a length equal in value to the horizontal component (a^2) and lead off on (b) when reversed (since it will be observed that the vectors (a^2) (b^2) are in opposite directions) a length equal to (b^2). By completing this parallelogram, as shown in the figure, a second resultant is secured in the direction of line (x' x') of equal value to the resultant in the direction of line (x x) and at right angles. From this it will be clear that the initial forces have been combined in a manner corresponding, respectively, to the vertical and horizontal vectors given by the parallelogram of forces drawn to represent the transformation desired, the result being two electromotive forces having the required phase difference.

Fig. 2 is a second diagram, representing exactly the same method of phase transformation and differing only from Fig. 1 in showing each of the three initial electromotive forces resolved into components instead of two only, as before. In other words, in Fig. 2 neither of the original phases are assumed to correspond in direction with either of the required new phases.

In the invention transformers or compensators are used for combining the electromotive forces in the manner pointed out, since the turns of the transformer windings can readily be proportioned so as to secure electromotive forces of the different phases having the necessary relative values, and the directions of the transformer windings can be reversed when necessary, so that the electromotive forces combined may correspond not only in value but in direction with the vectors in the parallelogram. In many cases, however, other forms of apparatus may be employed. One suitable arrangement of transformers is shown in Fig. 3 for effecting the phase transformation corresponding to Fig. 1. The mains of a six-wire three-phase system having independent circuits are represented by (1) (2) (3) (4) (5) (6), of which (1) and (2) con-

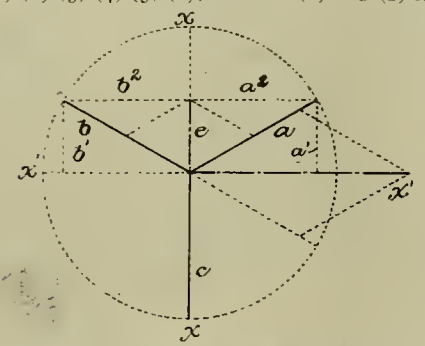


FIG. 1. STEINMETZ'S PHASE TRANSFORMERS.—THREE ELECTROMOTIVE FORCES DISPLACED 120°.

stitute one circuit, (3) and (4) a second circuit, and (5) and (6) the third circuit. Two transformers with independent magnetic circuits are represented by (T T'). Transformer (T) has three primary coils (C) (C') (C^2), whose turns are proportioned so as to correspond, respectively, with the lines (c) (a') (b'), Fig. 1. The coil (C) is reversed relatively to the other two in order that its electromotive force and the resultant of that due to coils (C') (C^2) may act in the same direction. The reason for this reversal will be apparent from what has already been said in connection with the diagram, Fig. 1. The three coils are coupled to the circuit mains, as shown in the diagram, so that each receives an electromotive force displaced 120 degrees from either of the others. The secondary coil (C^3) of the transformer is connected to mains

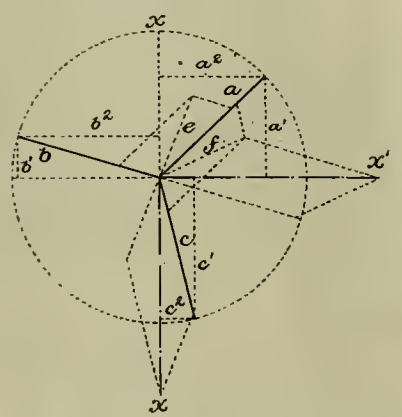


FIG. 2. STEINMETZ'S PHASE TRANSFORMERS —THREE ELECTROMOTIVE FORCES RESOLVED INTO COMPONENTS.

(7) and (8), forming one branch of a quarter-phase system. Transformer (T') has two primary coils (C^3) (C^4) whose turns are proportioned to correspond with lines (a^2) (b^2), Fig. 1, and coil (C^4) is reversed in direction. Coil (C^3) is connected to the same branch of the circuit as coil (C') of transformer (T) and coil (C^4) to the same branch as coil (C^2). The secondary coil (C^5) of this transformer has its terminals connected to mains (9) (10), forming the second branch of a quarter-phase system, or one terminal of the coil may be connected to the main (7), as indicated in dotted lines, in which case the main (9) is unnecessary, since (7) will serve as a common return. With this arrangement the conditions correspond with the diagram Fig. 1 in all respects. The three electromotive forces induced by the coils (C) (C') (C^2) correspond in value and direction with the vectors (c) (a') (b'), and hence when combined they will give rise to a resultant magnetization in the transformer core, and consequently to a secondary electromotive force in coil (C^5), represented in the diagram Fig. 1 by line (x x). The electromotive forces induced by coils (C^3) (C^4) similarly correspond in direction and value with the vectors (a^2) (b^2), Fig. 1, and hence the magnetic phase and secondary electromotive force induced in the

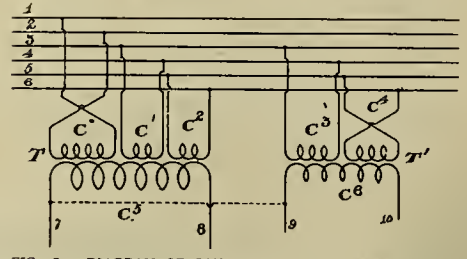


FIG. 3. DIAGRAM OF CONNECTIONS FOR PHASE TRANSFORMERS.

coil (C^5) correspond to line (x' x'), or, in other words, the electromotive forces in circuit (7) (8) (9) (10) differ by 90 degrees. The primary and secondary windings will also be so proportioned in any given installation as to give the desired transformation of potential between the primary and secondary sides as well as the transformation of phase.

Fig. 4 shows another form of invention designed to illustrate the use of compensators and also to show that it is not essential for all of the original phases to be transformed or combined. In this figure it is assumed that electromotive forces are maintained between the mains (1) (2) and (2) (3) 60 degrees displaced in phase—as, for example, by connecting the mains to what is known as a "monocyclic" generator. A compensating coil (R) has one terminal connected to main (1), while its other terminal leads to the main (4), forming the

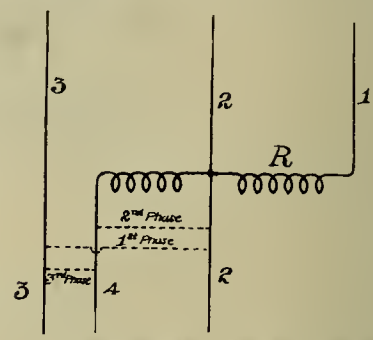


FIG. 4. COMPENSATORS USED IN PHASE TRANSFORMERS.

secondary or transformer system, together with the mains (3) and (2). The main (2) is connected to a central point in the compensator coil.

Several other arrangements embodying the same principles described are explained by Mr. Steinmetz in his patent, which is assigned to the General Electric Company.

Boston Entertainment for Foreign Electrical Engineers.

At a recent meeting in the office of President Charles L. Edgar of the Edison Electric Illuminating Company of Boston, men identified with Boston's electrical and commercial interests arranged for the entertainment, while they are in Boston, of the electrical engineers from abroad who will attend the International Electrical Congress at St. Louis. They will land in Boston on September 2d, arriving on the steamship Republic, and the party, including families and secretaries, will number about 250, it is understood. A reception at the Hotel Vendome is to be given in their honor, and Saturday, September 3d, will be a day of sightseeing, with open doors to all the electrical plants of importance in Boston and vicinity. The local reception committee comprises Charles L. Edgar, president; Charles B. Burleigh, secretary; President Charles W. Eliot of Harvard University; President Henry S. Pritchett of the Massachusetts Institute of Technology; Major-general William A. Bancroft, president of the Boston Elevated Railway Company; General Charles H. Taylor; Frederick P. Fish, president of the American Bell Telephone Company; Professor Elihu Thomson; P. F. Sullivan, president of the Boston and Northern Railway Company; C. A. Adams, C. F. Ames, James I. Ayer, Forrest E. Barker, Louis Bell, H. E. Clifford, Charles B. Davis, Louis Duncan, R. L. Warner, Thomas C. Wales, C. S. Sargent, C. H. Hodgkinson, Sidney Hosmer, Henry P. Walcott, Hammond V. Hayes, Ira N. Hollis; A. E. Kennelly, George H. Lyman, Edward B. Pillsbury, W. L. Puffer, and Thomas Sherwin.

Liquid-expansion Electric Meter.

Electric meters which depend for their operation on the expansion of a volume of gas which is heated by means of a coil through which the current to be measured is passed are not unknown. In some maximum-demand meters a suitable liquid acts as a seal, preventing the escape of the gas, and the heating of the bulb by means of a coil carrying the current to be measured expands the gas. These applications have been based on the principle of forming a trap which catches the liquid that overflows when the bulb is warmed by the current. A new form of this class of meter has been patented by an Italian engineer, Carlo Clerici of Milan, in the operation of which the liquid forms a continuous column and is never parted by the action of the current into two separate bodies. The meter may be used as an ammeter, a voltmeter, both for direct reading and as a maximum-demand indicator, the latter being the use for which the device is best adapted.

Fig. 4 is a diagrammatic sketch of a device embodying the principle on which the new meter is based, while Figs. 1 and 2 show different forms in which the invention may be practically carried into effect.

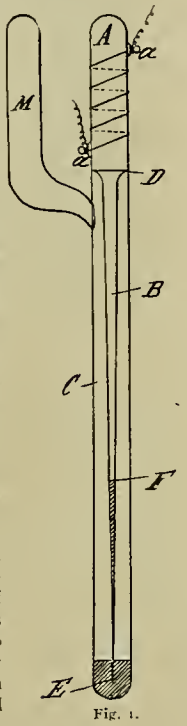


Fig. 1.

According to Fig. 4, (A) is a glass bulb connected with a tube (B), tapering downward, whose lower end enters another bulb (C) containing a suitable (not too volatile) liquid, but not filled completely. Tube (B) and bulb (C) are welded together at (D). The open end (E) of tube (B) dips into the liquid. On tube (A) being heated, the gas contained therein expands and finds its way out the orifice (E), rising in bubbles through the liquid. On (A) being allowed to cool, the equilibrium will be restored as soon as a quantity of liquid proportional to the quantity of gas driven out from (A), and therefore to the whole quantity of heat received by (A), has risen along the tube (B) up to the level (F).

Fig. 2 shows a modified form of the same apparatus, according to which the difficulty of welding the tube to the bulb is done away with. According to Fig. 2, the bulb is substituted by a tube surrounding the thin tube (B) throughout and welded to the tube (A) at (D).

The working of the apparatus is the same as already described with reference to Fig. 4. The position of point (F) is of course to be ascertained by means of a suitable scale.

The apparatus may be employed as an ammeter if the coil (a a) be inserted in series into the circuit through which the current to be measured flows. It will, on the contrary, work as a voltmeter on coil (a a) being shunted between two points of a circuit whose potential difference is to be ascertained. In both cases the apparatus will act as a maximum indicator, as the liquid column risen up to (F) within the tube (B) will not sink on the current lessening gradually or suddenly or being entirely turned off. The instrument may nevertheless be also employed as a direct-reading ammeter or voltmeter if the tube (B) be allowed to fill with liquid and the sinking of the liquid within it be measured while the current is on.

To reset the instrument, (A) must be heated so as to drive out the whole liquid from the tube (B). The instrument is then turned upside down, so as to cause orifice (E) to emerge from the liquid, which will collect at the part which is at the top when the instrument is in its normal working position.

Fig. 3 shows a more complete form of the instrument mounted on a wood tablet (Q) and provided with a scale (R), having in its middle a slot into which a mirror (S) is inserted to facilitate the correct reading of the height of the liquid column. Two brass hoops (l) secure the ends of the heating coil to both ends of the bulb (A).

According to Fig. 1, the tube (C) is connected with an expansion chamber (M), intended to compensate for the differences of temperature of the ambient air, especially in the case of the instrument being inclosed in a box, as is usually the case when employed to prevent the surreptitious addition of lamps by the consumer.

The instrument may also be fitted with a cut-out switch to allow of the reading when the current is on, which is by far the most seldom case, as the instrument will find its chief employment in lighting plants, and the reading will have to take place during the day.

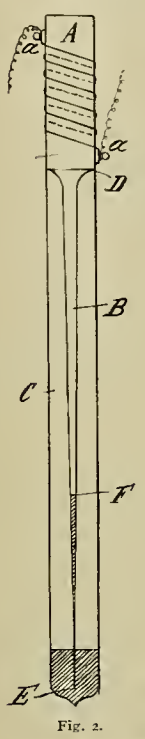


Fig. 2.

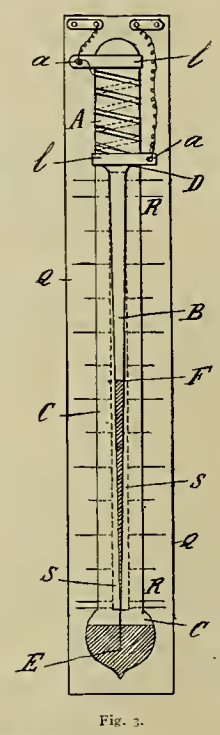


Fig. 3.

Fig. 4.

LIQUID-EXPANSION METER.

New York Central Contemplates Further Electrical Equipment.

Reports are current that the New York Central railroad in furtherance of its plans ultimately to electrically equip that part of its system between New York and Buffalo, contemplates the displacement of steam as a motive power between Canastota and Rochester.

Under the plans now receiving the consideration of the railroad officials there is to be no alteration in the route, as the changes are to be confined to preparing the roadway for the new rolling stock and the provision of electric motors of the newest design, similar to those to be used on other portions of the New York Central system. The Auburn branch of the Central from Syracuse to Rochester may also be transformed into an electric road.

W. J. Wilgus, fifth vice-president of the New York Central system, is quoted as saying:

"We are considering the subject of electric installation for our roads, and changes in the motive power are under serious consideration and have been for some time. The recent improvement in electric locomotives is of such convincing nature that we felt impelled to see in what manner it could be applied to our properties. So in a very broad and general way we began our investigations. I am not at liberty to designate any particular part of our system on which the changes now in contemplation are to be made, except on the New York city terminals, the plans for which have already been made public.

"Our reasons for seeking to make a change are purely business ones. We wish to give our patrons the best service possible, and wherever we find it advisable to establish an electric system we will do so. We hope to give better train service, with more frequent and speedy trains, and do away altogether with the dangers and annoyances of smoky engines."

Self-regulating Transformer Litigation.

The Westinghouse Electric and Manufacturing Company has been granted a preliminary injunction directed against the Montgomery Electric Light and Power Company in the self-regulating transformer case. The patent involved in the suit is No. 469,809, granted to William Stanley, Jr., dated March 1, 1892, for improvements in systems of electric distribution. Judge Coxe of the United States Supreme Court, Northern District of New York, in his opinion, says that the "essence of the invention is the length of the wire on the primary coil and not the instrument or method by which that length is determined." It is not pretended that the length of wire on the defendant's coil was ascertained by an application in each instance of the Stanley rule, but it is established that the length required by that rule is, approximately, used by the defendant. The defendant's transformers are automatically self-regulating and are shown to have substantially the same length of wire measured in feet as the complainant's transformer.

Continuing, Judge Coxe says: "Stanley made a valuable invention. The patent describes the invention with sufficient clearness to enable skilled electricians to practice it without difficulty. The defendant has appropriated the invention, although its transformers were not designed in the manner pointed out by Stanley."

"Stanley's contribution to the art should be judged by the conditions existing when he made his invention over 18 years ago. It is unfair to belittle that invention by comparing his crude recommendations with the scientific methods which have been discovered since that time. His invention remains unchanged, but experience has substituted improved methods of carrying it out. The defendant uses transformers constructed by the improved methods, but they are none the less the transformers invented by Stanley."

What Is the Nature of Electricity?

What electricity really is, whether it is a form of matter or simply a stress in the ether, is a question upon which scientists are still divided. Albert G. Whitney, in a contribution to the Chicago Daily News, upholds the theory that electricity is matter, and makes some interesting if not entirely conclusive comments on the subject.

"Electricity," says Mr. Whitney, "has an inclination of gravity; the inclination of the gravity of electricity is distinct from and independent of the gravity of the earth's mass. How are the last two propositions determined? In the same manner as science has clearly determined that water has an inclination of gravity; that its inclination of gravity is upon the same lines of inclination as all the other constituent elements of the earth's mass, and hence dependent upon the same center of gravity as the others. If electricity were no more than 'a strain,' 'a force,' 'an energy,' the force of gravity could not exist within it, nor would there be manifestations of gravity therein. The appearance of the force of gravity in a metal does not differ from its appearance in a gas. The force of gravity only exists in matter."

"Electricity is made to do work within the earth's mass on its hasty flight therethrough because mankind has learned how to harness the force of gravity within its substance. The gravity of electricity obviously is independent of the earth's gravity, because the substance—electricity—will not combine with or stop an instant in or incline the least fraction of a degree with any of the elements of the earth's mass."

It is further stated that "electricity is an entity of the ether; it manifests the existence of the force of gravity within it; it passes freely from interplanetary space to the earth's mass into interplanetary space again. The hasty passage of electricity through all the known substances of the earth's mass does not afford to mankind, with mankind's present knowledge, sufficient opportunity for an analysis of its substance; but, by reason of its gravity, mankind may know that it is a form of some kind of matter. Electricity, in all respects excepting its clear manifestations of the force of gravity within it, is yet practically an entire stranger to science."

Architects for United Engineering Building.

The conference committee of the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, the American Institute of Mining Engineers and the Engineers' Club, appointed to select architects for the United Engineering Building in New York city, in carrying out the wishes of Andrew Carnegie, whose gift of $1,500,000 makes possible the building of this structure, announces that the successful competitor for the United Engineering Building is Mr. Herbert D. Hale of Boston, with Henry G. Morse of New York as associate architect. Mr. Hale is a grandson of Edward Everett Hale. The successful competitors for the Engineers' Club are Whitfield & King of New York city. These selections were made by the committee with the assistance of Prof. W. R. Ware as expert adviser.

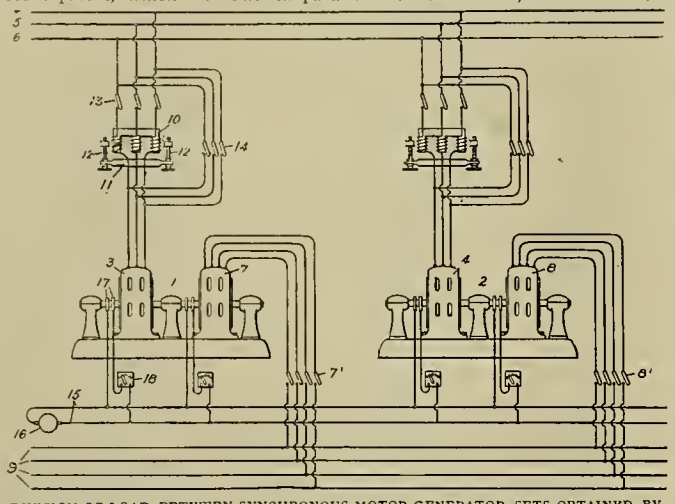
The United Engineering Building will occupy land 125 feet front by 100 feet on West Thirty-ninth Street, while the club, with a frontage of 50 feet and a depth of 100 feet, will face on Bryant Park and the new Public Library. The United Engineering Building, aside from quarters for the three national engineering societies named, as well as other societies enabled to participate in the accommodations, will have several fine auditoriums and a magnificent library. The club building will be about 11½ stories high, with the usual accommodations of a club and some 60 or 70 bedrooms for members.

Electric Elevated Railway in Havana.

An electric elevated railway has recently been constructed in Havana, Cuba, by the Havana Electric Railway Company. The line connects the Lug Street surface line with that of O'Reilly Street along the harbor front. The immense amount of street traffic at this place, along the wharves, made an elevated structure necessary. The entire structure is 1,800 feet in length. This important part of the city was without any street-car service before the elevated structure was built. The parts were all designed and built in this country.

Division of Load Between Synchronous Motor-generator Sets Obtained by Reactances.

One of the drawbacks to the operation of synchronous motor-generator sets is the difficulty in obtaining a uniform division of load between the motors, the corresponding elements of which are connected in parallel. By a synchronous motor-generator set is meant a synchronous alternating-current motor having its rotating member geared to the rotating member of an alternating-current generator. In case one motor-generator set is operating under considerable load and a second set is connected in parallel with it, the latter will frequently refuse to take its share of the load, and manipulation of the field rheostats of the motors or generators fails to help the matter in any way. Jonathan E. Woodbridge of Albany, N. Y., in a recent patent, which he has assigned to the General Electric Company, proposes to effect the desired division of load by inserting more or less reactance in one or both of the motor circuits. If the reactance be in the circuit of the motor of the unloaded motor-generator set, this set may be caused to take up its share of the load by cutting out the reactance either gradually or suddenly, so that the motor is caused to run a little in advance, urging forward the generator coupled to it, and thus causing it to take up its load, the effect being similar to that produced by opening wider the throttle of a steam engine driving an alternating-current generator in parallel with other generators. The increased power supplied causes an increase in the load carried by the generator.



DIVISION OF LOAD BETWEEN SYNCHRONOUS MOTOR-GENERATOR SETS OBTAINED BY REACTANCES.

In the accompanying diagram are represented two motor-generator sets, (1) and (2), the motor elements of which consist of three-phase synchronous motors (3) and (4) connected in parallel with each other across the three-phase supply mains (4) (5) and (6). The two-phase alternating-current generators (7) and (8) are coupled, respectively, to the driving motors, being in turn connected in parallel with each other across the mains (9) of a two-phase alternating-current distribution system. Although the driving motors are shown as of the three-phase type and the generators corresponding of the two-phase type, it will be obvious that the number of phases of the motors and generators may be anything desired, and may be either alike for the motors and generators or different, as indicated in the diagram.

In series with the supply leads of each of the motor-generator sets is connected a reactive coil, which is preferably adjustable for the purpose of regulating the division of load between the generators of the two sets. The particular means for furnishing reactance to the leads of the motors may assume a wide variety of forms. In the diagram is shown but one of the numerous arrangements which may be used. In this case the three-phase leads are supplied, respectively, with three windings mounted upon the corresponding branches of a three-legged core (10), the magnetic circuits of which are adapted to be closed or opened to a greater or less extent by means of an armature (11), adjustable, by means of screws (12), toward or away from the main core (10). A set of switches (13) serves to close the supply circuits of the motor through the windings of the reactive coil. Another set of switches (14) serves to close the circuit from the supply mains (4) (5) and (6), directly to the motor (3), short-circuiting the reactance coils, which may be completely cut out of circuit by then opening the switches (13).

The motor (4) of the motor-generator set (2) may have its leads supplied with reactance coils and controlling switches of the same description as that set forth in connection with the motor (3) of the set (1). This arrangement is indicated at the upper right-hand portion of the drawing.

The direct-current field windings of the motor-generator sets may receive their current from any suitable source, as from a pair of direct-current bus bars (15), supplied with current from a direct-current generator (16). The leads extending from these bus bars convey current to the rotating field magnets of the machines through collector rings (17), the intensity of current being adjusted by means of a rheostat.

When it is desired to put a motor-generator set into operation with another set already under load the reactance in the leads of the motor of the latter set is either cut out or reduced to the lowest possible limit, this operation being performed either by means of the switches (14), which cut the reactance out of circuit, or by means of the adjustable armature of the reactance coil. The motor-generator set which is to be thrown into parallel with the one under load is started up, so that its motor element is being driven from the source of current supply, while its generator element remains disconnected from the consumption circuit. The reactance of the newly started machine is then increased to such a value as to bring the generator element exactly in phase with that of the machine running loaded on minimum or no reactance. The two generator elements are then thrown in parallel with each other, after which the reactance of the newly started machine is either gradually or suddenly reduced to such an extent as to make the generator pick up its proper share of the load. As the reactance is cut out of the leads of a newly started motor-generator set the generator element is shifted forward in phase, and thereupon commences to pick up its load, the extent to which the load is added being determined by the adjustment of the reactance in the circuits of the driving motor.

In cutting out any machine the reverse operation may be performed. The reactance in circuit with the machine to be cut out is therefore increased to such an extent that the generator element no longer carries any part of the load, after which the whole set may be out of circuit without any disturbance of the system.

First Dynamo Described in a United States Patent.

The earliest United States patent on electric generators was issued on March 30, 1852, under the title "Electric Whaling Apparatus." The apparatus was the invention of Dr. Albert Sonnenburg and Philip Rechten of Bremen, Germany, says the Scientific American. The invention provided a means for capturing whales "by the application of electric galvanic current conveyed by a conductor to the instrument commonly called 'whale iron,' or 'harpoon,' and which is used to be thrown into the fish." The current was produced by means of a "magnetoelectric rotation machine." The inventors describe their generator as a machine containing "four or more horizontal permanently fixed boat magnets placed opposite each other, which produce the electric current in four or any other convenient number of inductors. The inductors are attached to a rotation axle by a cross, a disk, arms or other means well known in the construction of magnetoelectric machinery and get their rotation before the magnetic poles by means of a crank or other suitable gearing. Through a commutator on the axle on which slides a strong steel spring in the shape of a fork, the counteracting currents in the wires on the inductors are thrown into one and the same direction." The current was conducted to the harpoon head by a "gilt copper wire covered with india rubber, and thus completely isolated from salt water." On harpooning a whale the machine was operated, generating a current which flowed through the animal, the circuit being completed through the sea water to the copper bottom of the boat and thence to the dynamo. As to the power of this machine, the inventors claimed that the whale received "about eight tremendous strokes at each turning of the machine handle. If only two turns be made each second, she receives 960 strokes each minute—so formidable a power that no living being can resist the same." In order to reassure the operator of so deadly a machine the inventors state that "there is no possible personal danger in using our machine or apparatus, except the man who throws the whale iron take the metallic part of it into one hand and put the other hand at the same time into the sea when the machine is in motion. But such a position is not to be assumed, as it cannot take place except intentionally." The patent also contains some interesting advice in regard to the proper care of the machine. "If good care be taken of the apparatus, there is no wearing it out; only keep the wet out and do not let it be thrown about or be roughly handled. Should the machine refuse its wonted effect, examine whether the inductors be too remote from their magnets. The distance between the inductors and their magnets should be such that a French playing card can be put between them. Examine whether the steel spring on the commutator be in such a condition that intensive sparks appear when the machine is in motion; if not, regulate it by the small screws connected with the same."

When Is a Storage Battery Fully Charged?

[From the Question Box of the National Electric Light Association.]

QUESTION.

How can one tell when a storage battery is fully charged?

ANSWERS.

B. A. Schak, Kalispell, Mont.: A battery may be considered completely charged when, with constant current flowing, the voltage reading has remained steady for a period of not less than 15 minutes.

A Peters, Excelsior Springs, Mo.: When the current is constant and the electromotive force of each cell ceases to rise; also when the specific gravity of electrolyte ceases to rise.

S. C. H., New York Edison Company: First, when the specific gravity ceases to rise; second, when the voltage curve becomes flat; third, when both oxygen and hydrogen gases are given off when charged at the normal rate. Upon the method of operation depends the use of one or all of the above methods.

Edison Electric Illuminating Company of Boston: The surest way to tell when a storage battery is fully charged is by watching the voltage of a number of cells that have been in circuit during the whole charge. Near the end of charge the voltage rises very quickly, until it reaches a point where it rises very little. About 15 minutes after this point is reached the battery will be fully charged. It is necessary, especially for the last half hour, to keep the charging current constant, because otherwise the voltage readings will vary with the current. When recording voltmeters are in use with the battery the point of the end of charge is easily found. If it is possible to take specific-gravity reading on pilot cells, the end of charge will be indicated when the density of the acid reaches the same point that it reached at the end of the last preceding charge.

F. M. Farmer, New York city: When the voltage has risen to about 2.5 volts per cell, or ceases to increase after another half hour of charging. Also by vigorous boiling and gassing of the electrolyte, the bubbles giving a sharp explosion if a lighted match is applied to them

Electric Storage Battery Company, Philadelphia: A storage battery may be considered as fully charged when the voltage and specific gravity of the electrolyte cease rising during a period of one-half hour, the battery being charged at its normal, or eight-hour rate.

Charles H. Peters, Durango, Colo.: Roughly speaking, when electrolyte boils.

Ernest Lunn, Chicago Edison Company: In general, a battery may be said to be fully charged if while the normal charging current is passing through the cells the specific gravity of the electrolyte ceases to rise. The recording voltmeter curve also furnishes a very reliable means for indicating the time to cut the battery off charge, as the curve ceases to rise and begins to run straight at about the same time that the specific gravity stops rising.

G. Wilbur Hubley, Louisville, Ky.: By indications of voltmeters, testing the specific gravity of the electrolyte, or by noticing when the point of "boiling" of the electrolyte is reached.

Street Railway Traffic in St. Louis Increasing.

Nearly 15,000,000 more passengers were carried by the St. Louis Transit Company during the three months which ended June 30, 1904, than during the first quarter of the year. The figures also exceed by 12,000,000 the second quarter of 1903. The quarterly report of the company, filed with City Register Fitzgibbons, shows that during the months of April, May and June there were made 1,551,168 trips by the company, upon which were carried 50,027,717 passengers. During the same period of 1903 there were 1,367,454 trips made and 38,421,172 passengers carried. Last year a law was passed requiring daily instead of quarterly reports from street-railway companies, and providing that the companies pay car licenses at the rate of one mill for each passenger carried. Upon this basis the company would have to pay the city $50,027 for the quarter just ended. The street-car companies are fighting the law in court and have obtained a temporary order restraining the city from enforcing it.

The Seattle Electric Company of Seattle, Wash., has concluded to abandon carrying liability insurance and will hereafter assume its own risks. The condition of the company's property has been brought up to a high standard, and every step has been taken to avert the possibility of accidents.

Electric Lighthouse at Heligoland.

The large lighthouse at Heligoland, in which arc lamps are used, occupies one of the most important points on the German coast at the entrance to the Elbe on which is the port of Hamburg. Fig. 1 shows this lighthouse at night. The height of the light above high-water mark is 270 feet. The installation is one of the largest in the world, the total light emitted being about 30,000,000 candlepower, and the duration of the flash about one-tenth of a second. The flashes follow one another at intervals of five seconds. These results are obtained by erecting three reflectors, placed at angles of 120 degrees on a rotating platform, the reflectors being 30 inches in diam-

FIG. 1. ELECTRIC LIGHTHOUSE AT HELIGOLAND. —THE LIGHTHOUSE AT NIGHT.

eter and of paraboloidal form, with a focal length of something less than 10 inches. The lamps are supplied with direct current, each taking 34 amperes. The platform makes four revolutions a minute, and the crater of the positive carbon has a diameter of 9.7 millimeters.

Below the center of the platform are arranged six mercury contacts for conveying current to the lamps and the motor driving the platform. These mercury contacts consist of iron ring-shaped basins containing mercury, insulated from one another by mica. Into these mercury basins dip switches, which are mounted on a rotating slab, are connected to terminals leading to the various parts of the machinery. The arc

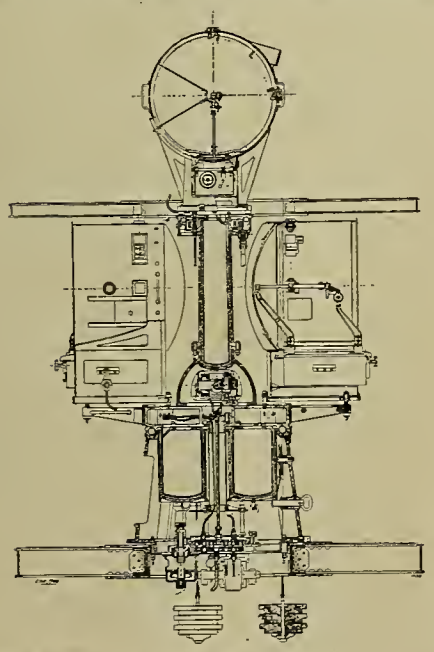


FIG. 2. SECTIONAL VIEW OF LIGHTHOUSE LAMPS AND MECHANISM AT HELIGOLAND.

must always be kept in the focus of the reflector. For this purpose small mirrors and lenses are mounted by which an image of the arc is thrown on pieces of opal glass, which are mounted on the case of the reflector. On these opal glasses are vertical and horizontal marks, and the position of the arc has to be so adjusted that the horizontal line passes through the center of both carbons and the vertical line through the tip of the positive crater. When this adjustment is made, it is known that the arc is in the focus of the paraboloidal reflector. For purposes of adjustment the lamp can be moved bodily in the direction of the axis of the reflector, the positive carbon can be moved both vertically and horizontally, and the negative carbon is capable of vertical motion. The carbons are placed horizontally in the optical axis of the reflector, and the lamps employed are of the ordinary shunt type, made by Schuckert. A general view of the optical apparatus is given in Fig. 2.

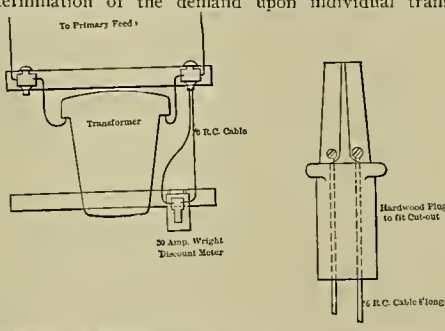
The whole of the switching arrangements are made in a room immediately below the lantern. Current is brought from a small station, distant about 220 yards. The machines are two steam dynamos, giving 216 amperes at from 65 to 75 volts. One of these machines is used as a spare in case of need. The makers carried out tests at their works in order to see that the lamps complied with the specification, which was to the effect that the minimum light emitted was to be 30,000,000 Hefner candles. It was found that with a voltage of 45, a mean candlepower of 34,000,000 was obtained with 26 amperes supplied to each lamp, the maximum of 11 readings being over 39,000,000. With 34 amperes a maximum of nearly 43,000,000 was obtained at the works at Nuremberg, and on the sea coast, with a clearer atmosphere, better results than this were to be expected. The readings were taken at a distance of 1,450 yards with a Weber photometer.

As for the construction of the reflector, by drawing a curve showing the intensity of emission in various directions from the crater of the arc and placing the crater in the focus of the parabola, it is found that a reflector having a diameter equal to three times its focal length would collect practically all the light and convert it into a beam consisting of parallel rays. If the crater of the arc was a mathematical point the emitted beam would consist of parallel rays; but seeing this is not the case the rays have a slight divergence. In the case of the Heligoland lighthouse the angle of the cone so formed is two degrees 14 minutes.

The foregoing facts are taken from the Electrical Magazine of London and are based on an article by O. Krell in the Elektrotechnische Zeitschrift of Berlin.

Method of Determining the Demand Upon Individual Transformers.

George S. Haley of Rutland, Vt., in the "wrinkles" department of the last National Electric Light Association meeting, gives a simple method for the determination of the demand upon individual trans-



METHOD OF DETERMINING THE DEMAND UPON INDIVIDUAL TRANSFORMERS.

formers. Mr. Haley's description of his apparatus is as follows:

"It is ofttimes necessary to know the amount of current that a certain transformer is called upon by the lamps or other apparatus to deliver. The easiest way to obtain this is to measure the primary current passing to the transformer. The accompanying sketch and short description following will give an idea of a simple arrangement that makes testing transformers very easy indeed.

"We are using the insulator-type, primary cut-out, manufactured by the General Electric Company. A duplicate plug was made of hard wood, with an extended handle six inches long and two inches in diameter. Two of the brass clips from an old plug were placed upon the wooden one, and through two holes in the handle, two No. 6 rubber-covered cables were connected to said clips. These cables are about eight feet long and connected to a 30-ampere Wright discount ammeter, which is mounted upon a board about eight by 12 inches. Upon the back of the board are two pieces of wrought iron of suitable size to hook over an ordinary cross-arm.

"To test a transformer, it is only necessary to place the ammeter upon a convenient cross-arm, pull out the plug in one of the transformer cut-outs and insert the plug upon the end of the cable. We usually leave it in service for two nights, and then remove it to some other transformer."

Electric Oven for Chemists.

Chemists in evaporating solutions of various kinds often desire a heat of constant temperature—more constant than can be obtained from a direct-heated plate when the gas pressure changes. A contributor to the Cement and Engineering News describes an oven for this purpose which is heated by incandescent lamps. This oven has among its advantages cleanliness, durability and evenness of temperature. By its use analyses may be started in the evening and the solutions left to evaporate during the night. The oven consists of a copper box 35 inches long, 4½ inches deep and five inches wide. The cover is made to fit the top of the oven closely, and may be arranged to be held in place with bolts. The apparatus stands on six iron legs. This enables the operator to turn on or off any lamps desired. Sockets should be soldered firmly in place. The lamps are connected in parallel, and the circuit equipped with a cut-out switch.

In the usual construction seven 32-candlepower lamps are employed. The cover, which fits tightly on the oven, has six holes 3¾ inches in diameter. These holes are placed midway between adjacent lamps. Lids can be made to close the openings of the oven, an opening being cut in the lid two inches in diameter, which fits a 250-cubic-centimeter Jena beaker. If only three or four solutions are to be evaporated, only four or five lamps need be operated; the rest of the openings can be covered with a circular plate.

Western Electrician's Register at the World's Fair.

Among those recently registered at the booth of the Western Electrician at the Fair are: J. S. Riddle, Barnesville, Ohio; J. A. Brite, Bowie, Texas; H. T. Matthews, Bowie, Texas; W. J. English, New York; M. A. Miner, North Platte, Neb.; Luiz F. Braga, Rio De Jamias, Brazil; Allen M. Rossman, Ithaca, N. Y.; J. O. Taylor, Champaign, Ill.; W. L. Hanson, Chicago, Ill.; C. F. Presscott, San Bernardino, Cal.; W. H. Raven, Chicago, Ill.; Geo. R. Houston, Elyria, Ohio; Otto C. Miller, Los Angeles, Cal.; C. A. Nickerson, St. Louis; E. L. Furniss, Denver, Colo.; M. Alan Humtle, Lancaster, Pa. (Yale '06); J. H. Thomas, West Chester, Pa. (Yale '04); J. B. Reeves, Griffin, Ga.; L. A. McKee, Chicago, Ill.; Jas. R. Biggar, New Orleans, La.; J. R. Abner, Albuquerque, N. M.; M. Mintz, Inside Inn; Prof. J. C. Kelsey, Lafayette, Ind., Purdue University; John W. Early, Columbus, Neb.; Hugo Jone, city chemist, Chicago; Henrich Homberger, Abner Doble Company, San Francisco, Cal.; J. W. Pullman, Greenville, Mich.; Fly Johnson, Fort Worth, Texas; T. E. Ballenger, Tishomingo, Ind. Ter.; A. M. Foreman, Paducah, Ky.; Harlan H. Stead, St. Joseph, Mo.; P. Baner, St. Louis, Mo.; J. P. O'Shee, Montreal, Canada; E. W. Kinney, Schenectady, N. Y.; W. E. Keily, Western Electrician, Chicago; Mrs. W. E. Keily, Chicago; Mildred Keily, Chicago; R. A. Heim, Denver, Colo.; C. J. Kennedy, Chicago, Ill.; J. F. Rolfes, Springfield, Ohio; W. J. Gilsdorf, Toledo, Ohio; W. C. Hixson, Oakland City, Ind.; H. W. Warmer, Muncie, Ind.; Eugene Smith, Buffalo, N. Y.; Gordon H. McCormick, Buffalo, N. Y.; H. J. Kusel, Chicago, Ill.; Henry Braun, Allegheny, Pa.; J. Lawrence Hagy, Electric Storage Battery Company, Philadelphia, Pa.; F. H. Blackburn, Fostoria Incandescent Lamp Company, Fostoria, Ohio; Louis J. Bohn, Lawrence, Kan.; C. E. Delafield, Wagner Electric Manufacturing Company, St. Louis; Irving Ingraham, Ingraham & Barnes, St. Louis; Geo. S. Bowen, Elgin, Ill.; E. P. Riviere, New Orleans, La.; F. Trumbull, Plainville, Conn.; A. V. Chisholm, St. Louis; Dr. H. Gradte, Chicago, Ill.

Interurban Railways Prosperous in Iowa.

The interurban railway business in Iowa has been profitable beyond the expectations of the early promoters. The reports recently made to the state executive council show that the interurban railway line between Des Moines and Colfax, 23.41 miles in length, made a net profit last year of $33,277. The Waterloo and Cedar Falls line, 31.2 miles in length, reported a net profit of $36,114. The Mason City and Clear Lake line, only 14 miles in length, cleared $10,468. The state executive council last year valued the Waterloo and Cedar Falls line at $10,000 per mile, making its total valuation about $312,000, which was much in excess of actual cost of building; upon this valuation, however, the net income of $36,114 represents an earning capacity of 10.2 per cent. The Colfax interurban line is also valued at about $10,000 per mile, and its net profits represent a return of nearly 15 per cent.

The following are the reported income and expenditures of Iowa's four interurbans. Cedar Rapids and Marion—Income, $33,265.22; expenses, $17,302.09; net profits, $15,963.13. Interurban Railway (Colfax)—Income, $68,638.78; expenses, $35,360.81; net profits, $33,277.97. Mason City and Clear Lake—Income, $40,995.94; expenses, $30,527.54; net profits, $10,468.40. Waterloo and Cedar Falls—Income, $85,544.61; expenses, $49,430.43; net profits, $36,114.18.

According to an agreement arrived at between German, Belgian and English manufacturers of steel rails, in regard to general export trade, English mills are to furnish 56 per cent. of the foreign orders received, while those of Belgium and Germany will supply together the remaining 44 per cent. "Is this an indication that the iron and steel interests of Europe are to combine in order to compete more successfully with those of the United States in the export trade?" asks Mr. Brainard H. Warner, Jr., United States consul at Leipsic. In 1902 Germany's exports of steel rails were valued at 35,127,000 marks ($8,360,226), of which 8,272,000 marks ($1,968,736) worth were shipped to the United States. The amount was even larger in 1903. The prospects are that the exports of German steel rails will fall off considerably this year, as the United States and Canada have ceased to purchase entirely, while Mexico, Great Britain, Holland and Japan have bought in much smaller quantities than formerly.

WESTERN ELECTRICIAN

EVERY SATURDAY.

PUBLICATION OFFICES:
510 Marquette Building, • CHICAGO.
TELEPHONE MAIN 1746.

Eastern Office, 193 Times Building, New York.
Telephone, 3806J Cortlandt.

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted. This paper is entered at the Chicago postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the old address as well as the new should be given.

CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—**the only general electrical paper published in the West**—thoroughly covers a territory *exclusively its own*. THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be furnished on application.

REMITTANCES.—All checks, drafts and other remittances should be made payable to the order of the publishers, the **Electrician Publishing Company**, and addressed to the offices of publication, Suite 510, Marquette Building, (204 Dearborn Street), Chicago, Illinois, U. S. A.

CONTENTS OF THIS NUMBER.

Portable Space-telegraph Stations for Military Purposes. Illustrated 57
Utilization of Electric Power in Italy 57, 58
Steinmetz's Phase Transformers. Illustrated 58
Boston Entertainment for Foreign Electrical Engineers .. 58
Liquid-expansion Electric Meter. Illustrated 59
New York Central Contemplates Further Electrical Equipment 59
Self-regulating Transformer Litigation 59
What Is the Nature of Electricity? 59
Architects for United Engineering Building 59
Electric Elevated Railway in Havana 59
Division of Load Between Synchronous Motor-generator Sets Obtained by Reactances. Illustrated 60
First Dynamo Described in a United States Patent 60
When Is a Storage Battery Fully Charged? (National Electric Light Association) 60
Street-railway Traffic in St. Louis Increasing 60
Electric Lighthouse at Heligoland. Illustrated 61
Method of Determining the Demand Upon Individual Transformers 61
Electric Oven for Chemists 61
Western Electrician's Register at the World's Fair 61
Interurban Railways Prosperous in Iowa 61
Editorial 62
Tendencies in Sub-station Design. By Howard S. Knowlton 63, 64
Important Changes in Stanley Company's Organization .. 64
The Power Plant of the Tall Office Building. By James Hollis Wells. (American Society of Mechanical Engineers and Institution of Mechanical Engineers) 64, 65
Street-car Fares in Australia 65
Corporation Telephones 66, 67
New Long-distance Trunk Line 67
Extensions and Improvements 67
Telephone News from the Northwest 67
Ohio Telephone Notes 67
Michigan Telephone Matters 67, 68
Southeastern Telephone Developments 68
Telephone Men 68
Electromagnetic Track Brakes. Illustrated 68
Book Table. Kellogg's Uses of Electricity on Shipboard. 68
Recent Live-wire Testing Devices. Illustrated 68, 69

DEPARTMENTS.

Correspondence 69, 70, 71
Great Britain 69
New York 69
New England 69, 70
Michigan 70
Ohio 70
Indiana 70
Dominion of Canada 70, 71
Texas and Mexico 71
Pacific Slope 71
Personal 71
Electric Lighting 72
Electric Railways 72
Societies and Schools 72
Publications 72
Miscellaneous 72
Trade News 73
Business 73
Illustrated Electrical Patent Record 73, 74

DATES AHEAD.

Ohio Electric Light Association (annual convention), Sandusky, August 16th to 18th.
International Electrical Congress, Hall of Congresses, St. Louis Exposition, September 12th to 17th.
International Association of Municipal Electricians (annual meeting), St. Louis, September 13th and 14th.
American Electrotherapeutic Association (annual convention), St. Louis, September 13th to 16th.
National Electrical Contractors' Association (annual convention), St. Louis, September 14th to 16th.

RADIUM, and the phenomena which attend it, we are inclined to look upon as mysterious and as unrelated in any way to other phenomena with which we are more or less familiar. That there is anything revolutionary in the recent discoveries concerning this new element is denied, by Prof. Robert A. Millikan of Chicago University. "Radium is an element not greatly different from all others," said Prof. Millikan in a recent lecture. "Its activity is not an isolated phenomenon. It fits into the orderly scheme of scientific knowledge and supplements established theories, but does not destroy them. The shooting off of particles from radium is correlated with other phenomena of physics. It is analogous to the exploding of stellar systems, which astronomers tell us constantly is occurring. The rate of the breaking up of the atoms—one out of one hundred billion a second—is no greater relatively than that of the disintegration of stars."

VISITORS to the Louisiana Purchase Exposition at St. Louis who are interested in electricity or electrical literature are cordially invited to call at the booth of the Western Electrician, which is in Block 1 (Section 13) of the Palace of Electricity, just west of the main northern entrance to the building. Here will be found copies of the current issue of the paper, bound volumes of the Western Electrician from the first number, a careful selection of electrical books exhibited by the Electrician Publishing Company, and other objects of electrical interest. Chairs are provided for weary sight-seers, and an attendant will extend a hearty welcome to all readers or friends of the paper.

A RECENT editorial comment in an English technical journal upon the meeting of the National Electric Light Association held in Boston last May contains this statement: "The association is representative of the electricity supply interests of the United States and may be compared in some ways with our I. M. E. A., save that it is not purely municipal in tone." To say that this association is not "purely" municipal in tone indicates a mistaken impression on the part of our esteemed contemporary and perhaps is a view commonly held in that country. The National Electric Light Association is, and always was, the exponent of all that is in direct opposition to municipal ownership of electric-lighting utilities. Its members are composed largely of men who represent the great industrial electric-lighting undertakings all over the United States, and to say that the association is in any way connected with municipal ownership, as implied by the statement, "not purely municipal," is in opposition to the principles of its organization.

WHEN space telegraphy first began to attract serious attention, like all other new things, it found many sanguine supporters. These adherents of the new method of communication were at once ready to predict that space telegraphy would soon displace the present aerial and submarine telegraph cables. It seemed to them but a natural sequence that the new art, being founded on scientific principles, would at once extend its field of operation and with the mere perfection of details open up a new era in telegraphic communication. These views are still held by some, but there seems to be little fear among the owners and promoters of telegraph and cable systems that such a state of affairs will ever exist. Indeed, unusual activity seems to be evident in the extension of submarine cables. Only recently has the second cable been laid between the United States and Germany, and now German and Dutch capitalists have formed a syndicate to meet the expense of laying a new cable to connect the German and Dutch possessions in the Far East, and also to link these possessions with the American cable at the island of Guam in the Pacific Ocean. In the face of these new enterprises, and with already existing cable and telegraph systems making a complete girdle of the earth, it does not seem probable that space telegraphy will ever become a serious competitor of the old and tried method of communication by wire.

ONE of the explanations often made to the public by telephone companies about to institute an increase in rates is that an increase of business means a still greater increase in operating expenses, necessitating an advance in the charge for service. To those not familiar with the apparatus and working of a large telephone exchange this seems to be an evasive statement, and it is immediately questioned by the customers of the company. "Why," they say, "could not the telephone company's arguments be offered with equal truth by the grocer?" "But the grocer charges no more for flour when he sells 20 barrels a day than when he sells only 10." This argument would be to the point if conditions were the same with the grocer and the telephone company; but they are not. As the business of the grocer increases his income increases in direct proportion to the cost of his stock. With the telephone company this is not the case. In a large telephone exchange one of the most costly parts of the equipment is the multiple jacks and their associated cabling. In a multiple switchboard the number of multiple jacks, and consequently the cost of this part of the equipment, increases, not in direct proportion to, but as the square of the number of subscribers. Suppose 200 new subscribers are to be added to the exchange. This means a new section with 200 answering jacks and 200 extra multiple jacks. But the expense does not end there, for on back through the board in each of the previously equipped sections must be added 200 multiple jacks. The number of jacks therefore amounts to enormous proportions as subscribers are added. For instance, a multiple board having a capacity of 6,000 lines, divided into, say, 30 sections of 200 lines each, would have 6,000 multiple jacks on each section, or 180,000 in all, whereas the first section installed in the exchange with 200 subscribers connected would require only 200 multiple jacks. A single strip of 20 of these jacks costs several dollars for its manufacture alone, to say nothing of installation and the necessary wiring; therefore, it is not surprising that as a telephone exchange grows that the cost of connecting each new subscriber increases far out of proportion to the receipts accruing to the telephone company, and that rates must be increased to cover the greater expense.

ONE of the most important fields opening up for the introduction and extension of the electrical industry in almost all its branches is that of the South African countries, and it is one which is well worthy of being closely watched by American manufacturers and exporters in these particular lines. A short time ago an electric central station was opened at Cape Town. At the opening ceremony attention was called to the abnormal increase in the consumption of electrical energy in that city, where the demands for private lighting purposes have increased to 37 times their original volume, while further growth and prosperity were assured. This showing is not abnormal as applied in general to the industry in South Africa. Indeed, the general adoption of electricity throughout South Africa is one of the most remarkable features of that country's development. It is shown by the success of her electrical enterprises, and still more by their constant expansion. In the growth and installation of street-car and lighting installations in so many centers, the formation of larger and still more comprehensive schemes, and in the eulogistic opinions expressed by those who have thoroughly studied the situation, we have proof of the forward tendencies in this direction. All this has been accomplished under what have really constituted most adverse conditions, when all classes of industry were still suffering from the effects of a long and peculiarly destructive war, and the whole country was being held back to a great extent by the subsequent unsettled conditions. The growth of the electrical enterprise in the past, great as it has been, is therefore but a poor criterion of the dimensions to which this industry will attain in the future.

In the past South Africa has offered an ample market for all forms of electrical plants, in which the United States has but sparingly participated. The volume of the demand has yet to be met, and it is this which will so richly repay any effort that may be made on the part of American houses to secure it to themselves. Electric traction has already sprung into remarkable prominence. Many are the schemes now under consideration, or already pigeonholed, awaiting only favorable conditions to bring them to fruition. Johannesburg is one of the latest examples in this respect, and it has been stated that next year will see the start of her electric-railway system. The progress made in the past—progress, moreover, opposed by so many difficulties—the peculiar conditions and requirements of the country, coupled with the present favorable position for growth and development, and the unhesitating testimony of those whose training and practical experience render them exceptionally able and expert judges, point to the fact that the market South Africa will offer for electrical plant is, perhaps, of greater dimensions, of a more remunerative nature, and capable of more immediate development than that of any other market in the world.

Tendencies in Sub-station Design.

By Howard S. Knowlton.

The modern sub-station for the transformation and distribution of electrical energy represents one of the most interesting later developments in the field of power transmission. Its relations to both the generating plant and the distributing system make it an important link in the chain of operations which attends the utilization of electricity over wide areas and upon a large scale. Although the sub-station has been in familiar use among electrical engineers for something like 15 years, it cannot be said with truth that its design has in any sense remained stationary during this period. In fact, one cannot visit a number of such stations without noting radical differences in the construction and arrangement of both buildings and apparatus. In spite of these departures from uniformity, however, certain tendencies in sub-station design can be seen in most installations of recent date, and it seems profitable at the present time to collect some of these indications of progress and bind them together for criticism.

Without high-voltage transmission for power, railway or lighting purposes the sub-station would be an economic impossibility. It owes its life more to the polyphase alternating-current system than to any other single factor in electrical development. Its future depends also upon the alternating current, particularly with reference to the passing of the rotary converter from the electric-railway field through the conquest of the direct-current motor by the alternating machine. As far as can be foreseen at present, however, the sub-station in the form of at least a transformer house will probably remain a permanent feature of electrical engineering methods.

Much attention has been paid of late to the betterment of the conditions under which the life of workmen is spent throughout all civilized countries. Gradually the sub-station has come to feel the effects of this movement, so that the best practice of today provides sanitary and comfortable living arrangements for the men whose days, and often nights, are devoted to keeping electrical machinery at the point of continuous and efficient operation. It is by no means uncommon to find sub-stations practically unprovided with wholesome water supply and without even the most elementary approved sanitary arrangements, but in all installations which are designed upon the basis of good practice these essential points are not neglected. Often a sub-station is located in regions remote from the convenience of cities and towns upon some dismal swamp or desolate plain in order to be near the electrical center of distribution in interurban railway work. Anything which can be done to make the sub-station more healthful—more attractive as a working place—means that a better class of attendants can be secured to live in the out-of-the-way places, and therefore is an insurance against operating disasters, which cannot be guaranteed by inferior labor.

Continuity of service is the very lifeblood of profits in electrical systems, and it is economy to spend a great deal of money to secure it. The practice of combining the attendant's home with the sub-station has found considerable favor in America. When pleasant and convenient quarters are provided for an operator's family close by his daily work, there is much less tendency for overtime duties to be slighted, and no small foundation secured for the employe's contentment. It is sometimes well worth while to locate a sub-station at some place a little off the center of distribution if the advantages of a locality from the standpoint of the attendant are considered. At all events, it is becoming much more generally the custom for designing engineers to realize that the attendant is to live on the spot where the station is to be built and accordingly to make the utmost provision for his comfort and convenience that a reasonable expenditure of capital can insure.

Following the matter a step further, it is far better to secure good attendance in sub-station practice and pay attractive wages than to entrust the operation of valuable machinery and apparatus to poorly trained and incompetent hands at low wages. The casual visitor to a sub-station goes away with the impression that the attendants have an easy time of it, and that perhaps ordinary qualifications are sufficient for successful operation. There could be no greater mistake, for, when emergencies arise, and they are certain to come sometime, the quality of attendance assumes an importance that is literally tremendous. An underpaid attendant of indifferent ability can wreak untold harm to the business of a company in such times of crisis. Instances have occurred too often in which even trained engineers have made mistakes in throwing switches, which resulted in heavy financial loss, not only through damages to machinery but also through the loss of revenue which accompanies a shutdown. Perhaps the foregoing remarks verge more upon the operating side of sub-station work than upon the constructional aspects of it, but operation and design are so intimately related that the writer feels the digression will be pardoned.

In all high-voltage plants the fire risk is a very serious question. The increasing use of pressures ranging from 20,000 to 40,000, and even 60,000 volts, is rapidly condemning the use of wooden buildings for sub-stations which are exposed to the vagaries of such high-tension current. Brick and concrete construction are the order of the day in this class of work. The most direct wiring is absolutely essential to safety at these pressures. Low-tension wiring may be safely run in more devious paths, but the course of the high-voltage current must be made as short and straight as human ingenuity can devise, and this fact is now generally recognized in all new and standard construction, if we may call "standard construction" that which represents the safest and most economical solution of the problems in hand. This does not mean that all new sub-stations are built according to approved ideas, however, for the exceptions are numerous and unfortunate.

Not long ago the writer visited a sub-station supposed to represent the latest type of correct design, and found that the high-tension wires were run through a special brick chimney only 18 inches wide from the top to the bottom of the building. It is easy to imagine the anxiety and discomfort of the unfortunate attendant whose duty calls him to crawl through this rathole of a conduit in case of trouble, particularly if leanness of body does not happen to be one of his physical characteristics. To be sure, the potential at this station is but 2,200 volts and cannot rightly be called very high, but its dangerous possibilities to human life are serious enough, and as the intention is ultimately to raise the voltage to 26,000, it is not an easy matter to praise the aforesaid chimney construction.

The supply of a liberal amount of daylight is now given due attention in modern design. The vast majority of sub-stations are located in places where sunlight and fresh air are available in quantities limited only by the climate of the region, and there is little excuse for dark rooms in such buildings. In the rotary-transformer room of a new sub-station the writer recently counted no less than 16 large windows, the room being about 35 feet long, 31 feet wide and 19 feet high. Not only is the work of attendants greatly facilitated by such liberal illumination, but the wasting of current for daytime incandescent-lamp operation is prevented, resulting in a money saving at the end of a year which is worth having. Sometimes in localities where power is cheap, as in mountain hydraulic plants, incandescent lamps will be carelessly run in the daytime both indoors and out. There is nothing to recommend this practice, as lamps deteriorate with use, even if the cost of power be low. This fault is particularly frequent in the surface districts of mining camps.

In dealing with the transmission of high-potential currents one of the most important means of obtaining continuous service consists of carrying the line through the country in as direct a route as possible. Bends and curves are good things to avoid. For this reason it is sometimes well to locate a sub-station on the outskirts of its distributing district in order that the main transmission line shall not be swerved from its course and subjected to the hazard of curved construction, guys, etc. The low-tension feeders in such a case amount to more in first cost than if the sub-station were located at the center of distribution, but the shortened length and reduced maintenance of the main transmission line warrant this method of construction.

Modern designs of high-voltage sub-stations demand that extraordinary precautions be placed at the entrance of the line into the building. The separation of the different wires of each phase is carried out to spacings of seven or eight feet with very high potentials, and the same type of insulators recommended for both inside and outside high-pressure wiring. Great care is necessary to prevent the entrance of moisture through the apertures in the wall which carry the wires into the building. In some localities a glass window of ample thickness and surface dimensions may be the best solution of the problem; in other cases the best plan is to bring the wires into the building by an upward slant, avoiding all contact between successive insulators. The 2,200-volt sub-station previously mentioned employed porcelain tubes for traversing the walls, the bricks being painted with asphaltum for a considerable area adjacent to the entering points of the wires.

Lightning arresters are placed in good practice so that a short length of non-inductive wire can be readily grounded on the further side of the air-gaps. In climates which permit, the fire hazard is reduced by replacing the arresters outside the sub-station building, but where an inside situation is necessary the designer taps the high-tension lines as close to the entering point as possible. Wooden floors are often encountered in sub-stations, and it cannot be said that good practice forbids their installation, but too much care cannot be taken inside such plants to avoid any possible contact of power circuits with any form of combustible material. One often finds great carelessness in the use of incandescent lamp cord, such as hanging it upon sharp edges of metal work. It is worth while to remark the increasing use of chemical fire extinguishers in all sorts of electric plants, the placing of sand buckets, asbestos or woolen blankets in accessible situations, etc. The use of water to put out sub-station fires is generally objectionable, unless such fires are located at a safe distance from apparatus and wiring. Recently the question of placing transformers in or over special pits which prevent the leakage of oil upon the floor in case of short-circuits or other troubles has been taken up by manufacturing companies. It is probable that sub-stations will be equipped with this improvement in the future, and, in fact, instances of the practice are now in operation.

Sub-stations in which there is likely to be considerable handling of machine parts and supplies are now generally equipped with some form of traveling crane. Unless the sub-station is very large, however, there will not be work enough to justify the expense of installing a power-driven crane, but a hand hoist which can travel the length of the machinery room is most essential. Plenty of sub-stations are today trying to get along by rigging blocks and tackle arrangements upon the girders and beams of the building, but this is an inconvenient scheme at best.

Sub-station wiring depends much upon the local circumstances of each particular installation, considerable latitude being permissible in carrying out details. As a general plan, it is a good idea to bring separate lines entering the station to their own high-voltage bus bars so that they may be operated independently. Each high-tension bus is then connected to the proper primary winding of a group of transformers. Knife switches and also oil switches or an approved form of high-tension circuit-breaker are usually connected between the lightning arresters and the transformer primaries, the advantage of the double breaking of the circuit being considerable in case the attendants desire to make repairs upon the switches. Sometimes it is feasible to dispense with the knife switches, but the additional safety which they afford generally warrants their use. The use of fuses in high-tension circuits is growing less and less in favor. An oil or plunger switch is a pretty reliable piece of apparatus, particularly if an overload relay is provided to open the circuit promptly in case of trouble. In large installations these overload relays are frequently fitted with "time-element" apparatus which allows temporary overloads to occur on the lines and apparatus without breaking the connections, and consequently interrupting the service to an undesirable degree.

Transformer secondaries may or may not be connected to common bus bars, according to local conditions. If the sub-station load is handled by rotary converters supplying railway lines with current, the rotaries can be readily supplied from independent high-tension lines which are not operating in synchronism, which allows feeding each sub-station from different groups of generators at the main plant, or even from different generating plants. It is, of course, necessary for primary lines to be operated in synchronism when the secondary leads are connected to a common set of bus bars. The crowding and crossing of low-tension cables should be avoided, but wide separation of opposite polarities is not essential if suitable insulation is employed.

The installation of single-pole main switches in each phase of the alternating circuits is not now considered as good practice as the combination of such switches in triple or quadruple pole units. In operating with very high voltages the closing of high-tension switches upon transformers subjects them to heavy strains of potential—a state of things which can generally be avoided by switching in the secondary windings if the common bus bars are already supplied from another set of transformers. In cases where there is but a single set of transformers in the sub-station, it is sometimes good practice to have the high-tension line connected permanently with the primaries of the transformers. The sub-

division of bus bars is a matter requiring the experienced judgment of an expert. Generally speaking, the smaller a sub-station, the less justification there is for multiplying the switchboard arrangements.

As for switchboard instruments, each phase of the alternating circuits should be provided with an ammeter. A high-tension voltmeter is likewise important, and should be arranged either to operate direct upon the high-voltage line or through a reducing transformer. In the latter event the voltmeter ought to be calibrated to read high-tension voltages, and not the secondary voltages of the reducing transformer. It is a pretty good plan to provide each entering high-tension line with a separate voltmeter. The power-factor indicator is now found on most new sub-station switchboards, but there is good ground to limit the equipment in this respect in cases where funds are limited. Indicating wattmeters are easily dispensed with also, but the direct-current output should always pass through recording wattmeters, preferably, with cyclometer dials. It is very important to be able to figure just what each unit of power output costs the sub-station, and unless direct-current wattmeters and alternating-current recorders are provided in each circuit which supplies that type of current to consumers, the results will be little more than financial guesswork. Standard practice equips each outgoing circuit with an ammeter and circuit-breaker also. For some time the positive and equalizing switches of the direct-current sides of rotaries or motor-generators have been mounted either upon the machine frame or a pedestal close by, relieving the main switchboard of much complication. Synchronizing indicators are now replacing the old forms of lamp synchronizing devices, which are so familiar in the earlier installations.

The keeping of accurate records and logs is an important phase of sub-station work. For this reason some kind of wall desk or table is now an almost indispensable feature of the equipment. The provision of proper blank forms for records is worthy of much attention by the management of power companies.

When all is said and done, in the matter of good sub-station design, it will be found that continuity of service and economy of operation are the determining factors of every new piece of work which is properly carried out. To this end simplicity and straightforwardness in arrangement are vital features in design. There should always be a definite and well-considered reason for the adoption of every added complication in wiring, apparatus and extra expenditure of money above the minimum which will supply continuous and reliable power. The appearance of the sub-station building should be on a par with the best structures of the operating company, and it will usually be found that a neat design is an efficient one. It is certain that finality in sub-station design has not yet been reached, but whatever the future characteristics of these secondary distributing plants may be, the factors of simple arrangement, safety to attendants and ease of operation will always be the mark of good engineering.

Important Changes in Stanley Company's Organization.

At a special meeting of the directors of the Stanley Electric Manufacturing Company, held July 12th, Dr. F. A. C. Perrine, first vice-president, and William W. Gamwell, treasurer, resigned their positions. The position vacated by Treasurer Gamwell remains unfilled, and the duties heretofore performed by him will be attended to by R. S. Murray, who has been in Mr. Gamwell's office during the last year. Cummings C. Chesney, chief electrical engineer, succeeds Dr. Perrine as first vice-president and general manager. Ex-Gov. W. Murray Crane retains the presidency of the Stanley company, and no other changes are contemplated for the present.

This step on the part of Dr. Perrine was taken in order to give him an opportunity to take up some business of his own and to do some engineering in the line of power-transmission work which he has for some time been contemplating.

The new directors and officers of the Lake Superior Corporation, who represent the financial institutions and capitalists who advanced the millions needed for the reorganization of the old Lake Superior Company, have returned from a tour of inspection of the properties of the concern, and express themselves as pleased with their condition and the future outlook of the corporation. The party spent nearly two weeks on its official inspection and carefully investigated every plant, the mines in the Mishipicoten district and the Algoma Central railway.

The Power Plant of the Tall Office Building.[1]

By James Hollis Wells.

Elevators.

Hitherto electric elevators have been but little used in tall buildings over 15 stories in height on account of the design not being suitable to high speed. When the speed exceeds 350 feet a minute, as it necessarily must in the higher buildings, hydraulic elevators running as fast as 600 feet per minute are preferable. Modern plants are installed with either triple-expansion or flywheel pumps, and one or more compound pumps in reserve. There are, however, no absolute rules that govern, as each case must be handled independently, the conditions carefully studied and experience is the chief guide. Tests are made, of course, before the building is finally accepted from the contractors, but these tests seldom tell anything final beyond that the plant is as designed and that it will do the work economically.

Each elevator is usually designed to carry safely 2,500 pounds exclusive of the weight of the car, and one car is arranged to carry safes usually weighing not more than four tons at a slow speed. This car should have specially designed pawling devices to hold the car in place at any floor. Vertical cylinders for hydraulic elevators are usually preferable to horizontal cylinders on account of having shorter cables. Cold rolled steel guides are better than planned, and, in fact, any device that gives smooth service is desirable.

It is a safe general proposition when a well-designed mechanical plant is installed to say that it costs less to operate an electric elevator than it does an hydraulic machine. Compound pumps generally require 70 pounds of steam per water horsepower-hour, triple-expansion pumps about 36 pounds and flywheel pumps slightly less.

High-speed, single-cylinder engines are guaranteed at 36 pounds of steam per horsepower-hour, compound engine 26 pounds, and steam-jacketed, four-valve compound engines 20 pounds. An average of 6½ water horsepower per car-mile per hour is required for hydraulic elevators, and for electric elevators an average of 3½ kilowatt-hours.

From this data it is easy to calculate the coal and water consumption, but of course there are many other items to take into account, and experience alone teaches the trained engineer just what these items are.

In many installations economical operation would be considerably increased by the use of a storage battery, in which case the engine load can be kept constantly at its full-load rating, which is its most economical producing point. Under these conditions the battery should be installed and connected in such a manner as to consume all the excess current, taking the peaks of the elevator-load requirements.

A double-pressure tank system may be installed. The usual practice is to carry low pressure in the tanks running from 150 to 175 pounds for low-pressure systems when the cars are few in number and centralized, and from 750 to 800 pounds when the plant is very large and scattered. A double-pressure system would be very much more economical to operate, the low-pressure tank operating under light-service conditions at a pressure of from 100 to 125 pounds, and the high-pressure tank under high-service conditions at a pressure of from 175 to 200 pounds, an elastic system adapting itself to the work to be done.

There is a great deal of controversy as to the number of elevators to be installed. It depends absolutely on the class of building and the nature of the business transacted therein and its location. Some engineers have compiled tables laying down specific floor areas to be served per elevator, but these rules do not always apply. The writer knows of one building having one elevator per 8,000 square feet of floor area which is under-elevatored, and of another close by with an elevator to each 16,000 square feet of floor area, which would have efficient service with fewer elevators.

Steam Plant.

The steam plant is a very large topic that cannot possibly be covered within the scope of this paper. The proper design of the steam plant is a matter of the utmost importance, as on it depends most of the economies of the tall buildings. It may be divided into two parts, the boiler plant with its accessories, including the power piping, and the heating and ventilating systems. These have all been fully described in books and papers written by most competent, experienced engineers, and in practice they agree generally. In designing the boiler plant it is customary to allow about 50 per cent. reserve over the estimated peak loads. A modern boiler plant is usually equipped with such requirements as will produce economy. Superheaters of sufficient capacity to allow the steam produced by the boilers to receive a superheat of from 75 degrees to 100 degrees Fahrenheit have been used with excellent results, and as a matter of course all pressure piping and valving should be designed accordingly. Much difficulty has been experienced in pressure piping by the use of the ordinary flanged joint with copper gaskets, but the writer has had very satisfactory results with Van Stone joints, or joints somewhat similar in design, for piping exceeding five inches in diameter.

To avoid vibration in the building the steam and exhaust piping has to be very carefully installed, and is usually supported from the floor of the engine room. The exhaust is carried above the roof and capped with a condenser head. This exhaust is connected into the heating system and also through the feed-water heater. All drips are carried back to a drip tank and pumped back to the boiler, with all returns through feed-water filters. The equipment consists of the boilers, feed-water heaters and pumps, filters, blow-off and drip tanks, house and fire pumps, back-pressure and reducing-pressure valves, hot-water meters, recording-pressure gauges, condensing and cooling coils, expansion and muffler tank, separators, pump governors, power, exhaust, heating and drip piping, engines and oiling systems, dynamos, ventilating, refrigerating, vacuum cleaning, electric wiring, switchboard, motors, plumbing and water supply, and a multitude of appurtenances, all of which have to be carefully designed and placed according to the requirements of the building and space to be occupied.

In estimating and proportioning heating surface the method commonly used is that prescribed by law by the German government in the design of heating plants in its public buildings, and is based on the loss in heat units per square foot of exposed surface transmitting heat to the outside air or buildings, as the case may be. On account of leakage it is also assumed that the air in the various rooms that are heated is changed once an hour, and that therefore a certain amount of heating surface is required to warm the air. Under certain conditions of location and exposure, and whether the building is to be heated continuously or intermittently, it is necessary to increase these estimates. In making the various increases the judgment and experience of the designing engineer must be used. In designing the mains and risers, supplying steam to the radiators the sizes of pipes are determined by the amount of condensation of the radiating surfaces and the velocity of the steam flowing through the pipes. In mains this velocity is assumed to be from 60 to 80 feet per second, and in risers from 25 to 50 feet per second.

The mains and risers are either a two-pipe system or a one-pipe overhead system, depending somewhat upon circumstances. Both systems have their advocates, but either, if properly designed, gives satisfactory results. An exhausting apparatus is often used in connection with the air lines, and the system is then run nearly at atmospheric pressure, thereby relieving the engines from back-pressure, a source of economy. It is a mistake, however, to reduce the size of the risers where it is intended to install this apparatus, for the heating system should be designed to work under gravity in case of the breakdown of the exhauster. There are several other devices of a similar sort often used, but the writer's experience with the straight-out gravity system has been most satisfactory. The other devices can be added, but the system will always work.

The artificial heating of a building is a problem which usually causes much thought and perplexity, and the solution is often very far from giving satisfaction. It seems to be simple enough in theory, but there are so many varying influences in practice to be guarded against that, however well arranged, no plans seem exactly to meet the conditions at all times. It is usually agreed in contracts for heating that the heating plant shall be capable of keeping the several apartments at a temperature of 70 degrees when the thermometer in the open air stands from zero to 10 degrees below. The apparatus, therefore, that fulfills this condition will be apt to overheat the rooms when the outside temperature is above the maximum, compelling the occupants to give strict and almost constant attention to the shutting off of the heat sources. Man is fallible, and often negligent; nerves and senses are slow to feel gradual changes in temperature until a degree is reached that is far from normal; consequently, rooms regulated by human hand are usually too hot or too cold, and often have sudden variations of from five to 10 degrees.

A cold wind will often make it extremely difficult to get one side of the building warm, while the others suffer from an excessive heat. Frequent and sudden variations in temperature, excessive heat alternating with chilling cold, are unhealthful and debilitating, and it is a well-known fact that a great deal of sickness is directly due to inefficient or absolute absence of control of the supply of artificial heat. In order to prevent such excessive variations, preserve a uniform temperature, to distribute the heat where and as it is wanted, and economize fuel by preventing waste of heat, heat regulation is often employed, and to get proper results the temperature of each room in the building is controlled independently of the others.

Such a system will insure a uniform and reasonable temperature at all times, never varying over one or two degrees, regardless of the variations of outside temperature and without any thought or attention whatever from the occupants, thereby decreasing the care and trouble incident to heating plants, entirely removing the necessity of opening or closing steam valves or registers and promoting health and comfort. By a simple device the degree at which regulation occurs can be varied, so that different rooms can be kept at different temperatures or changed

1. Abstract of a paper read before the joint meeting of the American Society of Mechanical Engineers and the Institution of Mechanical Engineers of Great Britain in Chicago, June 2, 1904.

as frequently as desired. By the same system, where air for ventilating purposes is supplied by a fan system, this air can be kept uniform and at any temperature desired.

There seems to be a general complaint that office buildings are, as a rule, too hot for the personal comfort of the occupants, and the reason is simply that on account of the necessity of having to supply radiators large enough to meet the maximum requirements, and the inattention that is usually given to such radiators, it is only natural that such results should follow, because the occupants are usually busy with their regular duties and the attention is not called to the overheating of the rooms' until the temperature has reached a most uncomfortable point. Then the heat is shut off and the reverse takes place for the same reasons. It is usually customary to open the windows in order to reduce the heat, and perhaps to a certain extent to regulate it by admitting cooler air from the outside. This, of course, results in draughts, which are not only disagreeable but dangerous to health. It is no uncommon sight in moderate weather to observe that a very large per cent. of the windows in office buildings are opened in the attempt to overcome the disagreeable condition incident to the heating plant, thus demonstrating the necessity of some method of regulating the temperature.

It is an almost self-evident proposition in the case of tall buildings that, where the heat sources are controlled by a thermostatic system, at least 50 per cent. of the offices will have their heat shut off most of the time, which is proof that a reduction or saving of that amount of heat will be effected. As it is usually customary to heat such buildings with the exhaust steam from the engines used for the electric or elevator plants, little actual saving in the cost of heat can be effected. This, however, would be quite an item if the steam was generated directly for heating purposes. The amount of saving in the cost of heating perhaps should not be considered as important as the health and comfort of persons renting the various offices, and for whose comfort the owners of buildings usually furnish such modern improvements as will render them desirable for occupancy and keep them fully occupied.

Artificial ventilation by means of fans electrically driven is often used on the lower stories. One tall building recently erected in New York has every room heated and ventilated by means of an indirect system operated by fans. This is an extraordinary case, however; it is usually impracticable on account of the cost of installation and the amount of room taken up by the fans, heaters and ducts. In the New York Stock Exchange the air is warmed in winter, and by means of an immense refrigerating plant cooled in summer. These are all special methods, however, and the great bulk of the heating is done by the direct method; that is, radiators under windows in the rooms.

In many buildings there are refrigerating plants installed both for cooling the drinking water and for making ice, which is sold to the tenants.

Cleaning systems have recently come into use and have given much satisfaction. These are air systems operating either under vacuum or compression.

Electric Plant and Wiring.

The engineer who is at the head of this department has his work cut out for him. It is the most complex and difficult portion of the design and requires a large amount of technical education and experience. Practice changes continually, and the science has advanced so rapidly that an up-to-date electrical engineer has to give more time to his profession than does the engineer in any other deoartment. In laying this portion of the work before you the writer will take a specific case which will illustrate the method of design. Let it be understood, however, that the figures used are an average and that they are the results of tests and records made in perhaps 50 of the tall buildings in New York city. The building in question is designed for banking rooms on the first and second floors and above offices. Three boilers of 350 horsepower each are located in the cellar and the plant in the basement. The electric portion of this plant consists of two 125-kilowatt, one 100-kilowatt, and one 50-kilowatt generators, two fan motors of 15 horsepower each, and engine plant of sufficient horsepower to operate the entire electric installation. These engines will be of the four-valve tandem compound type and the dynamos direct-current 120-volt machines. The total floor area to be lighted is 196,700 square feet, and taking the average rate at one light for each 37 square feet of floor area, the number of lights as laid out on the plans is 5,316 plus 250 lights allowed for decorative effect in banking rooms, the total number of lights to be wired for is 5,566. From experience we find the average working loads to be as follows:

	Per Centage of Total.	Lights, K. W.	Power, K. W.	Total, K. W.	Operating Plant, K. W.
Absolute peak load	70	214	20	234	0.016
Average peak and running load for dark days	60	184	20	203	0.008 and 0.01
Average peak load for 8 months	30	92	20	112	0.008
Average day load for 8 months	30	92	20	112	0.008
Average day load for 6 months	20	62	20	82	0.01
Average low load for 12 months	16	49	20	69	0.01
Average nights, Sundays and holidays				50	0.02

In addition to the above there is usually an increase of 10 per cent. over the above running loads on account of the desires of tenants. Under ordinary conditions it is customary to allow 1.6 horsepower in engine for each kilowatt output of the generator and 1.8 horsepower in boilers for each kilowatt in generators. Therefore, in practice we select the following main plant, which is elastic in its working and will take care of the following conditions:

(1) Maximum load 70 per cent. of the total connected load plus 10 per cent.—257 kilowatts.

(2) Average load 30 per cent. of the total connected load plus 10 per cent.—123 kilowatts.

To operate, therefore, under these conditions, we have selected the following plant:

Two generators of 125 kilowatts capacity each, either of which will carry the average peak running load, or both connected in multiple will carry the absolute peak loads which are on for short isolated periods only.

One generator of 100 kilowatts capacity to carry early-running and low-average loads for 12 months.

One generator of 50 kilowatts capacity as an auxiliary unit for nights, holidays, Sundays and odd times.

Not only will this plant fulfill these conditions, but by means of the various combinations which may be made, conditions between these averages may be satisfied economically. The cost of operating this electric plant may be estimated from the following table, allowing in addition thereto for motor operation 304 days at 10 hours per day and 20 kilowatts per hour, amounting to 60,800 kilowatt-hours per year:

Table Showing Kilowatt-hours of Lighting Load.

Winter Schedule:

Months.	Days.	Sundays.	Holidays.	Working Days.	7 A. M. to 8 A. M. Per Cent. Load.	7 A. M. to 8 A. M. Equivalent K.W.	7 A. M. to 8 A. M. No. Hours.	7 A. M. to 8 A. M. Total K. W. Hours.	8 A. M. to 3 P. M. Per Cent. Load.	8 A. M. to 3 P. M. Equivalent K.W.	8 A. M. to 3 P. M. No. Hours.	8 A. M. to 3 P. M. Total K.W. Hours.	3 P. M. to 6 P. M. Per Cent. Load.	3 P. M. to 6 P. M. Equivalent K.W.	3 P. M. to 6 P. M. No. Hours.	3 P. M. to 6 P. M. Total K.W. Hours.	6 P. M. to 7 P. M. Per Cent. Load.	6 P. M. to 7 P. M. Equivalent K.W.	6 P. M. to 7 P. M. No. Hours.	6 P. M. to 7 P. M. Total K.W. Hours.	Total K.W. Hours Per Month.
January	31	4	1	26	20	61	1	1,586	25	76	7	13,832	60	183	3	14,274	50	153	1	3,978	33,670
February	28	4	2	22	18	55	1	1,210	24	74	7	11,396	50	153	3	10,098	40	122	1	2,684	25,388
March	31	4	0	27	17	52	1	1,404	23	70	7	13,230	33	101	3	8,181	20	61	1	1,647	24,462
October	31	4	0	27	17	52	1	1,404	24	74	7	13,986	34	104	3	8,424	21	64	1	1,728	25,542
November	30	4	2	24	10	58	1	1,392	30	92	7	15,456	60	183	3	13,176	50	153	1	3,672	33,696
December	31	5	1	25	21	64	1	1,600	34	104	7	18,200	70	214	3	16,050	60	183	1	4,575	40,425

Summer Schedule:

					7 A. M. to 8 A. M.				8 A. M. to 4 P. M.				4 P. M. to 6 P. M.				6 P. M. to 7 P. M.				
April	30	5	0	25	14	43	1	1,075	21	64	8	12,800	30	91	2	4,550	20	61	1	1,525	19,950
May	31	4	1	26	14	43	1	1,101	19	58	8	12,064	29	89	2	4,628	19	58	1	1,508	19,301
June	30	4	0	26	11	33	1	858	18	55	8	11,440	28	86	2	4,472	18	55	1	1,430	18,200
July	31	5	1	25	10	30	1	750	17	52	8	10,400	27	83	2	4,150	17	52	1	1,300	16,600
August	31	4	0	27	10	30	1	810	17	52	8	11,232	27	83	2	4,482	17	52	1	1,404	17,928
September	30	5	1	24	12	37	1	888	19	58	8	11,136	29	89	2	4,272	19	58	1	1,392	17,688
Total day load per year																					292,850

Total day load per year	292,850
Average night loads at 5 p. c., or 16 k.w., 365 nights, 12 hours per night per year	70,080
Average Sunday and holiday loads at 10 k.w., 61 days, 12 hours per day per year	7,320
Motor k.w. hours per year	60,800
Grand total k.w. hours	431,050

Assuming, therefore, the total output of the machines through the bus bars of the switchboard to be 431,050 kilowatt hours per year, the engines would generate

$1.6 \times 431{,}050 = 689{,}680$ horsepower-hours,

and the boilers would generate

$1.8 \times 431{,}050 = 795{,}890$ horsepower-hours.

Assuming an engine guaranty of 24 pounds of steam per horsepower per hour and a direct evaporation of eight pounds per pound of coal, then the total coal consumption will be 1,193 tons, and the water consumption 305,620 cubic feet. It is safe to assume that only 50 per cent. of this water is wasted and that the remainder is returned to the boilers.

Taking the cost of a good grade of coal at $3.75 per ton, water at 10 cents per 100 cubic feet, oil and waste at $400, interest and depreciation of $3,000, ash removal at $225, five per cent. of the cost of the coal, and charging one-half the cost of the force in the fire and engine rooms to this account, or $2,500, would make the total cost of operating the electric plant $10,751.55, or approximately 2¼ cents per kilowatt-hour.

All of the data herein contained are from actual practice and do not wholly agree with theory, but as we have before stated, there are so many elements entering into the problem that sooner than base everything on pure theory we necessarily let the results of practice govern. In the design and construction of dynamos the trade seems to agree, but there is the great diversity of practice among high-speed engine builders. One will use a 1,200-pound flywheel on an 85-horsepower engine and another calls for 2,000 pounds. Sizes of shafts, lengths of bearings, and in fact nearly all parts vary so materially that one wonders why there is not some absolute rule adopted by them. The designs are so similar that there is no reason for the great dissimilarity in sizes, unless it can be a commercial reason.

We have not attempted to more than touch upon the fact that there must necessarily be fire equipment and well-designed systems of water supply in tall buildings, and that large pumping plants are also an essential part of the equipment. Reservoirs are established both in the cellar and on the roof, connections made on all floors, and in case of fire with Siamese or twin connections with the street. Water pressure must be reduced in sections by means of reducing-pressure valves and great care exercised to avoid leaks, undue strains or water-hammer in the pipes. In addition, the building is equipped with interior telephone, ticker, messenger and bell wiring, mail chutes, ventilating screens, and in fact innumerable devices for comfort and convenience that aid to rent it. The very best of talent is studying every day to improve, and it is the aim of the designer to make each building superior to its predecessor until it seems as though now we must have reached the very acme of success, and today the wonder of the world is the American tall building. It is safely constructed, comfortable and sanitary, a model in every respect and a monument to the American architect and engineer.

Chicago Street-railway Situation.

The City Council adjourned on July 18th for the usual summer vacation. No franchise ordinance was presented by the local transportation committee. A letter from the Chicago Union Traction Company, raising legal objection to the council's order to vacate Adams, Harrison and other streets was placed on file without notice by the council and a resolution was adopted instructing the local transportation committee, in awarding bids for the reconstruction of lines ordered vacated, to give preference to bidders financially able eventually to combine all the surface roads into one system. This may mean that the Chicago City Railway Company will be favored.

Receiver Marshall E. Sempsell, in a letter to the City Council, refuses to give any publicity regarding the stockholders of the bankrupt Union Traction Company without an order from court. Judges Grosscup and Jenkins will sit on next Tuesday to pass on the answer of the Union Traction lawyers in regard to the recent ruling on the 99-year act. In their decree the lawyers claim everything that the company claimed before the decision, and the city will file a strong objection to it.

Before adjourning, the ordinance of Alderman Dever, submitting to popular vote at the November election the question, "Shall the city of Chicago proceed to operate street railways?" was made a special order for the first meeting of the council in the fall.

Street-car Fares in Australia.

The commissioner of electric railways in Australia, Mr. Kircaldie, in a recent conversation while visiting in Canada, had this to say on the system of charging fares on street railways in Australia: "We are the only people that have the tramways under government control. We have not a uniform rate, as you have it in Canada, but the fares are divided in sections, each of which is about two miles in length. For each section we charge a fare of two cents, and by this low rate we induce the public to board cars to travel very short distances, often not more than 200 yards. Your Canadian street railways lose considerable business by charging the uniform rate no matter what the distance is. An evidence of the success of this section-rate plan is the fact that last year our tramways carried 140,000,000 passengers."

The central feature of the machinery exhibits at the World's Fair in St. Louis is the huge Allis-Chalmers engine coupled to a Bullock alternator. The engine is capable of developing 8,000 horsepower when operating condensing, at 150 pounds pressure of steam, and running at 75 revolutions per minute. It furnishes the current for the decorative lighting of the buildings and grounds. Recently it was suddenly called upon to take the entire load ordinarily carried during the day by a large plant in the same building, and aggregating about 5,400 horsepower. Having carried this load as long as it was needed, the Allis-Chalmers giant then took up the regular lighting work for the evening. The engine has worked perfectly ever since the steam was first admitted to its cylinders, and it is popularly known among the exhibition people as "Big Reliable."

Corporation Telephones.[1]

Herbert Laws Webb: I consider the subject has been approached from the wrong side. The question of telephoning a city is the question of handling the telephone traffic of that city. That is an engineering question, and I do not find in any one of Mr. Bennett's reports, or in his paper itself, any mention of the real question—the question of handling the traffic. What a telephone exchange is built for is to make telephone connections. What you want to get is the best, quickest and most economical telephone connection. Now, Mr. Bennett has worked the wrong way about. He has fixed a rate in advance, and then tried to make his system fit his rate. The proper method of working the thing on engineering lines is to find out what the service is to cost and then fix the rate. As a general rule the whole question has been put on the basis of making a rate of about £5, and making the average capital cost, ranging from £14 or £15 a line up to about £20 a line, and this has been put forward in such a way that the engineering—the real engineering—question has been entirely omitted. Now, this class of work, this method of putting forward the telephone problem, has led to the adoption of poor telephone engineering methods, and you will notice all through this paper descriptions of systems which make the telephone subscriber the operator. That is entirely a wrong way of approaching the question of handling the telephone traffic of a great city. The subscriber himself should not be the operator at all. The least possible amount of work should be left to the subscriber to do, and the work should be done by the expert who is the operator at the exchange. We have in the municipal exchanges the call-wire system and the ring-through system. These are the principal systems which have been described. Now, the call-wire system is open to very many objections. It seems to me at this late day almost absurd to have to stand here and tell you all the objections to the call-wire system, but since it has been adopted in Glasgow, and has been held up as a modern and up-to-date system, giving an efficient service, I think it is only proper that some of them should be pointed out.

In the first place, it has the very grave objection of making the subscriber the operator, or relying upon the subscriber to do part of the work that should be done at the exchange. Then it involves the use of two sets of lines. The subscriber's service is dependent on two sets of lines being in order. It increases your plant at the most costly part, which is the line plant. That results in a mixed system, because when you get to your small exchanges, where your subscribers are scattered, it becomes too expensive to run round the extra line for a call-wire, and you revert to some system of direct signaling, which results in your having in the same general exchange area more than one method of working. You have a man using the telephone in a different way, say, in his house, from the way he has to use it in his office, and that will give you a great deal of bad service, because people won't remember to do different things in different places with their telephones. Then a very great objection to the call-wire system is the double use of numbers. A subscriber has to give two numbers. Now, one of the very great difficulties in handling the traffic of a large telephone system is the difficulty caused by the errors that occur from "wrong numbers." We all know that when you use numbers very much you are apt to make mistakes. You are apt to transpose the figures, to repeat the figures in the wrong way you have read them off from the book, and that error is increased very much if you have to say off two sets of numbers to memorize the number you are going to call, and say your own number as well, so that the percentage of errors due to wrong numbers, which is one of the most annoying errors in the telephone service, is much increased by the use of the call-wire.

This question of numbers is so important that in New York they have recently decided not to increase a telephone exchange above 10,000 subscribers, so as not to get numbers of more than four digits. It was felt that if numbers of five digits were in general use serious evils would arise from confusion and transposition of numbers from using such long numbers, and that the time of the operators and of the plant would be materially drawn upon in repeating such long numbers. Now, in working by the call-wire, and especially with all the "party reds" and "party blues" and "y's" and "x's," and so forth, which you have in the Glasgow directory, you must get very long numbers in the working of the Glasgow municipal system. That is a great difficulty. Then, of course, it makes the junction working more awkward. The operator has temporarily to abandon listening to the call-wire while she is working through the junction call. At the busy times, of course, that is a disadvantage. At the busy times of the day the work both for subscribers and for the operators gets very trying. With several people trying to struggle through at the same time the strain on the operator is hard, and the strain on the subscriber is hard.

Another great difficulty in working the call-wire system is that it makes what we call team work impossible. A very high standard of service is only maintained and a very rapid average answer is only maintained when you get operators helping each other. That is, the operator at either side of a given operator helping her neighbor. When a call comes in opposite this operator, and she is already engaged, the next operator takes it up, and by that team work you get a very high average of efficiency and a very rapid average answer. With a call-wire, where subscribers are grouped so many to an operator, of course, that is impossible. Again, it makes the supervision of the service impossible. You can only get very high efficiency if you can supervise your operators by means of supervisors and monitor operators. With a call-wire system you have no signal, so that you have no supervision. Now, the call-wire system has been abandoned a great many years ago practically everywhere except in municipal telephony, and it seems to me quite an extraordinary thing that it should have been adopted in 1900 as the basis of a modern telephone system. Now, the call-wire in Glasgow is combined with the ring-through system, and the ring-through system is also a very disadvantageous system when you come to consider the economy and efficiency of telephone operating. In any given connection you have a certain amount of time spent on the work of getting the connection through and getting the lines disconnected when the conversation is finished. That time is time spent by the operator, to a certain extent, and time spent by your plant. If you add to that time unnecessarily, you waste the time of your operator and of your plant. That is a very important point which seems to have been overlooked.

When you have a large system, as you have in Glasgow, with many junction wires, you have got to cut down as much as you can the operating part of the average connection so as to save the time of your plant and get the most out of your operating labor. Now, if you have any system which depends on the subscribers as the operators, which depends on the subscriber especially to call off, and to ring his correspondent, and so forth, you must necessarily get a lot of waste time. Further, you find that the ring-through system almost invariably—I suppose invariably—develops into a "ring-back" system. Your subscribers get so much accustomed to ringing each other that many of them always answer a ring by a ring, and you have many people every day going through the idiotic performance of ringing to and fro at each other two or three times before they get together on the telephone. That must involve a tremendous amount of waste time on the average connection. You will only get a rapid connection, quick working, a minimum amount of waste time and waste of labor on each average connection when you get automatic signaling, only that, of course, is a poor form of it, where the subscriber simply lifts the telephone off the hook and replaces it to give the signals.

I can give you some figures to show the enormous difference that system has made on the time of operating the average connection. In New York, under magneto working—that is, calling and ringing-off by magneto—the total time of operating a local connection was 44.7 seconds. That is made up of 27.6 seconds from the time the first subscriber called to the time the called subscriber answered. All those tests were taken in that way. That represents the time that the calling subscriber has to wait until he gets his correspondent. Of course, the actual operation of connecting, of inserting the plug, takes very much less. These figures include the delay of the called subscriber in answering, but as that represents the service that the subscriber receives, that is the time we always take—27.6 seconds up to the time the called subscriber answers, and 17.1 seconds from the time the conversation was finished to the time the two lines were disconnected and returned to their normal condition. That represents the actual time of the operating on the average connection, and although that 17.1 seconds for the disconnection no doubt seems to you slow, the reason for that is this—that the magneto call-off involves the subscriber remembering to ring off, and in any system where you make it a charge upon the memory of the subscriber to ring off you have many subscribers who won't do it, who habitually fail to do it. That necessarily sends up the average length of time during which the lines are left connected after the conversation is finished, because you have many times, when the call-off signal is not given—it occurs thousands of times a day in Glasgow on both systems—and consequently those lines are often left up two, three, five or ten minutes, and on a large number of tests those long periods send up the average. Well, now, five years later, when the common-battery system was uniformly in use in New York—with a uniform method of working all over the city—the time was reduced to this—the time of connection, that is, to the called subscriber's answer, to 23.7 seconds, and the time of connection came down from 17.1 to 2.8 seconds. In the common-battery system the subscriber cannot forget to ring off, because all he has to do is to put the telephone back on the hook. Now, you see the gain in time is very great—in the total time of operating the connection, and when you come to a junction call, it is found that with the common battery working the total gain in the operating of each average connection is 34 seconds. You must apply that to the daily traffic of the system and you will see that you get an enormous aggregate gain in time every day, and that gain is spread over your operating time and over the use of your junction plant.

Mr. Gill: I do not regard iron pipes at all as a protection to lead-covered cables against electrolysis. When you have a cable in an iron pipe it touches the pipes at certain places, and the whole then becomes a composite conductor consisting of an iron pipe and lead sheath, and the current density in each part of the composite conductor will vary. For example, at a joint in the iron pipe the current will crowd into the sheath, and after the joint is passed there will be a flow in the other direction. Mr. Swinburne, in a lecture to the Incorporated Gas Institute, dealt with the resistance of pipe joints. You will have a difference of pressure between the lead and iron, and if your pipe is damp inside you will get electrolysis. There will be electrolysis if the conditions are there. In some traction systems the conditions are not there. I have a piece of lead sheathing here, which I pass round so that anybody who would like to examine it may do so. That belonged to a cable which was laid in an iron pipe. There was a fault in the traction system, and owing to that fault the iron pipe got in contact with the trolley wire and became alive. A hole was burned in the lead sheath, not by electrolysis, but if you will consider the matter you will find that the conditions were such as I have described. The pipes were not bonded to the rails. It was a straight iron pipe, lead jointed—the usual practice. In any case, it all occurred over a length of about 50 yards.

Mr. Eastman: To mention the word relay to a switchroom inspector five years ago was very much like holding a red flag before an infuriated bull. Many of the relays in use by the telephone company at that time were always giving more or less trouble, though this was very carefully hidden from the outside public. Being an old National man, I think I am speaking with some authority. The trouble was due to the relay either failing to respond or failing to make proper contact in the local circuit, which meant that no signal was received by the operator. Even today a great deal of trouble is experienced with relays, though they have been considerably improved, and the perfect relay has yet to be introduced. In most of the modern systems one or more relays are necessary in connection with each line. From an engineering point of view, I do not for a moment defend the call-wire, but at the same time I certainly consider that Mr. Webb is wrong when he contends that no supervision of the service is possible. In the call-wire distributing board at present used by the department a supervisor can tap every operator's position and ascertain what is going on, and a shorthand clerk also does a certain amount of tapping on these positions, keeping full details of the conversations taking place between operator and subscriber. Again, should an operator become too busy, it is possible to take a portion—say, a third—of her subscribers from her and transfer them to an operator who is less busy. I cannot agree with Mr. Webb that the operator should do all the operating, as it appears to me that the system instead of being improved will be retarded. From my own point of view, I always feel more satisfied in calling up subscribers myself, as I feel certain that some effort at least is being made to obtain an answer, whereas if the ringing is left to the operator the subscriber, if he receives no reply, is dubious as to whether the subscriber wanted has been rung up or not. An altercation may then ensue between the subscriber and the operator, in which case precious time is being lost which could be devoted to answering other subscribers. Of course, when I say that the operator is ringing up the subscriber wanted, I do not necessarily mean that she has to press her ringing key the whole of the time, as the ringing may be automatic till the called subscriber takes his telephone off the hook.

You will notice that neither of the gentlemen advocating the common-battery system has made the slightest reference to the quality of speech with this system. My experience of the common-battery system is that when the line is speaking well it speaks very well indeed, but the speech is extremely variable, depending to a large extent on the number of subscribers connected and the condition in which some of those subscribers' lines may be.

I notice that Mr. Webb gives certain figures for magneto working, and I can only feel that the New York subscribers were not getting the best possible work out of this system, and I think we can beat them on this side of the water, as in a system of some 4,000 subscribers working on the same principle I have personally taken tests in which the average time in calling to receiving an answer from the called subscriber was 16 seconds against Mr. Webb's 27.6 seconds, and the average time for clearing was 11 seconds, a total of 27 seconds, compared with Mr. Webb's 44.7 seconds. I may say that this test was spread over many months, and would suggest to Mr. Webb that the very slow operating he mentions may have been due to bad operators, or bad supervision of operators, and that in the five years which supervened till the second test was made special efforts were made to obtain smarter operating, especially as a new system was introduced, and that the improvement was not entirely due to the difference of system.

A. Watts [communicated]: The broad statement is made that relays as compared with break jacks are clumsy and expensive and also are fallible pieces of apparatus. Here, again, there is a sharp difference of opinion, the extra cost of jacks, such as those described in the paper, over an ordinary branching jack, on an exchange of any considerable size, must

1. This is part of the discussion on Mr. A. R. Bennett's paper on "Corporation Telephones," read before the Glasgow Section of the Institution of Electrical Engineers, on April 12, 1904, and presented in abstract in the Western Electrician last week.

be as much if not more than the cost of a "cut-off" relay. It may be admitted that relays are fallible pieces of apparatus, but no telephone apparatus is infallible. With a battery in circuit in the way described I should very much prefer the use of a relay rather than a multitude of break jacks in series. A well-designed relay, properly adjusted, and fitted with a dustproof cover, is responsible for a very small percentage of trouble.

Mr. Bennett: Mr. Webb says that the central-battery system has been a very great improvement in New York, and from this I deduce that the system which it replaced must have been an atrociously bad one, for he says that the average time taken to get a connection was 45 seconds, and that the central-battery system has reduced that to 23.7 seconds. The reduction certainly means a great improvement; but the service remains slower than the Glasgow corporation's, and slower than that of any corporation. Since the statement was made I have looked over the Glasgow records from 1902 downward and I find that it is very unusual for 23 seconds to elapse from the time of asking a connection to hearing the voice of the subscriber called; so that an average such as they are content with in New York would not be considered good work in Glasgow. Although I would be the first to admit that the call-wire has drawbacks, yet I repeat what I said before, that when properly worked the call-wire system is beyond all comparison quicker than the central-battery system. Some of you have probably had experience of the Post Office exchange in London. There the system is such as Mr. Webb recommends. I have taken great pains to test it, as has also my assistant, Mr. Macfee, who, unfortunately, is away in Holland and cannot be here tonight.

We find that the service, even when the connections asked for are confined to subscribers linked with the central exchange, so as to exclude branch switch-rooms, is at least twice slower than in Glasgow. At the offices of postoffice subscribers in London I have selected six numbers, all on the central exchange, and set about trying how long it would take to speak to them all, one after the other. According to my tests—and they were made with the object of giving the system every possible advantage—I found that it was not practicable to get it done in less than four minutes, and usually it took longer, sometimes very much longer. In Glasgow you can, as a matter of common practice, do the same thing on the Corporation exchange in 112 seconds, which gives an average of 18.2 seconds per call, and very frequently you can get through in from five to seven seconds—that is, from putting down the call-wire key to hearing the voice of the person you want. Of course, you have to use the system intelligently and obey the instructions carefully. On the central-battery system the speaking is extremely variable in quality, and is on the whole far inferior to that which you are accustomed to in this city. With one subscriber the result may be excellent; you call up another subscriber and you can scarcely hear him; the third will probably be between the two; and in the case of the fourth you can scarcely hear anything for the terrible noise on the line, and so on. Therefore, in the important matter of speaking, I am quite sure that the central battery cannot compare with the Glasgow, or with the Portsmouth, or Swansea, or Brighton Corporation systems.

In connection with the central-battery system there is a point about which subscribers complain very much. When the operator makes your connection you hear a tremendous crack in the telephone. I am so accustomed to telephones that it does not disturb me much, but there are subscribers who assert that it affects them very much indeed, subscribers who say that it actually hurts them. About secrecy, you don't get any secrecy with the central-battery system. An operator, by a small motion of her finger, can put herself in connection with the line and hear all one has to say, and, if she is careful, you need not know that she is there. I think that is a drawback, and it is a drawback which we have endeavored in all earnestness to avoid, or at least minimize, in corporation exchanges. It is true, as one of the speakers remarked, that you cannot dodge the operators altogether, for if you use a parallel multiple switchboard an operator may plug in on a distant multiple and so tap; but we can avoid, and we do avoid, listening by the home operator, who is the most likely offender. In small switchboards, like those in use in Bearsden, Milngavie, Stepps, Cambuslang, and other places, it is impossible for the operator, unless she is also an electrician, to get in and hear what occurs.

Mr. Webb's remarks as to the inconvenience of the system of numbering corporation subscribers have no foundation in fact. He says that in New York the numbers are arranged so as to avoid the use of more than four digits. So are ours. The x, y, z, etc., of which he complains, are prefixes which replace names. In New York each exchange has a name prefixed to a number, like "Courtland 9642." In Glasgow the "Courtland" is replaced by a letter, and that is all. No number in Glasgow, apart from party lines, has more than one letter and four digits, so that our method is actually shorter and saves time, breath and printing. On the central-battery system the operator just before she connects gives a short ring to the called subscriber, and then puts you through. If the called subscriber hears the bell and answers quickly, that is all right; but if he does not hear the bell or does not answer quickly, then you are left standing at your instrument, and, not getting any answer, do not understand what the position is; and it is perfectly obvious that you have to ring off and get the operator again and say, "I cannot get so and so. Will you give him another ring?" which she has to do. If the subscriber does not then reply, you have to do this a third time, and so on. With the Glasgow system, if the subscriber you call up does not answer to the first ring, you ring on and on until you get him, and that is practically a very considerable advantage. The Brighton system does that too, and this in addition—it notifies the operator that a connection which has been made is effective, and she can put it out of her mind until the ring-off comes. If the called subscriber does not reply the operator knows (without tapping), and if she is smart and has time she can take steps to discover the reason and find a remedy.

New Long-distance Trunk Line.

The American Telephone and Telegraph Company is building a new long-distance trunk line to handle the through traffic between Chicago, Indianapolis and Cincinnati. At Indianapolis, where large construction gangs are at work, it is stated that the work will be completed in 90 days. The Bell company thus far has been handling the Chicago business out of Indianapolis by way of Dayton or Terre Haute. At Dayton connection has been had with the Chicago-Philadelphia trunk line and at Terre Haute the connection has been with the Chicago-New Orleans trunk line, which comes north through Evansville and Vincennes. In handling Cincinnati calls Indianapolis has sent them by way of Dayton or Louisville. The Cincinnati line affords new south and eastern connections and gives Indianapolis a more direct route into Washington, Baltimore and Richmond.

The new Chicago-Indianapolis-Cincinnati line will consist of not fewer than eight pole lines, and not less than eight wires will be strung through Indianapolis in the next two weeks. The line closely follows the Big Four road from Chicago to Cincinnati, but in following it runs along country highways and the distance between the two points is more than a hundred miles longer than the railroad line. The line touches Fowler, Lafayette, Thorntown, Lebanon, Indianapolis, Shelbyville and Greensburg. This will make the ninth trunk line that the American Telephone and Telegraph Company has built in Indiana, and the third north-and-south trunk line.

GENERAL TELEPHONE NEWS.

The city of Lake Arthur, La., has granted a franchise to the Cumberland Telephone and Telegraph Company for the construction of a telephone system.

J. H. Lochbaum and associates are petitioning the City Council of Sumas, Wash., for a franchise for the construction and maintenance of a telephone line for 50 years.

The Union Telephone Company of Trump, Md., of which C. L. Almony is president, has increased its capital stock and will extend its lines to Freeland and Bradenbaugh.

The Rocky Mountain Telephone Company will at once begin the construction of an extension from Weiser, Idaho, to Bourne on Mann Creek, a distance of about 12 miles.

The Wheeler and Kanona Telephone Company (N. Y.) is extending its system, to the great advantage of the rural communities, and is putting in poles between Wheeler and Prattsburg.

The Grant County (New Mexico) Telephone Company will extend its telephone line from the G. O. S. Cattle Company's ranch to Gila Hot Springs, 65 miles north of Silver City, N. M.

J. W. Herron, J. H. Haste and J. F. Morse are named in the incorporation of the Windsor and Okaw Mutual Telephone Company, which will operate a telephone system, with headquarters at Shelbyville, Ill.

The Southwest Oklahoma Telephone Company, headquarters at Frederick, O. T., has been incorporated with a capital of $5,000. C. A. Smith, J. O. West and B. F. Flowers of Frederick and others are interested.

The Central Oregon Telephone Company has been incorporated at Prinville, Ore., by A. L. Goodwillie and W. E. Guerin. The line will run to Bend and make connection with the Pacific States Telephone Company.

The Missouri and Kansas Telephone Company has connected the Braman Mutual Telephone Company's lines with its toll lines at South Haven, Kan. The Braman company is one of the largest rural lines in Western Kansas and Oklahoma.

The Santa Barbara (Cal.) telephone exchange, put into operation on April 1st last, by the Home Telephone Company, now has 752 subscribers out of a total population of 3,000. A feature of the exchange is that every subscriber has a direct wire. The exchange equipment is of the highest order, being central energy, with an ultimate capacity of 1,500 lines. The company is a local organization, and its officers are: President, F. R. Vail; vice-president, E. A. Gilbert; secretary, J. R. H. Wagner; treasurer, Alfred Edwards.

Telephone News from the Northwest.

Connection has been completed between Sioux Falls, S. D., and Aberdeen by the Northwestern Telephone Exchange Company.

The Northern Telephone Company contemplates installing a local exchange for Westhope, N. D.

The Merchants' and Farmers' Telephone Company of Shakopee, Minn., has been incorporated with $10,000 capital stock.

The Nebraska Telephone Company has expended $25,000 in improvements to its system at Deadwood, S. D., and surrounding towns.

R. B. Elce has sold the local telephone exchange at Mitchell, S. D., to the Dakota Central Telephone Company.

Howard McLaughlin, a lineman of the Northwestern Telephone Exchange Company, Minneapolis, fell from a pole at St. Anthony Park and fractured his skull.

The Tri-state Telephone and Telegraph Company was granted admission to Northfield, Minn., for a toll station by the council, but the mayor has vetoed it.

C. F. Craig of Leeds, N. D., has sold the local exchange to G. C. Candee of Drayton, N. D. A new building is being erected for the central office.

The North Wisconsin Toll Company has completed a telephone line between Ashland, Wis., and Pratt.

The next meeting of the Independent Telephone Association of South Dakota will be held at Sioux Falls next January.

The Portage (Wis.) Telephone Company has arranged to connect with the toll lines of the Wisconsin Telephone Company.

The local telephone company at De Smet, S. D., will extend its lines to cover rural service.

The Iowa Telephone Company, it is said, will put in $80,000 worth of improvements on its system at Ottumwa, Iowa. R.

Ohio Telephone Notes.

Work on the extensions of the United States Telephone Company's lines is being pushed rapidly, and by the end of the summer $150,000 will have been spent in new lines. The company is connecting up gaps and adding exchanges in various parts of the state, so that its service will be complete when it is connected up with the other long-distance companies. The most important lines now under construction are from Dayton to Richmond, Ind., Denison to Cadiz, Piqua to Lima, and Columbus to Lancaster and Nelsonville. The following lines will be started at once, the material having been ordered: Columbus to Pataskala, Columbus to Newark, Columbus to Zanesville, Zanesville to Cumberland, Newark to Lancaster, Columbus to Mt. Vernon and Thompson's Corners, Columbus to Delaware and Marion, Columbus to Dayton, Lima to Van Wert. Improvements will be made on the lines from Cleveland to Milan and from Cleveland to Lorain and Elyria. Estimates have been made on 11 other lines, but the material for these has not yet been purchased. The lines recently completed are from Thompson's Corners to New Philadelphia and Denison and from Lansing, Mich., to Lanesburg, Mich.

The Reading council now has an application for a franchise from the Queen City Telephone Company, and Mayor Cooper says that it will be granted. A resolution has been passed forbidding the Cincinnati and Suburban Company erecting more poles or stringing wire in the village.

The Bell Telephone Company is building a line from North Baltimore to Norwalk, where it will connect with the main line.

The Dexter City-Southwestern Telephone Company of Dexter City, Noble County, has been incorporated with a capital stock of $10,000 by B. T. Worrell, Adam Shriver, G. W. Hutcheson and others.

President Frank L. Beam of the Ohio Independent Telephone Association has appointed the following named as members of the executive committee to have charge of the various districts into which the state was divided: Ed L. Barber, Toledo; Cyrus Huling, Columbus; Dwight E. Sapp, Mt. Vernon, and James B. Hoge, Cleveland. Mr. Beam is chairman ex-officio.

The United States Telephone Company has increased the wages of its 50 operators 10 per cent. Twenty of these operators are employed in the Cleveland exchange.

An injunction is threatened against the Tri-county Telephone Company, which is working on a line south of Akron. It is claimed the company has no franchise and is setting the poles in the public highway. It is believed that consents of the property owners is all that is required in this case. C.

Michigan Telephone Matters.

The Michigan State Telephone Company of Detroit is offering public schools free telephone service. It will also install telephones in the residences of the inspectors at the rate of $21 each. It is estimated that about 82 telephones will be required.

The Peoples' Telephone Company of Wayne and Monroe counties is constructing a new line between Carleton and Stoney Creek. A new line has also been added to the main line out of Flat Rock. Farmers find it a great convenience and many telephones are being installed.

The business of the Michigan State Telephone

Company is growing very rapidly. According to one of the directors of the company, the subscribers, irrespective of the toll lines, have increased from about 45,000 to over 60,000 since the formation of the new company.

It is understood that negotiations are in progress whereby the Twin City Telephone Company of St. Joseph, controlled by local capitalists, will be merged with the Michigan State Telephone Company. Rates will be raised and improvements made in the line. The Independent telephone companies had practically driven the Bell company out of Benton Harbor. The Twin City company's lines extend north to Grand Rapids and to all points in Northern Indiana and Southern Michigan. W. H. Badour will be manager of the consolidated companies in St. Joseph, and W. Stacey in Benton Harbor. W.

Southeastern Telephone Developments.

R. B. Scarborough is the chief promoter of a new telephone system at Conway, S. C. The charter has been received, but stock will not be offered for sale until the exchange is in working order.

The Southern Bell Telephone Company is now erecting a long-distance line from Wilmington, N. C., to Marion, S. C., to connect with a line to Florence, S. C. The distance is 80 miles.

The Covington telephone exchange of Covington, Ga., was completely destroyed in a recent fire in that town.

A dispatch says that a telephone system will be installed at Pavo, Ga., by Mr. Parish of Moultrie, Ga., who will be president. The Bell service will be used.

A representative of the Cumberland Telephone Company recently visited Pulaski, Tenn., to confer with the city attorney regarding the telephone assessment, which, it is said, may be raised to $25,000. L.

TELEPHONE MEN.

Paul J. Weirich, manager of the United Telephone Company, has been elected general manager of the Monroe Telephone Company at Monroe, Wis., and also retains his position with the United.

Samuel T. Howe has been appointed manager of the Bell telephone system at Topeka, Kan. R. B. Gemmell, acting manager, will remain for a time as Mr. Howe's assistant. Mr. Howe has a long and successful business record in Topeka and is a trusted public official. He is at present a member of the City Council.

Magnetic Track Brakes.

Magnetic braking for electric cars has been the subject of much discussion, and various forms of magnetic brakes have proved successful in practical operation. The subject was taken up exhaustively by the American Institute of Electrical Engineers at its meeting on December 19, 1902, reported in the Western Electrician December 27, 1902. The Westinghouse magnetic track brake is well known, but a system which may not be so familiar in this country is that of the British Thomson-Houston Company. A foreign correspondent, A. Steens, offers the following contribution on the subject:

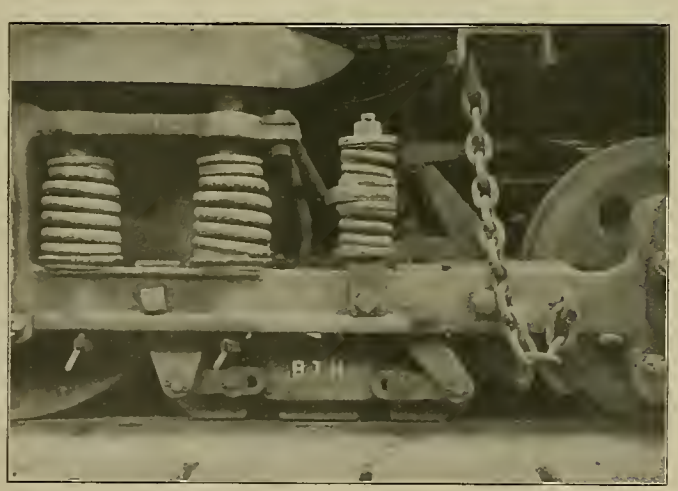


Fig. 1. General View of Thompson-Houston Brake.

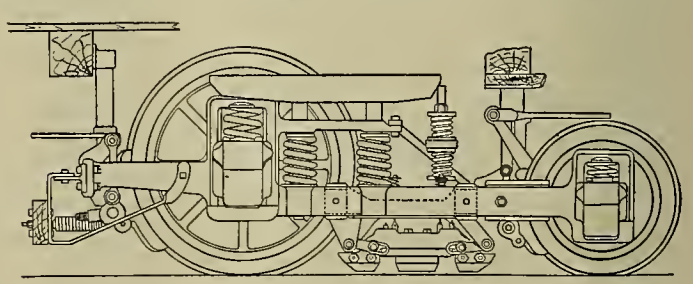


Fig. 2. View Showing Arrangement of Brake Parts.

ELECTROMAGNETIC TRACK BRAKES.

The British Thomson-Houston electromagnetic track brake consists of suitable electromagnets which, when energized by current, are drawn into contact with the rails. The current is generated by the motors acting as generators, and the braking action is obtained both by the drag of the electromagnets on the rails and by the direct retardation of the wheels, due to the motors acting as generators.

The brake (Fig. 1) consists of a properly designed cast-steel shoe suspended from a bracket fastened to the side of the car truck. This bracket is well ribbed and braced and is provided with heavy lugs which take the thrust through cast-steel links in compression.

The bracket is formed to act as the seat for two compression springs which support the brake proper by wrought-iron eye bolts. These springs keep the brakeshoe free from the track when it is not in use. Fig. 2 shows more in detail the mechanical construction.

The brakeshoe itself consists of a substantial steel casting with a cored recess, into which the magnetizing coil is placed. A steel core extends through the coil, providing two magnetic circuits, each of which is completed by the section of rail immediately under the brakeshoe. The terminals of the magnetizing coil consist of well-insulated flexible wires brought out through bushed holes in the top of the cast-steel frame of the shoe. They consist of two wires in duplicate and are of sufficient length to extend from the end of coil winding to the car underframing without a joint.

Each shoe is provided with wearing plates for contact with the rails. These plates are steel castings held in place by machined bolts so placed that the plates may be renewed without removing the brakeshoe from the truck.

The brake has been developed in two different forms. One of these consists of a large shoe with a bracket designed to suit the various types of single trucks. Two shoes of this type constitute a set, the windings being connected in parallel. This insures protection against failure should the winding of one shoe open-circuit. The other is designed for double-truck cars, four shoes per car constituting a set, and one shoe being attached to each side frame of each truck. The operating coils of the two shoes on one truck are placed in series, and these are placed in parallel with the two on the other truck. Thus in case of injury to any one shoe or coil only half of the braking effort of the car would be rendered inoperative.

Magnetic track brakes increase the effective adhesion of the car, the adhesive force between brakeshoe and rails being about one ton for each brake magnet. Accurate control is thus insured even on wet and greasy rails. Being entirely independent of the wheel brake, it is impossible to skid the wheels by the application of the track brake.

In comparison with the rheostatic method of braking, it is said to require less current for the same effective braking efforts with a consequent reduction in the heating of the motors; there is less strain on the insulation, and the wear of the gears and pinions is less.

Being energized by current from the motors, the brake is quite independent of the line current, and it will act whether the car is running forward or backward. It is especially well suited for coasting down gradients at a uniform and safe speed, with the car under perfect control at all times and the possibility of skidding the wheels is eliminated. The action of the track brake is in no way connected with the wheel brakes, which are left quite separate and independent. This insures a smooth action. The system provides a simple and effective brake without wear on wheel heads and brakeshoes and reduces the cost of maintenance. It also insures the free and independent action of the hand brake at all times, allowing the driver to hold the car with the hand brake after bringing it to rest on a gradient with the track brake.

All the apparatus involved is of the simplest character. The brake may be applied to any car equipped with a rheostatic braking controller with but slight alterations to the car wiring, and without any changes in or interference with the existing hand-brake gear.

The efficiency of the brake as an emergency and service brake has recently been demonstrated by a series of tests carried out under actual working conditions on one of the heaviest routes in England. A four-wheel double-deck car with two motors was used and some tests were made with the magnetic-track brake with the following results:

EMERGENCY STOPS.

Speed on Applying Brake.	Time to Stop.	Distance to Stop.	Grade Down.
25 miles per hour	4 seconds	25 yards	1 in 13
14 miles per hour	1.6 seconds	5.3 yards	1 in 14 Level

SPEED REGULATION DESCENDING GRADES.

Speed Maintained.	Grade.	Current Per Motor.
5 miles per hour	1 in 13 1 in 14	4 amperes
5 miles per hour	1 in 17	3.5 amperes
5 miles per hour	1 in 45	2 amperes

The first test represents extreme conditions, such as a car running away down a steep incline, and considering the gradient and the high speed the stop was very rapid, being made in about 2½ car lengths.

The second test would correspond to the case of a car traveling at a moderate speed and obliged to pull up suddenly; it will be seen that such a stop can be made in less than a car length.

The second table is interesting, inasmuch as it shows that a low and even speed can be maintained when the car is coasting down steep grades, so that it is always under perfect control. If necessary the car can be brought to a stop by further movement of the controller handle and held at rest by the wheel brake.

BOOK TABLE.

Uses of Electricity on Shipboard. By J. W. Kellogg. New York: Marine Engineering. 1904. Pp. (5½ by 8 inches), 78, with 24 illustrations. Price, $1.

The book consists of a series of articles reprinted from Marine Engineering and published to satisfy a demand for a thoroughly practical source of information regarding the use of electricity on shipboard. Each of the articles forms a chapter in the book and is complete in itself. The subject matter is so presented that one not having had special training along electrical lines may easily understand the terms used. The headings of a few chapters taken at random will give an idea of the nature of the subjects treated. "Electric Fixtures and Fittings," "Electrically-driven Auxiliaries" and "Electric Wiring for a Small Steamer," are examples. There are also several illustrations showing typical electrical apparatus for marine work. An appendix of two chapters is devoted to small lighting plants for launches.

Recent Live-wire Testing Devices.

Persons connected with the operating departments of electric-light and power companies have felt the need of a satisfactory device for determining whether current is flowing in a cable or not. Valuable time is frequently lost in locating trouble, owing to the trouble men not being provided with satisfactory testing outfits. Accidents have also occurred, due to jointers cutting cables which they supposed to be dead. Any system of numbering or tagging cables may become wrong, due to changes, and may well be confirmed from another source, particularly in the case of high-tension cables. The compass method of testing, while generally satisfactory for direct-current cables, will not answer on alternating current. The testing outfit illustrated by Fig. 1 was designed for use on alternating-current lines, but is also satisfactory for direct-current work, provided the current is supplied from a generator. It would not work on a battery circuit, as the sound heard depends on the commutating action of the generators.

This testing outfit, which is manufactured by the Minerallac Company of Chicago, consists of a telephone receiver and a small current transformer with a hinged core. The secondary wiring of the transformer is connected to the telephone receiver and the hinged core is clamped around or against the cable to be tested, the cable forming the primary of the transformer.

The device will be found very sensitive and will work on single, duplex or three-conductor cable. It will be more sensitive on single-conductor cables than on the others. On single-conductor cables an alternating current of one ampere, or a direct current of two amperes, will give a distinct indication. On large cables carrying heavy currents it is not necessary for the iron core to enclose the cable completely.

Figs. 2 and 3 illustrate an electroscope devised for the purpose of affording a rough-and-ready means for determining the presence of a dangerous potential in an electrical conductor. Workmen are thus enabled to make their own determinations and take their own precautions against danger to life before touching any electrical conductor that may carry a dangerous

potential. In every large or small power station or distributing sub-station involving high potentials there are always possibilities which may cause accident, such as, for instance: failure or improper operation of switching and similar apparatus, failure of

FIG. 1. RECENT LIVE-WIRE TESTING DEVICES.
—RECEIVER AND TRANSFORMER TEST SET.

insulation on cables and connections, failure and misunderstanding or confusion on the part of station or sub-station operating men in executing orders, and so on. With the electroscope the workman can, without any danger whatever to himself, determine whether the apparatus or conductor is "alive" or not. It will also be found a convenient instrument for the use of troublemen on overhead work. By hold-

FIG 2. ELECTROSCOPE TESTER
HELD TO A "DEAD" WIRE.

ing it each side of a primary fuse block the indications will show if the fuse is blown.

The device consists of a glass tube, in which is hermetically sealed a copper plate carrying an indicating leaf similar to that in the ordinary goldleaf electroscope. In using, the end of the electroscope is held in close proximity to the conductor to be tested. It will indicate positively all potentials in

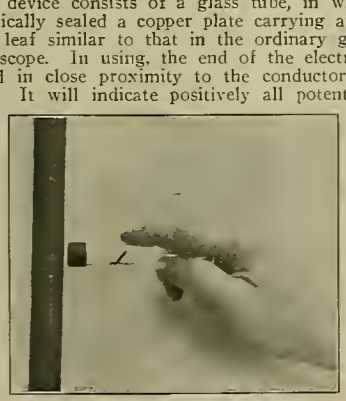


FIG. 3. ELECTROSCOPE TESTER
HELD TO A "LIVE" WIRE.

excess of 500 volts. If the conductor is "dead," the indicating leaf will remain flat, as in Fig. 2. If the conductor is "alive," the indicating leaf will tend to take a position at right angles to the tube, as in Fig. 3. It will not, however, work on a grounded conductor, or a conductor surrounded with a lead sheath.

The International Building Company of Baltimore City, Md., has been incorporated for dealing in land and manufacturing and selling hot water, steam and electricity for motive power, heating, lighting, etc., by William R. Miller of Baltimore County, and Charles R. Habighurst, Robert M. Miller, Howard E. Miller and Miller R. Creighton, Jr., all of Baltimore. The capital stock is placed at $20,000.

CORRESPONDENCE.

Great Britain.

London, July 6.—The question of surface-contact electric traction has received but little discussion in this country hitherto, and no scientific society has had read before it a paper on the subject. Last week, before the Incorporated Municipal Electrical Association, a body largely composed of the corporation electrical engineers, the engineer to the Wolverhampton corporation described the working of the Lorain system in that town. The discussion which followed showed a certain amount of prejudice against the system, but the remarks of the representative of the Lorain Steel Company have a certain interest. The engineer to the London County Council tramways gave it as his opinion that Wolverhampton was just the wrong place to start such a system. Mr. Wetmore, however, was equal to a reply. It appears that one of the chief characteristics of the streets of Wolverhampton are carts laden very carelessly, with all sorts of scrap iron, pieces of which continually fall upon the track, and it was with a full knowledge of these facts that the Lorain company took on the Wolverhampton contract, with the impression that if these difficulties could be overcome the conditions in any ordinary town would present no difficulty whatever. He said there was no case on record in which the armature in the contact box had stuck, and, altogether, the company was of the opinion that the system was as near perfection as was possible with present knowledge.

The question of running-powers over tramways has received more attention during this parliamentary session than it probably has at any other time. It may possibly be remembered that both a committee of the House of Lords and afterward a committee of the House of Commons granted compulsory running-powers to the Tyneside Tramways Company over a portion of the tramways belonging to the Newcastle corporation, and vice-versa, and one would have thought that, having passed two such tribunals, the company must have made out a good case. The matter was brought up, however, in the House of Commons and a discussion by the full House took place, with the result that the bill was sent back to the House of Commons committee for different arrangements to be made. Undoubtedly, a narrow-minded policy is being pursued by the local authorities in this matter, and it is just one of those things that tend to bring true municipal trading into bad repute. The tendency in Great Britain, nowadays, is for the local authorities to regard any company as its natural enemy and one with which no communication of any kind is to be held.

It is announced that arrangements have been made whereby the English De Forest Wireless Telegraph Company will acquire all the space-telegraph patent rights belonging to Mr. Nevil Maskelyne. Mr. Maskelyne is the gentleman who earned the sobriquet of "scientific hooligan" some time ago by interpolating an irreverent remark during the course of a lecture at the Royal Institution by Professor J. A. Fleming, F. R. S., when so-called syntonized messages were being received from Cornwall in London.

Zone fares have finally been sanctioned upon the electrified District Railway, and the experiment upon a line of such length will be watched with interest. It is anticipated that electrical working will commence on January 1st.

The electrical service upon the whole of the 37 miles of line of the Northeastern railway which has been reconstructed for electric traction, has now been commenced. The accelerated service which the company is able to give with the new motive power should win back for them much of the traffic that has been abstracted during the last few years owing to the increasing network of electric tramways in the new cable district. There are other reasons, however, why the working of the lines will be watched with critical eyes. Unfortunately, one or two fatal accidents have occurred on the line, due to small boys getting on to the third rail, and quite an outcry is being made. A report is being prepared on the matter and perhaps some solution of the problem will be arrived at.

The new electricity supply bill which aims at improving the conditions under which powers for the supply of electricity are now granted, is now before a House of Lords committee. For many years the industry as a whole has been seeking some such reforms, and yet immediately an effort is made to meet the necessities, the municipalities are at once up in arms to preserve their existing rights, as they put it. There seems to be a horrible dread that the companies will get more out of the proposal than the municipalities themselves, and if their views are adopted, this will go a long way toward defeating the very object for which the bill was framed. In fact, at present it looks much as if the large amount of opposition to the various clauses will prevent the bill passing the session at all. G.

New York.

New York, July 16.—The Rapid Transit commissioners have favorably reported on a proposal for the construction of a subway under Sixth Avenue for the tracks emerging from the proposed tunnel of the New York and New Jersey company. These tracks, if authorized, will be at a sufficient depth below the surface to allow of a second subway being made above them. Arguments have been heard this week between representatives of the New York and New Jersey Railroad Company and the Lackawanna railroad as to the alleged interference with the latter's privileges by the construction of the proposed tunnel under the Hudson River. The Lackawanna counsel claimed that his company would be prevented from carrying out contemplated improvements.

John B. McDonald, contractor for the New York subway, announces that a school of instruction for future employes has been opened under the charge of Jackson Bell, E. Dutcher and James Dougherty, three highly experienced Manhattan railway men. Applicants for instruction must be between the ages of 21 and 40, and when appointed will receive from $1.50 to $3.50 per day.

A majority of judges of the Appellate Division of the Supreme Court have decided that the granting of transfers by surface railways is not mandatory, but that the traction corporations are bound nevertheless to consider the convenience of the public in this matter. This decision leaves the general position unchanged, for there is no standard of public convenience in this city.

Bridge Commissioner Best, on the last day of this month, will open bids for the wiring of the trolley tracks over the Williamsburg bridge. He promises that electric cars shall be running over the southern track of the bridge on September 1st, and on the northern tracks on October 1st.

Judge Kelley, on Saturday, last, gave an unexpected decision to the effect that such franchises of the Brooklyn Rapid Transit Company as have not been operated within five years of their original granting are void. Judge Kelley was formerly counsel for the Long Island railroad and has an intimate personal knowledge of local street franchise conditions. The Brooklyn Rapid Transit owns quite a number of unutilized franchises, which will be affected by this decision unless it is reversed.

The announcement previously made in this column that the Consolidated Gas Company was taking over the Westchester Lighting Company has been denied, but from a certificate of incorporation filed this week is appears that the Westchester concern proposes to absorb a portion of the New York business. The new incorporation has the title of the New York and Westchester Lighting Company, with a capital of $250,000, organized for the purpose of supplying gas and electricity for lighting, heating and power in the entire city and county of New York, the cities of Yonkers, New Rochelle and Mount Vernon, and about 30 towns in New York state south of Albany. The office of the company is to be at Portchester and the directors are, Cortland Betts, of Morristown, N. J.; Frederick W. Gilbert, of 209 Clinton Street, Brooklyn, and Joseph E. Freeman, 107 West Eighty-second Street, New York.

In addition to the bid of the Nassau Light and Power Company for the public lighting of the Merrick district, Hempstead, L. I., as already announced, the Queens Borough Gas and Electric Light Company has offered to provide lamps at the rate of $25 flat. The bids will not be acted upon until the legality of the stipulation that the cost is not to exceed $18 per lamp has been decided.

A number of electric lights are being put along the beach adjacent to Dreamland, Coney Island, in order that patrons of this pleasure resort may bathe in the ocean after dark.

The General Electric Company is looking forward to good business during the ensuing 12 months. Its trade in turbine engines is expanding, and it is getting quite a share of contracts in connection with the conversion of steam lines. The company is in the market for the delivery of 3,200 tons of pig iron in September.

The Keystone Electrical Engineering and Supply Company has been incorporated this week with a capital of $5,000. The local directors are Henry Mellenhausen and William Hewins.

The New York Telephone Company announces that it will give a reward of $250 for the arrest and conviction of any person who criminally receives any of the company's property.

The local authorities at Amityville, L. I., have notified the New York and Long Island Telephone Company that the present overhead wires must be placed underground.

David Campbell, who has been employed on what is now the Brooklyn Rapid Transit system for the last 50 years, has been granted two weeks' vacation. During his term of service he has been conductor, collector and ticket taker.

It was announced this week that the New York Herald has discontinued its space-telegraph station on the Nantucket Lightship at the request of the United States Lighthouse Board. For about two years past incoming and outgoing Atlantic liners have been reported from Nantucket with almost uniform reliability. The action of the board is alleged to have resulted from representations made by the German government, but such an explanation is almost incredible. D. W. W.

New England.

Boston, July 16.—Employes of the Chase-Shawmut Company, while engaged in work for the electrical equipment of the tunnel in the vicinity of the old State House, last Wednesday morning, were routed by the explosion of a small gasoline furnace used by them in their work, but happily none was seriously injured.

On July 12th the members of the city government

of Salem, Mass., were the guests of James F. Shaw of the Boston and Worcester and connected trolley systems for a run from Salem to Worcester, a distance of 66 miles, and return. A dinner at the Suburban Driving Club in Shrewsbury, and a circuit of Lake Quinsigamond were features of the day's outing. The run of 66 miles from city to city is said to be the longest continuous trip by a single car in New England.

The selectmen of Hull, Mass., in which town Nantasket Beach is located, have been asked to permit the establishment of a trackless-trolley-vehicle system in town, to run between pleasure-resort points along the shore roads, similar to those in use in European countries.

The Edison Electric Illuminating Company of Boston will have its new units at the L Street plant in South Boston in operation in a very short time. One of them will be in readiness, probably, before the close of this month and the other early in August. When in full working order and connected with the suburban plants that have been acquired by the company, the power plants in the outlying districts will be shut down and current will reach the consumers from Boston.

The Stockbridge Electric Company of Stockbridge, Mass., has been organized to manufacture electrical appliances under the patents of Stephen D. Field, who has a number of valuable inventions—including an amplifier for cable messages, obviating the necessity for repetitions; a multiple telegraph instrument, an electric-light service meter, and other devices. The organizing has been effected under New Jersey laws; the capitalization is $25,000, all subscribed, and the officers and principal stockholders are: President, Rutherford B. Trowbridge, New Haven; vice-president, Stephen D. Field, Stockbridge; treasurer, Robert C. Stetson, Stockbridge. The workshops of the new concern will be in Stockbridge.

Incorporators of the Fitchburg and Nashua Electric Railway Company contemplate the construction of a 12-mile link between the New Hampshire Traction Company's system in Southeastern New Hampshire—through Nashua in that state, bridging the Merrimack River north of the city—and the New York, New Haven and Hartford's trolley system in Central Massachusetts and Connecticut. Such a scheme would present an outer encirclement for the Boston and Northern road, which in turn encircles the Boston elevated road, centered in the Hub and its suburbs.

The Waltham Street Railway Company was a petitioner before the Massachusetts railroad commissioners, July 12th, for an increase of $40,000 in the capital-stock issue of the corporation.

A power-supply plant, to furnish electric power to the Hoosac Valley Street Railway Company, the Pittsfield Electric Street Railway Company, the Stanley Electric Company, and other large concerns in Berkshire County, is contemplated by officials of some of the concerns that would utilize such a service.

Work on the construction of the Rockland, South Thomaston and Owl's Head railway in Maine, now nearing completion, was interrupted a few days ago by the placing of an attachment for $30,000 thereon at the behest of M. Sorretto of Boston, the contractor. President C. E. Meservey of the railway company states that the trouble was due to a controversy between the contractor and the company concerning extra work. Boston capitalists, including Bordman Hall and J. H. Dalton, are among the promoters of the road. B.

Michigan.

Detroit, July 16.—The Detroit aldermen have requested that an ordinance be drafted which will compel the street-railway companies of Detroit to change their style of fenders. With a crowd on the rear platform the present fenders on the cars are elevated from 14 to 16 inches, and they are no protection to life whatever.

There is a plan on foot for a municipal lighting plant at Traverse City. At present the street lights cost $4,600 annually. It is estimated that a plant could be installed in connection with the city waterworks for $16,000, and operated with no additional cost for fuel. The matter will be considered by the council at the next meeting.

The Common Council of Pontiac has decided to advertise for new bids for lighting the city. It has also decided to engage A. S. Hatch, electrical engineer of Detroit, to prepare specifications on which the new bids will be based.

Manistique will spend about $50,000 for electric-light and power improvements.

According to the statement given out by the Municipal Lighting Commission of Detroit, an arc lamp costs $41.03 a year. This is a reduction of nearly $1 from figures shown last year. The total cost of operating the plant is given as $123,093.99. One hundred and forty-three new arc lamps were installed during the year. The amount spent for investment during the whole year is estimated at $63,903.97. After allowing for depreciation, the plant shows a net investment of $824,021.24.

Following the consolidation or arrangements for a community of interests between the Detroit, Ypsilanti, Ann Arbor and Jackson, the Jackson city lines and the Consolidated Traction Company's lines comes the announcement that extensive improvements are to be made in the line west of Chelsea in the way of a new Y, to connect the tracks of the Consolidated company where it branches off to Wolf Lake, so as to admit of running excursions to Wolf Lake from Ann Arbor and Jackson. Arrangements have also been made west of Grass Lake to use the five-mile stretch in which the Ann Arbor line parallels the Consolidated line, and which practically gives them a double track for five miles out of Jackson. Messrs. Hawks and Angus left this week for New York on business in connection with the road.

The village of Shelby has been confronted with the proposition of either shutting down the municipal lighting plant or raising the rate so as to put the plant on a self-supporting basis. It is possible that the outcome of the matter may be the installation of a new plant, the present one being inadequate to supply the needs of the village.

The new Detroit, Monroe and Toledo Short Line electric road has been completed from Detroit to Sibley, the nearest point, and is transferring its passengers to Detroit. It is well built and very smooth. The track is rock-ballasted and admits of very fast time being made. The road is built upon private right-of-way. The traffic since its completion has been very good and a large amount of good through business is expected.

The Simpson Computing Company, now located at Elkhart, will immediately move to Detroit. The factory employs 100 men. It is understood that nearly all of these men will move to Detroit. C. G. W.

Ohio.

Cleveland, July 16.—In the case of W. L. Snyder against the Springfield-Xenia Traction Company the Common Pleas Court of Clarke County has allowed a decree of foreclosure and an order of sale in favor of the Cincinnati Trust Company, which holds the mortgage. The date of sale has not yet been set. Fred Green, former manager, is the receiver. It is stated that the bondholders committee has arranged to buy in the road and reorganize the company. The committee consists of James M. Hutton of Cincinnati and W. H. Lamprecht and W. S. Hayden of Cleveland. There are now $500,000 bonds outstanding.

Contracts have now been let for the completion of the Fort Wayne, Van Wert and Lima road. The Coon-Hogue Company of Indianapolis will lay the rails and put in the overhead work, the Cambria Steel Company furnishing the steel.

The Village Council of Norwood has sold $6,000 electric-light improvement bonds. They run 25 years and draw 4½ per cent. interest.

The Columbus, Buckeye Lake and Newark has established a fast through service from Columbus to Zanesville, effective July 15th. Cars will leave each place on the hour and the schedule time has been fixed at three hours flat. The local service will not be disturbed.

It is reported that Superintendents Gunn and Brown, in the service of the Dayton, Springfield and Urbana, have resigned, as has Freight Agent Mench, and that still others will follow them. G. F. Mansell has been appointed auditor of the company. It is not known what has caused the changes.

The Columbus Railway and Light Company has refused to allow a claim of nearly $1,500 for outages, and if the city insists the company may turn the lights off. The company is furnishing lights without contract until the city plant can be got in operation.

A report has been current that Horace E. Andrews has closed a deal for the Syracuse Rapid Transit Company's property and will as soon as possible join it and the Utica and Mohawk Valley line, which he and his syndicate own. In connection with this story is another, that as soon as the purchase of the Syracuse road is consummated both it and the Mohawk Valley will be turned over to the Vanderbilt interests that are now seeking to establish a big traction system in New York state. There have been rumors that all the traction roads of Northern Ohio might be combined under the control of the Vanderbilts.

The Lake Shore electric railway has made a number of traffic connections with steam roads running west and has developed quite a bit of new business in that way. The roads each get their full fare, but the average rate to the passenger is less than it would be to go by steam route all the way. The steam roads also get considerable business in that way that would go to competitors were it not for the connections with the electric line. Quite a little St. Louis and other western business has been worked up in this way.

Reports from Springfield indicate that a company has been formed for the purpose of purchasing the lighting plant from the Appleyard interests. The company holds a franchise for hot-water heating as well as light, and the new concern desires not only to put in a new and modern light plant but to establish a heating plant to be operated with the same power plant.

For the year ended May 31st the report of the Cincinnati, Dayton and Toledo railway shows net income of $6,021, as compared with $24,008 in 1903. The gross earnings were $502,990, as compared with $489,493 last year, but the operating expenses were $301,787 in comparison with $271,812 last year. This reduced the net income from $217,680 to $201,202.

The National Electric Porcelain Company of East Liverpool has been incorporated with a capital stock of $50,000 by George P. Ikert, George Kaufman, G. S. Thompson, P. V. Mackle and others.

O. M. C.

Indiana.

Indianapolis, July 18.—W. B. Wright, formerly auditor of the Indianapolis Journal Company, has been appointed auditor of all departments of the Indianapolis and Cincinnati Traction Company, with offices in the State Life Building in this city. Mr. Wright formerly lived at Connersville.

With the completion of the Northwestern traction line and the car sheds almost completed for the Anderson and Noblesville line, the city of Lebanon is taking on new life. The Boone County farms tributary to the city are recognized as among the very best in the state, and the new factory interests are now adding an element which contributes to the prosperity of the community.

The final report of the Union Trust Company, receiver for the Home Heating and Lighting Company of Indianapolis has been filed in Superior Court and approved by Judge Carter. The Union Trust Company resigned as receiver on June 30th, having served two months, when objection was made because of the connection of Samuel E. Rauh with both the heating company and the trust company. A balance of $1,036.95 is turned over to the Marion Trust Company, which succeeded to the receivership, and $150 is given the Union Trust Company for its services.

The Jeffersonville City Railway Company has made the first step toward extending its lines to the surrounding towns, and Manager J. H. Duffy states that within six months almost every town within a radius of 25 miles will be linked to Jeffersonville with electric railways. The first line is to touch at Utica, Prather, Charlestown, Otisco, New Washington and adjacent towns, and it will ultimately be pushed to Madison.

B. B. Jones has been working steadily for several months on an interurban railway to be built from Columbus through Azalia, to the south line of the county, where Jackson, Jennings and Bartholomew Counties meet, and from there either to Seymour or to North Vernon. He has $30,000 subscribed for stock in the proposed road and hopes to double this amount in the next month. The company will incorporate at $60,000. If the line comes to Seymour it is the purpose to extend it on to Louisville.

Plans for the reorganization of the Chicago and South Shore Railway Company are rapidly being formulated, and from present indications it will be possible to close up the receivership in September, at which time the system will be sold at public sale under the direction of Judge Anderson of the United States District Court at Indianapolis. The new company will be composed principally of the bondholders of the road, and they will be in a position to make a better offer for the system than any outsiders. The reorganized company will be ready to step in as soon as the receivership is closed up and the road sold, should it be the purchaser, as it undoubtedly will be. The bondholders' committee, which recently made an inspection of the system, was composed of T. W. Spence and F. H. Spence of Milwaukee, Wis.; R. L. Henry, Chicago; A. D. Mallory, Batavia, Ill., and M. A. Hews, Chicago. The committee was accompanied by Receiver F. H. Fitch of Chicago and Receiver Lemuel Darrow of Laporte. The committee was exceedingly gratified at the excellent condition of the road and the improvements that had been made during the receivership.

The Jeffersonville City Council has adopted an ordinance permitting the Louisville and Southern Indiana Traction Company to build an approach to the Big Four bridge viaduct from Court Avenue to Market Street. This means that the trolley cars will be running from New Albany to Louisville via Jeffersonville and the bridge within a few months.

Financial men in Louisville, Ky., are taking quite an interest in the Louisville and Southern Indiana Traction Company and within the last few weeks have purchased about $100,000 of its bonds. The bond issue for the present will be $300,000. The authorized capital stock is $2,000,000 common and $1,000,000 preferred. The indications are that this will be one of the leading roads of Southern Indiana. Its rights and franchises are much more valuable now since it has gained an entrance to Louisville over the Big Four bridge. T. N. C.

Dominion of Canada.

Winnipeg, Man., July 15.—Winnipeg has the greatest electrical-power possibilities outside of Niagara Falls, in the Dominion of Canada, and a combination of capitalists has within the last few days been formed to develop the great water power. It is located at Silver Falls on the Winnipeg River and will furnish an ample supply of power and light to Winnipeg for years to come. The company has been incorporated by the Manitoba Legislature under the name of the Manitoba Water Power Electrical Company, with a capital of $5,000,000. Following are the officers: President, Hugh J. Macdonald, K. C., ex-premier of Manitoba; vice-president, Daniel McMillan, lieutenant-governor of Manitoba; secretary and treasurer, R. P. Roblin, premier of Manitoba.

A general meeting of the shareholders of the Winnipeg Electric Street Railway Company has been called for August 2d at the company's offices in Winnipeg to consider the purchase of the capital stock of the Winnipeg General Power Company.

Mr. F. S. Kilby, late of Port Arthur, has been appointed inspector of the Winnipeg street-railway company.

The council of Brighton, Ont., has decided to submit a by-law to the property owners on August 9th for the purchase of $20,000 first-mortgage bonds of the Ontario Electric Railway Company.

A by-law to purchase the electric-light plant and run it as a municipal concern has been carried by the taxpayers of Thamesville, Ont.

General Manager W. C. Hawkins of the Hamilton Radial Electric Railway is advertising for bids for the extension of the street railway from its present terminus at Birmington to the town of Oakville, a distance of 10½ miles.

J. W. Ross and others of the town of Hawksburry have been incorporated as the Hawksburry Electric Light and Power Company, with a capital stock of $100,000. Headquarters are in Hawksburry, Ont.

The St. John Street Railway Company has been making some improvements and additions to its plant for the operation of its railway system and the lighting system. It has put in a Corliss horizontal compound-condensing engine which can be worked up to 1,500 horsepower. A new generator has been supplied by the Canadian General Electric Company of Toronto. It is a 650-kilowatt machine direct connected. The company retains in addition to this new power producer all the other machinery which was used in the conduct of the street-car service. This company also owns and operates the electric-lighting plant, of which all the lighting machinery has been renewed entirely. The present plant gives the railway company power to increase the service 50 per cent., and it is capable of standing a much heavier overload for a time.

The taxpayers of Kingston, Ont., having paid $182,000 for the electric-lighting plant formerly owned by a private company, are now about to spend another $100,000 to bring the plant thoroughly up to date and to equip it for any increases in business. The company which owned the plant made a yearly profit of $20,000, and the council thinks this can be increased to $30,000.

The Toronto Street Railway Company has now completed the doubling of its power-plant capacity, which was begun last fall. A few days ago the new storage batteries were connected up and the surplus power generated during the hours of the light load was stored to assist in the work of transporting the crowds at six o'clock in the evening. During the day 6,000 horsepower is stored up, which may either be utilized in the hour between 5:30 and 6:30 p. m. or called into service in any quantity desired and distributed over a longer period. The maximum capacity of the storage batteries is 6,000 horsepower for an hour. H.

Texas and Mexico.

Austin, Texas, July 14.—The Pleasure Pier Traction Company has been organized at Port Arthur, Texas, for the purpose of constructing and operating a suburban electric railway, electric power plant and union depot. John A. Young is one of the incorporators.

L. W. Dunn and associates are promoting the project of constructing a street-railway system and installing an electric-light plant at Cleburne, Texas.

It is reported that the Galveston City Railway Company of Galveston, Texas, will make extensions and improvements to its system.

The plans have been completed for the early erection of a new power plant at Dallas, Texas, by the Dallas Light and Power Company. The new plant will cost about $500,000. The plant will be completed and ready for operation in about a year. The old steam engines now in use will be replaced with steam turbines.

The City Council of Fort Worth, Texas, has passed an ordinance authorizing the Northern Texas Traction Company to immediately construct certain proposed extensions of its lines in Fort Worth.

A local company, with a capital stock of $50,000, is building a street-railway line Aldama, Mexico. The stockholders are Aureliano Navarro, Celso Aguirre and Francisco Hermosillo.

A German company is making a strong effort to obtain from the municipal authorities of Guanajuato, Mexico, a franchise for the establishment and operation of an electric-light and power plant. The present contract which the city has with the existing American company expires next month.

A tunnel 400 meters long is being constructed through a mountain near Colima, Mexico, for the purpose of affording a channel for the water that is to be conveyed from the Naranja River to be used in operating the electric power plant that is to operate the proposed electric street-railway system in Colima, as well as to furnish the city with electric lights.

The City Council of Teocaltiche, state of Jalisco, has granted a franchise for the establishment of an electric-light and power plant there.

Arrangements are being made by Antonio A. Mott for the establishment of an electric power plant near Coatsacoalcos on the Ozoloapam River, Isthmus of Tehuantepec, Mexico, to generate electrical energy for the various plantations and mills of that section. There are many American planters on the Isthmus of Tehuantepec, and they have adopted the latest mechanical methods of handling their crops.

The Federal District Railway Company of the City of Mexico has under consideration plans for the construction and operation of an electric belt line around the city. The proposed line will pass through all of the principal suburbs of the city.

An electric-light plant is to be installed at Santiago Ixquintla, Mexico.

It is stated that S. Pearson & Son of London, England, who own the street-railway system at Vera Cruz, Mexico, will soon let the contract for nearly $300,000 worth of equipment for the lines. The plans of the firm contemplate converting the system into electric traction and the extension of the existing lines. It is reported that this firm is negotiating for the purchase of other street-railway systems in Mexico.

A large electric power plant has just been installed by the Rothschild syndicate at its Inguaran copper mines, in the state of Michoacan, Mexico. This plant is used to operate the mines of the syndicate. It also contemplates the construction of an electric railway from the mines to a point on the National railroad of Mexico.

Official announcement is made of the purchase of the railroad which extends from the outskirts of the city of Guadalajara, Mexico, to the Grand Canyon of the Santiago River by Jose Maria Bermejillo, who will operate the road in connection with his system of street-railway lines in that city. It is Mr. Bermejillo's intention to operate the new line, as well as his city system of railway, with electric power. Pending this improvement, animal traction will be used on the scenic road.

Arrangements are being made for the transmission of electric power to the mining camp of El Oro, Mexico, from the plant of the Mexican Light and Power Company at Necaxa, a distance of 161 miles. Many of the prominent mining companies have contracted to use the power, these contracts aggregating nearly 8,000 horsepower. R. M. Raymond, general manager of the El Oro Mining and Railway Company, says that his company will use about 2,500 horsepower and that the electrical machinery necessary at the mines will cost about $75,000. It is estimated by experts that the use of electric power will make a saving of about 25 per cent. in the cost of operating the stamp mills and other machinery. H.

Pacific Slope.

San Francisco, July 15.—On the occasion of the twenty-ninth triennial conclave of the Knights Templar, which will be held in San Francisco in September, a beautiful electrical illumination will be made. Some idea of the extent of this illumination can be gained from the size of the figures. The lowest bid for the plant is $53,000, and for the current, $25,000, and this in the face of keen competition and close figuring. Over 150,000 lamps and 10,000 Chinese and Japanese lanterns will be used. Union Square will be the center of attraction and will be surrounded by a colonnade of ornamental pillars, while within and surrounding the Dewey monument will be a small palisade. These will be connected by strings bearing multitudes of lamps and woven in fantastic shapes.

One of the large power plants at Borel, on the Kern River, has been completed and is supplying power to Los Angeles, 128 miles distant. The other large plant cannot be completed for a month or so. At present the current is transmitted at a pressure of 45,000 volts, but this will be raised to 65,000 as soon as the other power house is tied on. About 20,000 horsepower can be developed with the present equipment. The power is to be used by the Huntington syndicate in operating electric-railway systems in Los Angeles, Pasadena, Pomona, Riverside and the adjacent country.

The Joshua Hendy Machine Works has contracted to do the electric wiring in the addition to the large apartment house of H. H. and M. G. Bancroft on Van Ness Avenue.

The formal transfer of the franchises and rights-of-way obtained by John Hays Hammond and Harold Wheeler for the Visalia (Cal.) electric car line have been made to the Visalia Electric Railroad Company.

The county commissioners have granted the trolley franchises asked for by Robert Houston in the promotion of a trolley system embracing parts of King, Snohomish and Skagit counties, Wash.

W. D. De Varhey has secured a franchise to construct and complete an electric plant and telephone system in Albany, Ore.

The Consolidated Electric Light Company has been incorporated at Portland, Ore., by H. M. Bassford, C. P. Johnson and others, with a capital of $10,000. A.

Seattle, Wash., July 15.—The Oregon Waterpower and Electric Company of Portland, Ore., has completed the electric street railway to Estacada. Simultaneous with the building of this line began the extensive power developments in that section. Numerous companies have been formed for utilizing the great power of the mountain streams for manufacturing and irrigating purposes. Recently plats and notice of the proposed appropriation of four different streams have been filed with the recorder of Multanomah County.

The Washington Water Power Company of Spokane, Wash., is preparing to commence work on the extension of its line near Wallace, Idaho. A large power house is being constructed near Post Falls.

The City Council of Chewelah, Wash., has been asked for four franchises. D. S. Strobeck has petitioned for franchises for waterworks and an electric-light and power plant. G. W. Armstrong asks the council for a franchise for putting in gas for heating and lighting, and F. W. Dickey and farmers in the vicinity want to put in a telephone line.

S. H. Bell, acting in the interest of Henry Hewett, Jr., of Tacoma, has signed all relinquishments of the rights of the latter in the Sumpter-Bourne railway project.

The Lewiston (Idaho) Gas Company is contemplating the construction of a $50,000 gas plant. P.

PERSONAL.

George A. Fenn has been chosen by the West Side Park Board, Chicago, to act as chief electrician of the West Side park system to fill the vacancy caused by the resignation of James McLaughlin.

W. C. Warren has been appointed manager of the Toledo (Ohio), Port Clinton and Lakeside electric railway and will take up the duties within a short time. Mr. Warren has for some time occupied a similar position with the Toledo and Indiana railway.

Sales Manager J. W. Brooks of Pass & Seymour, Solvay, N. Y., visited Chicago last week. Mr. Brooks is making a western trip, visiting his company's several local agencies, and will touch at a few cities in the Central states before returning to the factory at Solvay.

Dr. Schuyler S. Wheeler, president of the Crocker-Wheeler Company, sailed July 13th, with Mrs. Wheeler, on the White Star liner Baltic. On the pier, he said that he had planned a coaching trip in England. This is Dr. Wheeler's second trip abroad this year, as early this spring he went on an automobile tour through the south of France.

W. B. McKinley of Champaign, Ill., Republican nominee for Congress in his district and head of the syndicate which recently sold the plant of the Quincy Gas and Electric Company of Quincy, Ill., has just subscribed $1,000 to the fund for building a new Y. M. C. A. building in Decatur. Mr. McKinley is one of the prominent figures in electric-railway building in Illinois.

Louis Terven, E. E. (University of Wisconsin), has recently been appointed chief electrician of the Nernst Lamp Company, Pittsburg, Pa. Mr. Terven was for some time electrician of the United States navy yard, Port Royal, S. C., which position he resigned to enter the experimental laboratory of the Nernst Lamp Company. Later he was given charge of the chemical engineering department of this company. A second promotion in so short a time speaks well for the engineering ability of Mr. Terven.

S. W. Bangs, for many years connected with the Western Union Telegraph Company in the operating department, died at his residence, 6612 Drexel Avenue, Chicago, a few days ago from concussion of the brain. Mr. Bangs, it will be remembered, was found by the police on the morning of November 28th last, in an unconscious condition, having been attacked, it is thought, by thugs. He has been ill ever since that date, and no clew has ever been found to his assailants. At the time of his misfortune Mr. Bangs was chief operator of the city lines of the Western Union.

Parker F. Morey, former president of the Portland (Ore.) General Electric Company and a wealthy and well-known citizen, died at his home, near Oswego, Ore., early this month of heart failure. He was 60 years of age. Mr. Morey was a native of Maine and had resided in Clackamas County since 1892. For several years he lived at Oregon City. He was for several years president of the Portland General Electric Company. A few years ago he resigned active direction in the company's affairs, but retained large holdings of stock therein up to the time of his death. After his retirement from active service with the General Electric Company he removed with his family to his farm near Oswego, where he has since resided. Mr. Morey leaves a widow, a son and two daughters.

Lyman B. Brainerd was elected president of the Hartford Steam Boiler Inspection and Insurance Company at the recent meeting of the directors in Hartford, Conn. He succeeds the late J. M. Allen. Mr. Brainerd came to the company from New York March 2, 1894, where he held the position of manager of the bond department of the Equitable Mortgage Company, and he was made assistant treasurer of the Hartford Steam Boiler Inspection and Insurance Company. Five years ago he was made treasurer of the company, and he will retain this office with the presidency. He is a director in the Case, Lockwood & Brainerd Company, a director of the Security Company, a trustee of the Society for Savings and is also a trustee of the Hartford Theological Seminary and chairman of its executive committee. Mr. Brainerd was born in Westchester Society, town of Colchester, March 27, 1856, the son of Asa Brainerd. He received his education in the common schools and at Wilbraham Academy. His first business experience was as a canvasser for the State Mutual Fire of Hartford. He is identified largely with the financial and educational interests of the city and is a member of the Farmington Avenue Congregational Church. The other officers elected are: Vice-president, Francis B. Allen; secretary, Joseph B. Pierce; assistant secretary, Louis F. Middlebrook; supervising general agent, Charles S. Blake.

ELECTRIC LIGHTING.

The City Council of Fremont, Neb., has decided to enlarge the electric-light plant at that place.

The town of Timmonsville, Ga., contemplates establishing an electric-light plant and system of waterworks. Bids are being received.

At a recent special election in Kellogg, Iowa, the proposition to bond the city for the purpose of building an electric-light plant was approved.

A company has been organized to build an electric-light plant and cold-storage plant in Peabody, Kan. Local capitalists are backing the company.

The Pembroke (Ky.) Water, Power and Light Company has been incorporated with capital of $10,000. The company is formed to supply the town of Pembroke with electric lights and water.

The City Council of Bainbridge, Ga., has called a special election for August 8th for the matter of issuing bonds to the amount of $20,000 for the purpose of purchasing the electric-light plant.

R. W. Downer and associates of Pembroke, Ky., have organized a company and will proceed at once to erect an electric-light plant and system of waterworks in that city. The company is incorporated with a capital of $20,000.

East St. Louis, Ill., is to have a new electric-lighting company to be known as the Illinois Illuminating Company. The incorporation of this company has been effected, with a capital of $50,000, by G. E. Harris, G. E. McNulty and E. G. Bruckman.

E. E. Sayler and associates of Saybrook, Ill., have incorporated as the Saybrook Electric Light, Heat and Power Company, with a capital of $10,000. They propose to install and operate a light, heat and power plant in the city of Saybrook.

The Jasper (Ala.) Water, Light and Power Company has been incorporated with a capital of $50,000, by J. H. Cranford, L. W. Lollar and others. The company will furnish water, gas and electricity for the town of Jasper.

The Potomac Light and Power Company has been incorporated with a capital of $50,000 and has secured a site and applied for a franchise in Cumberland, Md. The incorporators are G. M. Rotch ford, William Somerville, A. T. Wilson and Lloyd Lowndes of Cumberland.

ELECTRIC RAILWAYS.

The North Texas Traction Company of Hadley, Texas, will expend $100,000 in improvements, including the enlargement of its power house.

An electric line will be built by the Spring River Power Company from Galena, Kan., to Baxter. The company will also establish a park at Lowell.

The directors of the Metropolitan Street Railway Company of Kansas City have elected the following-named officers: President, Bernard Corrigan; vice-president, W. E. Kirkpatrick; secretary, treasurer and auditor, J. A. Harder.

Orin J. Peterson of Kansas City has been appointed receiver of the fola (Kan.) Electric Company by Judge Pollock in response to the petition filed by W. F. Baumhoff of St. Louis, who holds five-sixteenths of the stock of the company.

Papers have been filed at Norristown, Pa., for the building by the Schuylkill Valley Traction Company of a branch line through Limerick and Pottsgrove townships, to be known as the Trappe and Limerick Street Railway Company. The new line is to enter Pottstown on Queen Street.

The famous Jungfrau railway is being rapidly pushed forward, and the great tunnel up through the heart of the mountain has now reached an altitude of over 10,000 feet. When 2,000 feet more have been pierced through the rock the Mer de Glace will be reached, where a fine station, observation gallery and buffet are to be cut out of the solid rock. The view from the Mer de Glace station will be the most magnificent in the whole of the Swiss Alps.

Chicago capitalists have organized the Omaha and Nebraska Central Electric Railway Company, to operate a long interurban railway in Nebraska. It will be 200 miles long and will extend from Omaha to South Omaha and in a westerly direction through Millard, Wahoo, David City, Osceola, Stromberg, Arborville, Aurora and Hastings. The road will carry passengers, mail and freight, and be constructed of standard gauge. It will be equipped with high-speed cars of modern construction, and there will be a public telegraph and telephone service in connection with it.

The ordinance passed by the Chicago City Council last week giving the Northwestern Elevated Railroad Company permission to extend its line under certain conditions was returned to the council at the meeting on July 18th, bearing Mayor Harrison's veto. The mayor told that the franchise had been rejected by the company on account of the universal transfer and half-fare provisions and suggested that these requirements be omitted. Later in the evening the ordinance was reintroduced with the suggested amendments, but was referred to the committee on local transportation. As this was the last meeting before the council's summer vacation, the people of the northwest section of the city are again disappointed in their hope for rapid transit downtown.

Judge Lochren of the United States Circuit Court of Minnesota has handed down a decision holding that the Twin City Rapid Transit Company has a right to build lines on all streets in St. Paul except a few on which it surrendered the right on condition that no other company would be allowed to construct lines on those streets. The company is permitted to go ahead with the construction of its proposed extensions, which have been held in abeyance while the litigation was pending.

The report of the Chicago and Milwaukee Electric Railroad Company shows large gains for June and for the first half of the year 1904. The increase is due to the natural growth of traffic in the North Shore territory and to the earnings of the Libertyville branch, opened last September. The gross earnings for June this year were $40,837, as against $22,482 last year. The net earnings were $25,701 and $14,740, respectively. For the first half of this year the gross earnings were $163,250 and the net $90,663, compared with $93,720 and $53,873, respectively, last year.

President H. H. Polk of the Interurban Railway Company of Des Moines, Iowa, announces that his company has decided definitely upon its extensions and improvements for this year. A 35-mile extension is to be made to Adel or Dallas Center, where the road will connect with a road to be built east from Council Bluffs by the Western Iowa Electric Railway Company. The two lines will be operated in conjunction with each other when completed and will afford a continuous passenger and freight service from Des Moines to Council Bluffs and Omaha. Another improvement to be made is an electric belt line for freight purposes to be built along the river north of the city.

The United Railways and Electric Company of Baltimore has issued car-trust certificates to purchase new electric cars. This plan, while much in vogue among steam railways, is a new departure among electric street railways. The company has ordered 150 cars for winter service, to be delivered in the fall, at a cost of $400,000, and the car-trust notes to be issued in payment have already been purchased by a Baltimore banking firm. The company, it is said, has treasury assets more than enough to pay for the cars, but rather than dispose of them at this time, it has determined upon the new plan of payment. The certificates will bear interest at five per cent. and run for 10 years, 10 per cent. of the total issue to be retired each year.

It is said that both the Siemens & Halske Company and the Allgemeine Electric Company have elaborate schemes for the construction of a high-speed electric railway from Berlin to Hamburg, Germany, a distance of 180 miles. The offer of the former company, it is said, is to construct the railway at a cost of $17,500,000 for a single-track line and $26,000,000 for a two-track line, guaranteeing a speed of 100 miles an hour. It is estimated that with $5 first-class fares and $3.75 second, 520,000 passengers annually would make the single line and 850,000 the double line profitable. The Allgemeine company is willing, it is said, to guarantee a speed of 125 miles an hour for the same fares, but estimates that the cost of construction would be higher.

The Virginia Passenger and Power Company, embracing the Richmond Passenger and Power Company and the Richmond Traction Company, has been placed in the hands of receivers upon petition of the Bowling Green Trust Company. William Northrup and Henry T. Wickham were named as receivers. The Virginia Passenger and Power Company is capitalized at $15,000,000 and operates in three Virginia cities, Richmond, Manchester and Petersburg. Frank Jay Gould is the majority stockholder. The explanation of the application for the appointment of a receiver is that it was made by the Gould interest to prevent, as it claims, the disintegration of the properties.

SOCIETIES AND SCHOOLS.

Five papers are to be presented at the next meeting of the American Railway Mechanical and Electrical Association at the convention in St. Louis, October 10th and 11th. In addition there is to be a "question box." Secretary S. W. Mower of 12 Woodward Avenue, Detroit, is sending out question blanks to members, upon which they are requested to submit any questions pertaining to the electrical and mechanical departments which they desire brought up at the convention. These questions should be mailed to the secretary not later than August 1st. These questions will be printed and submitted to the members for replies as soon after that as possible. Questions and answers will be embodied with the discussion in the annual report. The questioners' names will not be made known.

Volume V. of the Transactions of the American Electrochemical Society embodies the complete proceedings of the fifth general meeting of the society which was held in Washington, D. C., April 7 to 9, 1904. An excellent likeness of President Henry S. Carhart is given as the frontispiece. A complete list of the officers and members of the various committees is given. The first part of the book is taken up by the minutes of the meeting and the report of the business session. Following this is a directory of members alphabetically arranged and another showing the geographical distribution of members. The remainder of the book is devoted to the papers and discussions presented at the Washington meeting and the numerous illustrations which were a part of these papers are reproduced. Volume V. contains 279 pages.

PUBLICATIONS.

To those expecting to visit the exposition Bulletin No. 47 of the Crocker-Wheeler Company will be interesting. It is devoted to the power of the Intramural railway. A fine map of the exposition grounds is contained in the bulletin, also large and handsome pictures of Crocker-Wheeler generators.

A leaflet from the Northern Electrical Manufacturing Company of Madison, Wis., is descriptive of motor-driven fan equipments. Several types are illustrated, in each the fan being direct connected to the motor. One of the forms is quite unusual in appearance, consisting of a vertical motor with the fan mounted on the top end of the shaft.

Catalogue No. 18 of the Manhattan Electrical Supply Company of New York, is a voluminous publication containing 640 pages and listing almost innumerable electrical fixtures and appliances. The book is profusely illustrated and every attempt has been made to make it a complete and up-to-date reference book of standard electrical supplies. Any attempt to enumerate the articles listed in the catalogue would be useless in a limited space. It may be said, however, that the company in selecting the goods represented has attempted in all departments to secure standard grades and to eliminate as far as possible duplications.

MISCELLANEOUS.

The Empire Ship Building Company of Buffalo, N. Y., has decided to use electric power to pump out its floating drydocks in the Erie Basin. A 35-horsepower motor will be located on each of the two docks, and the electricity will be supplied by a cable laid along the bottom of the basin.

"Sparrows have compelled the engineer of the big power house in Racine, Wis., to build a hood of wire netting about the whistle. The mouth of the great steam horn has proved so popular with the birds for nest-building purposes that the whistle has sunk to a mere twitter," says the Kilbourn (Wis.) Mirror-Gazette.

The first installment of the electric equipment of the Reading Company's North Franklin colliery, near Pottsville, Pa., has been installed. If the experiment using electrical machinery is successful others of the company's large collieries will be similarly equipped. J. S. Jennings of Bluefield, W. Va., is chief engineer in charge of the electrical equipment.

The Orange County Gas and Electric Company of Middletown, N. Y., has been placed in the hands of George A. Swayze of Middletown as receiver, on the application of Henry Floy, president of the company, who obtained a judgment against the company for $10,766 for salary and money advanced. The company has a capital stock of $300,000, of which $200,000 is outstanding.

The Board of County Commissioners of Galveston County, Texas, has had plans prepared for a big causeway, which will be built across Galveston Bay, to connect Galveston Island with the mainland. The causeway will be placed at the disposal of the steam railroads and will also be used by the Houston-Galveston interurban line to obtain an entrance to Galveston. The plans provide that the causeway shall be 80 feet wide, with a draw in the center. It will provide a double track, a wagon way and a walk for pedestrians.

A recent report on the development of the resources of the state of Maine calls attention to the fact that the richest copper belt in that state is in the town of Bluehill, Hancock County, and is four miles and a half wide. Another belt that promises well is situated in the town of Marion, Washington County. At West Quoddy Head in Lubec there is a vein of lead and copper, and at Cutler there are veins of lead, copper and zinc. Copper has also been found in Kossuth Township, near Carroll, and in several other towns in the state. Owing to the great demand for copper, occasioned by the rapid multiplication of telegraph and telephone lines and other applications of electricity to industrial development, it is thought likely that the copper mines of Maine may at some time be profitably worked.

The pneumatic-tube service between the postoffice and the Union Station annex in St. Louis was inaugurated recently by W. E. L. Dillaway of Boston, president of the St. Louis Pneumatic Tube Company. The new line in St. Louis is 7,600 feet long with tubes eight inches in diameter. Each cartridge for carrying packages will hold from 500 to 600 letters without crowding. The time of transit between the station and the postoffice will be about two minutes and 25 seconds, but cartridges can be inserted in the tubes to follow each other at intervals of about 15 seconds, thus enabling the operator to dispatch four cartridges a minute. The system will soon be extended to the Eads Bridge entrance, and eventually to the Relay Station in East St. Louis.

TRADE NEWS.

E. E. Werner, F. R. Hattersley and J. B. Chopin of St. Louis, Mo., have incorporated as the Millers Engineering Company and will manufacture electrical and mechanical apparatus.

At a meeting of the board of trustees of the India Rubber and Gutta-percha Insulating Company, held on July 1st, a dividend of 2½ per cent. on the capital stock was declared, payable July 11th.

The city of St. Ignace, Mich., is in the field for the installation of a complete incandescent electric light plant. Further particulars may be had by addressing the office of the city clerk.

A firm whose name has not yet been made public has received the contract for 54,000 tons of castings for the eastern section of the Pennsylvania and Long Island tunnel under the East River in New York. The price is said to be at the rate of $27 a ton.

Sealed proposals will be received by C. W. Goodman, superintendent of the United States Indian School at Phœnix, Ariz., until July 29th for building material, subsistence supplies, shop tools and electric supplies. The electric supplies needed consist of 700 electric lamps, 600 rosettes, sockets, insulators, tubes, cleats, wire, etc. A full list and descriptions are obtainable at the school.

A recent consular report from Edinburgh, Scotland, announces that no trade in that city has a better prospect at this time than that of the electrical engineering firms. The demand for motors and all other electrical apparatus will undoubtedly continue to grow from month to month, and American companies prepared to compete in these lines of manufacture have now their best opportunity. Recent developments mean an expanding market, to which American manufacturers of electrical machinery and supplies may find it profitable to devote earnest attention.

The Allis-Chalmers Company extends a cordial invitation to its friends to use as their headquarters the facilities which the company has provided at its power exhibit in the Machinery Building. The 5,000-horsepower Allis-Chalmers engine and the Bullock generator stand in the center of the Machinery Building, with commodious spaces all about the unit, affording views of the largest generating unit ever placed on exhibition. These spaces have been so fitted up by the Allis-Chalmers Company as to afford the best of accommodations for visitors, who will there find not only comfortable resting places but also writing tables and stationery, attendants who will receive and forward mail and telegrams and who will check the parcels and wraps of visitors and provide iced water, all, of course, free of charge.

Sealed proposals will be received at the office of the supervising architect, Treasury Department, Washington, D. C., as follows: Until August 15th for the installation of a conduit and electric-wiring system for the postoffice at Lawrence, Mass. Drawings and specifications may be obtained at the office of the superintendent of construction at Lawrence or of the supervising architect, Washington. Until August 22d for the construction (except heating apparatus) of the postoffice and courthouse at Florence, S. C. Drawings and specifications may be had of the postmaster at Florence, or of the supervising architect, Washington. Until August 29th for the construction (including plumbing, heating apparatus, electric wiring and conduits) of the postoffice at Moberly, Mo. Drawings and specifications may be had of the postmaster at Moberly, or of the supervising architect, Washington.

Recently at Solvay, N. Y., Pass & Seymour brought together their chief representatives in a pleasant reunion. Attending the meeting were Secretary and General Manager B. E. Salisbury, Sales Manager John W. Brooks, New York Sales Agent W. Brewster Hall, Boston Sales Agent A. M. Little, and L. John Bergman of the company's credit department. These gentlemen were together in and about Syracuse and Solvay for two days and were handsomely entertained by Mr. Salisbury on board his yacht. Mr. Salisbury took the party up the Seneca River from Solvay, making a trip of about 30 miles and stopping on the return trip at Three Rivers. The party disbanded after two days of social and business intercourse, voting the Pass & Seymour company, as represented by General Manager Salisbury, the "prince of entertainers."

BUSINESS.

The F. Bissell Company of Toledo, Ohio, states that during the present season it has sold over half a million feet of Bull Frog G. & B. duplex telephone wire.

Pass & Seymour of Solvay, N. Y., report large sales of their new fuseless rosette for concealed work. They will gladly mail a sample to interested parties on receipt of request.

The residence which Louis C. Tiffany, vice-president of Tiffany & Co., New York, is building at Cold Spring Harbor, N. Y., is equipped throughout with H. W. Johns-Manville Company's "Noark" fuses, also with 85-per cent. Magnesia pipe covering.

The D. & W. Fuse Company of Providence, R. I., states that it has recently secured a large contract from the Manhattan elevated system of the Interborough Rapid Transit Company, New York, for cutouts and fuses for heavy service. This order has been delivered and the fuses are in operation, using four fuse boxes on each car.

Dodge & Day, modernizing engineers of Philadelphia, have just completed the installation of the 340-horsepower Buckeye vertical, cross-compound engine, direct connected to two General Electric 100-kilowatt continuous-current, compound-wound generators. They are also at work on a three-motor, electrically operated locomotive crane for this company, to handle beams, angle irons and other heavy structural material for use in a new storage yard.

The De Beers Mines Company of Kimberly, South Africa, has cabled an order for a third Westinghouse-Parsons steam-turbine generating outfit of 1,500 kilowatts capacity for its power plant at Kimberly. The new turbine unit will be similar in every respect to the two which have been in operation for somewhat over a year. The new turbine unit will operate at 150 pounds boiler pressure, 35 degrees superheat and about 23 seconds vacuum. Taking into account the altitude of Kimberly, this would be equivalent to about 27 seconds vacuum at sea level. The new unit will be shipped via New York in about six months.

Mason, Harvey & Co., of Chicago, manufacturers of high-grade touring cars, call attention to their line of electric vehicles, of which they have a full line in stock. Low operating expense and quiet running are the features especially recommended by the company for these machines.

The Gould Storage Battery Company has just closed a contract for a large railway battery for the Edison Electric Illuminating Company of Topeka, Kan., which will furnish power to the street-railway company. This installation will have a capacity of 640 amperes at 600 volts at one-hour-discharge rate, with an ultimate capacity of 800 amperes. The battery is to be used to take care of the fluctuations of railway load.

The Central Electric Company, Chicago, announces the fact that it is general western agent for Helios-Upton enclosed arc lamps, and calls especial attention to its Continental Lamp. This lamp is fitted with a direct-current choke coil, fully protected by patents, and the company makes the statement that, because of this choke coil, the lamp will give 30 to 40 per cent. more candlepower than any other direct-current multiple-arc lamp on the market.

The L. B. Allen Company of Chicago is pleased over a letter which it recently received from a member of the American Institute of Electrical Engineers in regard to the Allen soldering stick, which the writer of the letter desired tested at a large repair shop. In the letter it was stated that the foreman of the shop made a "very careful test of the Allen soldering stick. He was very enthusiastic about it, and it was not only tried on armature work in their shops but also by their outside men in other construction work. He showed several samples of joints made by the Allen stick, and, to use his expression, 'it was better in every respect than soldering solutions or acid and less dangerous, especially in armature work, where drops of acid are likely to produce corrosion, and consequently short circuit.'"

The Electric Storage Battery Company, of Philadelphia, has recently closed contracts for installations of Chloride accumulators as follows: With Westinghouse, Church, Kerr & Co. for the Long Island Railroad Company, Harmil, L. I.; Portsmouth, Dover and York Street railway, Dover, N. H.; California Gas and Electric Corporation for the Petaluma and Santa Rosa Electric railway of California; Toledo Railways and Light Company, Toledo, Ohio, and the City Railway Company, Dayton, Ohio. Contracts have also been closed for lighting and power service with the Mutual Life Insurance Company, New York city; Central Oil and Gas Stove Company, Gardner, Mass., and two residence plants. Over 2,000 cells of Chloride accumulators have been ordered for use in train lighting on the New York, New Haven and Hartford railroad, and over 600 cells have been ordered for the Atchison, Topeka and Santa Fe railroad for signal service.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued (United States Patent Office) July 12, 1904.

764,592. System for the Control of Electric Furnaces. Woolsey M. Johnson, Laharpe, Kan. Application filed November 16, 1903.

A system for the control of electric furnaces comprises a pyrometer, an indicating device connected with it, a regulating device for the furnace circuit, and means connected with the indicating device for operating the regulating device.

764,595. Method of Converting the Energy of Fuel into Electrical Energy. Hugo Jone, Chicago, Ill. Application filed November 7, 1901.

In this method of generating electrical energy there is a metal, the oxid of which yields chiefly carbon dioxid in addition to the metal in its reduction by carbon, as the positive plate with a solution of an alkali as the electrolyte in a galvanic cell. Electrical energy is generated by oxidizing the metal and then reducing that battery product, which contains the metal oxidized in the battery reaction, to the metal by means of the oxidation energy of fuel, and repeating the oxidation of the metal with generation of electrical energy.

764,608. Electromagnet. David L. Lindquist, Yonkers, N. Y. Application filed March 8, 1904.

An electromagnet having a polygonal laminated core is provided with integral symmetrically disposed pole pieces at one end. Coils are mounted on the pole pieces with means for producing currents of different phase in the coils.

764,626. Sparking Plug. Alphonse F. Pieper, Rochester, N. Y. Application filed April 22, 1901.

The sparking device comprises a stem having laterally extended ends carrying tubular insulation. A supporting shell shorter than the stem is composed of a more expansible material and surrounds the insulation and is arranged intermediate the ends. Separate pieces of insulating material at the ends of the shell surround the tubular insulation, and sparking terminals are suitably connected in relation thereto.

764,649. Automatic Motor Controller. George H. Whittingham, New York, N. Y. Application filed October 20, 1902.

Several devices are each adapted to cutting out resistance. A magnet is adapted to retard each of the devices, and means electrically overcome the retardation of each of the magnets successively.

764,651. Rheostat. Charles Wirt, Philadelphia, Pa. Application filed November 6, 1903.

In a rheostat there are combined a casing, a resistance therein and contact sections bearing directly against the resistance. Means are supplied for forcing the contact sections against the resistance, and means for producing and sustaining a circular pressure between adjacent sections whereby the sections are secured in position.

764,674. Electrical Heater. Lovell B. Pemberton, Redondo, Cal. Application filed January 4, 1904.

A cylindrical conducting coil and a cylindrical water coil are placed adjacent to each other.

764,688. Trolley. George E. Smith, Exeter, N. H. Application filed June 5, 1903.

The trolley is composed of a main truck and its supporting harp, an auxiliary truck and its swinging frame and movable fingers pivoted to the latter frame and provided with spring-pressed pins that normally keep the fingers wide apart.

764,690. Apparatus for Telephone Switchboards. Edwin H. Smythe, Freeport, Ill., assignor to the Western Electric Company, Chicago, Ill. Application filed January 23, 1903.

An electromagnetically actuated toll device comprises a switch for applying current to actuate the device, a monitor-signal, a circuit for the signal completed in contacts of the switch when the latter is operated to actuate the toll device, and a blocking device adapted to prevent the display of the signal.

764,692. Overhead Trolley. William J. Sumner, Holyoke, Mass., assignor to the Coburn Trolley Track Manufacturing Company, Willimansett, Mass. Application filed February 6, 1904.

The trolley has a pendant and a stud non-rotatably secured therein at right angles to which a trolley wheel is rotatably mounted.

764,732. Apparatus for Telephone Switchboards. Frank R. McBerty, Evanston, Ill., assignor to Western Electric Company, Chicago, Ill. Application filed October 24, 1902.

A connection switch establishes connection with an electric responsive device and a key effects the actuation of the device. Switch contacts are actuated upon breaking connection at the connection switch to complete a signal circuit, and means prevent the completion of the signal circuit, which are actuated in the operation of a key.

764,792. Automatic Electric Light for Telephone Booths. John L. Bolan, South Connellsville, Pa. Application filed August 23, 1902.

An electric lamp is connected in a local circuit by taking the telephone receiver from the hook, thereby lighting the booth.

764,807. Trolley Retractor. Richard H. Ham, Stockport, N. Y. Application filed September 29, 1903.

Embodied in the apparatus are a trolley catcher, a support therefor, a trolley rope secured to the catcher, and means for axially moving the support in the direction the reverse of the movement of the catcher effected by a pull on the rope. The latter will then be caused to partially or wholly encircle the catcher.

764,812. Electrical Insulator. Charles W. Jefferson, Schenectady, N. Y., assignor to the Mica Insulator Company, New York, N. Y. Original application filed August 8, 1902. Divided and this application filed December 18, 1902.

A separate scale of mica is toughened by a coating of a dried adhesive insulating substance capable of being softened. The scale is adapted to be used as a unit in building up an insulator.

764,813. Electric Battery. Pierre J. Kamperdyk, New York, N. Y. Application filed December 26, 1902.

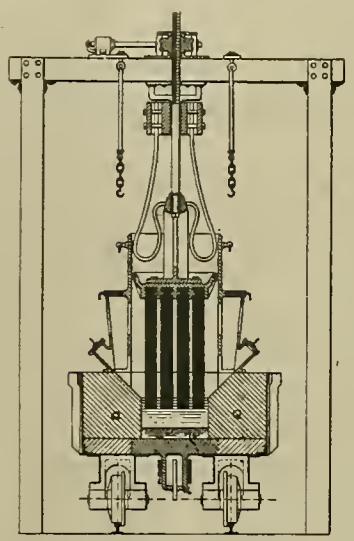
The negative pole electrode comprises a flat plate of zinc and a number of conducting wires protected against corrosion and inclosed in the plate with their ends projecting from the upper edge. The wires extend both longitudinally and transversely of the plate and serve to maintain the shape of the plate when partially exhausted by the action of an exciting agent. They also serve as conductors connecting the several portions when the plate is fractured or partially disintegrated, the ends serving as a negative pole.

764,814. Electric Measuring Instrument. Arthur A. Kent, Philadelphia, Pa. Application filed November 21, 1903.

In a measuring instrument are combined a permanent magnet having a projection intermediate its poles, a coil for energizing the projection to distort the permanent magnetic field according to the flow of current in the coil, and means for indicating the amount of distortion of the field.

764,815. Telegraphic Transmitter. William E. Miller, Sr., St. Louis, Mo., assignor of two-fifths to Luman M. Strong, St. Louis, Mo. Application filed February 19, 1904.

The parts of the telephone transmitter are as follows: A magnet, a key with its co-operating terminal, a contact member included in the circuit including the magnet, a second contact member normally in contact with the first mentioned contact member, an armature for the magnet, a member adapted to engage the co-operating contact member and means whereby upon attraction of the armature the co-operating contact member is positively engaged by the member and is thereby positively carried out of engagement with the first-mentioned contact member.



NO. 765,001.—ELECTRICAL APPARATUS FOR MANUFACTURING VANADIUM.

764,826. Galvanic Battery. Charles B. Schoenmehl, Waterbury, Conn., assignor to the Waterbury Battery Company, Waterbury, Conn. Application filed November 2, 1900.

A basket, circular in cross section, holds a depolarizer having exterior perforated tapering side walls producing a conical-like receptacle larger at its top end than the other.

764,827. Galvanic Battery. Charles B. Schoenmehl, Waterbury, Conn. Application filed July 23, 1901.

A depolarizer receptacle comprises an annular perforated basket broader through the top than the bottom and a central chamber within the basket having perforated side walls and openings through the bottom of the basket to insure access of the solution.

764,829. Incandescent Lamp Holder. Walter H. Scott, Chicago, Ill. Application filed February 2, 1904.

Associated with a socket-head is a threaded lamp-engaging member normally freely rotatable on the head together with means for securing the member against rotation.

764,836. Electro-fluid-pressure Switching Mechanism. Walter J. Bell, Los Angeles, Cal., assignor of one-half to Leon F. Moss, Los Angeles, Cal. Application filed August 6, 1903.

A switching mechanism is comprised of a switch element, fluid actuating means including a double-acting pump for moving the element, solenoid-magnets for reciprocating the pump piston, and a pole changer for the magnets operated in the movement of the magnet armatures.

764,852. Pump Controller. William F. Irish, East Orange, N. J. Application filed May 6, 1903.

Combined with a motor-driven pump is a receptacle supplied by the pump, a controller for the motor operated by the fluid supply for the pump, and a governor, operated by variations in the level of the fluid in the receptacle, for controlling the operation of the motor controller.

764,856. Electric Railway. Timothy Mahoney, San Francisco, Cal. Application filed August 4, 1903.

In an electric railway system is a trolley wheel comprising a magnetizable rim and magnetizable spokes, the spokes united at their inner ends to form a central hub. A series of coils, one for each core, are provided, and all made from a continuous conductor and wound in the same direction, with one terminal of the conductor connecting with the rim and the other terminal of the conductor leading to the interior of the hub.

764,911. Electric Clock. Henri Campiche, Geneva, Switzerland. Application filed February 25, 1904.

In an electric clock are an electromagnet, a balance wheel and an escapement wheel, with means actuated by the electromagnet for imparting an impulse to the balance wheel, means actuated by the oscillation of the balance wheel to rotate the escapement wheel, and means for intermittently closing the circuit to the electromagnet.

764,915. Trolley Guard. Anton Christensen, Chicago, Ill. Application filed April 29, 1904.

The apparatus comprises a trolley stand, pole and wheel, a guard hung on the wheel spindle, a link pivoted to the pole socket, a lever pivoted at one end to the link and at its upper end to the stand, and a connecting rod between the lever and guard.

764,942. Electric-railway System. Wilber E. Guthrie, Chambersburg, Pa. Application filed February 5, 1904.

A contact box for electric railway systems consists of a box provided with a cover, a surface contact having a stem extending down through the cover, an armature bar carrying at one end a supplemental contact and a device for pivotally connecting this armature bar at a point between its ends to the lower end of the stem of the surface contact. The end of the armature bar carrying the supplemental contact normally tends to swing down. Another supplemental contact is supported above the supplemental contact, one of the supplemental contacts being connected with the feed-wire and the other to the surface contact.

764,963. Toll Register for Telephones and an Electrical System for Controlling Same. Harold D. Stroud, Chicago, Ill., assignor to the National Measured Service Company, Chicago, Ill. Application filed June 4, 1902.

Mechanism for counting telephone calls consists of a set-back mechanism comprising an electromagnet, a circuit extending therethrough, and a member movable by the armature of the magnet. The setting-back mechanism is constructed to remain in functionally inoperative position after actuation by the magnet. Interconnections between the setting-back mechanism and the manually operable mechanism whereby the operation of the latter serves to restore the former to operative position are provided.

764,994. Electric Roasting Oven. Georges E. Dutertre, Lavallois-Perret, France. Application filed October 7, 1903.

Mechanical parts are described of an oven which is heated by electric current passing through filaments.

764,998. Electric Igniter for Gas Engines. Edgar Ford, Wilmington, Del. Application filed October 15, 1903.

Details are described.

765,001. Process of Manufacturing Vanadium and its Alloys. Gustave Gin, Paris, France. Application filed May 9, 1903.

Electrical manufacture of vanadium alloys is accomplished by subjecting an anode made of an agglomerated mixture of carbon and vanadium oxid to electrolytic action in a fused bath consisting of calcium fluorid and a fluorid of the metal with which the metal is to be alloyed. The latter is introduced in a metallic state in proximity to the cathode. (See cut.)

765,003. Trolley Pole-head. John E. Greenwood, Utica, N. Y. Application filed August 29, 1903.

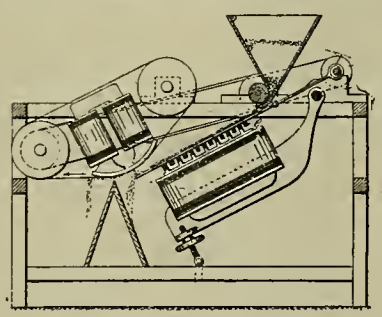
Collectors are mounted on a flexible member on the trolley head.

765,004. Trolley Pole-head. John E. Greenwood, Utica, N. Y. Application filed August 29, 1903.

Combined with a trolley pole is a cap piece pivotally mounted thereon, a leaf spring supported on edge on the cap piece and collectors arranged in tandem on the spring.

765,013. Magnetic Ore Separator. Frederick J. King, Croydon, England. Application filed March 31, 1902.

A magnetic separator comprises a set of magnet bars for sorting the material, and another set of curved magnet bars at right angles to the first set and overlapping the lower end of the first set for the purpose of separating the sorted material. (See cut.)



NO. 765,013.—MAGNETIC ORE SEPARATOR.

765,030. Combined Starter and Regulator for Electric Motors. Edward T. Moore, Newburgh, N. Y. Application filed November 10, 1903.

In a combined starter and regulator for electric motors are two independent series of resistance devices, one of which decreases as the speed of the motor increases up to a maximum speed, and the other of which is brought into play as soon as the motor attains its maximum speed and increases to effect a decrease of the speed of the motor. (See cut.)

765,032. Magnetic Brake. Jacob F. Motz, Phœnixville, Pa. Application filed May 28, 1902.

A mechanical brake is provided with a lever. A longitudinal solenoid is provided at one of its ends with a ring of magnetic material, and a solid armature formed of iron and brass, the iron portion being disposed within the solenoid and normally free to move. The brass portion is loosely connected with the lever.

765,039. Pressure-controlled Electric Switch. William J. Pugh, Davenport, Iowa, assignor to the Automatic Electric Pump Company, Davenport, Iowa. Application filed November 16, 1903.

Combined with a gage or indicator having a rotatable shaft are a contact finger attached to the shaft adapted to make electrical contact with a contact, and a spring attached to the shaft adapted to make contact with another contact, the contacts being connected to opposite poles of an electric circuit.

765,040. Pressure-controlled Electric Switch. William J. Pugh, Davenport, Iowa, assignor to the Automatic Electric Pump Company, Davenport, Iowa. Application filed December 24, 1903.

In a pressure-controlled electric switch a plunger subjected to air pressure on one side actuates the switch.

765,058. Automatic Clutch for Type Casting and Composing Machines. Maurice Wehrlin, Paris, France, assignor to the Compagnie Internationale de l'Electro-Typographe Meray & Rozar, Paris, France. Application filed May 18, 1903.

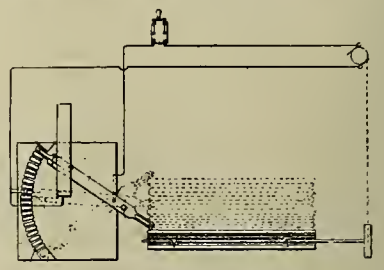
Combined with a driving clutch plate are cams on the plate, a loosely mounted clutch plate, a clutch lever connected to the plate, a lever arranged to engage the clutch lever, and electrically controlled means for bringing the lever into engagement with the cam.

765,059. Type-casting and Composing Machine. Maurice Wehrlin, Paris, France, assignor to the Compagnie Internationale de l'Electro-Typographe Meray & Rozar, Paris, France. Application filed June 6, 1903.

Electrical mechanism brings the type characters in front of the mold, and other electrical means regulate the position of the characters.

765,060. Storage Battery. Theodore A. Willard, Cleveland, Ohio, assignor to the Willard Storage Battery Company, Cleveland, Ohio. Application filed August 13, 1903. Renewed June 1, 1904.

A sheath, envelop or casing for storage batteries is formed of non-conducting material, having integral side and bottom walls, the side walls having vertical spacing ribs and provided with cone-shaped perforations.



NO. 765,030.—MOTOR STARTER ANU REGULATOR.

765,064. Telephone Desk Set. Peter C. Burns, Chicago, Ill., assignor to the American Electric Telephone Company, Chicago, Ill. Application filed March 2, 1903.

The essential parts are a hollow base, an upright standard rising from the base, and adapted to support a transmitter and a hook switch, a threaded member depending centrally from the upper wall of the base, and a bottom plate screwed on to the lower end of the member.

765,075. Trolley Harp. Charles L. Hooper, Rochester, N. Y. Application filed December 15, 1903.

Parallel arms, a shaft supported by the arms, and spring contacts consisting of members having downwardly extending portions embracing the shaft are the essential features of the harp.

765,078. Asynchronous Motor. Paul Jigouzo, Vanves, France. Application filed December 1, 1902.

A rotatable shaft, a frame provided with openings, a bell fixedly secured to the shaft and provided with openings, an armature carried by the bell, and an inductor arranged within the interior of the armature, make up the parts of the motor.

765,136. Overhead-conductor Point-operating Mechanism. Charles G. Goord, Brighton, England. Original application filed May 8, 1903. Divided and this application filed September 17, 1903.

Overhead-conductor point-operating mechanism comprises a switch operating by the rail-point a magnet upon the overhead frog, an electric circuit including the magnet and the switch and conductor connections operated by the magnet.

765,137. Trolley Fork. Charles G. Hartman, Glens Falls, N. Y., assignor of one-half to Edward Ball, Glens Falls, N. Y. Application filed December 21, 1903.

A trolley fork is provided with means for temporarily holding the trolley-wheel pin, and means for permanently holding the pin.

765,142. Telephony. Isidor Kitsee, Philadelphia, Pa. Original application filed March 7, 1901. Divided and this application filed August 27, 1903.

In a telephone switchboard are line terminals, plugs for the terminals, movable contacts having portions adjacent each of the plugs and adapted to be connected with any one of the plugs, and means for preventing all but a single plug from engaging one of the contacts not in use.

EXPIRING PATENTS.

Following is a list of electrical patents (issued by the United States Patent Office) that expired on July 19, 1904:

366,654. Electric Bell Coupler for Steam Railroads. Joseph M. Duhy, Medford, and J. L. Edmester, Chelsea, Mass.

366,660. Electric Boot-blacking Apparatus. Henry R. Gardener, Boston, Mass.

366,673. Device for Holding Incandescent-lamp Filaments While the Same Are Being Flashed. H. Lemp and Merle J. Wightman, Hartford, Conn.

366,695. Quadruplex Telegraphy. G. Smith, Astoria, N. Y.

366,717. Inclosing Cell for Electric Batteries. Camile A. Faure, New York, N. Y.

366,777. Voltaic Belt. J. B. Judd, Council Bluffs, Iowa.

366,824. Apparatus for Measuring Electricity. G. Forbes, London, County of Middlesex, England.

366,938. Electric Arc Light. S. Doubrava, Prague, Bohemia, Austria-Hungary.

366,941. Dynamo Electric Machine. James W. Easton, New York, N. Y.

366,970. Telegraph Instrument. William A. Melhourne, Swanwick, Ill.

366,994. Attachment for Telephones. T. C. Bradford, Cincinnati, O.

367,002. Electric Lamp. Charles A. Homans, Winchester, Mass.

367,003. Earpiece for Telephones. George A. Huewe, Cincinnati, Ohio.

367,004. Earpiece for Telephones. George A. Huewe, Cincinnati, Ohio.

WESTERN ELECTRICIAN

EVERY SATURDAY

Vol. XXXV. CHICAGO, JULY 30, 1904 No. 5

Temporary Power Plant of Chicago First National Bank Building.

Probably the finest office building in the city of Chicago will be that of the First National Bank of Chicago, which is now rapidly assuming a finished appearance, on the outside at least, although there is a great amount of interior work to be done before all of the structure will be ready for occupancy.

The building is located on the corner of Monroe and Dearborn Streets and was erected in two sections, one of which is now completed and occupied. The second section, on the corner, is completed, as far as the steel work is concerned, and the masonry is laid about half way up. When completed this magnificent building will rise 17 stories above the street level. It fronts 191 feet eight inches on Dearborn Street and 231 feet on Monroe. Its exterior though plain is imposing, the two sides facing the streets being faced with granite. The bank will occupy the entire second floor, while the remainder of the building will be given up to offices, with stores on the ground floor. Fig. 3 is a reproduction of an architect's drawing and shows the building as it will appear when completed.

According to the plans of the building, the boiler room of the isolated plant which is to furnish heat, light and power, is to be in the portion of the building first constructed and the engines and generators in the later portion. This necessitated, of course, a temporary plant in the first part to heat and light it during the time in which the other part was being built. A temporary plant of this nature, though rough and crude in its appearance, is interesting, in that it always represents a certain amount of originality in its construction and embodies many ideas on the part of the engineer which are brought forth by the restrictions which are necessarily laid upon him, such, for instance as limited space. Indeed, the installation of the temporary plant may often be even more difficult than that of the permanent one.

In the building under consideration the electrical equipment composing the temporary plant comprises two 150-kilowatt, 125-volt Crocker - Wheeler generators, direct connected to two 225-horsepower Ball vertical non-condensing engines. Fig. 1 is a picture taken in the somewhat cramped quarters of the engine room and shows one of the generator sets and the two switchboards, with their associated wiring. The second generator and engine are back of the first set and just out of range of the picture.

The two generators are of the direct-current type with eight poles each and driven at a speed of 225 revolutions a minute. They deliver current to a two-wire system extending over the building and furnishing connections for both light and power.

The main switchboard is shown edgewise in Fig. 1 and consists of four panels, two generator panels and two service panels. This board is but a temporary structure and will be scrapped when the equipment is moved to the new part of the building. The wiring back of the board, as will be noticed in the picture, is not particularly neat in its appearance, but it serves its purpose well for the few months that it will be required and no trouble has so far originated in this part of the plant.

Near the rear wall of the room is shown the temporary switchboard for the different motor circuits about the building. Just at the left of the motor switchboard is a small motor driving a correspondingly small air compressor. This compressor furnishes compressed air to the barber shop and also for operating the valves of the heating system.

There are two automatic motor-driven centrifugal bilge pumps, the motors with the armatures vertical and connected to the pump shaft. In the engine room there is also a triplex Deane house pump driven by a 15-horsepower motor.

At present there are three boilers installed, and they are permanently in place, the boiler room, as previously stated, being in the part of the building first erected. These boilers are of Stirling make, hand stoked at present, though in the future mechanical stokers will be installed. They are of 150 horsepower each.

The elevator service of the building will be especially good; the total number of elevators will be 21 hydraulic and one electric lift. The hydraulic plant consists of one duplex compressor pump 18 by 29 by 18 inches, with an 8½-inch water plunger. Besides this, there is a small pump for the Sunday and night load. The water from the elevator system discharges into the suction of the large pump and is used over again, what waste there is being made up by an auxiliary pump, also discharging into the suction of the large pump. The elevators are run on schedule time. The signal for starting is given by a gong in the cage of each elevator. The circuits of the gongs are controlled by an ordinary time-stamp clock movement with a few alterations to adapt it to the purpose. Thirty - six - second intervals of starting are maintained by the clock. Current for the timing circuits is obtained from a small storage battery, which also furnishes current for a house-telephone system, connecting the offices of those having charge of the building, such as the chief engineer, engine room, janitors' department, etc.; the rented offices are not connected by this system. Fig. 2 is a view of the two exhausters used in the Bostedo pneumatic delivery system, which is used between the different departments of the bank. As seen in the picture, there are two of these exhauster sets, identical in size. Each is driven by a 26-horsepower motor, which is connected with the shaft of the exhaust fan by a "noiseless" chain. The fans exhaust the air from the system of tubes connecting the several departments. The vacuum maintained in the tube is sufficient so that the inrush of air when a packet is inserted will carry the latter along to its destination. A number of motors are installed about the building for various purposes. The ventilating fans are motor-driven, as well as the machinery in the printing department of the bank. Everywhere that motors are installed in the basement of the building where dampness is likely to occur the motors are placed upon brick pedestals several feet high, insuring for them a dry foundation and the best ventilation to be had.

As to the future permanent plant, it may be said that it will be, in general, about twice the size of that now temporarily installed. There will be four 150-kilowatt generators and six 150-horsepower boilers. There are now 8,000 incandescent lamps connected, besides 33 arc lamps. The total number of lights when the building is completed will be nearly 15,000.

The architects of the building are D. H. Burnham & Co. of Chicago and the electrical installation is in

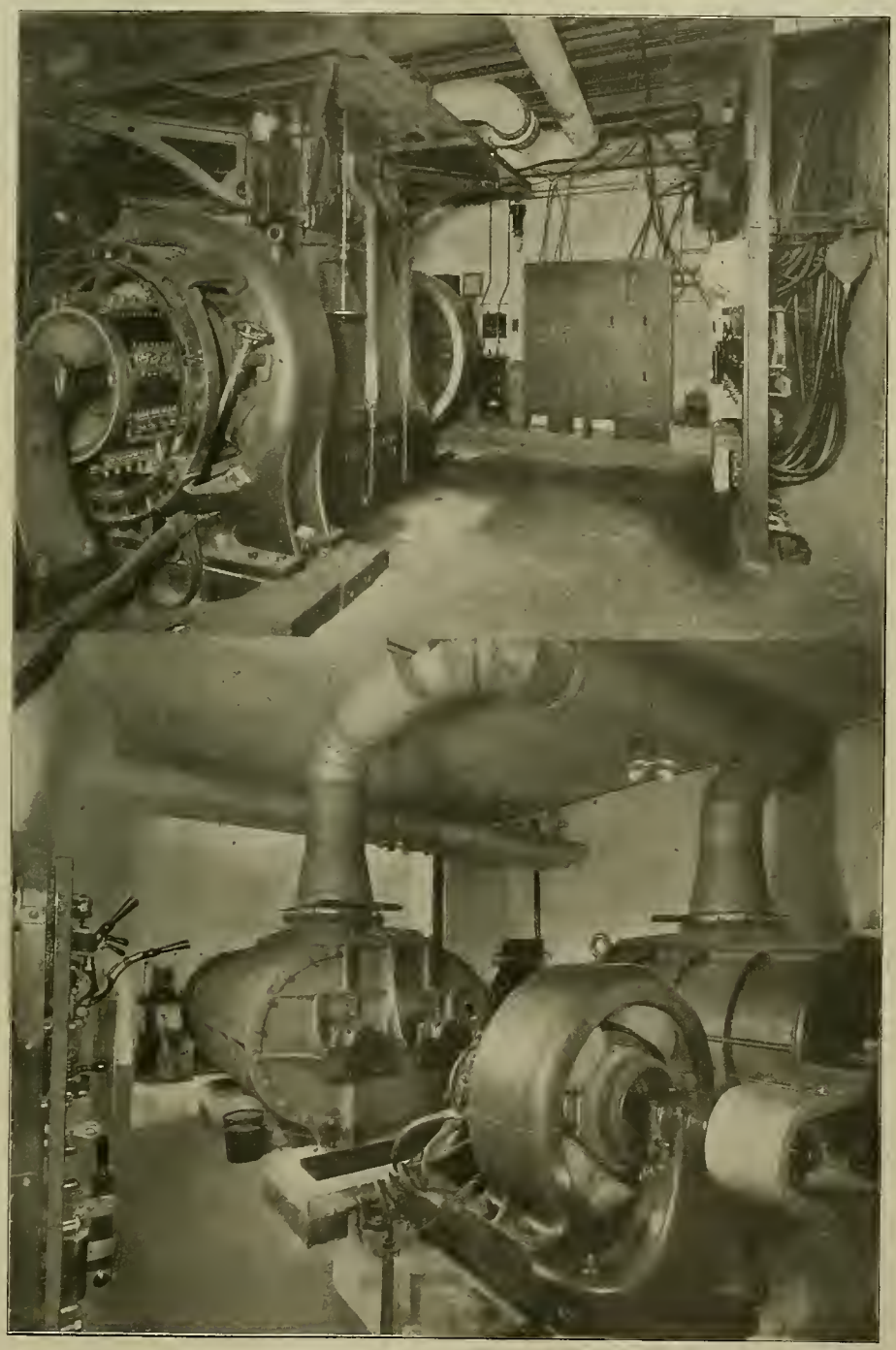


Fig. 1. View in Temporary Power Plant.
Fig. 2. Motor-driven Pneumatic Apparatus.
TEMPORARY POWER PLANT OF CHICAGO FIRST NATIONAL BANK BUILDING.

FIG. 3.—CHICAGO FIRST NATIONAL BANK BUILDING WHEN COMPLETED.

charge of Charles M. Wilkes, their engineer. W. L. Jackson is the chief engineer of the plant.

Brooklyn Rapid Transit Company's Extensive Improvements.

The Brooklyn Rapid Transit Company is gradually weeding out its old and out-of-date rolling stock, making preparations for a new steam-turbine plant, building a new shop for the repair of the elevated cars, and is completely rebuilding every one of its closed coaches for elevated service and making them of a type symmetrical with the Coney Island expresses. It will be the work of a year or more to complete the transformation. When it is complete, the elevated trains will be a credit to Brooklyn.

The Westinghouse electropneumatic unit switch group control, a sample of which has been installed on one of the cars of an experimental train will be used. This system is similar to that now being put upon the cars of the Metropolitan elevated road in Chicago and described in the Western Electrician July 16th. In this system of train control all the motors in a train are operated simultaneously by operating one master controller, usually on the front car of the train.

Compressed air is used for operating the controller in conjunction with low-voltage battery current, making the control apparatus safe against the high potential currents used to operate the motors of the train. The controller has been designed to give smooth acceleration, saving the passengers from disagreeable surging on starting the train.

Each motor car is equipped with two 150-horsepower motors. Trains are usually made up of five cars, consisting of three motors and two trailers, giving 900 horsepower per train. As at present arranged, this power gives a maximum train speed of 42 miles per hour.

The trucks have been designed especially with a view to affording a smooth, easy-riding train, and the brake mechanism has been arranged to give easy and pleasant stops, avoiding as far as possible the uncomfortable jolting which has hitherto been experienced in stopping trains.

Emergency valves have been placed in each car and connected with a blue cord through the train, so that in case of emergency the train can be stopped from the platform or any part of the interior of any car.

A new type of gate has been applied, making it easier for passengers to enter or leave the train. All cars are now being coupled together with automatic couplings, holding the cars firmly together and preventing disagreeable surging of the cars in a train. The motorman's cab has been fitted up with such emergency supplies as extra train links, fuses, etc.

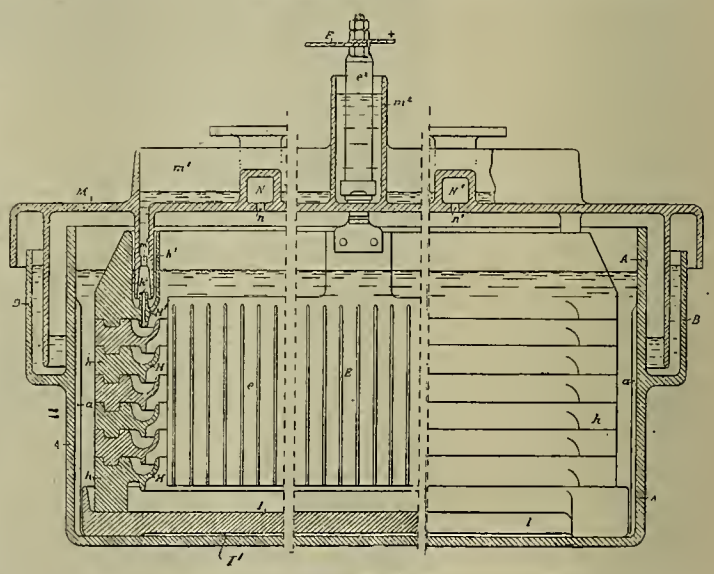
All cars are equipped with fire extinguishers of the most modern type, and these are regularly inspected and kept in operating condition at all times.

Hand in hand with these improvements to the running stock go the plans for a great generating station to be driven by steam turbines. The Allis-Chalmers Company is said to have secured a contract to supply electrical machinery, aggregating 100,000 horsepower, to the Brooklyn Rapid Transit Company, at an estimated total cost of $2,000,000. This is claimed to be the largest electrical contract ever awarded in the United States and is a triumph for turbine-driven machinery. The first specification calls for the provision of six 5,500-kilowatt turbo-generators, operating at 750 revolutions a minute. The three-phase, 60-cycle alternators are to be wound so as to give either 6,000 or 11,000 volts. These engines are to be installed in the new power house now being built on Kent Avenue. When completed this power house will have a total capacity of 100,000 horsepower and its equipment will include 12 separate 5,500-kilowatt generators. This machinery will be used to drive the surface and elevated cars in the Borough of Brooklyn, both of the Brooklyn Rapid Transit Company and its dependent companies.

Hazard-Flamand Electrolytic Hydrogen and Oxygen Cell.

A report by Professor Dalby upon the Hazard-Flamand process of producing hydrogen and oxygen electrolytically, abstracted in the Electrochemist and Metallurgist, contains an excellent description of the new cell for this purpose. The accompanying illustration is a section of the cell showing the arrangement of the parts.

In the box (A), which forms the cathode, and is provided with ribs (a) for increasing the lateral surface, are transverse partitions cast in one piece with the box (A), and likewise ribbed for increasing the surface. The deep gutter (B) is filled with an insulating fluid and receives the edge of the cover (M). The cover is insulated from the vessel containing the electrolyte by ebonite blocks. In the chamber formed by the transverse partitions is the anode (E), likewise provided with ribs. A conductor is led through the cover and insulated therefrom. The anode is arranged in a bell (e^2), and projects into the cylindrical holder (m^2). The latter is in one piece with the cover and closed in, gas-tight, with paraffin. The several positive electrodes are connected in parallel. The anodes are surrounded by diaphragms, which consist of long gutters (H) of Y-shaped section, made of ebonite, porcelain, glass, etc., the upper parts of these gutters almost surrounding the lower arm of the gutter next above. It will be noticed that the lower parts are not in contact with the bottom of the gutter next below. The fixing of these gutter rings is shown at (h). The lowest ring rests with its side projections upon the insulated cap (I), which latter has the function of preventing the hydrogen evolved from the bottom of the vessel from passing into the anode chambers. The uppermost ring (H') is a different shape from the others for the purpose of completely closing the anode cells. The cover (M) projects downward into the uppermost gutter (h') by means of a circular flange. The gases are collected by two canals (N) in the cover, connected by suitable openings (n). The pipe connections branch from these canals. The flanges (m') in the cover serve as containers which communicate with the inside of the decomposing vessel and are filled with electrolyte which prevents the escape of gas from the opening (h^2) and (m^3). While the apparatus is in action, if the level of the fluid in (m') varies from inattention, the gas will escape into the air through (m^3), but without mixing in the apparatus; likewise, no mixture of the gas takes place if the internal pressure rises because of irregularities in the conducting off of the gas, as in that case the gas escapes from the apparatus as soon as the level of the liquid has sunk to the lower edge of the bell (m).



HAZARD-FLAMAND ELECTROLYTIC HYDROGEN AND OXYGEN CELL.

The particular feature, which, at first sight seems to be the most striking, is the type of the diaphragm. This offers no resistance to the passage of the electric current, as the electrolyte has a clear passage through it, and above all so effectively prevents the electrolyzed gases from mixing that the oxygen when analyzed will show 99 per cent. of oxygen. The electrolyte is composed of 15 per cent. caustic soda in distilled water, the latter being replaced from time to time. The output and efficiency vary with the current density.

Copper Market Situation.

Improvement of an appreciable character has taken place in the copper market during the last few weeks and the retrograde movement of last month has been checked. Prices are about one-quarter to three-eighths of a cent higher than they were about the middle of June. Europe has continued to take our copper at an unprecedented rate every month this year. With the broadening of the foreign market copper producers are less dependent on domestic consumers. An average of 19,000 tons of copper a month have been exported for the last six months, yet the visible supply in Europe, July 1st, stood at more than 4,000 tons less than on July 1, 1903.

Probable Electric Railway Across New York State.

Much speculation has been indulged in recently regarding the purchase of the Syracuse (N. Y.) Rapid Transit Railway Company's property and the combination that will be made between the Andrews-Stanley syndicate, the purchasers, and the Vanderbilts, who have become heavily interested with them both in this and the Utica and Mohawk Valley electric roads. Horace E. Andrews has been engaged on this plan for two years and as a result sees before him the possibilities of a traction line across New York state with an entrance to the metropolis. The connection to be established between the traction roads and the New York Central, a Vanderbilt property, will be through the West Shore railroad, a portion of which will be equipped with electricity at once to make the connection between the Utica and Mohawk Valley and the Syracuse Rapid Transit. However, it is expected that more of the road, which was recently rebuilt, will be used later on and cars will go directly into New York city. At first the portion of the Andrews-Stanley property that parallels the West Shore road will be used for local business and the through cars will go over the railroad by means of a third-rail system. This will give an excellent service, and Mr. Andrews expects to see the largest system of electric roads built up from this connection in the world.

The Utica and Mohawk Valley has 102 miles of track and the Syracuse Rapid Transit 67. With the portion of the West Shore to be used the syndicate will have 283 miles of road. A company will probably be organized within a short time to take over both systems, or one will purchase the other, probably the latter, as at a meeting held recently E. V. W. Rossiter, first vice-president, and John Carstensen, fourth vice-president of the New York Central, were elected to the directorate of the Syracuse Rapid Transit, while Mr. Andrews was chosen president. H. B. Newcomb and H. D. Coffinberry of Cleveland will remain on the board of directors. Mr. Andrews will be the executive head and manager of the company that takes over the property, and under his guidance the development of the trolley enterprise will proceed. He will retain his office of president of the Cleveland Electric Railway Company and remain a resident of Cleveland, but will keep in close touch with all that takes place on the New York properties. The Utica and Mohawk Valley was built for service and the best construction work was employed. The Syracuse property is also in splendid condition. This places the new arrangement upon a strong footing for business that will be developed through the new connections.

The report that the Vanderbilt interests would at once invade the West and that all the roads entering Cleveland would be united under one company was promptly denied by those in authority. No plans have been made so far as is known for such a combination. Not many of the roads in Northern Ohio come in competition with the Lake Shore as they did with the New York Central. They will act as feeders rather, and for this reason the Vanderbilts will probably cultivate a closer friendship with them.

An attempt has been made to purchase the property of the New York and Long Island Traction Company, which is owned by George A. Stanley and other Cleveland men, but they have refused to sell. The road is only partially built and has not yet shown its value. It touches a number of large residence towns and will be a valuable property when completed.

The franchise of the Louisville (Ky.) and Mt. Washington Electric Railway Company has been revoked by the Fiscal Court because the company failed to begin construction within the time limit. The intention was to build a line from Louisville out the Bardstown Pike to Mt. Washington and Fairfield.

British Hydro-electric Plant at Oates-Royd Mills.

Great Britain offers very little opportunity for the development of waterpower, as the rivers are comparatively small and the fall not great. Still there are opportunities for the installation of small waterpower plants which will operate profitably. As an example of such an installation the hydro-electric plant at Oates-Royd Mills, Luddenden, Yorkshire, is described in the Electrical Magazine.

The entire plant, as now extended, consists of three units. By reason of the conditions governing the water supply, the plant has been installed in two separate power houses, shown in Fig. 1. Fig. 2 is the interior of No. 1 house, in which all three generators are placed, and of these the end

FIG. 1. TWO POWER HOUSES OF BRITISH HYDRO-ELECTRIC PLANT.

ones are direct connected to their respective turbines, the center one being belt driven from a turbine fixed in an adjoining building. This first plant derives its water from two sources. The mill furnished with electricity is driven by three steam engines, and the surplus condensing water, collected in a 2,600-gallon tank, is delivered to the power house, 190 feet below, through 12-inch cast-iron pipes, the flow equals 120 cubic feet a minute in winter and 20 cubic feet in summer; this constitutes the first source. The second source is a disused mill dam, some 300 yards from the first mill, draining the adjoining hill land. Water from this is allowed to fill during the day and night, and furnishes water from 6 to 8 a. m. and 4 to 5 p. m., producing about 13 kilowatts. There is a fall of 140 feet from this dam to the power house. The third turbine is supplied from the River Ludd, which flows through the valley past power house No. 1. A public path separates the river and building, consequently the third

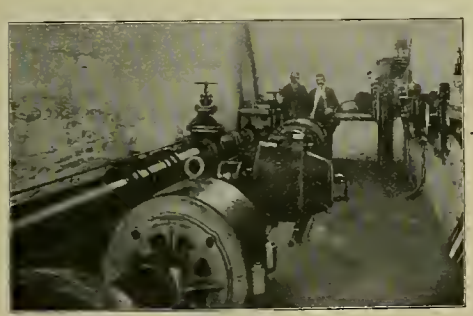


FIG. 2. INTERIOR OF POWER HOUSE NO. 1, BRITISH HYDRO-ELECTRIC PLANT.

turbine could only be installed on the opposite bank, as will be seen in Fig. 1. A hundred yards up stream is the dam providing the necessary fall, and from this a goyt was built to power house No. 2, a tailrace being sunk to about 50 yards downstream. In building both goyt and tailrace, the hillside formed the back wall, and the stone taken out was used for the front wall and bottom of the goyt, the tailrace being sunk in solid rock. The turbine operates a vertical shaft, bevel-geared into a horizontal shaft, crossing the river on 12-inch H-girders, and terminating in a 60-inch pulley wheel inside power house No. 1. The distance across the river between the buildings is 40 feet. The turbine runs at 108 revolutions per minute, the main shaft 170 revolutions per minute, and the dynamo, to which it is belted, 650 revolutions per minute. The two sources of water in No. 1 power house are controlled by piping and valves, arranged to divert either supply to either turbine, or to run both turbines from one supply.

The above are the chief hydraulic features of the plant, the electrical arrangements calling for no special comment, except that automatic switches are used wherever possible. The generators are run up singly and switch themselves in on the line when up to voltage, and continue running without attention. The battery installed at the mill is under control of special switches, and when placed in circuit needs no other attention than regulating about every half hour.

Three machines are run for the full load, but during the day only one is used for battery charging. The combined plant has a capacity of 76 kilowatts. It furnishes current to about 1,300 lamps.

"Wrinkles" for Central-station Practice.

In the "wrinkle" department of the Boston National Electric Light Convention there are described two things which will be found very handy by the average central-station operator. One of these is a method of showing the difference between new and old incandescent lamps and was presented by E. H. Mather of Portland, Me.

With companies whose customers purchase their own incandescent-lamp renewals it is frequently necessary to adopt some method to induce the customers to renew dim lamps before they burn out. The following has been used with good satisfaction:

Two standard lamp sockets are attached rigidly to a small strip of brass, as shown in Fig. 1, and wired in multiple to a lamp cord that is connected to a standard attachment plug. Upon receiving complaint of poor lights, an inspector takes this two-light device and a voltmeter to the house or store making the complaint, and after ascertaining to his own satisfaction, by the use of the voltmeter, that the potential is all right on the secondary wires,

FIG. 1. LAMP-TESTING DEVICE FOR CENTRAL STATIONS.

shows the complainant the difference in illuminating power between an old and a new lamp. To one socket of the two-light device he attaches a new lamp, and to the other socket one of the lamps complained of; then, after turning out all lights in the room, the two-light device is held over a newspaper and the old light turned on, then cut off and the new light turned on; this repeated two or three times shows the difference between the two lamps.

This method of demonstration is more effective

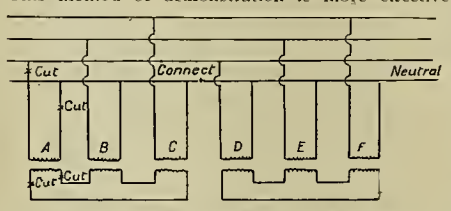


FIG. 2. CONNECTIONS FOR USING TRANSFORMERS AT FULL CAPACITY.

to the layman than a voltmeter test, and, ordinarily, it is not difficult to convince a customer that the discolored lamps need to be replaced by new ones.

Fig. 2 shows connections for making use of two transformers to their full capacity when two sets are connected in Y to the same primary and one transformer of one set burns out.

Where two sets of transformers are used with the same primary voltage and connected in Y, if one transformer burns out, the other two transformers can be used up to their capacity by connecting the neutral of this set of transformers to the neutral of the other set, and cutting out the burned transformer secondaries connected delta, as shown in the diagram. The latter wrinkle was contributed by H. C. Hoagland of Kalamazoo, Mich.

Electrolyte for the Wehnelt Interrupter.

In a paper recently read by D. E. Hauser before the Spanish Physical and Chemical Society it was stated that the use of a sulphuric solution in connection with the Wehnelt interrupter, as so far employed, presents two essential drawbacks—first, the necessity of a relatively high voltage as required for its operation, and second, a comparatively high current traversing the primary of the Ruhmkorff coil, according to the great value of the voltage. The first difficulty, which only concerns small coils, has partly been overcome by Mr. Carpentier by augmenting the conductivity of the electrolyte, raising the temperature of the latter by a rather complicated arrangement. The second drawback has so far been obviated by increasing the resistance of the interrupter, diminishing the surface of the platinum point so as to have the latter reach an incandescent state at a much lower expense in current. Another process for diminishing this increase in inefficient current consists in using an electrolyte, which under otherwise equal conditions gives rise to an increase in the number of interruptions of the current traversing the primary of the coil, and according to the great self-induction of the latter, to an increase in the inductive resistance. This increase results in the intensity of the current in the primary being diminished without any absorption of energy. The electrolyte best fulfilling this condition is a half-saturated solution of magnesium sulphate slightly acidulated with sulphuric acid. This electrolyte, though exhibiting a considerable conductivity, is not corrosive, and allows of starting the operation at a much lower voltage, although it works perfectly well as far as 118 volts, the author having discontinued his work with this limit.

In the tables recorded by the author some experimental results are given, beginning with the sulphuric solution of the specific weight of 1.195 and adding afterward to the latter successively increasing amounts of magnesium sulphate or potassium alum. In order to separate the effects due to the sulphuric acid from those caused by the salts, the author employed in a second series of experiments, first, a more concentrated solution of sulphuric acid without salts, and afterward a sulphuric solution more diluted and containing increasing amounts of salts.

As a result of these experiments a considerable decrease in the intensity of the current necessary to excite the interrupter has been found. With a solution of sulphuric acid of the specific weight of 1.195, the interrupter would begin working for 65 volts and 26 amperes, but with considerable oscillations in the indications of the measuring instruments. Using a solution of sulphuric acid of the specific weight of 1.050, containing 20 per cent. of magnesium sulphate, the interrupter has been started at 20 volts, with a consumption of only five amperes. Only at a point corresponding with 118 volts have 20.5 amperes been reached, whereas with the sulphuric solution more than 25 amperes were necessary under equal conditions, and with a number of interruptions much lower than with the magnesium solution.

The above voltages indicate the number of volts absorbed while the primary and the interrupter were connected in series. The influence of potassium alum is very singular, the number of interruptions being very much increased even for lower voltages. Further experiments were made with electrolytes containing sodium bichromate, the results being much inferior to those obtained with the above solution, besides the drawback of a very considerable corrosion. A current of 20 amperes was the maximum limit which the arrangement of these experiments would allow. A. G.

Western Electrician's Register at the World's Fair.

Among those registered at the Western Electrician's booth at the fair since last week are P. C. Burney, Austin, Texas; J. Austin Brooks, Manchester, Eng.; Miss Carrye Montgomery, San Francisco, Cal.; Philip B. Woodworth, Lewis Institute, Chicago; Frank Clark, Chicago; James L. Uno, Hoboken, Mich.; W. B. Larrabee, New York; Fred L. Barrett, Houghton, Mich.; Milton Hartman, Cleveland, Ohio; Harry Burns, Macon, Ga.; Walter R. Jacobs, Portland, Me.; C. F. Newsom, Indianapolis, Ind.; C. H. Klein, Baltimore, Md.; E. V. Zoeller, Torbon, N. C.; V. Karapetoff; J. Schunster, St. Louis; Robert Reggott, Bradford, Eng.; W. J. McClennan, Albany; M. A. Kuss, La Salle, Ill.; Otis Meyres, Memphis Telephone Company, Memphis, Tenn.; G. W. Brady, W. Scheidel Company, Chicago; P. A. Haradon, Harrisburg; T. M. Work; V. V. Newell, Lane & Bodley Company; J. B. Simons, Indiana, Pa.; F. Rauch, Chicago; E. M. Green, Fredericksburg, Va.; P. A. Reed, Kansas City, Mo.; L. A. Strader, Richmond, Va.; J. Navarro Viola, Buenos Ayres, Argentina; F. M. Frelles, Buenos Ayres, Argentina; H. Mahler, Chicago; R. N. Palmer, Norwich, Ontario, Canada; S. K. Rhoads, Altoona, Pa.; Robert N. Davidson, St. Louis; J. E. Sayer, Bham, Ala.; H. W. Helman, St. Louis; John Albrecht, Berlin, Germany; W. J. English, New York; T. C. Ralph, St. Louis; J. Jackson, St. Louis; M. A. Bryte, San Francisco, Cal.; John L. Peters, New York.

Magnetic Club Outing.

The outing of the Magnetic Club of New York this year, being the seventeenth annual, was, as usual, very enjoyable. Cove Hotel, Livingston, Staten Island, was the scene of the event and about 80 persons attended the festivities. The Western Union Telegraph Company tendered its coal boat Western Union, which conveyed most of the number to the grounds. On arriving a light luncheon was served and then the programme of track and field contests was carried out. The winners of the various events received valuable prizes. Dinner was announced at the conclusion of the games and for two hours a merry scene presented itself about the tables. President Jones made an address and heartily welcomed all present. Secretary Murphy read letters of regret from many prominent men who were unable to be present. After dinner the prizes were awarded. Each member to qualify for a contest was required to contribute a small sum to the relief fund of the General Slocum disaster. This resulted in a fund of $25, which was sent to Mayor McClellan of New York.

The consolidation of the Detroit, Ypsilanti, Ann Arbor and Jackson Railroad Company and the Jackson Consolidated Traction Company, both electric roads operated in the state of Michigan, has been completed. The consolidated property is under the control for a term of years of the following managing committee: Walter C. Kerr of New York city, George C. Smith of Pittsburg, L. H. Hole of New York, W. N. Coler, Jr., of New York, J. D. Hawks of Detroit, S. F. Angus of Detroit, and W. A. Boland of Jackson, Mich. The property is to be operated as one system with J. P. Clark, formerly with the Indiana Union Traction Company, as general manager. Detroit is the eastern terminus, and Jackson the western terminus of the system, which has a total mileage of 125 miles.

Division of Load Between Compound-wound Direct-current Generators.

[From the Question Box of the National Electric Light Association.]

QUESTION.

How can compound-wound, direct-current generators of different types and sizes running in parallel be made to divide the load automatically?

ANSWERS.

William R. Gardener: If the difference is small, it may be compensated by means of the hand regulator, but if large, then german-silver or copper-ribbon resistance should be inserted in series with the series coils of the dynamos. The work done by each machine may then be increased or diminished by varying the resistance and each machine be made to take only its own share of the load.

A. Peters: The series winding of all machines must have the same drop to bus bars when the current for which each machine is rated is passing through the series coils of that machine.

F. W. Bullock: My experience has been that with 75-kilowatt General Electric compound-wound, multipolar, 125-volt, direct-current machines operating in parallel with 33-kilowatt, Thomson-Houston bipolar, compound-wound, 110-volt, direct-current machines the larger machines have a tendency to carry more than their share of the load. To make them divide the load automatically I remove the shunts of the smaller machines so that their series coils compound at full strength, and, then by increasing or decreasing the resistance of the shunts to the series coils on the larger machines make them divide the load automatically with the smaller machines.

J. Manley: Put the machines in parallel under full load and adjust the rheostat until they divide the load equally and the voltage is right at the center of distribution; this means the pressure at the bus bar. Call this A; next, run one dynamo without any load and adjust the rheostat until the voltage equals the voltage of the lamps. Put on full load and adjust the shunt in the field winding until the bus pressure equals A. This must be done without moving the field rheostat. Do the same with other machines and they will divide the load equally.

Augusta Railway and Electric Company: When the voltage curve from no load to full load of both machines is the same they will divide the load automatically if speed is kept constant.

F. M. Farmer: By first adjusting all the machines individually for the same degree of compounding, either "flat" or "over" as desired, and then adjusting the resistance of each series field circuit (by inserting cable in series it necessary) inversely as the capacity of the machine. That is, with one machine as a standard and requiring no change, another machine with half the capacity should have twice as much resistance in its series circuit.

M. P. R., New York Edison Company: By shunting some of the current from series field winding of stronger machine through a resistance connected in parallel with it; or, by adding turns to series field winding of weaker machine.

L. J. Lisberger: Compound generators can be made to operate in parallel, dividing the load proportionally and automatically, by using the usual equalizer connection. The generators will most probably have different characteristics curves, but can be regulated as a rule through the medium of the shunt field. Often good results can be effected by the removal or addition, as the case may demand, of some of the resistance of the shunt across the series field.

New Members of the Institute.

At the directors' meeting of the American Institute of Electrical Engineers, held in New York city on July 19th, 50 new names were added to the list of associate members. Among the number were the following-named:

O. W. Barnhart, North Shore Electric Company, Evanston, Ill.; Orrin Burch, Union Carbide Company, Saulte Ste. Marie, Mich.; B. C. Condit, American River Electric Company, Stockton, Cal.; C. E. Condit, Tonopah Light and Power Company, Tonopah, Nev.; F. W. Ells, Browning Manufacturing Company, Milwaukee, Wis.; J. H. Fahnestock, Chesapeake and Potomac Telephone Company, Washington, D. C.; H. W. Goode, Portland General Electric Company, Portland, Oregon; A. G. Grier, Western Electric Company, Chicago, Ill.; O. F. Kern, Mt. Whitney Power Company, Three Rivers, Cal.; Paul Lebenbaum, Southern Pacific Company, San Francisco, Cal.; Anson Marston, Iowa State College, Ames, Iowa; J. E. Mateer, Westinghouse Electric and Manufacturing Company, Wilkinsburg, Pa.; W. N. McKee, Mowcaqua Electric Company, Mowcaqua, Ill.; R. W. Myers, United States Engineers, San Francisco, Cal.; J. B. Riddle, Ashburton Mining Company, Fair Oaks, Cal.; E. G. Robinson, Ballard Electric Company, Ballard, Wash.; F. G. Tracy, C. G. Tracy & Co., Glyndon, Minn.; H. B. Warren, Warren Electric Manufacturing Company, Sandusky, O.; W. A. Whittlesey, Pittsfield Electric Company, Pittsfield, Mass.; R. I. Wright, Electric Controller and Supply Company, Cleveland, O.; T. H. Yawger, Rochester Gas and Electric Co., Rochester, N. Y.

The Canadian Pacific Railway is proposing to use electrical power for the operation of its big plants throughout the West and will develop waterpowers to acquire the electrical energy. For this purpose the company is receiving the assistance of W. F. Kingsbury of the Westinghouse company of Pittsburg, who has been looking over the railroad company's new electrical plant at Fort William and also examining into the possibilities of waterpower there. In Winnipeg Mr. Kingsbury will make a thorough investigation into the electrical equipment of the new shops.

The Electrothermic Production of Iron and Steel.[1]

BY ALFRED STANSFIELD.

Although the electric furnace is still in its infancy, and its full powers are unknown, it is quite obvious that the possibility of applying heat exactly at the required point, of producing a temperature which may be as high as that of the electric arc, and of doing this without being obliged to blow through the furnace a stream of air and other gases is one that, in certain cases, may outweigh the greater cost of electrical energy. A very high temperature can easily be produced by electrical heating in a furnace containing strongly reducing gases, and this fact has already been utilized in the production of certain alloys of iron, such as ferro-chrome, ferro-tungsten, ferro-silicon, etc., in which cases the value of the alloy and the difficulty and expense of producing it by ordinary furnace methods has led to the use of the electric furnace in preference to cupola or crucible furnaces, in spite of the greater cost of electrical heat. Is it possible, however, that the expensive electrical energy will ever be used commercially for the production of iron or steel, metals which are produced with ease and economy by ordinary furnace methods? The answer to this question must depend mainly upon the relative cost of fuel and electrical energy. There are at present no electrical iron or steel-smelting furnaces equal in size to a modern blast furnace, or even an open-hearth furnace, so that satisfactory demonstrations of their efficiency on a large scale are still lacking, but the great efficiency of electrical heating enables us to predict, with a fair degree of accuracy, the amount of energy that such furnaces would require, and such calculations are supported by the working results of small furnaces already in operation.

The author has obtained a number of figures for the cost of production and the selling price of electrical power, and these placed the cost of producing an electrical horsepower, under very favorable conditions, from waterpower, at 0.13 cent per hour, while the price at which it might be bought would be 0.16 or 0.17 cent, and in exceptionally favorable cases even lower figures might be obtained, it being understood that very large outputs are considered, that these are to be employed near the source of power and that the power is to be used continuously 24 hours a day and 365 days a year.

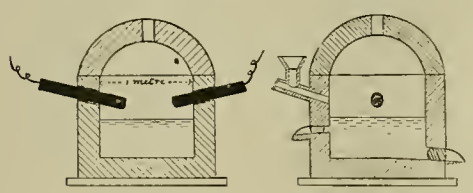


FIG. 1. STASSANO FURNACE.

The problem may be considered in two ways, either as a simple iron-smelting proposition, in which electric power is purchased with the other supplies, or as a scheme for the utilization of a waterpower in which the iron smelting is merely considered as a means to that end; and the price charged for electrical power would probably be different in these two cases.

Let us suppose that the iron smelter purchases power at 0.15 cent per electrical horsepower-hour, or 0.2 cent per kilowatt-hour. If 2,500 kilowatt-hours are required for the production of one metric ton of pig iron, the cost for electrical energy would be $5.

Against the cost of the electrical power may be set the cost of the fuel that is saved by using electrical heat. About 0.6 of a ton of coke is saved per ton of iron produced, and this, at $2.50 a ton, would amount to $1.50 per ton of iron.

Dr. Goldschmidt considers that the carbon electrodes used in the electric furnace will cost about 70 cents per ton of iron, and against this figure should be set the saving effected by the absence of blowing engines and hot-blast stoves.

We may, therefore, consider that the prices of fuel and of electrical power are the main factors to be considered as determining the relative cost of the two methods of smelting iron ores. It is quite clear that electrical smelting of iron ores cannot compete with the blast furnace using coke at $2.50 a ton, even in places where very cheap waterpower is available, but if the price of coke were $8 instead of $2.50, the saving of coke and blast would about equal the cost of the electrical heat, so that in localities where furnace coke costs upward of $8 a ton and where cheap waterpower could be obtained, it might be better to smelt iron ores electrically than by means of coke.

The methods usually adopted by electrometallurgists for the production of steel resemble more closely the open-hearth and crucible processes. Cast iron, obtained electrically or in the blast furnaces, is melted electrically, together with steel scrap and pure iron oxides, the impurities in the charge are eliminated, mainly as oxides in the slag and a metal is obtained which may retain the desired amount of carbon, or may be recarburized by suitable additions in the furnace or the casting ladle.

The electrothermic production of steel from intermediate products, such as pig iron and steel scrap, with the usual additions of iron ore, has been attempted by several experimenters. Kjellin's electric induction furnace is stated to be capable of producing molten steel from cold pig iron and scrap at the rate of one metric ton of tool steel for 800 electrical horsepower-hours,[1] the cost for power being, in this case, about one-fourth of that incurred in the production of pig iron from the ore—that is, about $1.25 per metric ton of steel. The conditions were exceptionally favorable, as charcoal iron was used; but, on the other hand, the use of molten pig iron would have further reduced the expense for power. The steel was said to be exceptionally good, and this was attributed to the absence of dissolved gases. Very little exact information is available in this connection, but it is considered that the superiority of open-hearth steel over Bessemer steel and of crucible steel over open-hearth steel is due, not entirely to a greater degree of freedom from the ordinary metalloids present in steel, but in part, at least, to the degree of freedom from dissolved gases, such as oxygen, nitrogen or hydrogen, these gases being likely to be most abundant in Bessemer steel and least abundant in crucible steel.

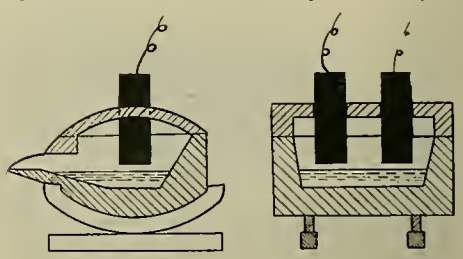


FIG. 2. HEROULT FURNACE.

Probably the greatest field of usefulness of the electric furnace in the metallurgy of iron and steel will be in the production of crucible steel. As it still pays to fuse this material in small amounts in crucibles, in order to protect it from the gases unavoidably present in an open-hearth furnace, it seems probable that the electric furnace which can fuse steel more cheaply than the crucible process and can protect it quite as effectually from any gases that may be found objectionable, must replace the crucible furnace.

It may also be expected to replace partly the open-hearth furnace, in the production, for example, of the more expensive varieties of steel in which the expense of fusing is of less importance than the soundness of the product.

Very many different types of furnace have been used for the electrothermic smelting of iron ores or the production of steel, but they may all be placed in one of two classes: (1) furnaces heated by means of an electric arc, and (2) furnaces heated by the passage of an electric current through the charge itself or through some poorly conducting part of the furnace.

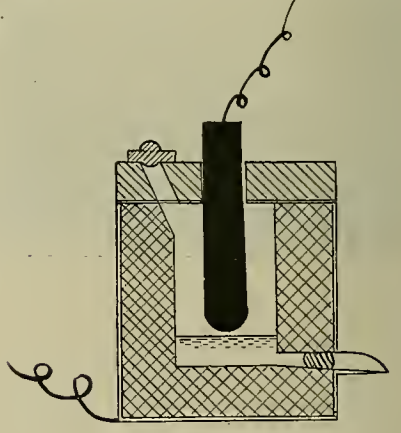


FIG. 3. SIEMENS FURNACE.

The Stassano and Heroult furnaces are examples of arc furnaces, and the Keller, Harmet and Kjellin furnaces depend upon the heating effect of an electric current flowing through the charge itself. The Stassano furnace (Fig. 1) is constructed of masonry and is lined with magnesite bricks. The working chamber is rectangular and is one meter square and one meter in height, with an arched roof or lid. The position of the carbon electrodes and the charging and tapping openings is clearly shown in Fig. 1, while a pipe through the lid removes the carbon monoxide resulting from the reaction.

An alternating-current arc is maintained between the carbons, which can be drawn apart by suitable mechanism, and the ore mixed with coal or charcoal is fed in at the side of the furnace and lies below the arc. The ore must, therefore, be heated by conduction and radiation from the intensely hot arc which occupies the upper part of the furnace, the method of heating being like that in the open-hearth furnace. An alternating current of 2,000 amperes at 170 volts is used in the arc, which, when the furnace

1. Abstract of paper read before a recent meeting of the electrical section of the Canadian Society of Civil Engineers.

1. This figure is an estimate of the output from a 1,000-horsepower furnace, the actual results obtained with a furnace of 200 horsepower were considerably more costly. Electro-Chemical Industry, Vol. I., 1903, p. 576.

has become hot, traverses the whole width of the furnace and consumes about 450 horsepower.

While the use of the electric arc has certain points in its favor, it seems unlikely that the greatest economy can be obtained in this way. Thus, for example, the heat can only penetrate the ore by conduction through the mass, and, meanwhile, heat is being lost by conduction through the upper walls of the furnace. Also the ore is not preheated before entering the fusion chamber and the waste gases, by passing through the arc on their way out, tend to escape at a very high temperature, and so to waste heat which might have been employed in pre-heating the ore charge.

In fact, both the pre-heating and the partial reduction of the ore might be effected by the hot carbon monoxide escaping from the furnace. The furnace was working in Italy on local iron ores and produced steel directly from the ores. Dr. Goldschmidt concluded that the steel would cost $18.-80 per metric ton and that the process could not be economically introduced into Germany.

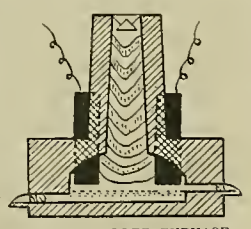


FIG. 4. KELLER FURNACE.

The Heroult furnace is like a tilting open-hearth furnace, and has two vertical carbon electrodes, as shown in Fig. 2. The current flows from one of these into the charge of ore or metal to be melted and back on to the other carbon, thus producing two ares between the carbons and the charge, which is also heated to a certain extent by the passage of the current through the molten slag and metal. The furnace was used at first for the direct reduction of iron ores, but has been found to be more suitable for the production of steel from scrap and pig. The transmission of heat from the arc to the charge will probably be better in this furnace than in the Stassano furnace, but considerable losses of heat must take place through the holes in the roof through which the electrodes enter.

The Siemens furnace (Fig. 3) has been frequently used for the reduction of metallic oxides and for melting metals. It consists of a crucible composed wholly or in part of carbon which is connected to one of the leads, while a carbon electrode which dips into the crucible is connected to the other. An arc is formed between this electrode and the contents of the crucible, and fresh quantities of the ore can be charged in from above until the crucible is full of the molten metal and slag.

The Siemens furnace is very convenient for experimental work on the reduction of difficulty fusible metals, such as chromium, tungsten, titanium, etc., and A. J. Rossi has employed it on a larger scale for the production of ferro-titanium and similar alloys.

The Keller furnace for the reduction of iron ores (Fig. 4) is of the resistance type. It is similar in construction to an iron blast furnace, except that the crucible of the Keller furnace is larger in section than the stack. Four carbon electrodes are inserted vertically into this enlarged crucible and dip into the slag. The current is carried by the fused slag and metal from one electrode to another, and, in this way, the charge is heated. The gases resulting from the reduction of the oxides in the ore pass up through the descending column and give up their heat to the ore and also effect the reduction of a part of the iron. The molten iron and slag are tapped out at intervals in the usual manner. The method of heating adopted in this furnace is more conducive

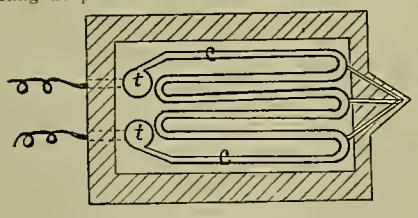


FIG. 5. GIN FURNACE.

to economy than is the heating by electric arc as in the Stassano furnace.

The Keller furnace, moreover, is suited to continuous introduction of fresh charges of ore, while the Stassano furnace is worked intermittently, which must tend to a waste of heat. Furnaces of the resistance type are also able to supply heat more or less uniformly through a large mass of ore and are, therefore, better suited than are furnaces to large scale operations. In the Keller furnace, however, it seems probable that the current would be carried from one electrode to the other, largely through the molten iron in the crucible, and as this is a relatively good conductor, most of the heat would be developed in the molten slag immediately surrounding each electrode, while the middle of the furnace would tend to be cooler.

In the manufacture of steel an intermittent method of smelting must be adopted in order to adjust the composition of the steel, and such furnaces as the Stassano and Heroult would appear to be suited to this, while the reduction of ore would be best effected in the Keller or similar furnaces in which continuous smelting and pre-heating of the charge is provided for.

The Kjellin and the Gin furnaces are remarkable, because in them the heat is produced by the passage of the current through the molten metal itself, instead of through the fused slag or through the air above the charge.

In this method a difficulty arises on account of the low specific resistance of the metal, because an enormous current would be required to heat up a bath of moderate size. Gin endeavors to overcome this difficulty by making his furnace in the form of a canal (cc) (Fig. 5) which is folded on itself and contains the metal; the current is introduced through water-cooled metallic terminals of large section (tt). It is intended to tap the steel from the three loops of the canal simultaneously. The canal is formed in some neutral refractory material like chrome iron ore.

The numerous difficulties which are likely to occur in connection with the use and maintenance of such a furnace are too obvious to need mentioning, but the principle employed may, perhaps, be developed in a somewhat different form.

The Kjellin furnace (Fig. 6) consists of a circular canal (cc), containing the metallic charge, which forms the secondary winding of a transformer of which (pp) is the primary coil and (aa) the iron core. In this manner an enormous current is produced in the molten metal without the necessity for any terminals to lead in the current. A furnace of this type has been successfully used for the production of steel, but the shape of the furnace would not be conducive to the production of steel of a uniform composition.

The Kjellin furnace has been used for the production of steel from pig and scrap, a certain amount of metal being left in the furnace to carry the current in the early stages of the following charge, but if molten pig iron were employed, this would be unnecessary.

The Gin furnace is intended to be used in the same way, but is still in the experimental stage.

The electric furnace, using carbon electrodes, is especially suited to operations of a reducing character, as the electrodes are then protected from loss by oxidation. In the production of steel, however, an oxidizing slag is employed to remove the im-

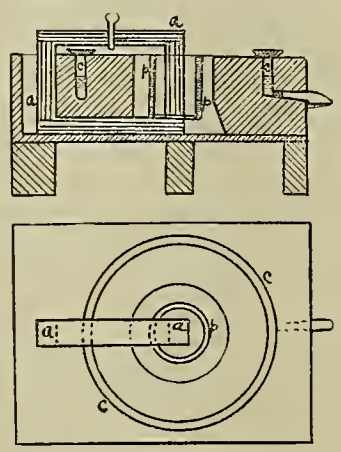


FIG. 6. KJELLIN FURNACE.

purities from the pig iron, and this slag would tend to corrode the carbon electrodes and itself to become deoxidized, and, therefore, unfit to refine the iron. This difficulty is met in the Heroult furnace by keeping the electrodes above the surface of the slag, so that the current passes into the charge by means of an arc. In the Gin furnace water-cooled metal electrodes are used, and in the Kjellin furnace electrodes are dispensed with altogether.

The production of crucible steel in the electric furnace may be considered to be possible both technically and financially, and furnaces might be installed for the production of tool steel, which at present is largely imported, the electric current being produced by means of waterpower or by gas engines run by blast-furnace gas. The utilization of titaniferous iron sands is a problem of considerable importance. These sands are difficult to smelt, partly because sandy ores are difficult to treat in the blast furnace and partly on account of the titanium, which produces a very infusible slag.

In smelting such ores in the blast furnace the titanium passes almost entirely into the slag, the iron produced carrying not more than a few tenths per cent. of titanium, but even this small amount appears to decidedly improve the quality of the iron for certain purposes.

In the electric furnace more strongly reducing conditions can be obtained than in the blast furnace, and it is possible to smelt a titaniferous ore so as to obtain a rich ferro-titanium, the titanium being reduced to the metallic state instead of remaining as oxide in the slag.

At a recent meeting of directors at Denver, Colo., J. R. McKinnie of Colorado Springs was elected president of the Denver-Boulder interurban electric railway, which proposes to expend $10,000,000 on lines. S. Simpson of Cleveland, Ohio, and Shirley Moore of Louisville, Ky., are members of the board of directors. Right-of-way has been secured and work will begin this fall.

Cost of Trackless Trolley Roads.

As regards the question of cost of trackless trolley roads the figures furnished by the Berlin General Electric Company in its operation of the Haida railroad are instructive. These show that a trackless overhead trolley car, capable of holding 22 persons, used about the same electric current as an ordinary street car, having room for 28 persons. With the trackless railroad about 25 per cent. more electric current was used than on regular street cars. It should also be said that the maintenance of the cars, owing to a greater wearing out of the rolling stock, and extensive need of lubricators, etc., is larger than on track cars. On the other hand, this higher cost of maintenance is met by an expense for tracks and the keeping of them in good condition.

A track road for every kilometer costs from $20,000 to $30,000, while a trackless road can be built for $3,750 to $5,000. A trackless road three kilometers long, now in active operation, estimated its cost at about $4,500 per kilometer, or a total of $13,500 for the whole distance.

The total cost per kilometer is five cents, or 15 cents for three kilometers. This five cents per kilometer compares favorably with that of the Great Berlin Street Car Company, which estimates its actual cost of operation at 5.17 cents a kilometer, and other street-car lines in Germany even report 6.25 cents per kilometer.

Similar favorable figures are given by Schiemann in the operation of the trackless line in the Bila Valley. According to the latest reports, after a three months' operation, the cost of electric current used was double that of a track road. This greater utilization of current was, however, only one-tenth of the sum which track roads require for interest and maintenance.

A large part of the income of the trackless roads is obtained by the carrying of freight, which is a source of profit even when the passenger traffic is inadequate. Furthermore, legally considered, the trackless roads are very useful, for they are not required to meet such stringent conditions as are asked of electric track lines. As a matter of fact, the streets are not at all injured by the trackless cars, but have a smoothening effect on the pavement over which they pass. It is believed here that even on asphalt pavement trackless cars can be successfully used.

Aerial Cable Across Great Salt Lake.

The particulars of a telegraph cable to be stretched across Great Salt Lake are given in the Telegraph Age, as follows:

A 35-mile heavy aerial cable, carrying 19 wires, will soon be stretched across the Great Salt Lake along the Lucin cut-off. The work will be done jointly by the Southern Pacific and the Western Union and will be the main line for all railroad and commercial-telegraph business between Salt Lake City and the coast.

When the great cut-off was first thought of it was informally planned to stretch the wires in the regular way along the track, but when the engineers got their first idea of the high winds on the lake it was at once demonstrated that the wires would not last long in such an unprotected place, and then it was thought that a regular ocean cable would have to be laid. But this was impracticable, too, as it was found that the action of the water would ruin the cable in a short time. So, as a last resort, it has been decided that the only way will be to stretch a solid cable across the whole of the lake section for about 35 miles. The wires will be fully insulated and protected and the cable will be strung just as strongly as it is possible to do the work, so that no trouble will result from high winds or higher waves. It will be a novel telegraph line, but then everything is novel about the Lucin cut-off.

Michigan Electric Association.

Electric-light managers and superintendents of Michigan met in Grand Rapids on July 20th and made permanent the temporary organization formed at Detroit on July 8th. The only business of importance transacted was the adoption of a constitution and by-laws. The association will be known as the Michigan Electric Association and will take in all interested in the production of electricity for light and power. The president was directed to select an executive committee to name the place and have charge of the first regular meeting, which will be held on October 11th. Mr. E. F. Phillips of Detroit is president and Mr. F. S. Hubbell of Milford, secretary, of the new organization.

Material has arrived in Jacksonville, Fla., for the construction of an electric railway to connect Jacksonville and Ortega. J. E. Butts, superintendent of construction, states that the road will start at the present terminus of the Riverside branch of the Jacksonville Electric Company and follow the bank of the St. Johns River. Arrangements have been made with the Jacksonville Electric Company to furnish the power for the road at present and also to furnish the cars, but it is the intention of the company to establish eventually an electric plant at Ortega for furnishing power and lights for that town.

WESTERN ELECTRICIAN

EVERY SATURDAY.

PUBLICATION OFFICES:
510 Marquette Building, - CHICAGO.

TELEPHONE, MAIN 1746.

Eastern Office, 193 Times Building, New York.
Telephone, 3806J Cortlandt.

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted. This paper is entered at the Chicago postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the old address as well as the new should be given.

CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—**the only general electrical paper published in the West**—thoroughly covers a territory *exclusively its own.* THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be furnished on application.

REMITTANCES.—All checks, drafts and other remittances should be made payable to the order of the publishers, the **Electrician Publishing Company,** and addressed to the offices of publication, Suite 510, Marquette Building (204 Dearborn Street), Chicago, Illinois, U. S. A.

CONTENTS OF THIS NUMBER.

Temporary Power Plant of Chicago First National Bank Building. Illustrated 75, 76
Brooklyn Rapid Transit Company's Extensive Improvements 76
Hazard-Flamand Electrolytic Hydrogen and Oxygen Cell. Illustrated 76
Copper Market Situation 76
Probable Electric Railway Across New York State 76
British Hydro-electric Plant at Oates-Royd Mills. Illustrated 77
"Wrinkles" for Central-station Practice. Illustrated 77
Electrolyte for the Wehnelt Interrupter 77
Western Electrician's Register at the World's Fair 77
Magnetic Club Outing 77
Division of Load Between Compound-wound Direct-current Generators. (National Electric Light Association) 78
New Members of the Institute 78
The Electrothermic Production of Iron and Steel. By Alfred Stansfield. Illustrated. (Canadian Society of Civil Engineers) 78, 79
Cost of Trackless Trolley Roads 79
Aerial Cable Across Great Salt Lake 79
Michigan Electric Association 79
Editorial 80
Anticipating Panama Canal Construction. By George E. Walsh 81
Heating Rates of Central Stations 81
Another Electric Railway Consolidation in New England. 81
Automobile Transit Company for Cleveland 81
Methods of Handling Toll Business. By F. S. Lane. (New York Independent Telephone Association) 82
Long-distance Connection for Oklahoma and Kansas Telephone Company 82
Ohio Telephone Notes 83
Telephone News from the Northwest 83
The Telephone in Kansas 83
New England Telephone News 83
Southeastern Telephone Developments 83
Ohio Independent Telephone Association 83
Extensions and Improvements 83
General Telephone News 83
The Origin and Development of Storage Batteries. By E. B. Walker. (Canadian Electrical Association) 84, 85
Inexpensive Testing Laboratory. (National Electric Light Association) 85
Further Development of Power Resources of the Niagara River 86
Lighting Situation in Bay City 86
Chicago Street-lighting Statistics 86
Sound-proof Telephone Booth. Illustrated 86
Security Drill Clamp. Illustrated 86
Cutler-Hammer Controller for Machine-tool Motors. 86, 87
Invers Time-limit Relay. Illustrated 87

DEPARTMENTS.

Correspondence 87, 88, 89
Great Britain 87
New York 87
New England 88
Dominion of Canada 88
Northwestern States 88
Ohio 88
Indiana 89
Michigan 89
Southeastern States 89
Rocky Mountain States 89
Pacific Slope 89
Personals 89, 90
Electric Lighting 90
Electric Railways 90
Societies and Schools 90
Publications 90
Miscellaneous 90, 91
Trade News 91
Business 91
Illustrated Electrical Patent Record 91, 92

DATES AHEAD.

Ohio Independent Telephone Association, Columbus, August 2d.
Ohio Electric Light Association (annual convention), Sandusky, August 16th to 18th.
International Electrical Congress, Hall of Congresses, St. Louis Exposition, September 12th to 17th.
International Association of Municipal Electricians (annual meeting), St. Louis, September 13th and 14th.
American Electrotherapeutic Association (annual convention), St. Louis, September 13th to 16th.
National Electrical Contractors' Association (annual convention), St. Louis, September 14th to 16th.
Colorado Electric Light, Power and Railway Association, Colorado Springs, September 21st to 23d.

VISITORS to the Louisiana Purchase Exposition at St. Louis who are interested in electricity or electrical literature are cordially invited to call at the booth of the Western Electrician, which is in Block 1 (Section 13) of the Palace of Electricity, just west of the main northern entrance to the building. Here will be found copies of the current issue of the paper, bound volumes of the Western Electrician from the first number, a careful selection of electrical books exhibited by the Electrician Publishing Company, and other objects of electrical interest. Chairs are provided for weary sight-seers, and an attendant will extend a hearty welcome to all readers or friends of the paper.

IN the running of alternators in parallel the question of excitation is an important one to successful operation. Some are of the opinion that a motor-driven exciter is adaptable to this work. Experience has pointed out, however, that considerable difficulty has arisen by its use, and has come about chiefly from the fact that any serious disturbance in the station voltage, such as might arise from a short-circuit on the line, has immediate effect on the motor of the exciter set or sets, and if the fall in the station voltage is great enough, even for a short period of time, the motor will be "killed," resulting in a shutdown of the station. As the voltage of the station depends upon the excitation, and the operation of the motor-driven exciter depends in turn upon the voltage of the station, it will be seen that such a combination is an extremely sensitive one and should not be adopted exclusively. Some such emergency apparatus as a storage battery to tide over momentary drops in the station voltage should be used as an insurance against possible failure of excitation. If it is especially desired to use a motor-driven exciter the induction motor is to be preferred to the synchronous motor for this purpose, since it is not so sensitive to disturbances of the line voltage, and it is not necessary that it remain in synchronism with the generators.

Now that the Panama Canal is assured, we naturally look forward with some expectancy to the activity which is likely to result to the electrical industry when work is actually begun on the great artificial waterway. The article by George E. Walsh appearing on another page of this issue anticipating in a general way what part electricity will play in the construction work is of interest. That there will be no such enormous expenditure of money upon machinery as was the case in the ill-fated French undertaking is to be expected, but the amount to be spent on electrical machinery should be much greater. Of the millions of dollars sunk in the French working plant, for machinery, very little was expended on electrical apparatus, for in the days of De Lesseps electricity was very little in evidence in work of this nature. With present methods, however, it will find application in almost all departments of the work. The decision to build the canal with American capital and American labor has not, as Mr. Walsh says, yet been fully appreciated by the general public. Manufacturers, however, are thoroughly alive to the possibilities in their respective lines, and those whose field is electrical machinery will no doubt have their fair share in the building of the new canal. A year will probably pass before the plans are completed and the work actually started, it being the intention to make all the preliminary arrangements so completely and thoroughly that everything will be ready for shipment at the proper time. When once on the ground the machinery will be subject to the ravages of the moist climate, which, in the case of the early apparatus used by the French, soon destroyed it in part or entirely. Here is an opportunity for an inventive mind to discover a really good preparation for metal which will preserve it in this climate.

THE electrical development and activity in Germany is constantly watched with keen interest by Americans. Not because Germany is such a large buyer of American electrical products, but because of the enterprise of Germans in modernizing their works and the readiness of German electrical engineers to consider and develop new processes and ideas for the advancement of the electrical industry. While this activity on the part of Germany warns of a possible strong competitor for the United States in foreign electrical trade, a glance at the report of the Frankfort Chamber of Commerce would seem to indicate no immediate cause for alarm on the part of American manufacturers. The second part of the annual report for 1903 contains statements made by large electrical companies in which the sentiment prevails that while the increased activity of Germany's industries during 1903 had a corresponding effect upon the electrical branch generally, yet the long-looked-for advance in prices and profits was not forthcoming on account of admitted keen competition. According to the Chamber of Commerce report, many orders were filled without profit, and many times goods were sold for less than the cost of production, this being due to the efforts of the great electrical companies to give as much employment as possible to their plants, which had been considerably extended and enlarged. Another cause for the lack of profits was the competition arising from the growth of native electrical industries in many foreign countries which heretofore had been profitable markets for German electrical goods. The strong efforts made by these domestic electrotechnical works to crowd out German supplies compelled German exporting concerns to offer exceedingly low terms in order to maintain their footing in these foreign countries. The high price of raw materials was also an obstacle under the above-noted business conditions. The prices of some of the raw materials advanced toward the close of the year; among these were copper, brass and dynamo wire. While the large electrical companies are thus shown to have realized small profits, for a time at least, yet the fact that the plants largely rank among the best, are electrically operated and are always employed, together with the enterprise and push of the men at the helm, keeps them always in the field as a strong competitor ready to grasp any opportunity that may present. German capitalists, coal proprietors and iron masters seem to realize how far the use of electric power may be utilized to cheapen the cost of production, and no doubt the wide application of electricity is an important factor which has added to the wonderful expansion of the mineral and metallurgical industries in Germany, Belgium and adjoining countries during the last decade.

WHETHER or not the chemical conversion brought about by cathode rays is purely an electrochemical phenomenon and in accordance with Faraday's law has been the subject of much experimentation among scientists. Dr. E. Bose of Göttingen University has made some close investigations of the simplest chemical action of cathode rays with a view to settling this question, the results of his experiments being given in the Physikalische Zeitschrift.

A solution of caustic potash, saturated in the hot state, was exposed for a long time to the effect of cathode rays in a convenient outfit, allowing of an electrolyte surface of about 80 square inches being radiated upon intensely, when a reduction attended by the formation of hydrogen was noted. The amount of electricity absorbed by the electrolyte was measured with the aid of a hydrogen voltameter under reduced pressure, this electricity being drawn off through a platinum electrode sealed into the bottom of the testing tube. As the gas present in the space where the discharges took place was partly dissociated into hydrogen and oxygen, a mixture of hydrogen and oxygen containing hydrogen in excess was withdrawn by means of a mercury air pump, and after the gases due to this dissociation were eliminated by an explosion the hydrogen in excess could be measured and its pure condition confirmed. The amount of hydrogen thus derived should, if the chemical effect of the cathode rays followed Faraday's law, have been equal to that evolved at the volameter, but the results were invariably the opposite of this, though of course no high degree of accuracy could be obtained with the apparatus. Over 10 times the amount of hydrogen was often derived from the partial vacuum than from the voltameter. There must therefore be, in addition to the electrochemical action, another chemical effect of cathode rays, due, obviously, to the kinetic energy of the cathode ray particles, this hypothesis being borne out by Dr. Bose's further observations. It was shown that under ideal conditions an amount of hydrogen even 1,600 times the electrochemical amount would be obtained. This result is, however, not arrived at, since in most cases the greater part of the kinetic energy of the rays is simply transformed into heat.

Anticipating Panama Canal Construction.

By George E. Walsh.

Although western engineers have so far apparently captured the largest prizes in the future building of the Panama Canal, the eastern manufacturers and shippers of electrical and other machinery will benefit a good deal by the enterprise. The full effect of the final decision to build the canal with American capital and labor has not been appreciated by the general reading public, but as preparations are now being made for beginning the work some estimates of its scope and character can be made.

In the first place the French working plant will be handed over to the American contractors, but from all trustworthy accounts this is in a sad state of decay and dilapidation. The millions of dollars' worth of machinery sent to the isthmus would be inadequate to meet the demands of engineers today, and very little of it would be used even though it were in a fair state of preservation. Through the wasteful practice of the early French companies money was expended in purchasing machinery that was of little real value even in those days. The dredges may be repaired so they can be used for some secondary work on the canal, but new modern American dredges of quite a different character will be needed.

The electrical equipment of the new plant that will be established on the isthmus will be one of the largest jobs ever undertaken by Americans outside of their own territory. Electricity will figure in nearly every department of the huge enterprise. In the days of De Lesseps it did not enter as an important factor at all, but engineering methods have changed considerably since then. Fully half the machinery that will be put in use on the isthmus will be directly or indirectly operated by electric current.

About a full year will be required to make the estimates and preparations for beginning excavation on the canal; but all this will be done so thoroughly and completely in this country that everything will be ready for shipment at the right time. The preparation will include the ordering of new machinery, the designing of electrical equipment for dozens of repair and manufacturing shops, and the assembling of different parts for final shipment. The detail work will thus all be finished in this country by the engineers before the first shipment of machinery is made.

In anticipation of this great undertaking there is an undercurrent of strength in several electrical lines, and manufacturers anticipate large orders the coming winter for certain parts of their products. Nearly everything made for the Panama plant will go down in duplicates, for the isthmus is too far away from manufacturing markets to permit of delays through breakdowns. In addition to sending duplicates of the machinery, repair and manufacturing shops will be established at some convenient point on the isthmus. One fully equipped electrical plant will be constructed where nearly all duplicate parts of ordinary motors and generators can be turned out as needed. This plant will be so completely equipped that the contractors on the scene can be almost independent of the rest of the world.

The great dredges which will do most of the excavating will be operated by steam, but many of them will have auxiliary electrical power, and nearly all of them will work in connection with overhead electrical hoists and aerial tramways. The carting of the material excavated from the canal to points far back from the embankments is one of the most difficult problems presented. The vicinity of the route must be fairly gridironed by overhead cableways. Electric cars and dumps will travel continuously back and forth on these cableways, and as fast as the dredges scoop up the dirt and rock the dumps will cart them far back from the embankment. The electrical operation of these overhead cableways is simpler and easier than by steam or compressed air and scores of motors will be needed for the work.

To excavate through the famous Culebra cut of the Panama Canal it is estimated roughly that nearly 45,000,000 cubic yards of soft rock and hard clay will have to be removed. With modern drilling machinery this work can be accomplished in much less time than the early engineers figured on. The modern electrical drilling machines will be used extensively, and designs for special types will shortly be placed. In fact, nearly all the machinery shipped to the isthmus will be designed especially for the peculiar work of that part of the world. The total outlay for electrical and other machinery will easily mount up into the hundreds of thousands and possibly millions of dollars. When it is remembered that the French sunk something like $20,000,000 in machinery to rust and decay in the moist climate of the isthmus, it will not be strange if one-tenth this amount will be needed by the American contractors. A good deal of the French machinery was poor and out of date when it reached its destination, and much of it was not needed at all; but after making due allowances for wasteful extravagance the orders for American machinery must still be enormous.

The repair plants, hospitals, quarters for the workmen and houses of the engineers and contractors will all be lighted by electricity, and the tool shops will be operated by electric power. These alone would require an extensive outfit, and the orders for the various parts would amount to large sums. When it is remembered that drills, scoops, dredges, dumps and other working parts of the machines need constant sharpening and repairing, it will be readily realized that the electrical tool and repair shops must be numerous and extensive in size and capacity.

Coming at a time when business has been passing through an extremely dull period, the preparatory work for finishing the canal is especially welcome. Nearly every electrical plant in the East anticipates some extensive orders for the Panama work. With this in view they are studying the question carefully. Some have even ventured to send agents to the isthmus for hasty examination of the conditions that prevail on the canal route. The climate there is peculiarly hard on all iron and steel. The tropical heat and moisture of the place render machinery of little use after a year or two unless carefully protected. It is in view of this that some of the electrical manufacturers have taken up the question of preparing machines protected from rust. In a moist, tropical country electrical machinery has always proved far more serviceable and lasting than steam machinery. The iron and steel parts are not exposed to moisture as much as steam plants must necessarily be. Moreover, it is possible to inclose most of the electrical parts in rustproof and moistureproof cases so that the vital parts are not directly exposed to fogs, dews and wet weather. Special preparations are also used by some manufacturers to protect their electrical dynamos, motors and other machines from wet weather, and it is possible that the engineers and contractors will either insist upon such provision against loss, or purchase the equipments under a guaranteed contract that they will be operative for a certain length of time. To prevent any loss through ignorance of the conditions prevailing on the isthmus the leading manufacturers are gathering trustworthy information either through special agents or government reports.

The actual excavation of the canal will be easy compared with similar works accomplished in this country in the past, but the climate and distance from all manufacturing centers will add difficulties that will greatly increase detail work. The engineers and contractors must consider questions beforehand that ordinarily do not come under their scope. The question of fuel will necessarily cause some trouble and uncertainty. Whether for electrical or steam plants the fuel problem must be considered from all sides, and a good deal of the machinery will be designed and ordered upon the strength of the decisions reached regarding the kind of fuel to be employed.

Eastern electrical markets are therefore looking forward rather hopefully to a year of unusual activity in certain lines, and not a few of them are branching out in new directions for the purpose of capturing more of the orders than would otherwise go to them. Electrical equipment of machinery will certainly receive a new impetus and development through the building of the Panama Canal by Americans.

Heating Rates of Central Stations.

A committee of the Commercial Club of Indianapolis has made a report in which it does not endorse the proposed advance in rates suggested in the petition of the Home Heating and Lighting Company of that city for a new franchise to increase its rate for hot-water heating from 17 cents per square foot of radiating surface to 25 cents. The Commercial Club in approving the committee's report says that not sufficient evidence in support of the increase from 17 cents has been found, and therefore recommends that all action be deferred until the plant shall have been in operation at least one more year under a receiver.

The report was prepared by Mr. C. Brown, consulting engineer, who gathered statistics from 50 central-station heating plants using hot water, as well as from many now using steam, and visited five cities in which such plants are established, including the three nearest approaching Indianapolis in size of plant. What follows is taken from Mr. Brown's report:

"The experience of practically all well-managed plants warrants the conclusion that a plant of any reasonable size with a sufficient power plant can operate at a good profit on all of a legitimate investment at a 17-cent rate or less, the income from the power plant being assumed to be sufficient to pay its own share of expenses and fixed charges. In case there is insufficient or no such power plant for supplying exhaust steam, the evidence is not so clear. With but few exceptions such plants produce at least fairly satisfactory returns with a 20-cent rate or less. Some of them are satisfied with lower rates, such as 18 cents. These are all small, with one exception. The evidence collected both by correspondence and by interview tends to show that for a heating plant standing alone or with small light and power plant connected with it, a rate approximating 17 cents is sufficient."

"One very important distinction should be made in granting future heating franchises. As stated above, plants which also supply light and power are able to supply heat at a rate of 17 cents or less, while the smaller plants, practically restricting themselves to heating alone, will need a higher rate. It is evident, therefore, that companies should be required to choose which class of plants they wish to construct, and that the rates should be fixed accordingly. A 17-cent rate is undoubtedly satisfactory for the well-constructed and well-managed combined plant. A satisfactory rate for a plant operating practically as a heating plant alone can be determined during the year and if this is found to be greater than 17 cents this increase in rate should be applied only to such plants and not to combined light, power and heating plants."

"If a rate which seems reasonable to the ordinary prospective patron of a central heating plant is to be maintained, it seems to be necessary to have an electric or other power plant of sufficient engine and boiler capacity to supply exhaust steam for heating the water for at least the minimum winter load, and the more the better. This condition is attained, however, in but few plants, and these supply light and also power to street railways or factories. Such plants are satisfied with a rate of 15 cents to 18 cents, unless there is some special reason not affecting the operation of the plant. A competent superintendent for a large plant considers that a plant can be run for heating only on a 20-cent rate."

"The design of the plant has much to do with the satisfaction which the financial returns give. Good insulation, full size of pipes, close approximation of amount of radiation in houses to their needs, short lengths of mains without taps, etc., are essential to economical operation, and plants well designed give satisfaction to the investors where other plants equally well situated in other respects are not so satisfactory."

"The cost of coal affects the output from a plant, and with this may be considered the length of season. Winter before last the coal strike put the price of coal up, and it was still high last year. For next winter the price is again less. Thus, from the experience of a plant similarly situated in this regard to our own, 16,000 tons of coal last year cost about $2.50 a ton. In an average winter, not more than 14,000 tons would be required. Next year's supply has been purchased at less than $1.50. Thus, our coal for last year would cost $40,000, and this year would probably cost not more than $21,000, a clear saving of $19,000, readily turning a deficit into a handsome surplus. This surplus next year would pay the interest on the bonded debt of $350,000, and leave a few thousand dollars surplus, which may be increased by other economies in management."

"Another city reports a similar experience on the coal question. Thus a light day's coal, which cost $21 last year, will cost $16 this year, when reduced to equal service. If one-eighth is deducted from the latter figure on the assumption that next winter will be an average winter, coal for next winter will cost two-thirds as much as it did last winter. This would make a saving in the Indianapolis coal bill of over $13,000, nearly enough to pay interest on the bonds. Indianapolis should be able to get better prices on coal than either of the cities referred to."

Concerning the rates charged in different cities, the report says: "The rates, when reduced as carefully as possible to a common basis of price per square foot of radiating surface vary from 12½ cents to 20 cents, the minimum rate being in force in a small plant which was established in 1898. No rate above 20 cents is reported from a hot water heating plant. It will be noted that 18 of the plants report an increase in rates since the plant was established. Four of these increases are from 12½ to 15 cents. One of these reports that the new rate is satisfactory and another is probably satisfied, for it is charging 15 cents, although its charter permits it to charge 20 cents."

Another Electric-railway Consolidation in New England.

The Consolidated Railway Company of Connecticut, it is announced, has purchased the New London Street Railway Company, capitalized at $250,000 and bonded for $150,000; the Norwich Street Railway Company, capitalized at $350,000 and bonded for $250,000, and the Montville Street Railway Company, capitalized at $250,000 and bonded for $250,000. Tucker, Anthony & Co. of Boston financed and operated these roads, and their sale to the Consolidated marks another important step in the New York, New Haven and Hartford's acquisition of competing electric roads in its zone of operations. The Consolidated is controlled by the steam railroad corporation. The latest absorptions make a through line from Norwich to Worcester a possibility, as the construction of a 20-mile link from Central Village to Norwich will complete the chain.

Automobile Transit Company for Cleveland.

The Citizens' Transit Company of Cleveland, Ohio, has been incorporated to operate an automobile service in competition with the trolley cars, so it is stated, by John U. May, who is at the head of the concern. The authorized capital stock is $600,000. Mr. May states that he will have one of the cars to be used on the ground within 60 days and expects to have enough to give a three-minute service on Euclid Avenue to Lake View within the next six months. The plan is to have a number of large electric cars that will carry from 16 to 20 passengers. The fare will be five cents. When that line is equipped other lines over the city may be added. The incorporators are H. H. McKeehan, W. C. Merrick, W. B. Stewart, G. W. Cottrell and Julian W. Tyler.

Methods of Handling Toll Business.

By T. S. Lane.

Any system for handling tolls must take into consideration compensation of the station originating business, the establishment of uniform rates, routings, division of mileage among different companies, method of settlement and a multitude of minor details. Such a system must possess three qualifications: It must be elastic, simple and equitable. Following the general qualifications are a number of specific problems which must be considered and definitely decided, such as rates, mileage, time limit of messages, night rates, method of dividing revenue between exchanges and toll-line companies, method of tariff division between groups of companies, method of reporting toll business, method of transmitting toll messages, franked business, accounting, forms to be used, etc.

To arrive at a uniform and equitable schedule of tariff rates, many toll-line companies have found the so-called "block system" of great assistance. The application of the block system is as follows:

A map of the territory to be covered is subdivided into squares of five or 10 miles, and each square numbered. This gives every station and exchange in the entire territory a block number whether station is connected or not. As the mileage between any two given points must determine the toll rate between said points, an easy way of arriving at the mileage is to consider the air-line mileage between any two given stations as being the distance represented by the air-line between the centers of the respective blocks in which said stations are located. In this way the air-line mileage between the center of each block to the center of all other blocks is ascertained at the start, and, having determined upon the rate per air-line mile, which is to govern the tariff, the rate between any station and all other points covered by the block system is immediately ascertained by referring to the rate governing the block in which the station is located. As soon as a new station is connected, it is only necessary to notify all other stations of the connection, together with the number of the block, and all stations by this means are informed as to the rate to the new connection.

The advisability of determining rates by the old method formerly used by the Bell Company, based on pole-line mileage, is so obsolete as to call for no discussion as to its applicability to a general system of handling toll business. Without competition, the plan of basing rates on pole-line mileage is doubtless practicable, but with two competing interests in any field an attempt to meet competition and base rates on pole-line mileage would result in a schedule of rates which would be unsatisfactory to the public and which would not represent intelligent competition. Between two points one company might have a pole-line mileage of 200 miles, and a competing company a pole line of only 100 miles. The company basing its rates on the air-line distance would be more liable to be right from a competitive point of view than would the company adopting pole-line mileage. On extremely long hauls between large centers, for instance, between Buffalo and Philadelphia, it might be advisable to modify the air-line mileage basis on account of extraordinary pole-line mileage as compared with the air-line mileage, and in fact any rates based on the above-mentioned plan can be easily regulated by issuing special rates to meet extraordinary conditions.

As to the amount of tariff to be charged per air-line mile, there is a wide difference of opinion. Some operating companies claim that a revenue of one-half cent per mile leaves a margin of profit. Others advocate a minimum charge of six-tenths cent per mile. A schedule of tariff rates, based on air-line mileage, should conform as far as possible to a charge of two-thirds cent per air-line mile with a minimum of six-tenths of a cent per mile, and no rate should be made of less than 10 cents between any two toll points.

The question of time limit for toll messages is one which merits careful consideration. The Bell companies long ago discarded the five-minute rate, and many of them are today making a low rate for a one-minute service. The making of five-minute rates by the model plants, from an engineering point of view, with the very start, the theory being that the Independent companies in offering a five-minute rate at the price their competitors were charging for three-minute service would be a great argument in favor of Independent toll-line service as against other toll-line service is wrong.

In meeting competition, toll-line service is considered chiefly from two points of view, viz., promptness and clear transmission, and of the two, prompt service counts for more, if anything, than the other, although both are essential. In the keen competition now under way between the two opposing telephone interests, the toll-line company which handles calls without delay will have all of the business that it can handle. In brief, the toll user prefers a three-minute service which he gets to a five-minute service for which he waits. It has been argued that "the five-minute time limit is good advertising for the Independent company, and that the toll user does not consume any more time than if limited to three minutes." This is false reasoning. If the advertisement does not make a sufficient impression on the toll user to cause him to make use of his full time limit, it has no value from an advertising point of view, and, on the other hand, toll users time their conversations and make use of the extra two minutes simply because it costs nothing, thereby unnecessarily blocking the service.

Experience has demonstrated that less than 25 per cent. of the calls made under the three-minute-limit plan use overtime. For instance, during the month of April one exchange originated 3,663 messages and received 4,488, a total of 8,151 messages, and out of these calls only 306 messages were overtime messages. The Union Telephone and Telegraph Company of Western Pennsylvania and the United States Telephone Company of Ohio have successfully used the three-minute schedule for some years, and express themselves as satisfied with the results.

A uniform scale of reduced night rates is desirable to apply between the hours of six p. m. and six a. m., when toll lines are comparatively idle unless an inducement is made for this period. A reduction in rates exceeding 25 cents can be made to profitable advantage, the minimum reduction being 50 per cent. No night rate on messages exceeding 25 cents to be less than 25 cents.

A simple and easily understood method of dividing revenue between connecting toll-line companies is as follows:

Deduct from the total revenue reprsented by interchanged business the originating commissions due each company, the remainder of the toll tariff to be divided between the connecting companies in proportion to the ratio existing between the air-line distance from the point of origin to point of transfer, and the air-line distance from point of transfer to the point of destination. For example, let A represent a toll station on one company's lines, C a toll station on another company's lines, and B the meeting point of the lines of the two companies. Suppose that the air-line distance from A to B is 20 miles and the air-line distance from B to C is 10 miles, and the number of messages during one month between B and C 100. The total mileage represented by the line from A to B will then be 100 times 20 miles, or 2,000 miles. The total mileage represented between B and C will be 100 times 10 miles, or 1,000 miles. The total mileage of the two companies for business between A and C will be 3,000 miles. If the rate between A and C is 30 cents, the toll revenues represented will be 100 times 30 cents, or $30. If each company deducts 25 per cent. for originating the business, there will remain $22.50 toll tariff subject to mileage division, and of this two-thirds should go to the credit of the company owning the line from A to B, and one-third to the company owning the line from B to C. Following out this plan of mileage calculation, the credit for each company on a month's business between all stations on one company's lines and all stations on the other company's lines can be included in one general settlement and the exact amount due each company on mileage easily ascertained. In arriving at mileage settlements between connecting toll-line companies, each company should assume the mileage of its subsidiary connections and should make a division of its share of the new revenue with such connections.

In reference to the division of tariff between toll-line companies and exchanges having no toll-line mileage, it must be borne in mind that the toll-line companies have their entire investment tied up in a system from which their sole revenue is toll business, and although exchanges at the termini of the toll line may represent a much larger investment than is represented by the toll line, the investment in the exchange depends only in a small measure on the toll-line business which is handled by the exchange, with very little additional investment. For instance, a toll message transmitted between two exchanges of 1,000 subscribers each, over a toll line having two circuits, involves the actual use for the time being of only one-thousandth part of the investment in the exchange, but at the same time ties up one-half of the entire toll-line system.

In making charges against and giving credit to various companies dividing toll revenue, the following method is used:

Charge each company with "tolls sent paid," "tolls received collect" and "messenger fees collected." Give each company credit for "messenger fees paid," "commission on originating business and mileage" (as shown by mileage statement). To get this information it is, of course, necessary for each company originating business to make a careful record of the business transacted with each station as follows:

"Number of messages sent out," "number of messages received," "overtime," "amount of tolls sent paid," "amount of tolls sent collect," "messenger fees collected," "tolls received paid," "tolls received collect," "messenger fees paid." So-called "deadhead messages" should be entirely eliminated and operators required to make a charge ticket for all messages, no matter by whom sent or for what purpose. A record can be made of company business subject to frank, and an adjustment of same made between companies interchanging business. Some contracts between large toll-line companies specifically set forth that neither company shall carry free business for the other.

In Chautauqua County are nine short toll lines, extending from Jamestown via Sherman and Mayville to Westfield, and thence east and west from Westfield along the lake shore. Some time ago these companies formed a traffic association for the purpose of establishing uniform rates and adopting a system for handling the business interchanged among themselves, as well as business to points outside their district. This association, known as the Independent Telephone Clearing Association, with its office at Sherman, receives a monthly report of the business transacted from each of the companies making up the association. The association employs a secretary, who makes a division of the revenue from the reports received, rendering each company a statement of its charges and credits. Remittances are made direct to the association secretary, who in turn makes remittances to those who have balances due them. The secretary's compensation is based on a certain amount for each message handled by him in the work of clearing the entire business, the amount being fixed at something like one-half cent a message.

The method of dividing revenue derived from business going to points on other lines outside of the association lines is as follows:

The association lines connect with the lines of the Inter Ocean Telephone and Telegraph Company at Jamestown and with the Union Telephone and Telegraph Company at Corry, Pa. Each of these toll-line companies renders a monthly statement to the association, treating the entire group of lines as one toll-line company. If the association has a balance due it from toll-line companies, it goes into the association fund for general distribution and is disbursed among association members, according to mileage furnished by each.

Switching fees are entirely eliminated in our interchange of toll business throughout the state, and should be entirely done away with, as their general adoption acts as a great handicap to the successful conduct of the toll business and gives competing interests a great advantage over the Independent toll-line systems. There has been some discussion relative to the formation of a state traffic association for the purpose of clearing interchanged business between the larger toll-line companies. This class of business represents, at the present time, a comparatively small amount, and we are not ready for an association of this kind for the reason that the revenue represented is not sufficient to warrant the expense necessary to maintain and conduct such an association.

So far as Western New York is concerned, the toll-line companies are having no difficulty in arriving at a division of revenue at a very small expense; in fact, at a cost of less than two per cent. of the gross business cleared. The real need is for a method of making a fair division in localities covered by short lines interchanging a large volume of business. If these different localities can be formed into associations, organized on similar plans and using similar methods, the results will be satisfactory throughout the state, and from these smaller associations we will gradually work into one joint traffic association in which the missionary work will have been accomplished. No manager of a state traffic association could at the present time be familiar with the conditions in all localities covered by short connecting lines, and the serious complications which arise in establishing rates, regulation and routings come from just such localities.

A still better plan for bringing about a uniform toll service would be a concentration of short lines under one management. For instance, in certain counties in which a dozen or more separately controlled lines are interchanging business, an association or even a corporation could be formed from among the various connecting companies, which could lease all the connecting lines and operate them as one line, allotting to each company a division of the net revenue in proportion to the pole-line mileage furnished.

"Unity of control" is a phrase which may not appeal particularly to a gathering of Independent association men, but at the same time the more we can intelligently concentrate "control of operation" of our toll lines, the nearer we come to perfection in uniform and efficient toll service.

1. Abstract of a paper prepared for the annual meeting of the New York Independent Telephone Association held at Buffalo on June 23d and 24th. Mr. Lane is of Buffalo and was elected secretary of the association.

Long-distance Connection for Oklahoma and Kansas Telephone Company.

The Kansas correspondent of the Western Electrician writes that the Oklahoma and Kansas Telephone Company, of which J. W. Pyle is president, with headquarters at Medford, Oklahoma, has connected its system with the long-distance lines of the Missouri and Kansas Telephone Company at Medford, Kremlin, Pond Creek, Caldwell, Wellington and Wichita, Kan. This company operates eight exchanges, 535 miles of toll lines, 32 toll stations and over 400 miles of rural lines. This will give the Bell connection with a large territory that has been entirely in the hands of the Independents.

The Oklahoma and Kansas company is one of the largest Independent companies operating in the territory and has a capital stock of $300,000.

The Michigan State Telephone Company of Detroit has been asked to establish telephone toll boxes along the toll roads leading out of Detroit. Automobile owners are said to be back of the scheme, which is to place boxes on the telephone poles at regular intervals, which can be connected with portable telephone instruments, to be supplied by the company.

Ohio Telephone Notes.

President F. S. Dickson of the Federal Telephone Company completed negotiations last week through which the John A. Roebling's Sons Company of Trenton, N. J., and the Standard Underground Cable Company of Pittsburg agreed to take United States Telephone bonds at 85 and accrued interest in payment of their claims, aggregating $624,000. This leaves $900,000 claims in the hands of outside persons and $2,000,000 due the Everett-Moore syndicate. The first will be paid off as soon as possible, and it is thought this will take but a short time. Several plans have been formed for taking care of the syndicate claims. When President Dickson took hold of the property the debts were about $4,000,000, and it seemed that the settlement was a long way off. As the Federal was a holding company, it was at one time thought best to get rid of all the properties in which it was interested. Many of them were sold and others may be, but it would seem that the syndicate will come out with considerable interest after the debts are all discharged.

In connection with this, the announcement has been made that a syndicate of Cleveland and New York bankers have arranged to loan the United States Telephone Company $450,000 for a term of three years at six per cent. Collateral of the United States company is given as security. The company is now earning $400,000 a year and it is estimated that the new money will place it in position to add to this, as the only thing lacking is a more extensive system to take care of the business offered. Some months ago the company secured $150,000, and this is being used in building extensions and making improvements where they are needed most. Extensions will now be commenced and prosecuted on an extended scale, with a view to taking care of the rapidly increasing business originated by the local exchanges over the country. Many new connections will also be made. At least 9,000 miles of wire will be strung. All the subsidiary companies of the Federal had an excellent business in June, with the exception of the Massillon plant. The deficit there was small. The surplus of the Cuyahoga Telephone Company for the month amounted to $6,634.98. Many of the others were as good.

The Colonial Hotel of Cleveland has made arrangements with the Cleveland Telephone Company to install a private exchange and equip the 200 rooms with telephones. They will be such that guests may call any point in the city or use the long-distance wires.

The Akron office of the Central Union Telephone Company has issued a new directory containing the names of all the subscribers there and at Canton, Massillon, Alliance, Barberton, Cuyahoga Falls, Louisville, Magnolia, Marlboro, Minerva, Sebring and Waynesburg. Each of these places will get out the same kind of a directory.

A meeting of the stockholders of the Home Telephone Company of Dayton will be held on August 12th for the purpose of voting upon the question of increasing the capital stock from $1,000,000 to $1,200,000. The additional stock will be preferred. The call is signed by President J. T. Barlow and Secretary J. C. Reber.

The management of the Home Telephone Company of Toledo held a reception for its patrons and friends on June 21st and 22d, in an effort to bring the company and the public closer together.

The Cherry Valley Telephone Company of Cherry Valley has been incorporated with a capital stock of $3,000. P. D. Spofford, E. H. Phelps and others are interested.

The Girard Telephone Company, Girard, has been incorporated with a capital stock of $35,000 by E. H. Stoze, J. C. Kehl, E. L. Huser, S. C. Hazen, J. G. Jones, W. J. Wallis and R. T. Izant. C.

Telephone News from the Northwest.

The village of Murdock, Minn., has granted a franchise for a right-of-way through that corporation to the Tri-state Telephone and Telegraph Company, for the long-distance line from Minneapolis to Grand Forks.

The Northwestern Telephone Exchange Company has awarded contracts for the erection of the new exchange building at Winona, Minn., to cost about $15,000.

Messrs. Stinson and Johnson of Kensal, N. D., contemplate installing a local exchange for McHenry, N. D. They will build a rural line to that point from Kensal.

The Fairfax Telephone Company of Fairfax, Minn., has been incorporated with $10,000 capital stock.

The Independent Telephone Company of Yankton, S. D., has arranged to build a toll line from Yankton to Mitchell.

The Hewitt and Wightstown Telephone Company has been granted admission to Long Prairie, Minn.

The Sheyenne Telephone Exchange Company has been granted a local franchise at Sheyenne, N. D.

The Storlia Telephone Company will receive bids for constructing a telephone line between Woonsocket and Letcher, S. D.

The Wakonda (S. D.) Telephone Company is making plans for the extension of the telephone system.

The Tri-state Telephone Company has begun work on a new system at Grand Forks, N. D.

The Farmers' Mutual Telephone Company of Stockport, Iowa, has been incorporated with a capital of $10,000. James M. Martin is president and D. Morris secretary.

Fred Pleggenkuhle has sold the telephone system at Sumner, Iowa, to E. Hurmence and V. C. Stevens.

The Iowa Telephone Company will erect a new exchange building at Waterloo, Iowa.

The E. H. Martin Telephone Company is making extensive improvements on its exchange building at Webster City, Iowa.

The Farmers' Mutual Telephone Company has been incorporated at Scranton, Iowa, with a capital of $10,000. R. Foy heads the list of stockholders. R.

The Telephone in Kansas.

The Katy Telephone Company of Elismore, Kan., has been chartered to build an exchange and rural lines. The capital stock is $2,800.

The Galena Home Telephone Company of Galena, Kan., has received its charter. The company is capitalized at $10,000, and will build an exchange and rural lines.

The Council Grove Telephone Company of Council Grove, Kan., has been chartered with a capital of $30,000. This company has been operating in Council Grove for several years under a franchise only.

The last 30 days in this territory has been severe on long-distance telephone lines and the telegraph lines, as high water has rendered the lines useless. All lines crossing the Salt Fork River (Oklahoma) were out over a week, and in some places have not yet been repaired. Lightning has also been worse than ever before known, doing serious damage to exchanges and toll lines.

The Missouri and Kansas Telephone Company at Atchison, Kan., has issued a circular stating that it expects to raise the rate of telephones next month from the present rental of $1.50 for business connections and $1 for residences to $2.50 and $1.50, respectively. The new company operating in Atchison, when applying for franchise, agreed to maintain telephones at the rate of $2 and $1, but has several times asked the City Council for permission to raise, which has been refused. It is said that the new company has about 1,000 instruments and the old company 800.

The Missouri and Kansas Telephone Company has let the contract for erecting a 70-foot steel tower in East Atchison, for the purpose of raising its wires and cables over the Missouri River, so that steamboat smokestacks will clear them. K.

New England Telephone News.

A semi-annual dividend of 2½ per cent. on Western Telephone and Telegraph Company preferred stock last week, announced in Boston somewhat unexpectedly for some of the stock exchange traders, gave the stock a little boom in State Street. The dividends heretofore have been at the rate of four per cent. per annum.

The acquiring of rights-of-way and locations for the line which the American Telephone and Telegraph Company is putting through from Hartford to Boston progresses satisfactorily to the company. Among the most recent grants in this connection was a permit in the important town of Milford, from Bellingham boundary to Medway.

About 100 operators from the telephone and telegraph offices of Boston and suburbs had their annual outing at Nantasket Point on Thursday, July 21st, with a harbor excursion, a dinner at the hotel at the Point and a programme of athletic sports as features of the occasion.

Plans for an extension of the telephone service of the Atlantic Coast life-saving stations of the government are under consideration. Superintendent William Bolton of this department having been in Newburyport and vicinity recently relative to the matter of connecting the service from Salisbury Beach station beyond Hampton River and with stations along the New Hampshire coast. B.

Southeastern Telephone Developments.

The Waite & Davis Telephone Company has been incorporated at Columbiana, Shelby County, Alabama, with $10,000 capital stock, to build telephone lines in Shelby County. J. R. White is interested.

At Maxton, N. C., the Carolina Telephone Company, which bought the local exchange some years ago, is meeting with much opposition, it is reported, on account of its announcement that it will install Bell telephones and double the rates.

At Nashville, Tenn., recently during an electrical storm 500 fuses were blown out at the plant of the Cumberland Telephone Company.

The Board of Aldermen of Statesville, N. C., has refused to grant a franchise to the Bell Telephone Company to operate in that city.

The Southern Bell Telephone Company is making extensive improvements at Tuscaloosa, Ala., where a first-class metallic circuit is being put in.

The Bell Company has completed the work of cutting over the telephones of the old Charlotte telephone system recently absorbed by the Bell company at Charlotte, N. C. L.

Automatic telephone exchanges, such as is in use in Chicago, can now be found in operation in all parts of the United States. The Automatic Electric Company has installed or is at work on exchanges in 29 cities and towns throughout this country, besides a system in Berlin, Germany.

Ohio Independent Telephone Association.

At a meeting of the executive committee of the Ohio Independent Telephone Association in Columbus, a few days ago, plans were formulated for the district organization that was provided for in the first general meeting two months ago, and arrangements were also made for a national association, based upon the plans adopted in Ohio. The representation in all the meetings will be by delegates. In the district organization, which will be under the guidance of nine vice-presidents, one representative shall be named for each 100 telephones or 100 miles of toll line or fraction thereof. One representative to the state organization shall be named for each 1,000 telephones or 1,000 miles of toll line or fraction. The plans for the national association are that there shall be one representative for each 10,000 telephones or 10,000 miles of toll line or fraction. The basis of representation in all cases goes by hundreds and multiples. An association similar to that in Ohio is to be formed in each state that has Independent telephone interests. Those connected with the association say that it is for the purpose of making the Independent movement more aggressive and placing the various systems in position to compete with other concerns in a legitimate way. A meeting will be held in Columbus on August 2d to complete the various plans outlined. The vice-presidents in charge of the district organizations are as follows: J. B. Hoge, Cleveland; W. F. Laubaugh, Akron; J. B. Rhodes, Zanesville; G. P. Thorpe, Wilmington; W. Gilbert Thompson, Lebanon; J. C. Reber, Dayton; G. E. Matheany, Lima; R. E. Hamblin, Toledo; Dwight E. Sapp, Mt. Vernon.

EXTENSIONS AND IMPROVEMENTS.

Telephone lines are being extended in the vicinity of Crosby, Barrington and Wayne, N. Y.

The Canadian Bell Telephone Company is about to install a telephone system in Deloraine, Manitoba.

A charter has been issued to the Conway Telephone Company of Conway, S. C. The capital is to be $3,000 and the company proposes to establish a telephone line between Conway and Marion. The officers are: President, R. B. Scarborough; vice-president, H. P. Little, and secretary, C. E. St. Amand.

The Bell Telephone Company is strongly disinclined to accept the franchise for installing telephones at North and South Tonawanda, N. Y. The Common Council insists that the maximum price for the use of instrument and service shall be $50 a year for business premises and $20 for private residences. Mr. Newcome Carlton, the local representative of the company, states that the conditions will not be accepted.

GENERAL TELEPHONE NEWS.

It is reported that the West Virginia Telephone Company of Parkersburg has purchased the property of the Marietta Telephone Company of Marietta, Ohio, the price being in the neighborhood of $80,000.

The Board of Control of Toronto, Ont., has drafted an agreement for a new telephone franchise for the Canadian Telegraph and Telephone Company. Two thousand telephones must be installed within 21 months. The franchise is for seven years and has provisions for renewal for five-year periods, with the right of the city to expropriate.

The Home Telephone Company has about completed its plant at Hopkinsville, Ky. The town has a population of 8,000 and the new company has secured a large number of business houses and residences for its service. With an automatic exchange and all-cable construction the plant is modern in every particular. The company has a contract to furnish all the telephones the city uses.

A public-school telephone system for the Chicago schools has been recommended by Superintendent Cooley. A report was submitted showing that of the 5,600 teachers, the absences each day on account of illness average 250. The proposed telephone system would largely obviate the necessity of dismissals, as every school would be connected with the board of education, thus facilitating the supplying of substitutes. A report from City Electrician Ellicott showed that the lowest cost of installing a system of six party lines would be $40,598. If the police telephone wires and operators are used the cost would be $30,000.

It is said that the long-distance telephone system of the Illinois Central railroad between Omaha and Chicago and between Chicago and New Orelans, is to be rebuilt. Two years ago the company decided to construct the line with copper weighing 175 pounds to the mile, it being guaranteed that this weight would conduct a clear conversation over a distance of 1,000 miles. It has now been demonstrated that it is impossible to talk over the entire line, the longest distance over which communication can be established on the line being 400 miles. The system is to be re-equipped with copper weighing at least 435 pounds to the mile.

The Origin and Development of Storage Batteries.[1]

By E. B. Walker.

In 1801 Gauthert first observed that if two metals—platinum and silver—were immersed in an electrolyte and a current passed through them, a secondary current could be obtained in the opposite direction by joining the two metals by a conductor.

In 1842 Grove observed that if two gases of strong chemical affinity were connected by pieces of metal through an electrolyte, a current would pass until the two gases were exhausted. In his experiment he used two test tubes inverted over strips of platinum foil in a vessel containing dilute sulphuric acid. The two tubes contained two volumes of hydrogen and one volume of oxygen, respectively. On joining the platinum strips with a wire a current passed until the gases in both tubes disappeared. On sending a current through the platinum and acid from a primary battery, the gases were formed again by electrolysis, thus storing a small supply of electricity, represented by the volumes of the gases. About 830 cubic centimeters of hydrogen at a temperature of 0° C. and 760 millimeters pressure, being equivalent to one ampere-hour. Grove constructed a battery of 50 of these cells and managed to obtain a small arc light.

The year 1859 opens the era of the first storage battery of any practical value. Gaston Planté discovered that if a current were passed through two plates of lead immersed in dilute sulphuric acid, a small current could be obtained for a short time, in the opposite direction to the charge, by joining the two plates with a conductor. This was due to the formation of lead peroxide on one of the plates, causing a difference of potential.

He also observed that by a series of charges and discharges of this nature, and by reversing the direction of the charge each time, the quantity of lead peroxide on one plate was greatly increased, while a spongy surface of pure lead was formed on the other; as this increased the capacity of his battery, he was able to construct a cell that was of some practical value. His method was to roll together two sheets of roughened lead, which were kept from touching by sticks of paraffined wood, and to immerse the whole in dilute sulphuric acid. The cell was then charged, discharged, and charged again in the opposite direction, until the plates were "formed," i. e., a coating of lead peroxide was formed on one plate and of spongy lead on the other. This process occupied a month or two, but after several experiments Planté succeeded in reducing this time considerably by soaking the plates in a bath of nitric acid, previous to the formation process.

Planté carried on his research work until 1879, but he does not appear to have succeeded in sufficiently shortening the formation period of his battery, although he is said to have made some experiments with mechanically applied active material.

Faure System.

As the long and tedious process of formation of the Planté element added much to the expense, it greatly checked the commercial growth of the storage battery.

In 1879, however, R. L. Metzger partially overcame this by mechanically applying to a lead plate active material in the form of a paste of lead oxide. This important improvement was not generally known, until Camille Faure obtained patents on a similar process, which is now known as the Faure system. Faure's first experiment was to cover an ordinary Planté plate with lead oxide, but he subsequently improved this by using an antimonious lead grid, with a paste of red lead, and sulphuric acid for the positive and litharge and sulphuric acid for the negative. The advantage of the antimonious lead grid over pure lead will be dealt with later.

Comparison of Planté and Faure Systems.

We now have two methods of making a storage battery, both of which have striking advantages, and both, unfortunately, striking disadvantages. In the Planté system the time of formation is long and a large amount of electric power is consumed; the proportion of active material to the weight is small, as the lack of mechanical strength of the lead makes it necessary to have a thick plate to withstand any strain; the lead plate is continually undergoing a formation process from the repetition of charge and discharge, which reduces its strength. On the other hand, the conductivity of the Planté plate is excellent, as the active material being formed directly on the surface is always in good contact with its supporting lead plate. The active material is not likely to be jarred off or forced off by the evolution of gases; rapid discharges of heavy currents may be maintained with little or no injury to the plates.

In the Faure system the advantages and disadvantages are almost diametrically opposed to those of the Planté. The formation is quick and may be accomplished in one continuous charge. The proportion of active material to the weight is large, therefore the capacity is increased. The antimonious lead grid has greater strength, and is more rigid than the lead plate. The antimonious lead grid is only very slightly subjected to the "forming" process, and therefore retains its strength.

Here it may not be amiss to explain the term antimonious lead grid. I have used it in a general way to represent those alloys of lead, antimony, arsenic and tin, which have been made with a view to obtaining increased strength and immunity from the electrolytic effects of the current on charge and discharge. Some of these are quite successful, but the manufacturers keep the exact composition secret.

On the other hand, the conductivity is lower than in the Planté, as it is difficult to maintain good contact between the active material and the grid. The expansion and contraction on charge and discharge is apt to loosen the active material and render it liable to fall out. Very heavy discharges are likely to force off the active material by forming gases inside of it.

Since this time the manufacturer has been endeavoring to produce a battery which will combine the advantages of both with none of the disadvantages. Needless to say, this battery has not yet been made, but nevertheless the improvements now existing are such that the storage battery holds an important place in modern engineering practice, and it is safe to say that few, if any, of the larger direct-current plants could be considered up-to-date without such an auxiliary.

To enumerate the varieties of batteries which have been patented and manufactured would occupy the remainder of the evening, but it may not be out of place to mention those which present radical improvements or entire departure from standard practice.

Methods of Manufacture.

In order to increase the capacity per pound, many methods of increasing the active surface of the lead plate have been devised.

1. Lead plates are scored all over with a sharp tool, which raises fine leaves on the surface and increases the area, in some cases, to 17 times the superficial area.

2. Grooves are cut in a thick plate generally by sawing.

3. Plates are built up of alternate laminæ of flat and corrugated lead, which are burned together at the ends.

In these three systems solid ribs are usually left at intervals in the plates, to increase the rigidity, which, however, never equals that obtained by the antimonious lead grid of the same weight.

The advantages of these systems in increasing the active surface are manifest, the drawbacks, however, are rather serious. In all three cases the chief support is pure lead, which, as was mentioned before, is subject continually to a formation process. Thus the thin leaves, ribs, or laminæ produced by these methods are apt to become formed right through and so break away. Too many ribs or laminæ will not allow sufficient room for the formation of the lead peroxide, and buckling or forcing off some of the active material is sure to result.

Plates of this type expand and contract laterally across the surface, and consequently are sure to buckle sooner or later, as it is manifestly impossible to keep this expansion and contraction the same for both sides of the plate.

The long formation process of Planté has been overcome to a great extent by the addition of lead-dissolving acids or salts. The formation of peroxide or sponge lead is so hastened that the time taken is not much longer than that required for the Faure system. In some cases it has been reduced to 50 hours. Care must be taken, however, to free the plates thoroughly from such chemicals before putting them into use, as otherwise the formation process will continue until all the lead is worn away.

In these ways the Planté plate has been so improved that from a standpoint of capacity and fairly quick formation little is left to be desired, but it must be remembered that the former is only obtained by a sacrifice of mechanical strength.

These methods refer more particularly to positive plates. Negative plates for batteries of these types have been made in a similar manner, although there is not so great a necessity for strength, and consequently the number of ribs is usually less.

The Faure system has resulted in more varieties than the Planté. The chief improvements have been the shaping of the grids so as to retain more firmly the active material and the discovery of pastes which set more firmly than those originally used by Faure. Various attempts have been made to increase the porosity of the active material by the addition of powdered pumice, asbestos, etc. The exact composition of the pastes used in the leading batteries of this type are kept secret.

With all these improvements the initial disadvantages still existed, although to a less degree. The next step was to cast the grid about active material formed into pellets. In the original chloride accumulator buttons of fused lead chloride and zinc were set in operation and an antimonious lead framework cast round them under pressure. The formation process removed the chlorine and zinc, reduced the buttons of one plate to sponge lead and oxidized those of the other to lead peroxide.

This method forms a very serviceable element with the important advantage that the strain caused by the expansion of the active material acts along lines radiating from the buttons and edgewise to the plate, consequently buckling is reduced to a minimum. This type, however, has been abandoned for a more improved pattern.

From these statements it would appear that a plate with the advantages of the antimonious lead grid for strength and non-corrosibility and of the Planté formation for durability of active material would be the most efficient combination. A few batteries of this type have been constructed, of which I shall mention two.

In one case a framework of antimonious lead is used on which are supported long narrow coils of lead ribbon, giving a large, active surface with a correspondingly large capacity. As the coils are free to expand and contract, little chance is left for buckling. On the other hand, the lead ribbon is weakened by the continual formation of lead peroxide, and consequently there is a likelihood of its being broken and the whole coil disintegrated.

The most prominent example of this class is made of a lead antimony plate cast under pressure with a series of round holes three-quarters of an inch in diameter throughout. Into these holes is pressed corrugated lead ribbon coiled into spiral buttons.

Such a plate combines many advantages, the antimonious lead alloy cast under pressure gives the requisite strength and non-corrosibility. The lead buttons are "formed" by an improved Planté method and the expansion due to the lead peroxide wedges them so firmly in the plate that good contact is assured; the strain of expansion acts in a similar way to that described previously in the chloride plate, reducing buckling to a minimum.

The negative plates of all types present fewer difficulties. The expansion and contraction are much less, and therefore the tendency to buckle and to shed active material is diminished. One of the difficulties seems to be a tendency to form lead trees, or fine branches of lead from the negative over to the positive, thus causing a short-circuit, unless the growth is removed by probing from time to time. This difficulty and the chance of plates short-circuiting if they are slightly buckled has caused a great deal of experiment with different kinds of separators and envelopes to protect the plates, various forms of parchment, celluloid, pyroxylin, hard rubber, asbestos cloth, porous earthenware and wood have been tried; of these only two are really successful, i. e., perforated hard-rubber sheets and wood. The cost of supplying perforated hard-rubber sheets for a large battery is prohibitive, and besides there is always a possibility of short-circuiting through the small holes. The wood separator, however, is a decided success. Difficulty was at first experienced by the formation of acetic acid, which is a solvent of lead, but this difficulty has been removed by chemical treatment, and the wood separator is now used by the leading manufacturers.

The manufacturers of the last battery referred to have lately developed a new negative plate, which practically does away with the branching toward the positive, and also the shedding of active material.

This plate is formed of a rigid frame of antimonious lead, with square boxes covered with perforated sheets of antimonious lead; in the boxes are placed square pellets of the active material. The perforated covering so protects this that the expansion and contraction take place altogether inside and any tendency to form lead trees is thus checked.

Other Forms.

Many novel and ingenious methods have been invented to prevent buckling and the shedding of active material. Among them is the use of earthenware grids, which support the active material and prevent it from any possibility of short-circuiting. While this is interesting from an experimental standpoint, it is of little commercial value, as the plate has low conductivity and the porous earthenware greatly increases the internal resistance of the cell. Another form is a battery built up of trays laid horizontally, one on top of the other; the active material is held by the trays and the whole forms a battery, somewhat like the voltaic pile. The high internal resistance and the difficulty of keeping the trays properly insulated makes this of little practical use.

Various experiments have been tried with active material without any grid. The material itself is a poor conductor, and on this account graphite has been mixed with it, and the whole compressed into flat plates on a framework of thin sheet lead, used solely to obtain good contact. In a prominent example the active material was formed of litharge and ammonium sulphate pressed into a flat plate. By various chemical processes this plate was formed into lead peroxide and hardened. A framework of lead was used to support it and to give the necessary contact, making the whole look like a school slate. The capacity was very high, being about 16 ampere-hours per pound.

These methods, however, while interesting from an experimental standpoint, are also of very little use, as the active material rapidly disintegrates.

Several batteries have been constructed, in which two different metals are used for the plates. The most notable of these are the lead-zinc battery and Edison's nickel-iron battery.

There is one inherent drawback in all batteries in which two different metals are used, and that is the probability of small particles of one of the metals being carried across to the other, thus forming a local cell. In the lead battery if a small particle of one plate were to be deposited on the other, a local cell would be formed, but action would only take place until the foreign particle was converted into the

1. A paper read before the Canadian Electrical Association at Hamilton, Ont., June 15, 1904.

same material as the plate. This, of course, could never take place in a cell using two different metals.

As regards Edison's battery, very little reliable information can be obtained on certain points. However, most of those who have made tests seem to be agreed. Recent tests made in London show the ampere-hours per pound to be undoubtedly higher than in the lead battery, the average voltage per cell is about 1.2, as against 1.95 in the lead battery. This makes it necessary to use about 70 cells of Edison's battery against 44 cells of lead battery, making a proportion of five to seven in weight for the same watt-hour capacity in favor of the lead battery. The internal resistance is high, causing bad regulation. The efficiency has been rated as low as 60 per cent., whereas the lead battery is rated from 75 per cent. up. The chief point urged by its advocates is durability; of this quality, however, we have no authentic proof. The writer heard, not long ago, that Mr. Edison had withdrawn his battery from the market, as he is not yet satisfied with it.

In the lead-zinc battery a peroxide plate is used for the positive, and a pure zinc plate for the negative. The advantages are higher voltage (about 2.5 per cell) and about 57 per cent. more capacity per pound in watt-hours. The drawbacks are the difficulties in redepositing the zinc and in preventing small particles of it from being deposited on the peroxide plate, thus causing local action.

Notwithstanding the numerous varieties of storage batteries which have been produced we are still limited to the Planté and Faure systems for all commercial work. Each has found its place and today the Planté system is almost universally used for stationary work and the Faure for vehicle work.

There is one particular feature about the Planté battery which renders it especially superior to the Faure type for heavy discharges of short duration, such as are required in the regulation of railway loads, and this is that the capacity of the Planté battery at the one-hour rate is 55 per cent. of its capacity at the eight-hour rate, while that of the Faure is only 46 per cent. Among the prominent types of batteries used today, the Planté for stationary work has a capacity of about 2.3 to 4.1 ampere-hours per pound of element, and the Faure for vehicle work about 4.8 to 5.6. The Planté negative is little used, as the advantages of this system which appear in the positive are not manifest in the negative. A good negative will often outlast two sets of positive plates.

Diseases and Their Remedies.

(1) Shedding of active material and loss of capacity.
(2) Corrosion of plates.
(3) Buckling.
(4) Sulphatation.
(5) Formation of lead growths from negative to positive.

1. Shedding of active material and consequent loss of capacity is caused by too rapid discharges, forming gases which force out the active material. Loss of capacity is further caused by the formation of excessive lead sulphate, which often clogs the pores of the lead sponge and forms a layer between the grid and the active material. The shedding of active material is also due to the following causes:

(1) Imperfect application of paste.
(2) Overcrowding of active material in the formation of Planté plates.
(3) Discharging at too high rates.

2. Corrosion of plates is caused chiefly by the presence of lead-dissolving chemicals in the electrolyte; on this account it is advisable, in replacing loss by evaporation, to use distilled water, unless very pure water is otherwise obtainable.

3. Buckling is due to heavy rates of discharge, which cause unequal expansion. It can also occur at low rates, if the active material is unequally applied.

4. Sulphatation: an excess of lead sulphate is formed when a battery is over-discharged. It can be removed by overcharging at a low rate, but if allowed to remain long after formation it hardens, and on account of its low conductivity cannot be reduced by its recharging.

5. The formation of lead trees, which we have already mentioned, has been overcome by the use of the box negative and wood separators previously referred to.

Applications.

There are many more uses of the storage battery than would occur to the layman. The simplest and most apparent application is "straight" storage work, as used in connection with automobiles. The efficiency of this method is not very high, about 75 per cent. being a fair average. However, by intelligent handling much higher efficiency may be obtained, 85 per cent. being about the maximum.

The next example of "straight" storage work is the use of batteries for supplying lights at night after the generators are shut down. This necessitates some method of controlling the voltage of the battery, which will drop from 2.1 volts per cell at the beginning of discharge to 1.75 at the end, with an average of 1.92 to 1.95. The three standard methods of regulating this discharge voltage are (1) resistance, (2) end cells, (3) counter electromotive-force cells. The resistance method is the simplest, but it is very unsatisfactory except when lights are burned continually, as every time a light is turned on or off the rheostat handle must be adjusted.

End cells are the most efficient method by far, for on 110-volt circuit 52 cells will be needed at the beginning of the discharge, and 63 or 64 cells at the end. These extra cells are cut in and out by means of an end cell switch. During the greater part of discharge 56 or 57 cells will be in use, the remainder only coming into service at the end, and thus they are only slightly discharged.

There is one drawback in the end-cell system, and it is that the different cells require different amounts of charge, necessitating great care on the part of the attendant to prevent overcharging. On this account the counter electromotive-force cell is preferable in small plants where efficiency is of less importance and where skilled attention is more difficult to obtain.

These counter electromotive-force cells are blank grids without active material, immersed in dilute sulphuric acid, and they offer an opposing electromotive force to the passage of the current of 2.3 to 2.5 volts per cell. The system is no more efficient than the resistance, but the fact that the potential difference of the counter-electromotive-force cell only varies between 2.3 and 2.5 volts from any load from one lamp to full load, makes the voltage regulation almost equal to that of the end cell.

Another feature of storage batteries for work of this kind is the necessity of higher charging voltage than the bus pressure. The maximum is 2.5 per cell, making a total of 160 volts for a 110-volt battery. Thus extra pressure must be obtained to the extent of 50 volts.

There are three standard ways of accomplishing this—one by cutting the battery into halves and charging in parallel, thus making the total necessary voltage 80, the remaining voltage is cut down through resistance. This, of course, is very inefficient, but is suitable for small plants where it would be too expensive to install a booster.

The second method is to use a specially wound generator of 160 volts maximum, which will operate successfully at 110 volts. The voltage is raised as the charge proceeds and the discharge voltage controlled by counter electromotive-force cells, or by tapping off the battery at the necessary point by means of an end-cell switch.

The third method is to use a small shunt generator of 50 volts capacity, termed a booster, connected in series with the battery and bus.

Regulating Batteries.

Storage batteries are now very generally used in regulating the rapid fluctuations in railway and other power circuits. Here the battery charges and discharges with fluctuations in the station load, and consequently does not have time to reach the higher portion of the charging voltage curve nor the lower portion of the discharge curve, thus raising the efficiency of the battery as high as 92 to 95 per cent. For work of this nature the battery will require a line voltage which fluctuates more than the battery voltage, or some means of regulating the latter so that the battery may take its share of the load automatically. A highly fluctuating voltage is not usually permissible except out on a long railway feeder where it cannot be helped. A battery installed at such a point will reduce the fluctuations in voltage and by supplying a source of power at the point of application will lessen the copper drop, as loads between it and the power house will be fed both ways.

Where constant potential is required as when a battery is installed at the power house, a booster with a compounded field or some other regulating device is necessary to regulate the battery voltage.

Many different devices have been patented in the way of regulating boosters. Most of them consist of some system of a series field opposing a shunt field by which the fluctuations of the external load are made to regulate the booster voltage, so that the battery will discharge and charge automatically with the rise and fall of the external load above and below the average, keeping the generator load constant.

It would occupy too much space to give a detailed description of the various styles of boosters, and for the same reason I have not alluded to many of the interesting characteristics of storage batteries.

Inexpensive Testing Laboratory.

[From the Question Box of the National Electric Light Association.]

Question.

What is the best method of maintaining the accuracy of standards for meter testing without an expensive laboratory outfit?

Answers.

Clayton H. Sharp: An excellent method for maintaining the accuracy of standards for meter testing is as follows: The laboratory should be equipped with a first-class voltmeter and ammeter of suitable range. These instruments should be periodically checked against a simple form of potentiometer and standard cell. The potentiometer need indicate only a few selected voltages, covering the range within which the station operates. An instrument specially designed for this purpose, which is reliable, accurate, simple to manipulate and inexpensive, has been designed by the Electrical Testing Laboratories, New York, and is on the market under the name of Lamp Testing Bureau pattern potentiometer. This instrument is in use by a number of the largest stations in the country and has been found to be very satisfactory. It is furnished complete with galvanometer and standard cell, all inclosed in a single box about the size of a Weston wattmeter box. Having an instrument of this kind the meter department can keep its voltmeter accurately checked to within 0.1 per cent., and can use this voltmeter to compare other instruments by.

To check the ammeter, a bank of lamps standardized for amperes is required. These lamps need to be carefully seasoned and to have their current consumption accurately determined at one of the voltages indicated by the potentiometer. By varying the number of lamps in parallel at this voltage any desired current value can be obtained and the readings of the ammeter can be checked. Standardized lamps for this purpose have been furnished by the Electrical Testing Laboratories for constructing lamp banks going as high as 130 amperes. If these lamps are properly selected low-efficiency lamps they will be very durable for this purpose and will change their current consumption at a given voltage very slowly indeed. Having after this method checked the ammeter and voltmeter, indicating wattmeters can be checked on direct current against them, and the reliability of the standards on which the station is working is very perfectly secured. The expense of an outfit of this kind is quite low, and its simplicity is such that it can be used by a person who has no special training in laboratory methods.

W. J. Mowbray: As a standard of voltage, a simplified form of potentiometer such as the L. T. B., six-point, $75 instrument, gives excellent results, especially if its standard cell be occasionally compared with two reference cells. Unfortunately a prejudice exists against the potentiometer for use in the average central station, caused, no doubt, by unfamiliarity with the simplified and portable type and by the idea that a potentiometer must of necessity be a laboratory instrument—expensive, delicate and extremely complicated. However, the aforementioned form should do much to remove this prejudice, as it is designed for central-station use and can be operated by any person competent to handle an indicating voltmeter. For ampere standards use ordinary incandescent lamps of 16 or 32 candlepower—50 and 100-candlepower lamps are less uniform in quality—and burn them at approximately 65 per cent. of their rated voltage. It is of course desirable to use the lowest possible voltage in order to get the longest possible lamp-life, but the 65 per cent. point is about the lowest at which the lamps will maintain their zero temperature coefficient. In other words, at a much lower voltage the resistance and hence the amperage will vary somewhat with the temperature of the surrounding air. At the above point, however, the lamps are almost everlasting, and if their use be confined to one or two hours per week for checking purposes the change in amperes would be less than one-tenth of one per cent. per year. Obviously, lamps that are mechanically perfect should be selected, and they should then be burned for perhaps 50 hours on rated voltage to season them and to facilitate detection of defects. The exact reduced voltage decided on is then applied by a potentiometer or by a voltmeter checked therefrom, and the amperage of each lamp or group of lamps—as indicated by an ammeter known to be correct—is noted for future reference.

C. C. Supplee: If no reliable standards are kept with which to check instruments, it is advisable to return them occasionally to the manufacturer to be tested. Careful handling is very essential in maintaining accuracy. If the pointer is approximately on zero with the current off and moves freely with current on, a good instrument can generally be relied upon for accuracy.

Unsigned: In purchasing standardizing instruments it is well to bear in mind the fact that in order to get results that are worth anything it is necessary to have the best instruments. The least expensive standardizing outfit that we know of is as follows:

One potentiometer with resistance, standard cell, galvanometer, and microscope for increasing sensibility of galvanometer; one standard 0.001-ohm resistance coil of 100-ampere capacity; one standard 0.1-ohm resistance coil of 10-ampere capacity; one Wheatstone bridge with galvanometer.

A detailed list of apparatus needed, with approximate price, is given below:

One potentiometer of simple design	$150
Two standard resistances with coils	115
One voltbox for use with potentiometer for voltage measurements, range 15, 150, 1,500	35
One standard Weston cell	15
One microscope	15
One Wheatstone bridge with galvanometer	125
Total	$455

By using the standard cell and the Wheatstone bridge the voltmeter standard can be checked by the "standard-cell method" and the voltbox omitted, but it is not advisable.

For the proper use of the above instruments it is necessary to have a steady current supply for voltmeter and also for ammeter calibrations. One hundred storage cells of eight ampere-hours capacity each can easily be arranged so as to be used either in series or in multiple, and with suitable resistances maybe used respectively for voltmeter or ammeter calibrations.

The Commercial Telegraphers' Union of America held its annual convention in the Capitol Building at St. Paul, Minn., last week. Resolutions were adopted favoring government ownership of telegraph lines. It is probable that the headquarters of the union will be moved from New York to the Twin Cities.

Further Development of Power Resources of the Niagara River.

That the project of the Niagara County Irrigation and Water Supply Company in the further development of the power resources at Niagara Falls, N. Y., is to be resurrected is indicated by the filing with the clerk of Niagara County of a large map showing the route of the proposed new developments. The map filed is signed by Charles B. Wortham of Buffalo as president, D. H. Potter as secretary, and Col. M. H. Alberger of New York as engineer.

The plan of the Niagara County Irrigation and Water Supply Company will be remembered as the scheme of William Love, who contemplated the building of a model city in the country east of the village of Lewiston. His plan was to dig a waterway from the upper river near La Salle, carrying the water to the heights of the Lewiston Mountain, where a high head would be obtainable. Mr. Love acquired options on many acres above and below the mountain, and there was much enthusiasm, but after ground was broken the scheme fell through.

It is the idea of the men now interested to revive this project, but instead of carrying the canal way to Lewiston they propose building it from near La Salle to the Devil's Hole, a spot just outside the city of Niagara Falls on the north. The waterway contemplated would be an open canal 120 to 250 feet wide and carrying from 12 to 20 feet of water. Its length would be about six miles. At the Devil's Hole the cliffs are very high, and a big head would be obtainable. The old Love franchise is a very generous one, and grants an unlimited supply of water. Under it the company is allowed to discharge the waters of the canal at any point in the towns of Lewiston or Porter, and as the Devil's Hole is in the town of Lewiston, three miles or so below Niagara Falls, and a similar distance from Porter, it meets the requirements of the franchise. If constructed on the present plan the canal would pass to the east of the lands of the Niagara Falls Power Company, going along the east and north sides of the city, passing to the north of the new manufacturing district of the Niagara Falls Hydraulic Power and Manufacturing Company. All about is country land that would make desirable manufacturing sites, railroad connections being very close. Three miles down the river the lower river is navigable, and it would be easy to reach the docks for water shipments.

Already notices in condemnation have been served upon owners who refuse to accept the company's offer of $300 per acre. The company is offering cash for what land it wants, the effort being to buy a strip about 500 feet wide the length of the route. Ten million dollars is mentioned as the cost of the complete development, and it is figured that 18 months would be required to dig the canal. It is intimated that the canal would be large enough to be used by barges all the way from the upper river to the power house.

President Wortham is quoted as saying that there has been for some months a persistent rumor to the effect that the Westinghouse people are anxious to get a foothold in connection with a great Niagara power development. The charter of the Niagara County Irrigation and Water Supply Company was granted in 1891, and the breaking of ground near La Salle some few years ago, it is thought, will serve to keep the charter good.

Lighting Situation in Bay City.

The Bay City (Mich.) Tribune of July 12th says: "The first round in the fight between the city and the Bay City Traction and Electric Company, the latter seeking to prevent the city from engaging in municipal commercial electric lighting, was fought out yesterday afternoon and the electric company held the honors. Judge Shepard, after a short deliberation, decided that the temporary injunction asked for by the company should stand." A representative of the company assured the court that on a trial of the case the company would positively show that the plant could not be built for the sum of $50,000; that it would cost approximately $100,000, and that the least amount under the specifications given would be $88,000. The people, he said, voted to expend $50,000, and to go ahead with the plans would simply be dishonest as well as illegal, it not being within the legal power of the city to follow such a course.

Chicago Street-lighting Statistics.

Statistics of the city for the first quarter of 1904 published by the Chicago Municipal Library and Bureau of Statistics show the total monthly average of street lights operated during the first three months of the year to have been 36,641, an increase of 188 over the corresponding period last year. The monthly average of gas lights used decreased by 231 lights; gasoline lights increased 92 and electric lights increased by 327 lamps. Following is a comparison with the first quarter of 1903, the figures being the monthly average for the three months:

	1904.	1903.
No. of gas lights operated	24,639	24,870
No. of gasoline lights operated	6,304	6,212
No. of electric lights operated by city	5,000	4,698
No. of rented electric lights	699	674
Total number of lights operated	36,641	36,453
Average daily candlepower used for lighting streets	12,771,625	12,108,783

Sound-proof Telephone Booth.

The accompanying illustration shows one of the telephone booths manufactured by the Yeshera Manufacturing Company of Toledo, Ohio. The demand for telephone booths for individual telephone users grows larger and larger as their utility becomes more and more recognized.

This booth has double walls. The inside and outside walls both extend to the floor on which the booth stands. The edges of the booth floor fit into grooves plowed crosswise of the inside walls. The inside walls are first put into position, the edges of the side walls fit into grooves plowed lengthwise of the front and back walls; screws draw them tightly together at the corners of the booth. The outside walls are put into position and fastened in the same

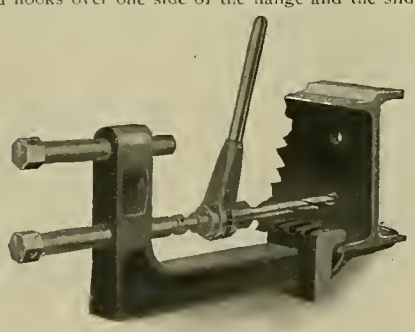
SOUND-PROOF TELEPHONE BOOTH.

manner as are the inside walls. The ceiling fits over the inside walls, the top over the outside walls, giving a clear air space on all sides and at the top. The floor rests on felt cushions. The outside and inside walls are held the proper distance apart by four small cushioned blocks at the extreme corners of each side. The doors walls are separate, and swing on different sets of hinges, necessitating the use of an adjustable extension lock, which is supplied with each booth.

By this construction the best possible sound-proof qualities are obtained. Plain or quartered oak is used or birch finished in mahogany, if desired. The wood is thoroughly filled and given a rich rub finish inside and outside. This is but one of a large line of booths manufactured by the company.

Security Drill Clamp.

A drill clamp for drilling track rails is illustrated herewith and is manufactured by the F. Bissell Company, under the name of the Security drill clamp. The clamps are made to attach to the base of any rail and to remain firmly there while in use. The end hooks over one side of the flange and the sliding



SECURITY DRILL CLAMP.

claw fits over the other. There is no bend nor spring to it, and when the drill is in use the alignment is preserved.

The vertical arm holds two adjusting screws, each one inch by eight inches, which follow the drill forward. They are of ample size and stand heavy use and are cupped to receive a ratchet head. Two screws are provided, to save time for the workman, and their centers are respectively set two and six inches above the horizontal arm. In use this arm comes tight against the rail base, so these measurements apply to the rail itself.

Cutler-Hammer Controllers for Machine-tool Motors.

In approaching the problem of controllers for motors driving machine tools, the Cutler-Hammer company has considered the machine-tool field as being divisible into two general sections, namely, machines of the surfacing type, in which the general form of the tool is cubical, and the operator is usually within reach of the controller, so that it may be directly and manually operated, and machines of the lathe type, which are elongated in form, and the general characteristics of which prevent the location of the controller within direct reach of the operator.

The apparatus herein illustrated is intended for use with the second class of machinery, and is particularly adapted for operation at a distance by means of mechanical transmission. The controllers in question are of two types, namely, the slate front and the drum type, and each has its distinctive fields of application.

The slate-front type of controller (Fig. 1) is particularly adapted for mounting below the bed of a lathe, for instance, with the fiber disk attached to the lever projecting between the legs of the tailstock end. This fiber disk is attached to the control lever by means of four countersunk machine screws, and holes are provided between these screws, forming an insulated attachment for a sprocket wheel. A similar sprocket is fixed on the end of the usual

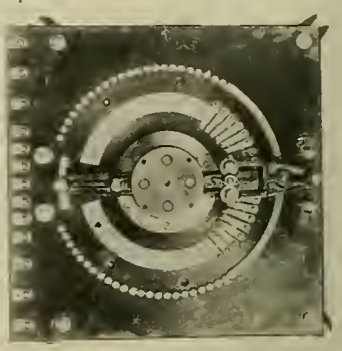


FIG. 1. SLATE-FRONT CONTROLLER

splined shaft device operated by handle of the tool post, and these sprockets are so proportioned as to give the total required movement to the rheostat lever by the desired angular movement of the tool-post handle. This provides for the cheapest form of connection, and, at the same time, for a simple and reliable device applicable through a wide range of service.

To meet conditions in which the slate-front type would not be applicable, such, for instance, as in larger machines where the skeleton-leg construction is replaced by closed pedestals, the drum type of controller (Fig. 2) has been designed. In general, these controllers are of ordinary construction, particular attention being given, however, to reduction of the length along the shaft, so that they may be

FIG. 2. DRUM CONTROLLER.

mounted in a horizontal position on the supporting pedestal without taking up too much room on the machine. This horizontal mounting makes possible the driving of the controller from the ordinary spline-shaft arrangement by means of a pair of spur gears of proper ratio.

The apparatus being intended for use where wide ranges of speed variation by field change are obtained, a large number of field-resistance points are incorporated, while the armature-resistance points have been reduced to a safe working minimum. In both the slate-front and drum-type controllers, on 110 and 220-volt service, 20 points of field control are provided; on 500-volt service, 18 points. The drum controllers have four points of armature resistance and the slate-front type eight. All armature-contact parts are cheaply and easily renewable in both constructions, and without disturbing any connections in the case of the slate-front type. In the case of the drum controllers, it is necessary to move connecting wires only when the contact fingers are to be replaced. This condition should not occur except at long intervals in ordinary service, and is, therefore, not considered detrimental. Blow-out magnets are provided at the breaking points on the slate-front type in all sizes, and are provided where necessary in the drum type.

Effort has also been made to reduce to a minimum

the labor of installing the apparatus electrically, and in the case of the slate-front controllers the field resistance is mounted directly back of the slate, and consists of porcelain resistance units. Under these conditions it is, therefore, necessaary to run only the armature and power lead wires and the leads to the armature resistance. In the case of the drum controller, the field resistance and armature resistance are mounted in the same framework, and the field connections to the drum are made in process of construction, the leads being brought out a distance of three feet from the drum, thus eliminating the trouble inherent to making a large number of connections in the necessarily confined space permissible. Ample provision is made for connecting the armature resistance and power leads.

Inverse Time-limit Relay.

The ordinary time-limit relay, as generally employed in connection with the tripping coil of a circuit-breaker, insures the line current from interruption until an overload shall have been sustained for a predetermined period which is long enough to threaten the safety of the apparatus. A movable contact then meets a stationary contact in the relay and the tripping circuit in the breaker is closed, causing it to rupture the line current. The action of the inverse time-limit relay is similar, except that the speed with which the movable contact travels is regulated by the amount of the overload, and it thus differentiates between a short-circuit, which requires an immediate action of the circuit-breaker and a slight overload, which will cause no damage unless sustained until the thermal effect is dangerous. Both types prevent unnecessary interruption of the service from slight momentary overloads by preventing the instantaneous operation of the circuit-breaker. In the simple time-limit relay the time element is fixed, while in the inverse time-limit relay

INVERSE TIME-LIMIT RELAY.

it is automatically adjusted to any excess of the normal current from a light overload to a short-circuit. The value of this feature is apparent.

The accompanying picture illustrates a new inverse time-limit relay announced by the Westinghouse Electric and Manufacturing Company. It is made in types for both single and polyphase circuits, the single-phase relay containing one electromagnet with its regulating mechanism and the polyphase type consisting essentially of two single-phase mechanisms in a case and properly connected.

The electromagnet consists of two coils connected in series with a series transformer and has a U-shaped laminated iron core, from which the moving contact is suspended. When an overload occurs the core is drawn into the coils, raising the moving contact until connection is made with the stationary contact and the tripping circuit is closed.

The variable time element is supplied by an air check, which is connected with the magnet core by a vertical rod. As the core and moving contact rise the air in the checking chamber is compressed and acts in the same manner as a dash-pot in retarding the closure of the circuit. An intake valve allows the checking chamber to fill quickly when the overload is removed, and the relay is thus automatically reset. The outlet valve furnishes the inverse time-limit feature, as the ball which closes the valve is held lightly under the compression of a coiled spring, the amount of the pressure upon the valve from within regulating the size of the opening. When a slight overload occurs the pressure upon the check is light and the air escapes slowly through a small opening. In the event of a short-circuit, the magnet core would be drawn rapidly upward, the air being expelled quickly from the valve which the pressure would force wide open, and the tripping circuit would be closed. The effect upon the time limit varies with the amount of overload, the length of time being in inverse proportion to the excess of current. Should the overload cease before the contacts touch the magnet core drops to its original position and the relay is reset.

CORRESPONDENCE.

Great Britain.

London, July 13.—The proposal contained in the bill promoted by the Tyneside Tramways Company that compulsory running powers should be granted it over the Newcastle corporation tramways after having passed committees of both houses of Parliament was rejected after a discussion in the House of Commons. The ground of the rejection of the motion was that the precedent created thereby would be too powerful in the future. The bill was therefore sent back to the House of Commons committee, which originally passed the bill, but without any instructions whatever. Consequently, when the committee sat again, a few days ago, the chairman informed the Newcastle corporation that the committee was in as free a position to act as it was previously. He therefore ordered the parties to come to an agreement within a fortnight, failing which the Newcastle corporation was to be prepared to produce further evidence to prove that the previous decision of the committee was wrong. The position which the corporation has taken up is that it does not wish to be compelled to give these running powers, but that it is willing to negotiate with the company with a view to an amicable arrangement. Yet when the representatives of the two parties came together the failure to come to a settlement has been due to the corporation. It is a one-sided policy that has met with much condemnation, although the municipalists in Parliament are bound to support the corporation.

The first waterpower scheme ever sanctioned in England has just passed the second House. The proposal is to utilize the waters of some lakes in North Wales on the slopes of Mount Snowdon and to transmit electrical energy over a large area by means of overhead wires. The area covered by the scheme abounds in collieries and quarries which are unworked, owing, it is said, to lack of cheap power. In the early stages of the bill there was much opposition, but this was overridden by Parliament, and it is to be hoped that sufficient funds will be forthcoming immediately to put the scheme into operation.

The municipal authorities in London have recently been holding several conferences relating to electrical matters. Much indignation exists as to the state of the law which allows a person to obtain an injunction in respect of alleged vibration from generating stations. This has resulted in a number of electrical undertakings having to purchase neighboring property at a very large figure to get rid of the injunction. This is one matter over which conferences have been held, and representations are now being made to Parliament to secure more fairness in the law. Another matter has reference to the purchase of the National Telephone Company. Two conferences have been held at the instance of the city corporation, but as the postmaster-general has promised that he will not purchase the undertaking of the company on arbitration terms, for the present the local authorities are satisfied. The fear is that the company may be bought up at a price far exceeding that of the actual value of the undertaking.

The accounts of the London County Council tramways department for the year ended March 31, 1904, have been issued. The tramway system in the hands of the council extends over 39⅞ street miles, of which 19¼ miles of double track have been reconstructed on the conduit system. The total number of passengers carried was over 133,000,000, compared with 109,000,000 during the previous year. The total gross revenue was over $470,000, but after all charges have been met there is a deficiency of over $40,000. As a matter of fact, a deficiency of $75,000 was provided for in the estimates for the year. One of the chief reasons for the deficiency is, of course, the temporary and expensive manner in which the council is securing its supply of electrical energy, and much better things are looked for when the large power station at Greenwich gets into working order. The deficit above referred to relates to the southern system, and peculiarly enough the old horse tramways in the north, leased to a company, have yielded the council a profit of some $135,000. Depreciation, interest and sinking fund have been provided for to the extent of over $500,000.

The Glasgow telephone accounts for the third year of working have just been issued. After meeting interest and sinking fund a net revenue of about $18,000 remained, and this has been placed to the credit of the depreciation fund, which now amounts to over $28,000. The telephone committee is considering the advisability of changing the present method of operating.

There are now 825 subscribers connected to the Swansea corporation telephone system and 120 awaiting connection. A report is being prepared upon some extensions which will cost $10,000.

Trial trips are now being run upon the system of trolley tramways in Middlesex adjoining those owned by the London County Council in the North of London. When completed a huge system will be in operation over both Middlesex and Hertfordshire, the adjoining county. G.

New York.

New York, July 23.—The Brooklyn Rapid Transit Company has an absolute monopoly of electric traction within its district and it is interesting to note that the traffic receipts for the week ended July 16th were the largest in its history. For Saturday, July 16th, the gross earnings amounted to $59,000, and on the following Sunday the returns were $93,000, the latter figure representing, on the basis of a five-cent fare, a passenger total of 186,000. For the month of June also the total gross earnings showed an increase of $219,000, while the operating expenses were only increased by $3,500. As a consequence of these increases the stock of the company has risen several points. A rumor that the Pennsylvania railroad (which already owns the Long Island railroad) has made arrangements to gain control of the Brooklyn Rapid Transit has been emphatically denied.

The new power house of the Interborough Rapid Transit Company at Eleventh Avenue and Fifty-ninth Street is approaching completion. The building is practically finished and already three of the 15 12,000-horsepower generators are in position and have been running in working order. The structure covers a space of 700 by 200 feet, and is of substantial and pleasing architecture. On July 20th it was inspected, together with a good portion of the new subway, which is to be opened on September 1st by Mayor MacClellan, August Belmont, the president of the Interborough company, John B. MacDonald, the tunnel contractor, Alexander Orr, chairman of the Rapid Transit commissioners, and a large number of civic officials and engineers.

The New York Central and Hudson River railroad will erect a large power house, at an estimated cost of $500,000, at One-hundred-and-forty-ninth Street, Bronx Borough, the current from which will ultimately work the New York Central's immediate suburban traffic when the pending electrification of its suburban lines is completed.

The New York, New Haven and Hartford railroad has bought out entirely, as from August 1st, the Norwich Street Railway Company, an electrical line, at a premium of five per cent. on its share capital, and this company, which now controls nearly all the trolley lines adjacent to its tracks, has a mortgage of $8,500,000 on the Harlem River and Portchester Railroad Company, which is seeking a franchise for electrical lines in the northern part of New York city, in rivalry with the New York, Westchester and Boston Railway Company. The latter company is proposing to increase its capital from $1,000,000 to $20,000,000, and the suspicion is that its franchise is being "held up" until the company obtains more funds.

In a damage suit against Subway-contractor John B. MacDonald, the appellate division has held that the defendant is not responsible for damages caused to property arising out of blasting operations by the sub-contractor. In this connection it may be noted that a "Commission of Examiners of Property" has been privately organized by the various contractors for the Manhattan and Brooklyn line. The commissioners will keep tab on all the work of the excavation, as far as affects property owners, and will endeavor to adjust all disputes without recourse to the courts.

The Staten Island Rapid Transit Company, through its representative, J. H. Maddy, has declined to sell its terminal rights and property at St. George, S. I., for $500,000. The company is standing out for $25,000 more, and alleges that its own valuation is $539,000. The matter will probably be adjusted amicably without condemnation proceedings.

The Cranford Company has this week been awarded the contract for the elevated extension of the Brighton Beach railroad. This work marks the commencement of the carrying out of a new policy to abolish all the grade crossings in Greater New York.

All the platforms on the Third Avenue elevated line are in process of being lengthened, in order to enable an additional car to be put on the present six-car trains during the rush hours.

A full plant, comprising steam engines, electric generators, wiring, switchboard and other fixtures, are required at the Jameco and Springfield pumping stations. Bids will be received by Commissioner Oakley, New York city, until August 3d.

William A. Carey, John C. Roffe, Alfred W. Watkins and W. F. Wahrenberger are scheduled as "temporary inspectors of electric lighting and conductors" in the employ of the city, at $1,252 a year each.

Lighting Commissioner Oakley has scheduled a number of streets in Brooklyn for the removal of overhead telegraph, telephone and electric wires, and the placing of the same underground. The work, as far as affects Brooklyn, has been proceeding gradually for the last two years, but in Manhattan no overhead wires are permitted except those connected with the fire alarms, and used for other official purposes. Telephone wires, both new and old, are also to be put underground at Rockville Center, L. I.

A number of policemen were detailed at the Brighton racetrack on Tuesday to send several hundred cipher telegraph messages immediately after a race. This was done, it is alleged, in order to test the good faith of the Western Union Telegraph Company in the matter of not giving preference to gamblers' messages. According to all accounts, the company stood the test satisfactorily, but some considerable delay was occasioned by the handling of such a large number of unexpected and hieroglyphic messages. It is interesting to note the organizers of the poolroom news syndicate have taken legal steps to compel the New York and New Jersey Telephone Company to restore its telephone instruments, recently seized in a police raid. D. W. W.

New England.

Boston, July 23.—Reorganization of the Bristol County and the Middleboro, Wareham and Buzzard's Bay street railway companies, which are now in the hands of receivers, is proposed by a committee of the creditors, made up of Charles A. Vialle (chairman), George H. Newhall, Edward P. Metcalf, Frank C. Wood and C. F. Choate, Jr. The Bristol County road has a floating debt of $480,000, and the Middleboro, Wareham and Buzzard's Bay road $700,000, but there is a valuable equity in the properties above the $350,000 outstanding bonds, and it is proposed that a holding company be organized to bid in the roads at the receivers' sale, a new stock issue to follow, with special privileges for the creditors.

The selectmen of the town of Hull have granted the petition for a trackless trolley in that town from Nantasket Beach to Nantasket Point. There is considerable enthusiasm in the town for the innovation on account of a recent declination of the railroad commissioners to interfere in a local controversy over existing service. The commissioners, it is understood, have no jurisdiction over a trackless route, and the selectmen have made what they consider very satisfactory terms with the promoters of the new style of transportation.

A new electric line from Rockland to Brant Rock and Kingston, in the southeastern part of this state, connecting several shore resorts with neighboring centers of population, is projected. Marshfield, once the home of Daniel Webster, will be one of the towns included in the route.

The Pittsfield Street Railway Company's stockholders are to meet to consider the matter of increasing the capital stock from $50,000 to $100,000. This is to be utilized, if approved, for the construction of new and important additions that were granted by the aldermen in 1903, revoked in 1904 when the new board came into office, and sustained as valid by the railroad commissioners upon appeal of the railway company to that body.

The railroad commissioners have authorized an additional stock issue of $100,000 by the Hoosac Valley Street Railway Company, to be offered to stockholders at $105 per share. The proceeds of 428 shares are to be applied to installing an additional power plant, and 288 shares will furnish the means for a projected extension in the college town of Williamstown.

Under a stringent law relative to the fraudulent use of street-railway transfer checks passed by the last Legislature, the Boston Elevated Railway Company on July 20th secured convictions in court against a woman and two of her customers for illegal sale on her part and illegal use by them of transfer checks of the company. It is estimated that the company has been losing thousands of dollars annually through frauds upon its exceedingly generous check system. The practices covered by the statute will be broken up if possible.

The West End Street Railway Company, which is operated under lease by the Boston Elevated Railway Company, was authorized on July 21st to issue 30-year four-per cent. bonds to the amount of $750,000 and 3,000 additional shares of common stock for the purposes of payment for permanent additions and improvements made to the property by the lessee from April 1, 1902, to March 31, 1904. The par value of the stock is $50, but the last sale was at 91½ on the stock exchange.

Locations have been secured for nearly all the links in the new Haverhill and Boston Street Railway Company, which got a special charter from the last Legislature with permission to bridge the Merrimack River in spite of much opposition from established lines in the same section, which it is designed to serve. Plans for a large power plant and car barns to cost $800,000, in the Bradford district of the city of Haverhill, have been drawn, and negotiations for a site have been in progress for a short time. Work will shortly begin on the construction of the road, it is stated.

The people who have built and so successfully operated the Boston and Worcester electric through line have mapped out a triangle for their field of operations and are applying themselves to the working out of the details of their plan very assiduously. Their most-in-evidence scheme now is the projected Boston and Providence line, to be similar in equipment and speed to the Boston and Worcester. Then will follow a line from Providence to Worcester, for which plans have already been pretty fully made. The trip from Boston to Worcester, 39¼ miles, is made regularly in two hours and 15 minutes, and it is proposed to cover the 44 miles from Boston to Providence in two hours, much of the route being near the highways on private land. B.

Dominion of Canada.

Ottawa, July 22.—An appropriation of $100,000 has passed the Parliament of Canada to provide for the electric-lighting and power plant on the Welland Canal. The government decided to substitute an electric-lighting system for that of gas. The power is also required for operating the locks. The Welland Canal is one of the oldest artificial waterways in Canada, and annual sums have been voted for it since the confederation of the Dominion. The total capital expenditure on this canal is $24,634,157. The route is from Port Dalhousie, on Lake Ontario, to Lake Erie, and is 26 miles long.

Plans for a corundum mill of 100 tons daily capacity, to be erected at Palmer Rapids, Renfrew County, Ont., have been accepted at a meeting, held in Toronto recently, of the Corundum Refining Company, which is composed of American and Canadian Capitalists. The company now controls nearly 1,400 acres of corundum lands in the Raglan Township, the greater part of which has been acquired by private purchase. Several tenders for $250,000 of bonds of the company were received, the bid of a syndicate headed by J. H. Jewell & Co., Toronto, being accepted.

In connection with space-telegraph stations recently established in Canada, the Allan Line Steamship Company has decided that, as it has its ships fitted up with the Marconi system, it will give its passengers as much benefit from the system as possible. Besides using it for such business purposes as reporting conditions on board or advising the captain as to conditions in the St. Lawrence or Gulf, the company will send a synopsis of the world's news to each ship that approaches Belle Isle. All the important events which have taken place after the ship leaves port will be written up in condensed form and sent to the ship. On shipboard the news will be bulletined for the benefit of the passengers, and the traveler will no longer land at Quebec or Montreal a week or so behind in knowledge of what has transpired throughout the world while he was on the high seas. The liner Tunisian was recently kept well supplied with the news on her way across the ocean. A news message of 100 words was sent her at Fame Point, on July 21st, and she caught it when 60 miles east of the Point. W.

Winnipeg, Man., July 22.—A charter is being applied for from the Manitoba Legislature to build an electric railway from Lac du Bonnett to Winnipeg. This is in connection with the development of a waterpower on the Winnipeg River, and in the application for a charter, which is to be made at the next session of the Legislature, the supplying of power will be one of the privileges sought. Messrs. McPherson and Sandison of Winnipeg are the solicitors for the intending incorporators.

General Manager Kent of the Canadian Pacific Telegraphs returned from an inspection trip to the Pacific Coast and announced that owing to largely increased business of the company a new copper wire had been strung all the way from Montreal to Winnipeg, and that it was decided to place another line between Toronto and Detroit and a new line along the entire route of the Pontypool and Bobcaygeon line. Owing to the rapid development between Lagon and Lake Superior it had been necessary for the company to erect over 600 miles of new lines since the beginning of the year, and 2,000 miles would be placed before the end of the year.

The work on the Winnipeg, Selkirk and Lake Winnipeg electric railway is completed and the road ready for the rolling stock. The road will carry passengers to the Winnipeg Dominion Fair and until electric connections are made will be operated by steam.

The Canadian Electric Traction Company of Toronto, composed chiefly of British capitalists, has awarded the contract for the power equipment of its line and power house to Bruce, Pebbles & Co. of Edinburgh, Scotland. The contract is valued at $210,000. The company's line will run from London, Ontario, through St. Thomas to Port Stanley on Lake Erie, a distance of 30 miles.

The City Council of St. Louis, Que., a suburb of Montreal, has given effect to the 20-year contract with the Montreal Light and Power Company, for lighting the streets and the construction of a fire station in the North Ward. This terminates the long legal battle between the municipality and the Citizens' Electric Company, now controlled by the Montreal Light, Heat and Power Company. The contract gives the town 70 arc lights, besides incandescent lights, at $75 a year.

John D. Simpson of Moosejaw, Assa., is advertising for tenders for the construction of a power house for waterworks and an electric-lighting system. Plans may be obtained from E. H. Bissett, 339 Main Street, Winnipeg.

A by-law has been carried at Preston, Ont., in favor of municipal ownership of the electric-light plant, and the council will raise $27,000 to purchase the arc and incandescent-light plant and to provide for the installation of machinery sufficient to meet the requirements of the town for some years to come.

The St. Johns (N. B.) Street Railway Company has finished the work on the construction of its line to Bay Shore Park, and the cars are now running. The cable has been laid across the suspension bridge. Seven double-truck combination cars have been added to the rolling stock and a new shed is being built.

The receipts of the Toronto street railway for the month of May were $201,829. The city's percentage was $24,219, as against $17,523 in May, 1903, and $9,374 in May, 1900. H.

Northwestern States.

George H. Morse has been awarded the contract for a lighting plant for Lincoln, Neb., at $65,000.

The Chippewa Valley Electric Railway Company is endeavoring to secure a street-car franchise at Eau Claire.

L. W. Cornelius has resigned his position as superintendent of the lighting plant at Rugby, N. D. The plant has been sold to John Kain of Devils Lake.

Plans have been accepted for the construction of an electric-light plant at Spring Valley, Wis.

Frank Burbank has resigned as superintendent of the Lakefield (Minn.) electric-light plant, to accept a similar position at St. James, Minn.

The county commissioners of Ramsey County, Minn., have voted a franchise to the Twin City Rapid Transit Company for a trolley line from St. Paul to White Bear.

E. L. Hospes has been elected president, and R. S. Davis, secretary and treasurer of the Stillwater (Minn.) Gas and Electric Light Company.

A large number of changes will be made shortly in the electrical power plant of the Sioux Falls (S. D.) Brewing and Malting Company.

The Eastern Iowa Railway Company has been granted a franchise for constructing a loop at Iowa City.

The electric-light plant at Lake City, Iowa, has been leased to Otto E. Brownell.

Construction of the LaCrosse (Wis.) and Southeastern Electric railroad was begun recently, in charge of the company's engineer, George Bradish.

A company has been organized at Greene, Ia., to purchase and operate the electric-light plant.

W. J. Dobbs has been elected president and A. T. West secretary of the Council Bluffs (Iowa), Tabor and Southern Electric Railway Company.

The contract for erecting a light plant at Thief River Falls, Minn., has been let to Carl Bartelson for $2,755.

Machinery is being installed in the new building of the Grand Forks (N. D.) Gas and Electric Company.

The Des Moines (Iowa) City Railway Company has plans prepared for a new downtown loop. The line on Seventh Street will also be doubled.

It has been decided by the court that the Outagamie Traction Company must secure a new franchise for the Appleton (Wis.) end of the proposed line and from there to Seymour.

The Virginia (Minn.) Light and Water Company will sell the plant and franchise to the city.

The contracts for electric generators for the state institutions at Madison and Davenport, Iowa, have been let to the General Electric Company of Chicago.

Boston capitalists contemplate building a trolley line connecting Rhinelander, Wausau and Stevens Point, Wis.

Walter Hill has been appointed as superintendent of the new electric-lighting plant at South Stillwater, Minn.

Ohio.

Cleveland, July 23.—The American DeForest Wireless Telegraph Company will establish a station at Youngstown, where many of the large furnaces of the steel corporation are located. It is the intention to keep in communication with the ore boats on the lakes.

The Clark County Court has ordered that the Springfield and Xenia Traction property be sold unless the claims of the Cincinnati Trust Company for $525,816 and W. L. Snyder for $3,712 be satisfied before August 12th. An entry has been made in favor of each of them.

Bentley & Sons have received the contract for building an addition to the power house of the Toledo Railways and Light Company at a cost of $30,000.

The new office building to be erected by the Columbus Savings and Trust Company at Columbus will have its own electric power and lighting plant.

The boilers in the lighting plant of the university at Athens exploded a few nights ago, causing a loss of $5,000. They are heated by natural gas, and this was left burning through the night.

The Cleveland and Southwestern is making arrangements to enter Lorain at a point that will give it a slice of the large steel-plant business. At present the local line there has all that business.

The surplus earnings of the Toledo Railways and Light Company for the first six months of this year are $118,544.81, as compared with $128,901.65.

It is stated that several Toledo men will ask the City Council for a franchise to operate a city street-car system on a lower rate of fare than the Toledo Railways and Light Company has been doing. Guy Major, Charles S. Ashley and others are interested in the scheme.

The Springfield, Troy and Piqua electric railway has been opened for business. On the first day 1,500 passengers were carried.

The Columbus Railway and Light Company has not yet indicated whether it will accept the price fixed by a recent ordinance for private lighting or not. The figure is five cents per kilowatt-hour.

The plant of the Stillwell-Bierce and Smith-Vaile Company at Dayton has been appraised at $1,265,000.

Arrangements are being made to put sleepers on the trolley roads from Zanesville to Indianapolis. The cars will be operated by the Holland Palace Car Company of Indianapolis, which now has two completed. Some changes must be made at Richmond, Ind., in order to allow the large cars to pass under a railroad trestle. Appleyard roads have had this plan in contemplation for some time. The officials believe they can make the run from Zanesville to Indianapolis in eight hours. O. M. C.

Indiana.

Indianapolis, July 25.—The syndicate of capitalists which recently purchased the Fort Wayne Electric Light and Power Company held a meeting at Fort Wayne last Thursday and elected E. C. Werner of New York president, to succeed H. P. Bondhight of New York. Arrangements are being made of the details of the merger by which the union of traction interests will secure control of the entire electric-light and power business of Fort Wayne, that city's traction lines and all of the interurban lines centering there, in addition to a big interest in the Indianapolis Traction and Terminal Company, the Union Traction Company of Indiana and the Fort Wayne and Wabash Valley Company. At Fort Wayne it is expected that the deal will be completed today, and the syndicate that is now the most powerful force in Indiana traction interests, will have added another to its list of holdings. The name of J. Levering Jones, the Philadelphia magnate who is prominent in all of the companies mentioned, is foremost among those conducting the negotiations at Fort Wayne. Others are Henry C. Boyer of Philadelphia, E. C. Werner of New York city, and James Murdoch of Lafayette, besides Fort Wayne men. The money for the sale of the light and power plant, $550,000, has already been paid over. The new company will erect an enormous power house capable of lighting the city and of furnishing power for the city and park and the interurban lines. The company controls a franchise for steam and hot-water heating, and the exhaust from the power house will be utilized in this way.

George F. McCulloch, appearing for the Union Traction Company and the Indiana Northern Traction Company, made a speech of more than an hour's length on Friday before the State Board of Tax Commissioners in an effort to get a lower assessment. The business of operating a traction line, he said, was not the most pleasant thing in the world and there were other things to be considered than the declaring of dividends. The innovations in the mechanical part of the business, he said, have made constant improvements necessary. He declared that the only way to obtain money to keep pace with the necessity of improvements was by increase of the capitalization. Mr. McCulloch said that much of the equipment put in only three or four years ago as thoroughly modern had since been replaced. Mr. McCulloch said that receipts had fallen off in the gas belt because the removal of factories, due to the failure of gas, had resulted in a decrease in population, and lessened traffic. He asked that the valuation of the line between Indianapolis and Muncie be made at $13,000 a mile instead of $15,000.

The damaging effect of the interurban railways on the business done by the steam roads was the text of the pleas made a few days ago before the State Board of Tax Commissioners by the attorneys for the Lake Erie and Western and the Big Four Railroad companies, both of which roads have suffered much from the competition with the electric lines. The Lake Erie was represented by John B. Cockrum, and the Big Four by J. Q. Van Winkle and Joseph Moses.

The Board of Public Works will receive bids on August 1st for the public lighting of Indianapolis, not included under the contract recently made with the Indianapolis Light and Power Company. The specifications drawn by City Engineer Jeup call for gas and naphtha lamps using Welsbach mantles. An all-night schedule is provided, and a fine of 50 cents a day is to be assessed for every complaint, according to the specifications.

A new move in a long controversy, involving through service between Newcastle and Indianapolis by the Indianapolis and Eastern Traction Company, has been made by the Newcastle city authorities. The Indianapolis and Eastern promised through service, but asserted that it cars could not go around the loop in Newcastle, because of a telephone pole at Fourteenth and Indiana Streets. The city has notified the traction company that if it will put in a proper curve and repair the street the telephone pole may be moved, as far as the city is concerned. It is feared that the telephone company will resort to an injunction, if necessary, to prevent the moving of the pole.

Charles S. Schindler, trustee of the bondholders of the Highland Railway Company at New Albany, Ind., opposite Louisville, has brought suit against the New Albany Trust Company, custodian of the bonds, and asks for the appointment of a receiver with instructions to reconstruct and operate the road. Bonds to the amount of $50,000 are outstanding and no interest has been paid on them since the middle of January, 1896. T. N. C.

Michigan.

Detroit, July 23.—The surveyors are at work on the new Grand Rapids and Owosso electric railway between Owosso and Pontiac, by the way of Vernon. E. M. Hopkins of Detroit and Frank Westcott are interested in this company.

The people of Almont have subscribed for nearly all of the $10,000 stock which is necessary to secure the extension of the Detroit United Railway from Romeo to Almont. The village has granted a franchise exempting the railway company from taxation for 10 years and giving it the right to operate cars on any schedule it may put in force.

The voters of Shelby have defeated the proposition to raise $10,000 additional to rebuild the electric-light plant in that village.

The Board of Public Works of Mackinac Island is considering the question of purchasing the water, light and sewerage system now in operation there. The plant was installed three years ago under the administration of ex-Mayor M. G. Bailey, and cost $108,000. It was decided at that time that the city should not operate the plant. The bonds are held by the Union Trust Company of Detroit and are for sale to the city of Mackinac at a great reduction from the amount originally expended. If the board reports favorably to the council the matter will be submitted to the people at a special election to be held soon.

Representatives of the Detroit, Pontiac, Lapeer and Northern electric road announce that the division of the road between Bay City and Caro, which is a part of the line to be constructed between Port Huron and Bay City, will be completed before winter. Contracts have been let for the roadbed, trackage, etc.

Hayes & Sons of Cleveland have accepted Bay City improvement bonds issued for electric-light improvements to enable the city to establish a commercial plant. The bid was $49,500.

Articles of association for the Grand Rapids, Holland and Chicago railway, capitalized at $1,350,000, have been filed. This company is organized to take over the property of the Grand Rapids, Holland and Lake Michigan railway. The incorporators of the company are George Hendrie, J. K. Andrews, A. L. Stephens, Henry C. Potter, Jr., Benjamin S. Hanchett, W. H. Beach and Strathern Hendrie.

E. F. Layman of Cincinnati, with nine assistants, commenced work on the survey of the new Battle Creek-Coldwater electric railway last week. The new line will compete with the Michigan Traction Company in taking passengers to Lake Goguac, Battle Creek's nearest summer resort. Battle Creek has two interurban lines in active operation, a line from Jackson to Battle Creek and that from Kalamazoo to Battle Creek.

The Detroit, Monroe and Toledo electric railway has established its headquarters in Detroit at 28 Cadillac Square, where a waiting room has been fitted up on the ground floor in connection with a ticket office. The upper floors are used as the general offices of the company. The running time now from Sibley to Toledo is two hours, but it is expected that when the through service is started that the time from Detroit to Toledo will be only a few minutes over that time. C. G. W.

Southeastern States.

Charlotte, N. C., July 23.—The mayor and council of Thomasville, Ga., have entered their protest with other citizens against a bill introduced in the state Senate providing for ownership of lighting plants by municipalities and making compulsory the purchase of existing plants.

The town of Batesburg, S. C., has contracted with Frederick Minshall of Abbeville, S. C., for the construction of the water and light plants in Batesburg at a cost not exceeding $18,500. There will be 28 street lights.

The Raleigh (N. C.) Electric Company is considering some needed extensions in the city.

The previously mentioned Belton Power Company of Belton, S. C., has been chartered by the secretary of state, with $100,000 capital. The concern will do a general mill business and sell electric power from Saluda River.

In the District of Columbia the electrical regulations regarding the production, use and control of electricity have been passed upon by the corporation counsel and pronounced correct, with the suggestion that the regulations be advertised a month before taking effect. L.

Rocky Mountain States.

Salt Lake City, July 22.—Senator Reed Smoot of Provo, Utah, and other capitalists, local and eastern, have been granted a franchise to operate an electric street-railway system in Provo. The same company also contemplates making application in the near future for franchises for the operation of street-railway systems in many other cities in the southern portion of Utah. Work on the Provo line will begin some time in August.

The Postal Telegraph-cable Company, through its Salt Lake attorney, has made application for the privilege of erecting poles and stringing wires in the city and county of Salt Lake. The telegraph company is rapidly progressing with its western lines, and the expectation of the officials is that the system in Salt Lake will be in operation by next September. The company is also making rapid progress with its lines in Wyoming.

The mayor and City Council of Red Lodge, Mont., have been summoned before the District Court to show cause why they should not be punished for contempt. This decision is a result of the refusal of the mayor and council to permit the Rocky Mountain Bell Telephone Company to erect poles and string wires through the streets of the city, under the terms of a decision of the state Supreme Court.

The survey has been completed for an electric railway that is to be constructed from Yucca, Ariz., to the mining camp of Cedar. The proposed road is to handle both freight and passengers.

The Public Utilities Company has been organized at Carlsbad, New Mexico, with a capital stock of $100,000. The charter of the company says that it is formed for the purpose of acquiring, installing, owning and operating telephones, telegraph lines, etc., and to acquire, construct and maintain a dam for the production of waterpower, which shall be used to generate electrical energy for electric-light systems. The incorporators of the company are William A. Finley, Matthew S. Groves, William J. Barber, J. O. Cameron and Dr. Fred F. Doepp.

It is announced by Charles M. Clark of the Globe Power Company that the big project of establishing an electric power plant for Globe, Ariz., and the adjacent mining camps is soon to be carried out as originally planned. The United States government granted the company the necessary right-of-way for its canal, transmission lines, etc., a few weeks ago. It is stated that the company has spent about $30,000 in surveys and preliminary work. It is estimated that the cost of constructing and installing the plant will be about $1,200,000. There will be one tunnel 7,657 feet long and about eight miles of small tunnels, ditches and flumes. The minimum horsepower to be generated is 6,000. G.

Pacific Slope.

San Francisco, July 22.—As a result of the death of a man who was struck by a live wire of the Bay Counties Power Company, that company is liable to lose its right-of-way through Solano County. The man was killed by a live wire carrying 40,000 volts, dangling across the county road. The franchise specifies that all wires across roads shall be 30 feet above the ground and fastened in a stable manner.

The Shasta Power Company, which is represented by Harry L. Shannon of San Francisco, has been granted a franchise to string wires through Redding. The plant will be located on Hat Creek, about 40 miles east of Redding, and will supply light and power for mines and towns in the northern part of the state.

The National Manufacturing Company, with offices and works at 660 Mission Street, San Francisco, has commenced the manufacture of electric and gas fixtures, of which it will make a specialty.

The Electric Appliance Company has secured a large store on the ground floor of the new building at 719 Mission Street, San Francisco, and workmen are now putting it in shape. A large stock of electrical specialties will be carried.

Dealers in electrical machinery and supplies in San Francisco state that business is very quiet. Work has been stopped on many large projects throughout the state, and while several new projects are being talked of and plans drawn up, there have been no large orders for apparatus. In the line of small goods it is different, the trade reporting a good business on account of the great amount of building going on here and in other large cities along the coast.

General Manager Jackson Dennis of the Ione and Eastern railway, Sutter Creek, Cal., has been in San Francisco, where he let contracts for the grading, building and equipping of the electric railway from Ione to Jackson and Sutter Creek. The Atlas Contract and Supply Company of San Francisco has secured all the contracts. The road is to be ready for passenger traffic by December 5th.

The trustees of Healdsburg, Cal., have awarded contracts for the new power plant at that place to the Tracy Engineering Company of San Francisco for boiler, engine and oil burner, amounting to $6,000, and to the Bullock company of Cincinnati for electrical machinery valued at $2,242.

The bid of the Standard Electrical Company for furnishing a new 150-kilowatt generator at the electric-light works has been formally accepted by the trustees of Alameda, Cal. The company is to take the 90-kilowatt generator, now in use, in part payment, and is to receive in addition $1,375 for the new dynamo.

H. H. Griffiths has accepted the ordinance passed by the supervisors of San Joaquin County, Cal., which conveys to him franchises for an electric road from Stockton to the Calaveras River on both the Cherokee Lane and the Lower Sacramento road. P.

PERSONAL.

J. Tait, city manager for the Canadian Pacific Railroad telegraphs at Winnipeg, Man., has been promoted to the position of assistant superintendent of the central and western divisions, under General Superintendent R. S. Jenkins.

Luther Allen of Cleveland has resigned as president of the Buffalo, Dunkirk and Western Electric Railroad, and Mr. Peters of the banking firm of Wyckoff & Peters of Buffalo has been chosen to succeed him. A portion of the road west of Buffalo is in operation and considerable more has been graded.

R. R. Haines, manager of the Postal Telegraph-cable Company at Los Angeles, Cal., has resigned from his position to enter upon a well-earned rest. Mr. Haines has an honorable career and is widely known in the West as the "Commodore." He is 78 years old and has displayed ceaseless activity in promoting the interests of the telegraph service throughout a period of 56 years. Upon his retirement the Postal employes of the Pacific division showed their

esteem for Mr. Haines by presenting him a handsome chest of silver.

Thomas S. Bigelow, familiarly known as the father of rapid transit in Western Pennsylvania, died at his home in Pittsburg on July 20th. Mr. Bigelow was a product of Pittsburg. He first entered the law business and built up a large practice, which he abandoned to enter the street-railway business. He conceived the idea of converting the old Pittsburg and Oakland horse-car line into a modern cable road and successfully carried out the project. Later he became vice-president and one of the principal stockholders of the Pittsburg Traction Company, and the whole system was rebuilt.

The following-named gentlemen have recently been transferred from associate to full membership in the American Institute of Electrical Engineers: William H. Pratt, designing engineer, General Electric Company, Lynn, Mass.; Louis B. Spinney, professor of physics and electrical engineering in the Iowa State College, Ames, Iowa; Edwin B. Katte, electrical engineer of the New York Central and Hudson River Railroad Company, New York city; Gilbert Rosenbusch, Waygood and Otis, London, Eng.; Dwight P. Robinson, in charge of the engineering department of Stone & Webster, Boston, Mass.; Charles H. Wilmerding, consulting engineer, Chicago, Ill.; Bancroft Gherardi, chief engineer of the New York and New Jersey Telephone Company, Brooklyn, N. Y.

Dr. F. A. C. Perrine, since his resignation from the Stanley company, will devote his energies to transmission engineering and to the work of the Construction Company of America, which owns the Sheboygan (Wis.) Railway, Light and Power Company and also operates the Greensboro Electric Company of Greensboro, N. C. When the Stanley company changed hands some time ago it was decided that Dr. Perrine should continue with the company under its new organization until the old affairs were straightened out. This he did until such time as he could conveniently leave his duties in other hands. His outside business having reached such a state as to require his immediate attention, he handed in his resignation as fifth vice-president, remaining, however, a director in the company.

ELECTRIC LIGHTING.

The Home Light and Power Company of Concordia, Kan., has been chartered to build and operate electric-light and power plants, with a capital stock of $50,000.

The Bucyrus Gas and Electric Light Company of Bucyrus, Ohio, has passed into the possession of James Finley of Pontiac, Mich., who will take charge on August 1st. The purchase price is said to be close to $100,000.

The Paris (Ill.) Gas Light and Coke Company has been absorbed by the Paris Gas and Electrical Company, which has been incorporated with a capital of $150,000. The officers of the new company are: President, A. A. Boyd of Michigan City, Ind.; vice-president, W. J. Hunter of Paris, Ill.; secretary, Frank Garretson of Michigan City; treasurer, J. E. Parrish of Paris. The gas, heating and electric-light plants will be remodeled and improved at once.

The city of Wausau, Wis., has recently accepted a proposition from the Wausau Electric Company to furnish the city with current for street-lighting purposes at the rate of 2.3 cents a kilowatt-hour, or approximately $29.75 per lamp per annum on the basis of an all-night schedule. The city is to own and operate all pole lines and lamps, which, it is said, will bring the cost up to $45 per lamp per annum. This is probably about as good a figure as any municipality can boast of for its lighting service. The series-enclosed alternating system is to be used, a constant-current lamp operating on 6.6 amperes being chosen. The buying of current by the city by the watt-hour but still operating its own system of lamps is somewhat unusual, it being the general practice to either build a municipal plant or else pay a stated amount to an operating company, the latter owning the complete system.

ELECTRIC RAILWAYS.

The boiler house of the East St. Louis and Suburban Railway Company has been destroyed by fire. For a time the entire generating plant was threatened. The loss is estimated at $50,000.

It is now possible to travel all the way from Philadelphia, Pa., to Jersey City, N. J., by electric trolley, changing cars about 12 times. The total fare by this route is $1.05, and occupies about nine hours.

The York County Traction Company has completed its electric railway from York, Pa., to York Haven, a distance of 10 miles. The new line will later be extended to New Cumberland and Bridgeport, where it will make connection with the Harrisburg street railway. It is thought that the whole system will terminate in Philadelphia.

The annual report of the Lancaster County Railway and Light Company, which controls the electric light, gas and traction companies, of Lancaster County, Pa., shows that the last year was a prosperous one, the net earnings being $81,258. President Gest recommended the extension of the traction system to various points in Lancaster County, and also reported that traffic arrangements had been entered into with lines to Reading and Coatesville.

Hugh A. Holmes of Kansas City has been granted a 50-year franchise to operate a double-track electric road on the main street of Ottawa, Kan. This road will be a part of the interurban system which is planned to connect Kansas City with southern points.

Grainger & Co. have received the contract for building a viaduct from the Big Four Bridge to Wenzel and Franklin streets in Louisville, Ky., the compensation being in the neighborhood of $200,000. This viaduct will make it possible for the Louisville and Southern Indiana Traction Company to enter the city.

Judge Gillpatrick has rendered a decision in the Leavenworth (Kan.) court to compel the Kansas City-Leavenworth electric railway to repair its bridges and resume operations along the Third Street line, as per the terms of its charter. The company had sought to discontinue service on the account of severe washouts.

Another attack has been made on the Union Elevated loop in Chicago. The attorney-general of Illinois has filed a suit in the United States Circuit Court asking an injunction against the further operation of the loop. Alleged fraud in obtaining frontage consents for the construction of the road is the ground upon which the suit is based.

The Public Service Corporation of New Jersey will improve its trolley line between Jersey City and Newark by laying a new track upon a strip of meadow land just purchased for this purpose. Traffic upon the existing line is often hampered by the drawbridges over the Hackensack River, and the new route will enable the corporation to build its own bridge.

As the result of its long period of work the local transportation committee of the Chicago City Council has decided on its final proposition to the Chicago City Railway Company in the franchise extension plan. At this writing the proposition has not been accepted by the street-car people, but if accepted will be the final act in the preparation of an ordinance in which the city will propose 13 years of absolute ownership for the company with a minimum compensation of five per cent. of the gross receipts during that period and 10 per cent. during the remaining seven years of the term of the franchise. The only new provisions in the ordinance will be the clauses relating to the absolute-ownership period and compensation.

The St. Louis Transit Company, which operates the larger part of the street-car system in St. Louis, has found itself short of power ever since the World's Fair began to attract large numbers of visitors. The traction plant was working at an almost constant 50-per cent. overload, and at rush hours the excess reached extreme proportions. The railway company recently applied to the World's Fair authorities for additional power, with the result that Governor Francis and the fair administration have, by contract, put at the service of the railway company during the day, from 2 p. m. until 7 p. m., when the loads are heaviest, the service of the huge Allis-Chalmers-Bullock unit in the Machinery building, used to supply current for lighting in the evening. The traction load which the engine and generator will now carry will be at least 3,000 horsepower to begin with, and may be much increased as the World's Fair crowds are augmented.

SOCIETIES AND SCHOOLS.

The council of the University of Birmingham (England) is preparing for the establishment of a chair of electrical engineering. Besides the salary which will be offered, it is proposed to allow the professor the liberty to undertake a certain amount of consulting work.

The College of Mechanics and Engineering of the University of Wisconsin has recently issued Bulletin No. 92 of the general series, containing a calendar of the university year, general information for prospective students, outlines of the courses of study, an alumni directory of engineering students, etc. The bulletin is well illustrated with pictures taken in the shops and laboratories of the engineering department and also a picture of the model of the university buildings and campus on exhibit at the World's Fair. Prof. Frederick E. Turneaure is dean of the College of Mechanics and Engineering.

One of the most practical illustrations of the real growth in numbers and general importance of the National Electric Light Association is to be found in the fact that advertising contracts for insertion in the proceedings of the convention have never been so quickly and easily obtained as for the book of the Boston meeting. Only a limited number are desired, but it has sometimes been uphill work to secure them. This year, however, manufacturers and supply houses seem to realize that the proceedings will be interesting enough to central-station managers to make the book an excellent advertising medium, and they are backing this belief liberally. The unusual size of the book will necessitate its being issued in two volumes; one volume to contain the "question box" and "wrinkles" and the other the remainder of the papers, reports and discussions.

PUBLICATIONS.

Water elevators made by the Jeffrey Manufacturing Company of Columbus, Ohio, are described and illustrated in a neat booklet. The elevators are of the chain and bucket type, and some special types are designed for irrigating and drainage purposes.

The Waterbury Company of New York city, in its bulletins Nos. 1 and 2, wishes to bring to the notice of the trade its latest designs of panel boards and switches. The bulletins are well illustrated and contain tables of prices of the various types manufactured by the company.

A novel departure from the general run of catalogues is Catalogue No. 104, just issued by the J. Lang Electric Company of Chicago. It is prepared in such size and form as to be especially adapted to be placed in a card index. Half-tone cuts well illustrate the Lang switches and price lists are conveniently arranged. The catalogue may be had on request.

The Union Electric Company of Milwaukee has a large line of rheostats, as indicated by its late catalogue on this subject. The articles described in its pages include motor speed regulators, with underload and overload devices, compound speed regulators, starting rheostats, etc. The resistances used are moisture-proof asbestos tubes wound with resistance wire and all joints twisted and soldered.

The Westinghouse companies are to be congratulated upon the handsome publication which has been prepared by them describing their joint interests. The booklet is especially attractive and is to be distributed at the World's Fair. It describes and illustrates the various Westinghouse works and products both in this country and abroad. An historical sketch of the company since its organization 40 years ago is given. Pictures of each of the different factories and works are contained, together with illustrations of the companies' most important products.

Bullock engine-type generators are described in the latest bulletin from that company, which contains some pictures of completed installations of these machines, besides detailed descriptions of all the parts. The generators are provided with an oscillating brush, which is used upon machines of 200 kilowatts and larger. The armature slots are of the same width top and bottom, enabling the best form of insulation to be used. The yoke is built of the best quality cast iron, divided horizontally and held together by two heavy bolts entering through countersunk pockets in the frame.

MISCELLANEOUS.

P. E. Crowley, superintendent of the New York Central railroad at Corning, N. Y., travels about in a specially equipped train. The locomotive is fitted with an electric headlight and Mr. Crowley's private car is lighted by electricity and ventilated by means of electric fans.

A prominent engineer and official of the New York Central railroad testified before a commission appointed to condemn land for the Jersey City-Hoboken tunnel spur of the New York and New Jersey railway that it now is virtually impossible for any of the railroads in New York city to increase their surface terminal facilities.

The Illinois Tunnel Company has taken another step toward the perfection of its plans for the underground handling of Chicago's merchandise. Dock property 700 feet deep and extending 400 feet north from Taylor Street has been purchased by the company for a consideration of $2,500,000. On this site will be erected large warehouses for freight-handling purposes. Every railroad in the city has connection with the property, where freight for tunnel distribution will be discharged. It is planned later to erect a large power house on the new site for the operation of the tunnel cars.

At a conference between representatives of the corporations using the Washington and La Salle Street tunnels under the Chicago River and city officials, the disposal of pipes, mains, conduits and wires passing through these tunnels was discussed. The companies agreed to co-operate with the city in the construction of two new eight-foot tunnels, one north and one west, to carry these pipes and wires when the street-car tunnels are broken up. Should the city desire, they will construct separate tunnels. City Electrician Ellicott estimates that two such tunnels will cost $40,000, and that each would have to be 500 feet long and should be 50 feet below the surface of the water. Work probably will begin as soon as negotiations are ended. The work, Mr. Ellicott says, can be done in 90 days.

Plans for the new power house of the New York Central railroad have been placed on file in the Building Department of the Bronx. As already state, the building will be located on One-hundred-and-forty-ninth Street, 95 feet west of Long Island Sound. It will be three stories in height, 236 feet long and 167 feet wide, and will cost about $500,000. The superstructure will be of granite, brick and terracotta, while the framework will be of steel. E. C. Weeks & Son have already begun work on the foundation. It is intended that the building shall be more attractive architecturally than the average structure of its kind. From the power house, when finished, will be furnished electricity with which to run all trains through the Central's tunnels to and

from the Grand Central station and as far north as the Bronx.

An "electric mule" was tested on the canal at Schenectady, N. Y., on Wednesday, in the presence of representatives of the Panama Canal commissioners, and a number of distinguished American and foreign engineers, including H. M. Diederich, the technical attaché of the German embassy. Results of the test have not been made public.

TRADE NEWS.

The city of Güines, Cuba, is about to build an electric-light plant and would be glad to enter into correspondence with any company interested in erecting such a plant. F. J. Pattin of Güines is in a position to give all information, plats of the city and information concerning a waterpower which is sufficient to drive a 5,000-light machine and located near the city.

The first four months of the present fiscal year have made a good showing for the General Electric Company, net profits being $483,000 larger than the quarterly proportion of last year, the total business being $1,980,000 above the quarterly proportion of last year's trade. The statement for the quarter contains the following: Sales, royalties, etc., $12,028,322; other income, $172,679; total income, $12,201,001; manufacturing cost, interest, etc., $9,766,571; balance, $2,434,430; dividends, $877,334; surplus, $1,557,096; previous surplus, $7,293,689; total surplus, $8,850,785.

M. J. Olmstead of Rochester, N. Y., together with J. O. Olmstead and Mary E. Olmstead, have incorporated the electrical firm to be known as the Olmstead Electric Company, with an authorized capital of $30,000.

Jaeger & Vanneste of Rock Island, Ill., manufacturers of dry-cell electric batteries, have leased the building of the Rock Island Shoe Company in order to secure additional facilities and adequate space to manufacture their product on a larger scale. Mr. Jaeger is widely experienced in the manufacture of electric supplies, and it is the intention of the firm eventually to branch out into the manufacturing of electric cooking utensils. Special machinery is being purchased and the factory promises to become one of the substantial industrial institutions of the city.

An official of the Westinghouse company says in regard to the announcement that Kuhn, Loeb & Co. have purchased $4,000,000 of Westinghouse Electric and Manufacturing Company's three-year, five per cent. notes that it is a part of a comprehensive plan with reference to the extension of the company's business in Europe, Canada and in other directions, and that the transaction will include the issue of the remaining 50,000 shares of treasury stock, par value $50, which it is proposed to offer to stockholders at $80 per share, and of which 37,500 shares have been underwritten at that price, all of which will be set forth in a circular letter to be issued to stockholders before August 1st.

The Fox-Callahan Phoncalarm and Electric Supply Company of Milwaukee, Wis., a comparatively new company, conducted by a number of young men of Milwaukee, has elected the following-named officers for the ensuing year: President, B. O. Fox; vice-president, T. E. Callahan; secretary-treasurer, W. J. Delaney; board of directors, George D. Tibbits, W. J. Delaney, T. E. Callahan and B. O. Fox.

BUSINESS.

W. P. Bowring, secretary and treasurer of the C. H. Worcester Company, Chicago, producer of cedar poles, has just returned from a two weeks' trip to the northern branches of the company.

J. P. Hornaday & Co. of Cincinnati, Ohio, have purchased, for Cincinnati and Cleveland (Ohio) capitalists, the waterworks and electric-light plant at Harrison, Ohio-Indiana. The Harrison water and electric-light plant completely controls all the public utilities of Harrison, both on the Indiana and Ohio sides of the line.

ILLUSTRATED ELECTRICAL PATENT RECORD.

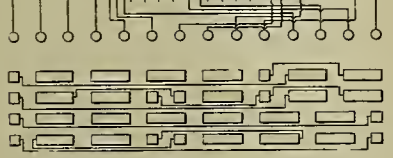
Issued (United States Patent Office) July 19, 1904.

765,183. Double-combination Local Spring-jack. James L. Kise, Wellington, Kan. Application filed January 29, 1904.

The spring-jack is placed in circuit with a number of sounders along with a resonator.

765,185. Controlling Apparatus for Electrically Propelled Railway Vehicles. Benjamin G. Lamme, Pittsburg, Pa., assignor to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Application filed September 29, 1902.

A controlling apparatus for single-phase alternating-current motors embodies a transformer between the supply circuit and the motor circuit, and an induction regulator for varying the voltage supplied to the motor or motors. The primary winding of the regulator has its terminals respectively connected to the supply conductor and to the motor circuit between the motors and the secondary winding of the regulator.



NO. 765,209.—MOTOR CONTROL.

765,189. Transformer Insulation. Odus B. Moore, Edgewood Park, Pa., assignor to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Application filed November 21, 1903.

An insulating piece for the edges of flat coils consists of a channel-shaped strip comprising one or more thicknesses of sheet material and embodying a corner portion in the form of a double plait having outwardly diverging edges.

765,203. Alternating-current Electrical Apparatus. Charles F. Scott, Pittsburg, Pa., assignor to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Application filed September 13, 1902.

Combined with a single-phase alternating-current motor are means for maintaining a constant ratio between the currents in the armature and in the field-magnet windings of the motor and at the same time supplying the windings with different amounts of current.

765,206. Brush Holder. Robert Siegfried, Pittsburg, and Chester B. Mills, Wilkinsburg, Pa., assignors to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Application filed November 21, 1903.

Associated with a bracket having an undercut groove in its face is a bolt projecting through a hole in the brush and having a head located in the groove.

765,207. Brush Holder for Electrical Machines. Robert Siegfried, Pittsburg, Pa., assignor to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Application filed November 21, 1903.

Mechanical parts are described.

765,209. Method of Operating and Controlling Electric Motors. Norman W. Storer, Pittsburg, Pa., assignor to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Application filed August 15, 1902.

One method of operating a series-wound electric motor having an unsaturated field magnet, at different speeds and with a minimum expenditure of energy, is to vary the electromotive force applied to the motor terminals and at the same time vary the field ampere turns without adding or subtracting any magnetizing winding. (See cut.)

765,212. Electromagnetic Block System of Control. Gnion Thompson, Duluth, Minn., assignor to the Thompson Safety Appliance Company. Application filed March 17, 1902.

In a normally open electric circuit including a source of electricity is a normally closed circuit-controlling contact, and a normally open circuit-controlling contact adapted to be closed by an electromagnet when the magnet is energized.

765,216. Trolley Guard. William C. Washburn, Cincinnati, Ohio. Application filed February 24, 1904.

The apparatus includes a collar upon the trolley pole, curved front arms jointed to swing backwardly under pressure and springs interposed between the arms and a front platform to return the arms to normal position after the pressure is removed or obstruction passed.

765,228. Coil-retaining Means for Electrical Machines. Isaac De Kaiser, Wilkinsburg, Pa., assignor to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Application filed November 21, 1903.

A core having teeth which forms slots for the reception of coils is provided with grooves adjacent to the free ends of the coils, which extend inwardly a short distance only from the ends of the core.

765,236. Controller for Electrical Transformers. Georges E. Gaiffe, Paris, France. Application filed April 4, 1902.

An economizing apparatus comprises a principal and an auxiliary transformer having their primary coils in series and connected with the mains and their secondary coils also in series and connected with the consumer's circuit. Means are supplied for cutting in and out the auxiliary transformer, controlled from the conditions in the consumer's circuit, and means short-circuiting the secondary circuit of the auxiliary transformer before the primary circuit.

765,255. Service Meter for Telephone Exchanges. Charles E. Scribner, Chicago, and Frank R. McBerty, Evanston, Ill., assignors to the Western Electric Company, Chicago, Ill. Application filed March 15, 1901.

An electric circuit is divided at one point into two parallel branches, one of the branches being normally open. A responsive device has a magnetizing winding in each of the parallel branches, the sum of the ampere turns of both the windings being approximately equal to the ampere turns of the winding in the permanently closed branch when the latter alone is complete. A switch controls the normally open branch.

765,263. Electro Fluid-pressure Switching Mechanism. Walter J. Bell, Los Angeles, Cal., assignor of one-half to Leon F. Moss, Los Angeles, Cal. Application filed July 25, 1903.

Switching mechanism comprises a switching element, fluid pressure means including a compressor for moving the element, a solenoid magnet for actuating the compressor, electrical means controlled from a moving car and including an armature for establishing a starting circuit to close the solenoid operating circuit, and a circuit-breaker operating in the further movement of the car to interrupt the operating circuit.

765,266. Audible Signaling Device. Walter J. Bell, Los Angeles, Cal., assignor of one-half to Leon F. Moss, Los Angeles, Cal. Application filed January 5, 1904.

An electromagnet within a bell is adapted when energized to pull up an armature, which rings the bell.

765,298. Method of Signaling. Richard W. Shoemaker and Lawson H. Giddings, Pasadena, Cal. Application filed June 25, 1902.

The method of signaling consists in propagating waves utilized in wireless telegraphy and defining each wave by energizing the primary of the induction coal with electrical impulses of dissimilar tensions.

765,311. Signal System. Samuel Friedman, New York, N. Y. Application filed June 23, 1902.

A signal system comprises a series of independent gangs of wires, the individual members of a gang being electrically connected, spaced laterally and arranged consecutively. A set of trolleys are spaced laterally to correspond with the members of a gang. Electric lamps of different colors are connected with the trolley, one with each.

765,348. Electric Elevator. Ernest H. Vogel, New York, N. Y. Application filed November 16, 1903.

A motor is placed on the platform of the elevator and drives the latter by means of a pinion working in an annular rack, integral with and on the interior of a worm drum.

765,370. Insulated Rail Joint. George A. Weber, New York, N. Y., assignor to the Weber Railway Joint Manufacturing Company, New York, N. Y. Application filed December 28, 1903.

Insulation is placed between the rail-support and the rail placed thereon.

765,383. Electric Secondary Clock. Fred I. Getty, Chicago, Ill., assignor to the American Clock Company, Chicago, Ill. Application filed December 2, 1901.

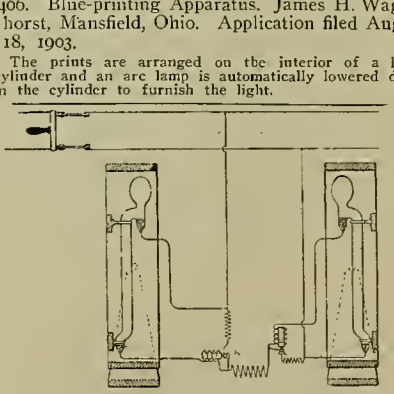
An electromagnet, provided with a movably-supported armature, weighted, tends to normally move out of closed position by gravity. A ratchet wheel forming an element of the clock movement is operated by the armature.

765,386. Automatic Fire-alarm System. John C. Howe, Indianapolis, Ind., assignor of one-half to Clinton E. Prouse and Daniel M. Maroney, Indianapolis, Ind. Application filed April 13, 1903.

Individual station alarm signals have corresponding indicator operating means arranged at a central station. A traveler is adapted to traverse the operating means in succession. Electrical connections are made between the individual-station alarm signals and the central-station operating means.

765,406. Blue-printing Apparatus. James H. Wagenhorst, Mansfield, Ohio. Application filed August 18, 1903.

The prints are arranged on the interior of a large cylinder and an arc lamp is automatically lowered down in the cylinder to furnish the light.



NO. 765,466.—STARTING DEVICE FOR MERCURY VAPOR LAMPS.

765,413. Selective Signaling Apparatus. John J. Comer, Parkridge, Ill. Application filed May 22, 1901.

A ratchet-wheel mechanism for a selective-signaling device is described.

765,435. Alarm Device. George M. Mayer, Chicago, Ill., assignor to Adolphus L. Noel, Mason City, Iowa. Application filed December 15, 1902.

A circuit-controlling arm, two springs connected therewith and acting in opposite directions, one stronger than the other, an electromagnet in a normally open circuit acting upon the arm in conjunction with the weaker spring, and an electromagnet in a normally closed circuit acting upon the arm in opposition to the stronger spring, are the essential features of the device.

765,441. Device for Use with Telautographs. Foster Ritchie, Hampstead, England. Application filed January 3, 1902.

The instrument is adapted to be used with a telautograph apparatus for adjusting and indicating the resistance of the external circuits.

765,449. Trolley Harp. Earl R. Warren, Holyoke, Mass. Application filed March 7, 1904.

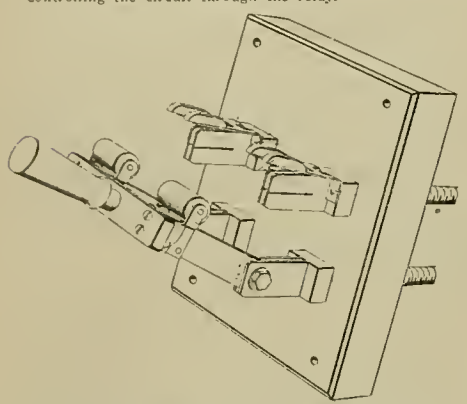
A trolley harp consists of opposing members comprising separated jaws or cheeks, one member being pivotally connected to the other and capable of a transverse swinging movement.

765,457. Page-printing Telegraph. Charles L. Buckingham, New York, and Emil Germann, Brooklyn, N. Y.; said Germann assignor to said Buckingham. Application filed August 25, 1902.

In a page-printing machine is a motor-driven escapement, with means for controlling the step-by-step movement of the escapement.

765,460. Motor Controller. Henry H. Cutler, Milwaukee, Wis. Application filed January 30, 1901.

Combined with a motor and a resistance therefor is a relay controlling the circuit through the motor and resistance, and a device responsive to fluid pressure for controlling the circuit through the relay.



NO. 765,609.—CARBON BREAKSWITCH.

765,461. Selective Signaling System. William M. Davis, Chicago, Ill., assignor to the Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y. Application filed March 27, 1903.

A serially connected condenser is connected between the line conductor and a return path. A rheotome signal bell in a circuit of high impedance is connected between the line conductor and the return path, with means located at the central station adapted to connect the terminals of a source of alternating current or the terminals of a source of direct current between the line conductor and the return path.

765,465. Method of Starting Gas or Vapor Electric Devices. Stanwood E. Flichtner, Englewood, N. J., assignor to the Cooper Hewitt Electric Company, New York, N. Y. Application filed August 10, 1903.

Starting a gas or vapor electric apparatus containing separated electrodes of mercury is accomplished by tipping the apparatus so as temporarily to store an excess of mercury at or near one electrode, then restoring the apparatus to its initial position, establishing a stream of mercury from that electrode to the other. By gravity the stream is interrupted while still descending to establish an initial or starting flow of current through a portion of the vapor.

765,466. Starting System for Gas or Vapor-electric Devices. Stanwood E. Flichtner, Englewood, N. J., assignor to the Cooper Hewitt Electric Company, New York, N. Y. Application filed August 10, 1903.

An electrical resistance is connected in shunt upon each of the lamps to be operated with means for tilting either device independently of the other and thereby dividing the circuit between the device and the resistance. Means are supplied for cutting out the resistance of either device when it is started. (See cut on preceding page.)

765,469. Shade for X-ray Tubes. Robert Friedlander, Chicago, Ill. Application filed September 19, 1903.

A shield for ray tubes, comprises a supporting body portion of paper pulp or the like, and a series of coatings of a white-lead drier imposed upon the base.

765,470. Electric-therapeutic Apparatus. Robert Friedlander, Chicago, Ill. Application filed June 6, 1904.

A seat or like rest has a series of vacuum-tube terminals secured thereto in fixed and separated relation, with means for connecting the tubes with a source of high-frequency electric current.

765,480. Battery Transmitter. Rasmus Hansen, Chicago, Ill., assignor to the Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y. Application filed June 23, 1902.

In a telephone-transmitter are a front plate having an opening to permit the passage of sound-waves, a mouthpiece carried by the front plate and registering with the opening, a diaphragm, an electrode secured to the diaphragm and a bridge across the opening in the front plate.

765,488. Telephone Transmitter. William Kaisling, Chicago, Ill., assignor to the Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y. Application filed April 17, 1903.

Combined with a circular front plate is a flange, a bridge fitting concentrically within the flange, slots in the flange, notches leading to the slots, and flange-headed screws, on the bridge, registering with the notches to permit the assembly of the bridge and the front plate.

765,489. Plug-seat Switch for Telephone Switchboards. William Kaisling, Chicago, Ill., assignor to the Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y. Application filed November 23, 1903.

A supporting frame is provided with an aperture. A supporting bar extends downwardly therefrom, and an actuating lever is pivoted at the lower end of the bar. Switch springs are disposed in the path of an actuating button to be engaged by the button upon downward travel.

765,516. Trolley. Wilson Selakosky, Lehighton, Pa. Application filed January 27, 1904.

Two fork-like arms extend up beside the trolley wheel to guide it to the trolley wire.

765,517. Locking Device for Ground Switchstands. Howard F. Smith, Parkton, Md. Application filed May 13, 1904.

The mechanical features are described.

765,530. Medical Battery. George F. Webb, Geneva, Ohio. Application filed May 3, 1904.

In a medical battery are combined elements for producing electromotive force, connecting wires engaging the elements and electrodes engaging the connecting wires, the latter electrodes being made of aluminium and provided with frosted surfaces.

765,544. Trolley Head. Stanislas Bourgeois, Manchester, N. H. Application filed October 24, 1903.

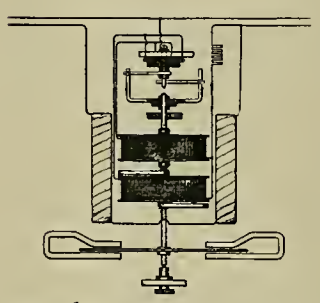
A U-shaped guard is connected at its opposite ends to the outer ends of the trolley-harp arms and straddling the under side of the wheel.

765,550. Electromagnet. Walter W. Brown, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed April 23, 1904.

Combined with an electromagnet is a movable member adapted to be raised thereby, means for decreasing the current through the magnet when the member is raised, means for restraining the member when the current is decreased, and means for releasing the member when the magnet is de-energized.

765,592. Electric Meter. Albert Peloux, Geneva, Switzerland, assignor to the General Electric Company, Schenectady, N. Y. Application filed October 16, 1902.

A commutator of an electric meter consists of two axial cylindrical portions, one of which is considerably larger than the other, and conducting members consisting of wires, a portion of each wire lying in axial grooves formed at the periphery of the smaller cylindrical portion. Another portion is embedded in the larger portion and extends substantially in a radial direction to the periphery of the larger portion. (See cut.)



NO. 765,592.—ELECTRIC METER.

765,609. Carbon Breakswitch. Charles C. Badeau, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed September 16, 1901.

In a switch are combined a contact-clip and switch-blade. A resilient finger removably attached to the clip lies side by side with it and carries a metallic contact in advance of the clip. A carbon roller is supported on the switch-blade and remains in contact with the finger after the blade and clip have separated. (See cut.)

765,612. Safety Device. Fred B. Corey, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed January 2, 1904.

Together with one or more motors operatively connected to a load are a braking system, a motor controller, a controlling system for the motor controller, a master controller for the controlling system, and means for rendering the controlling system inoperative when the brakes are applied. (See cut.)

765,617. Starting Means for Gas or Vapor Electric Devices. Stanwood E. Flichtner, Englewood, N. J., assignor to the Cooper Hewitt Electric Company, New York, N. Y. Original application filed August 10, 1903. Divided and this application filed September 19, 1903.

In a gas or vapor electric apparatus, a pair of electrodes, one arranged above the other, are provided with means for tilting the apparatus so as to establish a continuous flow of liquid from one electrode to the other, and means for applying a normal operating current to the terminals of the apparatus.

765,625. Socket for Incandescent Lamps. Norman Marshall, Newton, Mass. Application filed January 16, 1901.

A body portion supporting the current-carrying parts, a metallic shell surrounding the body, an insulating sleeve secured to the body, and means for obtaining access to the terminals without removing the insulating sleeve, are the parts comprising the socket.

765,632. Electric Time Switch. Carl G. Nylander, McKeesport, Pa., assignor of one-half to Frank J. Regensburger, McKeesport, Pa. Application filed February 15, 1904.

Details are described.

765,640. Key Mechanism for Key-actuated Instruments. William G. Spiegel, New York, N. Y., assignor of two-thirds to Sydney H. Carney, New York, N. Y., and William Watt, Brooklyn, N. Y. Application filed August 29, 1903.

The keys of a typewriter are made to close the circuits of electromagnets, which in turn draw down the printing plungers.

765,653. Electrical Switch Operated by Electromagnets. William Grunow, Jr., Bridgeport, Conn. Application filed February 7, 1902. Renewed November 27, 1903.

An electromagnetic switch embraces a fixed and a movable terminal. A circuit-closing magnet has its movable part operatively connected to the movable terminal; a second electromagnet has its movable part operatively connected to the movable terminal, and an automatic circuit-breaking device is adapted to break the circuit of the first-named magnet after the working circuit has been closed for a definite interval of time.

765,654. Art of Controlling Electrical Switches Operated by Electromagnets. William Grunow, Jr., Bridgeport, Conn. Application filed August 2, 1902.

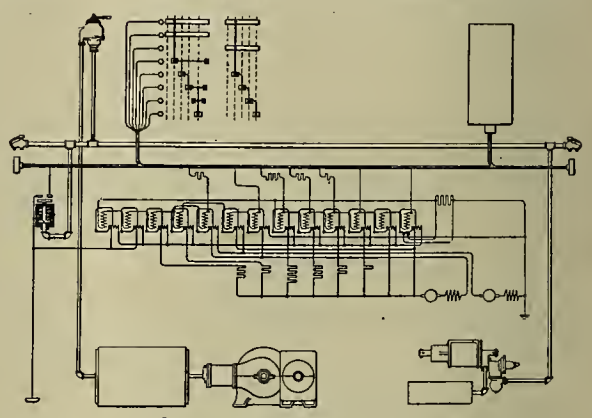
A method of effecting circuit connection between a source of electrical energy and a translating device without damaging arcing, consisting in utilizing a part of the current to primarily close the working circuit, is described.

765,655. Electrical Switch Operated by Electromagnets. William Grunow, Jr., Bridgeport, Conn. Original application filed August 2, 1902. Divided and this application filed May 17, 1904.

In connection with a switch, a circuit-closing electromagnet and a main-circuit electromagnet made operative successively, is a retarded-circuit-interrupting device adapted to interrupt the circuit to the first-named electromagnet after the circuit has been closed for a predetermined time through the other.

REISSUES.

12,240. Individual Telephone Switch and Lock-out Mechanism for Interconnecting Lines. Albert K. Andriano, San Francisco, Cal., and Hermann Herbstritt, New York, N. Y., assignors to the Direct-Line General Telephone Company, San Francisco, Cal. Application filed June 15, 1904. Original No. 691,229, dated January 14, 1902.



NO. 765,612.—SAFETY DEVICE FOR MOTORS.

Combined in an electric controller is a switch for connecting two motors, either in series or in parallel, a cut-out switch for connecting one terminal of the respective motors to the opposite line, and a stop for the series-parallel switch controlled by the cut-out switch.

12,242. Brush Holder. Edward D. Priest, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed May 15, 1901. Original No. 648,052, dated April 24, 1900.

A brush-holder comprises a socket, a plug located therein, a body of insulating material located between the plug and the socket, and an insulator arranged to be slipped endwise over the end of the plug and the socket.

12,243. Means for Insulating Electrical Apparatus. Edward D. Priest, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Original application for reissue filed May 15, 1901. Divided and this application filed February 20, 1903. Original No. 648,052, dated April 24, 1900.

Associated with a socket is a plug mounted in the socket and surrounded by a layer of insulating material and a split metal sleeve, the plug and sleeve being forced into the socket, and a layer of insulating material located between the end of the plug and the bottom of the socket.

EXPIRING PATENTS.

Following is a list of electrical patents (issued by the United States Patent Office) that expired on July 21, 1904:

367,042. Acoustic Telegraph. John H. Irwin, Philadelphia, Pa.
367,069. Electric Locomotive. E. S. Shaw, Cambridge, Mass.
367,082. Switch and Automatic Cut-out. M. J. Wightman and Herman Lemp, Hartford, Conn.
367,164. Insulator. H. K. Ruger, Bay St. Louis, Miss.
367,205. Electric Test System. J. W. Frost, Rochester, N. Y.
367,219. System of Telephonic Intercommunication. J. A. McCoy, Medford, Mass.
367,270. Electrically Actuated Vibrator. F. B. Colman, New York, N. Y.
367,294. Galvanic Battery. H. I. Harris, Islington, County of Middlesex, England.
367,332. Means for Individually Controlling a Number of Devices by Electricity. C. Baxter, Brooklyn, N. Y.
367,341. Electric Smelling Bottle. L. B. Fuller, Chicago, Ill.
367,350. Apparatus for Extinguishing Fires on Railroad Trains. J. F. McLaughlin, Philadelphia, Pa.

WESTERN ELECTRICIAN

EVERY SATURDAY

Vol. XXXV. CHICAGO, AUGUST 6, 1904 No. 6

French Electrical Exhibits at the St. Louis Exposition.

The French display of electrical apparatus at the exposition occupies the largest area allotted to a foreign country, and in this section will be found some interesting examples of foreign practice in electrical engineering, many of which are entirely at variance with American ideas and customs. On account of the high protective tariff, few French manufacturers of heavy machinery have ventured to send displays of this character, although some few exhibits are of more than ordinary interest, as representing modern French ideas in the electrical field.

Probably the largest contributor to the exposition is the Société Alsacienne de Constructions Mécaniques, and some few details of its machines are here given. The direct-connected unit of 1,000-horsepower capacity, installed as an item in the Exhibitors' Power Plant, is in daily service, and the unusual and distinctly foreign character of the exhibit attracts no little attention. The main exhibit of this company, in the Palace of Electricity, is shown in Fig. 1, and, in addition to a large collection of photographs of notable installations, three ingenious mechanisms are shown, the most interesting of which is the three-phase reversible booster shown in the center of the exhibit. This is a distant-control booster, of the induction type, by means of which the voltage of a system may be either raised or lowered by infinitesimal steps. The essentials are a vertical rotor, similar to that of an induction motor, connected by means of worm gears to the control motor shown at the top, and a stator, similar to that of an ordinary induction motor, the three windings being connected in series with the three mains. The rotor is in shunt with the system. The closing of a switch on the switchboard throws the gear of the control motor into mesh with that on the rotor shaft, permitting it to be displaced, and with the machine shown a variation of 40 volts is possible. The regulator in question is designed for use in the alternating-current side of a rotary set, and, by its use, with a normal voltage on the alternating-current side of 360 volts, corresponding to a direct-current voltage of 500 volts, a booster effect may be obtained between the limits of 445 to 555 volts. The variable-speed motor is provided with a commutator, and is designed for 50 cycles, 110 volts, and has a capacity of 25 horsepower. There are six poles, and the no-load speed is 1,000 revolutions per minute. Three brushes are disposed at an angle of 120 degrees around the commutator. The stator of the motor is connected in multiple with the system, and the booster operating in connection with the motor has its stator connected in the same way. The rotors are so connected that their electromotive forces are uni-directional, or in opposition, and the speed may thus vary as the result of variation of voltage between the brushes of the motor, without any rheostatic losses, and at practically the same high efficiency at all speeds. When the windings are connected in series, the maximum speed is greatly in excess of the synchronous speed, and increases when the electromotive force of the booster increases. The motor thus fulfills the requirements of high-starting torque, high speed on no load, and decreasing speed as it is loaded. The same considerations hold in the case of the use with single-phase current, the motor operating on the repulsion principle. The booster used in connection with these motors is capable of changing the pressure between the limits of 25 to 195 volts, the normal line voltage being 110 volts. The current required per phase is 70 amperes.

The Société Gramme has arranged an excellent display (Fig. 2) consisting chiefly of machine tools, grinders, drills, buffers, etc., a milling machine, a blower, and various types of the company's variable-speed, direct-current motor for use in driving tools, etc. A representative line of electrical measuring instruments, switches, rheostats and lamps is shown, and surmounting the case in the middle of the exhibit is the first machine built by Zenobe Gramme in 1869 and presented by him to the Institute of France. Comparing these machine tools with those of American manufacture, it is interesting to note that many of the Gramme machines are of the bipolar type, with the old-style Gramme armature and windings, although some of the motors are of the latest multipolar enclosed type. The transformers shown in this exhibit exemplify the European practice of building three-phase transformers, and even those for single-phase working differ widely from domestic lines. The exhibit also includes several cells of accumulator.

Two exhibits that attract a great deal of attention are those of E. Guinier and of Milde. These are shown in the accompanying pictures (Figs. 3 and 4, respectively), and from these it will be seen that the French reputation for beautiful effects in brass and bronze electroliers and lamps has been sustained. All of the pieces are exquisite in design and workmanship, and one in particular, in the booth of Guinier, is particularly striking. It represents three monkeys playing with bubbles, the latter being large globes of iridescent glass. The sculptor Meliodon is responsible for this clever conception. In this same booth is also shown a frieze of brass electroliers resembling a peculiar vine, the flowers of which hang in grapelike clusters. Within each cluster is a miniature incandescent lamp, and the design of the wall, molding and ceiling is skillfully carried out, using the same flower as a motif.

An interesting display of the new "electric-pearl" system of lighting, devised by Weissmann, is also

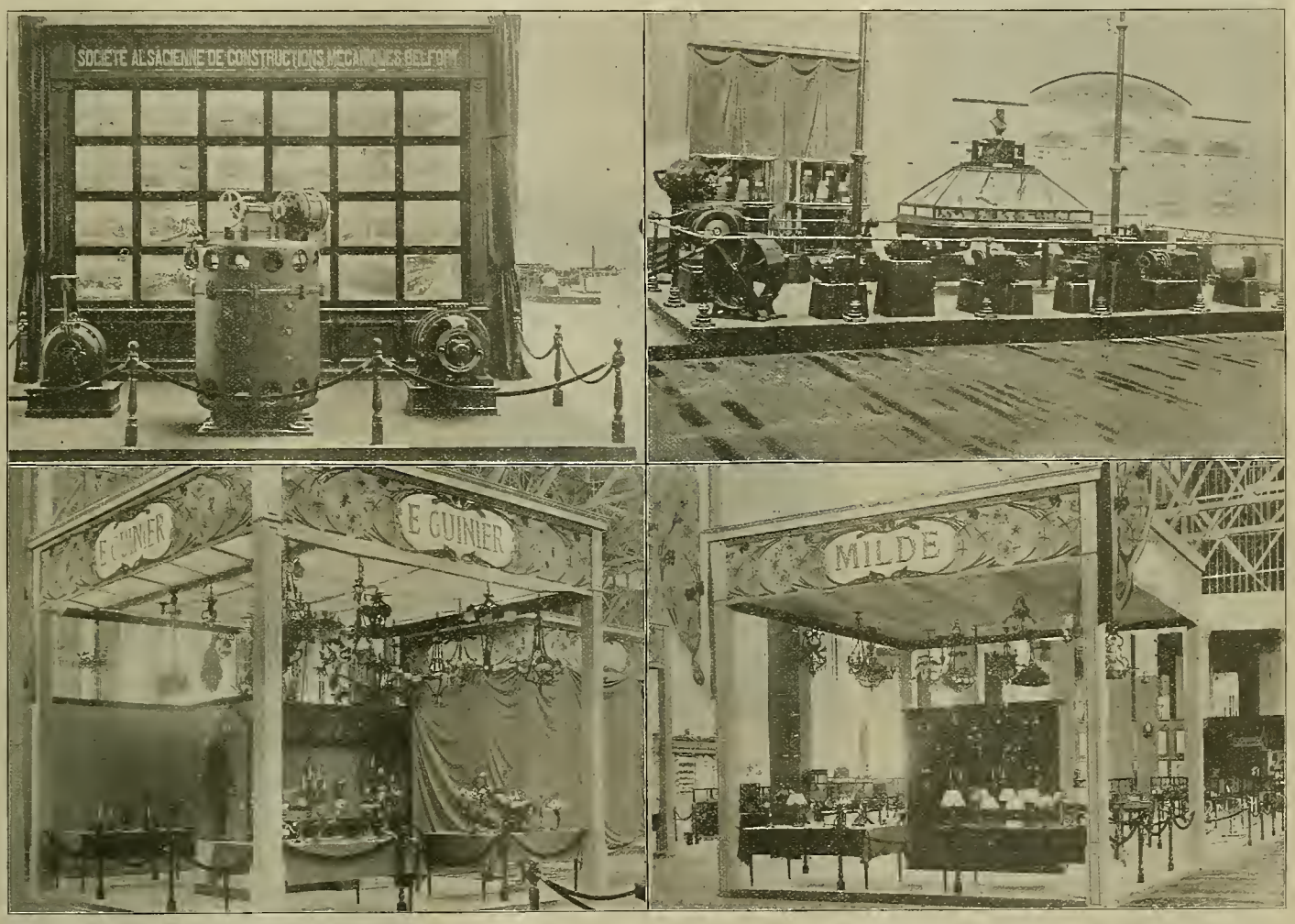


Fig. 1. Société Alsacienne de Constructions Mécaniques.
Fig. 3. E. Guinier.
Fig. 2. Société Gramme.
Fig. 4. Milde & Son.

FRENCH ELECTRICAL EXHIBITS AT THE ST. LOUIS EXPOSITION.

made, and a second installation of this beautiful novelty is shown in the French costume exhibit in the Manufactures Building.

Chief among the exhibitors of wire and cable is the Compagnie des Trefileries du Havre of Paris, whose display is shown in Fig. 5. A sample of line work is also shown, illustrating the use of iron poles and cross-arms, etc.

Grammont, one of the largest manufacturers of

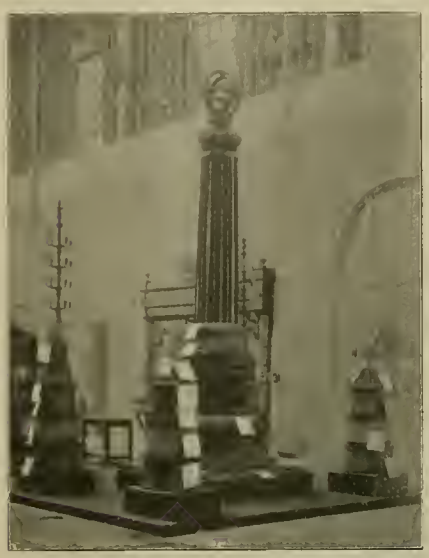


FIG. 5. EXHIBIT OF COMPAGNIE DES TREFILERIES DU HAVRE AT ST. LOUIS EXPOSITION.

cable, has a small but interesting case (Fig. 6), while exhibits of a similar class are made by Geoffroy & De Lore, the Société Industrielle des Telephones and the Société Française des Cables Electriques. This latter company also shows some sections taken from cable damaged by the eruption at Martinique.

The French Carbon Company has on exhibition some carbons fully five feet long and about a foot square—considerably larger than anything shown by a domestic exhibitor.

The Leclanche Battery Company shows batteries of the carbon-zinc-salammoniac type adapted to automobile and launch service, motor-cycles and general open-circuit work.

The storage battery exhibited by Henri Fredet possesses several interesting features and is meeting a ready market in France on account of the low cost and high efficiency. While the use of negative electrodes of mixed oxides is not unusual, still this is not the case with positive electrodes of the same type, although such a formation is superior both as regards capacity and cost of manufacture, the chief objection being the inevitable breaking away and disintegrating of the active matter. This liability to fall apart has been overcome in the cells in question by means of a chemical process, the object being to obtain without compression a perfect cohesion of the paste; to preserve the outer layers from a too energetic electrolytic attack; to enable the acidity of the electrolyte, and consequently the extent of output, to be increased without danger, and to eliminate from the electrolyte injurious chemical impurities. These considerations have been realized by the addition of a single compound to the mixture of lead oxide; this chemical is hydrosulphite of ammonia, and its action is all that can be desired. An automatic fuse, almost self-restoring, is an interesting item. This consists of a small tube of inflammable material filled with mercury and having a capillary perforation. When, due to a higher current or pressure, the mercury is forced apart by the formation of an arc, the simple pressure of the thumb on a small rubber bulb restores the fuse to its original state. In this invention a capillary tube is employed, which is divided longitudinally and imbedded in a springy, elastic material. The whole is fastened to a hood, and a pressure stud is mounted on the top. The space between the two rubber caps is filled with mercury, so that the current can pass freely from the screw thread on the casing through the copper wire attached to the upper socket. In the case of short-circuiting the mercury is vaporized and the current is interrupted. To re-establish the original conditions it is simply necessary to exert a small pressure on the rubber cap, when mercury is forced into the capillary tube, and the switch is ready for use.

A rather striking exhibit is that of the Appareillage Electrique Grivolas, shown in Fig. 7. This display is made up principally of small electrical apparatus, such as switches, rosettes, insulators, fuse blocks, etc., artistically arranged on several fine panels of finished wood.

Altogether there are nearly 100 exhibitors in this section, and many of these are well worthy of a careful inspection by the electrical fraternity.

Testing Primary Circuits for Grounds.

[From the Question Box of the Iowa Electrical Association.]

QUESTION.

In testing primary circuits for grounds, how is it accomplished?

ANSWERS.

Perry Electric Light Company, Perry, Iowa: With a magneto when the current is off and with a ground detector when the current is on.

Iowa City Electric Light Company, Iowa City: Primary circuits can be easily and safely tested for grounds with a static ground detector in circuit on main switchboard.

Brice Gas and Electric Company, Mason City, Iowa: We deem it essential to have a static ground detector in the primary wires at all times. This is the only correct method of testing for grounds in the primary circuits where the circuit is constantly in use. As soon as a ground is discovered the linemen are notified to remove it as soon as possible.

Marengo Electric Light and Power Company, Marengo, Iowa: With the Westinghouse ground detector.

Cherokee Electric Company: We have an electrostatic detecor connected to the bus bars continually, and in addition we use a small transformer and a voltmeter with switch so arranged that we can put the primaries of the transformer between any line wire and the earth, which will, of course, indicate

FIG. 6. EXHIBIT OF A. GRAMMONT AT ST. LOUIS EXPOSITION.

grounds, if any, on the opposite side of circuit. This method is very cheap and is practical.

Cedar Rapids Electric Light and Power Company: We use Westinghouse transformer and voltmeter type for regular tests. We also have static ground detectors, but do not entirely rely on them, as we have frequently found quite heavy grounds to exist on both legs of a circuit (of about same resistance), and the static, being balanced, did not indicate the trouble.

J. G. Boyd, Sioux City, Iowa: When alive, with usual switchboard device; when dead, magneto.

Government Coastwise Space-telegraph Stations to be Controlled by Navy.

Control of the coastwise space-telegraph stations now in operation by the government has been awarded to the navy by the action of the President, who on August 1st approved the recommendation of the board appointed by him some time ago, of which Rear Admiral Robley D. Evans was president, and whose duty was to pass on the entire question of space telegraphy.

The report recommends that in view of the fact that the space-telegraph coastwise stations are a part of the country's defense, and therefore belong to a military branch of the government, and because they are more important to the navy than to the army, the navy shall be given the control of them. Exception in favor of the army is made, however, in the case of those coastwise stations necessary for communication between the various army posts along the coast, provided these do not interfere with the other coastwise stations. The army, it is recommended, also shall have control of such space-telegraph stations on the inland frontier as are necessary to satisfactory communication, and of the stations in Alaska, where space telegraphy is the only means of communication.

Renewal of Lamps During Peak Load.

The Madison (Wis.) Gas and Electric Company contributes some figures on the subject of lamp renewals to the "Wrinkles" department of the National Electric Light Association:

In a station having a pronounced peak load for only a short period during the holiday season a material saving may be brought about by making a wholesale renewal of all lamps on the line, substituting lamps of a high efficiency for the short time of peak load.

Assume the station running on 3.5-watt lamps to be full loaded so that any additional load will require additional generating and distributing equipment, it is perfectly proper, then, to credit on one side of the balance the interest and depreciation on the investment, which will be saved by a substitution of, say, a 3.1-watt lamp, for with the same equipment of station and line it will be possible to furnish current for 11.4 per cent. more lamps; and against this must be charged the additional expense that will be incurred by the increased cost of lamp renewals for the short period.

Assume three per cent. regulation on the line, and the 3.1-watt lamp gives a life of 263 hours before dropping to 80 per cent. of its initial candlepower, while 492 hours life is obtained from the 3.5-watt lamp; or there is a loss in lamp life of 229 lamp-hours per lamp for each substitution which is made. If a station with 42,000 connected lamps is considered, this will represent an additional cost corresponding to 9,618,000 lamp-hours, provided each 3.1-watt lamp is used to the extent of its useful life.

The cost of lamp renewals being made up of the cost of the lamp, which will be assumed at 17 cents, plus the cost of labor of photometering and changing at 1½ cents per lamp, gives a total lamp renewal cost of

$$\frac{17 + 1.5}{492} = 0.00037$$

per lamp-hour, and having lost 9,618,000 lamp-hours, the expense incurred due to additional lamp renewals would amount to $3,558.66, provided all of the useful life of each lamp were used up, or the lamps burned 263 hours each.

In the station under consideration the actual average burning of each lamp during the month of December amounts to 45 hours, so instead of an expense of $3,558.66 for the increased lamp renewals that would be occasioned the expense would be

$$\frac{45}{263} = 17.1 \text{ per cent. of } \$3,558.66, \text{ or } \$622.76,$$

and to back against this there would be saved interest at six per cent. and depreciation at six per cent, or 11.4 per cent. of the investment of 42,000 lamps, which can be fairly taken at $10 per lamp. This would amount to an annual expense of $5,745.60 fixed expense due to interest and depreciation, or by the substitution of the 3.1-watt lamp for the month there

FIG. 7. EXHIBIT OF THE APPAREILLAGE ELECTRIQUE GRIVOLAS AT ST. LOUIS EXPOSITION.

would be a net saving to the company of $4,500.80 per annum.

Another factor should come into consideration at this point, and that is that the consumer is using a smaller amount of energy for a given amount of illumination during this short period, and he is benefited during this time by having a decreased bill, to which he will raise no objection, while the station will have its kilowatt-hour sales curtailed by an amount equal to the difference in lamp efficiency, provided the consumer is paying for his current on a straight meter basis.

Recent Single-phase Railway Improvements.

Two inventions of importance relating to single-phase railway operation have recently been patented, one by Charles F. Scott and the other by Benjamin G. Lamme, both of Pittsburg. Both relate in general to the control of single-phase motors for railway work

Mr. Scott in his invention seeks to provide a means by which the desired relation between the armature and field-magnet windings in single-phase motors may be maintained and at the same time a different amount of current may be supplied to the armature winding from that which is supplied to the field-magnet winding.

It has often been proposed hitherto to use single-phase alternating-current energy for operating motors in which the field-magnet and armature windings are connected in series and to vary the speed of operation of the motors by varying the electromotive force. In such cases, however, it has not been possible to supply the field-magnet windings and the armature windings with different amounts of current, whereas the design and operation of motors of this character make it desirable in certain cases and under certain circumstances to utilize different currents in the two members of the motor and at the same time to maintain a constant and definite ratio between the currents in the two members. This is done so that any variation in the current in one may be accompanied by a proportionate variation in the other, thus rendering the operation of the motor similar to that of an ordinary series motor. Mr. Scott proposes to accomplish this result by employing one or more series transformers. It is well known that the currents in the primary and the secondary circuits of such a transformer bear a constant ratio, which in turn depends upon the ratio between the turns in the primary and secondary windings. If the primary winding of such a transformer be connected in the supply circuit and the secondary circuit be connected to one element of the motor, then the current in the latter will be proportional to that in the supply circuit; but its absolute amount may be either greater or less, depending upon the windings. A series transformer may be employed with either element of the motor, and the other may be connected directly in the supply circuit, or two series transformers may be employed, one for each element of the motor. The series transformer or transformers may be either of the ordinary two-coil type or of the single-coil type.

Fig. 1 is a side elevation of a car provided with a propelling motor and a controller, the windings of the motor and the controlling apparatus being shown diagrammatically. The car is shown as provided with a trolley, which takes current from an overhead conductor supplied with energy from a single-phase alternating-current generator, and as connected to one terminal of the primary winding (4) of a transformer (5), mounted on the car, the other terminal of the primary winding of the transformer being connected to the return conductor, here indicated as the rails. It will be understood that what is known as a third rail or other forms of construction may be employed instead of the overhead trolley. The motor armature (7) is connected in series with the secondary (8) of a transformer (9), and the field magnet is connected in series with the secondary (11) of a transformer (12). The primary of the transformer (9) has one terminal connected to one terminal of the secondary winding (14) of the main transformer (5), and its other terminal is connected to one terminal of the primary (15) of the transformer (12). The other terminal of the primary (15) is connected to a switcharm, which is so constructed and arranged as to vary the active length of the secondary winding of the transformer (5), and thus vary the voltage impressed upon the windings (13) and (15). The local supply circuits, which respectively include the field magnet winding and the armature, provide a series relation for the armature and field magnet by reason of the fact that the primary windings (13) and (15) are connected together in series. Any desired ratio between the current in the armature and that in the field winding may be secured by placing suitable numbers of turns upon the two series transformers in accordance with well-known laws.

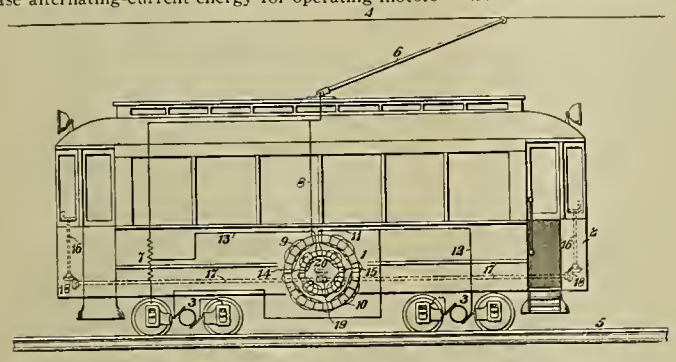


Fig. 1. Car Equipped with Scott's Motor and Controller.

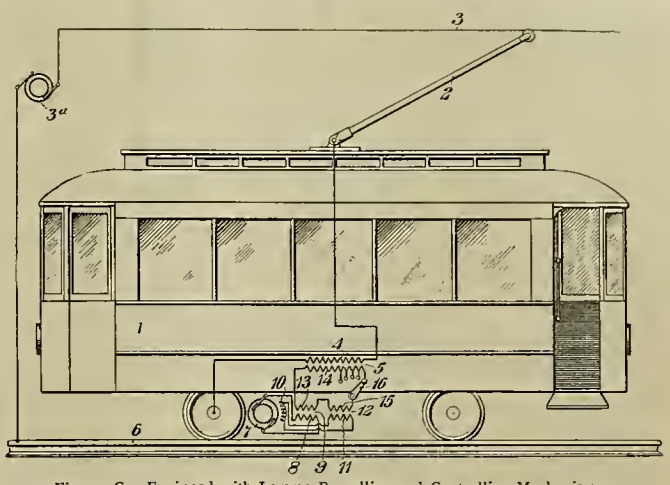


Fig. 2. Car Equipped with Lamme Propelling and Controlling Mechanism.

RECENT SINGLE-PHASE RAILWAY IMPROVEMENTS.

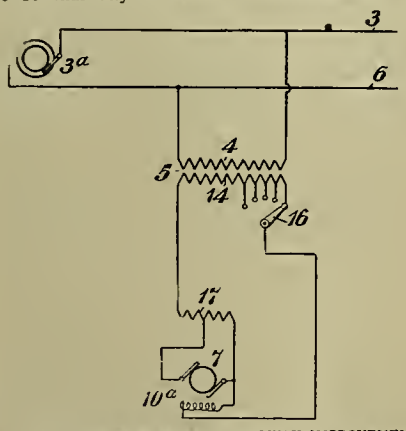


FIG. 3 RECENT SINGLE-PHASE RAILWAY IMPROVEMENTS. —AUTOTRANSFORMER IN SERIES WITH FIELD.

Fig. 3 is a modification in which an autotransformer (17) is connected in series with the field-magnet winding (10^a) in the local supply circuit and the secondary portion of the autotransformer winding is connected across the terminals of the armature (7). By means of this arrangement the current in the armature winding will be greater than that in the field-magnet winding. The advantage resides in the fact that the current supplied to the combination of field-magnet, armature and transformer windings may be much less and the voltage materially higher than would be possible if the transformer were omitted and the field magnet were wound to take the same current as that which passes through the armature winding, it being a fixed condition that the armature current and voltage shall not exceed a certain predetermined value.

The voltage across the combination of parts when the transformer is used may, if necessary, be two or three times as high as that which would be possible if the transformer were not used. It may be possible, therefore, to supply the combination directly from the controller and in certain cases directly from the main circuit.

The patent granted to Mr. Lamme provides a means for facilitating the speed control and also for minimizing the strains exerted upon the controlling apparatus by variations in voltage.

In Fig. 2 is illustrated a railway car equipped with propelling and controlling mechanism in accordance with Mr. Lamme's invention, which has to do more particularly with the means for varying the voltage supplied to the motors. Such voltage variation may be obtained either by varying the active length of one of the windings of a transformer, the secondary of which is connected to the motor circuit and the primary of which is connected either directly or indirectly to the supply or trolley circuit, or it may be effected by mechanical adjustment of the two members of the transformer, the one with reference to the other, so as to effect an inductional variation in voltage, or the two may be combined if desired.

The inductional form of voltage regulator is the one here shown, which is diagrammatically illustrated at (1), it being supported in a suitable manner and in a suitable position on the vehicle, which is propelled by motors (3) here shown as two in number. It is to be understood, however, that a greater number of motors may be utilized, and, in fact, where large vehicles are employed and it is desired to operate at high speeds it will probably be found advantageous to employ at least four motors.

The current for operating the motors is derived from a supply circuit carrying single-phase current, one side of which is indicated as an overhead trolley wire and the other side as the track rails.

The current from the trolley passes to one terminal of an autotransformer (7), the other terminal of which may be connected to the other conductor (5) of the circuit in the usual manner. Current from the trolley also passes to one terminal of the winding (9) of the stationary member (10) of the regulator (1), the other terminal of the winding (9) being connected to the motors by conductors (11) and (12), so that they are supplied in parallel, series connection of the motors being, however, within the scope of the invention.

An intermediate point in the winding of the autotransformer is connected by a conductor (13) to one terminal of the winding (14) of the secondary member (15) of the voltage regulator, and the other terminal of this winding is connected by means of conductors (11) and (12) to the motors.

The member (15) of the regulator may be rotated to effect inductionally the desired voltage regulation or adjustment by any suitable means.

It will be clearly understood without detailed description that rotation of the member (15) in one direction from a given position with relation to the

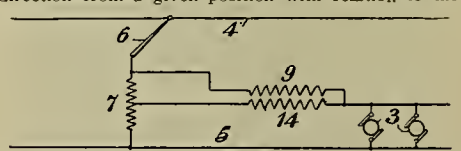


FIG. 4. RECENT SINGLE-PHASE RAILWAY IMPROVEMENTS —WINDING OF VOLTAGE REGULATOR BRIDGING AUTO-TRANSFORMER.

member (10) will serve to raise the voltage of the motor circuit and that rotation in the other direction will serve to lower such voltage.

The special arrangement of circuits, which constitutes the present invention, may be clearly seen by reference to Fig. 4; that is to say, the winding (9) of the voltage regulator is connected directly across from the trolley or supply circuit to the motor circuit so as to bridge both the autotransformer (7) and the winding (14) of the other member of the regulator. By reason of this arrangement of circuits when the voltages supplied to the motors exceed that represented by the point of connection between the conductor (13) and the winding (7)—i. e., when the voltages correspond to running speeds—a portion of the current taken by the motors flows directly through the primary winding (9) in shunt to the secondary of the regulator and to the transformer (7), thus relieving the windings to that extent, and consequently permitting the regulator to work at a relatively low degree of induction and at a reduced current.

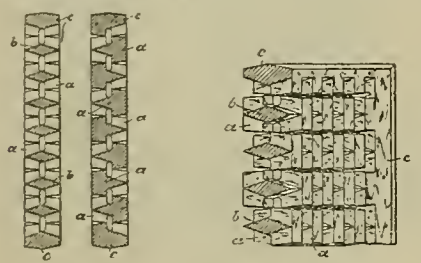
When the motors are supplied with relatively low voltages to obtain proper starting and accelerating speeds, the secondary windings of the regulator does a larger share of the work of voltage variation, and the regulator is worked at materially higher degrees of induction. It follows, therefore, that the regulator operates for only brief periods at high degrees of induction, that the average losses will be much less than with the usual arrangement of circuits, and that the combination is therefore particularly well adapted for continuous service.

Novelties in Accumulators.

The literature of accumulator patents shows little variety. The flood of inventions, which have no value except in the minds of their authors, is quite slowly subsiding. These are sometimes susceptible of practical exploitation, but, with few exceptions, they are mere variations of successful inventions already in commercial use. An anonymous writer says: "The larger manufacturers are neglecting more and more the theoretically beautiful discoveries of late years, which have no practical value, and continue to construct their accumulators in the simplest manner possible on well-known lines. As a result the commercial article today is pretty much one thing, except the trademark."

An enumeration of the innovations in the matter of chemical helps to the plain lead plate would be superfluous. A writer in the Zeitschrift für Elektrochemie, in an article on this subject, describes those inventions which present some interest. For a long time the constructors have increased the sizes of their plates, aiming to expose the largest surface possible, until now the robust and economical plates are not objectionable except in few instances, and are of large importance in stationary installations.

To accomplish the greatest possible surface ex-



FIGS. 1, 2 AND 3. ACCUMULATOR PLATES OF THE AKKUMULATOREN AND ELECKTRICITÄTSWERKE.

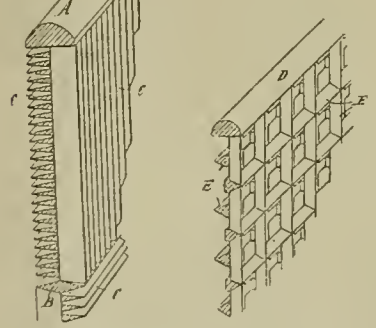
posure nearly every imaginable method has been adopted. The majority of these plates are made by casting.

Franke (German patent No. 119,266, 1899) claimed a casting machine for forming the Lehmann and Mann plates in which the cut is zigzag in form (German patent No. 100,137, 1897). The shells of the mold are furnished with plates arranged alternately, corresponding to the furrows in the casting. The essential point is that the plates corresponding to the furrows may be withdrawn from the casting readily, and permit this to be easily removed from the mold. Lehmann and Mann claim a modification of this process (German patent No. 126,320, 1898).

Plates of the Akkumulatoren and Elecktricitätswerke, preceding W. A. Boese & Co. (German patents Nos. 104,243 and 115,006), are shown in Figs. 1, 2 and 3. The points and bases of the hatchet surfaces (Fig. 2) are on the same line. Fig. 3 shows how the points and bases are in contact. Now the plates being pasted comprise two elements of a sort of network character—one of active matter, the other of lead. This disposition should insure good stability and good utility.

B. Kuettner's plates (American patent No. 690,589, and English No. 15,463) are shown in Figs. 4 and 5. The electrolyte can readily circulate through the plate, and the current is well equalized.

R. J. Gülcher (English patent No. 14,086) alter-



FIGS. 4 AND 5 B. KUETTNER'S PLATES, SHOWING LARGE OPENINGS FOR CIRCULATION OF ELECTROLYTE.

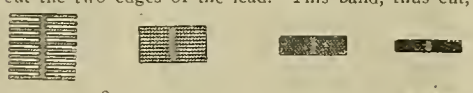
nates the lead plates of 0.25 to 0.4 millimeter thickness with strips of paper. These strips are shorter than the lead plates. The latter are then joined by soldering to a metallic frame, and the paper is removed by concentrated sulphuric acid.

Von Berks & Regner (German patent No. 118,996) plow the lead plates in much the same manner.

In the German patent No. 118,996 and English patent No. 11,509, followed by Boese & Co., is advocated casting the plate as seen in Fig. 6, then, by successive treatment by rolls (a), (b) and (c) of the apparatus in Fig. 10, reducing it to the form shown in Fig. 9. The lead is preferably covered with a thin coating of active material. The plate can be thus reduced to 0.05 millimeter in thickness. The surface thus developed is equal to 11 times the reduced size of the plate. Even 100 times this may be accomplished were it advantageous. These blocks of lead are mounted in a frame of metal.

E. Andreas (German patent No. 114,118) works his plates with a chisel-shaped cutter (Fig. 11). At each movement of the knife (c) the table (b), the inclination of which is constant, and which supports the plate, throws up a furrow. Figs. 12, 13 and 14 show the variations which may be produced.

W. Stockmeyer (German patents No. 135,080 and No. 128,068) shows a form for supplying a great surface, at the same time decreasing the manual labor. A band of lead, coming from the rolls, is led by a mechanical arrangement under knives which cut the two edges of the lead. This band, thus cut,



FIGS. 6, 7, 8 AND 9. ACCUMULATOR PLATES OF BOESE & CO.

is carried under a knife, which automatically cuts it into proper length to be massed in plates.

Rudy (German patent No. 128,030) cuts the leaves in a plate by means of circular knives, revolving in a direction opposite that of the plate.

In Englemann's machine (English patent No. 21,201) the plate is cut by two knives in the form of a comb.

In Gottfried Hagen's patent (German, No. 116,924) the plates, forming an aggregated plate of large dimensions, are furrowed alternately from top to bottom and bottom to top by a cutter, after which they are put together, as shown in Fig. 15. This arrangement facilitates the escape of the gas.

As to the forming of the surface, the processes are either purely chemical or electrolytic. In the latter case the anion must be capable of forming a soluble salt of lead.

The process of H. Beckmann (German patent No. 110,228) rests on the use of pure sulphurous acid, or a mixture of sulphite, or of a hyposulphite, with the sulphurous acid. As the anion SO_3 is finally changed into SO_4H_2, this process has the advantage of preventing the attacking of the electrodes after formation.

C. Luckow (English patent No. 24,960, German patent No. 137,076) uses as a formation bath alkaline hydrate solutions. The formation of the positives terminates in CO_3K_2.

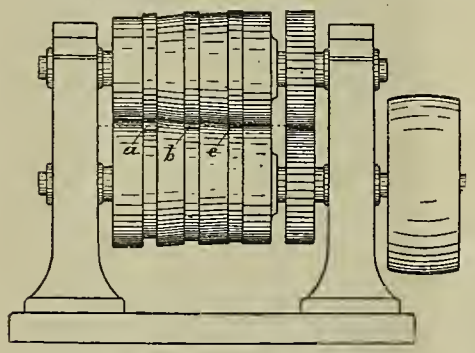


FIG. 10. MACHINE FOR ROLLING ACCUMULATOR PLATES.

The German patent No. 127,275 advocates the use of sulphurous hydrogen in very dilute sulphuric acid.

Krüger & Co. (German patent No. 109,921) precipitate spongy lead by either chemical or electrolytic action.

According to the German patent No. 132,450 of Franz Peters, ammoniacal solutions of two per cent. (with or without the addition of a small amount of salt) are effectual, while a five per cent. solution is worthless.

The American patent No. 699,412 of Rufus N. Chamberlain advocates formic acid, or, better, acetic acid mixed with sulphuric.

H. M. Martin (American patent No. 704,451) depends for success on maintaining a certain fixed temperature.

The negative plates (pasted) of the principal makers are nearly all made under the old, well-known methods.

Big Pneumatic-tube Scheme for London.

An organization composed of some of the strongest houses in London, to be known as the British and Foreign Syndicate, has been formed in London for the purpose of developing the pneumatic-tube business in the Old World. J. E. Milholland of New York states that he has spent four years in consummating the plans for the organization. The first construction work contemplated is the laying of 95 miles of double lines of tubes in London, involving an expenditure of nearly $15,000,000. The mileage will gradually be extended until the metropolis is covered with about 300 miles of double lines of tubes. Twelve-inch tubes will be used, as it has been demonstrated that these are sufficiently large to carry between 80 and 90 per cent. of everything sold in stores.

It is the intention of the syndicate to undertake the entire delivery of goods for large establishments, and the British Postoffice is to be treated on the same footing as are other customers.

Mr. Milholland states that the work of construction will be under charge of Sir John Wolfe Wolfe-Barry, with Professor William C. Unwin as consulting engineer.

Rubber Famine Not Imminent.

In view of the increasing demand for rubber created by the rapid development of electrical industries, the reports of United States consuls in the rubber-producing countries are of special interest. Some time ago one of our consuls in Mexico sent in a very discouraging report regarding the future of rubber culture in that country. He took a very pessimistic view as to the success of the plantations recently started there and in which American and English capitalists are heavily interested.

From the United States consul at Para, Brazil, a report has been received which gives a description of several very successful rubber plantations in that country which, the writer claims, demonstrates the success with which rubber trees may be planted and cultivated.

In this connection the statements of the editor of the India Rubber World are of esnecial interest and value, being based, as they are, upon actual

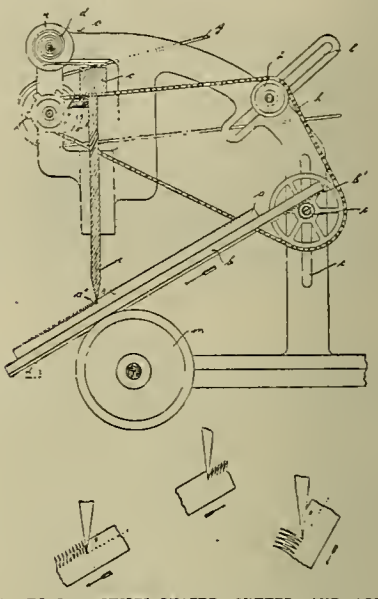


FIG 11 TO 14. CHISEL-SHAPED CUTTER AND ACCUMULATOR PLATES OF E. ANDREAS.

observation and investigation. The editor, who is making a tour of inspection in rubber-producing countries, takes issue with the Mexican consul, declaring that the plantations in that country are certain to become important sources of rubber. In Ceylon he found many flourishing plantations where the trees were raised from the seeds, demonstrating the complete success of this method of replenishing the rapidly diminishing rubber forests.

As there are vast sections of the country not yet planted, but which are adapted to rubber culture, there appears to be no immediate danger of a rubber famine so long as capital can be drawn into the starting of new plantations.

Chicago Street-railway Situation.

The Chicago Union Traction Company and the Chicago Consolidated Traction Company are dissatisfied with the assessed valuation of their properties and have asked that a cut of $4,940,267 be made in the valuation of their personal property as placed by the assessors.

Attorney Gurley told the reviewers that the Union Traction Company had submitted to the assessors an exact schedule, including the smallest articles and even the scrap iron owned by the company. He

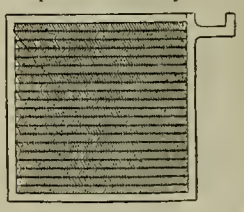


FIG. 15. FURROWED ACCUMULATOR PLATES OF GOTTFRIED HAGEN.

said that this schedule showed a valuation of $7,744,282, but that the assessors arbitrarily had raised it to $10,920,379. The schedule of the Consolidated Traction Company, he said, had been increased by the assessors from $1,769,567 to $3,533,737. He asked that the board confirm the companies' schedules.

The valuation of $7,744,282 is itemized in this way:

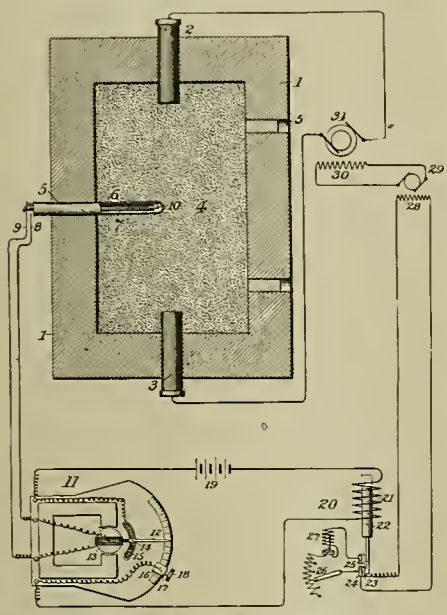
Track	$2,125,772
Electrical construction	1,034,486
Rolling stock	2,248,402
Steam engines and boilers	962,450
Van Buren Street tunnel	778,024
Material	117,972
Moneys	198,550
Tools, supplies and machinery	227,250
Horses, wagons, clocks, etc	22,876

Controller for Electric Furnaces.

Woolsey McA. Johnson of Laharpe, Kan., has recently patented an apparatus for controlling electric furnaces, which comprises a suitable pyrometer or other device capable of responding to and indicating temperature changes within the furnace. Regulating means for the furnace circuit and means connected with the pyrometer for operating the regulator are also described.

In the accompanying illustration the electric furnace is indicated as of the resistance type, the current passing between electrodes through a body of the material or charge to be treated.

The furnace is preferably provided with a number



CONTROLLER FOR ELECTRIC FURNACES.

of openings, which are normally closed by plugs except when serving for the introduction of the pyrometer. The pyrometer is shown as of the Le Chatelier type and comprises concentric cylinders (6) (7) of refractory material, such as magnesia or siloxicon, the end of the outer cylinder being sealed over the open end of the inner cylinder. The wires (8) (9), which may consist, respectively, of platinum and of platinum alloyed with 10 per cent. of rhodium or of nickel and iron or of other suitable dissimilar metals, are located within the respective compartments formed by the concentric cylinders and are united by soldering or otherwise at or near the inner end of the pyrometer at (10). The outer ends of the wires are connected to binding posts upon the pyrometer, and from these binding posts electrical connection is made to the binding posts of a suitable galvanometer. This galvanometer may, if desired, be provided with a scale, which may be conveniently graduated in degrees of temperature as determined for the particular instrument. The indicating needle (12) is preferably of platinum, is insulated from the movable coil (13), and is provided with a metallic contact (14), dipping into mercury. A second contact (16), preferably also of platinum, is secured to a movable block, the position of which upon the scale may be adjusted by means of a rack and pinion operated by a milled head. The mercury and the movable contact are terminals of an electric circuit which includes a storage battery or other generator, and the solenoid of a suitable electromagnetic regulator (20).

The electromagnetic regulator comprises, in the form diagrammatically illustrated, a solenoid (21) having a soft iron core, which is adapted to be raised when the circuit is closed through the solenoid. The core carries a contact (23), which in the position assumed by the core when the circuit is broken at the galvanometer is adapted to close the circuit through the field of the exciter, which furnishes current to the field of the furnace dynamo. When, however, the circuit is closed at the galvanometer, the contact (23) is brought by the movement of the core (22) into operative relation with a second contact (25). In this position a variable resistance and an electromagnetic cut-out are thrown into the circuit.

The operation of the device is as follows: Differences of potential in the wires (8) (9) corresponding to definite temperatures within the furnace chamber are indicated by definite positions of the galvanometer needle. The pyrometer is introduced into that portion of the furnace chamber in which the reaction is proceeding or into such other portion as may be found to have a definite temperature relation. It is preferable to introduce the pyrometer into the reacting mass within the chamber at what may be called its "critical point." By means of the milled head (18) the adjustable contact (16) is then brought to the point of the galvanometer scale which corresponds to or slightly exceeds the temperature desired. As the furnace temperature rises to this degree the needle makes electrical contact with the point, thereby completing the electric circuit through battery (19) and coil (21). By the movement of the soft-iron core (22) the contact (23) is immediately shifted from (24) to (25), thereby introducing into the field of the exciter the variable resistance (26) and the electromagnetic cut-out (27).

A Record in Tramway Construction in London.

[From the London correspondent of the Western Electrician.]

London, July 14.—The work of converting the old horse lines in the south of London has been rapidly pushed forward by the London County Council since the first section was described and illustrated in the Western Electrician early in 1903, and, so far as the permanent way is concerned, nothing unusual has occurred. One line, however, it was always felt, would present some difficulties, and that was a short piece of line worked by cable haulage near Brixton. An endeavor was made to carry out the conversion at the same time that the service was maintained, but it was soon found that this would be impracticable. Consequently, on March 2d, this year, the London County Council officially notified Messrs. J. G. White & Co., on awarding them the contract, that, in view of the importance of the thoroughfare, the work must be finished by July 1st. There was 18,000 feet of double-cable track well laid to be broken up. Ground was broken on April 6th, and for the breaking up of the old cable road some interesting devices were adopted, as shown in the accompanying illustration. In lifting the wheel rail Barrett jacks were used, but in order to save time in starting the operation, a jaw was fitted round the head of the rail, and this jaw was raised by two jacks mounted on iron wheels. In this manner the necessity of breaking up the roadway at each fresh start was obviated. In order to avoid the tedious process of unbolting the slot rail from the yokes wedges of varying thickness were driven into the slot, whereby the rails were forced apart, carrying the shoulders of the yoke with them. The concrete enclosing the old cable tube was found to be very hard and difficult to remove, but after the first 10 days it was discovered that by driving the wedges (four men to a wedge) a certain distance back on either side of the tube, a seam was opened up. The finding of this seam enabled the concrete to be taken out in large blocks.

During the first week the number of men employed was increased daily, until some 1,600 men were at work, and such progress had been made that on May 18th a car was run over the double line from Kennington Gate to Water Lane, a distance of 1¾ miles. On this section the roadway under the Brixton railway bridge was lowered eight inches from building line to building line. The Board of Trade inspection took place on May 20th, five weeks before time.

It is interesting to note that two weeks before commencing work a schedule of daily progress was made out, in which the date for the completion of tearing up was given as June 2d. This part of the work was actually finished on that date. The average of progress by all the gangs was 1,000 feet of single track a day. Considering the character of the work in taking out the old cable line and reconstructing the new conduits, it may be fairly said that this is a record in tramway construction in this or any other country.

The work was completed on June 13th, and the first car ran to the terminus on the 15th. The Board of Trade inspection was held on June 18th and the line was thrown open for traffic on June 19th, 17 days ahead of the stipulated date. There can be no doubt that could the manufacturers have delivered material earlier the whole work would have been completed by June 1st. The celerity with which the work was carried out completely allayed the fears of the frontagers and road authorities as to the friction and inconveniences usually connected with work of this magnitude.

Mr. Maurice Fitzmaurice, engineer to the council, made several alterations in the original construction of the track as carried out on the first Tooting line. The rail length was increased from 30 feet to 45 feet. On the Tooting line the rails were laid with Dicker joints, without any provision for anchoring. On this road the anchor rail joints were used; the rails were also anchored between joints. The position of the sumps was also changed from the margin to the center of the track and the sumps were spaced 140 feet instead of 180 feet, as formerly. The conduit tubes discharge directly into the sumps. The difficulties found in keeping clear the pipe connections from tubes to sumps are so avoided.

The whole of the work was carried out under the supervision of Mr. A. N. Connett, chief engineer to Messrs. J. G. White & Co. of New York. G.

Hints for Central-station Managers.

Several "wrinkles" from different departments of the Boston Edison Company were presented to the "wrinkle" department of the National Electric Light Association, as follows:

First—No person connected with a company furnishing light and power to the general public should allow any stress of circumstances to make him forget, even for a moment, that his rule of conduct to every one, whether rich or poor, powerful or humble, should be one of unfailing courtesy and politeness.

Second—Most business men who operate an isolated plant admit grudgingly, if at all, any item for its administration. All lighting and power companies pay salaries for equivalent work.

Third—When a solicitor can be made to see that he must redouble his efforts when a prospective customer says "no," he begins to be a valuable man.

Fourth—Consideration for his customers, a cheery and affable manner combined with plenty of diplomacy should be part of the qualifications of a solicitor. In the great majority of cases the impression created by the solicitor is the only one the customer has of the company.

Fifth—There are two ways of saying the same thing to a customer. One way will leave the impression that the solicitor is doing all he can for the customer under his instructions from his company. The other way will make the customer feel that the solicitor's treatment is unjust and that he is personally overbearing and discourteous. It is part of a solicitor's business to leave a customer in such a frame of mind that he is glad to see him again personally, and also ready to talk business with him as representative of his company.

Sixth—Every solicitor knows the unreasonable and overbearing customer; the one who talks loud, swears and calls the company a "gang of daylight robbers," etc. The solicitor feels like giving him as good

A RECORD IN TRAMWAY CONSTRUCTION IN LONDON.

as he sends, and without doubt there would be be a great deal of personal satisfaction in so doing. The company is paying the solicitor for business obtained, however, and does not consider personalities. Here is a chance for diplomacy. The loss of your temper only handicaps you for final results.

Seventh—Solicitors are apt to feel that the company's prices are high and that it would be much easier to sell current if reductions could be made or certain conditions could be modified. This is a narrow view of the subject, for the reason that prices have been fixed by the company on the basis of necessary income and must therefore be maintained. Anyone can sell current at very low rates, but it requires a man who is considered valuable by his company to sell current at its established rates.

Eighth—Liberality toward the customer counts largely for a company's success. No "peanut policy" can or will bring permanent success. Competition from isolated plants and the possibility of still worse competition in the shape of a rival company or a municipal plant may be the result of lack of attention to details through which liberal treatment can be shown to the customer.

Ninth—"The supply from an isolated plant is always limited in capacity. The supply from the Edison company is unlimited."

Tenth—The different departments of electric-light companies are constantly asking for data and information in regard to special classes of business.

WESTERN ELECTRICIAN

EVERY SATURDAY.

PUBLICATION OFFICES:
510 Marquette Building, · CHICAGO.
TELEPHONE, MAIN 1746.

Eastern Office, 193 Times Building, New York.
Telephone, 3806J Cortlandt.

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted. This paper is entered at the Chicago postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the **old address** as well as the new should be given.

CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING. THE WESTERN ELECTRICIAN—**the only general electrical paper published in the West**—thoroughly covers a territory *exclusively its own.* THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be furnished on application.

REMITTANCES.—All checks, drafts and other remittances should be made payable to the order of the publishers, the **Electrician Publishing Company,** and addressed to the offices of publication, Suite 510, Marquette Building (204 Dearborn Street), Chicago, Illinois, U. S. A.

CONTENTS OF THIS NUMBER.

French Electrical Exhibits at the St. Louis Exposition. Illustrated 93, 94
Testing Primary Circuits for Grounds 94
Government Coastwise Space-telegraph Stations to Be Controlled by Navy 94
Renewal of Lamps During Peak Load 94
Recent Single-phase Railway Improvements. Illustrated. 95
Novelties in Accumulators. Illustrated 96
Big Pneumatic-tube Scheme for London 96
Rubber Famine Not Imminent 96
Chicago Street-railway Situation 96
Controller for Electric Furnaces. Illustrated 97
A Record in Tramway Construction in London. Illustrated 97
Hints for Central-station Managers 97
Editorial 98
Electrical Exports for June and for the Year Ended with June 99
Western Electrician's Register at the World's Fair 99
Electric-railway Project in China 99
Relative Selling Price of Electricity and Gas 99
Steamship Company to Build Trolley Line 99
Ohio Electric Light Convention 99
Electric Railway in Life-saving Service 99
Hydro-electric Power Development at and Near Joliet, Ill., Using Chicago Drainage Canal Water. By Thomas T. Johnston. With discussion. (Western Society of Engineers) 100, 101
President of Lighting Company Held Responsible for Lineman's Death 101
Ohio Telephone Notes 102
Telephone News from the Northwest 102
Michigan Telephone Matters 102
The Telephone in Kansas 102
Card Display Device for Telephones. Illustrated 102
Bell Telephone Output for June 102
General Telephone News 102
Adaptation of Alternating Currents to Railways. By P. M. Lincoln. With discussion. (Engineers' Society of Western Pennsylvania) 103, 104
The Organization and Equipment of an Arc-lamp Department. By Samuel G. Rhodes. (National Electric Light Association) 104, 105
New Instruments of Precision. Illustrated 105
Large Electromagnet for Surgical Purposes 105

DEPARTMENTS.

Correspondence 105, 106, 107
Great Britain 105
New York 105, 106
New England 106
Dominion of Canada 106
Niagara Falls 106
Southeastern States 106, 107
Ohio 107
Northwestern States 107
Michigan 107
Pacific Slope 107
Personal 107, 108
Electric Lighting 108
Electric Railways 108
Automobiles 108
Power Transmission 108, 109
Societies and Schools 109
Publications 109
Telegraph 109
Space Telegraphy 109
Miscellaneous 109
Trade News 109
Business 109
Illustrated Electrical Patent Record 110

DATES AHEAD.

Ohio Electric Light Association (annual convention), Sandusky, August 16th to 18th.
International Electrical Congress, Hall of Congresses, St. Louis Exposition, September 12th to 17th.
International Association of Municipal Electricians (annual meeting), St. Louis, September 13th and 14th.
American Electrotherapeutic Association (annual convention), St. Louis, September 13th to 16th.

VISITORS to the Louisiana Purchase Exposition at St. Louis who are interested in electricity or electrical literature are cordially invited to call at the booth of the Western Electrician, which is in Block 1 (Section 13) of the Palace of Electricity, just west of the main northern entrance to the building. Here will be found copies of the current issue of the paper, bound volumes of the Western Electrician from the first number, a careful selection of electrical books exhibited by the Electrician Publishing Company, and other objects of electrical interest. Chairs are provided for weary sight-seers, and an attendant will extend a hearty welcome to all readers or friends of the paper.

A RECENT visit to the St. Louis Exposition demonstrated that the great exhibition is practically completed and that it is indeed well worth seeing. The "central picture" is beautiful and imposing, and at night, with the illumination and the plashing water of cascades and fountains, the effect is wholly charming and truly inspiring. The illumination is inevitably compared with that at Buffalo as the general impression of the whole exposition is with the World's Fair at Chicago. It misses something of the delicate, dreamy, lace-like effect that made the decorative lighting at the Pan-American Exposition the marvelous triumph that it was. On the other hand, it is more robust and has the advantage (on Festival Hall and the Colonnade of States) of three colors—yellow, red and green—rather than one, while the presence of the tumbling water of the cascades, through which the light gleams at one place in vivid emerald, adds greatly to the effectiveness of the picture.

One who was familiar with the Chicago World's Columbian Exposition of 1893 will see much to remind him of the White City and much that is quite different. Chicago had the finer setting and finer landscape architecture. Who can forget the sweep of the lake, the Wooded Island, the lagoons? St. Louis has larger grounds and greater attractions in the way of a rolling site and fine forest trees. The buildings of the two expositions may be placed on a par as to beauty of architecture. St. Louis has no individual structure so large as the great Manufactures Building at Chicago, but a greater area is covered by exhibit buildings and the spaces between them are greater. The inside appearance of the buildings at St. Louis is somewhat disappointing, because wooden construction is used entirely, and the posts, beams and trusses of rough wood, painted, give a rather bare, unfinished look to the interiors. The great vistas under massive steel arches that were characteristic of Chicago will be missed.

On the whole, the critical visitor will gain the impression that the Chicago exposition was more finished, more consistently worked out in all its details. The "central picture" of the St. Louis Exposition is very fine; but when one gets away from that the sculptures, the walks, the flowers and shrubbery—the general effect—are not so good as at Chicago. Then, too, there seems to be something lacking in the gayety and animation—the bright, eager interest—the "exposition spirit" of the visitors and attendants. Perhaps this will come later with the throngs of the autumn months. Perhaps there was more vim at Chicago because it was the first great exposition to be held in this country for a number of years and the first ever held in the West; in the year of grace 1904 possibly the American public has become blasé and exposition-surfeited. But, whatever the cause, there is a different "atmosphere" and not quite the same enthusiasm.

But the exhibits at St. Louis are very fine. No one who can do so should miss the opportunity to examine them. Among foreign nations Germany and Japan have particularly fine displays, although France, Great Britain, Austria and other nations are also creditably represented. Some idea of the French electrical exhibits is given in a brief illustrated article in this issue.

Electricity Building contains an interesting collection of apparatus, much of it in motion. Here may be seen a telephone exchange in operation, an incandescent lamp factory, interesting, historic, scientific and testing apparatus, marvelous instruments of precision, generators, motors, transformers, conduits, therapeutic devices—in fact, a varied and instructive collection of electrical machinery and appliances. While the electrical engineer or electrician will see much with which he is familiar, he will be interested in it all, while the non-electrical visitors, who constitute the majority, are enabled to learn a great deal by attentive inspection and study of the exhibits.

Machinery Hall, to use a familiar name, although the Palace of Machinery is the official title—all the buildings are "palaces"—is now a great center of interest, although the collection of exhibits here shown was one of the most backward on the ground in date of completion. This building, with its open vista of exhibits and cement walks, is one of the most attractive on the grounds. Here are the electrical generators, with the engines and turbines that drive them, of the service plant and the exhibits power plant, and the western end of the building has quite the appearance of a great central station, which in fact it is. Current is here generated for the service and decorative lighting and for the intramural railway. The foreign exhibits in this section of the building are few in number but exceptionally interesting. The domestic display is a good one, with units of varied type and up-to-date in design—not perhaps of the very largest size, but large enough to be representative and to impress the average visitor. All who are interested in heavy electrical machinery should not fail to visit the power plants of the Palace of Machinery and of the boiler house adjoining. The latter is somewhat disfigured—from an exposition point of view—by the use of soft coal as fuel, but it is nevertheless a model plant.

VICTORIA FALLS in the Zambesi River in Rhodesia, South Africa, certainly offer wonderful possibilities in the way of power generation. The cataract, or series of cataracts, for there are islands on the brink as at Niagara, is said to be about a mile wide and 420 feet high. These measurements are known with tolerable certainty, but there appears to be little reliable data as to the volume of water passing over the falls, which appears to vary greatly at different seasons of the year. Niagara, on the other hand, although smaller in height and width, has a tremendous and steady volume of water the year through, from an unrivaled series of reservoirs in the Great Lakes, and is likely to continue for many years the most useful waterfall in the world. Nevertheless the project of utilizing and electrically transmitting the power of Victoria Falls is one of surpassing interest.

The idea of "harnessing" the great cataract for the development of power was one which, in all probability, occurred to a large number of people, but the first practical steps in that direction were first taken simultaneously and independently by the Africa Trust, Limited, of London, and Mr. H. B. Marshall of Johannesburg. The first-named was originally inspired by Mr. Alfred H. Haggard, who had discussed the matter with the late Mr. Cecil Rhodes as early as 1890, and whose interest in the falls was deepened by subsequent conversations with Professor George Forbes, formerly one of the engineers of the Niagara installation. Upon the suggestion of Mr. Rhodes, who at once grasped the possibilities of the scheme and gave it his warmest approval and support, the two propositions were amalgamated, and took form as the African Concessions Syndicate, Limited, which syndicate, under certain terms and conditions, holds the sole concession for developing electrical power at the falls for a period of 75 years. Before the expiration of the concession results which may appear somewhat improbable to the present generation under existing circumstances may possibly have been brought about.

A few years since the falls were visited by Sir Charles Metcalfe, who, with Sir Douglas Fox, is consulting engineer to the Rhodesia railways. Sir Charles Metcalfe, upon his return from the falls, communicated his impression of their possibilities to Mr. Rhodes, and the latter, with his usual receptivity of large ideas, at once took action in the matter. The result was that the small capital of the syndicate was doubled, the new issue being taken by the Chartered Company. The management of the syndicate is at present in the hands of a board contributed by the Chartered Company, Mr. H. B. Marshall's group and the Consolidated Rand-Rhodesia Trust Company, with Sir Douglas Fox and Sir Charles Metcalfe as consulting engineers, as successors to the late Professor Hopkinson—a distinguished electrical engineer, who, it will be remembered, was unfortunately killed while on an Alpine climbing tour some two years ago.

The Trans-Continental, or Cape-to-Cairo railway, has already been completed as far as the falls, and the survey and preliminary work of planning out a great power plant will, according to the promoters, soon be commenced. The great commercial question is to obtain a market for the power. If this can be solved, the rest should be easy; the engineering of the great project, although of exceptional interest, should present no insuperable difficulties.

Electrical Exports for June and for the Year Ended with June.

Electrical exports from the United States for the month of June, 1904, show a healthy gain over the corresponding period last year. The total value of such exports for the month named amounted to $973,098 as compared with $736,597 for June, 1903, a gain of $236,501. A comparison of figures will show that the increase was due to a larger foreign business in both classifications—electrical appliances and electrical machinery. The former class, which includes telegraph and telephone instruments, gained $54,512 and the latter $181,989. Following are the figures: Electrical appliances—June, 1903, $320,045; June, 1904, $374,557. Electrical machinery—June, 1903, $416,552; June, 1904, $598,541.

Exports of electrical machinery only, for June, 1904, were divided in order of magnitude among the various foreign countries as follows: British North America, $156,210; Japan, $93,245; United Kingdom, $82,339; Mexico, $76,180; British Australasia, $55,925; other Asia and Oceanica, $27,579; Europe (besides Germany, France and the United Kingdom), $23,116; France, $21,225; Germany, $19,990; Brazil, $11,300; Philippine Islands, $6,540; British East Indies, $5,848; British Africa, $4,394; South America (besides Argentina, Brazil and Colombia), $4,010; Argentina, $3,053; Hongkong, $2,310; Chinese Empire, $2,128; all other South Africa, $1,385; Cuba, $1,209; Colombia, $459; other West Indies and Bermuda, $49; Central American states and British Honduras, $47.

Japan shows a great gain in electrical machinery, and for the month of June stands second on the list. The amount of electrical machinery exported to that country in June, 1903, was only $1,865, as against $93,245 for June, 1904. The United Kingdom, on the other hand, shows a falling off, the comparative figures for June, 1903, and 1904 being $160,117 and $82,339, respectively.

The following table shows the relative exports of electrical machinery and electrical appliances for the years ended June, 1902, 1903 and 1904:

Classification.	1902.	1903.	1904.
Electrical machinery	$5,379,746	$5,779,439	$ 5,645,809
Electrical appliances	3,631,759	4,206,617	4,861,204
Total	$9,011,505	$9,986,076	$10,507,013

It will be seen by these figures that, on the whole, the growth in the export of electrical appliances and machinery for the last three years has been practically uniform. Although in the last year the exports of electrical apparatus classified as electrical machinery has shown a slight decrease, electrical appliances have advanced strongly, making fairly good gain for the year, all things taken together.

Western Electrician's Register at the World's Fair.

Among those registered at the Western Electrician's booth at the World's Fair last week: K. W. Adkins, Linden, Mo.; C. F. Gustafson, Lawrence, Kan.; William J. Brownlow, Chicago; Phil T. Kissack, St. Louis; F. B. Mickley, South Bethlehem, Pa.; Germans Courress, commercial agent of Portuguese government; W. H. Enright, Chicago; R. J. Moore, Youngstown, Ohio; Charles McKee, Findlay, Ohio; F. P. Houisch, St. Louis; C. Pierce, St. Louis; C. L. Steenbergen, Gallipolis, Ohio; G. W. Myers, Redondo, Cal.; Carl Bodine, Chicago; J. J. Bodine, Chicago; J. Van Elten; W. H. Best, Nevada, Iowa; J. O. Scott, W. E. M. Company, St. Louis, Mo.; C. O. Lander, Greenfield, Ind.; W. E. Forbes, London, Ont.; F. Segiak, Warsaw, Poland; R. W. Killin, Mabley & Carew, Cincinnati, Ohio; Charles F. Mitchell Intramural service, Winnipeg, Canada; E. Charles Loomis, San Francisco; Gustave Martey, Belfort, France; C. A. Nickerson, Denver, Colo.; C. A. Carpenter, Chicago, Ill.; David Huber, Cleveland, Ohio; W. H. Arison, Carborundum Company, Niagara Falls, N. Y.; L. J. Gardner, St. Paul, Minn.; John C. Humebrook, Columbus, Ohio; L. D. Thornton, Chatfield, Tex.; E. P. Mullany, Buffalo, N. Y.; Edward M. Sheldon, Buffalo, N. Y.; George E. Drumell, Oklahoma City; W. Franklin, Tuxedo, Mo.; Charles Marquette, St. Louis, Mo.; Arthur Pletz, Cincinnati, Ohio; Gerhard Trinkler, St. Louis, Mo.; John Van Nuland, Chicago, Ill.; H. R. Snyder, superintendent main switchboard, World's Fair; Paul Krueger, Chicago, Ill.

Electric-railway Project in China.

J. P. McCoy of Shanghai, China, who is interested in building an electric railway to connect Shanghai with Hangchau and Suchau, is in the United States getting ideas which will be of use in that country. Mr. McCoy is the son of an American missionary, and has lived in China for 21 years. The three cities named are 90 miles apart, in a triangular shape. There is but one electric line of any importance in China. It is 30 miles in length, used mainly in hauling freight from Canton to the mines, and is of little service to passengers. Mr. McCoy believes there is a great opening for his enterprise. Shanghai has a population of 1,500,000 and the other two cities claim 1,000,000 each.

Relative Selling Price of Electricity and Gas.

[From the Question Box of the National Electric Light Association.]

QUESTION.

At what price must electricity be sold, using 16-candlepower, 3.6-watt lamps, 120-watt Meridian lamps, and 44-watt Nernst lamp to compete with gas at $1.50 per 1,000 cubic feet, using mantle with burner?

ANSWERS.

W. W. Freeman: If competition upon the basis of cost is intended, the price of electric current would have to be 10 cents per kilowatt-hour, or less, which is a lower rate than most companies make, even in competition with gas at $1 per cubic foot as against $1.50 as referred to; but, fortunately, electric companies can compete very successfully with gas at prices materially higher per unit of light on account of the many superior advantages of electric service. In view of this, customers are willing to pay as high as 50 or even 100 per cent. more for electric service than for gas. All electric companies are competing with gas more or less successfully, regardless of price charged for current.

George L. Colgate: Twelve cents per kilowatt-hour, graduated down, the reduction depending upon the increased number of lamp-hours used in each 24 hours, based upon maximum demand. For instance, the customer who has a maximum demand of 10 lamps would pay at the rate of 12 cents if his monthly bill is for no more than 15 kilowatt-hours. If, however, with this demand he used 45 kilowatt-hours his rate should be reduced to 10 cents; if he used 85 kilowatt-hours his rate would be nine cents; if he used 125 kilowatt-hours his rate would be eight cents, and so on down to a minimum of six cents, where from 250 to 300 kilowatt-hours are used on a maximum demand of 10 lamps. Then a somewhat lower rate could be made on a maximum usage, but in every instance the rate of 12 cents should apply where the maximum demand is used only an average of one hour per day.

M. W. Hanks: What the public is willing to pay for artificial light is dependent in a broad sense on the service obtained. If the service offered by gas lighting were equal to the convenient service offered by the electric companies an equal basis of charge might be possible; but the latter service is far superior in point of appearance, health and convenience, so it cannot be compared on a basis of equal areas lighted. That the use of electricity for illuminating is coming more and more into favor and advancing more rapidly than gas is sufficient reason for the continuance of the present charging rates for gas and electric illuminants.

Thomas B. Whitted: In this case it is evident that the person asking the question assumes competitive conditions. My experience has been that in case of competition it is a great deal better to get business houses to resort to arc lighting in every possible case, pitting electric-arc lighting against gas lighting. If we take the ordinary gas-arc with gas at $1.50, it gives us 500 candlepower on a consumption of 15 feet of gas per hour. Therefore, we can obtain for $1.50 500 candlepower 66.5 hours, or 500 candlepower one hour for 2.25 cents. Taking, on the other hand, an inclosed-arc lamp consuming, say, 400 watts on a meter charge of 10 cents per 1,000 watts, we are able to burn the electric-arc lamp one hour for 2.25 cents, and it gives us practically 1,200 candlepower, or double the candlepower of the gas-arc at only one-fourth of a cent more expense. The convenience of electric lighting in residences as against gas is such a strong point that in case of competition it has been my experience that very few electric consumers would change over to gas from electricity if the electric light for illuminating purposes is not sold at more than 15 cents per 1,000 watts.

George Mayer: Gas burners, with mantle, will consume four feet of gas per hour, costing 0.006 at $1.50 per 1,000 cubic feet, and producing the equivalent of two 16-candlepower incandescent lamps. One hundred and twenty watts at 0.006 would mean five cents per kilowatt-hour. It would probably be best to convince the customer of the desirability of electric over gas lighting.

Steamship Company to Build Trolley Line.

The Graham & Morton Transportation Company, operating boats on Lake Michigan, is expected to invade the territory of the Pere Marquette railroad next season with an electric railway. This action is the result of a bitter war which is being fought between the Graham & Morton Company and the Pere Marquette railroad over passenger rates between Chicago and Michigan points. The proposed electric road is to extend from St. Joseph to Paw Paw Lake and Kalamazoo, Mich., connecting with other interurban lines for Grand Rapids. At Holland the boat line has made traffic arrangements with the Grand Rapids and Holland interurban line and is now offering a rate to Grand Rapids considerably below that of the railroad. It is understood that the necessary capital has been secured and that the road will be in operation by next season. The steam road now refuses to handle tickets sold by the boat company or make connections with the steamers at St. Joseph, Mich.

Ohio Electric Light Convention

The coming meeting of the Ohio Electric Light Association will be held in the West House, Sandusky, Ohio, on August 16th, 17th and 18th. Judging from the programme, which has just been issued, the meeting will be an interesting one. The officers of the association are: President, J. H. Perkins, Youngstown; secretary-treasurer, D. L. Gaskill, Greenville; advisory committee, D. L. Gaskill, Samuel Scovil, Cleveland, L. C. White, Columbus; executive committee, R. L. Johnson, Akron, W. F. Hubbell, Wauseon, A. C. Blinn, Sandusky, A. W. Field, Columbus, J. F. Bendure, Lima; finance committee, E. H. McKnight, Middletown, Edward W. Plaisted, Kenton, E. F. Gwynn, Delaware. Following is the programme:

Tuesday Morning: Roll call and presentation of candidates, reading of minutes of last meeting, president's address, announcements, executive session.

Tuesday Afternoon: "A Day Load as a Factor in Central-station Earning Capacity," by L. D. Hoit, Wagner Electric and Manufacturing Company, St. Louis, Mo.; "Notes on the Incandescent Lamp," by E. H. Houghton, Bryan-Marsh Company, Chicago, Ill.; "Transformer Testing for Central Stations," by S. E. Johanneson, Westinghouse Electric and Manufacturing Company, Pittsburg, Pa.; "Relation of the Supply House to the Central Station," by P. R. Boole, Electric Appliance Company, Chicago, Ill.; executive session. In the evening a trip to Cedar Point and to the theater, as guests of the Warren Electric Manufacturing Company of Sandusky, Ohio, will be enjoyed.

Wednesday Morning: "The New Luminous Arc Street System," by H. W. Hillman, General Electric Company, Schenectady, New York; "Notes on Incandescent Street Lighting," by K. C. Randall, Westinghouse Electric and Manufacturing Company, Pittsburg, Pa.; "The Important Relation of Electric-heating Devices to Central Stations," by H. W. Hillman, General Electric Company, Schenectady, N. Y.; "A Symposium on Central-station Heating," by George Haler, Jr., manager the Gas, Electric Light and Power Company, Van Wert, Ohio; E. F. Gwynn, manager Delaware Electric Light, Heat and Power Company, Delaware, Ohio; J. A. Bendure, manager Lima Electric Railway and Light Company, Lima, Ohio; A. W. Field, secretary Columbus Public Service Company, Columbus, Ohio; executive session.

Wednesday Afternoon: "The Steam Turbine and Its Use," by E. C. Crocker, Warren Electric Manufacturing Company, Sandusky, Ohio; "The Instrument Equipment of a Testing Department," by Frank Conrad, Westinghouse Electric and Manufacturing Company, Pittsburg, Pa.; "Graded Costs of Electric Supply," by M. E. Turner, the Cleveland Electric Illuminating Company, Cleveland, Ohio; "Points for Consideration When Purchasing Series A. C. Arc Lamps," by G. Brewer Griffin, Westinghouse Electric and Manufacturing Company, Pittsburg, Pa.; executive session. A trolley ride to Ruggles Grove will be given the ladies, as guests of the Lake Shore Electric Railway Company, and in the evening a launch ride on Sandusky Bay will be the entertainment feature.

Thursday Morning: "Unaccounted-for Current," by W. E. Richards, Toledo Railway and Light Company, Toledo, Ohio; "Voltage Regulation—Does It Pay? Why?" by L. G. White, Columbus Railway and Light Company, Columbus, Ohio; "Topic for Discussion: Joint Use of Poles by Public Service Companies," discussion opened by D. L. Gaskill, president Greenville Electric Light and Power Company, Greenville, Ohio, and John H. Miller, manager Springfield Railway and Light Company, Springfield, Ohio. Executive session: Report of the executive committee, report of the secretary-treasurer, report of the finance committee, report of the advisory committee, reports of the special committees, report of the nominating committee, election of officers.

For all who desire, a trip has been arranged to take the afternoon boat to Put-in Bay. Upon arrival supper will be served at Hotel Victory and a ball will be given in the evening at the hotel, in honor of the association.

Electric Railway in Life-saving Service.

The Lake Shore Electric Railway Company in Ohio has made arrangements to carry the life-saving crew to points of emergency along the lake, whenever necessary. Captain Abbott concluded negotiations with the company for this purpose a few days ago. A complete outfit will be kept on a flat at Lorain and the car will be run out at the call of the life-saving station. This road runs along close to the lake almost the entire distance to Toledo from Cleveland. At least it touches all the important points. The steam roads may be used to some extent also, where any point can be reached quicker and better in that way. Between Lorain and Sandusky, however, the electric road will be used almost entirely.

A joint stock company, with an authorized capital of 2,500,000 lire ($482,500) has just been organized at Milan, Italy, for the purpose of utilizing the waterpower of the province of Liguria for an electric plant.

Hydro-electric Power Development at and Near Joliet, Ill., Using Chicago Drainage Canal Water.[1]

By Thomas T. Johnston.

In June, 1898, the writer was called in by Mr. John L. Norton, president of the Economy Light and Power Company of Joliet, to design and undertake the construction of a plant at the Jackson Street location in Joliet; hereinafter this will be referred to as the Economy plant. In July of that year the general plan was evolved, involving the arrangement of dam, head race, power house, tail race and size of units. In August a litigation involving this power arose between the Sanitary District and the state of Illinois, which led to the withdrawal of the writer from the enterprise, because he was at that time assistant chief engineer (and later consulting engineer) for the Sanitary District. The state of Illinois is the owner of the power at this site and leases it to the Economy company. The controversy turned on the elevation which should be given to the crest of the dam, in view of the flow of water which the Drainage Canal would cause. The court decided that the crest of the dam, which was an old one, constructed to facilitate navigation in the Illinois and Michigan Canal, must remain unchanged. This decision made it difficult to dispose of flood waters on the part of the Sanitary District, which difficulty was overcome by an arrangement being made to accomplish the desired end incidentally with the construction of the power plant as designed by the writer, and the court entered a consent decree accordingly. The arrangement stipulated that the state should pass water through waterwheels or overflow gates in any power plant which might be built, and in such manner that the water level above the dam should not raise higher than —36.00 Chicago datum. The capacity of the waterwheel installation is substantially equal to caring for all surplus waters in flood times, and, in case the wheels be not in operation, gates in the rear of the wheel bays will accomplish the same result. The Sanitary District, on its part, was required to excavate the tail race, which will be described further on. Another element of the consent decree was the requirements to feed the Illinois and Michigan Canal, at the opposite side of the river, with a flow of 30,000 cubic feet per minute. This is accomplished by means of a tunnel under the river, built by the Sanitary District, which also built the dam after the designs by the writer.

The litigation being concluded, the writer resumed his charge of the work. In October, 1900, the temporary unit was put in operation. In July, 1901, three other units were completed and in January, 1903, two others.

There exists in the Desplaines River, at or near Joliet, two other waterpower possibilities, the one, several miles above, and the other several miles below, the plant of the Economy Light and Power Company. The one above may be developed under a head variously estimated at 28 to 34 feet—we may say 32 feet for present purposes—and is known as the Lockport wateroower owned by the Sanitary District of Chicago. The one below may be developed under a head of about 20 feet, and is known as the Hickory Creek waterpower, and is owned conjointly by the Sanitary District, the state of Illinois and what has been styled as the Gaylord syndicate. The Gaylord people have title to 10 feet of the head on both sides of the river, while the title to the other 10 feet is divided between the state and the Sanitary District. It will be only at the end of a litigation, part of which is now under way, that this Hickory Creek power can be developed under 20-feet head, though nothing can intervene to prevent Gaylord from developing the power under 10-feet head.

Mention has been made of the intention of the Sanitary District to develop these two waterpowers. In this connection the following published statement as to cost and revenue is quoted:

> The cost of the Lockport development amounts to $2,750,000, in which is included the cost of the pole line complete for transmission to Chicago. The cost of the Joliet development, which also covers transmission, will be $990,000, or a total for the two developments of $3,740,000. With our flow of water at its maximum of 600,000 cubic feet per minute, the resulting power on the heads which we can secure at the respective sites will be for Lockport (32-feet head) 36,352 gross horsepower and at Joliet (20-feet head) 22,720 gross horsepower.
>
> I use only 75 per cent. of the gross horsepower when figuring what will be available for service. On this basis we would have at Lockport 27,264 net horsepower, at Joliet 17,040 net horsepower. I base my estimate of revenue on $25 per annum per horsepower for 24-hour horsepower. Even on these conservative figures the revenue from Lockport power would be $681,600 and from Joliet $426,000, or a total annual revenue of $1,107,600 as a minimum annual return on a maximum investment of $3,710,000. This work could all be completed within two years from the time the contracts are perfected.

The writer simply quotes these figures, without any intention of criticising or approving them, as a basis for some discussion of what may be accomplished by the transmission of this power to Chicago for municipal uses, or by otherwise using it. He is inclined to differ from the figures quoted in one particular only, namely, 70 per cent. of the gross horsepower, instead of 75 per cent. should have been used in arriving at the number of horsepower, the estimated value of which is $25 each. The reason for this is that a combined efficiency of waterwheels and electric generators exceeding 70 per cent. cannot be attained in practice, when the extraneous losses due to electric cables and waterwheel settings and obstructions, which are not included in guaranteed efficiencies of waterwheels and electric generators, are considered; and therefore only 70 per cent. of the gross horsepower can be had at the switchboard, where salable horsepower is measured. The writer has designed two water-driven electric plants working under substantially 35-feet head, and has not felt justified in estimating quite as much as 70 per cent. combined efficiency of waterwheels and generators, switchboard measurement being contemplated for power output.

The proposition to transmit this Sanitary District or drainage canal power to Chicago for municipal purposes is purely and simply of a commercial nature. The municipality, in this matter, is in the same position as the individual investor in industrial enterprises. The paramount question is: Will it pay, and, if so, how much? The processes of figuring the financial merits of the proposition will be just the same as if it were a private enterprise.

It will be sufficient to consider the matter in relation to the Lockport development alone, since the amounts of power considered are so large that there would be no economies eliminated by considering these two waterpowers together.

The municipality has substantially two uses for power: First, for water-supply pumpage; second, for electric lighting. It has been said that it might use power for its street-car uses; but this is so problematic and far in the future that it need hardly be considered at this time. All other municipal uses of power are very small or not applicable.

The application of electric power to the existing waterworks' pumping engine is practically out of the question. The speeds are such that a belt or gear or rope drive would be needed between the motor and pump. None of the pumps are built with a view to such a connection, and in the case of nearly all of them it is substantially impracticable to modify them, that such a connection could be made. From the point of view of the electrical engineer, it is easy enough to install motors. From the point of view of the hydraulic engineer, it is not clear how the application can be made. The author has been in intimate contact with the problem at Bridgeport, on a large scale, and has also had much to do with the Chicago waterworks engines at one time or another, and is of the opinion that the application of electric drive to the existing pumping engines is substantially impracticable.

However, without arguing this side of the question further, it may be stated that there is an objection to the use of waterpower electricity for waterworks pumping that is more serious than any financial question, and that is the absolute certainty of interruption in the operation of the power plant at Lockport by anchor ice. With the power plant at Lockport shut down, the water supply of this city would be stopped. And there seems to be no way of defeating the anchor ice. There have been several shutdowns, lasting for some hours, at the Economy Light and Power Company plant during this and last winter. The water enters the wheel bays, but does not congeal until it comes in contact with the iron or masonry, and then ice builds up quickly. We have had it completely block the entrances to the waterwheels while running and completely cover the wheels so they could not be seen. The action is so quick that no steam-driven adjunct would be a safeguard. Contingencies of this kind are hardly to be tolerated, and would seem to eliminate waterpower electricity from application to the waterworks pumping engines. It may be stated, also, that the improvements in steam performance of pumping engines in the last few years, by use of high steam pressures and superheated steam and other things have reduced the horsepower cost to something like $30 per year, and the end is not yet, as may be proved when the new pumps the city is so wisely installing at the Chicago Avenue station are tested. Now, take power on the switchboard at Lockport at $25 per horsepower per year, and let the losses between Lockport and the pumping station be 15 per cent., then the value of the power at the pumping station will be $29.41 per year. If this be true, it is not clear where the advantage in the transmission comes in.

The assumption of 15 per cent. loss is justified on the basis that the Lockport power would be transmitted to some central point, as near the heart of the city as possible, and at a very high voltage, say, 35,000. To this point the losses, including those through the transformer, would be 10 per cent. At this point the voltage would be stepped down to some intermediate amount, say, 12,000. From this point the power would be transmitted on feeder circuits to the several pump houses, thus involving another five per cent. loss. It would, of course, be utterly impracticable to run 30,000-volt circuits through the city, nor could the transmission be profitably made from Lockport to Chicago at the lower voltage.

The only other substantial use the municipality has for electric power is for street lighting, that is, for arc lights. It is claimed that there will be 36,352 gross horsepower in the water column at Lockport. As a matter of fact, the present legally required flow through the Drainage Canal will give but 24,000 gross horsepower. However, let the greater amount be assumed for the present. Taking the combined efficiency of waterwheels and generators at 70 per cent., there will be 25,446 horsepower on the switchboard at Lockport. The next question is as to how much of this power can be delivered at the point of application in Chicago. The nature of the case, as will appear further on, is such that we may assume a 35,000-volt transmission to the intersection of Ashland Avenue and Archer Avenue. Here there would be a step-down to about 12,000 volts, and thence a distribution in feeders to points of application, where there would be another step-down transformation. It can hardly be contemplated, that with main-line losses, three transformer losses and feeder-line losses, more than 85 per cent. of the Lockport power will reach the point of application of power. That is, there will be delivered 21,629 horsepower.

There is little doubt, and certainly it involves the least cost for installation, but that enclosed series, alternating-current arc lamps would be adopted for the service. The next question, then, is as to the number of lamps the power would serve. There have been installed recently two 25-light circuits of such lamps in Joliet, one lamp to each block, and both circuits near by the power house, and we find that by switchboard measurement at the power house, each lamp uses power at the rate of 0.67 horsepower. On this basis, the power delivered at the point of application in Chicago, would serve 32,282 lamps. If these lamps be placed one at every street intersection, and there be 16 blocks to the mile, which is the general rule, then an area of 112.5 square miles would be covered, which is not much different from the present populated area of the city. This would mean exceedingly intensified lighting, but either it or its equivalent would have to be installed to use the power, and the use of all the power must be contemplated, since it is contemplated that substantially all the water-driven electric plant is to be installed forthwith. It would certainly be the least expensive arrangement to make for installation and operation. Now, as to installation and operating expenses of such a system, our experience in Joliet indicates that, for an aerial construction the cost of lamp installation, including poles, wire, lamps, regulators and minor fittings, is not less than $80 per lamp. With underground wires, it is, of course, much more, but this element of cost will not now be considered. At $80 per lamp the installation cost would be $2,582,000, neglecting the cost of feeder lines. It appears from the reports that the city has been expending about $100,000 per year in extending its electric-light system, at which rate it would take over 25 years to make the installation needed to use the Lockport power, to say nothing of underground construction and of rising to the increased operating expenses.

The essential feature, however, is as to the cost of power to the city for electric lighting, waterpower electricity being used on the one hand, as against steam power on the other hand.

The taxpayer is asked to invest his money in this undertaking with a view to profit. The dividends are to appear in the shape of reduced taxes for other purposes. If he does not put his money in this undertaking he would have it available for other enterprises. It is therefore proper to treat the matter from an investment point of view.

The items which contribute to the cost of power to the municipality will, in general, be as follows:

1. Interest on investment.
2. Depreciation and maintenance.
3. Operation of plant.
4. Rent.
5. Going-concern charges.
6. Miscellaneous.
7. Sinking fund or equivalent.

Item 1 needs no discussion.

Item 2 refers to that expenditure which is needed currently and that money which is to be set aside annually for future expenditure, in order to keep the plant up to a uniform standard of usefulness.

Item 3 refers to fiscal-office expenses and power-house expenses.

Item 4 refers to the rent the municipality (Chicago) must pay the Sanitary District, which is assumed to be the same as anybody else would pay to the district. It is a revenue that the taxpayer must relinquish, if the item be not considered, and therefore it should be charged against the cost of power to the municipality.

Item 5 needs some explanation. There can be no question but that the interest on money expended during construction up to the time of operating the plant is a proper item to add to capital account. If the construction be done in two years, and the interest rate be four per cent., and the expenditure be made uniformly, then four per cent. of the cash investment may be added to the amount expended to arrive at the total investment. Thus, if $2,750,000 be the cash investment, then, adding four per cent. to this, the total investment becomes $2,860,000. This is true whether the money be raised by taxation or by bonds. Now, if upon completion of construction, the whole plant be put in operation substantially at once, then there would be no further increment to capital account, assuming, of course, that no accident or other causes made necessary any expenditures or losses beyond those involved in the other items of cost of power.

The nature of the case is such that substantially the whole cash investment is to be made in two years or such a matter. It has further been shown that, in order to use all the power, heavy investments must be made by the municipality to install apparatus and a heavy operation charge be incurred. These

1. Abstract of paper, and discussion before the Western Society of Engineers, Chicago.

are so large that there can be no hope of attaining to them short of some years, doubtless 10 years or more after the plant is in operation. During this period a portion of the plant must be idle, the magnitude of such portion diminishing as time goes on and until all the power is used. Meantime the taxpayer is getting no profit from the idle portion of the plant, and is a loser to that extent, unless, as has been contemplated at one time, that rental price for the whole power be paid from the time of completing construction, and then the municipality is the loser. Whether taxpayer or municipality is loser makes no difference. The loss exists, and for convenience may be assigned to the municipality in the form of excess rental. The accumulated amount of this excess is money invested in the production of the power, and should be added to capital account, or, what is the same thing, the interest on such accumulation may be entered as an annual charge for cost of power. The name to be given to this interest item is usually stated to be the expense of creating a "going concern." It has been recognized by arbitration boards and by the courts as proper in evaluating waterworks plants and is conceded to be between 15 per cent. and 20 per cent. of the cash investment in some plants. The interest on this 15 per cent. or 20 per cent. is the annual charge against the cost of power contemplated in Item 5 above. If it requires 10 years to bring all the force into use, at a uniform rate, then half of the rent paid in the 10 years would be paid without any return for it. It is money put into the cost of power on which there has been no return, and it has been put in for all time. Interest on this permanent investment should therefore be a charge against cost of power for all time.

Item 6 refers to legal expenses, administration charges, such as the proportional charges of expenses of trustees of Sanitary District, expenses for damages to life and limb of employes, and other unforeseen things. It may properly include a consideration of taxes, for reasons as follows: It has, in general, been governmental policy to encourage the development of public potentialities, thereby creating wealth, creating employment for more people and increasing the taxes available. Now, if this power is to be used by the municipality, it cannot uniform state of usefulness as contemplated by Item taxes which would otherwise be collected will be lost, and should be a proper charge against the cost of power.

Item 7 is one frequently required in the financing of industrial enterprises, and has in view the possibility that the plant, although it be kept up to a uniform state of usefulness as contemplated by Item 2, still, after a certain length of time, may pass out of use, say by the substitution of something better, without having any salvage value that will restore to the investor his original investment in it. It is not intended by the writer to assign to it any financial value herein, but he wishes to mention it for what it is worth. He will assume that the plant has, with the application of Items 1 to 6, inclusive, an indefinite life.

It is in order now to assign money values to these items, and it will simplify matters somewhat to assign these values to both water-driven and steam-driven plants conjointly.

Interest on Investment.—The estimated cash investment [water-driven] is stated to be $2,750,000 and time of construction two years. Adding interest on investment during construction—say, four per cent.—and the total becomes $2,760,000. The interest charge being taken at four per cent. would be $114,400 annually. The magnitude of the power under consideration is such that a number of steam units may be contemplated, each of which would ordinarily be called large—so large, that steam-turbine-driven generators may be considered, at a cost not exceeding $70 per horsepower, at point of application of the power—this cost including real estate, buildings, boilers, engines, generators, switchboards and all construction costs, including interest on investment during construction, up to point of application of power. It is to be noted that a steam-driven plant, being made up of a number of units, located at several more or less distributing stations, need not be constructed all at one time, and the construction period, when interest charges accumulate, would be much shorter than for the water-driven plant. At $70 per horsepower, and with 21,620 horsepower to generate, the total investment would be $1,514,000. The interest charge, taken at four per cent., would be $60,560.

Operation of Plant.—Say $20,000 per year [for water-driven plant], including heating, lighting, cleaning trash racks of debris and ice, care of pole line and all miscellaneous power-house charges. The item is so small that any error in it is of no import, and further discussion is unnecessary.

It is proper, in making the comparison in question, to contemplate the most modern and high-class steam-driven electric machinery. This seems to involve steam-turbine-driven generators, working with very high pressure superheated steam under the extraordinary economy developed in the last year or two by such machines, and involving high efficiency at fractional loads. The units will be large enough to justify the highest type of boiler construction and economic performance. With such machines the cost of 24-hour power should not exceed $24 per year for operation.

Rent.—Nearly five years ago the Sanitary District advertised for bids for leasing the undeveloped water-power at Lockport, and was offered $4 per horse-power per year, based on the gross horsepower, if the writer remembers rightly, and the plant to belong to the Sanitary District at the end of 50 years. In any event, it is worth more now. It seems to the writer that a rental value of $6 per horsepower for the gross horsepower is fair to have in view. There being 36,352 gross horsepower, the annual rent should be $218,112. No rent item is involved for steam-driven power.

Going-concern Charges.—The rent paid for 10 years will be $2,181,120, and if the power came into use at a uniform rate during this period, then the excess rent paid will be $1,090,500, the interest on which, at four per cent., will be $41,822 annually. Furthermore, the interest on investment will go on for 10 years, and amount to $1,144,000, thus adding half this amount to capital account, or $572,000. The interest on this amount is $22,880. The going-concern charge will therefore be $64,702 annually. Since a steam-driven plant may be installed gradually, to all intents and purposes, as the power is required, no charges are involved.

Discussion.

Isham Randolph, Chicago: The Sanitary District of Chicago owns, between Robey Street, Chicago, and Hickory Creek, Joliet, about 7,000 acres of land; more than 5,000 of these acres might, under proper conditions, be income-bearing; today they are as unprofitable as the arid sands of the desert. The mission of this great power which we are about to create is properly to turn the wheels of industry in factories located upon our own lands, alongside our own channel. Where in this broad land are there greater inducements for the establishment of great industrial enterprises? The finest artificial waterway man has ever built invites the deep-sunk keels of the great carriers of the Great Lakes to plow its ample flood. On either side and easy of access are the steel-laid tracks of transcontinental lines; crossing it at intervals are railways which girdle the great metropolis of the West and make the interchange between all the railroads which bring it prosperity and wealth. Add to this cheap power in its most convenient form and you have pictured the manufacturers' paradise. Had I the settlement of this great question I would make the dedication now to industrial enterprises along this "man-made river," and the West would see its own Lowell before half a decade should have come and gone.

Now the writer claims to have worked out the hydraulic determinations from which the probable flow lines in the Sanitary channel were arrived at, and so he did. Speaking with the wisdom derived from flow measurements and observations taken in the effort to determine accurately the ultimate outcome, the height at the controlling works when the lake is at datum and the channel is carrying 600,000 cubic feet per minute, will be something less than three feet below datum. These computations have been worked out by that careful and competent hydraulician, Ernest L. Cooley. Had the scientist who determined for us our hydraulic slopes and grades been able to predetermine these facts a different grade line would have been established, and a trifle of 1,731,600 cubic yards of solid rock excavation would have been saved, besides a few hundred thousand cubic yards of glacial drift.

At the time that Mr. Johnston made these computations he undoubtedly worked upon the best data which he could obtain, going to show the efficiency of large channels, but there was no data available giving results in such a channel as was then to be built, and he did the best he could, probably as well as any other man would have done, in reaching his conclusions. The fact that the actual demonstration of efficiency in the completed channel is much greater than his work led him, and us who relied upon that work, to expect, is not a valid cause for charging him with error in his work.

But in the light of present plans this excess excavation is not wholly lost, for the cutting of the Calumet-Sag Canal will bring in about 225,000 cubic feet which the rock channel must care for in addition to the 600,000 cubic feet for which it was originally designed.

This added volume, be it remembered, will add nearly 9,000 horsepower to the potentiality of the waterpower we are discussing without adding a dollar to the cost of the channel ways we are now providing, and the capital account will be swelled by only the cost of the hydraulic and electrical machinery necessary to generate the increased power, say $250,000, and our unit cost would then be about $83.33 per horsepower, including the cost of three miles of navigable channel.

Mr. A. S. Crane, principal assistant engineer of the Sanitary District, has revised my figures and finds that we will have an available head of 34 feet, with a flow of 600,000 cubic feet per minute, as against 32 feet, upon which I have based all my estimates of power.

G. M. Wisner: Mr. Johnston states that he does not consider 75 per cent. of the gross power in the water column a conservative figure for the net power of the switchboard, but under conditions similar to the proposed development at Lockport, and that he "has not felt justified in estimating quite as much as 70 per cent. combined efficiency of waterwheels and generators." As a matter of fact, the wheels installed at the "Soo" developed 82 per cent. efficiency and the electrical manufacturers are willing to guarantee 96 per cent. From actual tests made upon a 5,000-kilowatt machine as high as 97.8 per cent. efficiency has been obtained. But using 82 per cent. for wheels and 96 per cent. for generators, you have an efficiency of 78.7 per cent. I have therefore concluded that the Sanitary District engineers are perfectly justified in assuming an efficiency of 75 per cent. when the generators are directly connected with the water wheels; and this would allow over 2.5 per cent. for exciters.

Mr. Johnston assumes that power must be sold at Chicago for commercial uses, thus losing 15 per cent. of the power through line loss, etc. There is no doubt in my mind that with a cheap power a market can be created within five miles of the power house. I do not agree with him that five per cent. interest should be charged, as it would be possible to sell four-per cent. bonds above par to build this work. In his commercial-use table he has used three per cent. for depreciation, which is entirely too high. Assume that the undeveloped power is sold to a private corporation, would the city of Chicago or taxpayers be benefited by the $30,000 item of taxes which Mr. Johnston has charged against the cost of construction? It seems to me that the taxes would be lost to the taxpayers of the Sanitary District and go to the people of Will County, in which county the power plant is located.

In conclusion I wish to emphasize that the proposed Sanitary District development will net over 23 per cent. with a flow of 600,000 cubic feet per minute, and that the navigable features of this great work have been preserved, giving deep-water navigation from Joliet to the lakes; while under Mr. Johnston's scheme the navigable features are sacrificed, he creating instead a large pool, part of which is practically stagnant, thus producing a public nuisance.

It is also known that it is entirely feasible for the canal after completion to carry over 800,000 cubic feet per minute, and it is the intention of the Sanitary District to produce this flow. From all indications this will probably be accomplished within the next 10 years. This will add about 33 per cent. to the available power without materially increasing the cost of this development. With this amount of water flowing and the power judiciously leased the investment will show a net return of over 33 per cent. It may be said in criticism of this discussion that I have taken a "rosy view" of this power development, but it must be remembered when one speaks of developing steam power for $24 or even $30 per horsepower per year for operating expenses and $70 per horsepower for installation, when the construction of similar plants are actually costing from $112.50 to $150, that that is a very "rosy view."

President of Lighting Company Held Responsible for Lineman's Death.

A warrant was recently issued against Henry H. Rogers of the Standard Oil Company, who is president of the Richmond Light and Railway Company of Staten Island, charging him with manslaughter, as being responsible, with the company's directors, for the death of Edgar J. Coleman of Pittsburg, a lineman employed by the Western Union Telegraph Company. The warrant followed a verdict of a coroner's jury to the effect that Coleman's death, on July 1st, by a shock from an improperly insulated connection of the Richmond Light and Railway Company's wires at the Elm Park crossing of the Staten Island Rapid Transit Company lay at the doors of the directors and president of the light and railway company.

The warrant was issued on the advice of Assistant Corporation Counsel Whiddecombe after the coroner's jury had brought in its verdict. It is, in effect, an effort to bring the other directors into court to answer to the charge made against them.

Coleman and some other Western Union linemen were replacing old wires with new ones when the accident occurred. They were at work at the Elm Park crossing of the Staten Island Rapid Transit Company, where the wires of the telegraph company and those of the electric-light company are strung on the same poles. They had pulled down an old wire and were putting up a new one when it came in contact with an electric-light wire from which the insulation had been worn off. The current from the electric-light wire communicated with the telegraph wire, and Coleman received a shock that killed him instantly.

The jury's verdict was as follows: "We find that Edgar J. Coleman came to his death by an electric shock from a wire of the Richmond Light and Railway Company, and we censure and hold the president and directors responsible for the death of said Coleman by not having the electric-light wires properly insulated to save the lives of their employes and the public at large."

After six years of labor the Elizabeth suspension bridge, crossing the Danube at Budapest, Austria-Hungary, is open to the public. The bridge is 951 feet long in the main span and of unusual strength. It carries a double-track electric railway and also has passageways for teams and pedestrians. The structural materials were produced at the government steel works and the shops of the Hungarian state railways.

Ohio Telephone Notes.

The employes of the Cuyahoga Telephone Company of Cleveland received their dividend on the income of the business for the first six months of the year last week. This dividend amounts to 6 per cent. of the entire amount of wages received during that time. The plan has been in operation a year now and has proved quite satisfactory to the company, as well as the employes. They have taken greater interest in the work than ever, as predicted by President Dickson, and merit the amounts they will receive. President Dickson says that every employe feels a personal interest in advancing the business and increasing the earnings by giving good service—a sort of joint ownership, as it were. The co-operative plan has worked well in this case. The company now employs about 400 persons and the dividend will amount to several thousand dollars.

The Putnam County Telephone Company of Defiance has connected its exchange with the long-distance line of the Bell Telephone Company. It is a small company.

A report from Wellsville is to the effect that the proposed line through Yellow Creek and Washington townships will be built. Farmers and others are taking an interest in the matter and many subscribers have been received.

An exchange arrangement has been consummated between the Newark Telephone Company of Newark and the Gratiot and Brownsville Telephone Company, by which a number of new points may be reached from Newark.

The Bell people will erect a new building to cost $25,000 at East Liverpool, on land that cost $10,000 two years ago.

Arrangements made recently for the reduction of the debt of the Federal Telephone Company are gradually being worked out in detail. It will take some time to make the exchanges that will be necessary in order that the large creditors may secure the bonds they agreed to take. However, there will be no trouble in getting all matters arranged satisfactorily, and within a few years the securities are expected to make a good advance in price.

W. F. Crossley has resigned as manager of the Youngstown Telephone Company at Youngstown to become state manager of the Colorado Telephone Company.

The Girard Telephone Company, incorporated last week, will at once commence the construction of a plant in Girard. The Bell interests have had a monopoly of the business in that place, and a hot fight is anticipated.

Bonds of the Toledo Telephone Company are rapidly advancing in value. Brokers are endeavoring to hold the price down to 70 in order to fill orders as rapidly as received, it is said.

F. R. Hillhouse has accepted a position in the traffic department of the United States Telephone Company. He is a brother of A. S. Hillhouse, manager of the Stark County Telephone Company. C.

Telephone News from the Northwest.

A rural telephone line is being built from Mansfield to Scatterwood, S. D., and will ultimately be built to Aberdeen.

The Farmers and Merchants Telephone Company has applied to the council of Hudson, Wis., for a franchise to install a competing local exchange.

The Morton (Minn.) Rural Telephone Company has been incorporated with $25,000 capital.

The Afton (Iowa) Mutual Telephone Company has increased its capital stock from $10,000 to $25,000.

D. C. Bell has been appointed manager of the Union Telephone Company at Bonaparte, Iowa.

The Cascade County Rural Telephone Company has incorporated at Great Falls, Mont.; capital $50,000. C. F. Stork and others.

A new telephone system has been installed at Prescott, Wash. H.

Michigan Telephone Matters.

The Mt. Clemens Telephone Company has started to put its wires underground. It is expected that the work will be completed in about six weeks, as a large force of men are employed upon it. Mt. Clemens will then have one of the finest telephone systems in the state.

At a meeting of the directors of the Michigan State Telephone Company, held in Detroit recently, it was unanimously decided to spend $200,000 in betterments of the service and in extensions. A quarterly dividend of 1½ per cent. has been declared upon the preferred stock. Those present were: N. W. Harris and A. G. Farr of Chicago, Isaac N. Sprague of Boston, D. E. Waters of Grand Rapids, William C. McMillan, W. A. Jackson, Ellwood T. Hance, A. E. F. White and Henry Russell of Detroit. W.

The Telephone in Kansas.

The Kinsley Telephone Company is experimenting with rural lines run on wire fences. The company has several lines that are giving good service.

The Missouri and Kansas Telephone Company has just been able to get its line across the Saltfork in operation, which has been down for several weeks on account of high water.

L. R. Cole and L. F. Duggan, local and district managers for the Missouri and Kansas Telephone Company of Wichita, have been arrested and found guilty by Judge Wilson of contempt and fined $200 each and ordered to make restitution to the city for the violation of an injunction issued July 5, 1902. They were arrested for setting poles and stringing wires contrary to this injunction. The case has been appealed to the Supreme Court.

Card Display Device for Telephones.

A device admirably adapted for use as an auxiliary telephone directory of a number of persons or business houses with whom communication is frequent has recently been patented by S. Duncan Black of Baltimore. The accompanying illustration is a picture of the device attached to a desk telephone.

Each firm's name is written or printed at the top of a card on which is also printed the index letter of the name in large red type. Under the name is placed the telephone number and exchange, and under that any announcement pertaining to the business of the firm that may be desired. These cards are arranged alphabetically in narrow slots radiating from the center of a cylindrical holder.

The holder and its radiating cards are mounted on a shaft terminating in a milled nut, which projects through the sides of a cylindrical case in which the whole is enclosed. This cylindrical case has a short section removed from its periphery and a deflector inserted, the purpose of which is to engage the top of the cards as they are rotated and bend them back so as to make the card directly in front plainly visible. The case is provided with a suitable clamp for

CARD DISPLAY DEVICE FOR TELEPHONES.

fastening the device to the upper part of the telephone stand, or to a wall telephone, as desired.

When it is desired to find a telephone number of a person whose card is contained in the directory the milled nut is turned and the large red index letters rapidly and consecutively pass before the eye. When the index letter desired approaches the nut is turned slower until the desired card springs into position, where it remains until the directory is again used. It will be seen that with such an arrangement the finding of any name of the list is practically instantaneous. It is obvious that the time consumed in finding any card will not be more than two or three seconds.

The fact that the card is automatically held in position to read after once found will avoid the confusion and annoyance accompanying the forgetting and subsequent refinding of a number or exchange just as the operator is answering after a detention, the card always being before the eye.

This device possesses all the good points of the ordinary card-filing systems, with the great advantage of being much quicker, any card being instantly removable through the opening in the periphery of the case, or the side of the case may be removed by the loosening of a single thumb nut and the cards arranged at will.

The instrument presents a neat appearance, being nickel-plated and clamped on the upper part of the telephone stand so as not to interfere with the handling of the latter. Since it has about the same weight as the receiver, it acts to balance that instrument.

A newspaper dispatch from Bloomington, Ill., dated July 30th, says: Preliminary plans to organize the Central Illinois Independent Telephone Association, which will represent a capitalization of over $10,000,000 and include every central Illinois Independent telephone company, were made in this city today. Albert Schuler of Streator was chairman of the meeting and R. C. Critchfield of Minier secretary. A committee was appointed to outline permanent organization plans.

American Telephone and Telegraph Company's Report For June.

The American Telephone and Telegraph Company's instrument output statement for June and the first six months of 1904 shows smaller net results than the stockholders are accustomed to survey from period to period, the June gross output being less and the returned totals greater than for the corresponding months in the last four years. While the number of outstanding instruments has passed 4,124,000, the increase nevertheless has not been proportionately as great as in 1903 and 1902. Following are the comparative figures:

June:	1904.	1903.	1902.	1901.
Gross	83,312	87,608	96,653	96,300
Returned	44,144	42,189	41,741	34,221
Net	39,168	45,419	54,912	62,679
Since January 1st:				
Gross	591,684	600,064	589,109	469,923
Returned	247,190	235,141	226,267	194,567
Net	344,494	364,923	362,842	275,354
Outstanding, June 30th.	4,124,011	3,515,243	2,888,854	2,228,170

GENERAL TELEPHONE NEWS.

The Southern Bell Telephone Company is constructing a long-distance line from Statesville to Morganton, N. C.

The City Council of Lindsay, Ont., has decided not to renew the exclusive franchise to the Bell Telephone Company. Citizens are said to be in favor of competition.

A telephone system is to be built at Cheapside, Texas, by J. E. Lord, J. F. Elder an C. F. Carson, who are the incorporators of the Cuero and Cheapside Telephone Company.

The Lincoln County Rural Telephone Company, with headquarters at Tryon, Okla., and a capital stock of $5,000, has been incorporated by T. D. Rush, J. N. Smith and A. G. Walters.

The White-Davis Telephone Company of Columbiana, Selby County, Ala., has filed a notice of incorporation with a capital of $10,000. J. F. and W. P. White and others are interested.

The Farmers and Citizens' Telephone Company of Frankton, Ind., has been incorporated with a capital stock of $10,000. The incorporators are Thomas Bromley, Jr., E. H. Phillips and George A. Quick.

S. W. Roberts, S. F. Newhall and H. M. Fisk have formed a corporation for the purpose of constructing a telephone system in Cedarville, Ill., and throughout Stephenson County. The company is capitalized at $7,000.

The Central Energy Bell Telephone Company has been chartered in Indian Territory. The company intends to construct a telephone system in South McAlester at an estimated cost of $50,000. All wires will be placed under ground.

The Savannah (Tenn.) Telephone Company, the Tennessee River Telephone Company, the Clifton Telephone Company and the W. N. Sloan Telephone Company, all in Tennessee, have perfected arrangements to consolidate, and some extensions may be made.

Receivers have been appointed for the Standard Telephone and Telegraph Company, capitalized at $100,000, which operates in Bucks County, Pa., and in New Jersey. Both the Bell and Keystone companies have been trying to buy the property for some time.

A charter has been granted to the Cecil Farmers' Telephone Company of Elkton, Md., with $2,500 capital, and privilege of increasing to $50,000. The company will construct a telephone system in Cecil County. Elwood Balderston, Alfred B. McVey and associates are the incorporators.

The Direct Line Telephone Company has been incorporated at San Francisco, Cal., with a capital stock of $1,000,000. This is a reincorporation of the Automatic Direct Line Telephone Company, operating systems in San Francisco, and whose capital stock was $250,000. It is the intention of the company to establish systems in all the nearby towns.

The United Telephone Company of Pottsville, Pa., having raised its rates to subscribers, the City Council declared its franchise forfeited and ordered the company's poles and wires removed. The company thereupon canvassed its subscribers, asking them to petition the council to allow them to remain, promising in return a reduction of rates.

Toll rates for telephone companies are said to have been satisfactorily adjusted by the Independent telephone companies of Southern California. The rate schedules have been divided into seven different groups, varying from 25 cents for a quarter of a minute to 25 cents for three minutes. For example, the rate between Los Angeles and Santa Barbara, 125 miles, is 25 cents for the first quarter minute, 35 cents for a half minute, 50 cents for a minute and five cents extra for each additional quarter minute over one minute. The time limit has thus been reduced to the smallest practicable value, resulting in the toll lines being kept free from delays, which is not generally the case where a flat rate is charged for three or five minutes.

Adaptation of Alternating Currents to Railways.[1]

By P. M. Lincoln.

As an indication that the railway engineer has been able to adapt electricity to accomplish his ends, or perhaps it would be more correct to say that the electrical engineer has successfully applied electrical methods to the operation of railways, may be cited the fact that the capital at present invested in electric-railway enterprises has reached the enormous total of about $2,500,000,000. What is more surprising, is the fact that this total development has taken place within a period of time considerably less than 20 years.

The development of electric railroading up to the present time has been somewhat peculiar in one respect, and that is that the type of motor which has been employed has remained practically unchanged since the earliest development. Sprague, in his work at Richmond in 1887, which may be called the first commercial development of electric railroading, used the direct-current series motor, and today, with almost no exceptions, all traction enterprises using electricity as a motive power are using this same type of motor. The test of time and the trial of other types of motors has only served to prove still more conclusively the superiority of the series motor for traction purposes.

An analysis, on the one hand, of the requirements of traction in general, and, on the other hand, of the properties of the direct-current series motor, led to the conclusion that the superiority of this type of motor is due principally to the two following reasons:

First—Because the motor is inherently a variable-speed motor. It will, on account of this property, automatically adjust its speed to the load conditions that it is called upon to meet.

Second—Because its torque varies nearly in proportion to the square of the electric current input. In other types of motor the torque varies at a slower rate than the square of the current input. This property evidently reduces the amount of current required for a given tractive effort, other things being equal, over that required by another type. These two features are the ones which have made the direct-current series motor pre-eminent up to date in the railway field.

The motor, however, is by no means the only element in the traction problem. The entire problem may, for the purpose of our discussion this evening, be divided into three elements:

First—the generation of power.

Second—The transmission of power from the generating station to the cars or trains.

Third—The application of power to the cars or trains.

The requirements of the third element have demanded a motor characteristic as good as that of the present direct-current series motor. Since nothing better for traction purposes than the direct-current series motor has been offered, the result is that the other elements of the system have been subservient to the motor requirements. As the electric traction has developed with time, the handicap introduced by the necessity of using the direct-current series motor for the operation of trains or cars has been more and more apparent.

It began to be recognized that to gain the voltages necessary for transmission, alternating current would have to be used. The demands of the motor equipment, however, still made necessary the retention of the direct-current series motor, because no alternating-current motor had been developed of such characteristics as to justify abandoning the direct-current motor. The result of these conditions was naturally the rotary-converter sub-station system which is so general today. This system is, as indicated above, a natural development, and is designed to meet the two prime requisites of electric traction as it has existed up to date.

It has long been recognized that a motor which could operate on alternating current and which would possess at the same time the favorable speed and torque characteristics of the direct-current series motor would avoid the disadvantages which are most pronounced in the present direct-current system.

In fact, the advantage of a higher distributing voltage and the avoidance of rotary-converter sub-stations has induced some European engineers to forego the advantages of the speed and torque characteristics of the direct-current series motor and adopt the induction alternating-current motor for traction on some European lines. The induction motor is inherently a constant-speed motor and is therefore in no wise fitted for railway purposes, where a large proportion of the work is done at a varying speed. This system has the additional disadvantage of requiring two or more overhead trolleys. This, together with the unfit motor characteristics, were sufficient to condemn it in the eyes of American engineers, and it, consequently, has found no favor on this side of the water. In the opinion of American engineers, the advantages obtained were not sufficient to overcome the advantages sacrificed. Deficient though it is, the system showed up well beside the rotary-converter system, and only served to show still further the need of an alternating-current motor with suitable characteristics.

1. Abstract of paper and discussion presented before the Engineers' Society of Western Pennsylvania, at Pittsburg, March 15, 1904.

As time went on, however, and the need of the alternating-current motor became more and more apparent, the problem of building such a motor was again taken up. The basis of Mr. Lamme's work on alternating-current motor is the fact that an ordinary direct-current series motor will operate in the same direction, no matter what be the direction of current through it as a whole. Reversal in direction of rotation of the direct-current series motor is obtained by reversing the direction of current travel through the field relative to the armature. From the fact that it makes no difference which way the current travels through the motor, it follows that if the current be reversed very frequently the direction of rotation and the speed-torque characteristics will not be interfered with. It follows, therefore, that the commercial direct-current series motor is of a type which will operate successfully on alternating current, provided the frequency of alternation be slow enough. The introduction of alternating currents of commercial frequency with this type of motor, however, brings up many problems to be solved before such a motor can be successful. The principal difficulties involved are:

(1) The commutation.

(2) The losses due to circulation of alternating current.

(3) High self-induction.

These various problems have been attacked and solved by Mr. Lamme. Many people have an idea that there is something mysterious about the operation of the single-phase railway motor, that its successful operation is due to some occult reason. Nothing is further from the truth. The success of the alternating-current single-phase motor has been obtained primarily by the adoption of simple and well-known principles and overcoming by sheer excellence of design the difficulties encountered.

We pointed out above that the general electric-traction problem was made up of three elements—generation, transmission and application. The substitution of the alternating-current motor for the direct-current will make practically no change in the first and last elements, except the simple changing of the direct-current for alternating-current motors. The transmission element, for the purpose of this analysis, may be divided into two parts: First, high-tension transmission from generators to sub-stations, and, second, distribution from sub-stations to cars. To the first part the substitution of alternating current will make little change—simply that from polyphase transmission to single phase. The second part will be modified by the abolition of the rotary converter and the adoption, in general of higher alternating-current distributing voltage in place of the 500 to 600 volts direct current of the present day. All that will remain of the sub-station will be simply the static transformer. In the alternating-current system the sub-stations will, in general, be considerably more frequent.

The current will be taken from the high-tension line and by the static transformers reduced to a potential which can safely be put upon the trolley. Just what this trolley potential will be will depend solely upon the element of safety, and not, as heretofore, upon the element of commutation and motor insulation. The rotary converter being omitted from the sub-station, will do away with the necessity of skilled attendants. A large element of operating expenses at every sub-station will therefore be avoided. The avoidance of operating expenses makes possible putting these sub-stations more frequently, consequently the distance which the current will have to go from the sub-stations to the trains or cars will be much shorter. This will in turn affect both the cost of the conducting system to take the current from the sub-station to the cars and will also reduce the losses.

Discussion.

Charles F. Scott, Pittsburg: I read, not long ago, a book by Mr. George S. Morrison, entitled "The New Eooch." It is a book which every engineer should read. It mentions the progress of the human race, from its earliest savagery up through various steps to civilization, and notes that there have been different epochs, one of which is marked by the introduction of animal power, a new power brought to aid that of man's muscles. The introduction of the beast of burden marked a new epoch way back in the ages preceding civilization, and yet there was nothing new in the means of passenger transportation for ordinary service, such as that through our cities, nothing new from those pre-historic times down until the time within the memory of us all. There was nothing but travel by horseback and by carriage; in Pittsburg there was not even a car on rails until some 40 years ago. The first street car running on rails in Pittsburg was in 1859. The horsepower was continued until along in 1888 or 1889, when the electric motor and the cable road were both introduced; but the cable soon disappeared and the electric road prevailed. That is, the horse had his full sway for unknown ages until within the last 20 years, and then was completely superseded by the electric road within a very few years. Both papers have pointed out that in the electric railway, certain elements have prevailed from the first commercial railways until the present. They have been of one type: there has only been one new element of note, and it has simply been a means to extend the direct-current motor system. All the development that there has been, therefore, in the past expansion and extension has been along certain defined lines, and certain limitations have been reached. Now something is presented which is radically new, in that it affords a means of overcoming the limitations which have been encountered; something which is cheaper, that can do things which could not be done before, and yet something which contains those fundamental characteristics in the older system which are so well adapted to the work to be done. Moreover, the new system which seems so well to meet an extending field, gives promise of a new era of development and extension in railway work. It overcomes many of the difficulties which are encountered in the ordinary forms of apparatus for the operation of heavy locomotives, those of the order used in steam-railway service. It overcomes the difficulties which are encountered under the present system in the extension of long suburban lines. It overcomes many of the difficulties which are encountered in heavy city work; and it overcomes these difficulties in a way which in general involves a less cost. So that, as far as one can judge from the indications, and indications which are based on apparatus which has been made and tested, we have something now presented to us which opens a new field in railway work.

Mr. Clark: I would like to ask Mr. Lincoln the number of cycles, the number of alternations and the voltage on the new alternating line.

Mr. Lincoln: The standard frequency will be 25 cycles per second, which is a standard which has already been adopted for many power plants. The two frequencies which have commanded the greatest use in this country are 25 cycles for low-frequency work and 60 cycles for high-frequency work. We have adapted this alternating-current system to 25 cycles, the standard low frequency. When we come to the voltage that a customer wants to use—if the customer wants to use a low voltage, as a matter of safety, we can adapt the system to the use of low voltage, but the customer will have to put up with the difficulties which naturally accompany low voltage, such as losses in expenses of the distributing system and the difficulty of collecting the large currents from the working conductor. But in the matter of voltages we have a very flexible system and can adapt it to whatever is desired.

Mr. Schatz: I think Mr. Lincoln has made it very evident why the alternating-current motor is going to come into use very extensively, and I think it would interest us all to hear something about that motor. The one thing is how they are going to build those motors in opposite directions, so that the cars can be operated in both ways. Probably there are some other little things, too, that might be interesting.

Mr. Lincoln: There is nothing mysterious about this motor. It is simply the direct-current motor, as you find it on the cars to which it has been attached, made good enough for an alternating current of 25 cycles per second. The principle is exactly the same. The direction of current through any service motor can be reversed and the motor will never know the difference. That is, the trolley may be either passive or negative without disturbing the operation of the car. It follows, therefore, that you can run a block with a positive trolley, and the next block with a negative trolley, and the motor will run along all right. If you keep on increasing the frequency of alternation, the motor keeps on working the same way. With commercial frequencies certain problems arise, due to the circulation of alternating current in the motor. These problems are taken care of by proper design.

Perhaps the question was how the motor was going to be reversed in direction. Well, just exactly the same as the direct-current motor is reversed, that is, by reversing the direction which the current travels through the field relative to the armature. The alternating-current motor is reversed in exactly the same manner as the direct-current motor. The control of the motor is merely a voltage control. There are a number of means which can be applied to changing the voltage at the motors and keeping a constant-trolley voltage at the same time. One of them is to bring out loops from the transformer windings, so as to obtain a number of different voltage points and to throw the motors from point to point on the transformer windings, as it is desired to change the voltage. That method has certain constructional objections, such as the breaking of the heavy currents at the points of contact. The method which will probably be very largely used, is to use what we call an induction regulator. That consists of a transformer whose secondary is movable with reference to its primary, so that by simply moving the secondary through an arc of 80 degrees, we may get a variation in the voltage applied to the motors. That is, the voltage of this induction regulator may be made to add to a certain voltage furnished by the transformer, or it may be made to subtract from this certain fixed voltage; so that the total range of voltage is the certain fixed voltage plus the regulator voltage as a maximum down to the certain fixed voltage minus the regulator voltage as a minimum. And that scheme has the advantage of having no contacts to make or break. The current is not made or broken at any point in the operation of the regulator, so that the difficulty which is now being experienced to a considerable extent with direct-current controller apparatus, due to the breaking of heavy arcs, will be avoided.

Mr. Storer: One of the places where the alternating-current motor is going to help the direct-

current system, and is going to displace it, is the collection of the current, or the power necessary for operating large trains. It is a big question, a serious question, to devise means for collecting the current necessary for operating a heavy train or accelerating it quickly and moving it, when the power is generated at such a low voltage, as we have with a direct-current system. In the express service, which has been contemplated on the Interborough system in New York, that is, in the subway trains, they intend to operate eight-car trains, and each one of these cars is to be equipped with two 200-horsepower motors. The power required in accelerating that train will run up to about 5,000 amperes. Now that must be collected from a third rail, a section of third rail the length of the train. It means that very heavy conductors are required; very good contacts must be used, and if they do not make the most perfect contact, there is going to be serious trouble. That was found to be the case when the first electric locomotives for the Baltimore tunnel were put into service; there was the greatest difficulty in collecting the current. Sometimes the trolley shoe which they used would become simply welded to the overhead conductor, which was in the form of a rail of some description, and it was scarcely possible to pull it away without tearing the whole structure down. Again, in moving the train along, there would simply be an electric shower of fire from the conductor all the time, caused by the heavy current. Now with this alternating current they will probably use a voltage five to six times as great, and that means dividing the current by five or six, as they case may be, which cuts that difficulty right down.

While I have always been interested in the direct-current railway system, since I started in work, I must say that I am very glad to see the alternating-current system come along, and I believe that this motor has tremendous possibilities. I can see the difficulties that are in the way of it probably as plainly as anyone, but the qualities of the motors are such that they will eventually make it thoroughly successful, and it is only necessary to drive out the weak points in it by commercial service for a few months, when no one need be afraid to adopt it, either for city or suburban, interurban or long trunk lines. I think that is the motor which is going to be used for the trunk lines of the future. The time of the steam locomotive is passing. It may be early to say that it will not be in existence in five or 10 years, because it will be used for a good many years, but the electric system is bound to displace it in the course of time, and it is the single-phase alternating-current which is going to do the work.

Mr. Scott: One of Mr. Storer's figures I have resolved into a different form. He states that a train on the subway in New York requires 5,000 amperes. Now 5,000 amperes, at 600 volts, develops a power equivalent to that required for the operation of 60,000 ordinary incandescent lamps. That is the power taken for a single train in starting.

Mr. Peck: I have had occasion recently to ride over some of the long interurban roads in Ohio and Indiana. On these roads the drop in the feeders is so great that at night the lights almost go out; and one rides along for miles without being able to read and hardly to recognize the people across the aisle of the car. With an alternating-current system, it will be possible to have better lights, for, on account of the higher voltages employed on the trolley, there will be less loss in the feeders, with correspondingly higher voltage on the lamps, thus adding to the comfort and pleasure of the passengers.

Mr. Waters: I would like to ask Mr. Lincoln if these alternating-current motors can be used satisfactorily for short distances over the present direct-current system. Are any running over a direct-current line for a short distance in the city?

Mr. Lincoln: The motor being practically a direct-current motor, can, of course, be used on direct currents. A difficulty when operating an alternating car on direct currents comes in the controlling mechanism. Such control as gives the best results when operating as an alternating-current car cannot be used when operating as a direct-current car. Another difficulty which arises is, that, in order to make a successful alternating-current motor, the voltage which can be applied is limited to a point which is below the voltage of the direct-current motor; so that the motors, if operated on direct currents, have to be operated in series. There are certain disadvantages to operating motors constantly in series, which would naturally accrue to the alternating motors when operating on direct currents. It is perfectly possible to operate these motors on direct currents, but it makes a somewhat complicated arrangement.

Mr. Smythe: There is just one question I would like to ask, and that is in regard to the overhead construction. Relative to the new system, what effect is that going to have in regard to the trolley and feeder systems, as we have them now under the direct-current system? Is it going to curtail the circular millage of the feeders, as we now use them, for a 500 to 600-volt direct current?

Mr. Lincoln: That reduction of the amount of distributing copper is one of the main points of advantage of the alternating-current system. The reduction may be obtained either by raising the voltage or by placing the feeding points of the system closer together. As a rule, the systems which we have figured upon, we have estimated upon simply the trolley wire alone for the secondary distributing circuit. Usually mechanical considerations do not allow of the use of less than a certain size trolley, possibly No. 00, and that amount of copper, by spacing the sub-stations at conveniently frequent intervals, is entirely sufficient, and usually entails a much less loss than occurs in the present direct-current system. That means the elimination of the feeder systems, as they exist today. It is cheaper to put in transformers, as a rule, than to put up copper.

The Organization and Equipment of an Arc-lamp Department.[1]

By Samuel G. Rhodes.

The organization and equipment of a separate department exclusively for the care and maintenance of the arc-lighting service becomes necessary where the number of arc lamps is large. The service is best maintained at the highest standard when the work is specialized, and the interests of both the consumer and the company are best served by such an organization. In considering this subject, the experience and data will be drawn from the arc-lamp installation of the New York Edison Company. The arc-lamp service supplied by this company at the present time represents a total of 19,300 arc lamps of the following types and classes of service:

COMMERCIAL LIGHTING.

14,035 direct-current multiple inclosed lamps
641 alternating-current multiple inclosed lamps
225 direct-current series open lamps

CITY LIGHTING.

1,116 alternating-current series inclosed lamps
775 direct-current series open lamps
2,400 direct-current multiple inclosed lamps
426 25-candlepower incandescent lamps

Of this number, 5,400 are furnished under wholesale contracts, covering supply of current only, and are trimmed by the customer, who, in addition, furnishes all renewals and makes all repairs.

The area within which these 19,300 lamps are installed is 38 square miles, of which 1,740 lamps within an area of 18 square miles are located in the Borough of the Bronx, and 17,560 lamps within an area of 17 square miles in the Borough of Manhattan, the total area of the latter being 20 square miles.

In order to facilitate the canvassing for new customers and the extension of the field of arc lighting the contract department has included in its organization an arc-lighting engineer. Under his direct supervision is the acquisition of new arc-lighting business, the retention of existing installations and the general care of the commercial business connected with this branch of the company's service. To him is referred prospective arc-lamp business out of the ordinary, and in many instances, in addition to being the contract agent of the New York Edison Company, he acts, as it were, in the capacity of engineer for the customer. His services cost the customer nothing, and it is intended that he shall endeavor to secure for the customer the best results for the least expenditure. His assistance may be of special importance where the customer has found that his business does not warrant the illumination provided and desires a rearrangement of his installation.

When the current is introduced in the consumer's premises the arc-lamp department is advised of this connection, the form of contract the customer is operating under, and any other detail that should be in its records to enable the department to keep in close touch with the customer. The installation is at once inspected by the foreman trimmer, the requirements of the service are noted and the customer is added to the route of the trimmer in whose territory the installation is located.

In maintaining the character of the service and the upkeep of the apparatus—of each particular installation regardless of its size, requirements or location—it has been found to be unwise to rely entirely on the trimmer, be he ever so careful a workman and conscientious an employe. Some form of tabulated reports and records should be provided for the inspections and supervisions of this work, and while it is essential that all systems of providing records be complete and in detail, they should be of the simplest character. The card-filing system is used as far as possible. The cards are filed according to avenues and streets, and when the customer ceases to be a customer the card is placed among the disconnected installations. Reference is possible at any time, and the exact status of the customer's installation quickly available.

The concentration of one class of business in a separate division or department, if of enough magnitude, not only tends to the proper maintenance of the service, but specializes the work and insures the best results. The specialization of arc lighting not only improves the quality of the work but makes possible economies not obtainable under any other form of organization. The development of the inclosed lamp has opened great possibilities in the exercise of economy if the maintenance and repair accounts are carefully scrutinized.

The trimmer who is responsible for a route with an average of 650 lamps, and of as many as 25 different types, must, of necessity, be a better workman than the old open-arc lamp trimmer. With him rests, besides the regularity of the service, the fulfillment of the foreman's ideas on proper maintenance. While a trimmer may be classed as an unskilled workman, time expended in specially training him for his work is time well spent. Careful and constant coaching will in a short time give him a knowledge of the many little kinks and expedients to be made use of to insure the best utilization of the carbons and the highest quality of service.

Before the supplies required for the trimming of the lamps are furnished to the trimmer, they have been first compared with the specifications under which they were ordered. This comparison is made by the supply department, subject to the instructions of the arc-lamp foreman and before the material is put into stock. This precaution insures the delivery of carbons within the gauge limits, inner globes of the correct dimensions and squarely ground edges, and outer globes of uniformity as to size, shape, and, if of alabaster, of color also. A useful report turned in by the trimmer is that covering a change or contemplated change in the system of illumination. A "memorandum" is filled out by the foreman and forwarded to the lighting engineer. It has been our experience that other forms of illumination are usually installed temporarily on trial, and prompt attention to the report of the foreman often eliminates the suggestion of considering anything but arc lighting.

It is also made an evidence of good service on the part of the trimmer to receive no criticism of his work from the customer. This, in itself, would be impracticable without the co-operation of the trimmers and the repair branch of the department. The co-operation of the trimmer and the repair man is insisted upon and the routine is planned so that this co-operation is made easy. Each commercial trimmer personally O. K's his route at the close of the day to the foreman in charge of commercial lamps, and reports to him in detail any trouble that the customer may have complained of or any request made for information he may have received. The importance of these reports cannot be overestimated, as they are a direct expression of opinion from the customer, and if of averse criticism can be acted on at once and the cause of complaint removed. Every request of the customer, made either through the trimmer, another employe, or through other channels, is made part of the departmental records.

A repair slip is used, and in addition to the signature of the customary acknowledging the completion of satisfactory repairs, a check is provided as to the time consumed in making the repairs. This in itself is an important factor in securing service of the highest character. The usefulness of these slips is not yet exhausted, as reference to the reverse side shows the "trouble" and its remedy. The slips are filed in envelopes of about the same size and arranged in cabinets. The foreman does this filing, and he can thus keep in close touch with the condition of each individual installation by referring to the slips already in the envelope. The highest point of efficiency is possible, as the requirements of each installation are made a matter of record; any shortcomings are clearly shown by the contents of the envelopes, and steps can be taken to eliminate any particular cause for dissatisfaction.

The repairs to the customers' installations are also under the jurisdiction of the foreman of the trimmers. As most of the repair calls are of a minor importance, taking but little time to remedy, the most efficient way is to have the repair men report to the district headquarters and there receive and attend to repair calls. These repair men are expert wiremen, having a good working knowledge of the various types of apparatus connected to the company's mains, and in addition have been given a course of instruction in the arc-lamp repair shops. It has been the practice to keep these men posted by giving them bench work for two weeks at a time. When a repair man completes his day's work he files, on a separate report, the arc-lamp repairs he has made during the day, and what disposition he made of them. In this way one expert arc-lamp mechanic on the following day can inspect and repair the lamps on the entire system that require repairs to their mechanism. One man will make repairs of this character that 10 repair men turn over to him. This method is a positive check on the character of the work of the repair man as well as the trimmer, and confines extensive repairs, outside the repair shop, to one man.

Should the lamp require changing, the adjustment room is called on for a new or readjusted lamp. The entire stock of arc lamps is carried in one place—a scheme that has been found to decrease the amount of surplus stock. The arc-lamp shops are equipped to repair and readjust lamps of all types and systems, the various types of current required being available. The work is under the supervision of a working foreman, who is responsible for all the lamps that are tested and for their operation after leaving the adjusting room. It has been found that one man is required for each 600 open lamps, while one man can readily look after the shop repairs necessary to an installation of 2,000 inclosed lamps. But few records are required in the shop, and those of purely a departmental character. Arrangements are made for keeping the repair costs of the different types of lamps, by whom repaired, the number of lamps repaired weekly, the number of new lamps sent out, and the length of service obtained from each lamp.

There is but little change in the methods employed in trimming the inclosed lamps for street lighting as compared with the old type open-arc lamps. In

1. Abstract of a paper read before the National Electric Light Association at Boston, May 24, 1904.

the congested districts of the city the street lamps are suspended from all iron Bishop Crook posts without steps and an 18-foot rung ladder is used to trim with. For inclosed-arc city lamps—lighted from dusk to daylight every night, using an 18-foot ladder for trimming—one man takes care of about 85 lamps each day; trimming the lamps, cleaning the outer globes, and changing the inner globes on such lamps as have the inner globes discolored. The route of the city inclosed-lamp trimmer varies daily, the average distance covered being approximately seven miles. For the same class of service in the suburban districts, with the lamps spread over a larger area, the trimming is done with the aid of a horse and cart. The routes vary from 12 to 19 miles, the average being 14 miles a day, each route being made up of about 115 lamps. The trimming of the city and commercial arc lamps of the Brush, Thomson-Houston and Adams-Bagnall open-arc types, is restricted to trimmers who are assigned to this class of service exclusively. The routes average seven to 10 miles and are made up of from 110 to 125 lamps. It is well to confine open-arc lamp trimming—the lamps requiring attention each day—to a route composed exclusively of such lamps, leaving the inclosed-arc trimmer free to change his route from day to day, according to circumstances.

The severe requirements of municipal lighting in a metropolitan city necessitate an organization that will fulfill every requirement and keep the service up to the very highest standard.

About 1,100 constant-current, alternating-current inclosed lamps connected to overhead circuits in the Borough of the Bronx, and about 800 constant-current, direct-current open lamps on the underground circuits in Manhattan, are in use for city lighting, in addition to 2,400 direct-current multiple lamps. The services of three night linemen in the various districts are available in case of either an open or grounded circuit, and with the help of the nearest patrolman the lineman, except in extreme cases, can repair a circuit in a short time. Night patrolmen are allotted to a territory in which they can see all of the lamps at least three times each night after the lamps are all started. A daily report of the outages in his district is made by each patrolman in a book provided for the purpose. This report is entered in detail and, in addition to the inspector's report, the repairs made are filed opposite the original entry. A simple form of card-filing system is used as an index to the specific reports of any individual lamp.

Each morning the foreman goes over the report of the previous night and stamps the date on the lamp card with a dating stamp. Reference to the dates on the card provides an index so that the previous reports can be ascertained in detail. He is thus enabled to note when the last report was filed against the lamp, the nature of the trouble, and how long the lamp has been in service, and to order a new lamp installed or give orders for its repair. These cards also provide a method of keeping a record of the condition of the post equipment.

In addition to the arc lighting in Manhattan and the Bronx there are 101 alternating-current series-inclosed lamps and 356 alternating-current, series, 25-candlepower incandescent lamps in the Riverdale section. These lamps, together with the commercial service, are supplied from a 6,400-volt transmission line between the generating station at One-hundred-and-fortieth Street and Rider Avenue and the Yonkers station. The Riverdale section is nine miles distant from the Bronx district, and it has been found best to operate it as an independent district. The maintenance of the outside equipment and the operation of the sub-station are both in charge of two linemen. These men trim the lamps, start up the constant-current transformers at dusk and take them off at daylight, inspect the city lighting after starting time, make minor repairs to both the commercial and the city installations, and take care of all line trouble in their territory. These men report the installation requirements in detail and are governed by the instructions of the Bronx district superintendent.

The 2,400 direct-current multiple lamps are connected to underground low-tension mains and are turned on and turned off individually. Failing of the final adoption as yet of an entirely satisfactory automatic time switch, notwithstanding the many types that have been, and many of them still, under test, we have had to resort to the boy brigade to do this work. Boys, preferably over 14 years of age, and almost exclusively schoolboys, are employed at this work, and for 45 minutes' actual switching work both night and morning receive $2.50 weekly. They are divided in sections and report before commencing work to the regulator at the nearest sub-station. Three men in charge of the boys cover the entire city, and as the labor is of an erratic kind, care must be taken to learn that the boy is actually at work. The lamp-post keys are withheld until 10 minutes before the starting time, and then are given to the boys. Each of the three men calls by telephone the various stations the boys begin work from, and in the event of the failure of a boy to report he takes his place on the route.

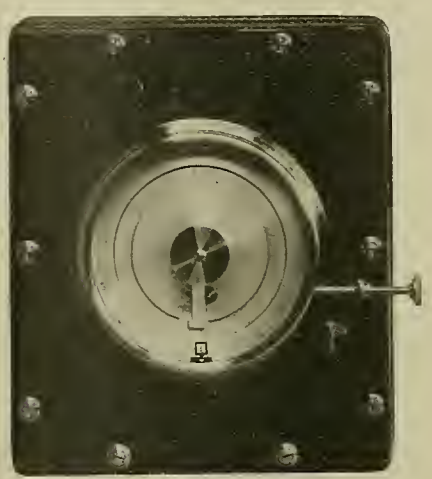
The Canadian government has announced that its new space-telegraph stations on the St. Lawrence River at Heath Point, Fame Point and Anticosti are now open. The Dominion service boat Stanley has been equipped with the system.

New Instruments of Precision.

In order to bring the standardization of electrical instruments to a place in keeping with its importance the Westinghouse Electric and Manufacturing Company has developed a line of instruments of precision which combine the accuracy of the best-known standards with the portability, rapidity and ease of manipulation of the testing instruments now in vogue. The advantages of both types have been retained, with the elimination of those features which detract from their value in general use.

The cases of the instruments are of polished mahogany, with all exposed parts finely finished. The mechanism is mounted in a cast frame made of a high-resistance alloy and suspended from the top plate. This is made of black enameled slate, giving a rigid construction and not affected by warping or changes in temperature. In principle these instruments operate on the mutual attraction between two systems of movable and stationary coils arranged in inductive relation to each other, the two systems of coils being so arranged as to neutralize the mutual induction and the effect produced by any external field. The readings are thus equally accurate with direct and alternating currents, and there is no necessity for reversing the readings on direct currents as with ordinary standards. The controlling force is very large, rendering negligible any friction effects.

The voltmeter dial, illustrated herewith, shows the general form used in the different instruments. The scale is accurately graduated upon a five-inch circle, all the divisions being uniform and thus equally legible over the entire range. By means of the vernier, tenths of a division may be read, giving a range of 2,000 readable divisions, greatly



VOLTMETER DIAL.

exceeding the readable range of any other standard instrument in general use.

The sight wire is shown in a square frame, which is attached to the movable system. When current passes through the instrument the sight wire is carried to the right of zero. By means of the large knob the vernier is turned to the left until the sight wire is approximately upon zero, a fine adjustment being obtained by the knob upon the right. Two rubber-covered voltage terminals are supplied, also a stop for holding the movable element in a fixed position when the instrument is not in use.

The resistance or multiplier is used in the potential circuit of the voltmeter and wattmeter. The potential coils of the instruments are adjusted to a uniform resistance of 100 ohms, and the external resistance is subdivided so as to give total values of 1,000 ohms or multiples thereof. When in use a resistance of 1,000 ohms is employed for each 100 volts nominal potential. The resistances are accurately checked, and thus form standards of resistance as well as measuring instruments. As the same values are used for both voltmeter and wattmeter, one resistance will answer for both instruments.

Large Electromagnet for Surgical Purposes.

Electromagnets for attracting particles of iron or steel from the eye have been made use of extensively by physicians, but hitherto the magnets have not been of sufficient strength to draw the particles out if embedded deeply. Recently an electromagnet of unusual strength and said to be the largest yet built for medical purposes has been placed in the Bridgeport Hospital at Bridgeport, Conn. The core is said to weigh several hundred pounds and is over four feet high. A mile and a half of copper wire is used in the windings.

From its great weight it was undesirable to make it movable, and so it is placed in a vertical position, and the patient, standing near, rests his face on a brass support, his eye just clearing the point of the magnet. This point can be removed so that it can be sterilized.

CORRESPONDENCE.

Great Britain.

London, July 19.—The difficulty between the Newcastle corporation and the Tyneside Tramways Company as to running powers over each other's lines has now been settled. The interesting part of the transaction is that an agreement has been come to upon precisely the lines laid down by the House of Commons committee, which passed the bill, so that now it will go down to posterity that the Newcastle corporation and the Tyneside company gave each other running powers by agreement and not by the compulsion of Parliament. The rather weak argument made by those members of Parliament, who were responsible for throwing out the compulsory running powers, was that they objected to them simply because they were compulsory. In effect, while arguing against running powers, they agreed with them. However, an agreement has now been come to because the committee to which the bill was recommitted was a particularly strong-minded one. The chairman put it upon the corporation to prove to him that the previous decision was wrong, but it may be inferred that the corporation felt unequal to the task. The agreement in question is to last for 10 years or for such longer period as the company may be in possession of the lines. The one feature about the agreement is that no increased value is to be placed upon the company's undertaking by reason of the running powers whenever the undertaking is sold to anyone.

In connection with the large waterpower transmission in the North of Wales, to which I referred a week or two ago, some 18 miles of electric railway for tourist purposes will be built by the same company, and already the details of the first power station, which will have a capacity of 10,000 horsepower, are well developed. The generating sets will be six 1,000-kilowatt turbine alternators. Some 100 miles of overhead transmission lines will also form part of the first contract.

Some discussion took place at the last meeting of the London County Council with reference to the deficit upon the southern tramways, reported in these notes last week. Several speakers adversely criticised the accounts and the chairman of the tramways committee made an explanation. He referred first of all, to the disadvantages of having a large portion of the lines under reconstruction. Then, at the beginning of the year, the loss was put at $75,000, whereas it was only $40,000. As a matter of fact, if the undertaking had been in the hands of a company, a five per cent. dividend could have been declared. But the council was providing large sums for interest and sinking fund, in order to repay the whole cost of the installation in 25 years. Further, the fact that the large generating station of the council at Greenwich was not yet working had made a difference of $75,000. Again, the cost of maintenance, with the conduit system, would be much less than with an overhead system, and large expenditure in future years upon reconstruction of overhead equipment would not be necessary. The accounts were eventually adopted.

A question of tramway running powers, more or less on a par with Newcastle, is now being settled at Glasgow. Under the Paisley Tramways Act, the Glasgow corporation was called upon to run a service of through cars into Paisley, but an agreement has been found impossible. Consequently, the Board of Trade has been called upon to appoint an arbitrator to decide the matter.

At the annual dinner of the National Telephone Company, which was held last week, some interesting figures were given as to the progress of the company during the last year. Forty-five new exchanges have been opened, the total now being 1,095. The total number of subscribers is now 300,000, no less than 40,000 additional ones having come on during the year. The increase in the number of messages was no less than 94,000,000, the total number transmitted being 938,000,000. During the last 10 years the company's exchanges have increased by 103 per cent., the subscribers by 275 per cent., and the number of messages by 283 per cent. It is frankly admitted that the telephone system here is greatly behind that in the United States, although the company naturally declines to take the blame for this. G.

New York.

New York, July 30.—Mr. John B. MacDonald, contractor for the New York subway, conducted most of the members of the Democratic national committee through the subway on Thursday. Mr. Perry Belmont and Maintenance Engineer W. H. Hamilton assisted in entertaining the guests, who partook of luncheon at Claremont.

Almost coincident with the positive announcement that the subway is to be opened on September 1st comes a strike of the painters, who are supposed to be putting the finishing touches to the sections to be opened. A sympathetic strike affects 270 electrical workers, but will in no way interfere with the completion of the power house, on which the contractor, the Westinghouse Company, is employing non-union labor. Contractor John B. MacDonald says that the strike will not delay the opening day.

Four of the 12 8,000-horsepower generators will be ready at the Interborough power house on Fifty-ninth Street for the opening of the subway. Two

of these giants were tested last week, the power being switched on to drive the elevated trains, thus diminishing the amount of current to be purchased from the Metropolitan company.

It has been arranged that as soon as possible after the opening of the subway in September the Interborough Rapid Transit Company will operate trains over the new viaduct through to the Bronx borough from One-hundred-and-forty-ninth Street to Bronx Park. This section is actually ready for starting a train service as far as the tracks and general equipment are concerned.

On Tuesday the Board of Aldermen by 62 votes against eight approved of the application of the New York and Westchester and Boston railroad to construct various electric trolley lines in the Bronx and adjacent places. On this result being announced the representative of the applicants said that his company was in the field to make an offer to construct the proposed East Side subway, which, if put through, would enable Westchester cars to be run along Lexington Avenue and Broadway to the Battery. The general supervision of the Westchester line will be under Samuel Hunt, who is said to be a trustee of the Cincinnati Southern railroad, and the engineering plans will be under the direction of John Bogart, formerly state engineer of New York state. The contract for the construction of the line will be placed with James P. MacDonald, who has completed arrangements to put 15,000 men to work as soon as the right-of-way is secured. As announced last week, the stock of the company has been increased from $1,000,000 to $20,000,000.

Bronx residents and their various taxpayers' committees are growing impatient at the delay by the Board of Aldermen in dealing with the franchise of the Port Chester railroad. A day has now been set for hearing, and although this is in a sense a rival scheme to that of the Westchester company, there are members of the Board of Aldermen who say that there is plenty of room for both companies.

The Bridge Operating Company was incorporated at Albany last week. This company will operate the electric traffic on the Williamsburg Bridge, but is in reality only a documentary corporation organized for the convenience of the Brooklyn Rapid Transit and Metropolitan systems. The directorate includes H. H. Vreeland, president of the Metropolitan, and E. W. Winter, president of the Brooklyn Rapid Transit.

During the last two months the Brooklyn Rapid Transit Company has economized considerably in tolls for its surface cars over Brooklyn Bridge by not running the cars between nine p. m. and six a. m. Passengers between these hours must take the elevated trains and transfer at the Brooklyn end. It is interesting to note that the tolls for the elevated trains are commuted for a lump sum. The company says that the tracks are being repaired and that Superintendents Smith and Graham, who supervise this work, will have it completed within nine more nights.

The Pennsylvania railroad, under the name of the New York Connecting Railroad, is applying for a franchise to cross Hell Gate and Ward's Island by a bridge, thus uniting the boroughs of the Bronx and Queens and giving a connection with the New York, New Haven and Hartford railroad. Meanwhile the members of several unions at work on the Pennsylvania tunnel have struck work this week, this being the first strike upon this undertaking, which is in the hands of the O'Rourke Contracting Company.

A coroner's jury has held the Astoria Heat, Light and Power Company responsible for the death of a workman named Ernest de Ratier by failing to provide proper means of warning when danger threatened.

F. J. Alvin, general manager of the American Electrical Novelty Company, has returned to New York after an extended tour, which included the St. Louis Exposition, where his company has a typical and interesting exhibit.

Magnetic pressing machines are scheduled as the chief production of the Lindsay Manufacturing Company, a concern incorporated this week in this city, with an authorized capital of $10,000. The first directors are Franklin Lindsay and E. P. Camp of New York and C. E. Woodruff of Chicago.

Brooklyn has now a new electrical enterprise, in the form of the Newburger Electric Company, with a capital of $10,000. Associated with the concern are Herman DeDos, R. B. Banton and Banton Moore.

Electric work is to be put into public schools Nos. 107, 108 and 130 (Annex 1), Manhattan.

The coming mayoral election at East Orange, N. J., turns upon the subject of laying a trolley line along Central Avenue, a project which has been before the city for the last 14 years. Dr. Charles S. Stockton is the candidate who favors the granting of the franchise.

The village of Wave Crest, Far Rockaway, L. I., is asking for public electric lighting. Wave Crest is the only section of Far Rockaway without street lamps.

Justice Scott, in the Supreme Court, on Monday, after hearing arguments relative to the restitution of telephones to the racing syndicates, advised that the plaintiffs could bring a damage suit for breach of contract. The plaintiffs alleged that they were losing money on account of having to distribute their information without the aid of telephones. On Tuesday the syndicate withdrew its application for a mandamus calling for the restoration of the instruments. D. W. W.

New England.

Boston, July 30.—The Springfield Suburban Street Railway Company, which got a severe setback a few months ago by an adverse decision of the railroad commissioners on its application for a competing line in the city of Springfield, where an established system has a franchise, has appealed to the Supreme Court to review and annul the commissioners' findings on the ground that the latter exceeded their authority in their ruling. The Springfield aldermen have granted locations to the established company recently, which are practically the same as those asked for by the suburban company.

In furtherance of the plan to consolidate the Bristol County and the Middleboro and Buzzard's Bay street railway companies a circular has been issued to the stockholders proposing the formation of a holding company, to be known as the Southeastern Electric Companies. An 11-mile connecting link of railway is contemplated and $150,000 additional capital will be required to carry out the consolidation scheme.

The threatened lawsuit over the matter of a charge made by the city of Brockton for street repairing on the line of the Old Colony Railway Company's locations in that city has been averted by concessions on the part of the counsel for the company. The right of the city, under the terms of the original grant, to make such a charge is admitted by the attorney for the railway company. This admission, however, is applicable only to the "original-grant" lines, the contention in Brockton—like the Worcester case now pending before the United States Supreme Court, with United States Senator George F. Hoar retained by the city of Worcester as counsel—being to the effect that the city cannot enforce such conditions on grants subsequent to the original ones, these later grants being held to be of a different nature under the provisions of a statute passed in 1808 by the state Legislature. The outcome of the case of the city of Worcester against the Worcester Consolidated Street Railway Company, carried up from the Massachusetts Supreme Court, will have great interest for the Brockton authorities, therefore, as well as the Worcester municipal administration. Several other cities also await the decision with much concern.

A section of the Atlantic Shore Line, 10 miles in length, between Kennebunk Port and Biddeford, in the state of Maine, was opened July 24th. The only link lacking now in connecting systems close along the New England coast from Providence, R. I., to Portland, Me., is the gap of a few miles from York beach to Kennebunk Port, which will probably be built within a year.

Consolidation of the Whitman Light and Power Company with the Edison Company of Brockton by the absorption of the Whitman concern and an issue of 1,000 new shares of stock at par by the Edison Company have been authorized by the Massachusetts Gas and Electric Light Commissioners.

The New York, New Haven and Hartford Railroad Company is reported to be negotiating now with the Connecticut Railway and Lighting Company for the latter's trolley lines in Bridgeport, Waterbury and New Britain, provided it can secure them without taking over the electric-lighting departments of the company's business in the cities named. B.

Dominion of Canada.

Winnipeg, July 20.—The Levis County Electric Railway Company's road has ceased to run since the 17th as the result of a dispute with the Chaudiere Electric Power Company over a note for $2,700. The directors state that it is their intention to install a plant of their own so as to be independent of all outside influence.

The Hamilton, Beamsville and Grimsby Electric Railway and the Hamilton Street Railway Company have been having a misunderstanding. The latter company has neglected to carry out the order of the City Council to extend its Sherman Avenue line south to Idaho Street and give the former running powers over the extension, so the Hamilton, Beamsville and Grimsby Company secured a permit from the city engineer, and late at night proceeded to build the line itself under the cover of darkness. The street-railway company got out an injunction at four o'clock in the morning and the work was stopped. In the meantime the service of the Hamilton company is considerably impaired, as its old line has been pulled up. According to the street-railway company's agreement with the city, it forfeited its rights-of-way on the street when it failed to build the extension asked for by the city.

Many improvements have recently been made in the St. John Street Railway Company's line and plant, and these have proved so successful that the directors have resolved to double-track the road, and Manager Earle has instructed Chief Engineer H. A. Brown to go ahead with the work at once.

Novel means were employed by the Dominion Coal Company to prevent the Cape Breton electric railway, in which Boston men are interested, from extending its tracks across the main line of the Sydney and Louisburg railway at Sydney. Ever since the Electric company built its railway, two years ago, it has been trying to obtain the consent of the coal and steel companies to the placing of a level crossing over the double tracks at this point, but without success, and so appealed to the City Council at Sydney to assist in coercing the companies to give way to its demand. A resolution was passed by the council to the effect that rights be given the Cape Breton Electric railway to cross the Dominion Coal and the Dominion Iron and Steel Company's railroad at rail level, and the Electric company's manager sent a gang of men to install the crossing, but were met by the other company's employes, who ran an 80-ton locomotive across the crossing point with two heavy freight cars and left them there.

Manager Leonard and Secretary Drinkwater of the Canadian Pacific Railway and Mr. George Clare are arranging for the transfer of the Berlin, Waterloo, Wellesley and Lake Huron to the Canadian Pacific Railway Company.

Engineer W. F. Jennings met the City Council of the city of Hamilton with plans showing the route which the road will take from Toronto to the frontier at Niagara. The plans show that the electric road will cross Burlington Beach on the Grand Trunk right-of-way, and an hourly service with cars running at a high rate of speed will be given. The company intends to construct a loop line into the city of Hamilton and will carry freight as well as paseengers. H.

Niagara Falls.

Niagara Falls, N. Y., July 29.—The Niagara Falls Power Company is building a new 24-duct conduit from the New York end of the upper steel arch bridge in Niagara Falls up Niagara Street to Fourteenth Street, and thence to its power stations. In this conduit will be placed the cables that will connect the plant of the Canadian Niagara Power Company with the generating stations of the Niagara Falls Power Company, thus ensuring a continuous-current service to the patrons of both companies.

Marcus Ruthenberg is establishing a plant on the lands of the Niagara Falls Power Company for the reduction of iron by electricity on a commercial scale. Temporarily the installation necessary is being placed in a stone building near the International Acheson Graphite plant. One thousand two hundred horsepower will be taken from the Niagara Falls Power Company, and if the results are all that is expected the business may be enlarged. Mr. Ruthenberg has been doing extensive experimental work in Lockport, and the success he attains at Niagara Falls will be awaited with much interest.

Recently while George E. Cox of Niagara Falls and John M. Morehead of Chicago were experimenting with a machine they were engaged in perfecting the gas pressure in the apparatus blew out the plug, and the gas, taking fire, both men were severely burned in the explosion. The experiment was made in front of the Union Carbide plant at Niagara Falls and both men were quickly taken to the Memorial Hospital, where their injuries were dressed. Mr. Cox was most severely burned and also had his wrist broken by the flying valve, which also struck Foreman George Robinson in the leg, but did not do serious injury. O. E. D.

Southeastern States.

Charlotte, N. C., July 30.—The town of Douglas, Ga., has sold $20,000 worth of bonds to a Chicago firm, and will shortly let the contracts for a new electric-light and water plant, to be modern in every respect.

Report No. 2 of the receivers of the Virginia Passenger and Power Company has been filed and the court has authorized the continuation of certain improvements inaugurated before the receivership. The amount involved is about $42,000. Seventeen thousand dollars is asked for motor generators, transformers, wire, etc. The completion of the big power plant will enable the company to secure enough power to operate the Petersburg and the interurban lines.

The Southern Electric and Manufacturing Company of Anniston, Ala., is to erect shops soon and will make a general line of electrical supplies, electric fans, etc. The capital stock is $50,000. E. H. Goodhart is treasurer and Frank G. Lake president.

The Raeford Power and Manufacturing Company of Raeford, N. C., has been chartered, with a capital stock of $200,000 authorized, to develop water and electric power and operate textile plants. J. W. McLaughlin, T. B. and W. J. Upchurch of Raeford and John Blue of Aberdeen, N. C., are the incorporators.

Wall Street and Pittsburg capital is reported to be interested in a proposed interurban electric line from Nashville, Tenn., to Franklin, and possibly to Columbia. Plans are being prepared by the Westinghouse Electric and Manufacturing Company.

Surveys have been made for an electric line nine miles in length, from Boone Ford to Burnsville, N. C., Chicago capital being behind the enterprise. The road may be eventually built on to Asheville, N. C.

The W. T. Weaver Power Company of Asheville, N. C., has ordered a three-phase alternating-current generator of normal 1,200-horsepower capacity, to be delivered by October 15th. This will double the capacity of the present plant. President Weaver says the French Broad River, on which the plant is located, is one of the best streams in the country

for generating power, on account of the uniformity of flow. The new generator was ordered from the Bullock Electric Manufacturing Company of Cincinnati.

The Williams interests, controlling the Norfolk (Va.) Railway and Light Company, will, it is stated, expend $500,000 in a new heating plant and ice plant. The company has met with great success in disposing of electric power and is now said to be working out plans for extending its interests.

An injunction was recently granted in the Corporation Court restraining the City Council of Alexandria, Va., from disposing of the city electric-lighting franchise to Charles F. Thompson. The matter will be argued before the courts August 1st. The contention is that the light plant cannot be sold without a special act of the General Assembly.

Plans are being prepared for the new lighting plant for the state buildings at Richmond, Va., and bids will soon be called for. The accompanying appropriation is $25,000. L.

Ohio.

Cleveland, July 30.—An investigation of the affairs of the Miami and Erie Canal Transportation Company has been in progress before Referee Fuller at Cleveland for the last few days. The object is to ascertain who are really the stockholders and who first owned the stock of the company. W. H. Lamprecht, a broker at Cleveland, acted as trustee for the stock and testified that $125,000 and one quarter of the capital stock had been transferred to C. C. Richardson for himself, George B. Cox, Thomas N. Fordyce and Dan J. Ryan. It is said that Cincinnati lawyers suggested that the Cleveland people pay back the money and return the stock, but in return the Cleveland interests suggested that the Cincinnati people make that complementary exchange and they would be willing to listen to a proposition to settle the matter and get it out of the courts. Some of the witnesses testified that it was the original intention to make an electric road along the canal bank and that George B. Cox was depended upon to arrange matters with the politicians to have the state give the company that right. However, the plans did not work out right and this trouble will probably still further confuse them. There will doubtless be much difficulty in learning who the original stockholders really were and how the transfers were made to others.

The Fort Wayne Smelting and Refining Works have petitioned the probate court at Akron, asking that Will Christy, J. R. Nutt and C. F. Moore be required to appear and show what interest they hold in the Akron Traction and Electric Company. These men are all interested in the Northern Ohio Traction and Light Company. The Fort Wayne company claims to have a judgment against the former company for $243.37 and that the sheriff has been unable to find anything upon which to levy.

Bonds to the extent of $450,000 will be issued by the Conneaut and Erie Traction Company shortly, for the purpose of securing funds for making important extensions of its lines between Conneaut and Erie, as well as other improvements. A mortgage for $1,250,000 has been filed in favor of the Fidelity Trust Company of New York, as trustee for the bondholders. This covers the original $800,000 bonds also.

James White has been granted a franchise to construct an electric line on Main street in Carrollton. This is a portion of the road that is to be built between Steubenville and Canton. It is said the engineering work will all be completed by fall and early in the spring the construction will begin at both ends and at a number of intermediate points. The plan is to have the line in operation by the fall of 1906. Mr. White represents the Chicago capitalists who are interested in the new road.

The Scioto Valley Traction Company has placed its line between Columbus and Lancaster in operation. It is a third-rail system and its operation will be watched with interest.

The probable erection at Niagara Falls of an immense electric power station is being discussed in Cleveland, in connection with the wide distribution of current that may be attempted. It is said plans have been made to build a plant large enough to supply electric roads over that section of the country, including the Andrews-Vanderbilt lines. It is also thought that current will be brought as far west as Cleveland, for manufacturing purposes.

Secretary John DeWitt, of the Toledo, Columbus, Springfield and Cincinnati Railway Company, is endeavoring to arrange for a bond issue of $90,000 to equip the portion of the line completed between Lima and Westminster, which will form a connecting link between Cincinnati and Toledo.

President W. Kelsey Schoepf, of the Cincinnati Traction Company, has denied the rumor that any plans have been made to consolidate that company with the Indiana Union Traction Company.

An agreement has been reached by which the cars of the Toledo, Bowling Green and Southern will be taken from the end of its own line into Toledo over the tracks of the Toledo Railways and Light Company. The Toledo, Bowling Green and Southern has agreed not to attempt to do a city business and the portion of its line inside the city will be placed in the hands of a trustee. The city road receives three cents of each five-cent fare for the service.

Toledo people are said to be back of a plan to build a line from Muncie on a direct line to Toledo. It will be known as the Muncie and Northeastern. James Kutz and Edward Finn of Toledo, have been in Muncie some time investigating the franchise matter.

W. G. Taafel, general manager of the Citizens' Electric Light and Power Company at Newark, committed suicide a few days ago by throwing himself into the Licking River. He was receiver for the Newark Savings Bank and became despondent because of financial matters. He left a note saying he was innocent of any wrong-doing in connection with the bank. Mr. Taafel was at one time a machinist but became one of the leading business men of the town later on.

The Forde Lighting Company of Garrettsville has been incorporated with a capital stock of $25,000 by A. W. Green, W. B. Martin, O. G. Martin and others.

The Columbus Railway and Light Company has refused to make a discount from their bill to the city for outages and threatens to turn off the lights if it is not paid in full.

The question of granting a franchise to the Toledo Railways and Light Company has again been taken up by the City Council and it is believed it will be settled in a short time. The council asks that universal transfers and some other conditions be included in the franchise.

An effort will be made to secure a franchise for a line on Doan Street, in Cleveland, extending south from the present terminus at Superior. People are anxious to have a cross-town line in the East End, as it is now difficult to reach many points without making the trip entirely to the business center of the city and back to the point desired on another line. The city administration, following its usual obstruction policy, is objecting to granting a franchise, unless the company will submit to its dictation as to fares and other conditions over the entire system.

People of Cleveland are uncertain what they want in the way of an extension of franchise for the electric street-railway system. Some of the advocates of a three-cent fare proposition have given it up and say that a reduction, with a good service and a sensible system of transfers. O. M. C.

Northwestern States.

Minneapolis, July 30.—M. L. Burt of Bedford, Iowa, will buy the electric-light plant at Lamoni, Iowa.

Bonds of $7,000 for enlarging the electric-light plant have been voted at Winthrop, Minn.

The city of Royalton, Minn., has voted $10,000 for the purpose of erecting an electric-light plant.

George W. Bowman has asked for a 20-year franchise for a street-railway system at Monroe, Wis.

The St. Paul Gas Light Company has been authorized to extend its electric-light service to the St. Anthony Hill district of St. Paul, Minn.

Tomas Lowry of Minneapolis is negotiating for the purchase of the car-works property at West Duluth, Minn.

C. D. Smith has completed the survey of the proposed interurban line from Fond du Lac, Wis., to Milwaukee.

The Davenport (Iowa) and Suburban Railway Company has let the contract for the construction of switching tracks and repair shops to the Folk Company of Milwaukee, Wis.

Municipal ownership of the electric-light plant is being vigorously agitated at Boone, Iowa. R.

Michigan.

Detroit, July 30.—The Detroit United Railway Company is building a new depot at Ortonville which will be a very fine structure, containing waiting rooms, office and freight depot.

A new electric railway company has been organized with a capital of $300,000, to be called the Adrian and Ann Arbor Electric Railway Company. The following-named officers have been elected: President, C. R. Miller of Adrian; vice-president, Mark R. Bacon of Wyandotte; treasurer, William Gartner of Detroit; secretary, ex-County Clerk Payne of Detroit.

It is understood that the city of Escanaba is liable to go out of the municipal-lighting business, as the operation of the electric-light plant by the city is not a financial success.

The Detroit, Monroe and Toledo Short Line has apparently been successful in its effort to enter Detroit over an old franchise granted by the village of Woodmere to Irvine, Peppers & McGlaughlin. The board of Woodmere decided to allow the company to use the old franchise, providing the electric line agrees to give a five-cent rate from the River Rouge through Detroit to the end of the line and transfers on the same basis as at present in use on the Fort Street line. The company has been given 30 days to accept the franchise, which becomes operative 90 days after acceptance. It is thought that the terms of the old agreement gives the present company the right to cross the Pere Marquette railroad at grade and an effort will be made to build across the tracks. The railroad keeps an engine stationed at the crossing to prevent any attempt to lay tracks, and some interesting complications are looked for when the street-car company commences the crossing.

In Pontiac the old plan to light streets only on dark nights is to be done away with. A 10-year contract has been awarded to Jules G. Hoffman to light the town at $57.30 per light per year. The Pontiac Standard Lighting Company, which has had the business for 13 years, will take a back seat.

The Detroit Board of Commerce listened to an interesting lecture this week from E. E. Brownell, electrical engineer of Dayton, Ohio, in regard to electrolysis of water pipes. He said there is only one way the evil can be eliminated, and that is by the underground double-trolley system in use in New York, Washington and Cincinnati, but the adoption of this system of negative and positive trolleys connected by the car above would add $10,000 a mile to the cost of the road. He said that in order to justify that the city must be one of at least 300,000 inhabitants, and even then it could not be successfully adopted if the electric-railway company's stock was watered. C. G. W.

Pacific Slope.

San Francisco, July 29.—The Electric Heater Company has been incorporated in San Francisco with a capital stock of $75,000 by A. C. Swalley, J. A. Davis, F. C. Maguire, H. L. Searles and others.

The North Mountain Power Company will proceed at once to string electric wires from Junction City to Eureka, a distance of 20 miles. The John A. Roebling's Sons Company has received the contract for the wire and brackets.

The mining districts of Trinity Center, Carrville and the Coffee Creek district have at last been placed in touch with the rest of the world by a telephone line which has been constructed from Delta, 30 miles distant.

W. M. Spencer and J. A. Stroud of Oakland, Cal., are interested with Fresno capitalists in a proposition to generate power near Tehipite Dome for use in Fresno and vicinity, and have been incorporated under the name of the Tehipite Dome Power Company.

F. P. Hurst of the Molalla Power and Irrigation Ditch Company has taken the right to appropriate water from Molalla River to operate an electric plant to furnish Canby, Hubbard, Woodburn and other valley towns of Oregon with light.

Sealed proposals will be received by the town clerk of Sebastopol, Cal., up to August 26th for a franchise to erect and operate poles and wires for the transmission of electricity for light and power purposes in Sebastopol.

The new city lighting plant at Cedar River is nearing completion and work on the city sub-station at Seattle, Wash., has begun.

The Katella Water Company has about closed a contract with the Edison Electric Company for the construction of an electric pumping plant at Anaheim, Cal. A 40-horsepower motor will be put in.

C. B. Lewis has started a survey of the San Juan road for the extension of the Watsonville Transportation Company's electric road to Hollister, Cal.

The Citizen's Light and Traction Company is contemplating an entirely new lighting system for the fair grounds at Salem, Ore. Nearly all the arc lights will be taken out and the grounds and buildings will be supplied with incandescent lights, which are thought to be more satisfactory.

Victor A. Scheller, Joseph H. Rucker and T. C. Barnett are interested in a project to construct an electric railway on Mount Hamilton, Santa Clara County, Cal. A.

PERSONAL.

Wilbur B. Driver, president of the Driver-Harris Wire Company, has almost entirely recovered from his recent severe illness and expects soon to assume his usual duties as selling representative for his company.

Joseph Francis Muchmore of New York city died on July 23d, after 28 years' service as a receiver for the Brooklyn Heights Railroad Company. The funeral took place July 25th and was largely attended by his former friends and colleagues.

Benjamin F. Peach of Lynn, Mass., at a recent meeting of the stockholders was chosen clerk of the Electric Light and Power Company of Leominster, Mass., to succeed the late Dr. C. A. Wheeler Mr. Peach is also a director of the corporation.

A. T. Holbrook has been appointed district sales manager of the Boston office of the Nernst Lamp Company, located at 501 Atlantic Avenue, and will have supervision of the entire New England territory. Prior to his appointment Mr. Holbrook was connected with the district office at Pittsburg. He is one of the oldest employes of the company, starting in at the commencement of its commercial life.

Benjamin Frank Jacobs, age 71 years, known to thousands of patrons of the Boston Elevated street-railway system as the man who had nine stripes on his coat sleeve, indicating 45 years of continuous service in the company's employ, died of apoplexy on July 29 as the result of over exertion in running to summon hospital aid for a fellow employe who was injured near the south terminal station, where

"Frank" has been stationed as starter for the last five years.

August Belmont of New York, president of the Interborough company, visited Judge A. B. Parker at Esopus one day last week, in company with his brother, Perry Belmont. On the previous day Mr. Belmont's horse, Lord of the Vale, won the Seashore Handicap at Brighton Beach.

Charles Trossen, a young inventor of Chicago, was accidentally killed last week at his home, 241 Webster Avenue, by the explosion of an iron boiler in which he had mixed some chemicals while experimenting for the invention of a powerful electric battery which he had conceived.

Frank Hellen of the Detroit City Gas Company has recently resigned as superintendent of distribution to accept a responsible position in Rochester, N. Y., with the gas, railway and electric-lighting company of that city. On leaving the Detroit company he was presented with a diamond by about 50 of his associates.

F. A. La Roche, president of the F. A. La Roche Company of New York, with four others reached St. Louis last Sunday in an automobile after a continuous run of 1,600 miles without having, it is said, actually stopped the machine. The run was accomplished in 158 hours and 28 minutes. During the trip Mr. La Roche slept less than six hours.

The death is announced of Francis Edward Macmahon of Colchester, England, who is generally credited with being the inventor of the telegraph tape ticker. In addition to the ticker, Mr. Macmahon invented a chainless bicycle and a tap of peculiar construction, and had been experimenting of late to discover a substitute for indiarubber. He was also interested in the development of space telegraphy.

E. K. Adams, a young electrical engineer of New York, died at Watkins, N. Y., July 21st from nephritis when only 30 years of age. Both at Yale and Columbia, where he was a student, he showed marked aptitude for the study of electricity, and became an expert draughtsman and mechanician; he also assisted Dr. Pupin with some of his work while at Columbia. He was an inventor of merit, among his latest devices being a system for station annunciation for electric railways. Mr. Adams was a member of the American Institute of Electrical Engineers and many clubs of art and science. He leaves a widow and a child one year old.

Walter C. McKinlock has been appointed district sales manager of the Philadelphia office of the Nernst Lamp Company, located at 1121 Walnut Street, and will have supervision of this whole territory, consisting of Eastern Pennsylvania, Maryland and the District of Columbia. Previous to his appointment, Mr. McKinlock, for the last two years, was the successful representative of the Western Electric Company, Chicago and New York, for that territory comprising Western Pennsylvania, West Virginia and Maryland, with sales offices in the Empire Building, Pittsburg, Pa. Among central-station managers, superintendents and purchasing agents, Mr. McKinlock is very popular and has many stanch friends who no doubt will be glad to hear of his advancement and aid him materially to a large measure of success in his new position.

J. H. Hallberg of New York city has been retained as consulting engineer for the Atlantic mills in Providence, R. I., where extensive electrical developments are under way. This mill already operates about 1,000 arc lamps, about 1,000 incandescent lamps and several hundred horsepower in direct-current motors, and there has now been erected a new power plant, in which is installed a 600-horsepower Westinghouse steam turbine direct connected to a two-phase 440-volt 60-cycle generator, which will furnish power for a number of motors installed in one of the present mill buildings. Since being in charge of this plant Mr. Hallberg's recommendations and suggestions have been the means of reducing the operating expenses of the present equipment to a considerable extent, and he is now looking into the matter of electric drive for the mill machinery in the plant, which will probably require an ultimate electrical equipment of 4,000 horsepower.

ELECTRIC LIGHTING.

The Morrison (Ill.) Electric Lighting Company has decreased its capital stock from $40,000 to $20,000.

A franchise will be granted on August 9th by the city of Holland, Va., for the construction and operation of an electric-light plant.

The proposed $50,000 electric-light plant for Wilburton, I. T., is to be constructed, the city having awarded the contract to James Dignan.

A bond issue of $45,000 has been voted by the city of Ocala, Fla. A portion of the money will be used in improving the electric-light plant.

The Edinburg (Ill.) Light, Heat and Power Company has been incorporated, with capital of $30,000, by J. R. Harrington, L. E. Swigert and others.

It is stated that between $6,000 and $7,000 a year can be saved to the city of St. Joseph, Mo., in operating expenses of the electric street-lighting plant if the present antiquated machinery is discarded and modern equipment installed in its place. The matter is to be voted on soon.

Through the liberality of friends an electric-light plant from which all the buildings and campus will be illuminated is being installed at Bucknell University.

The Homer (Ill.) electric-light and power plant has changed hands. It has been purchased by W. S. Thomson of Fithian and G. C. Browen for a consideration of $8,000.

The Arlington (Tex.) Light and Power Company has been incorporated, with capital of $10,000, by W. Dugan, W. C. Weeks and others. It will operate electric-light plants.

The lighting contract between Ionia City, Mich., and the Ionia Electric Company expires in October, and bids are being advertised for preparatory to making of a new contract.

Frederick Minshall of Abbeville, S. C., has secured the contract from the city of Batesburg, S. C., for the construction of an electric-light plant and system of waterworks in Batesburg.

The People's Light, Heat and Power Company is being organized at Norfolk, Va., and will apply for a franchise for an electric-light and power plant. The company will have a capital of $100,000.

The City Council of Danville, Ky., has passed an ordinance for the granting of a franchise for an electric-light and power plant. The city will receive bids until August 10th for the construction of the plant.

The Central Power and Manufacturing Company has been incorporated by Charles R. Huntley, William R. Huntley and Daniel T. Nash, all of Buffalo, N. Y. The capital stock is $10,000. The company will generate electricity for light, heat and power for public and private use and will operate in the cities and towns of the counties of Schenectady, Saratoga, Albany and Rensselaer, New York.

Kingston, Ont., has employed John M. Campbell, electrical expert, to oversee changes in the gas and electrical plants. The city will take over the Kingston Light, Heat and Power Company's plants, and they will become municipal utilities. The city has notified manufacturers that flat rates are abolished for the present. New rates will be made later on.

Fifteen hundred new arc lamps will be installed on 30 miles of streets of the Northwest Side, Chicago, when the new electric-lighting station planned by City Electrician Ellicott at Fullerton Avenue and the North Branch of the Chicago River is completed. This will be one of the first results of the bond issue for permanent improvements. The station will cost $100,000, and Mr. Ellicott expects to have it completed by January 1st.

The city of Granite City, Ill., is desirous of having some responsible company locate there for the purpose of putting up and operating a modern electric-light and power plant. A plant would be required capable of furnishing 150 arc lights and 5,000 incandescent lights, also of sufficient capacity to furnish current to the various industries of the city demanding power. Fred A. Eisele of the city light committee states that the town is one of the best in the state, and he considers the opportunity an excellent one for the right persons.

ELECTRIC RAILWAYS.

The Portland Southern Electric Company, with a capital stock of $1,000,000, has just been organized at Salem, Ore., with John A. Albert, a leading Salem banker, as the chief local promoter. The object of the company is to operate an electric road between Salem and Portland.

On August 1st the Lehigh Valley Traction Company increased the rate of fare between Allentown, Pa., and Bethlehem and South Bethlehem from five to 10 cents. The company, after the same date, inaugurated a special car at a five-cent fare between Allentown and Siegfried, and Allentown and Coplay.

The Lehigh Valley Traction Company has been organized under the laws of New Jersey, to construct a trolley line from Morristown to Newark, N. J., and eventually to Easton, Pa., passing through Afton, Hanover, Moorehouse and Livingston. Connections will be made with some of the existing lines, including the tracks of the Public Service Corporation.

Suit was filed in the United States Circuit Court recently by the Fidelity Trust Company of Kansas City against the Kansas City and Olathe Railway Company, the Bracey-Howard Construction Company and the Kansas City and Topeka Railway Company. The petition asks that a receiver be appointed for the Kansas City and Olathe Railway Company and that the mortgages held by the company be foreclosed.

Work on the Fargo street railway has been temporarily stopped for lack of funds. The material is practically all there, but the funds for construction have been delayed. The franchise for Fargo was for 20 years, and that first granted by Moorhead was only for 10 years. A special election was called and the citizens voted for an extension to 20 years, but there has been some delay in the formalities incident to that, and stocks that were to have been sold cannot be disposed of until everything is straightened out.

The new interurban line between Kaukauna and Green Bay, Wis., is fast approaching completion, and the company has set August 24th as the date for a carnival at Green Bay to celebrate the event of opening this important stretch of electric road. The line is an important one for the Fox River valley, as it connects Fond du Lac, Oshkosh, Neenah, Menasha, Appleton, Kaukauna and several other smaller towns.

J. P. Hornaday & Co. of Cincinnati, Ohio, have, as fiscal agents, agreed to underwrite one-half of the securities of the Shreveport and Northeastern railway, extending from Shreveport, La., through Minden, connecting with the Louisiana Northwestern railway and several other railway systems in Western Louisiana. Construction work will proceed as soon as preliminary arrangements are completed. The road will be, as now laid out, 42 miles in length, and will have first-class equipment and terminal facilities at Shreveport. The road traverses a splendid territory, and it is expected to develop a large amount of freight traffic.

It is announced that the right-of-way for the Delaware Suburban Railway Company from Wilmington to Elkton, Md., has been secured and that work will be commenced within two weeks. The line will then be pushed to completion as rapidly as possible. High-potential current will be used, which will be reduced at several stations by rotary transformers into the usual current of 550 volts, which will be used on the line. Special attention will be paid to the roadbed and the equipment of the road. The cars used will be of large size, fitted with cross seats, and similar to those used upon steam railroads and upon western electric roads.

The Danville and Sunbury Electric Railway Company has started the survey for an electric railway between Danville, Pa., and Sunbury. The building of the line from Sunbury will serve as another link to the great trolley system that is rapidly advancing over the entire state. With the building of the line between Berwick and Shickshinny and the Danville and Sunbury road the entire distance between Sunbury and Forest City, by way of Wilkesbarre, Scranton and Carbondale will have been covered, making a total of 104 miles. Lines from Shamokin to Danville and from Shamokin to Sunbury, which will be built in the near future, will connect every town in Central Pennsylvania.

Negotiations have been completed for the merging of the City and Suburban Railway Company and the Portland (Ore.) Railway Company into one concern, with a capitalization equal to the combined capital stock of the two existing companies. The merger will include the transfer of approximately a hundred miles of street railway, and stock valued at about $4,000,000. The combination will form one of the strongest financial organizations in the entire Northwest. Negotiations for the merger of the two companies have been in progress for many weeks. The rivalry between the two companies has resulted in many parallel tracks, operated in the residential districts at a loss.

AUTOMOBILES.

Figures recently compiled by the authorities of Hartford, Conn., which was the first American city to abolish the horse and substitute automobiles for police-department work, indicate that the cost of maintenance for an electric outfit in the department is about 60 per cent. of that when horses were used. The automobile equipment installed three years ago comprises an electric patrol wagon and an electric ambulance, the two doing the work of four horse-drawn vehicles. In his report Cornelius J. Ryan, chief of police, states that the patrol service covers the entire city, which has 90,000 inhabitants, spread over an area of 10 square miles. The report is a strong indorsement for the use of electric vehicles, especially for city use.

POWER TRANSMISSION.

The Niagara, Lockport and Ontario Power Company has voted to mortgage its corporate property for $24,000,000, to secure bonds for the same amount. The company has modified its certificate of incorporation so as to permit the transmission of electric power as far east as Utica, N. Y., and south to the Pennsylvania line.

The Valley Counties Power Company is now engaged in digging the tunnels to carry the water from the reservoir to the power house on Butte Creek near Oroville, Cal. The pipes have been set in cement in the tunnels, it being the calculation that when the pipes are rusted or worn away, that the cement inside of the rock tunnel will form a pipe. Machinery is now being hauled to the power house, and installation will soon commence.

The proposed waterpower electric plant for Nashville, Tenn., is assured by the statement that Meikelham & Dunsmore of New York city and C. H. Ackerman of Binghamton, N. Y., have arranged for the placing of $100,000 of stock and the disposal of $4,000,000 of bonds of the Great Falls Power Com-

pany. This company is promoted by C. H. Fisk of Detroit, Mich.

SOCIETIES AND SCHOOLS.

The Northwestern Electrical Association will hold its St. Louis meeting from September 12th to 16th, the week of the International Electrical Congress. The headquarters of the association will be at the Forest Park University Hotel, a first-class, permanent, fireproof building near the main entrance to the exposition grounds. An $8.50 round-trip rate from Milwaukee and a $6 rate from Chicago have been secured, with special through cars. In order to secure hotel and railroad accommodations those intending going with the party should notify Secretary Thomas R. Mercein at once, address 85 Michigan Street, Milwaukee.

PUBLICATIONS.

The Jeffrey Manufacturing Company of Columbus, Ohio, contains instructions for the care and operation of direct-current electric generators, which will be found of value by dynamo operators. There are also several good diagrams which illustrate the descriptive matter contained in the bulletin.

A copy of the pamphlet issued by the Manufacturers' Advertising Bureau contains a description of the Employes Club of the Weston Electrical Instrument Company of Newark, N. J. The pamphlet was prepared for the Louisiana Purchase Exposition at the request of the Bureau of Statistics of Labor and Industries of the state of New Jersey. There are contained in the reading pages a complete description of the organization and working of the club, together with illustrations showing the interior of the clubrooms, dining hall, baths and numerous other conveniences connected with the club. The management of the club is undertaken by a committee of employes. Part of the pamphlet is also devoted to the manufacturing departments of the Weston company's works, giving a brief description of the equipment and management of the plant.

The Sunbeam Incandescent Lamp Company of Chicago has just issued an attractive new catalogue, descriptive particularly of Sunburst Prismo lamps. This type is designed for use where something between the arc and the ordinary incandescent lamp is required, and the company reports a good demand for these lamps and that they are giving excellent satisfaction. This type of lamp is made either with the Prismo glass reflector or the metal reflector and collar. The former, however, is the favorite. A copy of this catalogue can be procured by writing either direct to the manufacturer or to the Western Electric Company of Chicago, which is sales agent for these lamps and also for the New Baby Bunghole lamp, likewise furnished by the Sunbeam company. The latter are particularly adapted to decorative work and are made in all voltages from 90 to 130 and in two and four-candlepower sizes.

TELEGRAPH.

An important event in Central Persia was the arrival of the telegraph line at Kerman. When complete it will connect direct with India. It is believed that the benefits of the extension of the line will be immense. In the east, brigandage will be reduced by the prompt notice that can be given along the line, while the long-disused caravan routes between Southern Persia and India will again be brought into use. Baluchistan will also be a great gainer by the new state of affairs. The line is expected to be complete by the end of this summer, and the work is regarded as a triumph for the four Englishmen who are in charge of the 200 Persian and Indian workers. The cost of the line works out at about $650 per mile.

It is probable that France will be included in the cable agreement entered into between Holland and Germany some time ago by which cable connection with Cochin China, independent of British cables, is to be obtained. It is provided by the Dutch-German agreement that Holland shall extend her East Indian cable line from Java via Borneo to the north of Celebes and Menado, while the German-Dutch Cable Company, which has been formed by virtue of the agreement, undertakes to continue the extension until it meets the American cable in the Philippines, where the cable will be carried via the Palawan Island to Shanghai, where a German postoffice is situated. Holland and France have now concluded an agreement whereby a French cable from Saigon is to be connected with the Dutch Indian cable between Pontianak, Billiton and Batavia.

SPACE TELEGRAPHY.

Contracts have been closed between the Marconi Wireless Telegraph Company and the Holland-America Steamship Company for the equipment with wireless apparatus of the steamships Rotterdam, Potsdam, Amsterdam, Noordam, Statendam and Ryndam, and a new ship now in the course of construction.

Successful demonstrations are reported from Wilkesbarre, Pa., of the space-telegraph system invented and recently patented by the Rev. Joseph Murgas; and towers are now being erected to enable the method to be tested between Wilkesbarre, Scranton and Philadelphia. Father Murgas discards the Morse dot and dash alphabet, but uses, it is said, musical notes of different pitch. He is hoping to develop enough different notes to supply the alphabet.

MISCELLANEOUS.

The Electric Cotton Mills Company, recently incorporated to erect two large electrically operated cotton mills, at Mabank and Paris, Texas, has organized, with W. I. Young of Greensboro, N. C., president and executive officer; J. E. Sirrine of Greenville, S. C., vice-president, and T. J. Thornhill of Dallas, Texas, secretary-treasurer. The company is also interested in a large cotton factory at Greensboro, N. C. The capital stock of the new company is $1,000,000.

An electrical chronometer, which gives the time of an automobile race to the one-hundredth of a second, has been produced by the Mors Company in Paris. An instrument is placed at the starting point and another at the finish, the two being connected by a charged wire. When the start is made a current is sent through the line, which deflects a needle, making a dot upon a paper on a revolving drum. At the finish another dot is made upon the paper. A scale on the paper shows the exact time.

An organization of Mexican citizens, known as the Mexican Permanent Exposition Company, has been effected in the City of Mexico to install a permanent exhibit of the products of other countries best adapted to Mexican uses. The company is now erecting extensive exposition buildings, which will be ready for occupancy about October 1st. Mr. E. H. Talbot of New York city has been apoointed commissioner for the United States, with power to assign space and arrange details relating to exhibits. Until November 30th he will be located in the Mexican section, Manufactures Building, St. Louis, Mo.

Whalemen of Nantucket are credited with operating an ingenious motor whaleboat which is destined to revolutionize the industry in which they are engaged. The boat has an electric motor driven by accumulators. When the whale is harpooned he dashes off at full speed, drawing the boat after him. The electric current is at once shut off from the accumulators, the pressure of the water on the screw drives the propeller shaft, which is coupled to the motor. The armature of the motor rotates and generates electric energy which charges the accumulators. When these are charged the captain sends an electric current through the wire harpoon rope, and this electrocutes the whale. Three electric whaleboats are said to be in service at the Siasconset station in Nantucket, and three more are to be installed at New Bedford.

TRADE NEWS.

The Holhird-Reynolds Electric Company has been incorporated at Los Angeles, Cal., with a capital of $12,000 by R. L. Reynolds, A. S. Halstead and others.

The customs department of New Zealand has promulgated a decision to the effect that copper wire, stranded, shall be classified as electric appliances, dutiable at 10 per cent. ad valorem.

The Swedish Riksdag has decided that electric dynamos, motors and transformers, or parts thereof, are for the future to be dutiable at the rate of 15 per cent. ad valorem. This decision now awaits the royal sanction before it becomes a law.

The Taylor Signal Company of Buffalo and New York, which is now fitting up electric signals on the Long Island railroad, has amalgamated with the Pneumatic Signal Company of New York, to form the General Railway Signal Company, with a total capital of $5,000,000.

The Southern Electric and Manufacturing Company of Anniston, Ala., has been incorporated with $100,000 capital to manufacture electrical appliances. Frank G. Lake is president; R. W. Munk, vice-president; W. L. Goodhart, secretary and manager, and E. H. Goodhart, treasurer.

The precise object of the Magnetic Power Company, incorporated last week at Albany, N. Y., has not been revealed. Its capital is put at the amount of $10,000, and the directors are J. O. Stevens of Plainfield, N. J., and Albert Graham and A. J. Raymond, both of Brooklyn, N. Y.

The Federal Electric Company announces the removal of its offices and factory to Girard, Pa., where modern facilities and additional shop equipment will enable it to increase its output and increase promptness and efficiency in handling orders. This change took place August 1st and the company cordially invites its friends to inspect the new plant at Girard.

Judge Hoyt H. Wheeler of the Circuit Court of the Southern District of New York has rendered an opinion in the case of the Weston Electrical Instrument Company, complainant, versus the Whitney Electrical Instrument Company, defendant, and a preliminary injunction has been granted. According to Judge Wheeler's opinion, "the defendant's instruments have the permanent magnetic field provided by a magnet and core of different and perhaps better shapes in some respects, but permitting movement of the frame in an arc of a circle to carry a pointer moving over a scale to indicate the measurement of the current. If these changes of forms are even patentable improvements the defendants have taken and used the invention of the patent in making and using those improvements. The difference in the form of the parts carrying the frame on pivots supported by the bridge-pieces is of the same sort. It does not vary the mechanical operation of the parts. These differences do not, any or all of them, amount to doing the same thing in different ways, but leave the operative parts doing the same thing in the same way."

Merle J. Wightman, an electrical engineer and inventor of note residing at West New Brighton, Staten Island, N. Y., and in business at 302 Broadway, New York, has filed a bankruptcy petition in the United States District Court. He schedules his liabilities at $5,146.69. As assets he mentions life-insurance policies for $13,000, 450 shares of stock in the Midland Railroad of unknown value and two patents taken out in 1890, also of unknown value.

The Bureau of Supplies and Accounts of the Navy Department is inviting sealed proposals until August 9th for furnishing the navy yards at New York, Portsmouth, N. H., and Boston, Mass., with a quantity of insulating tape, motor generators, conductor cable, copper wire and electrical supplies, a list of which, together with specifications, can be obtained upon application to the navy pay offices in the cities mentioned or to the bureau at Washington.

Sealed proposals as follows are invited by the Treasury Department, Washington, D. C., to be received at the office of James Knox Taylor, supervising architect, until three p. m. on September 6, 1904, for the construction (including heating apparatus, electric wiring and conduits) of the United States postoffice at Marshalltown, Iowa, in accordance with the drawings and specification, copies of which may be had at the supervising architect's office or at the office of the postmaster at Marshalltown; until three p. m. on September 8, 1904, for the low-pressure steam-heating apparatus complete, in place for the United States postoffice at Norwich, Conn., in accordance with the drawings and specifications, copies of which may be had at the supervising architect's office or at the office of the superintendent at Norwich; until three p. m. on September 1, 1904, for the installation of a conduit and electric-wiring system for the United States postoffice at Norwich, Conn., in accordance with the drawings and specification, copies of which may be obtained at the supervising architect's office or at the office of the superintendent of construction; until three p. m. on September 14, 1904, for the construction (except heating apparatus) of the United States postoffice at Laramie, Wyo., in accordance with drawings and specifications, copies of which may be had at the supervising architect's office or at the office of the postmaster at Laramie; and until three p. m. on September 15, 1904, for the construction (including plumbing, heating apparatus, electric wiring and conduits) of the United States postoffice and custom house at Grand Haven, Mich., in accordance with drawings and specifications, copies of which may be had at the supervising architect's office or at the office of the postmaster at Grand Haven.

BUSINESS.

The Crescent Company of Chicago calls attention to a lamp coloring and frosting which it is now manufacturing. It has just issued a neat bulletin and price-list devoted to this line.

J. F. Blauvelt, agent for the New England Butt Company of Providence, R. I., manufacturer of machinery for insulating electric wires, was in Chicago last week looking after the interests of his company.

The R. Gay Chemical Company of La Crosse, Wis., asserts it has a new formula for making a lamp frosting which is inexpensive to manufacture and will save money to lamp users. Further information will be sent on request.

The Holtzer-Cabot Electric Company of Brookline, Mass., is distributing among its friends a neat little leather matchsafe with scratcher attached. It is of convenient size for the vest pocket and opens by a slight pressure on the edges.

The Crocker-Wheeler Company received the following interesting letter from a Japanese engineer: "I beg you please to send me a copy of your precious catalogue, which I have a great interest, as I shall commence some trifling business for the electrical engineering in after a few months. If you favor it for me I should be in great thankfulness."

The Electric Appliance Company of Chicago reports that an unusually large number of central stations as well as isolated plants, are waking up to the advantage of buying lamps on contract. The company says it has already "got busy" entering these contracts and making preparations to handle the fall demand for Packard lamps.

"Two Sides of a Story" is an interesting folder from H. W. Johns-Manville Company of New York city, regarding Mobilene, a sheet packing for gas and gasoline engines for stationary, marine or motor-vehicle service. Mobilene is furnished in sheets 40 inches square or in rolls of the same width. It is one thirty-second inch thick and weighs four pounds per square yard.

ILLUSTRATED ELECTRICAL PATENT RECORD.

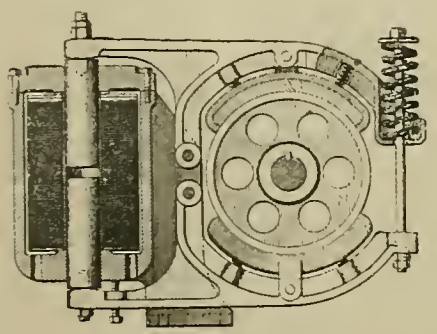
Issued (United States Patent Office) July 26, 1904.

765,657. Alarm for Pneumatic Feeders. Thomas J. Arnault, Everett, Wash. Application filed October 22, 1903.

An electric alarm is actuated by the swinging of the valve which controls the flow of the material in the tube.

765,686. Electrically Controlled Damper for Heaters. Frank J. Sprague, Oswego, N. Y. Application filed September 4, 1903.

In an automatic damper or valve-operating mechanism are a spring-actuated motor, an electromagnet, a pivotally mounted armature having a weighted end, the end being provided with a stop adapted to engage a notched rotatable member of the spring-actuated motor, and a brake device, so arranged that when the stop of the armature enters a notch of the rotatable member the brake will be brought into action to stop the motor.



NO. 766,117.—ELECTRIC BRAKE.

765,690. Apparatus for Producing Gyratory Magnetic Lines of Force for Therapeutic Purposes. Reinhold Trüb, Hombrechtikon, near Zurich, Switzerland. Application filed September 12, 1902.

An apparatus for producing gyratory magnetic lines of force for therapeutic purposes and the like, comprises a rotary shaft mounted in a bearing at each end, one or more electromagnets fixed to the shaft and rotating around its axis, and a block of soft iron separated from and opposite the poles of the electromagnets. Insulated electric conducting collars fixed to the rotating shaft, electric connections with the collars and coils of the electromagnets and means for rotating the shaft and electromagnets are other essential parts.

765,765. Automatic Fire Extinguisher. Joseph Butcher, New York, N. Y. Application filed November 15, 1901.

Combined with a water-service pipe having an outlet for the discharge of water for extinguishing fires is a two-way cut-off cock in the service pipe and a valve closing the discharge outlet. An electric motor operates the two-way cock and a locking device holds the valve at the discharge outlet normally closed.

765,768. Auxiliary Apparatus for Telephone Systems. William W. Dean, Chicago, Ill., assignor to Walter S. McFarlan, Washington, D. C. Application filed October 17, 1903.

A distributing frame at the central office permits the external and switchboard sections of the lines to be variously connected together. Auxiliary apparatus at the central office is designed to be used in connection with the telephone lines, and means for inserting apparatus in the lines at the distributing frame are provided.

765,773. Electric Printing Machine. George S. Gallagher, New York, N. Y., assignor to himself, Rupert L. Joseph and Frank E. Burrows, New York, N. Y. Application filed September 18, 1903.

An electromagnet automatically controls the movement of the type belt.

765,791. Elevator. Joseph Rice, Chicago, Ill. Application filed December 6, 1902.

A safety device for retarding the movement of the car is controlled by an electrically actuated catch for holding the retarding means inactive and means for energizing and actuating the catch by the movement of the car are supplied.

765,799. Typewriter-actuating Mechanism. William G. Spiegel, New York, N. Y., assignor of two-thirds to Sydney H. Carney, New York, N. Y., and William Watt, Elizabeth, N. J. Application filed October 27, 1903.

An electromagnet operates each of the printing members of the typewriter, the electromagnets being in turn energized by circuits opened and closed by the keys. (See cut.)

765,822. Telephone Exchange System. John P. Downs, Cleveland, Ohio, assignor to John F. McDonnell, Cleveland, Ohio. Application filed October 23, 1902.

The exchange apparatus comprises a multiple switchboard, multiple jack, plugs having testing tips and sleeves co-operating with the jacks, a test battery and an operator's telephone, a connection from the test battery to the ring of each plug, a variable-resistance device included in the connection controlled by the subscriber, and means to compensate for the variations in resistance to regulate the potential on the plug ring.

765,850. Trolley. Walter O. Miller, Louisville, Ky. Application filed February 10, 1903.

A spring controls the movement of the trolley support and a box contains the spring and allows a bodily movement of it without resistance preliminary to putting the spring under tension.

765,852. Trolley. Jacob M. Olinger, Vienna Cross-roads, Ohio. Application filed May 12, 1904.

The trolley harp is provided with arms. A journal pin is mounted in the arms and a trolley wheel is mounted on the journal pin.

765,889. Shunt. Jesse Harris, Rensselaer, N. Y. Application filed January 25, 1904.

Contacts are arranged for connecting metallic terminal blocks in an electric circuit. Shunt wires are connected to the blocks. A conducting plate of thin metal is bent to form two or more partially slightly separated surfaces, the plate being secured to and between the terminals.

765,904. System of House Wiring. Joseph W. A. Richardson, New Orleans, La. Application filed March 14, 1904.

Main-wire conduit strips contain separated passages for positive and negative wires, means for covering the passages, distributing boxes connected to the inner sides of the strips, outlet holes formed in the strips and connecting with the boxes, branch or feed-wire conduits communicating with the boxes and means for connecting the ends of the conduits with the boxes.

765,917. Hanger for Overhead Conductors. Sidney H. Cochran and Austin E. Anderson, Lynchburg, Va., assignors of one-third to Richard D. Apperson, Lynchburg, Va. Application filed March 24, 1904.

In a trolley-wire hanger are combined a cap and a post depending therefrom, the post having a transverse slot. An ear and cylindrical extension integral with the ear and provided with a transverse slot adapted to register with the slot on the post form a means whereby the parts are locked together by means of a suitable key passing through the slots. A locking member co-operates with the ear to hold a wire. (See cut.)

765,922. Electric Signal System. Joseph H. Harrell, Charlotte, N. C. Application filed September 30, 1903.

In a railway-signal system there are combined with the tracks and a switch a signal circuit, including suitable wiring extending along the road, a circuit-closing device operated by the switch and contact devices located at intervals along the road. The cars are equipped with signal apparatus, batteries and contact shoes, the latter being arranged to contact with the contact devices to close the signal circuit through a battery and signal apparatus when a car approaches the open switch from either direction.

765,926. Electrical Toy. John Kelly, Paterson, N. J. Application filed May 4, 1904.

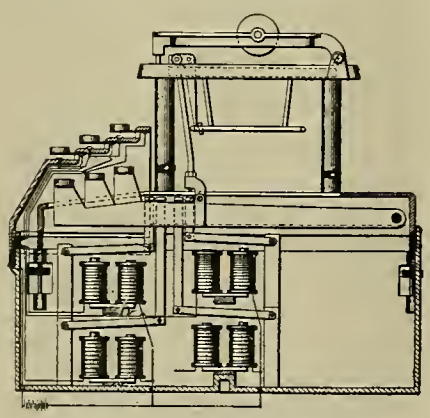
An electric toy comprises a portable induction coil and battery, two conductors from the coil and means for connecting the coil with two contact points mounted on one or two insulating finger rings.

765,948. Current Regulator. James J. Wood, Fort Wayne, Ind. Application filed August 17, 1903.

A coil and a core, one movable relatively to the other, and a differential compensating lever adapted in operation to vary the tendency of the movable member to separate from its complementary member, are the prominent features.

765,960. Electromagnetic Typewriting Machine-actuating Mechanism. Edward K. Curtis, New York, N. Y., assignor of two-thirds to Sydney H. Carney, New York, N. Y., and William Watt, Elizabeth, N. J. Application filed December 15, 1903.

Electromagnets thrown into circuit by the keys operate the levers.



NO. 765,799.—ELECTRIC TYPEWRITER.

765,974. Trolley-wire Clip. Albert E. Holaday, New Haven, Conn. Application filed December 30, 1903.

In a compression trolley clip the separate halves of the clip are each provided with a trolley-wire gripping flange and a hanger-bolt socket.

765,996. Manufacture of Brominated Indigo. Albrecht Schmidt and Rudolf Müller, Höchst-on-the-Main, Germany, assignors to Farbwerke, vorm, Meister, Lucius & Brüning, Höchst-on-the-Main, Germany. Application filed October 17, 1902.

A process for the manufacture of brominated indigo consists in electrolyzing indigo by means of a diaphragm in an aqueous suspension treated with hydrobromic acid.

766,004. Automatic Weighing Machine. Edward G. Thomas, Boston, Mass., assignor to the Automatic Weighing Machine Company, New York, N. Y. Application filed December 17, 1896.

An electromagnet automatically closes the valve admitting the substance to be weighed to the weighing apparatus.

766,005. Igniting Device for Incandescent Mantle Burners. Henry C. Thomson, Boston, Mass., assignor to the Electric Gas Lighting Company, Boston, Mass. Application filed November 6, 1902. Renewed January 26, 1904.

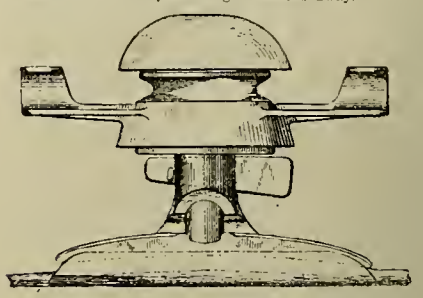
An electric spark at an electrode ignites the gas.

766,071. Electrical Quick-return System. Richard H. Stevens and Samuel S. Wales, Munhall, Pa. Application filed January 2, 1903.

An electrical quick-return device comprises adjusting mechanism, electric motors and means for shifting the electrical connections of the motors from series to parallel, and vice versa, whenever their direction of rotation is reversed.

766,078. Secondary Battery. Otto F. C. Walter, Berlin, Germany. Application filed December 1, 1903.

In plates of active mass for secondary batteries are arranged a system of interior channels and cavities, the walls of which consist of thin porous metallic films in intimate contact with the active mass, the films being the residues of a metal plate or grid melted away.



NO. 765,917.—OVERHEAD HANGER.

766,104. System of Motor Control. Arthur C. Eastwood, Cleveland, Ohio. Application filed April 19, 1904.

Combined with a motor is a switch for reversing the direction of current flow through one of the members of the motor. Another switch closes the circuit of the motor independently of the supply mains and a controller having fingers and two series of contacts, with connections between the switches and the controller, is so arranged that the contacts in either series first engaged by the fingers will cause operation of the switches for short-circuiting the motor.

766,117. Brake. Fred A. Rundle, Harvey, Ill. Application filed March 3, 1904.

Electromagnets on each end of the brake-beams pull upon the latter in such a manner as to draw the brake-shoes on to the wheels. (See cut.)

766,146. Method of Purifying Water. William M. Jewell, Winnetka, and Willford J. McGee, Oak Park, Ill., assignors to themselves and Omar H. Jewell, Chicago, Ill. Application filed January 26, 1903.

The method of purifying water consists in introducing an insoluble salt of barium and a soluble reagent adapted to unite with the product of reaction between the barium salt and the impurity to be affected, and electrolyzing the mixture.

766,155. Telephone Repeater. David H. Wilson, Chicago, Ill., assignor to George W. Kretzinger, Chicago, Ill. Application filed August 13, 1903.

A telephone repeater comprises a core having a coil thereon, adapted to be connected with the instruments at each end of the line, a receiver associated with the core, a transmitter associated with the receiver, a coil on the core in circuit with the transmitter and a source of electric supply in the transmitter circuit.

EXPIRING PATENTS.

Following is a list of electrical patents (issued by the United States Patent Office) that expired on August 2, 1904:

367,359. Galvanic Battery. Horatio J. Brewer, New York, N. Y.

367,422. Electric Ore Detector. Lemuel Mellett, Milford, Conn.

367,451. Galvanic Battery. James Serson, Boston, Mass.

367,469. System of Electric Distribution. Elihu Thomson, Lynn, Mass.

367,470. Regulator for Dynamo-electric Machines and Motors. Elihu Thomson, Lynn, Mass.

367,471. Coupling Compound Dynamo-electric Machines. Elihu Thomson, Lynn, Mass.

367,475. Roof for Suspended Electric Conductors. Charles J. Vandepoele, Chicago, Ill.

367,568. Electric Arc Lamp. Merle J. Wightman and Hermann Lemp, Hartford, Conn.

367,598. Electric Railway Signal. Edward M. Chase, Boston, Mass.

367,627. Electromagnetic Car Brake. Jacob Herrington, Sharon, Pa.

367,630. Electric Distribution by Secondary Batteries. William Hockhausen, New York, N. Y.

367,650. Electric Typewriter. James F. McLaughlin, Philadelphia, Pa.

367,651. Electric Motor. Alexander W. Meston, St. Louis, Mo.

367,663. Electric Programme Clock. Andrew J. Reams, Augusta, Kan.

367,670. Electric-light Switchboard. Charles E. Scribner, Chicago, Ill.

367,685. Electric Magnetic Railway Brake. Charles J. Vandepoele, Chicago, Ill.

367,705. Galvanic Battery. Paul Raoul de Faucheux d'Humy, London, Eng.

367,541. Electric Ore Indicator. Lemuel Mellett and Jerome Prince, Milford, Conn.

367,548. Electric Conductor. Thomas S. Reed, Bridgeport, Conn.

367,730. Cable Rack for Switchboards. John A. Seely, New York, N. Y.

367,731. Deposition of Platinum by Electricity. William A. Thoms, London, County of Middlesex, Eng.

367,734. Terminal for Electric Cables. Robert H. Widdicombe, Chicago, Ill.

367,754. Telephone Exchange Apparatus. William M. Goodridge, Highland Park, Chicago, Ill.

WESTERN ELECTRICIAN

EVERY SATURDAY

Vol. XXXV. CHICAGO, AUGUST 13, 1904 No. 7

Chicago's Automatic Telephone Exchange.

Not only telephone people but electrical men generally and a large portion of the public at large are interested in the large automatic telephone exchange of the Illinois Tunnel Company, which is now in operation in Chicago, the largest of its kind in existence. This exchange, as it was first installed, was described in the Western Electrician of March 28, 1903. At that time the exchange was not in commercial operation, no connections having been made or the distributing system placed in the elaborate network of tunnels owned by the company named. Since that time, however, things have changed greatly, and the exchange is now in running order with over 8,000 of its present capacity of 10,000 lines taken up, and most of the office and other buildings in the downtown district of the city either connected or wired ready for connection.

FIG. 1. CHICAGO'S AUTOMATIC TELEPHONE EXCHANGE.—GENERAL VIEW OF AUTOMATIC SWITCHES ON THIRD FLOOR.

While the apparatus and the method of operation were described in the previous article, a brief description at the present time will be of interest, no doubt, to many. But in this article attention will also be given to the methods of operation of the system as a whole, in order to place before the readers of the Western Electrician the place the automatic telephone now fills in the business activity of the city.

It should be understood at the beginning that as yet the automatic system is confined to the downtown business center of the city, an area of something less than two square miles; in other words, to the district which is underlaid by the system of the Illinois Tunnel Company. In this district are the government and municipal departments, the great wholesale and retail stores, the large railroad stations, the principal office buildings and the leading hotels of Chicago. Just what the future scope of the automatic system will be cannot at present be foretold. However, the indications are that before long it will outgrow this central territory and extend over the outlying districts of the city.

The telephone exchange is located at 177 to 181 Fifth Avenue in a four-story brick building with a basement. This building contains the telephone-exchange apparatus, which was built by the Automatic Electric Company of Chicago, and the offices of the telephone department of the Illinois Tunnel Company. From the exchange the telephone lines radiate in all directions through the tunnels of the Illinois Tunnel Company and at the proper places are tapped from the cables and led up into their respective buildings, as will be described.

Considering first the operation of the exchange apparatus, it is to be understood that 60 200-pair lead-covered cables enter the exchange from the tunnels and are led directly up to the second floor to the rear of the distributing frame, where they are pocketed with eight-branch divisions, which are fanned out on the terminal blocks shown on the rear of the distributing frame in Fig. 7. Fig. 6 is a view of the front of the distributing frame. This frame is in no way dissimilar to the ordinary distributing frame in the manually operated exchange. The clips on the front are connected on one side to the circuits leading to the switch banks and on the other to fireproof jumper wires leading through the frame to the terminals at the back which connect them to the outgoing cables. The ordinary carbon-mica lightning arrester is used and is inserted between the clips on the front of the frame. A 25-ohm heat coil is placed in each side of the line.

From the distributing frame the circuits are led to the selector switches. These switches are, of course, the primary feature in the automatic system. They are divided up into groups of 1,000 lines each. On the second floor is the "0" to "1" group or board; on the fourth floor the "2" to "5" groups, and on the third floor the "6" to "9" groups. A good general view of the third floor, showing the racks of automatic switches, is given in Fig. 1, and it indicates the general arrangement of the groups of selector switches. Fig. 4 is a view of one of the groups of switches by itself.

The operation of the switches, while seemingly a puzzling process, is comparatively simple when sifted down to the few principles upon which it is based.

To begin with the telephone, the instrument used in the Chicago automatic system contains the regular local talking circuit and the so-called calling device. This calling device consists of a dial on the front of the instrument, with 10 finger holes numbered from 1 to 0. The dial is fastened on the same shaft with a wheel with 11 teeth. Ten of these teeth are adapted to ground one line and the eleventh tooth is arranged to ground the other line. Rotating the dial from point five means grounding of the one line five times and of the other line once. When the receiver is replaced on the hook both lines are grounded simultaneously. Suppose subscriber No. 2222 wishes to call 5679. He puts his finger into the finger hole No. 5, rotates the dial, pulls his finger out and the dial rotates back. The same is repeated consecutively with Nos. 6, 7 and 9. Then the subscriber presses the ringer button.

The mechanism by which the call is made into the exchange is called a "switch." It is a machine about 13½ inches high, four inches wide and five inches deep. It is necessary to use what are called first selectors, second selectors and connectors. The mechanical make-up of these three different types is almost identical. The most important movable part is the shaft, which is a one-eighteth-inch steel rod, moving in bearings in front of the rack or frame. This shaft (see Fig. 5) carries in its middle a piece milled so that the upper half of this piece shows 10 circular teeth and the lower part shows 10 vertical teeth. On the lower end of the shaft three so-called wipers are attached. The wiring is shown in Fig. 3. Attention is called to the extension of

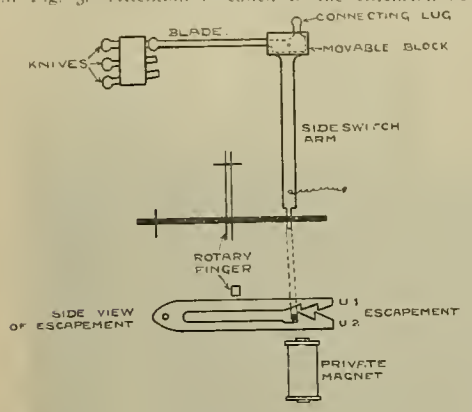


FIG. 2. SIDE-SWITCH IN CHICAGO'S AUTOMATIC TELEPHONE EXCHANGE.

the rotary armature, which may be called the rotary finger.

Another important movable part in every switch is the so-called side-switch. This is a combination of four switches adapted to be thrown into three different positions. (See Fig. 2.) The side-switch arm ends in a peculiarly shaped piece, the so-called escapement. When the private magnet is energized and again de-energized the side-switch arm slips under the outer tooth (U 1) of Fig. 2. In Fig. 5 the rotary finger is also shown. As soon as the rotary armature makes a motion the rotary finger oscillates the escapement and the side-switch is thrown from one position to another one by the motion of the rotary armature.

When the switch is in its normal position the side-switch is in the position (A), Fig. 3. This connects the line relays (V R) and (R R) through 500-ohm coils to the 50-volt battery. Grounding the vertical line means energizing the vertical magnet; grounding the rotary line means the closing of a local circuit for the private magnet (P M). When both relays—the vertical and the line relays—are pulling up simultaneously the release circuit is closed. The object of the impulse through the private magnet (P M) is the switching of the side-switch from the first position to the second position, as shown in Fig. 2. As soon as the side-switch is in the second position the interrupter circuit is closed for the rotary magnet (Fig. 3). As long as the side-switch is in the second position the shaft is rotated.

The subscriber pulls No. 5, that is, the first step to call 5679. He will ground the vertical line (see Fig. 3) five times. The vertical magnet will respond five times and lift the shaft five notches. The following rotary impulse throws the side-switch from the first position to the second position. The switch starts to rotate. The rotary finger of the rotary armature oscillates the escapement, and when the rotary armature is in full stroke the escapement is moved and the side-switch thrown from the second to the third position. Pulling No. 5 moves the switch up five notches and rotates it one notch around.

The connector has one more relay, the so-called ringer relay. Every switch can be lifted 10 notches and can be rotated 10 notches. By this are obtained 100 positions per wiper, or 300 contacts arranged in cylindrical sections, called banks, the contact pointing toward the inside of the cylinder.

Rotating the dial from point "five" will lift the selector to engage the first contacts of the fifth row to which a second selector is attached. This second selector is located in the "5000" group. Pulling now "six" will lift the second selector into the "six" row and automatically rotate the wipers to the first contact to the "six" row. To these contacts a connector is attached, which is located in the "600" group of the "5000" group. Pulling now "seven" will lift the connector to the "seven" row and switch the side-switch from the first to the second position. On account of the wiring in the connector (see Fig. 3), the connector will not rotate automatically. Pulling now "nine" will rotate the connector nine steps and throw the side-switch of the connector from the second position into the third position. Now the subscriber pushes the ringer button; that means the energizing of the ringer relay, which throws the ringing current on the called line. The called line is attached to the bank contact of the connector.

Every subscriber is connected by two lines to a first selector. The banks of 75 first selectors are

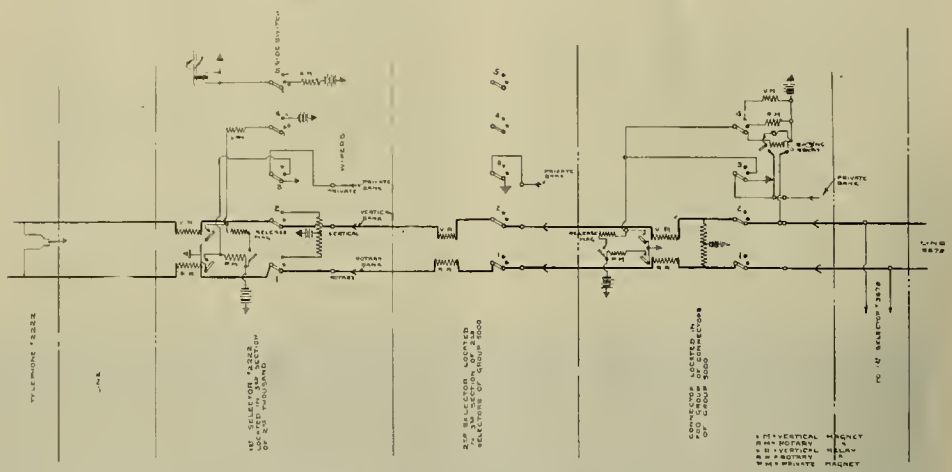
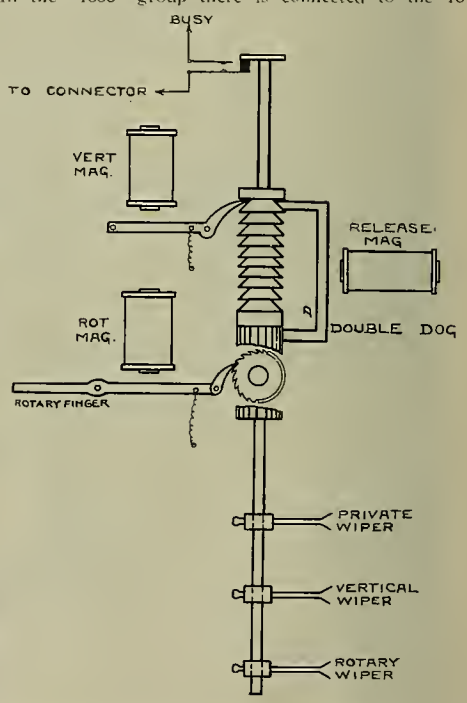


FIG. 3. CHICAGO'S AUTOMATIC TELEPHONE EXCHANGE.—DIAGRAM OF CONNECTIONS IN A TYPICAL CONVERSATION.

wired together, that is, the contacts of some or all of the 75 banks are connected together. In the group "2000" there will be 13 sections of 75 subscribers and one section of 25. The same arrangement is made in all the other thousand groups. The first setcion of the "1000" group is connected by a 300-wire cable to the first section of the "3000" groups, etc. Then section two of the "1000" group is connected with section two of the "2,000" group, etc. In the "1000" group there is connected to the 10



Energizing Vertical Magnet Means Lifting of Shaft.
Energizing Rotary Magnet Means Rotating of Shaft.
Energizing Release Magnet Means Pulling Back Double Dog and Restoring Shaft to Normal Position.

FIG. 5. CHICAGO'S AUTOMATIC TELEPHONE EXCHANGE.—SHAFT MECHANISM OF SWITCH.

FIG 4. A GROUP OF SWITCHES IN CHICAGO'S AUTOMATIC TELEPHONE EXCHANGE.

rotary, 10 private multiple lines, 10 pairs of wires, and these wires end at 10 second selectors. This is repeated 14 times. In the "2000" group the 10 multiples of the second row are again connected to 10 pairs, which end in the second selectors placed in the group "2000." This again is repeated over the 14 groups, and so on. This gives 14 groups of 10 second selectors in each thousand. Now the banks of the second selectors are again connected together inside of the "1000" group and the 10 multiples of the first row are attached to 10 pairs of wires, and these wires end at 10 connectors. Suppose one is considering the "3000" group and the 14 groups of second selectors in this "3000" group. All the banks of this second selector are multipled together, and from the first row of this 10 pairs are multipled together to 10 connectors, and from the second row 10 other pairs are multipled together to 10 other connectors. To the first group corresponding to the first row the lines of the subscribers with the numbers 3100-3199 are attached. To the second group

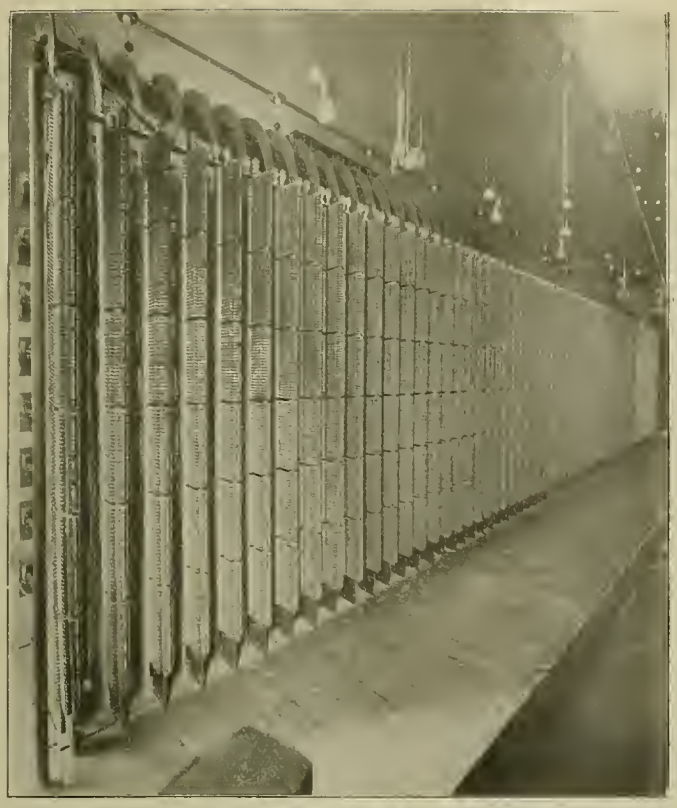


Fig. 6. Front of Distributing Frame.

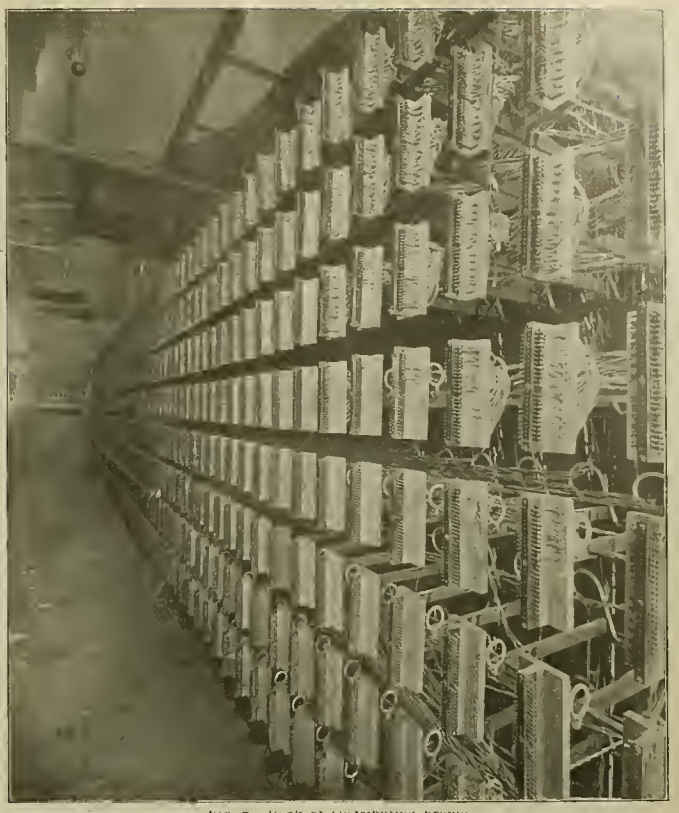


Fig. 7. Back of Distributing Frame.

CHICAGO'S AUTOMATIC TELEPHONE EXCHANGE.

of conductors the lines of the subscribers numbering 3200-3299 are attached, etc.

When a connector "stands" on a line the private bank contact is grounded over the private wiper (Fig. 3). Another connector trying to engage this same contact will be released. The private magnet is energized by the last rotary impulse and throws ground on the release magnet. The ground comes from the private bank.

The power plant is all in duplicate. There are two motor-generators for charging the batteries, which are shown, together with the power board, in Fig. 8, and are located on the fourth floor. The motor-generators were built by the Sprague Electric Company of New York and are of 2.8-kilowatt capacity each and deliver 37.5 amperes at 75 volts on the generator side. Beyond the motor-generators in the picture are the interrupter, "howler" and busy-signal machines, and beyond them again the ringers. This apparatus is similar to that used for the same purpose in the manual exchange and needs no detailed description. The batteries are located in the basement. There are two of 26 cells of 300-ampere-hour capacity.

Having described the exchange equipment, attention may now be directed to the distribution. At the start it may be said that this is entirely underground which makes line trouble a very small item in the expense of maintenance. Sixty 200-pair cables, as mentioned before, leave the exchange. These are led down into the tunnels and branch out to the various buildings to be served.

Here, just a word may be said concerning the tunnels. These are owned and operated by the Illinois Tunnel Company and will be used for transporting freight beneath the surface by means of electric cars. They are about 40 feet below the surface of the streets and, with the exception of a few lengths of trunk tunnels, are six feet wide by 7½ feet high, horseshoe-shaped. At present there are about 22 miles of these tunnels, and they underlie all the downtown streets. Fig. 9 is a view in one of the tunnels and shows the method of hanging the cables from the roof.

As originally planned, the distributing boxes for each building to be served telephonically were to be placed in a recess in the side of the tunnel, the wires from there leading up into the building. But this plan was found unsatisfactory when the tunnels came to be used for other purposes. A few of the boxes were, however, installed in this way. But the plan now followed is to drive a four-inch iron pipe from the basement wall of the building down through the side of the tunnel and seal up neatly around the end of the pipe. The cable is then run up through the pipe into the basement of the building, and the distributing box is located there.

In the terminal boxes are terminal strips of 200 pairs, if the building be a large one. These strips are four in number and are lettered from left to right, A, B, C and D. The incoming cables are connected to the B and D strips and the house cables to the A and C strips, where it is a four-strip box. Where the distribution is to be 25 pairs to the floor, for instance, as is the case of one large office building, where there are 16 stories served, each cable is divided up into two 100-pair cables. The first 100 go up four floors, dropping off 25 pairs at each floor, and the second hundred proceeds from there on till all are gone. The second cable of 200 pairs is then split up and serves the top of the building. Small terminal boxes are placed on each floor and the clips correspond to the clips in the basement box. If one building does not use all of one cable, only that amount needed is tapped off, the remainder being carried on to some other point.

A very accurate system is maintained by the company in regard to the distribution of the lines and very little is left to the lineman. When a certain telephone is to be installed the lineman is told the building, floor, room, it is to be put in, with the pair of wires to use, and he goes there and finds his terminals awaiting him, thanks to the very carefully prepared maps and charts which enable his superintendent to give him this information.

In the superintendent's office there is, for every cable leaving the exchange, a map of the city showing the building or buildings which it serves. Besides this map, there are charts for each building similar to the one shown in Fig. 10. The chart in this case represents the circuits in multiple with cable No. 33 which are connected to incoming strip B of the terminal board. Incoming strip B, as seen, serves the upper floors of the building. The first column at the left indicates the exchange pair number. To the right of this is seen a column indicating the pair numbers for both A and B strips which go to the bottom of the column. Next are indicated the jumpers from strip A to strip B, showing the strip, pair and floor to which the circuit is carried by the jumpers from A to B. Next is shown the outgoing strip A, and under it the floor, pair and room; then, by following on to the right, is found the telephone number. The spaces under each heading that are left blank are filled in with pencil, and these markings can be erased and others inserted in their place as the telephones in the building are removed or changed, so as to make any change in the jumpers from one strip to another in the terminal board.

Thus every telephone connected to the entire system is under the immediate observation of the superintendent, it may be said, and that official can at once trace any circuit from the exchange to the subscriber's set, and so give directions intelligently for all installations or for following up trouble.

Reverting to the exchange, some interest will attach to the methods of locating trouble. In case of a cross on a line, the trouble is immediately noticed by the shaft of the selector switch not raising. The release magnet moves up and down, but makes a different sound from the ordinary click, which is at once noticed by one in constant attendance on the

FIG. 8. POWER BOARD AND APPARATUS IN CHICAGO'S AUTOMATIC TELEPHONE EXCHANGE.

FIG. 9. CABLES IN TUNNEL LEADING TO CHICAGO'S AUTOMATIC TELEPHONE EXCHANGE.

apparatus. Upon noting that the shaft does not rise, but that the magnet armature is actuated, it is known at once that that particular line is crossed.

For indicating a ground on a line a thermostat arrangement is used. When a ground comes on, a small asbestos-covered tube is heated so as to expand sufficiently to release a spring which flies down and makes the circuit of a signal bell and a

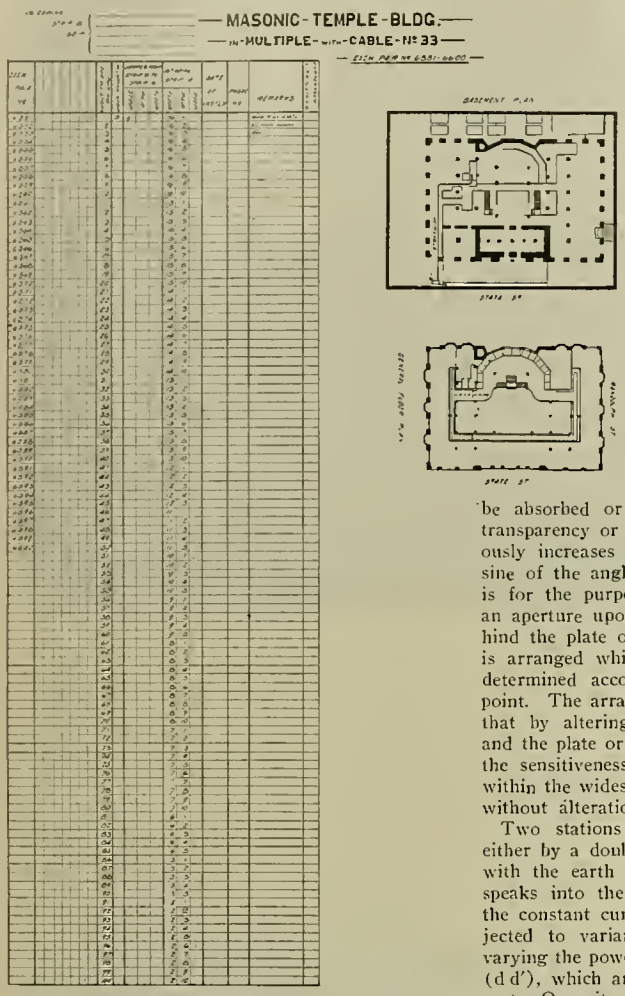


FIG. 10. CHICAGO'S AUTOMATIC TELEPHONE EXCHANGE.—CHART OF DISTRIBUTION FOR OFFICE BUILDING.

signal lamp located on the particular shelf of the section where the grounded line terminates.

A short-circuit on a line will show on the second-selector switches in a similar manner to a crossed line in the first-selector switches; i. e., by the shaft not raising.

In the operation and maintenance of this exchange there is required one man for every 2,000 lnies. At present there are 8,287 lines connected. The switch and instrument troubles, taking the average, are reported as 26 cases a day. The exchange is visited by people coming from all parts of the world.

Many Alleged Electrical Fires Not Electrical.

The quarterly fire report of the electrical bureau of the National Board of Fire Underwriters, just issued, again proves that many fires attributed to electrical origin are, on careful inspection, found to be, in many cases, due to other causes. Reports of 145 actual electrical fires, aggregating a loss of $172,000, were received during the quarter ended with June.

Reports were received of 107 fires, losses aggregating $13,611,900, supposed to have been due to electricity, but they are not included in the report, as the causes could not be definitely proved as electrical, principally because the fires destroyed the conclusive evidences of their origins. One of these fires occasioned a loss reported about $12,000,000.

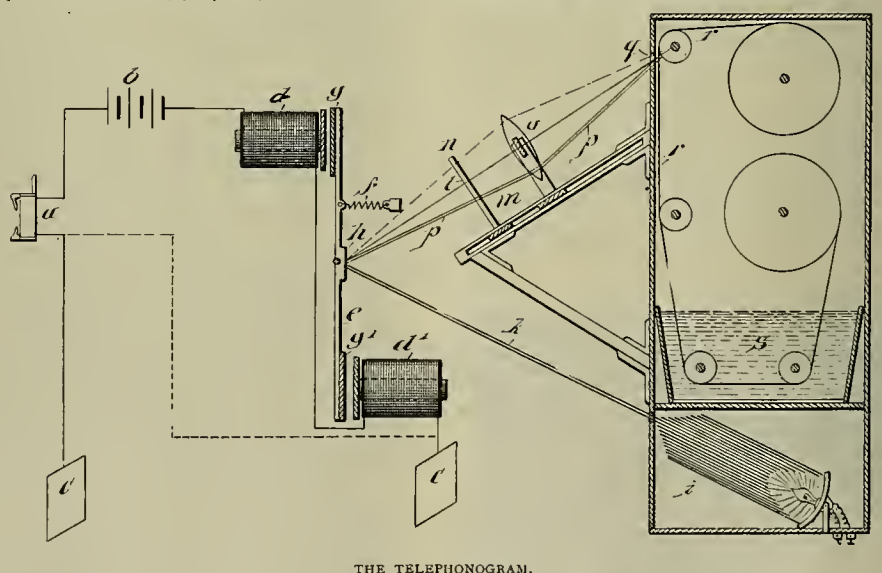
Thirty-nine fires, losses aggregating $250,407, reported as due to electricity, have upon further and more reliable investigation, been found to have been due to other causes. Of these a $40,000 loss is attributed to a log from a fireplace, a $5,000 loss was caused by hot ashes; a $7,000 loss was caused by matches; a $5,000 loss was of incendiary origin. Other fires attributed to electricity were found to have been caused by a gasoline stove, a swinging gas jet, grease, a defective flue, a gas stove, etc.

The Telephonogram.

Under the title of "Telephonogram Apparatus" Christian Hülsmeyer of Düsseldorf, Germany, has patented in the United States the device shown diagrammatically in the accompanying drawing. The invention relates to apparatus for the conversion of variations in the intensity of electric current into variations in the intensity of light.

In the devices hitherto known for the conversion of variations of current intensity into variations in light intensity there have been used, according to the present inventor, either polarized, dispersion or throttle devices. These, however, fulfill the requirements made of them only imperfectly, because with them not the quality but the quantity of the bundle of rays is controlled according to the variations of the current. For a perfect action of such devices it seems necessary that the control should proceed in direct or inverse proportion to the current variations, which in the device forming the present invention is attained by causing the bundle of rays falling upon a mirror which oscillates in accordance with the current variations of the electromagnets to be absorbed or transmitted by a fixed plate, the transparency or power absorption of which continuously increases or diminishes corresponding to the sine of the angle of incidence. If the arrangement is for the purpose of throwing such rays through an aperture upon a sensitive plate or film, then behind the plate or film a system of prisms or lenses is arranged which concentrates the bundle of rays determined according to its quality upon a given point. The arrangement is preferably so constructed that by altering the distance between the mirror and the plate or prism system and the light aperture the sensitiveness of the apparatus may be adjusted within the widest limits according to the requirement without alteration of the mechanical parts.

Two stations are connected with one another either by a double-wire connection or a single wire, with the earth as return connection. If the caller speaks into the telephone or microtelephone (a), the constant current of the line battery (b) is subjected to variations of intensity, which result in varying the power of attraction of the electromagnets (d d'), which are inserted in series in the line current. Opposite the electromagnets (d d') is placed an equal-armed lever (e), which, controlled by the



THE TELEPHONOGRAM.

spring (f), can oscillate easily to and fro. At both ends this lever carries two soft-iron plates (g g') and on its axis of revolution a little mirror (h). The entire apparatus of the receiving station is placed in a dark chamber. Out of a light chamber (i) there is projected through a slit a bundle of rays (k) upon the mirror (h), which rays are reflected out again at the same angle. The reflected ray (p) then penetrates a plate (l), the transparency of which constantly decreases from (m) to (n), and this in such a manner that the same is equal to unity at (m) and is equal to zero at (n). By means of a cylinder lens (o) the bundle of rays is constantly refracted toward a line (q). At the point (q) there is caused to pass uniformly a sensitive strip (r) by means of a clockwork or an electric motor, which band is then drawn through the fixing bath (s) and wound up in the manner of the cinematograph.

The operation of the photochemical fixing is as follows: The variations of resistance arising through the sound waves in the microphone (a) causes variations of intensity of the line current, which are indicated by the varying attraction power of the electromagnets (d d'). The lever (e) is consequently more or less attracted, and therefore the bundle of rays (p) is more or less drawn away from its position of rest. In accordance with the deviation the bundle of rays (p) is more or less absorbed by the plate (l), and consequently also the sensitive band (r) is more or less darkened. If then the band (r), which has been exposed to light and fixed, be passed in the well-known manner between a selenium cell and a source of light, the telephonogram will be again heard in a telephone inserted in a constant-current circuit. As has been already stated, the distance between the mirror (h) and the plate (l) or between the prism system (o) and the light aperture (q) should be adjustable. By this means the sensitiveness of the apparatus can be adjusted within the widest limits according to the requirement without alteration of the mechanical parts. This may be effected in the most simple manner by arranging the plate (l) and the cylinder lens (o), together with the fixing arrangement, adjustably upon a frame.

New York Rapid-transit Subway.

The sum of $50,000 has been appropriated for the official celebration of the opening of the New York subway system, which will take place in a month or so. There will be prayers and speeches, the running of special trains, public demonstrations of the advantages of the subway, music at various points and fireworks in the evening. The portion of the subway to be opened extends from the City Hall, opposite Brooklyn Bridge, to One-hundred-and-forty-fifth Street, a distance of about nine miles, or nearly the whole length of Manhattan Island. The extension of the line under the Harlem River into the borough of the Bronx is promised to be opened on January 1, 1905.

Progress is being made on that portion of the subway which will extend from the Battery to City Hall. This week electric hoists have been put up on a platform over Broadway at Exchange Place to expedite the work of construction at that point.

The Wanamaker store people publish a map in the endeavor to demonstrate that when the subway is opened they will be at the "transit center" of the city—Tenth Street and Broadway. A precisely similar claim is put forward by the owners of a new office building at Forty-second Street and Broadway, two miles farther up town. This new method of advertising promises to engender many controversies.

American and German Electrical Exports.

During the first three months of 1904 the exports of electrical machinery from Germany amounted in value to $1,309,000, in addition to electric motors valued at $975,000. During the same period the exports of electrical machinery from the United States amounted to $1,561,871, while the total electrical exports, including appliances and telephone apparatus, were valued at $2,642,019.

Sectional Third-rail Railway System.

A system of current collection for electric railways which possesses some novel features has recently been patented by Timothy Mahoney of San Francisco. The system is somewhat of a compromise between the regular third-rail and systems of surface contact similar to the Dolter system. In the construction proposed by Mr. Mahoney a third rail is used which, unlike the ordinary construction, is divided into insulated sections, each section being dead except when the car is immediately over it.

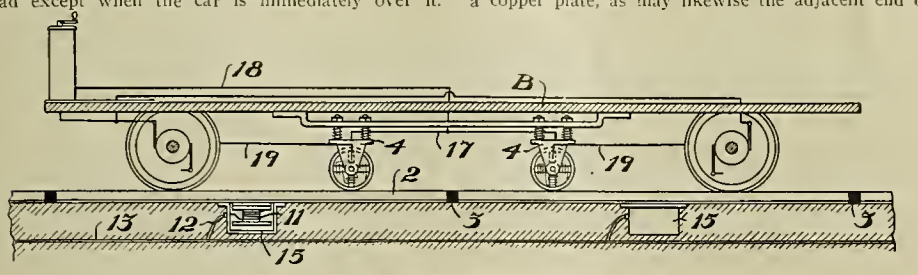


FIG. 1. SECTIONAL THIRD-RAIL RAILWAY SYSTEM.

The current is carried by a conductor beneath the surface.

Fig. 1 illustrates diagrammatically the general features of the car and apparatus. Between the tracks of an ordinary street railway is the sectional surface trolley rail (2), the sections being suitably insulated one from another. A motor car is provided with two trolley posts (4), disposed between the car trucks and each having a roller magnetic trolley running continuously on the sectional rail, the distance between the trolleys being approximately equal to the length of a section of rail to insure the engagement of one trolley with a section before the other leaves it.

This magnetic trolley is one of the features of the invention, for it combines the functions of a current collector for the motor as well as furnishes

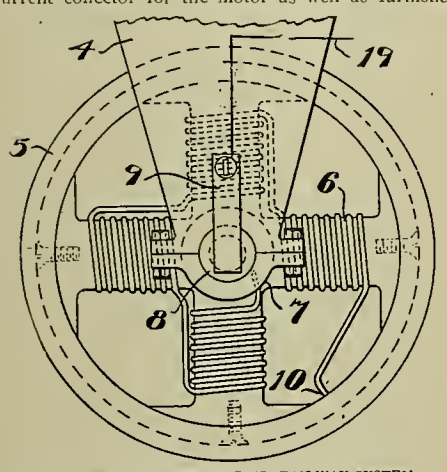


FIG. 2. SECTIONAL THIRD-RAIL RAILWAY SYSTEM.—DETAIL OF MAGNETIC TROLLEY.

the means for actuating the switch to cut the current into the trolley rail from the main, thus doing away with separate actuating magnets on the car. The details of the wheel are shown in Fig. 2. It consists, essentially, of a soft-iron annular pole piece and combined wheel rim, removably secured to iron spokes radiating from a hollow hub. The hub is journaled suitably in the conducting trolley post, and has one end capped with a copper plate (8), which latter is in frictional engagement with a brush (9) having a fixed point of attachment with the trolley post. The rim is preferably concaved in cross-section to aid in maintaining its engagement with the trolley rail. Each spoke is wound after the fashion of an electromagnet, a single wire having one terminal attached to the rim, as at (10), and wound around the spokes successively and passing from there into the hollow hub and having the other terminal connected to the copper plate. The spokes thus wound are converted into magnetic cores, and the winding is such that all the magnets are of the same polarity. Hence if the outer poles are all north the entire rim will be north.

The second essentially novel feature of the invention is the switch, shown in detail in Fig. 3. This comprises simply a magnetic pole-piece of opposite polarity to the trolley magnets disposed in and connected with the feed wire from the main supply circuit and located beneath the rail and adapted to be lifted into engagement with the rail by the passing trolley magnet and then to be held against the rail by its own attractive force so long as current is passing from its particular trolley-rail section to the car. The switch consists of a soft-iron spool with rectangular heads, wound a few times with a feed wire leading from the main. The end of the wire is connected electrically with the spool.

The spool is encased in a suitable iron box, having an interior lining of insulating material and disposed centrally beneath a section of the trolley rail. The rail itself forms the cover for the box, and a suitable lead gasket preserves a water-tight joint when the box is finally bolted in place. The surface of the rail included within the box may be provided with a copper plate, as may likewise the adjacent end of the spool, to insure better electrical contact of the parts when the spool is lifted. The wire passes out of the box through a suitable opening in the side afterward sealed to prevent any ingress of moisture. It will be seen that the full current to the car passes around the switch core to energize it as a magnet and also connects directly to the core to convert the latter into a conductor.

In operation with the car traveling in the direction of the arrow (Fig. 1) the front trolley, as it comes on to a trolley-rail section and approaches the box of the section, will lift the armature magnet in the switch box to cut the current from main into the rail. The current then passes from the rim of the front trolley through the spokes, hub, trolley post and connections (17) (18) to the controller, thence to the motor, and finally to one of the track rails to complete the circuit. Wires (17) and (18) on the car connect with both trolley posts on the car, so that current may be taken simultaneously from two sections.

Brushes (9) are connected by circuit with the track rail. The trolley magnets are connected in multiple, so that the magnets of both trolleys will always be in a state of excitation in readiness to act on a switch immediately in advance of either end of the car, according to the direction of travel. The current for the trolley magnets passes from the trolley rail to a wheel rim, thence around the spokes to plate (8), brushes (9), circuit (9), and the car wheels to the track rail.

The moment the front trolley magnet has acted to lift the armature, as previously described, and the circuit between the feed main and the trolley rail has been closed, the switch itself is converted into a magnet of high power, since the full current for the motors is passed a number of times around the spool. The switch then adheres to the rail, which becomes for the time being its armature. Before the first trolley passes from the active section the rear trolley has come upon the section, and the current passing from the main through the lifted switch to the rail will continue to pass to the car through the rear trolley, even after the front trolley has gone on to the next section to actuate its switch. The

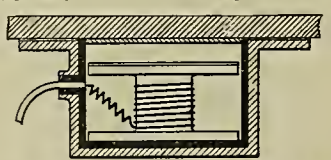


FIG. 3. SECTIONAL THIRD-RAIL RAILWAY SYSTEM.—DETAIL OF SWITCH.

moment, however, the rear magnet passes from the section the circuit between that section and the return conductor is broken and the switch loses its power as a magnet, falling to the bottom of the box.

The advantages of the switch mechanism lie in its simplicity, its cheapness of construction, and in the fact that it can be economically operated. It requires no other circuit than that which connects the rail and the main feed wire. The rail itself forms the cover for the box, since the latter need not be very large, inasmuch as the rail is half the switch. The spool being small requires very little power to move it, and its own magnetism causes it to adhere to the rail when lifted.

The advantages of the magnetic trolley, according to the inventor, are that it makes a good contact with the rail on account of the magnetic attraction, which holds the trolley against or in contact with the rail around curves or on heavy grades. It rolls very freely, therefore doing away with friction caused by one magnetized body sliding over another, as in some systems. This is a very important feature of the invention. It will also be noted that these trolleys, of which there are two on every motor car or train, both act as contact devices or current collectors; but they are functionally different. The forward magnet, according to the direction of travel, is the one that acts, essentially, on the switch magnetically to lift the switch, while the rear magnetic trolley acts on the switch mechanism rather merely as an electrical conductor. If the car is reversed, then what was the rear trolley before becomes the front trolley and the active switch-operating agent.

The Contest of Electricity with Steam on Railroads.

Electric-railway competition is developing fast and being met by steam railways in various ways, says the Railway Age. The New York, New Haven and Hartford early tried the experiment of substituting electricity for steam on branch roads, but seems to have settled on the plan of buying out the parallel trolley lines, and it now controls an almost continuous electric road from Springfield, Mass., to Long Island Sound, about 100 miles. The Boston and Maine has pursued the plans both of buying and of building in the New England states with apparent success. The New York Central has begun the work of acquiring separated interurban roads paralleling its main line through the heart of New York state and proposes to connect them by electrically equipping portions of its superfluous West Shore tracks, so that electric service all the way from Albany to Buffalo seems to be a near possibility. From New York city northward the Central is preparing for extensive suburban service by electricity on two of its lines; and from Albany and Schenectady northward the Delaware and Hudson company is apparently proposing to replace mutually injurious competition by purchasing the trolley lines and continuing their useful work in harmony with its steam service.

For three years the promoters of the New York and Port Chester Railway Company have been struggling for permission to build a four-track, third-rail electric railway from One-hundred-and-thirty-second Street, New York, through the Bronx region to Port Chester, 21 miles, competing with the Harlem division of the New York Central and with the New York, New Haven and Hartford. Meantime a rival enterprise, the New York, Westchester and Boston, has appeared, proposing to build a four-track electric road to be operated by the third-rail system from One-hundred-and-thirty-eighth Street to Port Chester, 25 miles, with branches to White Plains, 13 miles, and to Throgg's Neck, six miles, the four tracks making a total track mileage of 176 miles. This company, which has just been voted a charter after a sharp struggle in the Board of Aldermen, promises to build a railroad over private right-of-way, fenced in; no grade crossings on highways or railways; 90-pound rails on oak ties, stone ballasted; bridges and stations of masonry and steel; cars of steel and fireproof materials, vestibuled, fitted with toilet rooms, lavatories, baggage space and other conveniences; two tracks for local trains, which are to maintain a speed of 45 miles an hour, and two for express trains which will attain 60 miles an hour; trains in the morning and evening hours to be run on a headway of five minutes; five-cent fares between all stations in the city limits, and other fares to be "considerably lower than those charged by the steam railroads for the same distance."

The financing and constructing of this enterprise appear to be in remarkably strong hands, and the contract calls for completion of the road within two years. Extension of train service from Harlem River to the lower end of the city is ultimately expected to be reached by the construction of the East Side subway under Broadway and Lexington Avenue. The Port Chester enterprise, which the Westchester company appears to have distanced, is still expecting permission to build through the Bronx, and it is not improbable that two high-class four-track electric roads will be competing with two "converted" steam roads along nearly parallel routes in the northern suburbs of Manhattan.

Proposed Power Plant on the Santiago River, Mexico.

W. A. Rogers of New York and associates are promoting the project of establishing a large electric power plant on the Santiago River, in Mexico, with the view of transmitting the electrical energy to the city of Aguascalientes, a distance of 110 miles from the site of the proposed generating station. Mr. Rogers now holds, in connection with J. M. Garcia, Lazaro Lepetich and Latour de Vasquez, all of the City of Mexico, what is known as the Perez concession for the utilization of waterpower along the Santiago River. This concession was obtained from the federal government by Fecundo Perez, an attorney of the City of Mexico, about a year ago. The concession covers a stretch of river 45 kilometers long, beginning at Las Juntas and extending to a point two kilometers below the town of San Cristobal. In that distance the river has a fall of 206 meters, and it is estimated that at least 30,000 horsepower could be generated. The owners of the concession are organizing a company in the United States to carry out the project.

WESTERN ELECTRICIAN

EVERY SATURDAY.

PUBLICATION OFFICES:
510 Marquette Building, · CHICAGO.
TELEPHONE, MAIN 1746.

Eastern Office, 193 Times Building, New York.
Telephone, 3806J Cortlandt.

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted. This paper is entered at the Chicago postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the **old address** as well as the new should be given.

CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—**the only general electrical paper published in the West**—thoroughly covers a territory *exclusively its own.* THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be furnished on application.

REMITTANCES.—All checks, drafts and other remittances should be made payable to the order of the publishers, the **Electrician Publishing Company,** and addressed to the offices of publication, Suite 510, Marquette Building (204 Dearborn Street), Chicago, Illinois, U. S. A.

CONTENTS OF THIS NUMBER.

Chicago's Automatic Telephone Exchange. Illustrated. 111, 112, 113, 114
Many Alleged Electrical Fires Not Electrical 114
The Telephonogram. Illustrated 114
New York Rapid-transit Subway 114
American and German Electrical Exports 115
Sectional Third-rail Railway System. Illustrated 115
The Contest of Electricity with Steam 115
Proposed Power Plant on the Santiago River, Mexico 115
Editorial 116
Chicago City Railway Franchise Ordinance Is Drafted 117
Diplock's Pedrail Tested 117
World's Fair Visitors of Last Week 117
A Proposed System of Standard Instruments for Operating Companies. By H. P. Davis. With discussion. (National Electric Light Association) 118
D. & W. Fuse Company's Exhibit at St. Louis. Illustrated 119
A Zinc Exhibit at the World's Fair. Illustrated 119
Coal Testing and Timber Preserving at the Exposition 119
Condition of Chicago Elevated Railways 119
Ohio Telephone Notes 120
Telephone News from the Northwest 120
Michigan Telephone Matters 120
Telephone Men 120
Extensions and Improvements 120
Effective Organizations of Independents in Ohio and Other States 120
General Telephone News 120
Toledo Home Telephone Company Gives a Reception. Illustrated 121
Manufacturers and Dealers 121
Porto Rico's Telegraph Service 121, 122
Costs and Profits of Electric Railways in Germany. By Frank H. Mason. (U. S. Consular Report) 122
The Law of Electric Supply in Great Britain 122, 123
Obstacle for Trackless Trolley 123
New Telephone-cord Manufacturing Company 123

DEPARTMENTS.

Correspondence 123, 124, 125
Great Britain 123
New York 123, 124
New England 124
Southeastern States 124
Texas and Mexico 124
Ohio 124
Michigan 125
Northwestern States 125
Rocky Mountain States 125
Pacific Slope 125
Personal 125
Electric Lighting 125, 126
Electric Railways 126
Publications 126
Societies and Schools 126
Telegraph 126
Miscellaneous 126
Trade News 126
Business 126, 127
Illustrated Electrical Patent Record 127, 128

DATES AHEAD.

Ohio Electric Light Association (annual convention), Sandusky, August 16th to 18th.

Minnesota Telephone Association (convention), Minneapolis, August 31st and September 1st.

Northwestern Electrical Association (mid-year meeting), Park University Hotel, St. Louis, Mo., September 12th to 16th.

International Electrical Congress, Hall of Congresses, St. Louis Exposition, September 12th to 17th.

International Association of Municipal Electricians (annual meeting), St. Louis, September 13th and 14th.

American Electrotherapeutic Association (annual convention), St. Louis, September 13th to 16th.

National Electrical Contractors' Association (annual convention), St. Louis, September 14th to 16th.

Colorado Electric Light, Power and Railway Association, Colorado Springs, September 21st to 23d.

Michigan Electric Association (annual meeting), October 11th.

American Street Railway Association (annual meeting), World's Fair grounds, St. Louis, October 12th and 13th.

Kansas Gas, Water and Electric Light Association (annual meeting), Leavenworth, Kan., October 18th and 19th.

VISITORS to the Louisiana Purchase Exposition at St. Louis who are interested in electricity or electrical literature are cordially invited to call at the booth of the Western Electrician, which is in Block 1 (Section 13) of the Palace of Electricity, just west of the main northern entrance to the building. Here will be found copies of the current issue of the paper, bound volumes of the Western Electrician from the first number, a careful selection of electrical books exhibited by the Electrician Publishing Company, and other objects of electrical interest. Chairs are provided for weary sight-seers, and an attendant will extend a hearty welcome to all readers or friends of the paper.

A DIVINING ROD rehabilitated by modern science is what the electrical ore-finder seems proving itself to be. This device consists essentially of an apparatus for establishing an electric circuit between two predetermined points in the ground and then ascertaining by a telephone or galvanometer test whether any metallic body, as a mass of ore, intervenes. It was first brought out in this country and described in the Western Electrician several years ago. A similar contrivance has more recently attracted attention in England. At a recent trial at Coniston, in Northwest Lancashire, the problem was to find a lost lode of copper, which had been "faulted," that is to say, dislocated, by a displacement of the rock strata. The ore-finder succeeded in locating the lode, and it was found later by blasting down under the spot indicated. The apparatus is founded on well-understood principles, and it should prove to be useful in many cases, although of course its value can be easily overrated.

THOSE who go over the sea in ships often return with tales of wonder commensurate with the deeps which they traverse. Thus Captain Urquhart of the British ship Mohican tells of a strange meteorological phenomenon encountered off the Delaware Breakwater last month. The ship ran into a fiery cloud, and "it appeared as if the whole world was a mass of glowing fire." Equally as strange, every metallic object was magnetized, and the needle of the compass "was flying around like an electric fan." Chains, bolts, spikes and bars were as tight to the deck as if they had been riveted there. Evidently the wooden deck must have been supported on iron beams. Further, the captain relates, "The hair on our heads and in our beards stuck out like bristles. We noticed that it became difficult to move arms and legs." This latter condition was alarming as well as puzzling, but fortunately the cloud began to lift, passing off to sea, and things soon regained their normal condition. Captain Urquhart hazards the conjecture that the cloud must have been composed of some magnetized substance combined with phosphorus. His story is certainly interesting, and, assuming that he is a veritable personage and that the newspapers have not exaggerated an ordinary electric storm, we trust that he will send a signed account of his experience to the United States Weather Bureau for the investigation of the learned scientists of that department.

WHAT we predicted long ago as the attitude of the steam railroads toward electric-railway competition is now coming to pass. The older companies operating steam railroads are themselves becoming to a constantly increasing extent electric-railway companies. This is true to a notable degree in New England, in and near New York city and along the line of the New York Central. It is asserted that the Vanderbilt lines now own or have a controlling interest in 910 miles of electric railways, representing a capitalization of $19,800,000. We are not in a position to guarantee the exactness of these figures, but it is certain that the managers of the great group of railroad properties known as the Vanderbilt system are awake to the possibilities of electric power. Very recently a party of high officials went over the Lake Shore road, which has suffered from electric competition. According to current report, the purpose is to buy competing electric lines where they can be acquired, or, if this is not practicable, to equip portions of the steam road to secure the advantages of electricity. It is evident that the day is not far distant when the former steam-railroad man will have divested himself of all old prejudices and admit that a railroad is a railroad, whether operated by steam or electricity. The Illinois Central Railroad Company may well find the present a good time to put aside its hesitant policy and get in step with the march of events.

MANAGERS of interurban electric railways recognize the value of freight haulage, and most of the newer lines are being equipped with trackage sufficiently heavy to allow of the development of this character of service. But many of these lines lack terminal facilities of their own, and in the larger cities must operate over the tracks of the city companies. As a rule city people are not inclined to have the lines, already overcrowded by passenger traffic, further obstructed by freight cars, and they raise a vigorous protest. Yet the courts have ruled that there is nothing to prevent the railway companies from making such arrangements. Since there is no legal hindrance, some of the congestions of traffic due to teaming might be obviated by making use of freight cars on the street-railway lines during certain hours of the night, to transport merchandise from the freight depots to the business centers. Teaming in the cities to and from the freight houses to the big wholesale and retail stores and to the shops and factories is one of the most serious problems of city street maintenance and control. The business is all congested in a few hours during the day. From midnight until nearly seven o'clock in the morning the streets are, however, practically deserted, and the street-car traffic dwindles down to almost nothing. In view of these facts it would seem that not only should the movement of interurban freight be confined to this period of the night, but also that much of the heavy hauling now done by teams might well be done on electric freight cars; leaving the streets less obstructed during the day. In Chicago it is proposed to operate this electric freight service, in the downtown district, in tunnels under the streets, but in other cities, where a tunnel network does not exist, existing surface tracks might possibly be utilized at night.

AFTER months and years of tedious discussions and negotiations the street-railway franchise problem in Chicago is still unsettled, and the great metropolis of the West continues to be afflicted by street-railway service, that, so far as the surface cars are concerned, is antiquated and disgraceful. But a few recent developments of some importance are to be noted. For the present the negotiations between the aldermanic committee on local transportation and the Chicago City Railway Company rest with the ordinance just framed by the committee and intended to wipe out all previous grants and satisfy all claims, including those under the 99-year act, of the Chicago City company. An abstract of the ordinance appears on another page of this issue. Whether it will be accepted by the company cannot even be guessed, but it is put forward as representing the best and final efforts of the committee in the solution of the franchise-extension tangle, and it is recommended by the committee for passage by the City Council that it may be submitted to a vote of the people at the fall election.

Interest in Union Traction affairs centers in the arguments before Judge Grosscup on the formal decree to be entered on the recent decision on the 99-year act by that jurist. In the disputes which have arisen between the city lawyers and traction attorneys the most important matter passed on by the court at that time was that in streets where rights under the 99-year act exist they extend only to the city limits of 1875 and not to the limits of today. This cuts off these rights at Fullerton Avenue on the North Side and Western Avenue on the West Side. The decision that these 99-year acts extend only to the city limits of 1875 is expected to have an effect in inducing the Chicago City Railway Company to accept the ordinance of the committee on local transportation. It means that the South Side rights only go to Thirty-ninth Street.

If the Chicago City ordinance is accepted by the municipality and the company, it will mean an expenditure of perhaps $15,000,000 for conduit and overhead construction, new tracks, power house, substations, new rolling stock and the like. The system will be practically built anew. A similar stipulation will be made with the Union Traction Company, so that the settlement of the controversy is of interest to electrical business men and electrical engineers who may have little regard for the local aspects of the question.

Chicago City Railway Franchise Ordinance Is Drafted.

A complete tentative ordinance renewing the franchises of the Chicago City Railway Company has been framed and put in shape to be presented to the Chicago City Council as the report of the committee on local transportation, the result of its effort to solve the vexed franchise-extension problem, so far as it relates to the company named. Accompanying the ordinance was a statement from the committee, signed by Milton J. Foreman, chairman, in which the reasons actuating the measure are set forth. The Chicago City Railway Company has not yet stated whether it will accept the ordinance, and on this point the committee says that while the measure is by no means satisfactory in some particulars to the company, it should be passed in its present form. "It concedes the company all it may fairly ask; it secures to the city all for which it has struggled. We regard it as the best obtainable solution of the perplexing problem." These are the words of the committee.

The following is a list of advantages which the committee believes will be secured for the city by the passage and acceptance of the ordinance:

1. The surrender of the "99-year" claims of the company, with the relinquishment of its rights under all prior grants in exchange for this grant.

2. The right of municipal ownership, after 13 years, without payment for unexpired or disputed rights, being the only available method without condemnation proceedings and payment of prohibitive compensation.

3. The right to require the company to sell to another corporation on like terms as in case of sale to the city.

4. The immediate reconstruction of the lines of the company, with resulting first-class service.

5. The continuous control by the city of the service.

6. Provision for universal transfers from the company to other companies from any natural division of the city to the other divisions.

7. Provision for joint use of tracks by the company and other companies operating in the district bounded by Twelfth Street, Halsted Street and Chicago Avenue.

8. Provision for improved paving and the use of grooved rails.

9. The right to require the company to use subways when built.

10. The right to require the company to rearrange its tracks, loops and terminals.

11. The right to require extensions of three miles of double track per annum.

12. Through routes on Halsted and other streets, with right to require rerouting of cars.

13. Underground contact construction north of Eighteenth Street.

14. Compensation to the city.

15. Greatly improved relations between the city and company.

The term of the new ordinance is 20 years, with a provision that at any time after 13 years the city may improve the opportunity of municipal ownership under terms specified in the ordinance. Explaining its action in fixing 13 years as the date when municipal ownership may be undertaken the report says:

"It is essential that the city by this ordinance shall secure the present waiver and surrender by the company of all its existing rights and claims, in exchange for a definite and comprehensive grant. The fixed average term of 13 years has been arrived at by way of a compromise commutation of the existing grants and claims of the company. In this commutation allowance is made for all undisputed grants, the claims above mentioned under the '99-year act,' and something for said grants without express limit of time. We regard the result, taken in connection with the other provisions of the ordinance, as a satisfactory solution of a difficult problem. We believe that any other solution would require extended litigation almost certain to end in a situation solvable only by compromise between the city and the company. We think this compromise should be made now."

The matter of compensation to the city under the ordinance is analyzed in detail, and calculations upon the present earnings with an increase estimated at $300,000 yearly are made. The rate fixed by the ordinance is five per cent. of the gross receipts for the first 13 years and 10 per cent. for the remainder of the grant. The compensation under the "$300,000 yearly increase in receipts" basis is to average during the first 13 years of the grant about $440,000 a year, or $5,700,000 for the period of 13 years. The compensation for the remaining seven years, on the same basis will average about $1,180,000 a year, or $8,260,000 for the period. If the company operates the lines for the full 20 years the city will receive in compensation under the figures of the committee the sum of $13,980,000. It is pointed out that the first-class construction required from the company in the ordinance will result in a greater increase in business than is estimated by the company's experts, and that will increase the compensation for the city.

Aside from the term of the grant and the fixing of a definite compensation to the city, the ordinance is much the same as the former one reported last November and published in abstract in the Western Electrician of November 7, 1903.

Improvements to the system to cost about $15,000,000 are provided by the ordinance, and specifications covering the general outline of the reconstruction required are contained in "Exhibit B." The following is a summary of the requirements in this particularly interesting part of the report:

On Clark Street, from a point at or near the foot of the north approach to the viaduct over Twelfth Street, north to Madison Street, the present track shall be removed and a new double-track underground-conduit construction laid. From Madison Street all tracks now in the streets which would interfere with the new construction, will be removed and a single track will be laid as follows: From Madison Street north on Clark Street to Washington Street, thence east on Washington Street to State Street, thence south on State Street to Madison Street, thence west on Madison Street to Clark Street, where it will join the double-track construction previously mentioned.

On State Street from Archer Avenue north to Madison Street, the present cable track and appurtenances shall be removed, and a new double-track underground-conduit construction laid. From Madison Street north all tracks now in the streets which would interfere with the new construction will be removed, and a single track will be laid, as follows: North on State Street to Lake Street, thence east on Lake Street to Wabash Avenue, thence south on Wabash Avenue to Madison Street, thence west on Madison Street to State Street, where it will join the double track previously mentioned.

On Wabash Avenue from Eighteenth Street north to Madison Street, the present cable track and appurtenances shall be removed, and a new double-track underground-conduit construction laid. From Madison Street north all tracks now in the streets which would interfere with the new construction will be removed, and a single track will be laid, as follows: North on Wabash Avenue to Randolph Street, thence east on Randolph Street to Michigan Avenue, thence south on Michigan Avenue to Madison Street, thence west on Madison Street to Wabash Avenue, where it will join the double track previously mentioned, subject to the right of the city to substitute another loop as provided in the accompanying ordinance.

The rails for the underground-conduit construction shall be of steel; shall be not less than nine inches in height and weigh not less than 100 pounds per yard, and shall be of the Trilby type.

Slot rails shall be of the "Z" form, made of steel, weighing not less than 66 pounds per yard, suitably joined by means of bolts and splices.

Conductor bars shall be of the "T" section, made of steel weighing not less than 21.3 pounds per yard, supported upon suitable insulators spaced not more than 15 feet apart, and joined together in such a manner as to properly carry the electric current without excessive leakage.

All rail joints shall be either cast-welded, electrically welded, or of a type which will give an equally smooth and even joint.

At all points where the underground-conduit construction terminates and overhead construction begins, the company shall construct suitable pits underneath the tracks, of ample size to provide for the removal or the adjustment of the plows attached to the cars.

The company shall also provide suitable plow hatches, spaced with sufficient frequency to preserve regular and uninterrupted operation of the cars, it being understood that these hatches shall not be closer than 2,000 feet apart.

All cable track of the company shall be reconstructed and converted into electric track, and all cable track not above designated for underground-conduit construction shall be provided with overhead electric construction.

All rails shall be not less than seven inches in height, and weigh not less than 85 pounds per yard. On all of said streets or portions thereof where granite, asphalt or brick pavement is laid a Trilby rail shall be laid; but a girder type of rail not less than seven inches in height and weighing not less than 85 pounds per yard, may be used on the streets or portions thereof not so paved, provided the difference in elevation between the head of the rail and the wagon tread is approximately thirteen thirty-seconds inch, and, provided, further, that at such times as the streets on which the girder rail is laid are paved with granite, asphalt, brick, creosoted block or other similar material, the company will substitute Trilby rails of the above-mentioned type for the girder rail previously laid.

In case the rails are joined by any other form of joint than a cast-welded or electrically welded joint, there shall be some form of bond used which will connect the ends of the rails together in such manner that the conductivity of the joints shall be equal to the conductivity of the rail. The rails of each single track and the inside rails of the double track shall be connected together by cross-bonds of 00 copper wire, spaced not more than 1,000 feet apart, and properly secured to the rails in such manner that the full conducting effect of the wire may be utilized.

For all cable lines south of Eighteenth Street new overhead construction shall be furnished, consisting of one 00 hard-drawn copper trolley wire over each track, carried upon galvanized-steel span wires attached to iron or steel poles set in concrete in such a manner that they will retain their proper position. Poles to be set in accordance with the city ordinances and regulations pertaining thereto, and to weigh approximately 900 pounds each. All work to conform to the following specifications:

The overhead wires may be suspended from iron or steel poles, set at the curb line, or from iron or steel bracket poles so set, the location and kind of poles to be determined for each new construction by the commissioner of public works.

The poles shall be of iron or steel, of an ornamental design, set in concrete and shall be kept thoroughly painted. They shall be set on an average of not less than 115 feet apart in such manner as not to obstruct cross-streets, alleys or private driveways.

The trolley wire shall not be less than 18½ feet above the rails, and shall be of hard-drawn copper, phosphor bronze, silicon bronze, or some other material equally as strong.

There shall be at least two insulations between the trolley wire and the supporting pole.

The present plants for supplying power shall be abandoned as soon as practicable, and in place thereof one or more plants shall be substituted, together with the necessary sub-stations, of sufficient capacity to supply the requisite amount of power to efficiently operate not less than 682 double-truck cars and 251 single-truck cars.

The switches [at the power house] shall be entirely enclosed in fireproof material, and shall be operated by levers, compressed air, auxiliary currents, or by such other means as will, so far as practicable, prevent personal contact with high-tension current.

All feeders leading out of power plants and sub-stations shall be provided with some form of safety switches or automatic circuit-breakers, designed to instantaneously open the circuit in case of a short-circuit occurring on the feeder or on the trolley wire which it feeds.

The company shall put into service as rapidly as practicable and operate on its street-railway system 682, or more, double-truck cars, each capable of seating not less than 52 passengers. In addition, the company may retain in operation at least 251 of the present single-truck cars now in service, it being understood that these cars shall be selected from the best cars now in service.

The improvements contemplated by these specifications shall be begun within 60 days after the acceptance of the ordinance by the company, and all the work shall be completed on or before five years from the date of said acceptance.

Diplock's Pedrail Tested.

Diplock's pedrail, which formed the subject of an illustrated article in the Western Electrician of February 27th last, was recently tested at Lincoln, England, in the presence of members of the Mechanical Transport Committee of the War Office. This tractor is in fact a walking machine and differs from an ordinary traction engine in that it is driven not by the adhesion of the usual wheels with continuous tires, but by a series of 14 feet arranged radially round a central driving axle. Several of these feet are on the ground simultaneously, and as each has an area of 95 square inches, great adhesive power is obtained. The machine is also enabled to move over very rough ground.

In the tests at Lincoln the tractor, which itself weighs about five tons, showed itself capable of hauling a load nearly as heavy as itself up a long hill with an average gradient of one in 12, and in parts of one in eight. It was then attached to a traction engine weighing 11½ tons, and as it hauled this a dynamometer showed the average drawbar pull exerted to be over one ton. The resistance of the load was then increased by screwing down the brakes of the traction engine, and when the drawbar resistance reached just over two tons—equivalent to a load of about 75 tons on a first-class, hard, level road—the tractor was unable to proceed. The stoppage, however, was not due to lack of adhesion, because there was no skidding or slipping of the pedrails, but to want of sufficient cylinder power. The same machine is now being fitted with double cylinders to increase the available power, and when this is done further trials will be carried out.

World's Fair Visitors of Last Week.

Among those registered last week at the booth of the Western Electrician in Electricity Building at the St. Louis Exposition were the following-named: Carl Dresler, St. Louis; A. S. Lindstrom, Los Angeles, Cal.; H. H. Freedheim, Eureka, Utah; C. W. Meacham, St. Louis; Otto Leutuiler, St. Charles, Mo.; R. N. Tower, Helena, Ark.; Valec Hedin, Vesteros, Sweden; Theodore P. White, New York, N. Y.; Charles Hayelo, Milwaukee, Wis.; J. C. Mead, Davenport, Iowa; J. Spaulding & Sons, North Rochester, Ind.; H. B. Grant, Deer Lodge, Mont.; I. D. Johnson, Parkville, Mo.; J. E. Spencer, De Leon, Tex.; A. J. McGuire, Fort Dodge, Iowa; John Dillon, Pine Ridge Agency, S. D.; F. R. Brown, St. Louis; Aaron Michel, Pittsburg, Pa.; W. E. Dickinson, Electric Test Company, Williamsburg, Va.; H. W. McCrossen, Bedford, N. Y.; Paul O. Auerswald, Greenville, Miss.; Captain Samuel G. Jones, United States Cavalry; A. Wonters, Hanover, Germany; Eugene Rosenfeld, Baltimore, Md.; Walter B. MacKenna, New York city; Elliot Baldwin, Bloomfield, N. J.; Carl Weirsenbach, St. Louis, Mo.; G. W. Ketter, St. Louis; R. T. Cormally, Atlanta, Ga.; C. B. Boyel, Dundas, Ont.; F. Johnson, G. I. Company, St. Louis; J. B. Blunt, St. Louis; William Scharf, Chicago; M. A. Silva, Los Angeles, Cal.

A Proposed System of Standard Instruments for Operating Companies.[1]

By H. P. Davis.

Electrical engineering is an exact science. Its units of measurement are definite and precise, and permit accurate calculation of minute quantities. In the design and manufacture of electrical appliances, the mathematical formulæ used and the engineering methods adopted result in a degree of exactitude that is not equaled in any other branch of commercial science. With the increase in electrical knowledge and the widespread industrial adoption of this form of energy for the production of power and light, the requirements of apparatus have become more severe and the standards of efficiency have grown constantly higher, until the laboratory standards of a few years ago have been transferred to ordinary commercial service, and the present basis of operation is one which a decade ago would have been deemed academic and unpractical.

The causes for this state of affairs are not hard to find. The development of electrical devices has been eagerly pursued by a host of inventors and engineers, and there is keen rivalry in all parts of the electrical field. To generate electricity at the lowest cost; to transmit and utilize the greatest proportion of the energy produced and to measure most accurately the output and consumption, are the ends sought in modern electrical engineering, and the eager strife to achieve pre-eminence has done much to raise the standards of accuracy to their present point.

The managers of central stations have also done much to induce a higher standard of efficiency by their careful and constant balancing of coal against kilowatts, their active search for possible leakages, and their readiness to adopt new devices which promise to yield better results. Generator losses, transformer losses, line losses and meter losses have received unremitting attention, and the manufacturers of electrical appliances have found that the only articles that are received with favor are those that show a high standard of efficiency and accuracy in performance. Instances are known where station managers who have made a change in transformers have changed an annual deficit into a dividend, and where those who have replaced old types of service meters with modern instruments have found that the production recorded at the station has closely approximated the sum total of the service-meter readings. Thus engineers have been spurred to greater efforts, not only by a rivalry among themselves, but by the urgings of the users of electrical appliances whose demands create the market. There is no other line of appliances in which efficiency counts for so much and in which a reduction in price to compensate for an inferiority in design or performance offers so little attraction.

Increased efficiency in the generation and utilization of electricity necessitates increased accuracy in the instruments designed to measure production and consumption, and the service instrument that will not in actual practice operate within two per cent. of accuracy is not considered worthy of consideration. The sensibility of the laboratory appliance is combined with the strength and stability of the field instrument, and the result is a system of measuring devices that with proper care will give exceedingly accurate results.

Such instruments require occasional tests and comparison with standard instruments of undoubted reliability, for their extreme sensibility and delicacy of adjustment make them as liable to injury from the wear and hardships of usage as other high-grade mechanical devices of similar nature. The testing or standard instruments to be of value must be superior to those with which they are compared, possessing great readability and accuracy, permanency of calibration, simplicity and convenience in manipulation and freedom from disturbance by local influences.

That the instruments now used as standards are painfully inadequate for many kinds of work, and are lacking in many important particulars, is well known to those at all familiar with the subject. Those that have the desired accuracy and reliability are complicated and require an unusual degree of skill and painstaking in their use, while those that are most generally used and have the advantage of portability and ease in handling, have secured their superiority in one direction by sacrificing important features in another, and thus do not fully and satisfactorily answer the purpose for which they were designed.

As an illustration of the lack of adaptability of this latter class of instruments, the calibration of integrating wattmeters may be cited. The best portable meter now on the market, and the one most generally used in this work, has an active range that does not exceed one to 10 times the minimum readable deflections. The average integrating wattmeter is, however, checked over a range of from one to 75 times the minimum reading. It will be seen that to take readings at different points in the range of this integrating meter would require several of the ordinary standards.

Besides the inconvenience attending the use of several portable instruments, it is well known that it is very difficult to get different standards that will check up accurately among themselves, so as to give a uniform result.

Another source of error in the instruments now generally used for standards is the effect produced upon them by external fields. This class of instruments is defective in having a very small controlling force, thus requiring very light and delicately balanced moving parts, and making the instrument very sensitive to external forces, such as static attractions on the needle, jarring from shipment, and the tendency of the moving part not to return to full zero. The arrangement of the scales is such that it is almost impossible to allow accurately for any zero error, owing to the divisions not being uniform.

The inaccuracies of the hand-drawn scales and the difficulty of reading the fractional divisions are also sources of error, and at low readings the thickness of the pointer and of the hand-drawn divisions amounts in some cases to as much as one per cent. of the readings when at one-fifth of the normal capacity.

The present available standards of high accuracy and permanency, such as the Kelvin electric balances, possess the disadvantages that they must be permanently placed upon some very rigid support, absolutely free from vibration; that, due to the complicated method of reading, the liability of an error in observation, except by a skilled operator, is very great. The length of time required to take readings and the fact that since they are not dead-beat, they can only be used where a very steady source of current supply is available, add to their disadvantages for general usage, while the difficulty of properly packing these instruments for shipment and recalibration, if any doubt arises as to their accuracy, makes it necessary to provide a standardizing laboratory to keep them in proper condition.

Manufacturers of electrical meters and indicators, who are constantly engaged in their testing and calibration, are daily made to realize that the standard instruments offered for sale are susceptible of great improvement, for their men are constantly hampered by the inconveniences due to the causes just mentioned, which, by constant repetition, become a source of serious annoyance and embarrassment. They also suffer the consequences of errors made by purchasers of their instruments who use checking standards of different kinds, and whose equipment is often incomplete. Complaints of the performance of service meters are so often found to be based upon tests made with unsuitable instruments that the first impulse when such a complaint is received is to ascribe the trouble to imperfect testing facilities. It is possible to locate the trouble when the reports show violent and inconsistent variations from accuracy, which are evidently caused by errors in observation of the readings of instruments and defects in the instruments themselves, but in others the truth is only developed by sending an expert with instruments of proper capacity and known accuracy to demonstrate that the error arises from the use of an unsuitable checking instrument rather than from a defect in the instrument tested.

The importance to the electric-light and power companies of having station and service instruments of known accuracy needs no extended comment. It is a matter of vital moment and is universally recognized as such. It is of equal importance that every possible facility should be provided for determining the accuracy of such instruments, in order that errors may be detected and corrected as soon as they occur. It is for this reason, as well as for the benefit of instrument makers, that a plea is made for better standard instruments, with greater adaptability to present needs.

The source from which relief from present inconveniences can most logically be expected is found in the manufacturers of high-grade electrical instruments. They have the equipment and facilities necessary for the manufacture of portable or semi-portable instruments possessing the desired requisites, and for their certification and periodical checking while in use, with trained and experienced engineers familiar with the problems involved and the means for solving them. Would it not be most natural and advisable for such a concern to design instruments of this nature, to offer them upon a fair commercial basis for the use of operating companies, and thus to give the purchasers the benefit of their exceptional facilities for designing, manufacturing and maintaining their accuracy in use?

It is not necessary that these standards take the place of ordinary portable instruments for the general run of service work in which a very high degree of accuracy is not required, but they should be provided for the calibration of other instruments, especially those requiring long ranges, such as integrating wattmeters, and practically to furnish in commercial form copies of the legal reference standards.

The service rendered by manufacturers of such standard instruments could, it would seem, be advantageously extended to cover their care and recalibration after they were put into the hands of purchasers. The technical training required for their design and manufacture; the extreme nicety observed in every detail, which makes extreme accuracy a fixed habit; the exceptional facilities for calibrating and the possession of primary standards of the highest possible degree of accuracy—all combine to make the manufacturers of these instruments the best able to care for them thereafter. They would be most familiar with the peculiarities of each instrument, and their records of performance, taken from time to time as the instruments were presented for checking, would enable them to give each an individual attention it would not otherwise have.

By taking upon themselves the responsibility for the perpetual accuracy of the standard instruments and by thus furnishing the purchaser with an insurance against inaccuracy, limited only by the length of life of the device, it would seem that their value to the user would be considerably enhanced, and their field of usefulness enlarged. There would be a distinct advantage in having such a service made as nearly universal as possible, and in having the care and calibration of such instruments centralized, in order that a uniformly high grade of accuracy might be secured, such as cannot be obtained with the present system, in which the owner is interested only in the continued accuracy of his standard instruments, which come from various sources and are calibrated in different establishments.

A part of the trouble with prevailing standards is caused by the lack of attention to their recalibration. This is partly due, doubtless, to the cost of having the standards checked, and partly to the length of time ordinarily required for the operation. To render the best service under the plan suggested, the manufacturers of the instruments should make no charge for recalibration, and should see to it that prompt return is made to the owners. It might even be found advisable to ask owners to send in instruments to be checked, when a considerable period had elapsed without such attention. The owner would be at no expense except for carriage, and should have no hesitancy in sending his instruments to the makers for attention when desired. The testing departments of operating companies would thus be kept in contact with a single standardizing bureau or department whose certificates should rank in excellence with those of the best and most favorably known government bureau or the most famous standardizing laboratories.

To render such a system successful requires an instrument far superior to all present types, and to cover the field properly the assortment should be made up of voltmeters, ammeters and wattmeters. Their principle of operation should be such as to give equal indications on either alternating or direct current, and they should not be affected by forces other than those they are required to measure, thus eliminating any influence of external fields. They should admit of very accurate readings of scale deflections at any point, and the estimation of fractional parts of divisions should be avoided so far as possible, especially if the divisions are unequal.

Moreover, their indications should be "dead-beat." To render negligible the effects of friction, the controlling force should be large, and the friction of moving parts small. This necessitates a support for the moving part to enable it to withstand a considerable amount of rough usage without injury or increase of friction.

The carrying capacity of the various circuits of the instruments should be such that no errors due to heating will be introduced, and, in addition to this, the temperature coefficient of the instrument as a whole would be small.

The construction of the movable parts should be such that violent changes in the quantity being measured can produce no injurious results, and the instruments should be so made as to allow shipment or transportation with positive assurance that the calibration will be unaffected from the consequent jars and shocks.

This presents what seems to be an ideal condition which may be made real. The present conditions certainly demand an improvement and the method outlined presents what is believed to be a feasible and adequate remedy for existing deficiencies. Would it not be worth the while to attempt to bring about a new order of things? Would not a general feeling of confidence in its testing standards and an improvement in adaptability be welcomed by the operating companies in general? Would it not be possible, by a concerted effort, to bring into use a new system of standardization on these lines which will prove of sufficient value to repay the thought and labor expended upon it, and shall be in keeping with the conditions in other portions of the electrical field? The subject is surely one worthy of consideration.

Discussion.

J. F. Dusman, Baltimore: I think two years ago a statement was made at the Cincinnati convention about this matter, and I would like to know what progress has been made regarding it, to avail ourselves of the National Bureau?

Mr. Davis: As far as I know, the government bureau is becoming gradually equipped to take care of this work. Their capacity is not sufficient to cover all lines of instruments, but they are gradually getting into shape.

Mr. Dusman: Within the last three months I had a difference in the readings of some ammeters. The readings involved were only up to about 6.5 amperes, but the standard as reported by one manufacturing concern was 0.2 of an ampere out, as compared with the test reported by the manufacturer of another instrument. Both claimed they had been tested by their standards in their very expensive laboratories.

It is reported that the Lehigh Valley Railroad Company will soon make public plans for buying a number of trolley companies in its territory and converting parts of its existing steam lines into a third-rail electric system. The Ithaca and Auburn division is to be the first part of the road treated with electric power.

1. A paper read before the National Electric Light Association, at Boston on May 26, 1904.

D. & W. Fuse Company's Exhibit at St. Louis.

In the accompanying illustrations are shown the two sample boards exhibited at the Louisiana Purchase Exposition by the D. & W. Fuse Company of Providence, R. I. This exhibit is in charge of the Western Electric Company, agent for the D. & W. Company, and is shown in Section 17 of the Electricity Building.

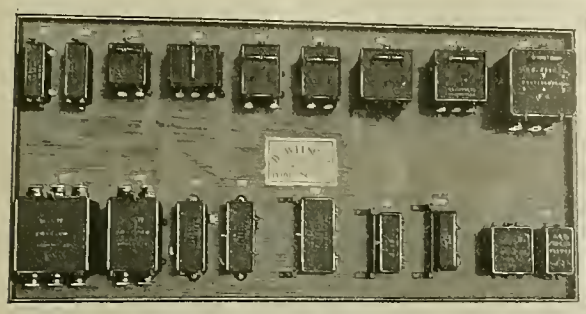


Fig. 1.

Fig. 2.

D. & W. FUSE COMPANY'S EXHIBIT AT ST. LOUIS.

Board No. 1 (Fig. 1), displays a complete line of boxes designed to operate satisfactorily on circuits ranging from 250 to 6,000 volts and comprising the following types: Transformer cut-outs, service switches and boxes, entrance cut-outs and railway cut-outs, all equipped with enclosed cartridge fuses, the types of contacts of the fuses varying according to the conditions for which the boxes are designed, some having the well-known clamp contact where extreme vibration renders a clip fuse impractical, while in other boxes the spring-clip fuse is used.

On Board No. 2 (Fig. 2) is mounted a complete line of low-potential cut-outs of the spring-clip type and also the type "A" or screw clamp contacts. This applies also to the 500 and 2,500-volt cut-outs and fuses. In addition to the bullseye indicating cartridge fuses, several of the company's specialties are shown, such as reloadable plug fuses and several types of panel fuses; also telephone, telegraph and fire-alarm protectors. The boards are made of cherry, eight feet by five feet, with aluminum name plates under each of the articles giving the catalogue number.

A Zinc Exhibit at the World's Fair.

Zinc for battery parts and similar uses has long been familiar to the public in general and the electrical world in particular, but outside the knowledge that it is used for some other things very little of the value and diversity of uses of zinc are appreciated even today, while the development of this metal has in fact been a rapid one. This development is well illustrated at the exhibit of the Lanyon Zinc Company in the Mines and Metallurgy Building at the St. Louis Exposition, where the company named has gathered together a great number of articles manufactured in zinc from the familiar washboard and battery rods to solid zinc nails and organ pipes. The cheapness, lightness and durability of zinc render possible its substitution for many other of the more expensive metals, such as copper and brass. The use of zinc for shoe eyelets is an example of this and is only one of the cases of substitution among many which might be mentioned.

The Lanyon Zinc Company, although at present a manufacturer of spelter, sheet zinc, zinc wire, rod and band only, has sought to exploit the various zinc workers with a view to extending the consumption of its manufactured products and to enlighten the general public regarding the nature, properties and applications of zinc, knowing that the more general the knowledge of its adaptability becomes the better will it be applied, and eventually employed for a much wider diversity of products.

The architectural uses of zinc are represented in this exhibit by a 66-foot facade of classic proportions worked in sheet zinc and stamped zinc ornaments, and by the zinc-tile roof upon the Metal Pavillion just outside the Mines and Metallurgy Building. The company's direct product is shown in several piles of spelter, casks of sheet zinc and a large display of rods, wire, tubing and bands.

A dining car is about to be established, it is said, by the Aurora, Elgin and Chicago Railway Company on its third-rail line. Within 15 days the new car, which will rival a Pullman in equipment, will be placed in commission. Although at first only available to special parties, the dining car eventually will be placed in general service, making four runs daily between Chicago and the Aurora and Elgin terminals.

Coal Testing and Timber Preserving at the Exposition.

Up in the Mining Gulch at the World's Fair in St. Louis there are now being completed two exhibits which perhaps equal any in the fair for interesting features, while standing far above the most in permanent value. These are the coal-testing plant of the United States Geological Survey and the timber-preserving plant of the Bureau of Forestry.

The Mining Gulch lies between the Palace of Mines and Metallurgy and the Inside Inn. Its entrance is diagonally opposite the southeast corner of the Mines and Metallurgy Building. The government coal-testing and timber-preserving plants stand along the railroad tracks which run up the gulch and are near the entrance. They are easily recognized from the fact that each building is painted with the red paint which is so commonly used on country barns. Each plant will depend for its operation or value largely upon Allis-Chalmers Company's machinery, in each case loaned without pay by the company.

The work of the coal-testing plant will be the determination of the respective fuel valves of every grade of coal which may be submitted. A 250-horsepower horizontal Allis-Chalmers engine in this plant will not only supply power for the various mechanical operations to which the samples of coal will be subjected, but will also serve to give practical tests through its power-producing qualities of the actual values of the various coals. The samples of coal will be analyzed, burnt under boilers under varied conditions, coked and used for gas producing. Their values for gas production and the power qualities of the gases will be tested in a gas engine. Records of every test will be kept, and it is believed that before the fair is over data will have been secured which may result in the early development of several new coal fields in the country.

The timber-preserving plant, which stands about a hundred yards farther up the gulch than the coal-testing plant, is under the direction of Dr. H. Van Schrenk of the Shaw Gardens, St. Louis. Its special work will be to test all the various methods offered for preserving railroad ties. For this purpose the Allis-Chalmers Company has lent, free of charge, a tie-treating retort and two tanks for the preservative solutions. Practically all the methods which are now in use for preserving railroad ties and other timber from rotting when exposed to earth and weather are alike in the treatment and differ only in the preservatives employed.

The system supplied by the Allis-Chalmers retorts and tanks consists in placing the ties in the retort, where the first operation is to dry out all of the water and sap by heat and exhaust all of this and the greater part of the air from the retort pumps proper. Then while the pores of the wood are all open and practically free from vapor moisture or air the preservative mixture is let into the retort from the tanks. The preservatives are thus, under the influence of the vacuum in the pores of the wood, carried into every part of the ties or timbers, no matter how thick or long they may be.

The great need of finding some process for making timber for railroad ties last in the ground beyond its natural life comes from the practical exhaustion of the country of its supply of such good timbers as white oak for this use. Railroads must to-day use timber of such kinds as they can get for ties, and much of this is of a very inferior quality. In order to protect these poorer class of ties from early decay many methods of preservative treatment have been devised, and almost every one has shown good results under certain conditions. At the plant now established in the gulch it is intended to treat various lots of ties by various processes. Each batch of ties will then be put into regular service in some railroad track and a record kept of each tie until it is worn out or rotted out. As these tests and records will be official, they will of necessity carry great weight with them.

Condition of Chicago Elevated Railways.

A statement of the operations of the elevated railways of Chicago shows that in their last fiscal year they earned 4.15 per cent. on a cash investment of $49,674,955 in the four properties. The amount given as investment represents the actual cash expended in the purchase of right-of-way, construction, power houses, real estate, and equipment necessary for the operation of the several lines from the time of organization to date, and has no reference to stocks and bonds.

The roads were all constructed from the proceeds of the sale of bonds. As these securities could not be marketed at their par value the companies have either paid, or are paying, interest on a larger amount of mortgaged securities than is represented by the cash invested. Deducting the interest charge, the official figures show that the profits which might be used for distribution to stockholders were equal to but 1.97 per cent. on the investment. Of the four systems only one is paying dividends. One line, the Lake Street elevated, did not earn the interest on its bonds and floating debt by $82,065.

The figures further show that the chief reason for the unprofitable character of the business lies in the cost of building and equipping an elevated railroad. This unusually heavy cost is not attributable to the structure and stations alone. With one exception, the elevated roads are largely built on private right-of-way. The companies purchased the property over which their lines were built. The Metropolitan elevated purchased its entire right-of-way, operating 37.66 miles of single track. The surface street railways operate in the streets at no expense for right-of-way, and with a relatively trifling cost per mile for construction, and they are at no expense for stations, street corners serving the purpose.

Excluding the Union loop, the local elevated railroads comprise 99.16 miles of single track, the average cost of which, including all investments necessary for operation, has been $500,957. The Chicago City Railway Company (surface), according to its last annual report, had 218.71 miles of single track. There was invested in the property $18,000,000. This includes real estate, power houses, equipment, etc., necessary for the operation of the property. The average cost a mile of the city railway's investment was $82,307.

A ZINC EXHIBIT AT THE WORLD'S FAIR.

Ohio Telephone Notes.

The Cuyahoga Telephone Company of Cleveland has brought an injunction suit against the Dime Savings and Banking Company of that city to prevent its further refusal to issue $167,000 bonds under an agreement when an issue of $3,500,000 was arranged. The bank was made trustee for the bonds. At the time $2,000,000 was issued and $100,000 more was to be issued when the first 1,000 telephones above 5,760 were put in operation. The next 1,000 called for $133,000 and in the same proportion up until the issue was exhausted. The bank has refused to deliver the last lot called for on the ground that lines using the same circuit from the same trunk, but otherwise separate are not single lines. The telephone company says that they are and must be so considered under the contract with the bank. The bank has filed a demurrer to the petition. All the money from this bond issue has been used in constructing the plant and making extensions.

Improvements are shortly to be made in the Federal telephone plants at Salem, East Liverpool and Sebring. General Manager McVey has been making a general inspection of the plants for the last few days.

The Phœnix Telephone Company of Steubenville has been connected with Wheeling, W. Va., and in a short time a service will be established between these points and Pittsburg. This will be done through extensions, which the Pittsburg and Allegheny Telephone Company is preparing to make.

The Germantown Telephone Company of Germantown is building a line north to connect with the Farmersville Telephone Company. It is believed that this will greatly improve the service of both systems.

Arrangements for the reduction of the debt of the Federal Telephone Company have had a good effect upon telephone securities in general, and the stock exchanges at Cleveland and other places have had opportunities for selling them when they can be had. It is beginning to be thoroughly recognized that the trouble experienced by the Everett-Moore syndicate was not that the properties were bad, but that they were caught under the necessity of placing some large bond issues when financial conditions were not favorable. The securities and the properties on which they are issued are as good as they ever were. The syndicate affairs have not been allowed to affect the individual companies, and the work of development has gone on as rapidly as could be under the circumstances.

The Columbus Citizens' Telephone Company of Columbus has filed notice with the secretary of state of an increase of capital stock from $750,000 to $1,250,000. The new stock will be preferred, cumulative, and draw six per cent. dividend.

The Franklin County Telephone Company of Columbus has been incorporated to build lines connecting that city with Westerville, Worthington, Galloway, Groveport, New Albany, Dublin, Hilliards, Lockbourne, Heyden, Reynoldsburg, Pleasant Corners, Black Lick, Girls' Industrial Home, Central College, Alton and a number of other places. Some of the lines have already been built. The capital stock is $150,000 and the incorporators are Isaac B. Cameron, Seth L. McMillan, Ralph Reamer, Homer L. Rose and Charles F. Johnson.

The Kentucky Court of Appeals has dissolved the temporary injunction recently obtained against Sol P. Kineon and others to prevent them from building telephone lines through Kenton County to connect their system with Cincinnati. This is considered a victory of Independent companies in that county. The Fiscal Court of Campbell County, Ky., has rejected the two bids for a franchise in the county, on the ground that both were too low. The Bell people bid $150 and the Kineon company $50, for the privilege of operating in the county. C.

Telephone News from the Northwest.

The telephone line from Brooten to Sunberg, Minn., has been completed.

The Hutchinson (Minn.) Telephone Exchange Company has increased its capital stock from $25,000 to $50,000.

The Northwestern Telephone Company has asked for an injunction preventing the Tri-state Telephone and Telegraph Company from making extensions to Winona and Willmar, Minn., from Minneapolis, according to their present plans, as it is alleged it will interfere with the wires of the plaintiff.

The Greenwood Prairie (Minn.) Telephone Company has moved into its new exchange.

The Elk River (Minn.) Telephone Company will build a line to Otsego.

The Zenith Telephone Company of Duluth, Minn., is making improvements on its system that will cost about $100,000. This includes considerable conduit work.

Waupaca, Wis., may have a new Independent telephone exchange put in.

A new rural line is being constructed into Jamestown, N. D., where it will connect with the Northwestern Telephone Company's system.

The Rothsay (Minn.) Telephone Company has filed articles of incorporation. The capital is $10,000 and W. J. Breen heads the list of stockholders.

James Abel will put in a telephone exchange at Lawton, N. D.

The Independent Telephone Company has applied for a franchise at Oconomowoc, Wis.

Application has been made for the appointment of a receiver for the North Dakota Telephone Company which operates lines from Grand Forks to Devils Lake, Larimore and other North Dakota towns.

The New London (Minn.) Central Telephone Company has completed its line at that place.

Blackburn & Spurlock, attorneys, have applied for a franchise at Omaha, Neb., for the Tri-city Telephone Company. It is planned to expend $500,000 in a system at Omaha, South Omaha and Council Bluffs, Iowa.

The E. H. Martin Telephone Company has installed a new 1,000-capacity switchboard in its exchange building at Webster City, Iowa. R.

Michigan Telephone Matters.

The Union Telephone Company has succeeded in winning out in a fight with the Michigan Telephone Company at Durand. The Michigan Telephone Company has cut down its exchange, and has dropped night and Sunday service.

The people of Delray and Woodmere are trying to bring about a change in telephone service, and agitation has been started for a telephone exchange. It is believed that this will have the effect of reducing prices.

A telephone war is in progress at Owosso, where the Bell company has operated very profitably until the Independent company was installed, which is also able to make a nice profit at a reasonable rate. The Independent company's patrons have increased steadily, until now the company has 950 telephones, besides a large number of rural patrons. This is considerably more than the number of telephones in use by the Bell company. Alderman Rigley has introduced a resolution ordering a contract made with the Bell people and ordering out all the Independent telephones in the city offices. This is asserted to be a result of a personal grudge against Mayor Parkill, who is also president of the Independent company. Hundreds of people are displeased because of the action of the council, which appears to have passed the resolution, and it is very likely to be rescinded. W.

TELEPHONE MEN.

President F. S. Dickson of the Federal Telephone Company, Cleveland, Ohio, and Mrs. Dickson are spending their vacition on the St. Lawrence River and at the Thousand Islands. They will be absent two weeks.

William B. Bentley has resigned as superintendent of exchanges of the City and Suburban Telephone Company at Cincinnati, Ohio, and his place has been filled by the appointment of J. E. Pavey, formerly superintendent of equipment.

Charles J. Glidden, for 17 years president of the Cleveland Telephone Company, and Mrs. Glidden, passed through Cleveland a few days ago with the New York-St. Louis automobile tourists. Mr. and Mrs. Glidden, who now reside in Boston, are engaged in making an automobile tour of the world and took this trip as a sort of relay. It is estimated that they will travel 40,000 miles if they make the trip proposed. They have already traveled 16,000 miles of this. They have the distinction of being the first autoists to drive a machine north of the Arctic circle. On August 16th last year they passed over this circle after a drive of 1,540 miles directly north in Sweden. They expect to continue on to the Pacific Coast after their machine is exhibited for some days at the fair in St. Louis.

EXTENSIONS AND IMPROVEMENTS.

The Maryland Telegraph and Telephone Company will issue $6,000,000 bonds, of which $2,000,000 will be used to build its proposed electric-light and power house, and the balance to retire the first mortgage bond and exchange for the general mortgage bonds.

A telephone line has been put in between Himrods, N. Y., and Dresden, Geneva, Penn Yan, Keuka and Dundee, by the Himrods Telephone Company, newly incorporated for this purpose. This is only another instance of telephone activity in the central part of New York state.

Preparations are being made by the New Telephone Company of Indianapolis for lengthening its underground system. Plats showing the extent of the contemplated improvement have been filed, and as soon as the material can be purchased work will be begun.

The monthly instrument statement of the Chicago Telephone Company shows an increase in the number of telephones connected to the system during the month of July of 918. The total number of telephones connected to the company's lines in the city and country is now 111,030, according to the report.

The Missouri Valley Long-distance Telephone Company is extending its lines and promises to be an important factor in the telephone business of Missouri. At a meeting of the directors of the Missouri Valley company, held at Carrollton recently, it was decided to build a copper-circuit toll line from Carrollton to Chillicothe. This will give the Chillicothe exchange direct connection with Kansas City, and will be a source of much revenue to the Missouri Valley company. The Missouri Valley is a home company.

Effective Organization of Independents in Ohio and Other States.

As a result of the plans formulated some time ago for an organization of Independent telephone companies in Ohio, it is probable that an association of more extensive scope—national or inter-state—taking in the two now in operation, will be formed along the thorough lines laid down in the Buckeye state. The object of such an organization will be the protection of Independent business from attacks of competitors, extending existing systems, establishing in new territory, standardizing equipment and the establishing of a basis for the interchange of business. A committee of the Ohio association is now in communication with Independent telephone men in other states. In Illinois the exchange managers have already become interested, and the result will likely be a strong organization that will cooperate with all others formed along the same line. The same plan of organization and work will run through from the district to the national body.

The executive committee of the Ohio association met at Columbus a few days ago and arranged for the organization of the state by districts and fixed dates for meetings in the various cities. The first will be held in Cleveland on the afternoon of August 16th and the second at Toledo the following day. The Lima district will be organized on the 18th, and so on until a meeting has been held in each of the nine districts. A plan for delegate representation was outlined in the Western Electrician some weeks ago. Each company is expected to send representatives. No company is so small that it is not entitled to at least one representative. Thus it will be seen that the plan takes in all, and an earnest endeavor will be made to have every company in the state as a member.

Independent interests have been going at rather a lax gait, it is said, for the last two or three years, and the weakness was not really discovered until the managers were brought face to face with the fact that their instruments were about to be thrown out of the postoffices. President Dickson of the United States Telephone Company and James B. Hoge of the Federal brought their forces together, however, and won a victory on that score. But they were by no means sure that an attempt to overcome difficulties in some other direction might not result in a different way, so it became apparent that the only safe course was a thorough organization of the allied interests. If possible the management of telephone interests in every state will be interested in the movement with the intention of making a national organization on the same plan as that adopted in Ohio. C.

GENERAL TELEPHONE NEWS.

The Bell Telephone Company has just completed the installation of a new telephone system in Denmark, S. C.

Improvements costing $15,000 are contemplated by the Charleston (W. Va.) Home Telephone Company. They include a trunk line to Columbus, Ohio, and short toll lines into the Kanawa coal fields.

The Pennsylvania railroad is putting in telephones between its signal towers and will use a telephonic system of intercommunication instead of the existing telegraphic methods to operate the block system.

The Rocky Mountain Bell Telephone Company has commenced action against the Utah Independent Telephone Company, asking that the Independent company be enjoined from using the same numbers as the Bell company in its business department.

Among the new work of the Cumberland Telephone and Telegraph Company at Natchez, Miss., is the installation of 100 telephones in the Natchez Hotel, being a telephone to each room. The Vidalia (La.) exchange is being equipped with a complete cable service, and a long-distance line between Vidalia and Jonesville, La., is being installed.

The Consolidated Telephone and Telegraph Company has been incorporated, with headquarters at Huntingdon, Tenn., and a capital of $50,000. The company intends to operate telephone lines in Hardin, Wayne, Perry and adjoining counties. The incorporators are J. K. and J. F. Barlow of Savannah, Tenn., T. S. Hughes of Clifton, Tenn., and F. E. Schwab of Nashville.

An ordinance has been introduced in the City Council at Covington, Ky., which provides for the sale of a franchise for a subway system for telephones and the transmission of messages and packages of merchandise. Just what is expected of this franchise does not appear, unless it is the intention to give the Independent telephone companies a chance to build an underground system through the streets.

The Minnesota Telephone Association (Independent) will hold its convention at the Fair Grounds, Minneapolis, on August 31st and September 1st. A number of interesting papers will be read and it is expected that there will be a good showing of exhibits by leading telephone supply houses. Among those who will address the convention will be J. J. Nate, who will talk on "The History of the Telephone."

Toledo Home Telephone Company Gives a Reception.

Judging from the reports in the Toledo (Ohio) daily newspapers, the people of that city were greatly interested in the reception extended to them by the Toledo Home Telephone Company on July 21st and 22d, and it is said that over 12,000 persons—patrons of the company and others—took advantage of the occasion to inspect the whole establishment, from top to bottom. Every visitor went away with a much clearer idea of the operation and management of the company than he possessed before. The result was entirely satisfactory, and the friendliest possible relations were established between the company and its subscribers. In connection with a reception, a beautifully illustrated souvenir booklet, "Let's Talk It Over," was distributed to each caller, and went a long way toward arousing the friendly and enthusiastic sentiments expressed by the subscribers. Not only was the reception a success from a social viewpoint, but the practical results were immediate, as much new business was secured; and it is believed that all Independent telephone companies might profit by this method of getting closer and better acquainted with their subscribers and friends.

MAIN OPERATING ROOM OF TOLEDO HOME TELEPHONE COMPANY.

Invitations were sent by telephone and by mail, and the handsome building of the company was thrown open from 10 a. m. to 9 p. m. on the days named. Flowers and plants were tastefully used to make more beautiful the various departments, and courteous young men acted as escorts and guides for the visitors. During it all service was uninterrupted, and the throngs saw all parts of the plant in actual operation. The plan originated with and was carried out by Vice-president Robert E. Hamblin and Manager C. E. Stinson of the Toledo Home Telephone Company, and as it was entirely successful, these gentlemen received many compliments.

TOLEDO HOME TELEPHONE COMPANY'S BUILDING.

The booklet above referred to gives some interesting information. The company is a home concern, as its name implies. Its franchise was granted in 1901 and it has erected a plant and created a service of the highest grade. An average of 152,000 calls is received on working days, and the number of subscribers connected is about 7,000. The present capacity of the main switchboard is 12,500 lines. There are 182,000 multiple jacks, 7,050 answering jacks and 1,950 trunk jacks—a total of 191,000 spring jacks on the board. The total number of connections in the exchange is 1,792,170, and the total number of underground wires is 19,600. The board is of the latest visual-signal type.

The operator's day is divided, of course, into regular "shifts," and the changing of these shifts is a matter much more complicated and important than it sounds. The operators in charge do not dare to leave their seats until the incoming girls are all ready to occupy them immediately. Accordingly, when one force is about to retire, and another to take its place, there ensues a very rapid and pretty piece of military drilling. The incoming operators form in line, each girl being allotted a special place in accordance with the position of her chair at the switchboard. Thus the first girl in line entering the door will occupy the last chair on the march around the horseshoe curve described by the switchboard; the second girl the second last chair, and so on down to the last girl, who occupies the first chair in the room. When the operators have marched around the room and taken a position at the back of their respective chairs, the girls occupying the chairs at a given signal make two moves—leaving their seats—while the newcomers slip into the places left vacant.

It is of interest to note that the number of calls answered by the information bureau, relating to new telephones, changed addresses and the like, reaches the astonishing total of 20,000 a day.

As shown by the picture, the company's building is an attractive one. It is well arranged for offices, power plant, terminal racks, main switchboard and the various departments of the exchange. The operators' dining and lounging rooms are on the second floor, and an especial effort is made to provide pleasant and cheerfully appointed rest rooms for the girls.

The Toledo Home Telephone Company is capitized at $2,500,000 and has about 250 employes. The plant was built by the Central Construction Company, in which Edward L. Barbour and James S. Brailey, Jr., are heavily interested. The Toledo company has introduced some innovations. For instance, it is possible for any patron of the company to call up "Central" and learn who called him up during an absence from home or from his office. Again, if a fire should be reported from any building occupied by a subscriber of the company as tenant, the subscriber, if he have a telephone at his home, will be immediately notified by the company.

MANUFACTURERS AND DEALERS.

The F. Bissell Company of Toledo, Ohio, is putting on the market its new Bullfrog flameproof wire for telephone-switchboard work. This wire, it is positively asserted, will not carry flame. It is made both duplex and triplex.

The Knickerbocker Construction Company of 15 Cortlandt Street, New York, has been awarded the contract for the installation of the underground and aerial cables for the new Lewiston-Auburn (Maine) Automatic Telephone Company, amounting to over 100,000 feet. The cable is being manufactured by the Stromberg-Carlson Telephone Manufacturing Company of Rochester.

The town of Neepawa, Man., is installing a modern telephone-exchange system, which will furnish both local and urban service to a large list of subscribers. In common with the policy adopted by a number of Canadian cities and towns, the plant will be controlled and operated by the municipality, and it is intended to afford the patrons a thoroughly up-to-date service. The entire order for apparatus, appurtenances, construction material and a large amount of lead-covered cable was awarded to the International Telephone Manufacturing Company of Chicago, which has furnished the equipment for nearly all of the Independent exchanges in the Canadian provinces.

Advices from New South Wales indicate that the beginning of the electrical conversion of the government railways will be on the line from Milson's Point to Hornsby.

Porto Rico's Telegraph Service.

In Porto Rico the insular government maintains a good telegraph service. It educates its own operators, and transacts the telegraphic business of the island in English and Spanish with equal facility. Every operator in the service must speak, read, write and receive from the wire in both languages, and all are expert typewriters.

To appreciate what this means it is necessary to recall the condition of affairs, when, after the United States government withdrew its military force, the civil officers of the insular government began the rehabilitation of the venerable telegraph system—a legacy of ineffectiveness and a travesty on its title. Tape and register were the rule, and speed in transmission was considered almost a joke. There was a telegraph-office sign hanging at 40 cross-roads throughout the island, and the Spanish government boasted of its "admirable communication with the interior." The fact was that the "raising" of an office on the wire was hailed as a triumph. Sometimes many hours, and even days, passed before communication could be established telegraphically, even with the wire in good condition. Operators were appointed through political influence, and a little thing like absence from their posts was by no means considered a sufficient cause for radical discipline. The Spanish manager of a telegraph office, where you filed your message, after several hours' trial, would tell you with a shrug of the shoulders that it was impossible to raise the office which should handle your dispatch. Worst of all, there never was anything done to remedy the evil.

How different is the situation now. The insular government has 42 offices in paying operation in Porto Rico. The island is 100 miles long and 36 miles broad, and very mountainous, yet the uniform rate is 25 cents for 10 words. There are 85 employes in the service, 14 of whom are women. A school is maintained in San Juan for telegraphic instruction. The school is divided into three classes. By gradation, not only telegraphy proper is taught, but before a pupil is employed he or she must be able to keep office accounts and reports proficiently, draw on blackboards correct diagrams of office and instrument connections and the topographic circuits of the entire island, and, in addition, demonstrate at the switchboard unquestioned ability to manage plugs, strips and battery understandingly and rapidly. The 14 women who are employed are in every way qualified to do all these things. Their reports are models of accuracy and neatness. The intercommunication of the insular system with a wireless system established in San Juan has given all operators a knowledge of space telegraphy. Heliograph work is also a feature of the instruction, and many of the operators are proficient with both day and night apparatus.

The lines are worked by 1,500 cells of bluestone. About 400 jars are located at each of the cities of San Juan, Ponce and Mayaguez. Renewals are made every three months. Climate seems to have no peculiar effect on solutions. About 100 miles of hard-drawn copper wire is in use. The majority of the wire is No. 9 G. I. All told, 1,300 kilometers of wire are in use. Poles are of hard native wood, a wood resembling mahogany being used extensively. There are many poles of tachuelo, ortegon and ausubo woods, which have been in use 30 years and which are still in fine condition, both above and below the earth. The first two woods will last indefinitely. Poles average seven and eight meters in length and 12 inches in diameter at base.

Operators are never paid less than $40 a month. The maximum salary is $1,200 per annum. Women are treated in every respect the same as men—required to do the same work and paid accordingly. Their employment marks the breaking down of the Spanish barriers of prejudice against woman's employment. The male Porto Rican fought hard against the innovation, but acknowledges now that the innovation has been justified by results.

For the fiscal year last reported the number of messages sent was 286,386 and the receipts $49,114.07, out of which $35,199.61 must be deducted for maintenance, showing $13,914.46 as profit. Considering the average salary paid, even at the humblest office, and the topographical difficulties of maintenance, a profit of one-third of the receipts is a creditable comparison with any of the large systems in the United States proper.

Dynamos could be used to advantage on the principal circuits. Storage batteries with rotary transformers or rotary transformers alone will soon be installed on main circuits. The Morse code is used. Wires are all single, although the pressure of business will soon require the use of the duplex at San Juan, Ponce and Mayaguez, on the San Juan-Mayaguez circuit. Spanish residents tried hard at the start to

successfully boycott the new system and wanted the old register scheme restored. They watched for "bulls" and mistakes like a cat watches a mouse. The service, by its admirable efficiency, however, has compelled universal acknowledgment that the insular government telegraph system is in every way excellent.

Telegraph lines parallel the tracks of the San Juan Railroad Company between San Juan and Carolina, San Juan and Camuy and Aguadilla and Ponce. Telephones, however, are used for dispatching trains.

Costs and Profits of Electric Railways in Germany.[1]

By Frank H. Mason.

The enforced publication of corporate finances and the exhaustive methods by which municipal accounts are kept and made public in Germany have enabled the Association of Electrical Engineers to collect and formulate some highly interesting statistics on the financial results which have followed the change from horse to electrical traction in street railways in this country. Although this transformation began later here than in Belgium and the United States, it was made with such promptness and energy that within a period of four or five years the horse car practically disappeared from Germany and was replaced by electrical tramways systems, which traverse all the cities and larger towns and connect each of them with practically every village and hamlet in a large and constantly extending radius. These systems have now been in operation long enough to supply some definite data as to the profits of such enterprises under existing conditions in Germany, which, measured by average street-railway dividends and the market value of their shares, have been in general somewhat disappointing. The net fact, which has been known to investors for some time, and which these newly formulated statistics confirm and explain, is that electric street-car lines, while serving the public infinitely better than any other method of city and suburban transportation yet devised, have proved in many if not most cases less lucrative to shareholders than the horse-car lines which they replace. There are several tangible reasons for this, some of which are more or less peculiar to Germany. Among these may be cited the fact that most German municipalities refused at the outset to permit overhead conductors to be used in important or centrally located streets, and the companies were therefore forced to use a costly type of car which would take its current in the suburban streets from an overhead wire carrying a voltage sufficient to charge at the same time storage batteries of sufficient capacity to run the car through the central districts where the trolley wire was forbidden. These storage batteries were heavy and expensive, they deteriorated steadily and were difficult to keep in order, and when the snow and ice of winter encumbered the tracks they failed so utterly in Berlin, Hanover and other cities that thousands of cars equipped with them had to be thrown out and their storage batteries removed. It was only at this heavy cost that the overhead trolley wire secured admission to the central districts of several German cities, and there are even yet in Berlin and elsewhere long stretches on important avenues where it is tabooed and underground conductors are insisted upon as indispensable.

A second important fact in this connection is that German municipalities are very exacting with tramway companies in respect to rates of fare, paving and all the other specifications of their franchises. Every step in the process of construction is subject to the inspection and control of the city engineers. Most franchises involve the responsibility of the company of laying and keeping in repair the pavement on all space between the two outer rails, a breadth, in case of double tracks, of 12 to 15 feet or more, and where, as in Berlin, the pavement is asphalt laid on deep foundations of rubble and cement, this becomes a heavy item in the cost of construction and maintenance, for no skill and experience seem able to avert the necessity of frequent upheavals for purposes of repair, in which asphalt and cement have to be cut out with cold chisels driven by sledges, a slow and toilsome operation.

Moreover, there are very few municipalities in Germany where electric current can be generated by any other or cheaper power than that of steam or gas engines, and no form of steam fuel is really cheap in this country. Although a very few of the largest central stations produce electric power as low as 1¼ cents per kilowatt-hour, in most others the cost averages from 2¼ to 3¾ cents, and in certain small stations as high as 10 cents per kilowatt-hour. Estimated by the ordinary German standard, the power consumption per car varies with grade, curves and other conditions from 450 to 700 watt-hours per car-kilometer, equal (in case of the latter figure) to 1,170 watt-hours per car-mile.

Finally, the outlay for track renewal and repair turns out here, as elsewhere, to be unexpectedly heavy. In the days of horse cars a well-laid track in a city of from 150,000 to 200,000 inhabitants would last from a dozen to 15 years. Now, with the far heavier and more frequent cars, the rails, especially at curves, wear in much less than half that period until the wheel flanges are found running on the bottom of the groove, so that the track has to be taken up and renewed. Another cause of frequent and expensive repairs lay in the fact that the surface resistance of the copper bonds with which the rail ends were united increased rapidly under certain conditions, until their use was largely superseded by the better system of welding the rail joints by means of electrical heat or thermite.

Still another increased item of expense has been that of labor. The motormen are naturally employes of a higher grade than horse-car drivers, and, being well organized, they have been able to compel increased wages and to shorten working hours, until the net labor cost per car-kilometer is more than 50 per cent. greater than in former years.

To all this is to be added the fact that the rates of fare in most, if not all, German cities are rigidly restricted by the authority granting the concession. In Berlin, for instance, street-railway fares anywhere within city limits are restricted to 10 pfennigs (2.38 cents), and for the same sum the passenger may ride on some of the suburban lines any distance up to seven kilometers (4.34 miles). From the latest published statistics, it appears that the average street-railway fares paid in 11 principal German cities during the year 1903 varied from 2.2 cents each at Frankfort to 2.72 cents at Hamburg, the mean average for Berlin and its suburbs being 2.35 cents, or less than half the usual five-cent fare that prevails generally in the United States. To complete the restrictions under which street railways operate in this country, most of their charters contain clauses providing that from a prescribed date the company shall pay to the municipality a portion of its surplus after disbursing a stipulated percentage as dividends. A typical contract of this kind stipulates that, beginning with 1903, the company shall pay to the city 35 per cent. of its surplus remaining after a 6½ per cent. dividend has been paid to stockholders, and 50 per cent. of the surplus after an eight per cent. dividend. Many charters further provide that after being operated by the companies for a specified term of years the whole installation, tracks, power plant, and equipment, shall revert in fee simple to the municipality which has granted to the corporation for a term of years the use of its streets.

The total length of German street railways at the close of 1902 was 1,906 miles, of which 346 miles, or about 18 per cent., were under municipal ownership. Of the latter, 65 miles were leased to individuals, leaving 281 miles of lines operated directly by the municipalities. The four longest municipal lines are at Frankfort, 26½ miles; Düsseldorf, 25 miles; Munich, 29 miles, and Cologne, 40 miles. It does not appear that fares over these lines are lower, but, on the contrary, that they are rather higher than those charged on similar lines worked by individuals or corporations. In Nuremberg, for example, the principal street railway charged, under private management, a uniform 10-pfennig (2.38-cent) rate, until the city, in order to complete a zone system, took over the private line and thereupon increased the rate of fare. On the whole, it cannot be said that experience has increased public sentiment in Germany in favor of municipal management of street railways, and several cities—among which is Barmen—which built their own lines, are now considering the plan of leasing them to private companies.

By far the largest and most important corporation of this kind in Germany is the Great Berlin Street Railway Company, which, with its various branches, operates 200 miles of track, of which 144 miles are owned and the remainder are controlled by the company. On its own lines the Grosse Berliner ran last year 40,400,000 car-miles and carried 295,000,000 passengers, whose fares aggregated $7,025,000. The total capital of the company is 100,082,400 marks ($23,819,611); its shares are today worth 184, and its 3½ per cent. bonds are quoted at 99.40. This, however, is the status of an exceptionally powerful and ably managed company in a large, level city, and is quite above the average financial condition of street-railway companies elsewhere in Germany, most of which have to be satisfied with four and five per cent. net earnings on their stock.

The Berlin company is at present in litigation with the city over a question which, as it involves the important point whether a municipality may grant franchises to new companies on streets already occupied by another lessee, has a certain pertinent interest in this connection. About two years ago there was opened for traffic the so-called elevated and underground railway, a double-track electric line of the most perfect construction and appointment, with two arms or branches running from a central station to points in the eastern and western parts of the city. Trains of three cars run over these branches at intervals of three to five minutes, and at such speed as to traverse a distance of 2½ miles in about 10 minutes. The line is very popular and carries an immense and steadily growing traffic, which naturally trenches more or less upon the business of the surface lines which belong to the Grosse Berliner. In order to reach a still more central and crowded portion of the city, the new company asks authority to extend its subterranean main stem from the present terminus at the Potsdam railway station northeastward to a point beyond the river. To this the Great Berlin company objects, and the municipality has applied to the courts to confirm its authority to disregard the protest and grant the franchise for what would be an important public improvement.

The one all-controlling fact which has enabled street railways in Berlin and other German cities to make head against the exacting requirements of municipalities and the enormous cost of conversion from horse to electric traction, with the increased outlay for labor, workmen's insurance, paving and other expenditures, has been the phenomenal increase in business, particularly in the suburban traffic in all the larger towns, which has come with the increased speed, the greater frequency of service, the better ventilation, space and comfort of electric cars. Whole suburbs have been built up within a few years by the influence of a single well-managed tramway line, which carries a legion of men and women to and from their daily toil in the city, more quickly and cheaply than the horse car could transport them half the same distance. And although the electric street railways of Germany, under the conditions above described are but moderately remunerative to shareholders, they hold a high place among the potent influences of modern civilization.

1. A report from the United States consul-general at Berlin, Germany.

The Law of Electric Supply in Great Britain.

[From the London correspondent of the Western Electrician.]

For many years now it has been felt that there have been several serious drawbacks in electrical legislation in Great Britain. The last act passed by Parliament relating to the supply of electricity was as long ago as 1888, and although vast strides have since been made in the industry, no effort has been made to keep pace with this advance so far as legislation is concerned. The need for reform was constantly, although more or less indirectly, being brought to the notice of the government, and in 1902 a powerful deputation from the Institution of Electrical Engineers waited upon the president of the Board of Trade and laid its grievance before him.

In 1903 the Board of Trade introduced in Parliament a bill called "The Supply of Electricity Bill," but at such a late period in the session that the crowded state of other public business in Parliament necessitated its abandonment.

This year the bill was revived and considerable progress made with it. It has already passed the House of Lords after considerable discussion and amendment, and as there is no reason to anticipate any serious opposition in the House of Commons, it is believed that it will pass. Therefore a brief comparison between the existing state of things and that proposed under the new act may be of interest.

In the first place a large reduction in the cost of obtaining parliamentary powers for supplying electricity is contemplated, inasmuch as it is provided that the provisional-order system shall be extensively used. This means that all differences between promoters and opponents are settled at a meeting held under the auspices of the Board of Trade, and that when Parliament is asked to confirm the decision of the board it is almost invariably a formal matter only. At present, under a large number of conditions, application has to be made direct to Parliament, and if the proposal is opposed it necessitates two expensive inquiries before committees. The new method of procedure would consequently place a much larger authority upon a single public body, and to this it is not unnatural that some dissatisfaction has been expressed. This opposition has also been strengthened because, as can quite be imagined, the measure, aiming, as it does, at an equality of advantage as between private companies and local authorities, takes away something with one hand and more than repays it with the other. This fact has been responsible for a large amount of the opposition, as both sides, with a selfishness which is sometimes termed business instinct, refused to partake in whatever disadvantage might be put upon them, at the same time willingly accepting anything giving them a gain over their present status.

The bill consists of 11 working clauses, the first of which was about the only one upon which both the companies and the municipalities found themselves in agreement. The clause has reference to land used for generating stations, and a great deal of discussion and litigation has taken place during the present year in this connection. The rather anomalous position exists that an electrical undertaker having purchased some land by agreement and erecting thereon a generating station, the owners of property on the adjoining land belonging to the same landlord can sue the electricity works for nuisance by vibration and actually obtain an injunction restraining the operation of the works. Two such cases happened this year, and the result was that the owners of the electricity works were compelled to buy up the neighboring property at an enormously enhanced value. If, on the other hand (but it seldom happens), the land for the generating station is purchased under an act of Parliament by compulsion, the neighbors can only secure an injunction against the works if negligence is proved. Therefore clause one places in the hands of the Board of Trade the power to grant the compulsory acquisition of land, with its consequent advantages, after a full inquiry into the facts.

Clause two is of local interest, but clause three for the first time allows the Board of Trade to grant provisional orders to a "bulk" supply authority to supply electrical energy to an existing electrical authority if necessary under compulsion. At present this can only be done by the authority of Parliament,

and if the consent of the local authority be withheld, this might be fatal to the chances of the scheme.

The right of purchase of electric-supply companies by municipalities has been a difficult question of late years, owing to the fact that many companies supply more than one local authority, and also to the fact that some companies have their generating stations outside the area of supply, thus leaving only the mains and perhaps the sub-stations liable to purchase by the local authority. This combination of circumstances has had the tendency to nullify the whole of the effect of the section of the existing acts relating to purchase, and a very necessary reform has been introduced into clause four of the present bill. In the first place the Board of Trade may, at its discretion, after full inquiry, exclude the application of the purchase clause from any undertaking. Further it is provided that a number of local authorities may combine in order to purchase a company which supplies the whole of them, and finally any company having under a special act of Parliament erected a generating station outside its area of supply shall not be liable to purchase without its consent.

A most contentious clause was clause six, which lays it down that the Board of Trade may dispense with the consent of any local authority to an application by a company to supply electricity within the area. This power of veto in the hands of local authorities has been a fruitful cause of the backwardness of applications of electricity so often to be seen in many towns in Great Britain, more especially in the matter of tramways. To the ordinary person, with prejudices neither way, it passes the understanding why a municipality should object to a scheme relating to its district and proposed by a company being heard by an impartial tribunal upon its merits. The chances are all in favor of the scheme being rejected if any fair reason is put against it by the local authorities. In tramway matters a scheme will not be looked at by Parliament unless the consents of the local authorities concerned are forthcoming. Therefore all interested in the electrical industry welcome this clause.

The remaining clauses relate to matters of detail, involving no important principle. The general trend of the bill is to meet a condition of affairs which has arisen since the passing of the Electric Lighting Acts of 1882 and 1888 and which could not possibly have been foreseen at those dates. The complaint has been that it is so long delayed. Even now [July 27th] since the bill above referred to was passed by a House of Lords committee a fortnight ago, nothing further has been done, and there is a fear that after all it may not be passed into law this session. There is a genuine complaint against such measures being brought in at the fag end of a session. Whether a change of government will bring about an improvement remains to be seen. G.

Obstacle for Trackless Trolley Company.

If the opinion of the attorney-general of Pennsylvania is to become general throughout the country, trackless-trolley companies may for some time experience considerable difficulty in securing charters for the promotion of their enterprises. Governor Pennypacker of Pennsylvania has recently been advised by Attorney-general Carson not to issue a charter to the Sayer Trackless Trolley Company, which proposed to operate trackless cars in Bradford County, on the ground that there is no law to authorize the chartering of such a corporation, and it would not come under the various laws governing street railways. Mr. Carson says: "All existing companies are subject to restraint. This proposed new company would be without restraint. No statute applies to it. It is not a railway nor a railroad, nor an omnibus line. If it were attempted to subject it to restraint of existing statutes, it might be found that no statute could be judiciously stretched to cover it, hence a gigantic creature of the state's creation had risen to roam at will, uncontrollable, because beyond the reach of the law."

New Telephone-cord Manufacturing Company.

The Runzel-Lenz Electric Manufacturing Company has recently been organized under the laws of the state of Illinois for the purpose of manufacturing telephone and switchboard cords and switchboard cables. The plant is located at 97-101 South Clinton Street, Chicago, and is equipped with the most modern and expensive machinery for manufacturing cords and cables. It is the purpose of this company to manufacture the highest class of goods at moderate prices. This company is now in a position to supply the trade in general. It consists of W. L. Runzel and J. M. Lenz. Mr. Runzel has been actively engaged in the electrical field for a period of 16 years and his experience in the cord and cable branches has covered a wide range. For the last two years he has been superintendent of the Stromberg-Carlson Telephone Manufacturing Company's cable plant at Rochester, N. Y. Mr. Lenz has been identified with the leading Independent telephone manufacturers for a period of eight years. Every prospect of success waits on this new and enterprising company.

CORRESPONDENCE.

Great Britain.

London, July 26.—The government has just introduced a bill having reference to the granting of license for the erection of space-telegraph installations. It applies to the whole of the British Islands and to all British ships while on the high seas or in the territorial waters abutting on the coast of the British Islands. The licenses, which must be obtained, will be granted by the postmaster-general with the consent of the Admiralty, the Army Council and the Board of Trade, and will be for such period as the postmaster-general may determine. The penalty laid down for not obtaining a license is $50 for a first conviction and $500 for a conviction on indictment, or imprisonment. Any apparatus so used without a license will be liable to be forfeited. The government has already very wide powers under the telegraph acts, and by some it is thought that the space-telegraph act above mentioned is superfluous, but apparently this is not the view of the advisers to the government. The object of the bill as officially set forth is to give the government control over space telegraphy in order to preclude its improper use in time of war or in any other national emergency. It is presumed that all British ships carrying outfits now will, should the bill pass into law this year, have to obtain licenses to continue working. Even experimental apparatus will have to be licensed.

In view of the general tendency there is nowadays to submit so many matters to arbitration for settlement the following figures will be interesting. They relate to the arbitration which decided the price which the Marylebone Borough Council had to pay to the Metropolitan Electric Supply Company for the portion of the company's undertaking within the Marylebone boundaries. The total costs in round numbers was $167,500, and of this the lawyers took $62,500 and the expert witnesses $46,250. The tenders for the council's new undertaking have now been obtained, and Messrs. C. A. Parsons, the turbine builders, were the successful bidders for the electrical machinery, tenders also having been sent in by the Westinghouse company and the British Thomson-Houston Company among others.

The question of converting the horse tramways in the north of London to electrical traction has always presented some difficulty to the London County Council. The three parties concerned are the London County Council, the various borough councils and the company to which the lines are leased. The latter, quite naturally, have always resisted the conduit system, first on the score of expense and also because the trolley system would enable intercommunication with an extensive system just being put into operation outside the county of London. The County Council originally favored the conduit system and agreed with the borough councils to this effect. But probably on account of their experience in the south of London the council is inclined to considerably modify its former attitude, and as a matter of fact has come to something like an agreement with the company in the matter, much to the indignation of the borough councils. And the embarrassing part of the whole business is that the trolley system cannot be installed without the consent of the borough councils. But it is only another example of a state of things that has retarded the electrical industry in several directions in Great Britain in the past.

Great diversity of opinion exists at the present time in Great Britain as to the necessity for a depreciation fund in connection with municipal electrical undertakings, and those that agree that some such fund is necessary are by no means agreed as to the exact percentage which should be set aside year by year. A special committee was appointed by the Hudderfeld corporation a short time ago to inquire into the finances of the tramway undertaking and they report it as an absolute necessity that three per cent. per annum on capital outlay should be set aside as a depreciation fund, regardless of receipts. It is also put forward that this should be materially increased in the future before any sums are voted from the profits for the relief of the rates, as otherwise portions of the track and plant will require renewal long before they are paid for.

The British Association for the Advancement of Science sent a powerful deputation to wait upon the prime minister last week with the object of invoking his aid toward securing some kind of state aid for universities. As usual, it ended with a promise to consider the matter, but as it is practically certain that a general election will take place in the autumn it looks as if the effort will have been wasted. G.

New York.

New York, August 6.—It is officially announced this morning that cars will run over the Williamsburg Bridge on October 1st.

Mayor McClellan on Tuesday signed the franchise of the Westchester Company for a system of electric trolleys in the Bronx. Those interested in the rival Port Chester scheme have, however, not reached the end of their legal resources and threaten to contest the legality of the new charter. Many Bronx residents think that there is ample room for both systems should they be faithfully carried out and not merely held over to prevent the operation of other possible franchises. One of the conditions of the granting of the application of the Westchester Company is that provision must be made in the company's conduits for three cables for police and other official telephone wires, as required by the Board of Aldermen from time to time.

The New York Central railroad has filed plans for an immense power house about a mile from Glenwood station. The building will be similar to that under construction at Port Morris, and the architect, Charles Wellesley Smith, promises that the foundations will be completed by January 1, 1905. This is the fourth or fifth power house planned by the New York Central, whose officials, by the way, are chary in giving out information for publication.

The New York and Rockaway Beach Railroad Company, which is to all intents and purposes the Long Island railroad, has renewed its lease with the Long Island railroad for 50 years. The New York and Rockaway Beach company operates the two-track trestle line across Jamaica Bay, and in the course of the coming winter the whole length of the trestle will be widened for four tracks. By the beginning of the holiday season of 1905 the trains will be run by electricity.

The Interborough Rapid Transit Company has just constructed a bridge between its Eighteenth Street elevated station on Sixth Avenue and the adjacent Siegel-Cooper dry-goods store. This is a notable innovation and should be quite a valuable asset for the store.

Ex-deputy Police Commissioner Piper before the expiration of his term of office visited London and Chicago, and as a result formulated a scheme of traffic regulation for this city. The Piper methods have been tried piecemeal and found satisfactory, and they are now to be systematically applied in the lower part of the city. One of the new regulations provides that heavy trucks must not move along the surface car tracks. The last-named rule has been strongly urged by the Merchants' Association, which is now taking action on the state railroad commissioners' report on traffic improvement. The merchants urge that longer surface cars should be installed in Manhattan. This agitation has inspired a humorist to prophesy that the coming cars will ultimately stop at two blocks at once and that the number of the street will depend upon which end of the car is used for alighting.

A committee of owners of property around Prospect Park, Brooklyn, has petitioned Mayor McClellan to take steps to bring about speed-regulations for the Brooklyn Rapid Transit cars. The Prospect Parkers want the speed limited to eight or 10 miles an hour, and suggest that an indicator be placed in each car to show the speed in miles per hour at any moment of motion. This complaint is really curious, for the Brooklyn Rapid Transit surface cars have long had the reputation of being the slowest-moving cars in Greater New York.

Sufficient consents have been obtained to authorize the laying of a track along the Thomson Avenue and Hoffman Boulevard in Long Island City, so that an entirely new section of Queens Borough can be traversed by the New York and Queens County railroad. Long Island City will thus be connected with Jamaica.

The famous Brooklyn Bridge, built 21 years ago, is now considered by experts to be carrying the utmost traffic it will bear. The two lines of surface cars run day and night during busy times at a headway of only 102 feet, and there is besides heavy traffic on the two elevated tracks. These lines are all worked by electricity, but two duplicate sets of metals accommodate the cable cars which are still used for local bridge traffic. There is also the foot-passenger promenade and the two roadways for vehicles. Constant attention is needed to keep the bridge in good condition and it is practically certain that the structure will have to be rebuilt in a few years.

The lockout ordered for next Monday by the Building Trades Employers' Association of this city will affect about 2,500 electrical workers. There are indications that the painters, whose action has occasioned the lockout, will surrender.

The New York Edison Company announces that its aggregate installation on Manhattan Island is approaching the equivalent of 3,000,000 16-candle-power lamps.

Justice McCall of the Supreme Court has dissented from the view that electric switches, wires and meters are real estate, and has accordingly reduced the tax assessment of the Edison Electric Illuminating Company of Brooklyn (controlled by the New York Edison Company) from $1,664,850 to $364,580, and has also wiped out an assessment of $80,000 on this corporation's real property for the year 1900.

The law which prohibits automobiles to be taken on to ferry boats under their own power does not, apparently, affect electrically-driven vehicles. The object of the regulation, which is now being enforced, is to protect the ferry boats against fire risks, and the gasoline supply has to be disconnected before an automobile can be put on board.

John D. Rockefeller is now making honey (as well as money) in an indirect way by electricity. Mr. Joseph H. M. Cook has a scientific apiary at Essex Falls, N. J., and feeds the bees on glucose manufactured at the New York Glucose Company's factory at Edgewater, N. J. This company, with an invested capital of about $4,000,000, is controlled by Mr. Rockefeller. At this factory electric machinery equivalent to 5,000 horsepower has been installed, and produces a daily output of 12,000 barrels of glucose and by-products.

Madeline Brooks, a young woman who some time

ago obtained compensation for injuries sustained by falling from a Coney Island car, has been arrested at Syracuse, N. Y., and now admits that she makes a business of falling off cars and feigning injuries.

W. S. Mears and New York associates have organized the Mears Ear Phone Company, with a capital of $100,000.

President William H. Baldwin, Jr., of the Long Island railroad is satisfactorily recovering from the effects of his recent operation.

The estate of the late William C. Whitney has been valued at over $21,000,000. Among Mr. Whitney's personal property were large numbers of shares in the Electric Vehicle Company, the Nassau Light and Power Company, and the Public Service Corporation; but, contrary to expectation, Mr. Whitney did not hold any of the stock in the Metropolitan street railway at the time of his death. The death duties on the estate amounted to $222,222.

Norman McCarty of the American Diesel Engine Company will return to New York on the 10th inst. from a prolonged business trip out West. Mr. McCarty has sold a large number of engines for the installation of small electric plants.

The W. C. Vosburgh Manufacturing Company, which makes a specialty of electric fixtures, has removed to a new and commodious factory and showrooms at St. Mark's and Underhill Avenues, Brooklyn. The firm's New York showroom remains at 23 West Twenty-fourth Street.

The Downward Electric Light Company has removed from 225 Fourth Avenue, to 32 Union Square, a distance of two blocks. The new office is fitted up with every modern improvement, and is in an entirely new skyscraper. Mr. James C. Wormly continues in charge, but is at present on a well-earned vacation.

Some ingenious new electric devices have been put in at the "Galveston Flood," a popular entertainment place at Coney Island.

The New York office of the London Times, 225 Fourth Avenue, has a telephone in every room, or 11 extensions altogether. At the New York Edison Company's general offices, 55 Duane Street, the rule is to have a telephone at every desk. In the contract department there are 18 instruments in use, and two of the larger desks have two instruments apiece. Even the mailing clerk has a telephone at his elbow. This seeming extravagance is fully justified by experience.

The New York and New Jersey Distributing and Circulating Company, more often characterized as the "poolroom syndicate," obtained an order on Friday for the restitution of its telephone service. The instruments were seized by the police in May, and although the police failed to sustain their charges, the telephone company refused to continue its service. D. W. W.

New England.

Boston, August 6.—The Norfolk-Western Street Railway Company's property was sold at Dedham last Wednesday to Fred S. Gore, a well-known Boston contractor and paver, for $18,100. The sale was decreed by the United States Circuit Court, and is subject to a mortgage for $100,000, held by the Beacon Trust Company. The road had been in the hands of receivers for a number of weeks.

A special parlor car constructed for President William A. Bancroft and his associate directors of the Boston Elevated Street Railway Company made a record run a few days ago with a party of officials aboard, speeding from Boston to Lynn, where there is a stretch of track across the Lynn marshes for a few miles with no speed limitations set upon it, at the rate of 72 miles an hour.

A disastrous head-on collision occurred on August 1st near Southboro on the Boston and Worcester Railway Company's line. Neglect to wait at a turnout was followed by the accident, and an investigation to fix the blame therefor is in progress. One woman passenger was killed; the motorman of one of the cars sustained fatal injuries, dying on Thursday; a young Boston actress was injured so badly as to necessitate amputation of one of her legs, and nearly a score of others required medical treatment, some being at the hospital still in a serious condition. B.

Southeastern States.

Charlotte, N. C., August 6.—The town of Newberry, S. C., has purchased from the General Electric Company a new outfit for lighting the town, consisting of two dynamos, sixty-five street lights, switchboard, etc. The new system cost $5,905.

It is said that an electric railway will be constructed from Eagles Nest, a summer resort, to Waynesville, N. C., a distance of five miles. Benjamin Sloan, proprietor of the Heyward White Sulphur Springs at Waynesville, is one of the promoters.

The directors of the Catawba Power Company at Fort Mill, S. C., at a recent meeting, decided to increase their capital stock from $750,000 to $850,000.

It is announced that the Knoxville Traction Company of Knoxville, Tenn., will expend $500,000 in building an electric railway through West Knoxville, and making improvements on the system and purchasing new cars.

The stockholders of the Birmingham Railway, Light and Power Company have decided upon a $10,000,000 bond issue to be protected by a mortgage. Part of the issue will be used to retire outstanding bonds. The greater part will be used, however, in carrying out projected and actual improvements. The company has also lately secured several large steam-heating contracts. L.

Texas and Mexico.

Austin, Texas, August 4.—The Arlington Light and Power Company has been organized for the purpose of installing and operating an electric-light and power plant at Arlington, Texas. It has a capital stock of $10,000. William Dugan is one of the incorporators.

J. O. Stillman, representing the American De Forest Wireless Telegraph Company, has been at Houston for several days making preliminary arrangements toward the establishment of a wireless-telegraph station there. He says that similar stations will be established in all of the principal cities of the state.

F. M. Haines, general manager of the North Texas Traction Company, denies that that company contemplates building an interurban electric line to Mineral Wells from Fort Worth.

It is stated that H. Woodson, who, as the representative of a syndicate of capitalists, is promoting the building of an interurban electric railway between McKinney and Bonham, is making satisfactory progress with the preliminary arrangements for the fulfillment of the enterprise. The road will be about 40 miles long. Hon. Rosser Thomas of Bonham can give information in relation to it.

Frank Remberts and G. D. M. Grigsby, who are the principal owners of the Texas, Sabine Valley and Northwestern railroad, contemplate extending the road from Center, Texas, to Shreveport, La., and to operate it with electric power.

The Rothschild syndicate, which owns the Inguaran copper mines in the state of Michoacan, Mexico, has just completed the installation of a large electric-light and power plant at the mines. The electric energy is generated by a waterfall near the mines.

Porfirio Torres Camarenas of Guadalajara, Mexico, has petitioned the state government for an exemption from taxes for a period of 10 years on an electric-light and power plant which he will install at Arandas, Mexico.

The construction of an electric railway between Guadalajara, Mexico, and the city of Aguascalientes is being considered by a syndicate of American capitalists. Among those who are said to be interested in the project are E. P. Shaw, former secretary of state of Massachusetts, W. H. Wilkinson and E. T. Barnett of Boston. The distance is 210 kilometers.

Engineer Arthur E. Springall has completed the survey for the proposed electric railway between Guadalajara, Mexico, and Chapala. This project is being promoted by J. N. Zermeno, an attorney of the City of Mexico. It is reported that Jose Maria Bermejillo, the millionaire Spaniard of Guadalajara, who owns the street-railway system in that city, is interested in the scheme.

At a recent meeting of the board of directors of the Compania de Tranvias Electricos at Torreon, Mexico, it was decided to endeavor to merge that company and the Torreon Electric Light Company into one concern. It is proposed that the same plant shall furnish power for lighting the city and operating the new electric street-railway system there. Engineer Fred Wulff can give information.

Aurelio Reyes of Guadalajara, Mexico, has entered into a contract with the City Council of Ameca, Mexico, for the establishment of an electric-light and power plant there. The plant will be operated in connection with the alcohol factory of Mr. Reyes at that place, and will cost about $20,000.

The City Council of Ixtlan del Rio, Mexico, has entered into a contract with Messrs. Ugarte and Garcia Fuentes of Guadalajara for the establishment of an electric-light and power plant at that place. The contract calls for the installation of 20 arc and 800 incandescent lights. It is the intention of the contractors ultimately to secure power from the falls of Elojo de Agua, situated about 40 miles from the place.

D. Aguirre & Co., who operate large cotton mills at Tepic, Mexico, have made a proposition to the City Council of Tepic to install an electric-light and power plant for furnishing lights and power for the city. If the proposition is accepted, machinery will be installed and the plant will be operated in connection with the company's cotton mills.

James Menzies of Boston has been in the City of Mexico completing arrangements for the installation of the new telephone system in that city. It is said that all of the preliminary requirements of the concession, which was obtained from the Mexican government for the proposed system, have been complied with. The work of laying the conduits for the underground wires will soon be under way.

The Markham Rice Milling Company of Markham, Texas, has built a new telephone line from the Markham rice mill to the El Camp rice mill, via the town of Midfield.

The work of constructing the new telephone system at Brownsville, Texas, has been commenced. The same company will establish a telephone exchange in the city of Matamoros, Mexico, situated opposite Brownsville. Judge James B. Wells of Brownsville is the principal stockholder.

The Mutual Telephone Company, which was recently organized at Waxahachie, Texas, will build a telephone line to Dallas and other places. W. D. H.

Ohio.

Cleveland, August 6.—Members of the Cleveland City Council and other city officials went over the route of the Doan Street cross-town line a few days ago and out on Woodland Hills where people are asking for railway conveniences. It is said that they are now a little more favorably impressed with the need of additional lines, but their antipathy to the company may prevent them from granting a franchise anyway. They have an idea that they will be able to force the company to any terms they may desire by holding up franchises for all new lines, notwithstanding the fact that the people are asking for the extensions. The Toledo Railways and Light Company is meeting with about the same opposition, although the people have been asked to express their wishes at public hearings given by the council committee on railways. It is possible that such action will be taken as the majority of the people desire. It seems that the officials want the road to make concessions in the way of lower fares and more liberal transfers, but a fare of less than six tickets for 25 cents would probably not enable the company to keep up the system properly and make a sufficient profit to pay fair dividends on the stock.

The Cleveland Electric Railway Company has secured a temporary injunction in the United States Circuit Court to prevent the city from giving the franchises on the streets now occupied by the Woodland and Central lines to the Forest City Railway Company. The hearing will take place on October 8th. The city claims that the franchises of the company on these lines expire in September, 1904, and March, 1905, respectively. The company claims they do not expire until 1908.

The officers of the Chicago and Indiana Air Line Railway Company, chosen a few days ago, are all Cleveland men. The name of the company was changed to the Chicago, Lake Shore and South Bend Railway Company and the capital stock was increased to $3,000,000. A bond issue was also approved. The line between Chicago and South Bend is to be completed this year.

The Harrison Water and Light Company of Harrison, Ohio, has been incorporated with a capital stock of $25,000 by A. L. Rich, V. T. Chambers, W. H. Theobald, G. W. Stearns and A. A. Kramer.

The Automobile Transfer Company of Cleveland has been incorporated with a capital stock of $10,000 to operate a general automobile livery and transfer business in connection with hotels. G. B. Siddall, F. A. Quail, O. G. Beehtel and others are interested in the scheme.

It is reported that Howard Campbell of Napoleon, Ohio, is planning a road to connect a number of Northern Ohio towns with Ann Arbor, Adrian, Saline and some other towns in Michigan. He will probably apply for a franchise in Ann Arbor at once.

It is said that the Toledo Urban and Interurban Company will probably take charge of the Toledo, Bowling Green and Southern on a lease about the first of the year. Besides paying the floating debt of the company the new corporation will probably make some extensions to the line.

Private right-of-way is being secured through farms by the Dayton, Germantown and Middletown Traction Company, which is expected to begin construction within a short time.

Several public meetings have been held in Toledo the past week to discuss the proposed new franchise to the Toledo Railways and Light Company. The worst feature in this case is that the people will not believe that it requires as much money to operate and maintain a system as is reported, and they think that immense profits are made. Some of the daily newspapers are doing all they can to stir up sentiment against the railroad company and cause it to put its rates of fare down beyond reason.

The investigation of the affairs of the Miami and Erie Canal Transportation Company before a referee has been postponed until it is seen whether plans for a settlement of the trouble come out all right. Cleveland and Cincinnati interests have been in consultation the last week and it was agreed to buy the claims against the company, Cincinnati people taking 40 per cent. and the Cleveland people the remainder. Those who purchase the claims will be protected by a first mortgage on the property. It is believed that all the claims can be settled for $60,000. Plans are also being made to reorganize the company or form a new company to complete the line to Dayton and put it in operation. It seems that many yet believe the state will grant the company rights that will enable it to get on a paying basis. It will probably take $250,000 to do this. A bond issue will have to be made and the stock assessed from $1 to $3 a share. The investigation has shown that it will be better to get the company on its feet than to allow the suit to proceed and perhaps place it in a more difficult position than it now occupies.

An agreement has been entered into between the Lake Shore Electric and the Toledo, Port Clinton and Lakeside by which the latter will run its cars over the tracks of the former between Genoa and Toledo. This will enable the company to put a good portion of the new road into operation at an early date. O. M. C.

Michigan.

Detroit, August 6.—James W. Walker, for some years consultnig engineer for the State Tax Commission, and A. H. Green, manager of the Solvay Process Company, have formed a partnership as consulting engineers in Detroit. Mr. Green will not sever his relations with the Solvay Process Company.

The Ann Arbor council has adopted a resolution which cuts down the speed of the Detroit, Ypsilanti, Ann Arbor and Jackson Electric Railway Company's cars to the rate of four miles an hour over a section of the track on Packard Street. The resolution will be in force until the company puts in heavier rails.

Wallace Franklin, Michigan manager for Westinghouse, Church, Kerr & Co., stated in an interview to one of the Detroit papers that he was unable to interest eastern capitalists in Michigan electric roads owing to the attitude of the Michigan Legislature in regard to taxation of steam and electric companies. Mr. Franklin is interested in the Grand Rapids, Grand Haven and Muskegon electric railway and other roads. It is understood that he is trying to finance a new proposition.

Assistant General Manager Brooks of the Detroit United Railway has given out a statement that his company will not equip its cars with a different fender from that now in use, although the council has passed resolutions requesting a change to a more effective guard. Mr. Brooks stated that the fender now in use is adequate and safe, and that the motorman has all he can do to operate a lever, controller brake, gong and sand lever, without being required to operate a complicated fender.

The new 800-horsepower engine set up in the Detroit Public Lighting Commission power house has been put in operation. Additional lights will be placed about the City Hall as soon as the engine has been thoroughly tested. The engine-and-generator unit showed a capacity of 570 kilowatts.

The Bay City and Caro Electric Railway Company has obtained a franchise through Bay City. Under the terms of the ordinance the road may not build extensions to any towns in the direction of Saginaw between Caro and a point three miles outside the Bay City limits. This cuts out any Saginaw schedule except by way of Bay City. It is asserted by the promoters of the road that Tom L. Johnson of Toledo is heavily interested in the project and that the company is the same which is pushing the Saginaw Southern line. It is also asserted that the company wishes to build west from Bay City to Midland and Clare and also establish a summer resort on the Kawkawlin River, seven miles from Bay City. The life of the franchise is 20 years.

It is rumored that W. A. Boland will build an electric railway from Jackson to Lansing. It is understood that a trip was made overland this week, in company with James P. Clark and Charles B. Hole of New York and William Stargo of Jackson.

The sale of the $250,000 water and electric-light bonds of the village of Alpena, made on June 25th, has been declared off. The bonds must now be readvertised and sealed bids will be received up to August 20th, when they will be opened and contracts awarded. The premium on the first sale was $10,000.

C. G. W.

Northwestern States.

Minneapolis, August 6.—Capitalists are contemplating building a trolley line from Sioux Falls, S. D., through Egan to Brookings.

The contract for the erection of a transformer house at Stillwater, Minn., has been let by the Twin City Rapid Transit Company to O. H. Olson. The power stations there and at Wildwood will be closed.

Bids will be received by the county clerk of Hennepin County, Minn., for installing plates in the battery tanks in the courthouse at Minneapolis.

Bids will be received until August 24th for erecting a power house at the Central School at Mason City, Iowa.

Fairbanks, Morse & Co. have secured the contract for a new engine and dynamo for the electric-light plant at Starbuck, Minn.

The Twin City Rapid Transit Company has been given a franchise for building a branch electric railway from Wildwood to White Bear, Minn.

The Des Moines (Iowa) City Railway Company will erect a car barn between East Grand and East Walnut Street and will extend its lines to that place.

The Cass Water, Light and Power Company's plant has been completed at Cass Lake, Minn.

The Winona (Minn.) Railway and Light Company will issue bonds for $400,000 with which to refund its old indebtedness and to improve and extend the present system.

The Sioux City Traction Company of Sioux City, Iowa, will extend the stockyards line to the Morningside line, doing away with the old elevated road. It will cost $30,000.

An electric railway will probably be built shortly from Racine to Burlington, Wis.

R.

Rocky Mountain States.

Salt Lake City, Utah, August 5.—The plant of the Salt Lake City Water and Electrical Power Company has been sold at public auction, the property selling for $37,500. The report of the commissioner has been filed, but the sale has not yet been confirmed by the court. The price previously fixed by the court was $45,000. W. S. McCornick, a wealthy banker of Salt Lake, was the purchaser. Notices, claiming the right to redeem in case the amount realized would not cover outstanding claims, were filed by creditors.

The Utah Light and Railway Company of Salt Lake has let a contract for the building of a transformer near its plant on the Jordan River at a cost of $15,000.

The Postal Telegraph-cable Company has made application to the council of Salt Lake City for the privilege of operating its system here. Outside of the city limits the poles of the Rocky Mountain Bell Telephone Company will be used by the company.

Preliminary work on an electric railroad to be constructed from Santaquin, Utah, to Preston, Idaho, is progressing and actual construction work will be commenced during the next few months. Senator Reed Smoot of Utah is the chief promotor of the enterprise.

Articles of incorporation of the Nevada Transit Company, which will construct an electric system between Reno and Sparks, Nev., have been filed with the secretary of state, the capitalization being $250,000. H. E. Reid, H. J. Gosse, S. H. Wheeler, H. J. Darling and E. R. Dodge constitute the board of directors. Surveys are completed and grading has been commenced.

G.

Pacific Slope.

San Francisco, August 3.—The Farnsworth Electrical Works, now located at 185 Minna Street, will soon remove to a fine large store in the Crossley Building, corner of New Montgomery and Mission Streets, in the center of the electrical supply district. This house makes a specialty of renting motors and repairing all classes of electrical machinery.

The Martland Electrical Company, a concern whose specialty is the wiring of modern buildings, has taken offices in the fine new building just opened for occupancy at 738 Mission Street.

An electric water heater has just been placed upon the market by Dr. Waterman of San Francisco and is meeting with success wherever used. The heating part consists of a resistance coil and is connected to an ordinary lighting circuit by means of a plug screwed into the lamp socket. The ordinary size consumes about five amperes of current and will boil water in one minute, it is said.

The San Francisco, Oakland and San Jose Railway Company, known locally as the Key Route, is doing a large business, and a third ferryboat is under construction. A new electric train to Piedmont has been put on.

J. K. Burch of San Francisco is in Lakeport investigating the advisability of erecting a light and power plant there. The company which Mr. Burch represents recently erected an electric plant at Mendocino City.

The East Shore and Suburban Street Car Company ran its first electric cars over the system on July 28th. The road at present connects the two towns of Richmond and will be extended steadily to connect with the lines of the Oakland Transit Company.

The Middle Fork Electric Company has been organized at Grant's Pass, Ore., for the development of power on the Middle Fork of John Day River. R. C. Reese of Dixie Meadows is president of the company.

J. W. Hartzell of Vallejo, representing the Vallejo, Benicia and Napa Valley Railway Company, has been awarded a franchise by the trustees of Suisun, Cal., for the construction and maintenance of an electric railway line over certain streets of Suisun.

The United States government has granted the application of Chief Engineer Ruddock of the North Mountain Power Company for a right-of-way for a pole line through all the public lands en route from the source of power in Trinity County to Eureka, Cal.

E. D. N. Lehe, manager of the Dixon Light and Water Company at Dixon, Cal., reports that he has made preliminary arrangements for installing an electric-light and power plant in Winters, this state. He has lately completed the installation of the several power plants on the banks of Putah Creek, the last of which is within six miles of Winters.

The trustees of Oceanside, Cal., have granted a franchise to John Johnston, Jr., for maintaining a gas and electric plant at that place.

The Riverside Home Telephone and Telegraph Company has been incorporated at Riverside, Cal., by J. Van Liew, F. W. Wachter, F. F. Graves and others, for the purpose of building a telephone line from Riverside to Corona, thence to Elsinore, via Hemet and Perris, and from Riverside to San Jacinto, via Hemet and Elsinore. The capital stock is placed at $500,000.

The trustees of Healdsburg, Cal., will have to readvertise for bids for their increased power plant. The reason is that the contracts formerly awarded were not preceded by advertising for the requisite number of days.

The Humboldt Milling Company of Fortune, Cal., proposes to extend its electric-light system to various points in the valley.

The West Side Telephone Company has been incorporated at Healdsburg by J. McClish, J. B. Wattles and others. The capital stock is placed at $6,000. The company will conduct a rural telephone line from Healdsburg, connecting the ranches in that section.

A.

PERSONAL.

Much sympathy has been expressed for Professor William A. Anthony, professor of physics and electricity at the Cooper Union Institute, New York, who is suffering from a hip fracture and a lacerated scalp resulting from a bicycle accident.

Mr. Charles L. Edgar, president of the Edison Electric Illuminating Company of Boston, was recently presented a fine bronze bust of Edison by his employes, associates and friends. The bust stands on a pedestal, the total height being six feet three inches.

George G. Mulhern, superintendent of the Cleveland Electric Railway Company, has been nominated on the Republican ticket for sheriff of Cuyahoga County, Ohio. Mr. Mulhern has been connected with Cleveland railways for many years, and is popular in business circles, as well as with the railway men.

E. B. Dwight, who has been manager of the Great Western Telegraph Company of Canada, with office at Detroit, Mich., has resigned, and, as the company will not operate an independent office, the work will be done by the Western Union Telegraph Company, which, it is understood, has control of the Great Western stock.

Colonel W. Worth Bean, president of the Benton Harbor and St. Joseph (Mich.) Electric Railway and Light Company, was in Chicago early in the week. Colonel Bean did not make the run around the end of the lake in his automobile this time, but he has done so before this, and he is prepared to give expert information to any one who wants to know about the sandy roads between St. Joseph and Chicago.

W. P. S. Hawk, superintendent of the sixth district, western division of the Postal Telegraph-cable Company, has decided to change his headquarters from Helena, Mont., to Salt Lake City, in order to be more centrally located in the new territory. Mr. Hawk has charge of the company's system from Rawlins, Wyo., to Spokane, Wash., embracing Wyoming (west of Rawlins), Idaho, Utah, Montana and Washington as far west as Spokane.

Friends of Mr. Max Osterberg, consulting electrical engineer, 11 Broadway, New York city, will be grieved to learn that he was taken suddenly and seriously ill about August 1st, the cause of his illness being cerebral apoplexy. The doctors have not given up all hope of his recovery, but it is said that his condition will probably never be such that he can again return to his former duties. Mr. Osterberg is a member of the American Institute of Electrical Engineers and he enjoys the respect and esteem of his associates.

Mr. H. P. Usher, for many years general business manager for the Goulds Manufacturing Company, Seneca Falls, N. Y., manufacturer of pumping machinery, has recently severed his connection with that company to engage in business for himself. Mr. Usher will locate in Los Angeles, where he has acquired an interest in the business of the S. J. Smith Machinery Company. A dinner was tendered Mr. Usher on July 16th by the company and was attended by the heads of the various departments. One of the pleasant features of the gathering was the presentation to Mr. Usher of a handsome gold watch and chain, suitably marked, as an evidence of the esteem in which he is held by his associates, who part with him with regret. Mr. Usher is very well known in the pump world as an exceptionally active and capable business man.

ELECTRIC LIGHTING.

T. R. Osmond of New York city contemplates establishing an electric-light plant at St. Augustine, Fla.

A new sub-station is now in course of erection at Hempstead Village, L. I., for the Nassau Light and Power Company.

The city of Douglas, Ga., has provided a bond issue of $20,000, the proceeds to be used for the construction of an electric-light plant and system of waterworks.

The Hopkinsville (Ky.) Gas and Electric Company has been incorporated to continue the plant of the Hopkinsville Gas and Light Company. W. T. Tandy and J. A. Young of Hopkinsville and W. C. White of Cadiz, Ky., are the interested persons.

By the breaking of a piece of machinery recently in the municipal electric-light plant at New Richmond, Wis., the plant was badly wrecked. One of the large dynamos was completely destroyed and other machinery and apparatus about the plant was broken.

An electric-light plant will be added to the large oil mill at Blossom, Texas, and will also be used for lighting the town. Machinery has been purchased and the plant is to be in operation in September. The plant will be owned by the Blossom Oil and Cotton Company.

The Sidney Light, Heat and Power Company of Sidney, Ohio, has been incorporated with a capital stock of $150,000. H. T. Bailey, J. W. Brown, F. W. C. Bailey, Wilson Carothers, E. J. Griffis, Andrew Dobbie and George T. Spahr are the incorpo-

rators. Messrs. Dobbie and Spahr are residents of Columbus.

William Dugan, F. A. Hood and associates have incorporated the Arlington (Texas) Light and Power Company and will supply electric light and power.

ELECTRIC RAILWAYS.

A judicial decision handed down this week states that dogs cannot be allowed to ride in trolley cars.

The Town Council of Bloemfontein, South Africa, has passed a resolution to introduce a system of electric railways. The Public Works Committee is preparing specifications, and advertisements calling for bids for the concession are to be published in South Africa, America and Europe.

Reports from Port Huron, Mich., state that the St. Clair Tunnel Company has decided to abolish the use of steam power and adopt electricity for moving trains through the Grand Trunk tunnel under the St. Clair River. A third-rail system, it is said, will be put in at an expense of $400,000.

J. F. Turk of Hammondsport, N. Y., has returned to that village after a prolonged stay in New York city, where he has been negotiating for the construction of the proposed electric road between Branchport and Hornellsville, via Hammondsport. He has not revealed the result of his trip, but it is assumed that the line will be constructed.

The local street-railway carmen's union of Bloomington, Ill., after a fight of seven months for an advance in wages, recognition of the union and easiest runs for the older men, has decided to call off the strike on the Bloomington and Normal Railway, Electric and Heating Company. The strike has been in progress since January 1st.

Of the Chicago elevated railway, the Northwestern and Metropolitan show slight gains for the month of July, compared with July of last year, while the South Side line showed a falling off. The Northwestern carried a daily average during July this year of 60,816 passengers and 59,393 last year. The Metropolitan carried an average of 102,142 this year as against 102,057 in July a year ago. The South Side company fell off in its daily average of passengers from 76,236 in July last year to 69,899 this year.

PUBLICATIONS.

A cleverly executed brochure entitled "What We Do" is issued by the Wellman-Seaver-Morgan Company of Cleveland, Ohio. This company does a general engineering and manufacturing business, and covers a wide field in the line of heavy machinery for mines, steel works and the like.

"A Girlless Telephone Proposition" is the title of a pamphlet issued by the Automatic Telephone Equipment Company of Boston. The pamphlet is of a lively sort, calculated to impress the reader with the advantages of the Strowger automatic telephone-exchange system. Some good arguments for the telephone as a business proposition are put forward, containing also a number of testimonials to this fact from leading business firms throughout the country.

The Fort Wayne Electric Works has just sent out two bulletins, No. 1056 and No. 1057, and a Catalogue of Parts, No. 2010. Bulletin No. 1056 clearly sets forth the individual points of excellence which combine to make the company's type-A transformers equal to the strenuous service for which they are built. The various parts are well illustrated and described. Bulletin No. 1057 equally well describes and illustrates the company's multiphase revolving-field belted generators, while catalogue No. 2010 shows every part of the form-C Wood alternating-current 104-volt arc lamps, with a detailed description of each part and a complete price list.

Bulletin No. 3057 of the Emerson Electric Manufacturing Company of St. Louis is descriptive of Emerson clutch pulleys for motors of one-sixth horsepower and smaller and gives a showing of miscellaneous pulleys for Emerson motors. A table is given showing the speeds obtainable from some combinations of grooved pulleys listed by the company. This company also publishes the Emerson Monthly, the last issue of which contains articles on uses of electric blowers, Peerless vibrators, hints on cleaning fans, back-geared induction motors, Emerson bargain list and an index to Emerson bulletins. Additional copies will be furnished on request.

A neat booklet, illustrating principally the company's exhibit at the Louisiana Purchase Exposition, has been published by the Bullock Electric Manufacturing Company. The Bullock exhibit at the Fair is one of exceptional interest and shows representative types of Bullock machinery and apparatus, all exhibited in motion. The booklet also shows the company's works and some of its motors, generators, controllers, etc. Several fine halftones of installations, made by the company for large power plants, are given, including one of the yoke of the 3,000-kilowatt generator for the Cincinnati Gas and Electric Company's plant, said to be the largest direct-current generator ever built.

SOCIETIES AND SCHOOLS.

The annual convention of the Ohio Electric Light Association will be held in the West House, Sandusky, on August 16th, 17th and 18th.

The Carnegie technical schools of Pittsburg are to have a department of electrochemistry, which, it is said, will be one of the most complete in the world.

It is reported that Professor Curie, the joint discoverer of radium, is to be the first professor of physics in the University of Paris, this new chair having just recently been created by the voting of a fund for the purpose by the French Chamber.

The engineering department of the University of Colorado is in charge of Henry B. Dates, S. B., dean. Regular four-year courses in civil, electrical, mechanical and chemical engineering are provided. The degree of bachelor of science is given. The university is a state institution and is located at Boulder, a thriving city of 10,000 inhabitants, 30 miles north of Denver.

The Electric Club of Pittsburg will have its second annual outing on Saturday afternoon and evening, August 27th. The steamer Francis J. Torrance has been chartered for the occasion. The club now has a membership of 600 from among the ranks of the various Westinghouse interests. The newly elected board of directors has completed its organization for the year 1904-05, with B. B. Abry as president; K. C. Randall, vice-president, and C. E. Downton, secretary.

TELEGRAPH.

The Western Union Telegraph Company is rebuilding its line from Chicago to Evanston, Ill., and is stringing a number of new wires. This work is part of an extensive plan of improvements between Chicago and Milwaukee.

According to Pittsburg reports, the Pennsylvania Railroad Company and Western Union Telegraph Company have renewed their right-of-way dispute. It is said that a cross-bill to a suit against the Western Union company has been filed in the United States Circuit Court by the Pennsylvania company. The bill asks the court for a perpetual injunction against the defendant company to restrain it from using any portion of the telegraph lines along the line of the Cleveland and Pittsburg railroad, claiming that the defendant company has no right to the use of the poles or wires, as all agreements and contracts made between the companies are now void. A partition of the property or the sale of the telegraph lines is also asked for.

MISCELLANEOUS.

The Rock Island railway is considering the advisability of installing a complete electric plant for its shops at Horton, Kan.

The Lincoln mine of the Jones & Laughlin Company of Pittsburg, located in the Mesaba range, near Duluth, Minn., has just completed the installation of a system of electric haulage, the second in the state and the first system of the sort on the Mesaba range. Four motor cars are used, two in the mine, hauling 20 tons of ore each.

The question of holding a large international exhibition in England is being discussed by important business firms of the United Kingdom, and the proposition is about equally favored and opposed. It is argued by some that a free-trade country has no need for an exhibition, "which merely helps foreign firms to copy methods." On the other hand, it is pointed out that this argument is equally strong both ways.

It is reported that the recent test of an electric "mule" for towing at Schenectady made such a favorable impression upon the legislative committee now considering the electric towing of canal boats that it is suggested that it will not be necessary to build the $101,000,000 barge canal from New York to Buffalo. The report, or rather the suggestion based upon it, apparently emanates from interested political or railroad quarters.

TRADE NEWS.

Electric cranes and other modern appliances are to be installed in connection with the harbor improvements at Victoria, State of Espirito Santo, Brazil.

A consular report states that an electric plant is to be installed at the freight depot at Brussels, Belgium. The depot belongs to the government, and the contract had not been placed at the time of writing.

The Maltby Lumber Company of Bay City, Mich., has changed its name to the Maltby Cedar Company. The company is one of the most progressive pole and tie concerns in the field.

For the purpose of carrying out extension projects that have been in contemplation for some time, the Westinghouse Electric and Manufacturing Company has offered to stockholders the remaining 50,000 shares of its treasury stock at $80 per $50 share. Holders of record on August 8th will be entitled to subscribe to the additional $2,500,000 at the rate of one share for every nine shares then held, the subscription lists to close August 15th. The balance sheet of the Westinghouse company as of March 31st last, which was issued on August 2d, showed a large increase in surplus. The surplus on that date was $11,882,105 as against $8,812,399 on June 30th of last year.

According to the United States Bureau of Labor the average wages of men employed in factories making electrical machinery in 1903 were as follows: Armature winders, 24 cents an hour; brass finishers, 27 cents; machinists, 27 cents; pattern makers, 37 cents.

F. M. Yarver, W. M. Foran, W. C. De Vane and W. C. Bryant have incorporated as the Savannah Electric Repair Company and will open an electric-repair house in Savannah, Ga. The company has a capital of $6,000 and privilege of increasing to $25,000.

The Yesbera Manufacturing Company of Toledo, Ohio, calls attention to its electric prisms, adapted to any incandescent lamp. These prisms are supported by the lamps themselves, no holder sockets being necessary, giving a neat and attractive appearance besides diffusing a softened light in every direction except below the level of the lamp, where the rays are intensified, owing to the refractory power of the prisms.

The Columbus (Ohio) Storage Battery Company has sold its whole business, including patents, stock, good will, etc., to the Dayton (Ohio) Manufacturing Company, which is now prepared to furnish storage-battery information relative to complete installations, with every facility at hand for the manufacture of storage cells from the smallest types up to 20,000 ampere-hours capacity or larger if desired. George W. Frost, who has acted in the capacity of sales manager for the Columbus Storage Battery Company for the last two years, will devote his entire time to the storage-battery branch of the business of the Dayton Manufacturing Company.

A receiver has been appointed of the assets of the Hutchinson Acoustic Company, manufacturer of appliances to improve hearing, 18 and 20 West Thirty-fourth Street and 110 to 114 West Twenty-third Street, New York. The action is the result of a suit brought by John T. Sproull as trustee of a mortgage of $50,000 made by the company in February last to secure an issue of bonds, in proceedings to foreclose the mortgage for nonpayment of interest due on August 1st. The company was incorporated in October, 1901, as a New Jersey corporation, with a capital stock of $500,000, and in January last was reorganized as a New York corporation. At that time its plant and machinery were valued at $40,000. The company had no rating at Bradstreet's.

BUSINESS.

It is reported from Trenton, N. J., that the potteries of the country making electrical goods, have agreed to combine to prevent cutting in prices.

The Buckeye Engine Company of Salem, Ohio, is calling attention to its electric blue-printing machines. Prices and full descriptions are furnished on application.

John H. Fowler, president of the Fowler Companies, Chicago, the well-known cedar producers, has just returned from a short trip in which business and pleasure were combined. Mr. Fowler states that his companies are doing a good business in the pole and tie lines.

C. E. Corrigan, vice-president of the Osburn Flexible Conduit Company of New York, was in Chicago last week in the interest of his company. Mr. Corrigan says that "Flexduct," the conduit manufactured by the Osburn company, is being used more extensively than ever.

The Lane & Bodley Company of Cincinnati is sole builder of the Twentieth Century heavy-duty Corliss engine. A cross-compound engine of this type (20 and 40 by 54-inch cylinder dimensions) is in service in the Intramural railway plant at the St. Louis Exposition and attracts much attention.

The American Electric Fuse Company has on exhibition at its office in Chicago one of the company's latest type of Allen-Bradley electric crane controllers, and demonstrations will be given to anyone interested. This controller has recently been tested by a number of the largest manufacturing companies in the United States, with excellent results. It is guaranteed for one year to purchasers.

The Nernst lamp is fast becoming introduced in the West as an efficient electric light for all kinds of commercial-lighting service. The Denver office of the Nernst Lamp Company, in charge of Mr. R. D. Marthens, has lately received contracts for lighting the United States Army Post at Fort Logan, Colo., and also the Central Drug Company, A. A. Turnace Billiard Hall, and the Schilling Mercantile Company, all of Cripple Creek, Colo.

The National Electric Company, successor to the Christensen Engineering Company, Milwaukee, manufacturer of Christensen air brakes and electrical machinery, has just completed extensions to its foundries and is soliciting orders for open-hearth crucible steel, semi-steel, iron and brass castings. Its foundries are equipped with every facility for rapid and economical output, and as the nature of its own work demands castings of the highest grade, material

furnished on orders will be of the same quality and receive immediate attention.

Pass & Seymour of Solvay, N. Y., call attention to their all-porcelain strain insulators, made of fine, strong porcelain. Actual test, it is asserted, shows that they will withstand any strain up to the breaking point of the ordinary size of wire used for guys and trolley-wire supports.

The Churcher alternating-current rectifier, manufactured by the Electrical Appliance Company of Cincinnati, is proving very successful. Automobile storage batteries may be charged from an alternating-current source. The company states that the apparatus is cheaper to install and has a greater efficiency than a motor generator. Descriptive bulletins will be sent on request.

A writer in the Brooklyn Eagle draws an interesting comparison: "The future of General Electric is admittedly full of great possibilities. Some persons identified with the company are confident that it will become more valuable as an investment than the Pullman company. It is pointed out that in addition to its value as a manufacturing concern Pullman possesses great value as the holder of real estate in large tracts near Chicago. The General Electric owns considerable real estate in New York and is the holder of many properties that are growing rapidly in value, such as the Schenectady Street railway, the New Orleans Street railways, etc. The Pullman company pays eight per cent. dividends on its stock and is earning about 15 per cent. General Electric pays eight per cent. dividends and is believed to be earning easily 25 per cent. The outlook for an important growth in its business is considered by some observers to be better in the case of General Electric than in the case of Pullman. These various considerations have drawn attention to the discrepancy in the prices of the two stocks, Pullman selling at about 222 and General Electric at 164. The reserve fund of the General Electric Company, in proportion to its capital, is about equal to that of Pullman."

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued (United States Patent Office) August 2, 1904.

766,166. Electric Sparking Plug for Gas-Engines. Albert Buchner and Elmer P. McClure, Chicago, Ill. Application filed March 19, 1902.

An electrode-carrying sleeve is inserted in the plug and an insulating bushing, inserted through the sleeve, carries the electrode.

766,171. Apparatus for Signaling from Graves. Edwin S. Crosby and Ell R. Henry, Lake Charles, La. Application filed November 27, 1903.

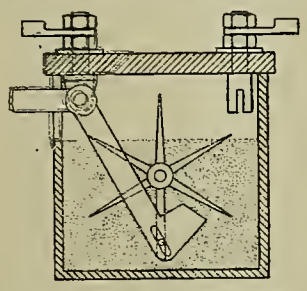
A conduit from an oxygen reservoir leads to the coffin. Mechanism for opening the oxygen reservoir, comprising a lever and a suspended weight held normally above the lever, are connected, with means arranged within the coffin so that the buried person may cause the descent of the weight and open the oxygen reservoir, at the same time throwing an electric bell in circuit with a battery to give an alarm.

766,177. Trolley. Orin Funkhouser, New Brighton, Pa. Application filed June 26, 1903.

The trolley wheel is held upon the wire by arms attached to the harp and extending upward.

766,182. Clipping or Grooming Machine. Albert L. Hale, Chicago, Ill. Application filed March 30, 1903.

A machine for clipping or grooming horses is driven by a flexible shaft attached to a small enclosed electric motor.



NO. 766,187.—ARC EXTINGUISHER.

766,187. Means for Extinguishing Arcs. Rudolf E. Hellmund, New York, N. Y. Application filed November 28, 1903.

Means are provided for opening or breaking the circuit. A mechanical device is used for moving a quantity of pulverulent substance, such as sand, near the arc, there being a connection between the circuit-opening device and the latter device, whereby they will act simultaneously. (See cut.)

766,189. Telegraphy. Francis W. Jones, New York, N. Y., assignor to the Postal Telegraph-Cable Company, New York, N. Y. Application filed November 13, 1903.

The movement of a key lever at one station is reproduced by a circuit controller at the other. This movement is produced by two Wheatstone transmitters, operated by perforated strips.

766,192. Measured-service System for Party Lines. James L. McQuarrie, Chicago, Ill., assignor to the Western Electric Company, Chicago, Ill. Application filed December 14, 1901.

Two service meters or connection registers at the central station corresponding to the sub-stations, respectively, are connected in alternative branches of a local circuit. An electromagnetic switch is adapted to transfer the local circuit between the alternative service meter branches. The electromagnetic switch is responsible to the operation of a suspension switch at one sub-station, but irresponsive to the operation of that at the other.

766,200. Machine for Inspecting Nails. Charles W. Sponsel, Hartford, Conn., assignor of one-half to Charles F. Taylor, Hartford, Conn. Application filed September 25, 1903.

Electromagnetic means are embodied in the machine for holding and turning the nails for inspection as they pass through the machine.

766,201. Magnetic Chuck. Charles W. Sponsel, Hartford, Conn., assignor of one-half to Charles F. Taylor, Hartford, Conn. Application filed February 6, 1904.

Essentially the chuck consists of a magnetic carrier, a coil, an electromagnet and means on the sides of the carrier and projecting above the magnet for preventing the effect of residual magnetism when the magnet is de-energized.

766,216. Storage Battery. Frank T. Cable, New Suffolk, and Grant E. Edgar, Greenport, N. Y., assignors to the Electric Boat Company. Application filed February 26, 1903. Renewed December 19, 1903.

A storage battery having an inner tank containing the cells is provided with covers for the cells, an outer tank, a cover on the outer tank elevated above the cell covers, thus providing a space over the cells, and an inlet and outlet to the space for maintaining a current of air over the cells.

766,223. Telephone System. William M. Davis, Chicago, Ill., assignor to the Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y. Application filed March 9, 1903.

Associated with the primary and secondary windings of an induction coil included only serially between the limbs of a telephonic circuit is a battery and a transmitter included in the circuit and a receiver included in a shunt circuit about the secondary winding to receive directly a portion of the current flowing in the circuit and to receive in addition the currents induced upon the secondary winding by the primary winding.

766,224. Selective-signaling System. William M. Davis, Chicago, Ill., assignor to the Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y. Application filed April 6, 1903.

A polarized signal bell and a serially connected condenser are connected between each line conductor and the return path. A rheotome signal bell in a circuit of high impedance is connected between one of the line conductors and the return path, a variable impedance being connected between the other line conductor and the return path to balance telephonically the bimetallic line. Means are located at the central station adapted to connect the terminals of a source of alternating current between either of the line conductors and the return path and to connect the terminals of a source of direct current between the return path and that line conductor to which the rheotome signal bell is connected.

766,225. Apparatus for Transmitting Messages by Telephone. Edgar W. Day, Baltimore, Md. Application filed April 11, 1904.

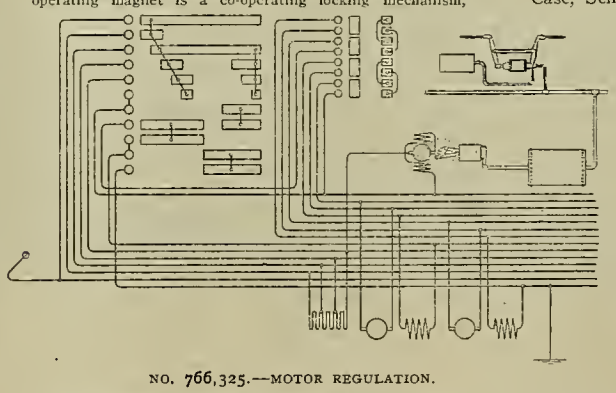
Telephonically transmitting the sounds reproduced from a series of individual phonograms is accomplished by a series of controlling devices corresponding to the phonograms and controlling respectively the individual telephonic transmissions.

766,229. Speed Controller. Edwin R. Douglas, East Orange, N. J., assignor to the Crocker-Wheeler Company, Ampere, N. J. Application filed February 24, 1903.

A roller connected by several link levers to the controller handle of the rheostat follows over the surface of the stock in the lathe. As the diameter is reduced by continued cutting, the levers act to move automatically the rheostat handle and increase the speed of the motor, maintaining the same circumferential velocity of the stock.

766,241. Telephone Locking Mechanism. Rudolph W. Goerb, St. Louis, Mo., assignor to the Controller Company of America, St. Louis, Mo. Application filed April 20, 1903.

Combined with a telephone, its call signal and call-signal operating magnet is a co-operating locking mechanism,



NO. 766,325.—MOTOR REGULATION.

a coin-controlling releasing mechanism for the locking mechanism and means whereby the magnet operates the call signal. The call-signal operating magnet can also operate the releasing mechanism to release the locking mechanism.

766,244. Self-oiling Bearing. Frederick Hachmann, St. Paul, Minn., assignor of 30 thirty-seconds to Frank L. Gazzolo, John R. Patty, Thomas L. Billingsley, Stuart B. Shotwell, Otto Muller and Charles Brenck, St. Paul, Minn. Application filed October 5, 1903.

A self-oiling bearing for trolley wheels is described.

766,248. Mechanical Electric-current Interrupter or Circuit-breaker. John O. Heinze, Jr., Lowell, Mass. Application filed March 9, 1904.

Conductor segments are placed on the periphery of a drum and insulated therefrom. Each segment forms part of a circuit and brushes follow along the segments, the circuits being broken at intervals by insulations which lift the brushes.

766,256. Electric Time Switch. Arthur W. Hutchins, Providence, R. I. Application filed April 27, 1904.

Escapement and releasing mechanism through which the switch proper is automatically opened and closed includes a swinging lever continuously traveling clock-controlled members operatively connected with the escapement mechanism, and means carried by and movable with the lever of the escapement mechanism and actuated by a tripper or member of the clock mechanism.

766,284. Insulated Hanger for Arc Lamps. Henry J. Pfiester, Cincinnati, Ohio, assignor of one-half to William A. McCallum, Cincinnati, Ohio. Application filed March 7, 1903.

A bell-shaped casing inclosing the top and sides of the insulator is divided in an axial plane. Means detachably unite the parts, the casing having a rib extending around its inner circumference and adapted to engage a corresponding groove in the insulator.

766,288. Electric-welding Clamping Device. Adolph F. Rietzel, Lynn, Mass., assignor to the Thomson Electric Welding Company, Lynn, Mass. Application filed December 4, 1903.

A clamp-bearing jaw or slide and a clamp-jaw detachably secured thereto are supplied with an adjusting screw for the slide and a fastening rod for the jaw passing longitudinally through the screw.

766,309. Control of Alternating-current Motors. Gabriel Winter, Vienna, Austria-Hungary, and Friedrich Eichberg and Johann Alexander, Berlin, Germany, assignors to the General Electric Company, Schenectady, N. Y. Application filed November 16, 1903.

The method of controlling an alternating-current machine consists in supplying alternating current to both members of the machine and varying simultaneously the voltage and phase of the current supplied to one member.

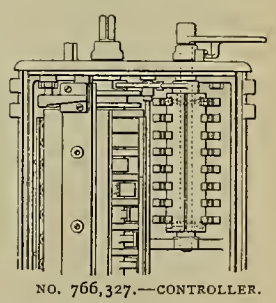
766,310. Control of Alternating-current Motors. Gabriel Winter, Vienna, Austria-Hungary, and Friedrich Eichberg and Johann Alexander, Berlin, Germany, assignors to the General Electric Company, Schenectady, N. Y. Application filed November 16, 1903.

In an alternating-current machine are means for supplying alternating current to both members of the machine and means adapted to vary simultaneously the voltage and phase of the current supplied to one member.

766,319. Switch Attachment for Cluster Electric Fixtures. Walter L. Bradshaw, Cambridge, Mass. Application filed May 27, 1904.

The device described comprises a cluster box and a cord-supporting and strain-relieving device in the box in engagement with the box.

766,325. Regulating Electric Motors. Frank E. Case, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed April 15, 1898.



NO. 766,327.—CONTROLLER.

The invention embodies a controlling device for the motor, brakes for the load and means actuated by turning on the controller of the motor for positively disengaging the brakes. A detent under the control of the motorman retains the brakes out of engagement with the moving load. (See cut.)

766,327. Controller. Fred B. Corey, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed February 4, 1903.

A reversing-switch cylinder comprises segmentally shaped interchangeable units, each of the units carrying sufficient contact segments to act as a complete reversing-switch cylinder for a predetermined number of motors. (See cut.)

766,335. Electric Railway. Philip Farnsworth, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed February 21, 1901.

A feeder, conductor sections and switches for connecting the sections with the feeder are associated with coils

which progressively close the successive advance switches, also coils which progressively open the successive rear switches. Auxiliary switches are operated by the coils which close the advance feeder switches to energize the coils which open the feeder switches of sections to the rear.

766,351. Reversing Switch. George H. Hill, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed March 11, 1903.

A unit for a switch cylinder comprises a disk of molded insulating material and a pair of conducting elements embedded in the insulating material and accessible from opposite sides of the disk.

766,353. Electric Billiard Register. Porter S. Hotchkiss, Lake City, Iowa, assignor to the Electric Billiard Register Company, Lake City, Iowa. Application filed August 6, 1903.

In an electric billiard register are a dial and an indicator with electrically operated means for moving the indicator step by step relative to the dial. Automatic means return the indicator, and electrically actuated means release the returning means.

766,354. Telephone Box. Charles C. Hughes, Baltimore, Md. Application filed December 10, 1902.

A telephone instrument includes a box having its back open. The box carries a transmitter, a receiver, a switch and a pair of electric terminals. A cover closes the back of the box and has line-wire terminals upon it to engage the terminals of the box when the cover is on.

766,355. Telephonogram Apparatus. Christian Hülsmeyer, Düsseldorf, Germany. Application filed October 13, 1902.

The apparatus comprises a telephone circuit, a mirror, means operated by the circuit for oscillating the mirror and means for throwing a constant bundle of rays of light on the mirror. A lens system concentrates to a band the rays reflected by the mirror. A transparent plate between the mirror and the lens system increases or diminishes in transparency continuously corresponding to the sine of the angle of incidence, and a sensitive film receives the rays when concentrated.

766,360. Fire-alarm System. Benjamin P. Ketcham, Carthage, N. Y. Application filed August 6, 1903.

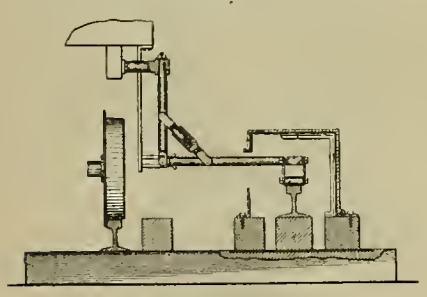
An alarm circuit is automatically governed by an annunciator circuit and has an electromagnet installed therein. An alarm mechanism, a power shaft for actuating the alarm mechanism, means for holding the power shaft against rotation and releasing it, the means being governed by the electromagnet, and a governor controlling the power shaft are the other features.

766,365. Apparatus for Washing Storage Batteries. James P. Lough, New York, N. Y. Application filed May 17, 1904.

Water is circulated through the battery by a pump, and the liquid is then caught in a precipitating tank.

766,369. Telegraphic Apparatus. Charles Meray-Horváth, Budapest, Austria-Hungary. Application filed March 31, 1903.

A perforating device is operated by slides engaging the punches and driving cams adapted to engage respectively the punches and the slides. The slide cam operates before the punch cam, the slides being adapted to bring the corresponding punches into position to be engaged by the punch cam. Electromagnets and means operated by the electromagnets move the corresponding slides into position to be engaged by the slide cam.



NO. 766,625.—THIRD-RAIL CONTACT.

766,375. Service Meter for Telephone Exchanges. James L. McQuarrie, South Orange, N. J., assignor to the Western Electric Company, Chicago, Ill. Application filed December 11, 1903.

Sub-station apparatus in a central-battery telephone-exchange system includes a service meter having step-by-step counting mechanism, a buzzer and a switch adapted to bring the buzzer into operative connection with the line, the switch being automatically actuated by the step-by-step mechanism at a given stage in its advance.

766,381. Electric Railway and Controlling Device Therefor. William B. Potter, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed March 3, 1898.

A number of electric motors act as momentum-driven separately-excited generators and have some of their armatures connected in series in the supply-circuit, with means for simultaneously regulating the fields of the motors.

766,391. Remote Switch-control System. John L. Hall and Howard R. Sargent, Schenectady, N. Y., assignors to the General Electric Company, Schenectady, N. Y. Application filed November 26, 1902.

Supply mains and branch mains are connected by an electromagnetically actuated switch. A relay is adapted to complete the circuits whereby the switch is alternately opened and closed.

766,399. Current-collecting Device for Electric-railway Systems. Abraham A. Shove and William Embley, Jerseyville, Ill. Application filed September 26, 1903.

The current collector comprises a slot bar, contact devices carried thereby, a bracket depending from the car, a pair of telescopically fitting members, of which one is pivotally connected to the slot bar and the other to the bracket, telescopic cups forming a spring casing and secured one to each of the members, and a compression spring disposed within the casing.

766,430. Telegraphic Instrument. Arthur R. Dickey, Missouri Valley, Iowa, assignor of one-half to Theodore F. Von Dorn, Omaha, Neb. Application filed May 13, 1902.

Mechanical details are described.

766,450. Telephone-exchange System. Isidor Kitsee, Philadelphia, Pa. Application filed November 23, 1900.

Fixed conductors have parts adjacent to each of the terminals in the board. The plugs are provided with electromagnetic devices and means to engage in one or the other of the fixed conductors. The plugs are also provided with an annunciating device.

766,451. Telephonic Transmission. Isidor Kitsee, Philadelphia, Pa. Application filed January 22, 1901.

Two telephonic stations are connected together through a metallic circuit. The metallic circuit is provided at different points with condensers in series, and also provided at different points with electromagnetic devices in multiple arc.

766,468. Rectifying and Interrupting Alternating Currents. William Scheidel, Chicago, Ill. Application filed December 31, 1903.

A combined high-frequency interrupter and rectifier embodies a containing cell formed of aluminum and constituting the cathode element. A liquid electrolyte is used. The anode and cathode elements are arranged in relation to each other, so as to constitute a rectifier and a high-frequency interrupter for an alternating current passing through the apparatus.

766,469. System for Temperature Regulation. Frederick M. Schmidt, New York, N. Y., assignor of two-thirds to George C. Germond and William H. Spelman, Brooklyn, N. Y. Application filed January 7, 1903.

Independently movable contacts adjacent a pair of terminals are adapted to form a circuit with an electromagnet and a source of electric current. Mechanism is placed intermediate a thermostat and the contacts whereby the movement of the thermostat causes one or the other of the contacts to touch its adjacent terminal.

766,474. Receiving Telegraph Instrument. Charles R. Underhill, Providence, R. I. Application filed June 1, 1903.

A receiving telegraph instrument comprises a number of character-recording devices and character-selecting components corresponding in number to the maximum number of signal components of any of the code characters representing the recording devices. They are controlled selectively by the signal components in combinations corresponding to those of the code characters.

766,490. Cut-out. Ferdinand Buchhop, New York, N. Y., assignor to the Meyrowitz Manufacturing Company. Application filed October 29, 1903.

Combined with a fixed plate forming one terminal of the circuit is a rotary plate arranged parallel thereto and adapted to make and break contact. A plunger is adapted to impart two movements in the same direction to the rotary plate by two successive opposite movements of its own.

766,496. Electric Arc Lamp. Arthur S. Deem, Reading, Pa. Application filed January 26, 1904.

In the arc lamp is a casing comprising a magnet having electrical connections, a yoke surrounding the magnet, dash pots connected to the yoke and a cross-arm carried by the yoke. Carbon holders are pivoted to hangers and to depending arms.

766,497. Balanced Cord-drop Attachment. Henry D'Olier, Jr., Philadelphia, Pa. Application filed March 7, 1904.

A member designed to hang from the lamp cord has a lamp socket in its side, which, as it hangs, holds the lamp out in a horizontal position.

766,502. Telephony. Isidor Kitsee, Philadelphia, Pa. Application filed March 13, 1901.

A method of transmitting speech over a line wire carrying a direct current useful for other purposes consists in causing alternating-current impulses to be generated in the secondaries of an inductorium connected in shunt as to part of the line wire, simultaneously, through the varying resistance of the transmitter. The impulses are received with the aid of a receiver electrically connected with the interposition of a condenser or condensers to the ground or return.

766,503. Telephonic Transmission. Isidor Kitsee, Philadelphia, Pa. Application filed August 2, 1902.

A transmitting station and a receiving station are connected electrically together through a series of closed circuits, each containing electromagnetic devices, the closed circuits being in electrical connection with each other through condensers.

766,504. Method of Producing Elements for Electric Cells. Isidor Kitsee, Philadelphia, Pa. Application filed April 14, 1902. Renewed June 16, 1904.

The method consists in the production of the supports for a series of elements as one mechanical unit and providing the supports electrically with a film of high oxide and the spaces in the plates with highly oxidized compound of lead. The supports are separated from each other and provided each with separate means to connect it to the circuit.

766,507. Time-circuit Controlling Apparatus. Henry C. Little, Boston, Mass. Application filed August 26, 1903.

Helically arranged escape members co-operate with a series of escape members. Means are provided for relatively rotating the two series and for accelerating the rotating members during escape periods. One or more circuits are controlled by the escape members.

766,619. Manufacture of Incandescent Electric Lamps. Harry Hoge, Asnières, and Jean Barolier, Paris, France. Application filed April 5, 1904.

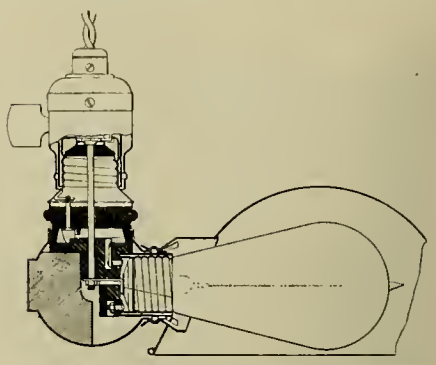
Improvements in the manufacture of incandescent electric lamps consist, first, in making cylindrical holes in the glass by inserting and fixing therein by fusion and flattening of the glass, metallic wires of any suitable kind, which are afterward removed; second, in drawing through these holes wires whose diameters are made approximately equal to those of the holes, and, third, in afterward applying a material capable of securing airtightness when cold, such as a thick solution of india rubber.

766,625. Third-rail System. Thomas Jenkins, New York, N. Y. Application filed April 6, 1904.

A cover for the rail has a side opening. A shoe carried by the outer end of an arm on the car is movable through the opening in the cover. (See cut.)

766,650. Electric Trolley. George Ondo, Delancey, Pa. Application filed March 10, 1904.

An electric trolley comprises a head and a wheel, a yoke having side members movable relatively to each other, elastic shoes mounted upon the members and springs connecting with the shoes.



NO. 766,800.—BALANCED CORD-DROP ATTACHMENT.

766,692. Hanger Cut-out for Trolley Wires. George Hall, Manchester, England. Application filed April 3, 1903.

In a hanger cut-out for trolley wires is a solid middle portion and a pivotally insulated lever fulcrumed to each end, with its inner end reaching over the middle portion and having a casing.

766,767. Electric Connection Rosette. Mortimer Norden, New York, N. Y., assignor to Mary Bittner, New York, N. Y. Application filed September 19, 1903.

An electric connection rosette comprises a head of elongated rectangular form made of porcelain or other suitable vitrified material and a base of similar form and material and having longitudinally disposed central recesses.

766,774. Apparatus for Automatically Stopping Railroad Trains. Hiram G. Sedgwick, New York, N. Y. Original application filed April 8, 1903. Divided and this application filed April 28, 1903. Renewed December 7, 1903.

In a train-stopping apparatus are two series of stop boxes, one series being adapted to be operated by trains moving in one direction and the other by trains moving in the opposite direction. A presser bar is in each box and a train-actuated means for moving the bar to its set position. Electric means operated through the train-actuated means are connected to the next box ahead of the opposite series to set the presser bar.

766,787. Enclosed Arc Lamp. Otto N. Wiswell, Lynn, Mass., assignor to the General Electric Company, Schenectady, N. Y. Application filed May 4, 1899.

An arc-inclosure is provided with an opening for transit of a movable electrode and a relatively easier path of discharge for the arc gases compared with that of the feed opening through a reservoir of inert gas open to the atmosphere and the arc inclosure.

766,788. Enclosed Arc Lamp. Otto N. Wiswell, Snoqualmie Falls, Wash., assignor to the General Electric Company, Schenectady, N. Y. Original application filed May 4, 1899. Divided and this application filed July 24, 1902.

In a cap for inclosed arc lamps is a plate having a carbon opening and arranged to engage with an end of the globe. A chamber communicates with the carbon opening at one point and with the atmosphere at another, into which the gas from the inclosure is free to enter and withdraw as the carbons move with respect to each other.

766,800. Balanced Cord-drop Attachment. Henry D'Olier, Jr., Philadelphia, Pa. Application filed March 4, 1904.

The lamp screws into a socket on the side of a member which hangs from the lamp cord. The lamp thus extends out in a horizontal direction. (See cut.)

EXPIRING PATENTS.

Following is a list of electrical patents (issued by the United States Patent Office) that expired on August 2, 1904:

367,866. Coupling Dynamo-electric Machines. Elihu Thomson, Lynn, Mass.
367,898. Magnetic Clock. Daniel Drawbaugh, Eberly's Mill, Harrisburg, Pa.
367,901. Arrester for Electric Currents. James P. Freeman, Chicago, Ill.
367,925. Electrical Annunciator. William C. Poole and John Schnepf, New York, N. Y.
367,931. Electric Coupling. Charles Runels, Lowell, Mass.
367,934. Commutator for Electric Generators. Oliver B. Shallenberger, Rochester, Pa.
367,956. Binding Clamp for Battery Electrodes. Horatio J. Brewer, New York, N. Y.
367,960. Electric-clock System. Charles L. Clarke, East Orange, N. J.
368,066. Railway Signal. Irving H. Brown, New York, N. Y.
368,088. Enclosing Case for Electric Machines. Charles H. Hines, New York, N. Y.
368,099. Primary Battery. Samuel W. Maquay, Tedworth Square, London, Eng.

WESTERN ELECTRICIAN

EVERY SATURDAY

Vol. XXXV. CHICAGO, AUGUST 20, 1904 No. 8

Electric Lighting at the Alhambra Theater.

In the general overhauling of Chicago theaters following the terrible Iroquois Theater fire of December 30th last, remodeling of the electrical equipment has occupied a prominent place. Electrical engineers have been required to solve the problem of equipping theaters with electric lighting in such a way as to meet the stringent requirements of the Board of Fire Underwriters and of the electrical inspection department of the city of Chicago, while likewise furnishing the theater managers the lighting facilities which they require to carry on a general show business. How this was done in the case of the Powers Theater was shown in a recent illustrated article in the Western Electrician. At the present time a brief description of the electrical work accomplished at the Alhambra Theater will be given.

The Alhambra Theater is at State Street and Archer Avenue, and is classed among the larger theaters of the city, seating 2,200 before the remodeling and 1,400 after. The difference is caused by wider aisle spaces, greater spaces between chairs and changes in the pitch of galleries. The theater building is surrounded by streets, alleys or courts on all sides, so that the improved exit facilities required were easily provided. It was erected about 15 years ago and has a small private electric-lighting plant under and back of the stage. This outfit consists of a Phœnix tubular boiler 16 feet long and 66 inches in diameter supplying steam to a simple Phœnix 85-horsepower engine direct-coupled to a Western Electric 110-volt, 48 - kilowatt, direct-current dynamo. In addition, outside sources of current supply are provided.

Two centers of distribution have been provided in wiring the building. One is the stage switchboard (Figs. 1 and 2) and the other is the box-office switchboard (Fig. 3). From the former 1,450 16-candlepower lamps are controlled. These furnish the lighting for the stage and auditorium. The board in the box office or ticket office at the entrance controls the 400 lamps used for signs, lobbies, exits and emergency lights. In the event of a fire on the stage the mere throwing of a switch in the box office, which is outside the theater building proper, will throw the emergency and exit lights on an outside source of current. It is considered that it is practically impossible for the theater to be left in darkness at any time when light is needed. Great care has been taken, also, to make the wiring as nearly fireproof and waterproof as possible, the circuits being run in iron pipe.

The wiring of the building is divided into 112 separate sections, each section or circuit carrying no more than 12 16-candlepower lamps. There are 92 circuits extending from the switchboard located on the stage and 20 circuits extending from the switchboard located in the box office.

Controlled from the stage switchboard, the 92 circuits supply border lights, footlights, strip lights, orchestra lights, proscenium lights, ceiling lights, box and box-front lights, balcony and gallery lights, parquet lights, dressing-room lights and all lights in the basement. Each circuit is fused at the switchboard and is provided with the necessary switch and dimmers required to enable the man in charge to have perfect control of all lights.

From the box-office switchboard 20 circuits supply corridor lights, entrance lights, rotunda lights, foyer lights, exit lights, cleaning lights, emergency lights, box-office and manager's office lights, decorating and sign lights. Each circuit is fused and provided with switches at the box-office switchboard, which is so located as to permit of operation by the man in charge of the ticket office, as can be seen by reference to Fig. 3.

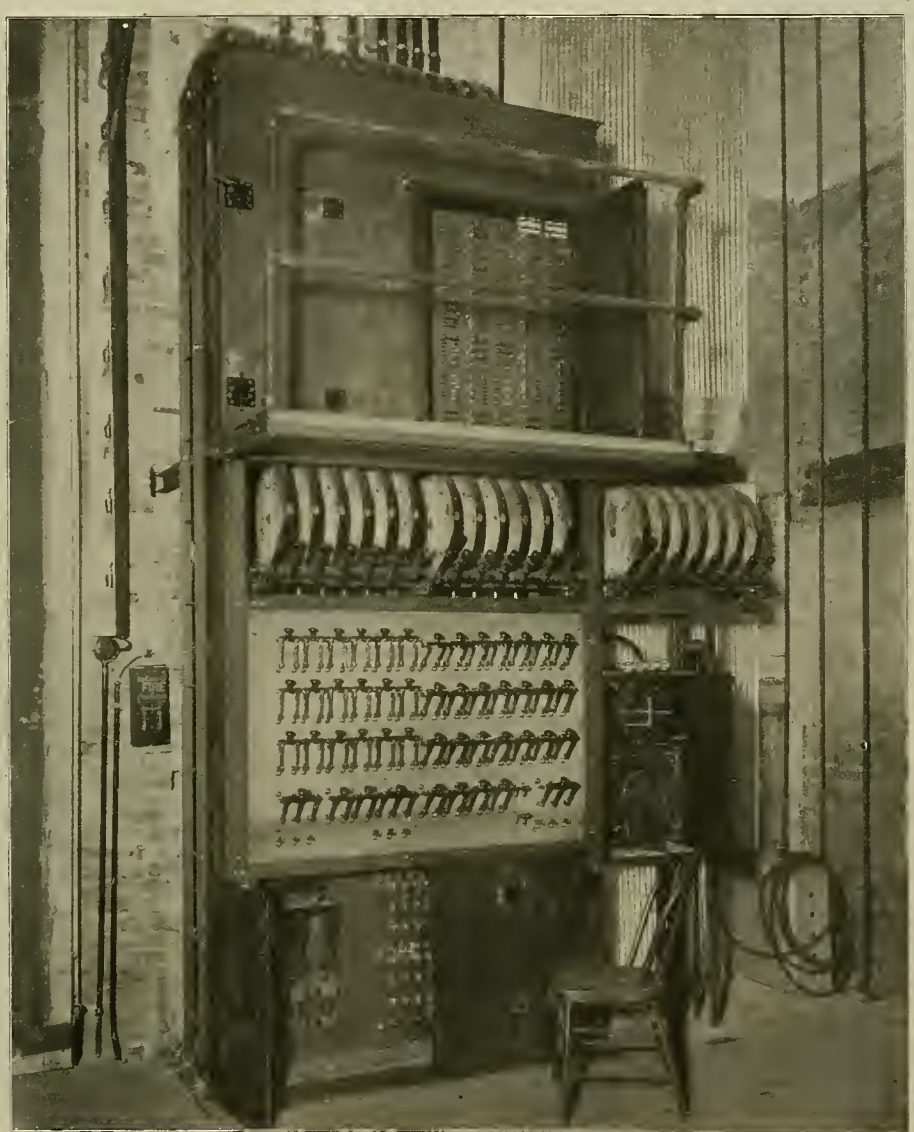


FIG 1. ELECTRIC LIGHTING AT THE ALHAMBRA THEATER.—STAGE SWITCHBOARD.

All wires in the building are installed in loricated iron conduit and are so arranged that they may be used either on the two-wire or the three-wire system. There are five borders of 96 lights in two rows each, with 48 clear lights, 24 blue lights and 24 red lights in each border. The lights of each border are in eight separate circuits of 12 lights each and are fused at the swithboard.

There are 96 footlights in two rows, consisting of 48 clear lights, 24 blue lights and 24 red lights. The footlights are on eight separate circuits, which are also fused at the switchboard. There are also five ground-row pocket lights on each side of the stage, provided with two circuits each for temporary stage lighting. These pockets are provided with stage plugs and receptacles, which are enclosed in iron boxes, which are flushed with the floor when temporary connections are made.

The stage switchboard (Figs. 1 and 2) is a double-decker, made in three separate sections and contains all fuses, switches and dimmers. The feed wires enter at the lower part of the board and are carried to the main fuses and switches. The path proceeds from the main switch to the bus bars, where the current is fused and divided into a number of smaller sections passing into the master switches. These master switches are used to control a number of small sections on the board without the necessity of applying all the switches when a quick change is required. They were put in in order to eliminate the use of large fuses. The master switches are connected to the bus bars for supplying different sections of lights which are at times to be operated separate from others. Each section is connected to the bus bars by individual switches, so arranged as to be connected and disconnected at will.

From the individual switch on the board, the current passes through the dimmers located between the switchboard panel and the tablet board at the top for the regulation of the lights. There are 19 Cutler-Hammer dimmers used for the regulation of the candlepower of the lights. These dimmers are so arranged as to be operated separately, or they can all be operated at the same time.

The current goes from the dimmers to the tablet boards on the upper deck, where the current is again fused and divided into several sections for supplying the lights throughout the building. The tablet board is divided into 30 separate sections and supplies 96 separate branch circuits.

The switchboard is iron-clad and is waterproof as well as fireproof, and seemingly offers perfect protection for the wires as well as for the fuses. In Fig. 1 two of the folding iron doors are shown open for the purpose of revealing the interior. The box-office switchboard is built along the same lines and is completely encased in an iron box with a door.

There is also a system of four private intercommunicating telephones, the wires for which are also run in iron conduit and are connected with the box office, stage electrician, fly gallery and orchestra.

In compliance with the recent order of the city authorities a 7,000-pound steel curtain—steel on the auditorium side and asbestos on the stage side—has been installed in the stage opening. This movable steel partition is 27 feet 6 inches high and 35 feet wide. It is raised and lowered, with the aid of a counterbalance, by a two-horsepower electric motor placed beneath the stage. The controller for this motor is placed on the stage switchboard (which, it may be mentioned, is located just at the right of the proscenium opening, as one faces the audience), and may be seen in its iron box at the right in Fig. 1. Thus the curtain can be operated by the electrician if desired.

Mr. Emery Stanford Hall was the architect retained for the reconstruction of the Alhambra Theater. The electrical work was entrusted to the Ernest Freeman Company of Chicago, electrical engineers and contractors, and this company is entitled to credit for the thorough and workmanlike manner in which its duties have been performed.

The "Electrification" of the Erie Canal.

By George E. Walsh.

The final rejuvenation of the ancient Erie Canal will be accomplished when electric towing of a satisfactory nature has been adopted and brought to a finish. At the present writing this is in a fair way of accomplishment, and the general opinion prevails among commissioners, engineers and experts that the "electrification" of the canal is merely

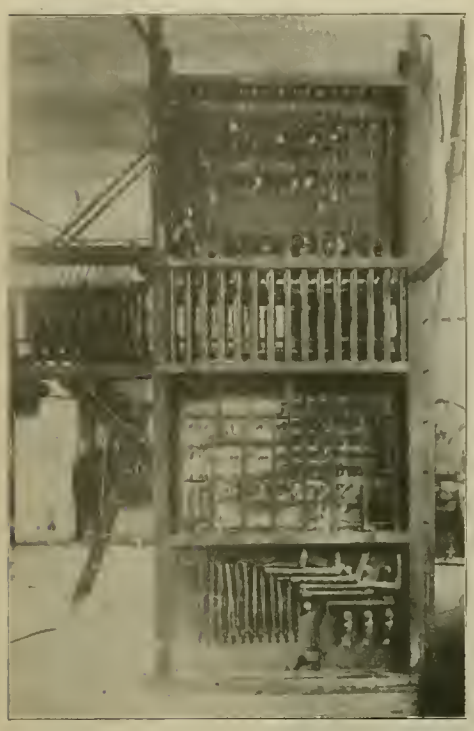


FIG. 2. ELECTRIC LIGHTING AT THE ALHAMBRA THEATER. —REAR OF STAGE SWITCHBOARD. (SEE PAGE 129.)

a matter of a few years, and that it is the only form of power that will enable this great waterway to take a new and successful lease of life.

During the present month a new electric canal towing and equipment company has been incorporated at Albany for the express purpose of making a bid for the work of equipping the canal with electric power and apparatus. Under its new charter the company is prepared to furnish power, and to manufacture new electrical towing apparatus and general equipment. It will proceed almost immediately to make tests of new machinery along portions of the canal.

The question of the towing apparatus that will be ultimately adopted on the Erie is one that still excites a good deal of concern and anxiety among engineers and manufacturers. There is hardly a week that passes that does not witness a trial of some new methods or a repetition of former experiments under somewhat improved conditions. It is generally recognized that when the matter is finally settled, and orders placed for new electrical towing apparatus for the canal, a sensible impetus will be given to electrical business in the East and parts of the West. There is hardly a manufacturing concern interested in electrical matters that is not keeping a sharp eye on developments in this direction.

In the latter part of July a test was made at Schenectady on the canal of a towing apparatus, the patents of which are owned by the International Towing and Power Company. The test was watched by a great number of prominent engineers from all parts of the country, and the results were considered satisfactory. Thirty-five hundred feet of rail had been laid down on the tow-path, and six loaded canal boats, with a total weight of about 2,800 tons, were then pulled at a speed of over four miles an hour. There was little washing of the embankment caused by the swell, in the wake of the boats, and hardly a perceptible current was left behind. There was no hitch in the operation of the machinery, and the inventor and owners of the patents expressed themselves satisfied.

"The question of the electrification of the canal," said one of the engineers present, "seems an assured fact now, for while several systems of towing are making a bid for the canal, any one should prove far more satisfactory than by mule or other antiquated method. It seems to be now merely a question of what system to adopt. In this respect we are not following the lead of any other nation. While recognizing the value of European systems and giving full credit to them for pioneer work in electrical canal towing, we expect to evolve a distinct American system that will prove the most satisfactory of any in the world. There is a multitude of patents pending in electrical towing, and there is some difficulty in unifying these so that the system which is finally adopted will not be involved in endless litigation. Whatever system is adopted finally must be the best, possessing features of merit that cannot be found in any other single system of the past. This of course is not easy to do. But the electrification of the Erie is one of the most important questions of transportation of the day. All depends upon its success whether the enlargement and deepening of the Erie is to prove of value or entirely worthless. The canal must be modernized so that it can compete with the railroads during the open season. It must be able to carry freight from the Great Lakes to the seaboard at minimum rates and without injuring the canal or causing the state to pay subsidies to keep it in a state of repair. In short, the Erie Canal question is come to this: Can electricity make or unmake it? If it cannot be electrified successfully it is doomed to failure, and the great expenditure of the state's money will once more go for naught."

The quantity of freight that must be handled by the Erie Canal will be enormous, and any electric system of towage will be taxed to its utmost. Nearly all of the different systems have been tested here at one time and another. The Lamb aerial system that was tried on the canal near Buffalo years ago was found inadequate to the needs of the day. The aerial system of canal towage is still used a good deal in England, but it is pronounced by American engineers as inadequate to the Erie. The motor carriage, which runs on an aerial cable, hardly furnishes sufficient power to haul the heavy Erie Canal loads along the waterway. In England tests of an aerial towage system showed that the cost at a speed of four miles an hour was 0.041 penny per ton-mile during a continuous haul of seven hours. The tractive force required for towing a barge of 100 tons at two and a half miles an hour was estimated at 250 to 300 pounds, and at a speed of four miles an hour a current was required of 15 amperes at 500 volts. The chief advantage claimed for this system was that no delays in passing were experienced, and bridges and tunnels offered no obstacles.

There are two canals on this continent that have recently been equipped with electricity that have attracted a good deal of attention, and the Erie engineers have recently made extensive studies of both to draw comparisons, and to facilitate a solution of the problems at home. The first of these is the Miami and Erie Canal, which represents the first three-phase traction system in the United States, and the second is the Cornwall Canal in Canada. The first canal equipment, including reservoirs and power stations, cost upwards of $8,000,000. The Baldwin-Westinghouse three-phase locomotives used on this canal weigh 22 tons, with a draw-bar pull of 9,600 tons, and the motors are of 80-horsepower capacity. Two induction motors operating in tandem can make a speed of four miles an hour, with a maximum load, and one motor, with a light load, has a maximum speed of six miles an hour. From five to seven canal boats are hauled by a single locomotive, with the overhead trolley lines carrying the current, and the track acting as the third conductor. The voltage on the transmission line along the canal is 33,000 volts, and the frequency 25 cycles per second.

The Cornwall Canal is electrically equipped for lighting purposes and for operating the locks, weirs and similar mechanism other than actual towage. The latter will follow as the engineers gradually solve numerous little problems that now confront them. The electrical equipment of the locks and weirs is quite important, and represents a decided improvement in canal construction. It will be necessary to equip the Erie similarly when electricity is finally adopted, and a study of the Cornwall Canal as a pioneer in this direction is attracting the attention of experts working on the Erie problem. For instance, the operation of the locks by electricity has proved so satisfactory that time and labor are saved nearly one-half. The electrical drive of all the machinery has reduced the number of men required at the different points along the canal. The motors used for both the lock gates and weir mechanism are of five horsepower. For a few seconds during the height of the operation the normal capacity of the motors is exceeded, but the balance of the time they run considerably under load. There are a number of weir gates to keep the various levels of the canal normal, which must be operated independently, and electricity has brought the solution of the problem to a fitting climax.

Likewise, the bridges are operated on the Cornwall Canal by electric motors. The rapidity obtained in opening and closing the bridges makes them superior to any other canal bridges in the world. As most of the bridges on the Erie are high this would not prove such a formidable problem except in the cities through which the canal flows. Electrically operated bridges would naturally have to be installed at such places. The supply of current all along the route would make the operation of the weirs, locks and bridges a matter of simple cost. The motors for driving the bridge mechanism are placed under the bridges, and they in no way prove objectionable or clumsy.

The equipment of the Erie Canal by electric mechanism for towing and operating bridges, locks and weirs will consequently be the result of study and experiment extended over a long period of time. All the different European systems have been tested at some time on the Erie, and from these new ideas have been obtained; but no one system has been adopted by the American inventors. Profiting by the success and failures of others, they are striving to produce an American system that will be adapted in every way to the needs of old historic Erie.

Kewanee-Geneseo Single-phase Railway.

In a week or so the Kewanee, Cambridge and Geneseo Railway Company expects to begin grading for an interesting 30-mile electric railway to be built between Kewanee and Geneseo, by way of Cambridge, in Henry County, Ill. The single-phase alternating-current system will be used throughout. The power house will be located near Cambridge and will be of 1,000 kilowatts' capacity at the start. Current will be generated at 2,200 volts and transmitted at 11,000 volts to the two end divisions of the road, where step-down transformers will be located to reduce the electromotive force to 2,200 volts, which will be the line voltage. The central division will be supplied at 2,200 volts directly from the power house. On the locomotives and motor cars the voltage will be again reduced to 500, at which the single-phase motors will operate.

The rolling stock will include two 40-ton electric locomotives, each equipped with four 250-volt motors (two in series) of an aggregate capacity of 600 horsepower. There will also be 10 passenger cars, each fitted with four 75-horsepower motors, and 20 coal and box cars. As will be surmised from this equipment, the company expects to haul coal and heavy freight under steam-railroad conditions. It is expected that 40 per cent. of the receipts will be from passengers and 60 per cent. from freight. The road will be laid with 60-pound rails, the maximum grade being one per cent. and the maximum curve five degrees. But the passenger traffic will be carefully looked after, as is shown by the fact that the company has purchased 72 acres of land between Cambridge and Geneseo for a pleasure park.

FIG. 3. ELECTRIC LIGHTING AT THE ALHAMBRA THEATER. —SWITCHBOARD IN BOX-OFFICE, CONTROLLING EMERGENCY LIGHTS. (SEE PAGE 129.)

The road will be built across country on the company's own private right-of-way, and in the towns 50-year franchises have been secured. It is of interest to note further that the company expects to mine its own coal.

Mr. W. H. Schott of Chicago is the president and chief engineer of the company. The other officers are: Vice-president, Theodore Boltenstern, Cambridge; secretary, Robert Olmsted, Rock Island; treasurer, George A. Anthony, Kewanee. The general contract has been awarded to a Boston syndicate, which has taken the company's securities. The company is capitalized at $850,000, with an issue of $750,000 of five per cent. 40-year bonds. Mr. Schott is the moving spirit in the enterprise, which is planned on carefully thought-out and up-to-date lines.

High-tension Insulators.

By R. Scott.

Wherever circuits of 20,000 volts or greater are employed in the transmission of electrical currents it is necessary that the line insulators employed should be of special design and should embody the following factors:

1. Great resistance to arcing between the cross-arm, pin or other supporting part and the conductor.
2. Large superficial area to give extensive surface over which the leakage current may creep.
3. The material employed must successfully resist any puncturing strains which may be developed.
4. The insulator must possess good ability properly to distribute the electrostatic strains developed by lightning or other electrostatic surges.
5. Low radius of gyration to prevent both the breakage of the pin or other supporting member and the insulator.
6. Protection against the precipitation of moisture on all parts.

An insulator should not be designed for the voltage of the circuit alone, but should be capable of

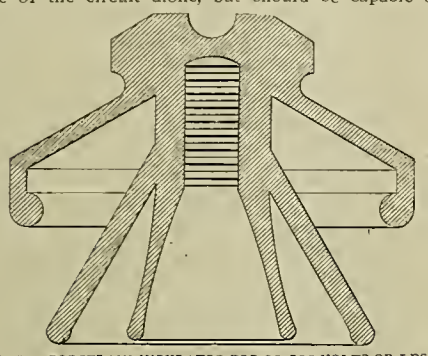


FIG. 1. PORCELAIN INSULATOR FOR 30,000 VOLTS OR LESS.

withstanding the overplus voltage which under normal and abnormal conditions is liable to occur. High-tension circuits frequently, without the coincidence of electric strains, develop areas or zones of high-tension surges, these being concentrated upon various parts of the line. Although such surges are electrostatic in character, their exact nature is not understood, but experience has shown that such concentrations of high potential actually exist and effect a disruption of the insulators whose design is such that they cannot withstand this abnormal potential.

Although the natural precipitation of moisture is usually in a vertical direction, it is not best to assume such conditions to exist in practice. For this reason the usual test is to spray water from a hose inclined about 30° from the horizontal and spaced about six feet from the insulator, the water having usually low pressure and the nozzle being of such design that the water is thrown upon the insulator in the form of a spray. Using the requisite testing voltage, it is thus possible to test an insulator under conditions even more adverse than those found in practice. Such tests show that the mechanical design or outlines of the petticoats exert a marked influence upon the behavior of the insulators.

To show the relation which should exist between the cross-section of the insulator between the conductor and the pin the following data are given: Taking the specific resistance of copper as 1, the specific resistance of rainwater is about 6,754,000,000, while that of glass is about 1,400,000,000,000,000. This shows that for a given insulation resistance, assuming that water is precipitated upon every part of the insulator, the relation between the superficial area and the cross-sectional area must be very great indeed. This does not take into consideration the depth of the film of water or its average sectional area, but the above figures give a general idea of the relation which should exist between both.

Another important consideration is the ability to withstand the tendency for setting up an arc after a circuit passing a minute current has been formed between the pin and the conductor. This ability depends entirely upon the air space intervening between the pin and the conductor measured around the superficial area of the petticoats, as it is not assumed in this case that the insulation has been ruptured in any way through its section between the conductor and the support. It is necessary in designing that the worst conditions that can be set up in practice be constantly borne in mind. An insulator may be designed which has a large sectional area and large superficial area, but which when operated under one-third of the testing voltage for a certain period of time in a region where large amounts of dust are precipitated upon its entire surface will fail because of the fact that the dust has so reduced the resistance from the conductor to the pin that a slight shower serves to set up a path which starts an arc between the conductor and the pin.

Another important factor which must be dealt with is the phenomenon of resonance, which occurs on lines having a relatively high frequency, such as 66. A test at double the voltage which the insulator is to withstand will result only in showing its capacity for withstanding a certain static potential. The same insulator when placed upon a line having a high resonance factor will fail, due to the concentrations of potential resulting on such a line.

Although the usual conditions of practice do not demand that an insulator be capable of withstanding twice its normal voltage, an abnormal condition may impose upon the insulator an even greater excess for a very small period of time. If such periods are successfully passed over no deleterious effects are produced, but if at such times the insulator should happen to be in such a condition that the disruptive tendency cannot be overcome, then failure will result.

Testing is for one purpose, namely, to ascertain the relative adaptability of insulators for various specific conditions of practical service. An insulator may be of such design that it will withstand a double or triple-voltage dry test, and yet fail at normal voltage in long-continued operation under practical wind-driven precipitation conditions. Usually, however, the successful performance under dry test renders unnecessary a wet test for ascertaining the arcing pressure. The arcing voltage, under conditions of short-circuit, would not produce the same effects in practice, due to the dissimilar conditions of the pin cross-arm and pole and the other insulators. If the system were grounded, the greatest stress on a rainy day would undoubtedly be between the conductor and ground, and with a comparatively low ohmic factor between the pin and ground would result in excessive strain on the insulator. Of course, every system is, in a measure, grounded by the multiple paths afforded by the poles, but as to this effect on the insulators it cannot be determined with any degree of accuracy.

Like some other electrical devices, an insulator embodies a large amount of uncertainty. Its action during long-continued service cannot be predetermined with any degree of certainty or accuracy. It must be a point of consideration to assume a number of conditions that must be accepted as affecting the operation.

The stresses which occur by long-continued variable-impressed voltage may be likened in their effect to the reciprocating stresses produced in the connecting rod of a steam engine. These stresses, when

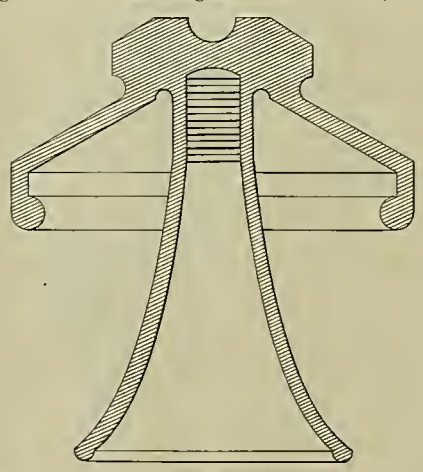


FIG. 2. INSULATOR USED IN MOISTURE-LADEN ATMOSPHERE.

repeated for 300 to 1,000,000,000 times, have about the same strain effect on the weakest parts as that which would occur were the rod bent at right angles and straight again at this particular part, with a radius of two or three times the thickness of the rod. The tendency of long-continued voltage strains, therefore, is ultimately to disrupt the insulator. This fact, therefore, should be in sight when designing any insulator.

It is possible for an operator having some experience to deduct from the performance of an insulator under test its relative integrity when in practical operation. The effects of various stresses and conditions manifest themselves in purring, humming or crackling noises, and partially visible arcing or creeping paths. When the point of visible discharge has been reached, without its being the result of inductive conditions, the voltage may be taken as the limiting pressure at which the insulator fails.

The points to be noted during the process of testing have been recognized as the following, which are arranged in the order of their precedence:

1. The first visible indication of the static brushes or discharges from the lower edges of the insulator.
2. The point at which a heavy discharge leaps from one part to another.
3. The point at which well-defined snapping and crackling occur, with indications of the establishing of general rupture.
4. The point of breakdown or puncture of the insulator.

Although the above points are usually separate and sharply defined, owing to the cumulative effect of the minute breakdowns, the time intervening be-

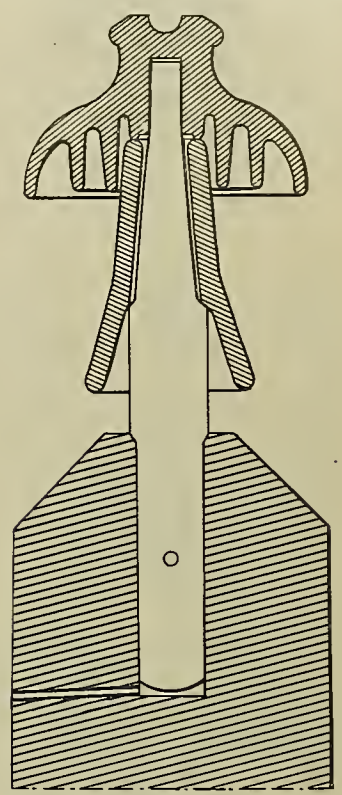


FIG. 3. MISSOURI RIVER GLASS INSULATOR FOR 55,000 VOLTS.

tween No. 1 and No. 2 is usually greater than that between No. 2 and No. 4.

Insulator manufacturers are all well aware of the effect of economy in construction.

No part of a high-tension system should require such careful selection of materials as the line insulators, operating as they do under conditions which are most adverse to the transmission of high-tension currents, and which represent in reality the only drawback to increasing the tension to a figure that is regarded at the present time as impossible. In a measure the adaptation of the line pressure to the line depends upon the insulation employed.

Economy, while a natural predisposition, should therefore be exercised in every other part of the system rather than on the line. Faulty or "economical-initial-cost" insulators usually manifest themselves in burned-out cross-arms, firework displays (pleasing to the eye but annoying to the company) and dangerous service.

Therefore if a high standard of construction is to be employed, it should commence and continue with the line insulators. As a necessary device a good insulator may be said to be very good, and a poor insulator very poor (and costly).

In Figs. 1 to 5 are shown in section a number of forms of high-tension insulators which represent the result of many years of development in construction. They will serve to show the reader the primary points on which stress is laid by the manufacturer, these points having been outlined in the above description.

Fig. 1 shows a porcelain insulator that has, under normal climatic conditions, been applied in various sizes to transmission systems operating at voltages up to 30,000. This insulator is designed for localities where the natural precipitation is abnormal and intermittent, with average dry atmospheric conditions.

Fig. 2 shows a design used in localities where a humid and moisture-laden atmosphere exists. The outline is such as to give a maximum of creepage surface. Its disadvantage is long radius of gyration, which necessitates the use of very strong pins.

In Fig. 3 the famous Missouri River transmission

insulator, introduced by Gerry, is shown. This insulator operates under particularly adverse conditions at 55,000 effective volts. Made of glass, in two parts, its creeping surface is very great. To prevent rotting of the pin by the accumulation of water, the cross-arm or pole is provided with a one-eighth-inch vent, as shown. The maximum diameter of the petticoats is 8 15-16 inches and the length of the sleeve eight inches.

In Fig. 4 is given a section of an insulator which has been largely used in Europe, especially in Switzerland, for voltages up to 60,000. Although but a slight departure from American designs, its special feature is to render dust and vegetable accumulations innocuous.

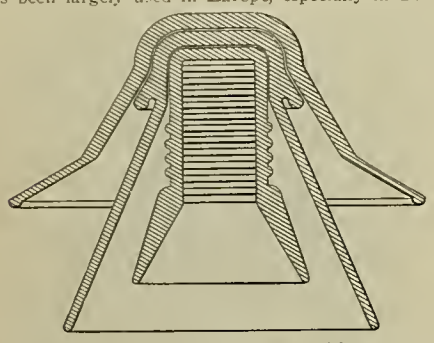


Fig. 4. Swiss Insulator for 60,000 Volts.

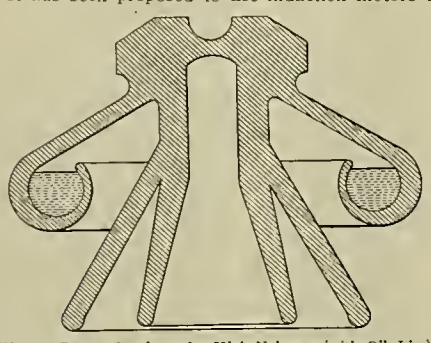


Fig. 5. Recent Insulator for High Voltages (with Oil Lip.)

HIGH-TENSION INSULATORS.

Fig. 5 shows an insulator which, while as yet but little introduced, gives a very high superficial ohmic factor. The great disadvantages are difficulties attending manufacture, high cost and uncertainty of behavior of the oil within the internally arranged lip. This represents a modification of the immortal Lauffen-Frankfort system of transmission (110 miles), the first attempt at transmitting energy over a long distance.

Referendum on Proposed Chicago City Railway Franchise.

Mayor Harrison has issued a proclamation concerning the proposed Chicago City Railway Company ordinance, which has been drawn up by the local transportatoin committee of the council. The mayor declares that he believes the proposed ordinance is the best that can be devised under the circumstances, but as a matter of keeping good faith with the public he has arranged for an expression of public opinion. If the public petitions for a referendum in sufficient numbers by September 9th the question will be placed before the voters at the November election. If the necessary number is obtained not later than October 20th the mayor will ask the council to postpone consideration of the ordinance and submit the matter to the people at the municipal election next spring. If the petition does not bear the necessary number of names the mayor will take it for granted that the public approves of the measure and the ordinance forthwith will be introduced in the council.

Advocates of immediate municipal ownership are undecided what action to take regarding the proclamation. In a general way all of the members of the municipal-ownership central committee are said to be fighting the ordinance. They take the position that there should be no ordinance, good or bad, extending the franchise of any street-car company. They contend that in this case the measure would postpone for 13 years the time when the city can take over the street-car properties. If the immediate municipal ownership advocates do not at once prepare their petition the ordinance, it is thought, will be passed and signed without the referendum.

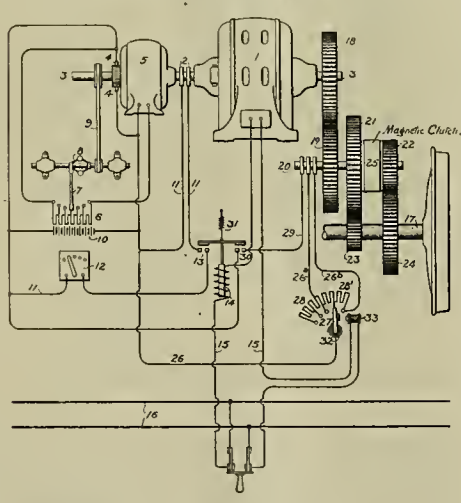
Public Lighting in Detroit.

As the Detroit Public Lighting Commission plant is now taxed to the limit to furnish the necessary light, the Board of Estimates will next spring consider a request from the lighting commission for an additional appropriation of $100,000. This amount is needed to install machinery at the lighting plant. The matter was given into the hands of the executive committee, with instructions to bring in a report on the condition of the plant. The committee made a careful review of all the present machinery and found that after the installation of the new unit, completing the change from the direct to the alternating system, both of the two large units will be loaded to their maximum capacity, and that consequently no more new lamps can be installed on the alternating system. The report also shows that any accident to either of these two units would result in placing one-half of the city in darkness, making the installation of a third unit an urgent necessity. But as the original steam capacity of the plant is at present taxed to its utmost, the extension will necessitate the installation of additional boilers, pumps and other machinery. The report furnished by the commission places the operating disbursements per arc lamp at $30.16, and asserts that the total gross cost per arc light for the year ended June 30, 1904, was $61.65. Last year this cost was $64.36, showing that an alleged decrease has been made in the gross cost per arc light of $2.71.

Synchronous Motor Adapted for Railway Work.

Among the many inventions relating to the use of alternating-current motors for propelling railway cars that of Alexander Churchward of New York, providing for the use of synchronous motors, is of considerable interest. This invention is covered by a patent (assigned to the General Electric Company) applied for on October 11, 1902, and issued August 9, 1904.

It has been proposed to use induction motors for railway work, but Mr. Chuchward says that a serious disadvantage of the induction motor for this purpose is its small air-gap, which prohibits its use except under the most favorable circumstances, since if the air-gap is widened so as to give the clearance necessary for universally successful operation the power factor is reduced, the leakage current being then very heavy. A synchronous motor, on the other hand, can be efficiently operated with a large air-gap, as the extra field current necessitated by the larger air-gap is but a small percentage of the whole and is hardly noticeable in the total efficiency of the machine. The synchronous motor, however, has little or no starting torque and must be artificially run up to synchronous speed before being switched into circuit and the load thrown on. In using such a motor for propelling a railway car means must be provided for starting the motor and speeding it up until it is in step with the generator before it is mechanically connected with the car axle. Moreover, means must be provided for varying the speed of the car independently of the speed of the motor (which remains practically constant) and for keeping the motor running while the car is making a short stop or when the line current fails or the trolley is not in contact with the working conductor. Furthermore, if two or more synchronous motors are connected with the same supply circuit and the load on one of them is quite variable and its field is not changed to meet such changing conditions a pumping effect is liable to take place in the other motors unless special provision is made to meet it. When the load changes the power factor also changes, because the variation in load causes the current to lead or lag, and this requires a readjustment of the field to correct it. The present invention aims to provide for all these requirements and to produce an organized combination of mechanism and circuits by means of which a synchronous alternating-current motor can be utilized for propelling a railway car.



SYNCHRONOUS MOTOR ADAPTED FOR RAILWAY WORK.

The accompanying drawing is a diagram of circuits and mechanism embodying the invention. The synchronous motor (1) is of the revolving field-magnet type, direct current being led to its field coils from a shunt-wound exciter (5), whose armature is driven by the synchronous motor. In the shunt-field circuit of the exciter is a rheostat (6), whose switch-arm (7) is automatically shifted to maintain a constant potential at the terminals (4). This is preferably accomplished by a centrifugal governor (8), suitably driven from the shaft (3), as by a belt. In shunt to the exciter terminals is a storage battery (10). The leads (11), which convey current to the collector rings (2), include a rheostat (12) and a switch (13), the latter being controlled by a sucking solenoid (14) in one of the leads (15), conveying alternating current from the mains (16) to the stationary armature of the synchronous motor.

The shaft of the motor is geared to the car axle (17) by speed-changing gearing, as shown. Electromagnetic clutches (25) enable either the spur gear (21) or the pinion (22) to be clutched to the countershaft. When the pinion is clutched the motor will drive the car slowly. When the spur gear is clutched the car will be driven faster. The clutches are supplied with direct current from the exciter (5) through a lead (26), which can be put in circuit with either clutch through a switch-arm (27), and two branch loads (26^a) (26^b), leading, respectively, to the clutch for the pinion and that for the spur gear. The switch-arm (27) is arranged to cut out a resistance (28) in circuit with the lead (26^a) and a resistance (28′) in circuit with the lead (26^b), passing without break from one to the other, and thus clutching first the pinion (22) and then the gear (21) with increasing strength in each case. The clutches are preferably friction clutches to permit a certain amount of slip until the full current strength is applied. The common return lead (29) for the two clutches has a switch (30), controlled by the solenoid (14). A spring keeps this switch and the field-circuit switch (13) open so long as no alternating current is supplied to the motor armature. A spring (32) returns the switch-arm (27) to the "off" position when the main circuit is broken and the series holding coil (33) in the circuit is de-energized.

To start the car the exciter is run as a shunt motor taking current from the battery, the centrifugal governor being adjusted to regulate its maximum speed to correspond with the synchronous speed of the main motor. When this speed has been attained the armature circuit of the main motor is closed, thereby energizing the solenoid (14) and closing the switches (13) and (30). The field coils of the main motor being thus supplied with current from the battery, the main motor falls into step and begins to drive the exciter as a generator, supplying direct current to the field circuit, the battery and the clutch circuit. Up to this time the car has been standing still, the clutches not being energized. The motorman now turns the switch-arm (27) to the first contact of the resistances (28), and the opinion (22) is clutched to the rotating counter shaft. Owing to the slip of the clutch when weakly energized, the car will start slowly, and as its speed accelerates the switch-arm is moved from point to point of the resistances (28) (28′) until finally the spur gear (21) is rigidly clutched to the countershaft and the car is running at full speed. If for any reason the main circuit should be broken, the spring (31) at once opens the field circuit of the main motor and the clutch circuit. The exciter, however, is kept running at full speed by the battery current and maintains the synchronous motor at the proper speed until the main circuit is closed, which will automatically close the field circuit at the switch (13), and the motor will thus fall into step again without any hitch or jar. When the main circuit opens the switch-arm (27) automatically goes to the off position, so that on the closing of the main circuit the motor will run free until the motorman closes the clutch circuit again.

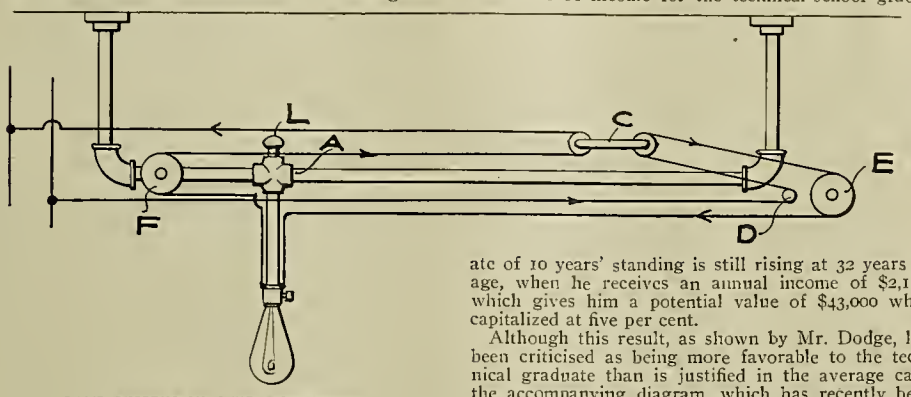
Postal Telegraph Extension in the Rockies.

On the Union Pacific Railroad Company's right-of-way the Postal Telegraph-cable Company will have completed within a month or six weeks a noteworthy extension of its pole-line system. The new telegraph line extends from Cheyenne, in Wyoming, west to Salt Lake City, Utah, and thence north, by way of Ogden, through the eastern portion of Idaho, to Butte, Mont.—a total distance of 920 miles. Much of this route traverses the Rocky Mountains. The line is composed of Michigan cedar poles 25 feet high, with seven-inch tops, spaced 40 to the mile in the mountains and 35 elsewhere. Each pole has one cross-arm, supporting three No. 9 copper wires. Six gangs of men are now at work on the job, which is being done under the supervision of Mr. C. M. Baker, superintendent of construction of the western division of the Postal company, who has just returned to his headquarters in Chicago.

Lamp Suspension over Workbench.

Willard F. Sheaf of Herkimer, N. Y., sends the accompanying sketch to illustrate a method of suspending an electric lamp over a desk, workbench, lathe, etc., in such a way that the light may be moved from one end of the workbench to the other, without any loose wire. The contrivance also allows the lamp to be placed out of the way when not in use.

The frame is made of one-fourth or three-eighths-

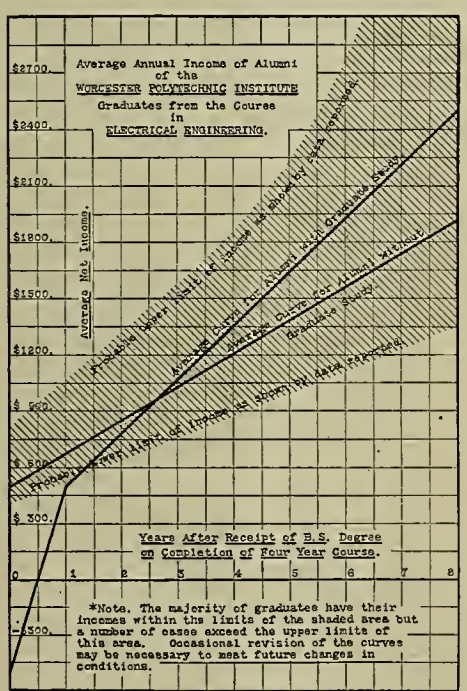


LAMP SUSPENSION OVER WORKBENCH.

inch pipe, attached to the ceiling by floor plates. (A) is a pipe-cross drilled out so it will slide upon the pipe, with a thumb screw (L) threaded through a pipe plug and used to fasten the lamp up out of the way when not in use and also to fasten it at any angle when in use. The arrows indicate the direction of the current in the lamp cord. Two movable pulleys linked together are shown at (C). (D) is a porcelain knob to which the lamp cord is tied and (E) and (F) are fixed pulleys. The lamp and movable pulleys (C) move in opposite directions. As one cord lengthens the other shortens, and vice versa.

Records of Electrical Engineering Graduates.[1]

The value of a thorough education fitting a young man for his life work is no longer a debatable question. The recent report of the United States Bureau of Education shows that a boy with a common-school education has practically one chance in 9,000 of gen-



RECORDS OF ELECTRICAL ENGINEERING GRADUATES.

eral recognition as a successful man in some department of human endeavor and usefulness.

A high-school education increases his chances of such success by about 22 times, while a college education gives a young man about 10 times the probability of success and advancement possessed by the high-school graduate, or about 200 times the opportunity open to the boy with only a common-school education.

While the basis of income which a man may be able to secure is, in many respects, a false standard of comparison, yet it is perhaps as definite a measure of his worth as any single method at our command. For this reason the following data presented by Mr. Dodge in his recent presidential address before the American Society of Mechanical Engineers are of much interest. From carefully prepared averages he found that in engineering work the average unskilled man at 22 years of age has reached his maximum earning capacity of $510 a year, which, capitalized at five per cent. gives him a potential value of about $10,000. The shop-trained man reaches his maximum of $790 a year at 24 years of age, while the curve of income for the technical-school graduate of 10 years' standing is still rising at 32 years of age, when he receives an annual income of $2,150, which gives him a potential value of $43,000 when capitalized at five per cent.

Although this result, as shown by Mr. Dodge, has been criticised as being more favorable to the technical graduate than is justified in the average case, the accompanying diagram, which has recently been prepared from data received from graduates of the Worcester Polytechnic Institute in Electrical Engineering, substantiates the conclusions drawn by him and further emphasizes the value of a thorough technical training.

This diagram is probably unique in that it shows most completely the financial prospects of technical graduates from year to year. As the Department of Electrical Engineering at the Worcester Polytechnic Institute has been established but eight years, there are data available for this period only, but during this time a large number of students have graduated, and data have been received from a sufficient number of them to represent conditions fairly. From these curves it is seen that the average graduate who receives $500 a year for his first position after leaving the Institute rapidly increases in value, so that, at the end of eight years, he may expect to receive an income of about $1,900; or, if he has been a graduate student at the Institute for one year, his income is shown to average about $2,500, which, capitalized at five per cent., gives him the income on an investment of about $50,000. By investing five years of his time and the cost of his college training, he has after a few years and for the remainder of his life increased his income earning value by not less than $40,000.

1. From advance sheets of the forthcoming (November) number of the Journal of the Worcester Polytechnic Institute.

Scheidel Electrolytic Rectifier.

The interesting electrolytic rectifier of William Scheidel of Chicago was briefly described, with a picture, in the Western Electrician of November 7th last. On December 31st following Mr. Scheidel applied for a patent for certain improvements, and this patent was issued on August 2, 1904. The present invention relates to the appliances and circuits used in operating induction coils and like apparatus, in the operation of which a high-frequency current is employed, and has for its object to provide a simple and efficient structural arrangement and combination of parts whereby alternating or other like

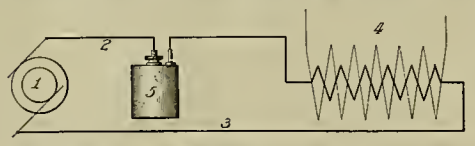


FIG. 1. DIAGRAM OF SCHEIDEL ELECTROLYTIC RECTIFIER.

variable electric currents are effectively utilized in the operation of induction coils and the like, and which is adapted to eliminate to a very material extent the rapid generation of heat and increase in temperature in the ordinary form of electrolytic interrupter when working with alternating currents, and in such elimination of heat attain a constant and effective high-frequency interruption of the current supplied to an induction coil during long-continued use of the apparatus.

In the accompanying drawings, Fig. 1 is a diagrammatic view illustrating the general arrangement of the present apparatus. Fig. 2 is a vertical section of an electrolytic interrupter embodying the improvement.

The improvement involves the rectification of alternating and like variable electric currents during their passage through a high-frequency electrolytic interrupter, so that the dual operation of interruption and rectification will occur in a substantially simultaneous manner in the single cell of the apparatus, and with which the passage of one phase of an alternating or like variable current through such cell is prevented, while free passage is afforded to the other and companion phase of such alternating or variable current and a simultaneous high-frequency interruption of the last-mentioned phase effected prior to its passage to the primary winding of the induction coil or other like apparatus.

To such end the invention consists in the formation of the cathode element or electrode of the electrolytic interrupter from aluminum or other equivalent substance which, when acting as a cathode, offers but little resistance to the passage of the electric current, but which, when acting as an anode, prevents the passage of such current. The other element or electrode of the apparatus is formed of platinum, carbon, or the like, while the electrolytic fluid will be phosphate of soda, or ammonia, or other like solution generally employed in rectifier cells.

Referring to the drawings, (1) represents the alternating or other variable-current generator; (2) and (3) the line wires; (4) an induction coil or other like apparatus, employing high-frequency currents, and (5) an electrolytic interrupter of any of the usual forms now in general use and which is arranged in circuit with the generator and induction coil, as shown in Fig. 1.

The containing-cell casing (6) in the present im-

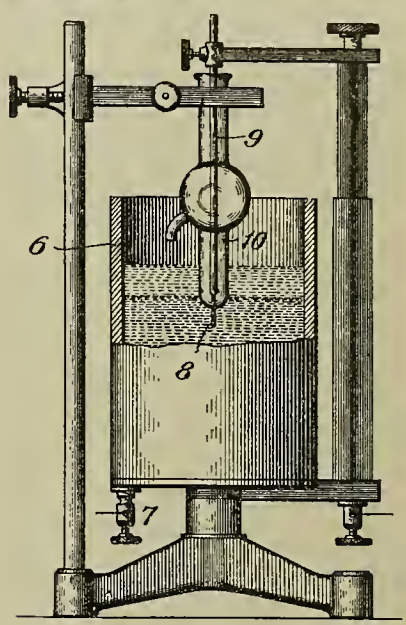


FIG. 2. SCHEIDEL ELECTROLYTIC RECTIFIER.

provement is formed of aluminum or other equivalent material, and which constitutes the cathode element or electrode of the present apparatus and to the end is provided with a binding-post connection (7) for one of the line wires of the alternating electric circuit of the system. (8) is the anode element or electrode, formed of platinum wire or like substance and secured in the lower end of a holder rod (9), which is suitably connected with the other line wire of the circuit of the present system. (10) is a tube of insulating material surrounding the anode (8), and having a small orifice at its lower end through which the anode projects into the electrolytic solution in the cell (6), as shown, and as usual in the present type of interrupters.

Sacramento Valley Wants Electric Railways.

Newspapers of California are enthusiastic in pointing out the great possibilities for electric railways in the Sacramento Valley, and it is asserted that there is hardly any other region in America so well adapted to the profitable working of such means of transportation. Every portion of the valley is capable of dense population, and the waterpower for the generation of electricity is all around the valley. "Electric lines for carrying power to other sections must pass through the valley," says the Colusa Sun, "and each will have a surplus of power and will have to hunt for some means of using it, and nothing will be so apparent as the electric railway over a level country. It is stated that a corporation has been formed for the purpose of constructing an electric road from Woodland to Suisun by way of Winters and Vacaville, and a surplus of electric power is given as one of the reasons for it at this time. We mentioned a day or so ago the fact that there was talk of lines from several points in the valley to Colusa, and in that the abundance of power is given as a factor. These electric roads will act as feeders to the heavier steam roads and to the river. Cheap and rapid transportation, added to such a vast area of good land as the Sacramento Valley, will make it one of the most desirable regions of the world."

WESTERN ELECTRICIAN

EVERY SATURDAY.

PUBLICATION OFFICES:
510 Marquette Building, · CHICAGO.
TELEPHONE, MAIN 1746.

Eastern Office, 193 Times Building, New York.
Telephone, 3806J Cortlandt.

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted. This paper is entered at the Chicago postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the old address as well as the new should be given.

CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—**the only general electrical paper published in the West**—thoroughly covers a territory *exclusively its own.* THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be furnished on application.

REMITTANCES.—All checks, drafts and other remittances should be made payable to the order of the publishers, the **Electrician Publishing Company,** and addressed to the offices of publication, Suite 510, Marquette Building (204 Dearborn Street), Chicago, Illinois, U. S. A.

CONTENTS OF THIS NUMBER.

Electric Lighting at the Alhambra Theater. Illustrated. 129, 130
The "Electrification" of the Erie Canal. By George E. Walsh 130
Kewanee-Genesco Single-phase Railway 130
High-tension Insulators. By R. Scott. Illustrated..131, 132
Referendum on Proposed Chicago City Railway Franchise 132
Public Lighting in Detroit 132
Synchronous Motor Adapted for Railway Work. Illustrated 132
Postal Telegraph Extension in the Rockies..... 132
Lamp Suspension Over Workbench. Illustrated..... 133
Records of Electrical Engineering Graduates. Illustrated 133
Scheidel Electrolytic Rectifier. Illustrated..... 133
Sacramento Valley Wants Electric Railways..... 133
Editorial 134
The International Electrical Congress and the September Conventions 135
New Method of Manufacturing Steel 135
Electric Dumbwaiters. Illustrated 136
New Punched Clip Lever Switch. Illustrated..... 136
Possibilities of the Electric Handshaker..... 136
National Electric Exhibit at St. Louis. Illustrated..... 137
The Edison Convention 137
Steel Rails Electrically Tested at Varying Temperatures 137
Rubber High in Price 137
Telephone News from the Northwest..... 138
Southeastern Telephone Developments 138
Ohio Telephone Notes 138
Dates for Ohio Independent District Meetings..... 138
Kinloch Long-distance Company's Plans..... 138
Telephone Men 138
General Telephone News 138
Operation of Synchronous Converters. By S. C. Lindsay. (American Institute of Electrical Engineers).. ..... 139, 140
A New System for the Care of Standard Instruments.. 140
World's Fair Visitors of Last Week..... 140
Rheostat Stand for Electric Flatirons. Illustrated..... 140
New Electric Locomotive on Jungfrau Railway..... 140
Questions for Railway Mechanics..... 140
Large Electric Watch 140

DEPARTMENTS.

Correspondence 141, 142, 143
Great Britain 141
New York 141
New England 141
Dominion of Canada 141, 142
Southeastern States 142
Ohio 142
Indiana 142
Michigan 142
Northwestern States 142
Rocky Mountain States 142, 143
Pacific Slope 143
Personal 143
Electric Lighting 143
Electric Railways 143, 144
Publications 144
Telegraph 144
Miscellaneous 144
Trade News 144, 145
Business 145
Illustrated Electrical Patent Record 145, 146

DATES AHEAD.

Association of Edison Illuminating Companies, Hotel Wentworth, New Castle, N. H., August 30th and 31st.

Minnesota Telephone Association (convention), Minneapolis, August 31st and September 1st.

Northwestern Electrical Association (mid-year meeting), Forest Park University Hotel, St. Louis, Mo., September 12th to 16th.

International Electrical Congress, Coliseum, St. Louis September 12th to 17th.

International Association of Municipal Electricians (annual meeting), St. Louis, September 13th and 14th.

American Electrotherapeutic Association (annual convention), St. Louis, September 13th to 16th.

National Electrical Contractors' Association (annual convention), St. Louis, September 14th to 16th.

Colorado Electric Light, Power and Railway Association, Colorado Springs, September 21st to 23d.

Michigan Electric Association (annual meeting), October 11th.

American Street Railway Association (annual meeting), World's Fair grounds, St. Louis, October 12th and 13th.

Kansas Gas, Water and Electric Light Association (annual meeting), Leavenworth, Kan., October 18th and 19th.

ROUND IRON or flat iron for bands on a round flume to carry water at about 35-foot head for a hydraulic power plant? That, in brief, is the question that a Canadian correspondent puts to us. Our inquiries lead us to believe that the use of flat or half-round iron is much more common than that of round iron for bands. There might be special conditions where the use of round iron would be advisable for this purpose, but these conditions are the exception for small or moderate flume diameters.

NOT the least interesting of the engineering features of the Cape-to-Cairo railway is the electric cableway across the Zambesi River, near Victoria Falls. It is used for conveying materials across the river at a place where a bridge is to be constructed. Here the banks are 400 feet high and 650 feet apart. A steel cable 2¾ inches in diameter is suspended across the gorge, and on this the conveyor travels. Two wheels support a frame carrying an electric motor and gearing, with a chair for the driver and the necessary levers to actuate the hoisting and traveling gear. The capacity of this conveyor is 10 tons, and it is able to transport 800 tons daily.

VISITORS to the Louisiana Purchase Exposition at St. Louis who are interested in electricity or electrical literature are cordially invited to call at the booth of the Western Electrician, which is in Block 1 (Section 13) of the Palace of Electricity, just west of the main northern entrance to the building. Here will be found copies of the current issue of the paper, bound volumes of the Western Electrician from the first number, a careful selection of electrical books exhibited by the Electrician Publishing Company, and other objects of electrical interest. Chairs are provided for weary sight-seers, and an attendant will extend a hearty welcome to all readers or friends of the paper.

AMERICAN electrical men are showing the enthusiasm which was to be expected in arranging for the visit of their foreign confrères who are coming to this country to attend the International Electrical Congress in St. Louis next month, to see the World's Fair, to view, cursorily, many of the things that the United States has to show in the way of electrical achievement, and incidentally to do some sightseeing. An ambitious programme has been laid out, including a "circular tour" of several cities of electrical interest, and our only fear is lest an attempt has been made to do too much in an itinerary of less than three weeks, which embraces a week's stay in St. Louis. The outlines of the programme are given elsewhere in this issue of the Western Electrician, and it will be seen that those who do the whole trip from start to finish will have a legitimate excuse for pleading fatigue at the end of it. Ours is a large country, however, and it is difficult to see what could have been left out. Of course it will not be compulsory for the traveler to see every interesting object or to visit every plant for which opportunity is offered; the judicious visitor will endeavor to seize occasion to save his strength; nevertheless, there will be so much worth seeing and such an honest desire to make the travelers really welcome in every place visited that our over-sea friends must come armed with a determination to be ready to be nearly always "on the go" during their "swing around the circle." After the various committees get through with them they can rest on shipboard or elsewhere.

STUDIES of the electrical industry of Germany are of interest, owing to the recent trade depression in that country, from which some lessons may be drawn. A recent British consular report reviews the development of the industry in Frankfort for the year 1903. The consul points out that this industry was, from the start, unfettered by any antiquated traditions or surroundings, and it was, further, cordially supported by the investing public, which supplied large sums of money to aid its development. From 1895-6 to 1900 the number of electric-light and power stations increased from 180 to 774, and the horsepower increased from 10,254 to 106,368. The kilowatt capacity of machinery in operation and of accumulators rose from 40,471 to 230,058. Toward the middle of 1900, however, the tide of public favor changed, and it is the opinion of many in Germany that the withdrawal of public interest in the electrical industry was the precursor of the general trade depression from which Germany has, to a greater degree than any other country on the Continent, suffered during the last few years. The blow fell not the less heavily from the fact that overproduction had been carried to extremes, and many leading firms had committed themselves in the matter of capital expenditure. The consul draws a distinction between those firms which became committed to the erection and equipment of complete electrical undertakings and those firms which specialized in the production of certain machines and apparatus. He thinks that the latter class of commercial undertakings has been better able to weather the serious crisis than the former, and in some cases has been able to earn more or less satisfactory profits. The return to comparative prosperity of the German electrical industry, which is a notable feature at the present time, is referred to, and while in the immediate future no increase is expected in the number of central stations, but rather an extension of existing stations, and while the number of horse-drawn tramways to be converted into electric systems is now but few, the natural development of existing undertakings is likely to provide work for those engaged in the industry on a comparatively safe profit-earning basis. The consul points to the tendency of German industrial companies in putting down isolated installations and to the use of electricity in mining and agriculture as hopeful factors in the development of the industry.

ANOTHER revolution in the automobile industry is heralded. The announcement comes through a daily newspaper in Paris, and possibly the new order may fail to "arrive;" revolutions do not always assume the proportions fondly foretold by their promoters. In this case a company manufacturing electric carriages has evolved a transmission scheme, of which this is the vague description given: "The system is simple. The motors and the wheels are one and the same thing, working together, running at the same speed and without any kind of intermediary. The 'live axles' can be placed in front or behind. They receive their motive power direct from the accumulators, and the chains, pinions and gearings are things of the past. A carriage with live axles can travel 20 to 30 per cent. farther than the ordinary carriage, for the reason that it is relieved from lost energy and has no impediments. In a word, weight is reduced, power increased, heating diminished, and absolute silence obtained, while wear and tear are brought to a minimum. This invention can be applied to any kind of vehicle, although at present the private carriage is receiving all attention. In the trial the new system, although primitively mounted, worked admirably at five speeds, varying between 4½ and 19 miles an hour, and with perfect silence. There was no jar in starting or in changing speed. The general appearance of the carriage is improved, as the motor being removed from under the vehicle the body can be built low. It may be said that the wheels on which the motors are placed look clumsy compared with those on the present-day carriages. This is simply a matter of first sight."

This device bears a close resemblance to the Holson "gyroscope" or hub motor first described in the Western Electrician over three years ago and exhibited in improved form at the Chicago Automobile Show of last February, forming the subject of a second illustrated article in the issue of this journal dated February 20, 1904. However, the gyroscope motor is not gearless. It is fastened immovably to the axle and carries an elongated armature shaft, disposed transversely to the axle, having a pinion on each end. These two pinions engage two annular gears within the wheel casing. The wheel is divided into two parts in a plane at right angles to the axle. Each section carries an annular gear or rack for the engagement of one of the pinions of the motor shaft, the racks facing each other. The armature is slightly inclined from a right angle, so that one pinion engages one rack and the other the gear facing the first, the two points of bearing coming at points diametrically opposite. As will be readily seen, the force applied by the shaft drives the two parts of the wheel in the same direction.

The Holson invention is very ingenious and has been applied to electric trucks with apparent success. It will be of interest to await a more accurate and detailed account of the Parisian apparatus to learn just how the motors and wheels are made "one and the same thing."

The International Electrical Congress and the September Conventions.

The International Electrical Congress will be convened in the Music Hall of the Coliseum, St. Louis, at 9:30 a. m., on Monday, September 12, 1904. The Music Hall is situated at Olive and Thirteenth Streets. All members of the Congress are invited to attend this meeting. After the opening ceremonies, it is intended that the Congress divide itself into sections, the section halls being on the second floor of the same building. The bureau of information and the offices of the secretary and treasurer will also be in the Coliseum Building. On Tuesday, Thursday and Friday the sections will meet on the second floor of the Coliseum from 9 a. m. to 1 p. m.

The committee of organization of the Congress was appointed by President Francis of the Louisiana Purchase Exposition in June, 1903. In response to invitations to join the Congress, 1,915 acceptances had been received up to August 1, 1904. Of this number, 1,542 are from North America and 373 from other countries. Over 1,300 certificates of membership have been issued to persons who have already become members by forwarding their subscriptions. The committee of organization is composed of the following-named gentlemen: President, Elihu Thomson, Swampscott, Mass.; vice-presidents, Bion J. Arnold of Chicago (chairman of the executive committee), Professor H. S. Carhart of Ann Arbor, Mich., Professor W. E. Goldsborough of St. Louis, C. F. Scott of Pittsburg. Dr. S. W. Stratton of Washington, D. C.; general secretary, Dr. A. E. Kennelly of Cambridge, Mass.; treasurer, W. D. Weaver of New York city.

The work of the Congress (in addition to that of the Chamber of Delegates) is divided into eight sections. The titles of the sections and the names of the officers of sections follow:

Section A. General Theory, Mathematical, Experimental.—Chairman, Professor E. L. Nichols of Ithaca, N. Y.; secretary, Professor H. T. Barnes.

Section B. General Applications.—Chairman, Professor C. P. Steinmetz of Schenectady, N. Y.; secretary, Professor Samuel Sheldon of Brooklyn.

Section C. Electrochemistry.—Chairman, Professor H. S. Carhart of Ann Arbor, Mich.; secretary, Carl Hering of Philadelphia.

Section D. Electric Power Transmission.—Chairman, Charles F. Scott of Pittsburg; secretary, Dr. Louis Bell of Boston.

Section E. Electric Light and Distribution.—Chairman, J. W. Lieb, Jr., of New York; secretary, Gano S. Dunn of Ampere, N. J.

Section F. Electric Transportation.—Chairman, Dr. Louis Duncan of Boston; secretary, A. H. Armstrong of Schenectady, N. Y.

Section G. Electric Communication.—Chairman, F. W. Jones of New York; secretary, B. Gherardi of Brooklyn.

Section H. Electrotherapeutics.—Chairman, Dr. W. J. Morton of New York; secretary, W. J. Jenks of New York.

For these sections 170 papers have been promised, and 67 of them were on hand on August 1st. The names of papers and authors for nearly all of the sections have already appeared in the Western Electrician. The complete programme will be published in a later issue, before the date of the Congress.

The government of the United States, at the petition of the committee of organization, has issued invitations to the various foreign governments to send official representatives to the Chamber of Delegates of the Congress. Up to August 1st the following appointments have been announced:

Austro-Hungary—Professor Charles Zipernovzky.

Italy—Professor Moise Ascoli, Professor L. Lombardi, Ing. A. Maffezzini.

Switzerland—Professor Ferdinand Weber, Professor François Louis Schüle.

Norway and Sweden—Professor Svante August Arrhenius.

Australian Colonies—John Hesketh, Esq.

Brazil—Señor Jorge Newbery.

India—J. C. Shields, Esq.

Mexico—Señor Rafael R. Arizpe.

United States—Professor H. S. Carhart, Dr. A. E. Kennelly, Professor H. J. Ryan, Professor S. W. Stratton, Professor Elihu Thomson.

The committee of organization has also issued invitations to the various electrical and physical societies all over the world to co-operate and to send delegates to the Congress. The following-named European societies have already engaged to co-operate:

The Institution of Electrical Engineers. (Delegates—R. Kaye Gray, Colonel R. E. Crompton, C. B., Professor John Perry, F. R. S., Dr. R. T. Glazebrook, F. R. S., H. E. Harrison, B. Sc., B. A.; W. Duddell, hon. secretary of delegation.)

La Société Internationale des Électriciens.

Associazione Elettrotecnica Italiana. (Delegates—Professor M. Ascoli, Professor G. Grassi, Professor L. Lombardi, Ing. E. Jona.)

Oesterrichischer Elektrotechnischer Verein. (Delegate—Herr Baron Wolfgang Ferstel.)

In North America the following-named societies have engaged to co-operate with the Congress:

The Royal Society of Canada. (Delegates—Professor W. Lash Miller, Professor Howard T. Barnes.)

The American Institute of Electrical Engineers, to hold a simultaneous convention and joint sessions with several sections. (Delegates—Ralph D. Mershon, Professor M. I. Pupin, Professor C. P. Steinmetz.)

The American Physical Society, to hold a simultaneous convention and joint session with Section A, September 15th.

The American Electrochemical Society, to hold a simultaneous convention and joint sessions with Section C, September 13th and 15th. (Delegates—Professor W. D. Bancroft, Professor H. S. Carhart, Dr. Louis Kahlenberg.)

The National Electric Light Association. (Delegates—George Eastman, G. Ross Green, Dr. F. A. C. Perrine.)

The Association of Edison Illuminating Companies. (Delegates—W. C. L. Eglin, L. A. Ferguson, Gerhard Goettling.)

The International Association of Municipal Electricians, to hold a simultaneous convention and joint meering with Section G. (Delegates—W. H. Bradt, F. C. Mason, Walter N. Petty.)

The American Electrotherapeutic Association, to hold a simultaneous convention and joint meeting with Section H on September 15th. (Delegates—Dr. Russell Herbert Boggs, Dr. Charles R. Dickson, Dr. James Herdman.)

The United States Navy Department has appointed as delegate to the Congress, Lieut.-commander Joseph L. Jayne.

The American Institute of Electrical Engineers has extended an invitation to the Institution of Electrical Engineers of Great Britain to visit the United States in September and to hold a joint meeting in St. Louis, in connection with the International Electrical Congress. A general invitation has also been extended by the American Institute of Electrical Engineers to European electrical societies, to join in a circular tour, visiting principal cities and important industrial centers en route to and from St. Louis. The circular trip will commence at Boston, September 2d, or New York, September 1st and 4th. Special traveling facilities, accommodations and receptions have been arranged for the benefit of the visitors.

All European Congress members who desire to join the circular tour should communicate with the secretary of the American Institute of Electrical Engineers, 95 Liberty Street, New York city, and arrange to arrive in New York not later than September 1st, or in Boston not later than September 2d.

A copy of the Transactions of the Congress will be forwarded to each member, at the address on his postcard or notice op application, unless a notice of change of address is received by the general secretary.

Preparations for the Entertainment of Foreign Visitors.

To entertain the foreign visitors to the International Electrical Congress and the St. Louis Exposition the American Institute of Electrical Engineers has appointed a general reception committee, of which J. W. Lieb, Jr., of 55 Duane Street, New York, is chairman, and a committee on transportation and arrangements, of which E. H. Mullin of 44 Broad Street, New York, is chairman. These committees have arranged an elaborate circular tour for the visitors, who are expected to arrive in New York or Boston between August 24th and September 3d. The itinerary, condensed, is as follows: Boston, September 3d; New York, 4th and 5th; Schenectady, 6th; Montreal, 7th and 8th; Niagara Falls, 9th; Chicago, 10th; St. Louis, 11th to 17th; Pittsburg, 18th and 19th; Washington, 20th; Philadelphia, September 21st.

Chairmen of the local reception committees have been named as follows: Boston, C. L. Edgar; New York, T. C. Martin; Schenectady, E. W. Rice, Jr.; Montreal, Professor R. B. Owens; Niagara Falls, George W. Davenport; Chicago, Samuel Insull; St. Louis, W. V. N. Powelson and W. A. Layman; Pittsburg, Charles F. Scott; Washington, General George H. Harries; Philadelphia, Joseph B. McCall.

In Chicago the local committee has appointed two sub-committees. B. E. Sunny, T. P. Gaylord and A. L. Tucker will look after the finances, while Mr. Insull, A. S. Hibbard, Frederick Sargent, G. A. Damon and Peter Junkersfeld constitute the committee on entertainment and programme. The committee will take charge of the visitors for the whole day (September 10th). The party will be entertained at breakfast, luncheon and dinner at the Auditorium Annex and will be taken to see such points of electrical interest as individual preference may indicate. The Fisk Street station, the telephone exchanges, the network of electric-freight tunnels and other installations will be visited. In the afternoon those who wish to go will be taken for a sail along the waterfront in the U. S. S. Dorothea, in command of Captain S. E. Darby of the Illinois Naval Reserves.

The Western Electrician is requested to announce that gentlemen connected with the electrical interests of Chicago who possess automobiles will confer a favor on the entertainment committee by placing the vehicles at its service for the day. Mr. Samuel Insull, 139 Adams Street, will be pleased to hear from gentlemen who can accommodate the committee in this manner.

Great Britain and Italy will be especially well represented among the foreign visitors, who are expected to number about 170. Among those already booked are R. Kaye Gray, president of the Institution of Electrical Engineers; Colonel R. E. Crompton, Professor John Perry, C. H. Merz, Dr. R. T. Glazebrook, R. Hammond, G. C. Lloyd, Francis G. Baily, G. Balfour, D. Bates, John T. Connolly, Professor J. D. Cormack, R. S. Erskine, W. P. J. Fawcus, W. Geipel, Thomas Hesketh, F. Hope-Jones, John L. Marr, Godfrey Pope, E. K. Scott and R. F. Willis. The Italian party includes Professor M. Ascoli, Professor Guido Grassi, Professor Luigi Lombardi, C. A. Curti, Professor F. Lori, A. Maffezzini and others. Many of the travelers will be accompanied by ladies.

New Method of Manufacturing Steel.

In a recent report from Melbourne, Australia, United States Consul-general John P. Bray declares that successful experiments have just been made there by the Iron, Steel and Metals Manufacturing Company at Melbourne, Victoria, for the purpose of proving the value of certain patent rights for the direct production of wrought iron and steel without first producing pig iron. Only a rough idea of the process may at present be had, he says, though trial runs with New Zealand magnetic iron sand are now being made on a somewhat larger scale than hitherto. The sand is first separated from its gangue by electromagnetic spearators, this treatment leaving a pure magnetic iron oxide. The sand is then fed from a bin into the furnace, which is of much interest, being chiefly mechanical and automatic in its operation.

The ore drops from the bin into a slowly revolving cylinder placed at such an angle that the ore travels forward continuously in it. As it does so it is heated to a dull red by the waste gases from subsequent operations. From this cylinder the ore drops into a second revolving cylinder, where the fine particles are subjected to the action of reducing gases, which reduce the magnetic oxide of iron to the metallic form, at the same time permitting the particles to retain their individuality. From this second cylinder the reduced ore drops into a smelting bath at the bottom of the revolving cylinders, and the molten steel or malleable iron, as the case may be, is tapped from this whenever that operation is necessary. It will thus be realized that the process is one of great simplicity and yet of much ingenuity. Not the least interesting part of it is the use of fuel oil for heating purposes. This is employed to secure concentration of heat and direct application in the furnace work. It is found that the fuel oil possesses many advantages over producer gas as used in existing smelting practice. The work done so far has demonstrated that not only is oil a cheap fuel, quite irrespective of the capital outlay that would be required if it was decided to utilize producer gas, but it is so thoroughly under control as to insure the best service.

The temperature at which iron ore melts is given variously at from 1,500° to 2,000° C., according to its purity. The accurate gauging of temperature in the furnace plays a very important part in the company's work, and accordingly an installation of thermoelectric thermometers has been made at the company's works. The apparatus consists of a couple, consisting of a platinum-iridium junction enclosed in a metal tube fully three feet long, which is placed in the center of the furnace, and the temperature is then recorded on the dial of a special form of voltmeter, each division on which represents 25° C. This voltmeter reads up to 1,600° and is placed at any convenient distance from the furnaces. The various thermometers are connected with a switchboard, which is again connected with the couples or tubes in the furnace. In the installation under notice four couples will be used, inserted in different parts of the furnace, and separately connected with the board, so that the reading of any thermometer can be taken and any discrepancy in the heat of different points of the furnace can be quickly remedied. It is interesting to notice that the voltmeter is so extremely sensitive that variations of heat down to 0.5 of a degree were easily noticeable in the trial test. The greatest temperature recorded was 1,300° C., equal to 2,340° F.

L. B. French of Detroit, Mich., who has been in Oregon for some time, is reported to have secured the right-of-way for an electric railway to connect Salem and Portland, Ore., taking in New Era, Canby, Barlow, Aurora, Hubbard, Woodburn, Gervais, Brooks and Chemawa. The route is 50 miles long and parallels the Southern Pacific railroad on the east side of Willamette River. The proposed road will have a double track and a site for the power house has been secured on the Sandy River.

Electric Dumbwaiters.

Within the last few years dumbwaiters have been developed from clumsy heavy affairs to automatic or semi-automatic, high-speed, electric push-button machines. The systems of electric dumbwaiters developed by the Burdett-Rowntree Manufacturing Company of Chicago give an illustration of the excellence which has been attained in this line. The machines of this company are usually so built that they are entirely automatic in their operation, the pressure on a button for an instant being sufficient to cause the car to start; the car stops automatically at the floor corresponding to the button pressed. If the car is in use or if any door is open, pressure on a button has no

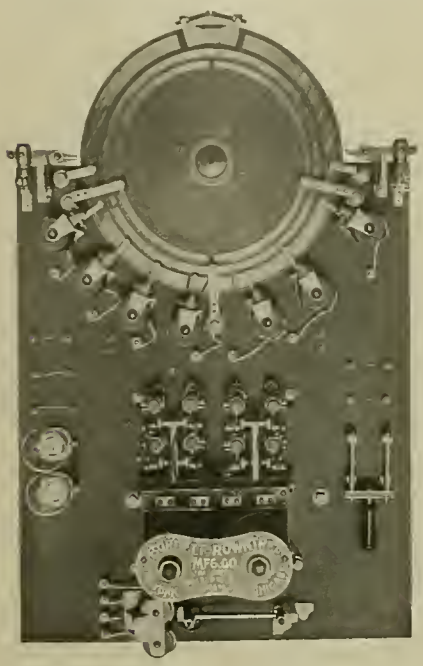


Fig. 1. Control Board.—View From Above.

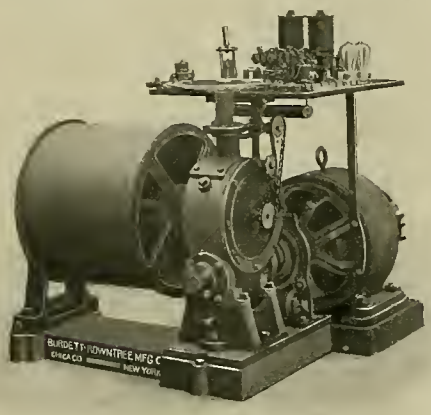


Fig. 2. Hoisting Mechanism with Push-button Control.

ELECTRIC DUMBWAITERS.

effect, so that no one will be injured in loading or unloading the dumbwaiter.

For cases where a dumbwaiter is constantly in use, such as in large department stores, the company has devised what is known as the one-point control system. This system is automatic, except that attendants are employed on each floor to facilitate the handling of goods. These attendants signal their wants to an operator in the basement, who controls the car. The operator is stationed before a control board, which is shown in detail in Fig. 1. Fig. 2 shows the control board in place directly over and attached to the hoisting mechanism. On the control board each dumbwaiter has a row of push-buttons corresponding to the different floors at which the car stops. Pressure on any button sends the car to the corresponding floor, where it automatically stops. Each dumbwaiter also has a row of buttons which rings a bell on the different floors, and each, also, has two annunciators, one of which receives the signal from a push-button on each floor, and the other is operated by a row of push-buttons in the car. For each dumbwaiter there is also an automatic signal lamp on the control board over the annunciator.

If someone on the fifth floor has a package to be sent to the eighth floor he pushes the button on the fifth floor, which immediately signals to the operator that the car is wanted at that floor. If the dumbwaiter is not busy the operator presses the fifth-floor button on the control board and the car immediately starts toward the fifth floor. The instant it starts the signal lamp over the annunciator goes out. As the car approaches the fifth floor it slows down automatically, coming to rest at the fifth floor smoothly and easily. The instant it stops there the signal lamp on the operator's board lights up again, and as soon as the door is opened on the fifth floor by the attendant the lamp goes out again.

If he does not open the door immediately, being inattentive or otherwise engaged, the operator knows it, because the lamp does not go out immediately after lighting up. He, therefore, rings the bell of that dumbwaiter on the fifth floor and continues ringing it until the lamp goes out, which shows that the door has been opened. The attendant on the fifth floor then loads the car with whatever he desires to send to the eighth floor. Before closing the door on the fifth floor, after loading the car, he pushes the eighth-floor button located in the car, thereby signaling to the operator that the load is to go to the eighth floor. He then closes the door, which lights up the signal lamp on the operator's board again. As soon as the lamp is lighted up the operator knows that everything is in order and presses the eighth-floor button, which starts the car to the eighth floor. The operator does not start the car until the lamp lights up, but if he is careless and attempts to start it the car will refuse to start, as unless all the doors are closed the car cannot be started. As soon as the car has stopped at the eighth floor, which the operator knows by the lamp over his board lighting up again, he rings the bell on the eighth floor until the door on that floor is opened.

Another type of installation is adapted for all purposes where the dumbwaiters are not used almost continuously, as for residences. This type requires no operator, but the car is controlled from any floor and can be brought to any floor and sent to any floor by simply pressing a button on any floor. In this case the car will not respond to a button if any door is open or if the car is in use. On every floor is a push-button box containing as many pushes as there are floors at which the car stops. Pressure on any button will send the car to the floor corresponding to the number of the button pressed.

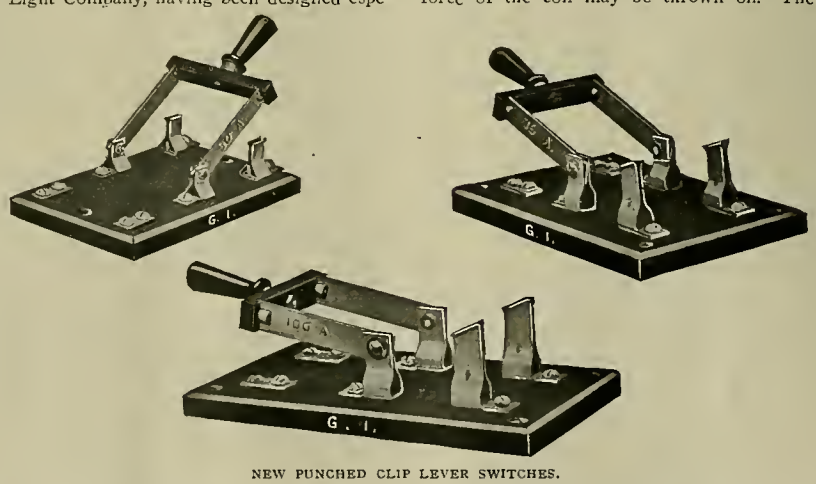
There are a variety of forms of control, each especially suitable for some particular purpose. Some are controllable from any floor. Some from only one floor and have a system of signals from the other floors. Some have full control from one floor and partial control from other floors, as, for example, the car can be sent from any floor to the main floor, but cannot be sent to any other floor except by the operator on the main floor, and he has full control of the car or cars at all times. Some have automatic unloading attachments whereby, when the operator presses a button, the load is automatically unloaded at whatever floor the car has been sent to, the doors automatically open and close again and the car is ready to be sent to another floor. Some have no automatic features at all and have an ordinary rope control similar to a freight-elevator-control rope.

The motors used for these machines are especially built for the work and a special patented system of motor winding is used. In the smaller sizes of automatic control no dash pot or rheostat of any kind is used, making the machines very simple, with fewer parts to get out of order, and are at the same time made more automatic in their action.

The automatic-control dumbwaiters are furnished with any capacity from 50 pounds to 1,000 pounds, and with any speed from 50 feet per minute up to 500 feet per minute, with standard construction, or up to 1,000 feet per minute with special high-speed construction.

New Punched Clip Lever Switch.

A new line of lever knife switches, illustrated herewith, is being manufactured by the General Incandescent Arc Light Company, having been designed especially to meet the demand for cheap, well-made switches for motor or lighting service in factories or similar installations. All conducting parts are made of pure rolled copper finished by dipping and lacquering and mounted on slate bases in a first-class, workmanlike manner. They are designed to meet the underwriters' requirements.



NEW PUNCHED CLIP LEVER SWITCHES.

This line of switches is made entirely front-connected; lugs, but no fuses, being furnished in every instance, unless otherwise ordered. They are recommended as serviceable in every case, excepting where a highly polished switch is required, on account of appearance. They are furnished in one style of finish only in sizes, 15, 25, 50, 75, 100 and 150 amperes, one two and three-pole, with and without fuses, single and double-throw, and spaced for 250-volt service.

Possibilities of the Electric Handshaker.

A patent has recently been issued to Mr. John Kelly of Paterson, N. J., on an electrical toy which forms an interesting novelty. The invention embodies no new principle, but the method of application is unique, and the "electric handshaker," as the toy might be called, ought to furnish much amusement.

The toy, which is hardly as innocent as its appearance indicates or its name would imply, consists of a small dry cell or battery connected in series with the low-potential winding of a miniature induction coil. The battery and the coil, with its minute vibrator, are enclosed in a metal case having wooden ends. The method of arranging the connections is simple and ingenious. The case is about the size of a thick pocketbook, being three inches high, 2½ inches wide and 1¼ inches thick.

The high-potential windings of the coil are connected, by two well-insulated wires, with two contact buttons mounted on the outside of an insulated finger ring. The ring is made of yellow or flesh-colored celluloid, in order to be inconspicuous, and is provided with a flap, so that it may be adjusted to fit any finger.

The patent specification states that "It is intended that the cell or battery and coil be concealed in the inside breast pocket or other convenient hiding place on the person intending to operate the toy. The two wires are to be run down the sleeve of the operator and the ring slipped on one of his fingers, the two contact buttons being turned toward the palm of the hand. If now, the circuit through the induction coil and battery being closed, the operator shakes hands or otherwise brings the two buttons on the ring into contact with another person, this person receives a most surprising and effective electric shock. Owing to the small size and the ingenious method of concealing the apparatus, the recipient of the shock does not at once discover the source of the discharge, and the toy is productive of much amusement."

The specification does not state who derives the amusement—probably the spectators, if the recipient is of a combative frame of mind. The specification further adds: "Instead of running both wires from the induction coil to the ring through one sleeve, one wire may be run down each sleeve of the operator and connected to a contact button on a ring on each hand. If the operator then induces a number of persons to join hands with him and form a ring, as is the custom in certain round dances, immediately the ring is completed an electrical shock is felt by all the persons composing the ring, with exception of the operator."

In order to avoid suspicion, the "operator" would do well to simulate the appearance of also receiving the shock. Owing to the small amount of actual power generated, the shock is, of course, entirely harmless, but the effect on the unsuspecting victim on turning on the current is startling. A small lever switch is mounted on the top of the case and two contact buttons allow the amount of shock to be regulated at will, as either one-half or the whole force of the coil may be thrown on. The battery can be run continually three hours, but used intermittently will last several months and may be renewed by simply removing the bottom of the case and slipping in a new cell. The patent on the "handshaker" has been assigned to Mr. S. E. Flichtner, superintendent of the Cooper Hewitt Electric Company of New York city, who assisted Mr. Kelly in developing the invention. Mr. Flichtner has not yet decided how he will dispose of the toy.

National Electric Exhibits at St Louis.

The National Electric Company, successor to the Christensen Engineering Company, Milwaukee, has an extensive exhibit at the Louisiana Purchase Exposition, showing to advantage its well-known Christensen air-brake equipments and electrical machinery. Its space at section six, Electricity Building, is handsomely finished and inviting to visitors. In this space a large 400-kilowatt direct-current engine-type generator is the largest unit shown. A 150-kilowatt, 500-volt, direct-current generator is driven by a 20-horsepower, 220-volt motor, and in

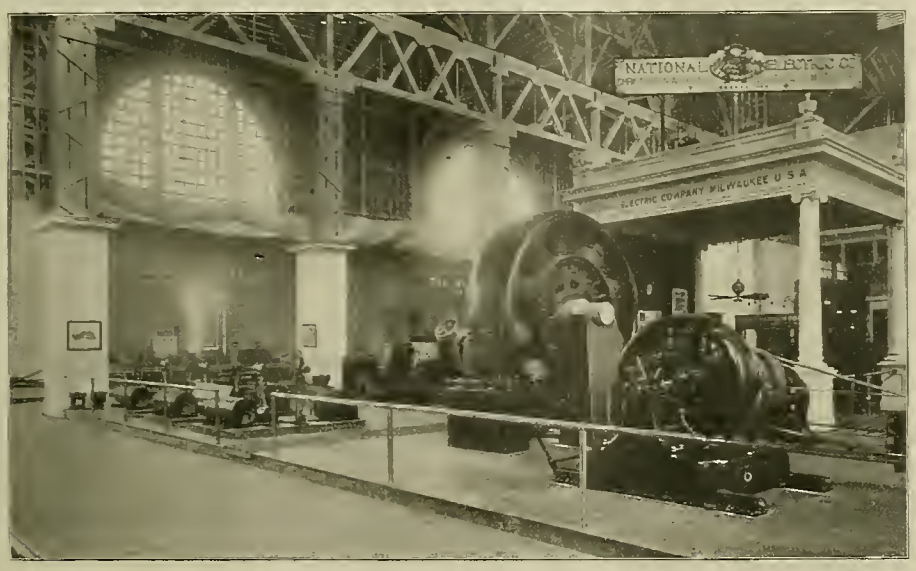


FIG. 1. NATIONAL ELECTRIC COMPANY'S EXHIBIT IN ELECTRICITY BUILDING, ST. LOUIS.

addition to these there is in operation a 150-kilowatt, 3,200-volt alternator, a 10-kilowatt motor generator set and a 60-kilowatt, 500-volt, direct-current generator belted to a 30-horsepower, 220-volt motor. A three-car train showing the operation of the company's air-brake control, such as is used by the South Side Elevated railway, Chicago, the Boston Elevated, and the Intramural railways is shown, together with a straight air-brake equipment, used for the instruction of motormen by electric-railway companies to show in detail the operation of this brake. Three hundred cars at the Buffalo Exposition were equipped with Christensen air brakes, and all cars operating within the grounds of the St. Louis Fair are controlled by this brake. It is an interesting fact to note that 11,000 are used in America and more than 1,500 in Europe, Asia, South America, Africa and Australia. Stationary and portable compressors are also shown. The National Electric Company extends a cordial invitation to all visitors to call and inspect its exhibits. Visitors are requested to register, and attractive souvenir literature will be mailed to the home addresses of all interested callers.

The National Electric Company, although comparatively young in the electrical field, is turning out some large direct and alternating-current generators for lighting, power and railway service. The unit illustrated in Fig. 2 is of 1,500-kilowatt capacity and is installed at block 46, Machinery Building, Louisiana Purchase Exposition, and direct connected to a 2,250-horsepower vertical cross-compound engine. The rated output is 1,500 kilowatts, 25 cycles, 6,600 volts, runnning at 83 revolutions per minute. The power generated is used for operating the large pumps, which lift the water that flows over the cascades.

Like all standard alternators built by the National Electric Company, this one is of the revolving-field type, leaving the armature stationary and easily accessible. The difficulty of properly insulating the armature coils is eliminated, as the windings are not subject to any mechanical strains whatever. The revolving field is of large diameter, giving additional flywheel effect to the engine, and the construction of the field coils makes them practically indestructible. All parts are accessible and the method of ventilation insures low temperatures.

The revolving field is made of cast steel in halves. These are bolted and secured together by shrunk links. The rim of the wheel is in channel cross-section, to which the cast-steel pole pieces are bolted. The field coils comprise 65 turns of 1½ by one-eighth-inch copper strap, wound on edge and thoroughly insulated, the outer edge of the coil being exposed to the atmosphere for cooling. Laminated pole shoes are secured to the ends of the pole pieces and serve to hold the field coils in position. These shoes cover a large polar arc, distributing the magnetic flux evenly. The field coils are insulated from the pole-pieces by fuller board and the pole shoes and spider ring by heavy fiber. The diameter of the revolving field is 16 feet and weighs approximately 50,000 pounds.

The frame is a circular cast-iron housing, into which laminated punchings with inwardly projecting teeth are assembled for the reception of the armature windings. The frame is exceedingly heavy and stiff, not requiring any external support, and is divided horizontally, the halves being firmly bolted and keyed together. Bolts and keys are contained entirely within the cross-section, obviating the use of side lugs. Large open spaces are provided in the sides of the frames, allowing a free passage of air from the ventilating ducts in the core.

The armature core is built up of laminated soft steel punchings, annealed and japanned before assembling, and ventilating space blocks are inserted at suitable intervals, providing openings extending around the circumference and allowing a free passage for the heat generated in the windings. There are six slots per pole, 2½ inches deep by 1½ inches wide, each being wound with 14 conductors of 0.37 by 0.28-inch compressed copper. The internal diameter of the armature is 16 feet three-quarters inch and the width of the core 16 inches.

Cast-iron collector rings and carbon brushes are used, enabling the machine to be operated with the

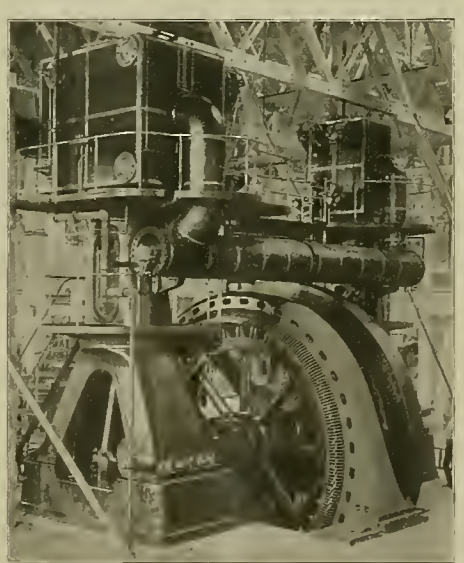


FIG. 2. NATIONAL ELECTRIC COMPANY'S 1,500-KILOWATT ALTERNATOR IN MACHINERY BUILDING, ST. LOUIS.

minimum amount of attention and at the same time provides a collector gear, which will carry a heavy temporary overload. The net weight of this alternator is 135,000 pounds. Following are the guaranties of the National Electric Company on this machine:

Efficiency at power factor 1:
- ¼ load 95.50
- Full load 95.50
- ½ load 94.75

Regulation—5.5 per cent on power factor 1.
Regulation—22 per cent on factor 0.
Short-circuit current with full-load excitation—450 amperes.
Exciting current at full load—80 per cent.
Power factor—240 amperes at 100 volts.

This alternator is excited with a 45-kilowatt motor generator set, the motor side being run off 220-volt lighting mains. The exciter current on the alternator is regulated by a rheostat in the shunt of the exciter. On July 15th the pit was flooded with water, but the machine was dried out and in operation on the following Monday. This alternator has been several times short-circuited, due to short-circuit on the switchboard and mains, but has not been disabled in any way. The temperature rise does not exceed 30° on armature and magnets on a continuous run at full load and 40° on the armature and magnets on a continuous run at 25-per cent. overload.

The Edison Convention.

The next annual convention of the Association of Edison Illuminating Companies will be held at Hotel Wentworth, New Castle, N. H., on August 30th and 31st and September 1st. Papers will be read as follows: "A Plea for Uniformity in Construction and Operation of High-tension Systems," Philip Torchio, New York, N. Y.; "Notes on Economy in the Production of Steam," W. F. Wells, New York, N. Y.; "Experiences with Automobile Charging Stations," Joseph W. Cowles, Boston, Mass.; "Vulnerable Points in Operation of High-pressure Alternating Transmission Supplying Large Distributing Systems," D. L. Huntington, Spokane, Wash.; "The Relative Efficiency of Electric and Hydraulic Elevators," W. C. L. Eglin, Philadelphia, Pa.; "Electric Heating and Cooking," H. W. Hillman, Schenectady, N. Y.; "Relations Between Length of Arc Voltage and Candlepower in Enclosed Arc Lamps and the Effect Upon Efficiency of Arc Lamps by Varying Size of Carbons," George N. Eastman, Chicago; "Gas Engines vs. Electric Motors," Fred M. Kimball, Schenectady, N. Y.; "Light and Illuminating Engineering," W. D'A. Ryan, Schenectady, N. Y.; "To What Extent Should Central Stations Make Investments?" John F. Gilchrist, Chicago; "Results Up to Date Obtained from the Use of the Wright Demand System of Charging," John W. Ferguson, Chicago; "Results Up to Date Obtained from the Use of the Wright Demand System of Charging," Arthur S. Knight, Boston; "Some Commercial Problems," Joseph D. Israel, Philadelphia; "Notes on European Testing Laboratories," Dr. Clayton H. Sharp, New York; "Measuring Instruments in Generating and Sub-stations," Caryl D. Haskins, Schenectady, N. Y.; "Troubles and Losses Between Generators and Customers' Services," Peter Junkersfeld, Chicago; "Some Data on Electric Power," Arthur Williams, New York.

Steel Rails Electrically Tested at Varying Temperatures.

The World's Fair Street Railway Commission, which is making exhaustive electrical tests at the Bullock Electric Manufacturing Company's exhibit at Section No. 15, Palace of Electricity, under the direction of Professors Norris of Cornell, Swenson of Wisconsin and Plum of Purdue, achieved some interesting results a few days ago while testing the temperature coefficients of steel rails. These tests are made by taking the resistance of the rail at a normal temperature, then passing a large enough current through the rail to raise its temperature though a range of 30 degrees Centigrade, and at various stages of heat making other tests. The results so far have been rather surprising. There seems to be but little difference in the resistances at the various temperatures. It has been suggested that this may be due to the presence at the same time of iron and carbon in the steel, the one losing in conductivity while the other gains with the rise of temperature. So far the drop in voltage has been found to be much smaller with direct than with alternating current and that it varies much with the variations of current density and saturation. The relationship has not been established. Tests for this purpose will now be made with constant-wave forms, those heretofore used having varied somewhat in this respect.

Rubber High in Price.

The prevailing quotations for the better grades of rubber in New York a week or so ago were from $1.16 to $1.20 a pound, and the prices still show a tendency to advance. The highest price at which crude rubber was ever held in New York prior to the present advance was $1.11, which figure was quoted early in 1900.

There was an advance in rubber last fall, but the price began to decline after $1.10 was reached. This decline continued until January of this year, when the price was only 98 cents a pound. Since the beginning of the present year values have steadily advanced until all former records have been broken.

Telephone News from the Northwest.

The Kensal (N. D.) Telephone Company will build a line to McHenry.

The United States Railway Signal and Telephone Company has been incorporated at St. Paul with a capital of $1,000,000. James A. Ballard heads the list of incorporators.

The Home Telephone Company of LeSueur, Minn., has dissolved, being absorbed by the Cannon Valley Telephone Company.

The Morrill (Minn.) Rural Telephone Company has been formed and officers elected. The line will connect with the Northwestern Telephone Exchange Company for long-distance service.

The Minnesota Telephone Company has been granted admission to Herman, Minn.

The Minnesota Valley Telephone and Telegraph Company has been granted admission to Heron Lake, Minn.

The Iron Range Electric Telephone Company, operating through Northern Minnesota, held its semi-annual meeting in Wadena, Minn., recently. For the first six months of this year it has paid a dividend of 9.6 per cent.

The Armstrong Telephone Company has been granted admission to Welcome, Minn.

The Steele County Telephone Company of Blooming Prairie, Minn., will erect a new building and replace the central-office equipment with a modern outfit.

The Hudson Prairie Telephone Company of Hudson, Wis., has been incorporated with $3,000 capital.

The local telephone exchange at Albert Lea, Minn., will overhaul its entire system, replacing all automatic with manual instruments and with a central-energy system.

The Iowa Telephone Company has bought a site in East Waterloo, Iowa, and will erect a central exchange building. Improvements are to be made in the city to cost $100,000. The company will also rebuild the local exchange for Cedar Falls, Iowa.

The Independent Telephone Company has started operating its new system at Webster City, Iowa, with about 100 instruments working. It connects with a great many farmers.

W. B. Bell has secured a controlling interest in the Thurman Telephone Company, operating a line from Hamburg to Pacific Junction, Iowa.

The Michigan Telephone Company will establish an exchange at Powers and Spalding, Mich., at once.

The Iowa Telephone Company is building a new copper circuit from Davenport to Des Moines.

The Farmers' and Merchants' Telephone Company of Artichoke Lake, Minn., has been incorporated with $10,000 capital.

C. E. Burgess, a stockholder of the North Dakota Telephone Company has brought action to have the affairs of the company wound up by a receiver. He alleges that the telephone line has been converted into a telegraph line almost to the exclusion of telephone business. A commission firm has bought a majority of the stock in the company and uses the line for commission telegraph business.

The Tri-state Telephone Company has opened communication between the Twin Cities and Winona, Minn., and is continuing the line on to La Crosse, Wis., which it is expected to reach by September 1st. The company is also building to Sioux Falls, S. D., via Mankato and Windom, Minn., and expects to complete the connection by September 1st. The line to Grand Forks is connected up as far as Dassel, Litchfield and Atwater. Connection is made along the north shore of Lake Minnetonka with Minneapolis.

The council of Duluth, Minn., has passed a new ordinance to require telephone companies to remove their wires for the passage of buildings being moved from one location to another. It is intended to get a legal ruling upon the matter at the earliest date. Eastern courts have held that house-moving is not an ordinary use of streets, but it is contended that in a new country where house-moving is more common, the same conclusion would not necessarily apply. The Minnesota Supreme Court has not acted upon the point.

The Farmers' and Merchants' Telephone Company of Shakopee, Minn., has been enjoined from proceeding with the construction of an exchange by proceedings instituted by the Northwestern company, which alleges that its franchise is invalid. The new company had erected a 50-foot pole when the work was stopped. One of the workmen climbed the pole and nailed an American flag to the top. Later, during the night, one of the men of the opposing force climbed the pole and placed crape upon the flag. He was discovered and was met at the foot of the pole with a pugilistic salute for desecrating the flag.

R.

Southeastern Telephone Developments.

The dismantling of the Gordon telephone system at Charleston by the recent purchaser, the Bell Telephone Company, has been completed, part of the equipment being shipped to Atlanta.

Union County, in North Carolina, is reported as being one of the largest equipped counties in the state with rural telephones, there being some 700 in operation.

The Franklin Telephone and Electric Company of Franklin, N. C., has been chartered with $15,000 authorized capital, by J. S. Trotter of Franklin, J. H. Weaver of Asheville, N. C., and others. The company contemplates putting in a telephone system and electric lights.

The Bell Telephone Company has been refused a franchise at Morganton, N. C., unless it shall accept the terms of the local exchange—the Burke Telephone Company—requiring $6 per year for subscribers to the Burke system to connect with the long-distance lines of the Bell company. The Bell company refused the terms offered.

L.

Ohio Telephone Notes.

Last week the incorporation of the Franklin County Telephone Company of Columbus was mentioned, together with the fact that a portion of its lines have already been built. The company has been in operation for two or three years, but had not been incorporated. It is owned by persons interested in the Citizens' Telephone Company of Columbus, and represents that company's suburban lines. A network of lines will be built throughout Central Ohio and exchanges have already been established in each village where the patronage will warrant it. The increase in the capital stock of the Citizens' Telephone Company represents the amount of money that is to be invested in the new building, switchboard and extensions of lines and underground work in that city. Owing to the connection of the Columbus company with the Cleveland syndicate, plans were not carried out there for improvements as soon as intended, but when they are completed there will not be a better exchange in the state. Plans have also been made for building a new trunk line from that city directly to Charleston, W. Va., by the United States Telephone Company. The company has a line to Huntington, but this is rather a roundabout way to make connection with Charleston and other up-river points.

The Prudential Trust Company of Cleveland has filed a petition in the Common Pleas Court of Hancock County, asking to be relieved of the trusteeship of the Findlay Home Telephone Company bonds, for the reason that it is unable to carry out the trust. The telephone company issued bonds to the trust company aggregating $150,000, to be held in trust.

The Central Union Telephone Company has begun the installation of a common-battery switchboard at Mt. Vernon. The work will probably be completed in November.

The Ohio Valley Telephone Company of Martins Ferry has been reorganized by the election of the following-named officers: President, Hunter S. Armstrong; vice-president, George Walters; secretary, William Steer. The plant will be improved and brought fully up to date at once.

A new exchange will be cut in at Ironton by the Central Union Telephone Company within a few days. Other improvements are being made in the system also.

The Central Union solicitors have been doing some energetic work in the southern part of Summit County on the rural system. They assert they will add 100 subscribers within the present month.

In the prize-essay competition among the Cuyahoga telephone employes on the subject, "What Can We Do to Improve the Business of the Cuyahoga Telephone Company?" 57 answers were received. They contained more than 200 suggestions and showed careful consideration of the matter. The prizes were awarded as follows: First, William E. Neville; second, R. E. Mattison; third, Edward Rauschert. The suggestions of three others, J. W. Barrows, R. Murphy and R. M. Ross, were considered of such merit by the committee that they were also awarded prizes.

The Cleveland Telephone Company will erect a building and branch exchange in Lakewood for the accommodation of subscribers in that suburb and Rockport. The improvement will entail the expenditure of $150,000, it is said. This company now has seven brick buildings in the city, employs something like 500 people, and, it is said, pays out about $500,000 annually in Cleveland for wages, taxes and expenses of various kinds. The company has made a number of improvements of late that add materially to the value of the service.

C.

Dates for Ohio Independent District Meetings.

Dates for the district meetings of the Ohio Independent Telephone Association, besides those held this week at Cleveland, Toledo and Lima, have been announced as follows by President Frank L. Beam: District No. 6, Dayton office Home Telephone Company, August 23d; district No. 5, Hamilton, St. Charles Hotel, August 24th; district No. 9, Columbus, Hartman Hotel, August 25th; district No. 4, Chillicothe, Warner House, August 30th; district No. 3, Zanesville, Clarenden Hotel, August 31st; district No. 2, Canton, McKinley Hotel, September 1st. Measures will be taken at all these meetings to bring the Independent companies closer together and prepare them for the forward movement that is being inaugurated all over the country. Ohio has been among the leaders in the Independent movement.

A telephone exchange has been installed at Brighton, Mich., by the Livingston County Mutual Telephone Company. This makes three telephone companies operating in the village and vicinity.

Kinloch Long-distance Company's Plans.

According to an official statement regarding the plans of the Kinloch Long-distance Telephone Company of St. Louis, which is beginning operations in Illinois and neighboring states, the company has completed lines to Terre Haute, and established connection with the Indiana and Kentucky Independent long-distance companies to Sedalia and Nevada, Mo., where connection is made with the lines of the Kansas City Independent telephone company, and has finished toll lines to Joplin. There are under construction now toll lines to Springfield, Ill., for connection with the Independent telephone companies operating in the northern part of the state of Illinois.

The company's mortgage, dated January 1, 1904, secures an authorized issue of $5,000,000 of first-mortgage five per cent. 25-year gold bonds, due in 1929. Of this amount $700,000 of bonds are to be issued on the present property and $300,000 whenever the company shall expend that sum for actual additions: the remaining $4,000,000 are to be issued from time to time when required in amounts equal to 75 per cent. of the actual cost of permanent additions and improvements, provided the net earnings amount to at least the rate of 10 per cent per annum on the principal of the bonds outstanding and also the bonds to be issued at the respective times. None of the stock is owned by the Kinloch Telephone Company, nor are the bonds guaranteed by it. The stockholders, however, are in the main also stockholders in Kinloch Telephone Company. The directors of the company are C. Marquard Forster (president), Julius S. Walsh, William D. Orthwein, Breckenridge Jones, William F. Noker, Rolla Wells, August Gehner, Philip Stock, Adolphus Busch, S. M. Kennard and Henry Nicolaus.

TELEPHONE MEN.

George F. Stearns of Eagle Grove, Iowa, has become manager of the Enterprise Telephone Company at Edgerton, Minn.

George D. Milne, assistant treasurer of the American Telephone and Telegraph Company, has been appointed assistant secretary also.

J. E. Scott will be the new telephone manager of the Michigan Telephone Company at Mt. Clemens. He is now looking over the situation before assuming control. J. M. Grantham, his predecessor, has done much to improve the service, and it is understood that the company has offered him another position in appreciation of his services. He has not decided upon his future movements.

R. W. Kemp, who for some time has been with the Missouri and Kansas Telephone Company of Kansas City, Mo., has resigned his position with that company and will open an office in Wellington, Kan., as consulting and contracting telephone engineer, confining his territory principally to Kansas, Oklahoma and Indian Territory. Mr. Kemp is only 24 years of age, but he has spent eight years in the telephone business, having worked in every capacity, thus giving him an excellent knowledge of the business which he is entering.

GENERAL TELEPHONE NEWS.

The Worden Farmers' Rural Telephone Company has been incorporated with a capital of $3,000 at Worden, Mich.

The Mutual Telephone Company has been organized at Middleton, Ore. C. F. Barrett is president and Charles Ashpole, treasurer.

The local telephone system at Cochran, Ga., has been bought by the Southern Bell Telephone Company, which will operate the system.

J. A. Gunn and Lem Keithley are working on the extension of the Big Valley farmers' telephone line to Highland Springs, Cal., taking in Carpenteria and other places.

The Boone County Rural Telephone Company has been incorporated with headquarters at Belvidere, Ill. The incorporators are F. W. Plane, D. W. Harningham and H. S. Hicks.

The assessed value of telephone and telegraph properties in Oklahoma places telephone property at $160,392, a gain of $42,390 over last year. Telegraph property is valued at $153,208, an increase over last year of $82,216.

The Cumberland Telephone and Telegraph Company, in its organ, the Cumberland Telephone Journal, publishes "A Pyramid of Strength," showing that the number of subscribers has increased from 2,470 in 1883 to 113,245 in 1904.

The telephone system of La Grande, Ore., is to be improved. The company proposes to install a common-battery service. A complete new switchboard with automatic attachments will be installed. The estimated cost of the change is $12,000.

Directors of the Peninsular Telephone Company of Tampa, Fla., met in the office of I. H. Detwiler at Toledo, Ohio, a few days ago and decided to extend the system and make improvements. Extension of the toll lines to connect with other systems was also taken up. The company is owned by Ohio people.

Operation of Synchronous Converters.[1]

By S. C. Lindsay.

It is the purpose of this paper to give a history of the experience we have had with 60-cycle synchronous converters in Seattle during the last three years and a half. As the Seattle Electric Company has a greater capacity in 60-cycle synchronous converters in daily operation than any other company in the United States, and as they have been operated under a variety of conditions, the writer thinks that his experiences might be of interest to others who are operating the same class of apparatus.

In the summer of 1900 we put into service two 550-volt compound-wound synchronous converters which were supplied with alternating current from the Snoqualmie Falls Power Company, the direct current from these synchronous converters being used to operate street cars and stationary motors. At that time the Snoqualmie company was transmitting to Seattle at 15,000 volts over two to three-phase lines, the conductors for each line being No. 2 solid aluminum wire. It was originally planned to use one line for power and the other line for lighting and such power loads as were not subject to large and sudden changes. The current for the synchronous converters was transformed to 340 volts by three 500-kilowatt transformers connected in △ on both sides.

With 15,000 volts on the lines and the lines in multiple, one synchronous converter would operate satisfactorily up to full load; when the second synchronous converter was put in they would begin to pump immediately, although the load would not be increased beyond the capacity of one synchronous converter. If both machines were left in circuit, the pumping would soon become so violent that the transmission-line circuit-breakers at the power house would open. Various adjustments of the field strengths between maximum and minimum improved matters very little. It was tried a number of times to operate two machines under this condition, but without success. At times there would be several hundred horsepower of induction motors in Seattle operating from the same system. We tried to operate the synchronous converters both with and without the induction motors in service, but without success, the results being a little more favorable with the induction motors running.

When the transmission lines were separated in Seattle, but still supplied from the same bus bar at the power house, we tried to operate a synchronous converter from one line and the induction-motor load and lights from the other line; with a very weak field a single synchronous converter would run comparatively steady without load, but would pump violently when loaded to one-third of its rated capacity, especially if it were a street-railway load. With the lines divided as above, two synchronous converters were synchronized on the same transmission line, but were not loaded nor even paralleled on the direct-current side. After running under this condition for a few minutes they began to pump, and the pumping soon became so violent that they had to be shut down.

After these results, no further attempts were made to operate two machines at a time until the power company began to transmit at 30,000 volts, when it was found that both synchronous converters would operate entirely satisfactorily up to their full capacity with the transmission lines in parallel, and when the lines were separated one synchronous converter would operate perfectly up to full load and 50 per cent. of overload, but when the second machine would be switched in pumping would commence unless the load was reduced. We could carry more load without any disturbance on one machine than we could on the two. It must be borne in mind that when these attempts were made to operate two synchronous converters from one line the line was loaded in almost every case with the induction-motor and lighting load that was always carried when both lines were in parallel.

In the spring of 1901 a third 550-volt synchronous converter was installed in the same sub-station with the other two machines, and connected to the same bank of step-down transformers. When the three synchronous converters were running at the same time they were, of course, in parallel on both their alternating-current and direct-current sides.

A 250-volt, shunt-wound, 500-kilowatt, two-phase, synchronous converter was also installed at the same time in another sub-station about one-quarter of a mile from the station where the 500-volt synchronous converters were installed, and was operated from the same system.

The addition of these last synchronous converters caused no trouble whatever as long as both transmission lines were in parallel, but when it became necessary to place the entire Seattle load on one line it was found that the 250-volt synchronous converter and one 550-volt synchronous converter would operate satisfactorily, but that two 550-volt synchronous converters would not operate satisfactorily when the 250-volt synchronous converter was shut down.

When the transmission lines were multiplied at Renton, and one line cut out betewen Seattle and Renton, all of the load in Seattle being carried by a single line between these two points and the two lines between Renton and the power house, all of the 550-volt synchronous converters and the 250-volt synchronous converter could be operated at the same time; but when all of them were heavily loaded there was more or less pumping, but it was not serious enough to interfere with the lighting to any great extent. Within the last year the conductors in the transmission lines have been changed from No. 2 aluminum to No. 0000 aluminum between Renton and the power house, and to No. 00 aluminum between Renton and Seattle. Since this change two or more 550-volt synchronous converters can be run from a single line without any trouble. The trouble experienced when first trying to operate more than one synchronous converter from a single line must have been due to excessive line drop, which caused an interchange of current between the synchronous converters.

While operating the three 550-volt synchronous converters from the same bank of transformers it was necessary to use great care in adjusting their field rheostats, so as to keep the load equally divided between the synchronous converters. If one synchronous converter was given a weak field and the other two a strong field, pumping would commence and soon become serious if the proper adjustments were not made. We had all three synchronous converters thrown out of synchronism several times from improper adjustment of their field currents. While operating under this condition it was found that a dirty commutator or too much oil applied to a commutator for the purpose of lubrication would cause serious trouble, and on one or two occasions threw all machines out of synchronism. Shifting the brushes to find the neutral point was also a prolific source of trouble. After these causes of trouble had been discovered we got fairly good results, but only by the most careful attention to the machines.

Experience with these rotaries operating from one bank of transformers leads the writer to believe that a worse combination cannot be had, and is something that should never be done except as a makeshift.

After running under this condition for two months a separate bank of transformers was installed for each synchronous converter, each bank consisting of two 300-kilowatt transformers, transforming from 2,200 to 340 volts, these transformers in turn being connected to a single bank, transforming from 30,000 to 2,200 volts, both transformations being made on the Scott two-phase to three-phase system. This change in no way affected the results of an attempt to operate on a single transmission line, but the troubles experienced from operating the three synchronous converters from a single bank of transformers were entirely removed.

The one thing that has caused more trouble than any other in the operation of synchronous converters, and the thing that has been responsible directly and indirectly for over 90 per cent. of all the troubles we have had with them, has been the frequent breaking down of the transmission line. Almost every time the line would break, all of the 550-volt synchronous converters then running would flash-over at the commutator, making a loud report, very similar to the discharge of a cannon. The breaking of the line caused a rise of pressure at the commutator of the synchronous converters great enough to jump the space between the positive and negative brush-holders of the machines. There were only two or three cases when the line broke down that the flashing-over did not occur. On several occasions when the line broke armature coils were burned out simultaneously with the flash. The flashing did considerable damage each time it occurred, by burning the commutator and brush-holders and tearing away parts of the mica insulation between the copper segments, which left small pockets that soon filled up with particles of copper and carbon dust. Whether the rise of pressure at the commutators was caused by the sudden opening of the line or by a short-circuit between the broken wires and the other two line wires is a matter that has never been determined, as no one qualified to make an intelligent report was ever present at the point of trouble when a break occurred. This trouble was finally stopped by grounding the neutral point of the two-phase windings of the step-down transformers. Although this was done primarily for another purpose, it produced an effect on the synchronous converters that we had long desired.

If the commutators are in first-class condition the damage done by a single flash has never been sufficient to cause serious trouble unless armature coils were burned out, the damage to the commutator being quickly removed by the use of a file and coarse sandpaper. When line troubles were quite frequent, say three or four times a week, the damage done to the mica segments by one flash would not be removed before another flash would occur, and the result was that a number of mica segments in each commutator would be wasted away from one thirty-second to one-sixteenth of an inch below the surface of the copper segment. These places would soon fill up with particles of carbon and copper dust, causing short-circuits between segments. These short-circuits would burn out, causing a flash and explosion at the commutators, very similar to that caused by line troubles, the principal difference being that current did not disappear from the transmission line when trouble was caused by these short-circuits. We experienced a great deal of difficulty from these short-circuits before the cause of the trouble was determined. The difficulty in locating the trouble was due to the fact that when a flash-over would occur and throw the synchronous converters out of synchronism they could be immediately brought to voltage, synchronized, and loaded again, without giving any evidence of the cause of the trouble. Sometimes the synchronous converters would be thrown out a number of times in a day from this cause, and again they would run for one or two days without any trouble. The cause of the trouble being determined, it was easily remedied by turning the commutators down until the mica and copper segments were even.

In the summer and fall of 1902 all of our synchronous converters were moved to the Post Street station, which had just been completed, and we now have in this station nine 500-kilowatt synchronous converters, five of which are 550-volt, three-phase, the other four being 250-volt, two-phase, which are used on the three-wire lighting system. As stated previously, each synchronous converter is connected to its own bank of transformers, the transformers for the 500-volt synchronous converters being connected on the Scott system, transforming from two-phase to three-phase.

The power purchased from the Snoqualmie Falls Power Company is also delivered to this station, making it a combined generating and sub-station. The synchronous converters operate equally well from the steam-driven generators in this station without the use of special inductance coils, as they do from the transmission lines, the only exception to this rule being when the steam-driven generators were operating considerably below their normal speed, say 114 revolutions per minute, their normal speed being 120 revolutions per minute. The action of the synchronous converters when run from the steam-driven generators at this reduced speed seems to be a tendency to slow down every time the engines pass their centers, which produces a very noticeable effect on all incandescent lights supplied from the generators and lighting synchronous converters. This trouble is caused by the irregular angular velocity of the prime movers, and cannot be considered as synchronous-converter trouble. In no case has this caused any trouble other than the effect on the incandescent lamps, even when the speed of the generators would fall as low as 110 and 112 revolutions per minute. As stated before, this effect entirely disappears when the generators are running at their normal speed.

During the last 18 months the transmission-line troubles have been very much less than they were before, and the troubles with the synchronous converters have practically disappeared. As the grounding of the neutral point of the secondary winding of the step-down transformers prevents the synchronous converters from flashing-over at the commutators when line trouble does occur, and various other improvements have been made in the transmission line, we have not had any more trouble with these synchronous converters than would be had with an equal number of direct-current generators of the same capacity.

Having the two sources of supply in the same station, where all of the synchronous converters are located, it has been necessary to operate some of the synchronous converters from the steam-driven generators and some of them from the power supplied by the Snoqualmie Falls Power Company, all synchronous converters being operated in parallel on the direct-current side. This combination is used with both types of synchronous converter, the pressure of each synchronous converter being controlled by Hartford regulators. This arrangement serves to steady the pressure variations caused by the fluctuations of the street-railway load, and the results are very much more satisfactory for smoothing out the load than when all synchronous converters are operated from the same source of supply.

As for care and attention necessary for synchronous converters, it is substantially the same as that required by direct-current generators of the same pressure and capacity. The commutators require sandpapering about once a week. Occasionally a commutator will require sandpapering twice in one week. No. 2½ sandpaper is used to bring the commutator to a smooth surface, and it is then finished with No. 1 sandpaper. A small amount of oil is used on each sheet of sandpaper to prevent the dust from flying. It is very bad practice to saturate sandpaper with oil for use on a commutator, as the excess of oil will form a paste with the copper dust that will be forced into the mica, if the mica is soft, as commutator mica should be. The excessive use of oil is especially bad if there happens to be a number of mica segments in a commutator that are not uniformly even with the copper segments. Very good results are obtained by spreading the oil evenly over the sandpaper, then absorbing the greater portion of it with clean waste, leaving enough to prevent the copper dust from flying, but not enough to form a paste.

We have tried for a long time to get a carbon brush that would be satisfactory, and we think that we have found one. In the meantime we have found a great many that were not satisfactory, the average life of a set of carbon brushes being from three to six months. We have a set of brushes in a synchronous converter that were put in the 28th of last May, and they are about half worn out. The wear on this commutator has been very small also. We have a set of brushes in another machine that has been in use since February 23d, and the wear on these brushes was found to be about three-sixteenths

1. A paper presented at a meeting of the American Institute of Electrical Engineers in Seattle, Wash., April 14, 1904.

of an inch when measured today. The brush just mentioned is a medium-soft brush, with a good deal of graphite in it. Pure graphite brushes are not at all satisfactory for synchronous converters.

A New System for the Care of Standard Instruments.

To be of any value, standard instruments must be accurate. It is manifestly unwise to conduct tests of service instruments by comparing their performance with that of a standard which is not known to be correct, for such action is very liable to result in a serious reduction of revenue to the station, or overcharges, with consequent dissatisfaction on the part of customers.

To be maintained in a uniform condition of accuracy, standard instruments require a periodical checking, for their superior sensibility and the fine adjustment necessary to fit them for their work make them as liable to variation as any other instruments of equally high grade. This checking should be entrusted only to a standardizing bureau whose equipment and experience warrant confidence in its operations and give authority to its statements.

That such periodical checking is not now customary is well known to those makers of electrical instruments whose dealings cover the different sections of the country, and who find that the performance of the service and station instruments they make is frequently checked by standards which are not only structurally inferior, but through faulty calibration are absolutely useless as checking mediums. This condition of things is so often found to obtain, that when any complaint is made of instruments supplied, the first disposition of the manufacturer is to doubt the correctness of the customer's testing apparatus, and when his expert visits the customer's place of business he carries standards of undoubted accuracy with which independent tests may be conducted.

It has seemed to the Westinghouse Electric and Manufacturing Company that the principal reason why the standard instruments in general use are not periodically checked is that no establishment which is properly equipped for standardization is in a position to handle the work upon a basis suited to commercial conditions. This company has found it necessary to equip a Department of Standards in order to secure the service it requires in the production of its instruments, and the contrast between the closely maintained accuracy of the checking instruments calibrated by its Department of Standards and the general lack of uniformity prevailing among the checking instruments in central stations is constantly made apparent. It was, therefore, only natural that when this company produced a line of instruments of precision, in the continual accuracy of which it had an active interest, that it should place the facilities of its Department of Standards at the service of owners of these instruments and encourage their periodical checking by eliminating all questions of delay and expense.

As ordinarily sold, all direct connection between the manufacturer and the instruments ceases when they are shipped to their purchasers. With the Westinghouse plan, an active interest is maintained in the instruments for the entire period covered by the period of free calibration (five years) and at intervals of greater or less frequency during this time the manufacturer reassumes a responsibility for the accuracy of the instrument by checking their performance and certifying to their accuracy.

To encourage periodical checking, the company guarantees that there shall be no delay in the examination of instruments by its Department of Standards and that they shall be promptly checked and restored to their owners. Unless repairs are necessary, there will thus only be a very few days in which the owner will be deprived of the use of his standards, and it will ordinarily be possible for him to send them away and get them back without any inconvenience because of their absence.

World's Fair Visitors of Last Week.

Among those registered last week at the booth of the Western Electrician in Electricity Building at the St. Louis Exposition were the following-named: H. Durholz, College Point, N. Y.; A. F. Eichman, Dayton, Ohio; August G. Ofenstein, St. Louis; O. W. Ditsch, Kansas City, Mo.; George C. Long, Belleville, Ill.; Vic. Zaltman, Belleville, Ill.; John C. Nuholm, Gas and Electric Company, Newton, Kan.; A. J. Hopkins, Chicago; J. M. Hogan, Bowling Green, Ky.; Anton Herm, Le Mars, Iowa; K. A. Albricht, St. Louis, Mo.; Edward A. Gray, Chicago; H. Baner, Crookston, Minn.; A. B. Bond, Pittsburg, Pa.; A. H. Kreitler, Moline, Ill.; William Deubach, St. Louis; F. J. Fowler, Munfordville, Ky.; Herbert C. Powell, Hamilton, Canada; Hubert Lewis, Desplaines, Ill.; James A. Lynch, Pittsburg; G. M. Gest and family, New York and Cincinnati, Ohio; J. M. Garza Aldape, M. E., Torreon, Coahuila, Mexico; William Mitchell, Ottawa, Canada; Charles W. McDaniel, Kansas City, Mo.; F. B. Lawton, General Electric Company, Schenectady, N. Y.; F. M. Nichols, Chillicothe, Ohio; Dr. F. H. Morrison, Kirksville, Mo.; Bert. Ahrens, New York city.

The electric-light plant at Smithville, Mo., owned by Harry Golden, has been destroyed by fire, causing a loss of about $3,000.

Rheostat Stand for Electric Flatirons.

A recent improvement in electric tailor's and laundry irons consists of a stand to receive the iron, which is also a rheostat, that is automatically put in series with the iron when placed on the stand, and short-circuited when the iron is removed. When it is realized that the iron must be supplied with current sufficient not only to provide for radiation but for the demands for the work while in the operator's hand without material reduction of temperature, it is clear that when the iron is idle the current is in excess of what is necessary to keep it at working temperature. The effect of this excess current is rapidly to raise the temperature far beyond what is desired, and if the iron is idle long enough the high temperature is injurious to the heater.

The automatic regulator, operating to reduce the

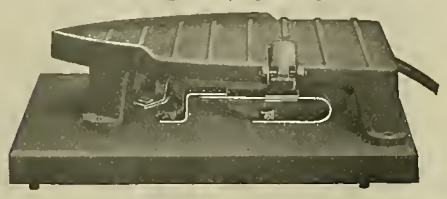


FIG. 1. RHEOSTAT STAND FOR ELECTRIC FLATIRONS.

current from 50 to 60 per cent. on the iron and from 30 to 40 per cent. of the total supply from the line, not only prevents the overheating of the iron, but effects a very material saving in the cost of operation, for in factory work, where irons are in regular use, they are shown by tests to be idle from 25 to 40 per cent. of the time they are kept in circuit.

Fig. 1 shows the stand without an iron and Fig. 2 represents a stand with an iron in place. The short-circuiting switch is shown mounted on the slate base under the rheostat, which is the support for the iron. An iron lever projects above the surface of the stand when the iron is in use, and the switch stands in the closed or short-circuit position. When the iron is placed on the stand the lever is depressed by the weight of the iron and the switch is opened.

The stand is wired in series with the iron, and the switch so connected that when the iron is off the stand, and the switch is in the closed position, it short-circuits the rheostat stand and allows the current to flow directly to the iron, and when opened by placing the iron on the stand the current flows through the rheostat stand to the iron and effects the reduction of current.

For machine irons and other electric tools not re-

FIG. 2. RHEOSTAT STAND FOR ELECTRIC FLATIRONS.

quiring stands a handle switch is provided to effect the same result when the handle is released by the operator. For electric soldering irons a bench stand for the reception of the iron is provided that produces the same result. For bench work where there is an irregular demand for a soldering iron much time is saved, for the soldering iron is kept ready for instant use with less than half the normal current supply while idle, and no overheating occurs to burn out the iron.

These articles are manufactured by the Simplex Electric Heating Company of Cambridgeport, Mass., and are the inventions of James I. Ayer, manager of the company.

New Electric Locomotive on Jungfrau Railway.

A new locomotive in which the electrical details differ somewhat from those of earlier locomotives is said to be in use on the Jungfrau railway in the Bernese Alps, Switzerland. The locomotive, weighing nearly 17 tons, is equipped with two 150-horsepower, 450 to 600-volt three-phase motors, running at 760 revolutions per minute. A speed of five miles an hour is maintained on both the up and the down journeys. Special arrangements are provided for regulating the speed of the locomotive on the down grade—when disconnected from the line—between the normal speed and five per cent. of this. The motors work as asynchronous motors on the up journey, but they can be connected up as self-exciting generators on the down run. They have three slip rings on the one side and a commutator on the other. The three brushes belonging to the latter are automatically lifted off the commutator by a three-phase magnet whenever the line circuit is connected up to the motors. A resistance capable of absorbing 170 kilowatts for a considerable period, is used both for starting and for braking.

Questions for Railway Mechanics.

S. W. Mower of Detroit, secretary of the American Railway Mechanical and Electrical Association, gives the following list of questions for the Question Box of the October convention. All answers should be in the hands of the secretary by September 1st.

1. What is a "frequency changer" and how used?
2. Of what use is a "power factor" on a circuit?
3. What is a reasonable life for brooms on snow sweepers?
4. What is the best material for a gear case, cast iron, steel or wood?
5. Is there any way of telling when a car axle is crystallized and unsafe?
6. What is the best method of preventing car circuit-breakers getting out of adjustment?
7. Can satisfactory results be obtained by using a 25-cycle machine for lighting purposes?
8. Which is the best material for car axles, common steel, cold-rolled steel or forged iron?
9. What is the best water and heat-proof insulation and paint to use in winding field coils?
10. What results have you obtained with asbestos-covered wire for winding fields? Have you had any trouble from moisture?
11. Which is the better pinion for length of service, for noiseless running, and for wear on the gear—machine-cut or hot-pressed?
12. What head-linings for cars, other than veneered, are on the market, particularly something in which glue is not used, and which are both water and fire proof?
13. Some roads have motor inspectors out on the street, under the mechanical department. Does the benefit derived warrant the expense incurred, and in what way?
14. Which is preferable for lubricating motor bearings, oil or grease? How do they compare in cost? How can oil be substituted for grease in the standard grease boxes of the Westinghouse 12A, G.E. 67, and G.E. 800 motors?
15. What are the relative costs of journal lubrication with regular grease, the Gelena system, and the automatic oil lubricator?
16. What are the comparative merits of steel-tired and cast-iron wheels, for interurban, suburban and ordinary city service?
17. Is it economical to grind cast-iron chilled car wheels with an emery grinder before they are put under a car? By so doing, is their life lengthened or shortened?
18. What has been your experience with rolled steel wheels, as regards wear, after they have been turned down once? Can you explain why the flange on one wheel should wear to a square shoulder, while that on the other end of the axle retains its shape?
19. What is the exact mode of procedure in winding "fireproof" fields that are to be filled with whiting, shellac or other fire-resisting insulations?
20. When babbitt metal is run into an armature shell, in cooling it contracts and pulls away from the shell. By what means could the babbitt lining be made to fit the shell tight?
21. Armature-bearing shells become loose in the motor frame. How can this be corrected in old motors, and could not street-railway motors be so designed as to prevent it, or to take up the wear?
22. How can flashing or burning be prevented with the K-12 controller on cars equipped with four G.E. 1,000 motors, 22-62 gearing, 600 volts on the line and a fast schedule; or any equipment where a heavy fast schedule has to be maintained?
23. What is the best method of testing an armature after rewinding? In using the Conant instrument for testing motor fields, widely different readings are often obtained when a certain coil is tested in the motor, then removed and tested separately. How can such errors be avoided, and by what method can weak fields be positively located?

Large Electric Watch.

The American Waltham Watch Company has shipped to London, England, a huge electric watch that is to be suspended from the Waltham Watch Building in London and will furnish the correct time to the public. The timepiece is said to be the largest of its kind in the world, and an interesting feature is that it has no movement of any kind with the exception of a mechanical device for carrying the hands on the dials, which is governed by electricity from one of the company's best timepieces in the building, and which was designed expressly for the work. The case of the watch is aluminum finished in gold, and is five feet in diameter. The two dials, one on either side of the watch, are each four feet in diameter. The numerals on one of the dials are Roman and on the other Arabic.

A space-telegraph station has been erected in the hills above Simons Town, South Africa, and experiments conducted between the station and gunboats in the bay have proved highly successful.

CORRESPONDENCE.

Great Britain.

London, August 3.—The government has issued a memorandum in connection with the space-telegraph bill, to which I referred last week, setting forth its reasons for desiring some form of state control in this matter. Three special reasons are given. The first one is the extreme importance in time of war, or emergency, of exercising control and supervision of all means by which information could be conveyed to an enemy. It is pointed out how easy it is for a private individual to set up a temporary installation on his property which, although it might escape observation for a time, would be exceedingly dangerous in case of war, especially if it were situated near the coast. The second reason put forward is the great difficulty of contending with interference between different installations, and the opinion is expressed that this can only be met by limiting the number of stations. The possibility is pointed out that the existence of a large number of private installations would tend to minimize the usefulness of space telegraphy for communication with the vessels of the navy. The third reason given is that in time of war or emergency it is important that the Admiralty should at all times be able to communicate with the ships, and with this view the government thinks it should have the power to stop absolutely the use of space telegraphy in private hands, when its use would interfere with such communication. So important does the government consider the space-telegraph bill that, although there are now left only about seven working days of the present parliamentary sessions—and a large number of bills are being abandoned wholesale—yet this particular one is to be passed at all hazards.

At this period of the year the half-yearly meetings of the various trading companies are being held, and interesting statements may also be more or less confidently anticipated. Thus, at the meeting of the Eastern Telegraph Company the chairman stated that, while holding the view that space telegraphy would not compete with long-distance submarine telegraphy, yet it had undoubtedly a sphere of usefulness. The company is now using space telegraphy for connecting up some of the islands of the Azores group, and it is desired by the Portuguese government that some of the further outlying ones shall be similarly connected. The company therefore intends to adopt space telegraphy in this manner in circumstances where the nature of the locality or the traffic do not warrant the laying of a cable.

The negotiations between the postmaster-general and the National Telephone Company with regard to the purchase of the undertakings of the latter have had some further light thrown upon them. The last opportunity when the government can purchase the undertaking before the expiration of the company's license is at the end of the present year, but inasmuch as six months notice has not been given, the opportunity has gone, evidently by desire. But negotiations are proceeding, whereby it is to be hoped that a satisfactory arrangement will be arrived at which will enable this great public service to be adequately and properly developed, and which will, at the same time, be equitable and fair to the shareholders of the company. So far as the public of London is concerned, however, there is a disinclination to agree to any sale by agreement before the term of the company's license expires, owing to the feeling that this could only take place at an inflated and unfair price.

The question of electrolytic damage to gas and water mains by reason of stray currents from electric tramways and lighting systems has evoked considerable discussion during the last year or two. The Board of Trade has framed a set of regulations which the gas and water companies contend are inadequate. A few days ago, however, a long discussion took place in the House of Lords on the question, with the result that it was definitely laid down that any protection to gas and water companies beyond that afforded by the regulations in question was unnecessary and undesirable. At last, therefore, the matter has been put upon a sound basis, and already one gas company has withdrawn its opposition to an electric-lighting order on this account.

The South of England railway companies, which serve the southern suburbs of London, are complaining of the disastrous effect of the opening and extension of the London County Council tramways. One company alone has lost 600,000 passengers during the last half year. G.

New York.

New York, August 13.—Some large speculative deals are now going on in the stock of the Metropolitan Street Railway Company and there are all kinds of rumors that a scheme is afoot to merge the Metropolitan, the Interborough, the Brooklyn Rapid Transit and the Public Service Corporation of New Jersey. There is nothing new in these suggestions, nor in a manipulation of such rumors. The bulk of these securities are controlled by a few hands, and if any large merger operations were pending, it is more likely that the prices would be driven down instead of up.

The railroad committee of the Board of Aldermen has turned down the application of the Port Chester company to cross certain streets in the Bronx with trolley lines, stating that it is "unable to determine the reliability of the company to properly perform the work or to obtain any information of its financial ability." Without going into any merits either way, this seems decidedly unfair to the company, which, through its counsel, has proffered a bond of $100,000 as a guarantee to make the road.

Some officials of the New York Central railroad have been traveling around up-state this week to make an examination of branch lines, with a view of reporting upon the practicability of installing electric power. The cities and towns affected by these plans include Rochester, Pittsford, Syracuse, Utica and Brockport, with a possible ultimate extension to Buffalo.

The Board of Aldermen approved on Wednesday of an extension of the Flatbush Avenue tunnel, Brooklyn, from the Long Island railroad station to the Park Side Avenue station on the Brighton Beach railway.

The Pennsylvania Railroad Company is gradually buying land in and around Long Island City, especially in the vicinity of the Blackwell's Island Bridge. These lands are for depots and freight yards.

New mail-carrying and sorting cars are to be put on the lines of the Brooklyn Rapid Transit in a few weeks. The interior fitting of these cars will be far in advance of the existing mail cars, and it is thought that much time will be saved by sorting mail in the cars en route.

The General Electric Company has recently installed four electric winches at the Brooklyn docks near Fulton Ferry. The winches are capable of being easily moved from place to place along the dock, and can be connected with power circuits at various points, according to requirements.

A number of new houses have been put up in the Merrick residential district at Hempstead, L. I., and wired in anticipation of the advent of an electric-lighting service. W. George Foster and W. J. Kenny, prominent residents, have urged the introduction of public lighting, but now it appears that no company is willing to bid on the terms laid down by the authorities, viz., $18 per 30-candlepower lamp per year. The Nassau company has bid at this figure for the first year, but asks $21 for the second and $25 for the third. The Queens Borough company wants $25 per lamp per year flat.

The Interborough Rapid Transit Company reported earnings today for the quarter ended June 30th. A surplus of $758,434, an increase of $211,113 over the corresponding quarter last year is shown. The Interborough began operating the Manhattan railway under lease on April 1, 1903. Consequently the quarter ended June 30th last is the first quarter which can be compared with a corresponding quarter in the previous year. The company's earnings for the fiscal year ended June 30, 1904, made up by combining the figures of the last four quarterly reports, show: Gross earnings, $14,187,684; operating expenses, $5,846,052; net earnings, $8,341,632; other income, $341,504; total income, $8,683,136; fixed charges, $6,757,412; surplus, $1,925,724. This sum is equivalent to 5½ per cent. on the outstanding stock of the company.

The Spence Portable Electric Conveyor Company has recently put in one of its interesting pieces of mechanism at the Old Dominion Pier, Bridge and Beach and West Streets.

The Electric Dredge Company, with headquarters in New York city, has been incorporated at Albany. The capital is $100,000 and the directors are Louis E. Spencer, Ezra A. Tuttle and Charles N. Flint.

The electric automobile timer, invented by A. L. McMurty, will be used for the first time during the coming week at the Long Branch (N. J.) automobile carnival. This instrument will record the hundredth part of a second.

A very curious allegation is being made in regard to the taking off of a number of trains on the suburban lines of the New Haven company. The commuters have protested very bitterly against the inconveniences resulting, and go so far as to declare that the company has taken off the trains as a retaliation for the refusal of the residents of New Rochelle to approve of trolley extensions in which the New York, New Haven and Hudson River railroad is supposed to be interested. President Mellen, however, has restored a few of the trains, and announces that the road will spend $10,000,000 in converting the Harlem River branch into a six-track electric road.

The New York Electric Music Company has been incorporated with a capital of $350,000. The incorporators are H. O. Coughlan, Joseph M. Mitchell and Kenneth K. MacLaren. The office is in Jersey City, N. J. D. W. W.

New England.

Boston, August 12.—At a meeting of the West End Street Railway Company's stockholders on August 9th, it was voted to issue the 3,000 shares of new stock and $750,000 bonds recently authorized by the railroad commissioners.

Work has been commenced upon a new battery station on Chatham Street for the Edison Electric Illuminating Company of Boston. It is to cost $35,000 and will be a four-story structure.

Samuel G. Colt has been elected a director of the Pittsfield Electric Company of Pittsfield, Mass., to succeed the late William R. Plunkett.

The Springfield Board of Trade has presented a petition bearing many signatures of merchants and other citizens to the Springfield Street Railway Company. It asks the company to establish a parcels-express service, such as the Legislature has sanctioned, and similar to those already in successful operation in a number of other business centers.

Much activity in Cambridge Electric Light Company stock, which has gone from an eight per cent. to a 10 per cent. basis this year, has resulted in a marked advance in the quotation per share. There are rumors current of probable future absorption of the company by the Edison Electric Illuminating Company of Boston, in spite of the fact that a stockholders' pool was formed last year to hold such a movement in check.

At a hearing in Duxbury, held by the selectmen on August 8th, relative to the matter of granting a franchise to the Plymouth County Street Railway Company, the sentiment of those present was found to be overwhelmingly favorable, a vote of 250 to eight being recorded informally on the proposition.

On August 11th, a hearing was held in Westboro in the cases of Conductor Edgar J. Balcom and Motorman William A. Dunn, charged with manslaughter on account of the collision on August 1st on the Boston and Worcester electric railway, from which two deaths have resulted. The state's case was based upon the contention that the signal system of the road is so perfect that the accident was due to negligence on the part of the defendants. The men were represented by counsel, but offered no controverting evidence, and they were held for the grand jury in $2,000 bonds each, which were furnished.

The New Hampshire railroad commissioners have dismissed the protest filed with them by patrons of the Portsmouth and Exeter Street Railway Company on account of increased rates of fare recently ordered by the company. The road shows a deficit for the last fiscal year, like most of the New Hampshire electric railways. It is leased and controlled by the New Hampshire Traction Company, operating six roads in all, whose aggregate deficit for the year ending June 30, 1904, was $114,541.

It is announced that at the annual meeting of the Chester and Derry electric road's stockholders, a dividend of 4 per cent. was announced. This road is one of the few successful ones financially in the state.

The Grand Army encampment in Boston is expected to swell the coffers of the electric-railway companies in Boston and vicinity. Preparations have been made on a big scale to handle the patronage anticipated.

The gross earnings of the Boston and Worcester street-railway line for the month of July were $55,940, compared with $38,718 for July, 1903. Operating expenses on this road are figured as only about 40 per cent. of the gross earnings, and the net earnings are upward of $30,000, therefore, for the month. The recent collision, however, will cost the road a good round sum. B.

Dominion of Canada.

Ottawa, Ont., August 12.—The statement that the Dominion government has entered into a contract with a Boston company for a submarine-signal service for the St. Lawrence River and Gulf, is officially confirmed. The apparatus will carry eight miles under water, and the receivers on the largest vessels will entail an outlay of $10,000 yearly.

The municipal-ownership party of the city of Sherbrooke, Que., has again sustained a defeat at the polls in respect to the control of the electric-light and power supply to the city. The proposition was defeated by the narrow margin of nine votes. It was proposed to issue bonds to the amount of $200,000 for the purpose of purchasing the plant of the Sherbrooke Light, Heat and Power Company or to install a new electric plant.

The Montreal Street Railway Company is doing considerable heavy track-laying this season by which the roadbed of its different car routes will be much improved. On several streets the work is completed, the old 70-pound rails being replaced by 96-pound rails. The work on many other routes is being pushed on. The daily earnings of the railway now rarely drop below $7,000.

The necessities of construction and development work in the New Ontario region have compelled the Ontario government to go in for a small measure of government ownership of telephones. A government telephone line is now being built from North Bay to the Temagami district, along the line of the new government railway. Another telephone line is also being built from New Liskeard to Haileybury.

The Ontario Power Commission, appointed to inquire into the question of the supply of electric power to municipalities within a prescribed district of Eastern Ontario, is prepared to proceed with its work as soon as the necessary funds are placed at its disposal. The committee has acquired a vast amount of preliminary information. Seven Ontario cities, the number required to form the first group under the agreement with the interested municipalities, have agreed to pay their proportion of the cost. Not only the Niagara power question will be examined, but a thorough report prepared on the cost of electrical energy in the various large cities of this continent.

The Chicago Telephone Supply Company of Elkhart, Ind., has made a reduction in its offer to install a municipal telephone system in the city of Brantford, Ont. Its first offer was $40,000. A few days ago, however, the company made another and more sat-

isfactory offer, proposing to install the system for $37,000. The officials of the company say, further, that the depreciatory damage to the system will not exceed two per cent. This came as a surprise to the civic authorities, who had been figuring on a much higher annual expenditure for repairs as a result of usage.

A Montreal electrical engineer has been in Ottawa in connection with certain improvements to the plant of the Hull and Ottawa Power Company, which is installing a new set of waterwheels, a 2,000-horsepower generator and a new switchboard. The company will furnish electric power to the new works of the International Portland Cement Company, at Hull, Que., which will utilize 3,000 electric horsepower. W.

Southeastern States.

Charlotte, N. C., August 13.—The town of Graham, N. C., has voted in favor of waterworks and electric lights and the contract has been forwarded to the Southern Service Commission, Washington, D. C., whose acceptance is practically assured.

The Fuller Flume Company of Waynesville, N. C., a $50,000 lumber and mining concern, has also secured in the charter privileges for the building and operating of telephone exchanges.

The use of electric power to supplant steam is rapidly being consummated at Asheville, N. C. The Asheville Cotton Mills recently contracted with the W. T. Weaver Power Company to supply electric power to run the mill.

A $300,000 electric plant will be erected at lock No. 3 on Coosa River in Alahama, to furnish power for the Anniston, Gadsden and Birmingham railroad. The promoters propose to erect a cotton mill, and connect the towns mentioned by trolley later.

The town of Marietta, Ga., has passed an ordinance permitting the Atlantic Interurban Railway Company to construct a local electric street railway. It is added that Marietta and Atlanta may soon be connected by trolley.

Senator W. P. Barksdale and W. D. Hill of Halifax County, Va., have been to Philadelphia to arrange for floating bonds for an electric railway from South Boston, Va., to Houston, Halifax County. L.

Ohio.

Cleveland, August 13.—The hearing of the affairs of the Miami and Erie Canal Transportation Company before Referee C. W. Fuller at Cleveland has been postponed to September 6th, in order to give the attorneys an opportunity to settle the trouble out of court, if possible. It is stated that the Cleveland Construction Company and the Westinghouse company, which hold the two largest claims, have agreed to the compromise settlement offered, and that others are coming in slowly. Some of the smaller claimants have hesitated to allow their bills to be discounted, but if those holding larger claims feel that it is wise to do so, they will likely follow suit. If the claims can be satisfactorily adjusted, it is probable that money will be secured at once to pay them and put the property in condition for operation from Cincinnati to Dayton.

In order to settle definitely the cost of carrying passengers in Toledo, the Toledo Railways and Light Company has asked the council committee on railroads to make an examination of the books and decide for themselves. The committee spent some time looking over the books and then asked council for permission to employ an expert accountant to go over the records with them. A committee from the Chamber of Commerce is also present with the council committee while this work is being done. The company has applied for a 25-year extension of franchise, and a large element has contended that it should not be granted unless the company agrees to a three-cent fare. The company claims that it costs more than three cents to carry a passenger, and invited the inspection of the books to prove it. Some of the business men think that the company should at least sell seven tickets for a quarter.

The ordinance providing for a franchise for the Cleveland Electric Railway Company from the south end of the short line on Doan Street to Woodland Hills, forming a cross-town line, was defeated at the last meeting of the Cleveland council by a vote of 22 to 10.

F. H. Blodgett of Wheeling, W. Va., has been awarded the contract for building the line of the Southeastern Ohio Railway, Light and Power Company between Zanesville and Crooksville in the coal fields.

It is reported that a syndicate of Ohio and eastern capitalists has been formed to purchase $1,000,000 bonds of the Northern Ohio Traction and Light Company outright. These will then be placed in the markets of the eastern cities.

No change will be made in the car schedules of the Cleveland electric railway, as claimed by some of the newspapers some time ago. During the fall, however, the number of cars will be increased somewhat and an attempt will be made to give the best service possible.

Colonel J. D. Platt, president of the Barney and Smith Car Company, purchased the plant of the Stillwell-Bierce and Smith-Vaile Company at auction a few days ago, paying $775,000 for it. This is over $100,000 less than two-thirds of the appraised value. The sale has been confirmed. Colonel Platt says that the plant will be operated, as it should be one of the leading industries of Dayton.

According to the returns to the city auditor, the gross earnings of the Cincinnati Traction Company for the first half of this year were $1,775,387. Of this the city gets six per cent.

The proposition to bond the town of Bellevue for $40,000 to build a municipal light plant was defeated a few days ago at a special election.

Work is now progressing nicely on the construction of the Columbus, Urbana and Western, which was reorganized and refinanced some time ago through the efforts of Senator Foraker and others.

An announcement has been made that the Columbus, Newark and Zanesville will shortly install parlor cars, to be operated between Columbus and Zanesville.

The Ada Water, Heat and Light Company of Ada has increased its capital stock from $75,000 to $100,000.

Three new palace cars will be put in use on the Lake Shore electric road the coming week, and it is expected that the present equipment will be supplanted by these cars as rapidly as possible. They have a seating capacity of 60 persons and are upholstered in dark-brown leather. Two floors, laid six inches apart, are filled between with mineral wool, which serves both to deaden the sound and make them fireproof. The interior has a full empire ceiling, with costly burlap covering. The upper windows are art glass in opalescent green, and the metalwork is mostly of polished brass. A speaking tube connects the conductor with the motorman. President Bicknell arranged this as a better means of communication betwen employes than has yet been used. O. M. C.

Indiana.

Indianapolis, August 15.—Walter C. Nelson, president of the Northern Traction Company, has filed in South Bend a mortgage of $3,500,000 to the Knickerbocker Trust Company of New York and Benjamin L. Allen, New York, co-trustee. The mortgage covers a proposed electric-car line to extend from South Bend to Chicago through New Carlisle, Laporte, Valparaiso and Hammond, Ind.

The Elkhart Electric Company has filed action in the Elkhart Circuit Court to have the Elkhart City Electric Company (C. G. Conn) perpetually enjoined from using the latter name, on the ground that it is so similar to that of the plaintiff that prospective patrons of the plaintiff are deceived into making contracts with the defendant; that its use by the defendant reduces the value of the good-will of the plaintiff, and that the mails of the two corporations are being constantly confused. The case cannot be heard until October, and it will not come to issue sooner, as no temporary injunction is asked.

Dining cars will probably soon be put into service on the Indianapolis Northern traction line. The officials of the Union Traction Company have watched the experimental use of dining cars and they believe they can be operated successfully. It is stated by the Indianapolis officials of the company that contracts for dining cars have already been let. The cars, it is said, will cost approximately $12,000 each and will rival in elegance and perfection of equipment the best Pullman dining cars in use on steam roads.

The first electric locomotive ever in operation on any of the interurban lines in Indiana pulled an excursion train over the line of the Indianapolis and Martinsville Rapid Transit Company a few days ago. The locomotive is built upon double trucks and is equipped with motors of a much higher power than those of the ordinary interurban cars. The car is only large enough for the equipment and one person.

The Richmond Street and Interurban Railway Company expects to put a new schedule into effect the first of September. The running time between Richmond and Dublin will be reduced at least 10 minutes. The interurban cars have been equipped with the new Bullock high-speed motors, and this will make the faster schedule possible. Under the new schedule the interurban cars will do no local business in Richmond. At present they take the place of the city cars, both entering and leaving the city. Under the new schedule the interurban cars will make only a few stops in the city. T. N. C.

Michigan.

Detroit, August 13.—E. M. Hopkins of Detroit has been in Holly for the last few days looking over the route of the proposed Owosso-Pontiac electric line, which was laid out by J. P. Hopkins and Frank Wescott of Vernon. It is the plan of this company to parallel the route of the D. and M. division of the Grand Trunk and run the line over a private right-of-way. Mr. Hopkins is interested in a number of other roads in the western part of the state which are now in successful operation. Identified with him are J. L. Hudson, Hamilton Carhartt and ex-Governor J. T. Rich of Detroit, Boyd Pantland of Grand Rapids and Governor A. T. Bliss of Saginaw. This line, when constructed, will be a part of the system which will eventually reach from Detroit to Grand Rapids. The line will pass through Gaines, Linden, Fenton, Holly, Davisburg, Clarkston and Waterford.

The Detroit, Ypsilanti, Ann Arbor and Jackson Railway Company is completing its plans for the limited cars between Detroit and Kalamazoo, which will reduce the time between these two points to about six hours. The running time of the limited cars between Detroit and Ypsilanti will be an hour and a quarter, shortening the regular time by 30 minutes. It is expected to have cars running on the new schedule within 30 days.

It is understood that the Detroit, Pontiac, Lapeer and Northern Railroad Company is to be constructed as soon as contracts are awarded. D. R. Curry of Rochester is one of the promoters of this road.

St. Ignace has decided by a special election to bond the city for $15,000 to cover the cost of the installation of an electric plant. The town has been in darkness since the fire of June 27th, which destroyed the plant.

Two weeks ago the city of Pontiac awarded the city lighting to J. G. Hoffman of Detroit for a period of 10 years. Since then the Common Council has reconsidered this action and given the contract to the Standard Lighting Company, which has had the contract for the lighting of the city for the last 13 years. The Standard company gives the city a guarantee against all litigation that may arise from the rejection of Mr. Hoffman's bid.

The action of the Bay City council is being criticized freely by business men of Bay City in regard to the Bay City-Caro electric-road franchise. It is understood that the promoters of the electric road are also disgusted with the situation. Committees from the Miners' Union, who want trolley connections so that their families can reside in the city, have been working for months with the promoters of the road, but they received doubtful consideration. It is understood that the council will reconsider its action, in view of the attitude taken by their constituents.

B. J. Arnold of Chicago has made a test of his new electropneumatic motor on the St. Johns line, and ran it at times at the rate of 25 miles an hour. It is understood that larger motors will be built, as Mr. Arnold is satisfied that his theory of the use of the alternating current for electric railways has been proved correct. Under his system the saving in operating and construction of electric railways will be great.

The directors of the Kalamazoo and Grand Rapids electric railway, which will extend from Kalamazoo to Grand Rapids by a circuitous route, have decided to begin building the road this month. It will be about 50 miles in length. C. G. W.

Northwestern States.

Minneapolis, August 13.—An electric plant is to be installed at the stone quarries at Stone City, Iowa. It will also furnish electric light and power for Anamosa, Iowa.

The council of Lake City, Minn., contemplates changing the city electric-light plant to an alternating system at a cost of about $5,000.

The Mankato Railway, Light and Power Company has been formed at Mankato, Minn., by local parties, to build a city street-railway and interurban line. It is proposed to build to Eagle Lake and St. Clair, and possibly to Madison Lake.

The Manistique Light Company of Manistique, Mich., will utilize the dam of the Weston Lumber Company, to generate electric power. The lumber mill burned some time since, and the dam has not been utilized since that time.

The council of Moorhead, Minn., is having plans drawn for an electric-light plant.

The Postal Telegraph-cable Company will build a direct telegraph line from Milwaukee to Madison, Wis. At present business between these points has to be handled by way of Chicago.

A proposition at Boone, Iowa, for municipal ownership of the electric-light plant was defeated by a vote of 827 to 561. A similar proposition was defeated five years ago by a vote of two to one.

A petition has been generally signed at Vermilion, S. D., asking the council to submit to vote a proposition to purchase the electric-light plant. It is also proposed to take over the waterworks plant and operate the two together.

The village of Spring Green, Wis., has bought the electric-light plant from the private owners.

The Railway and Light Company of Winona, Minn., has filed a trust deed securing a bond issue of $400,000, running to the Old Colony Trust Company.

The projected electric-railway line between Des Moines, Iowa, and St. Joseph, Mo., has arranged for an entrance to Winterset, Iowa, where an attempt was made to prevent the company from getting into the heart of the city.

The use of space telegraphy on Lake Superior has begun between the freight steamer Augustus B. Wolvin, bound for Duluth, over the entire length of Lake Superior, and a temporary station in Duluth. A permanent station is to be established on top of the Wolvin Building in Duluth, and the wireless system will be utilized. Stations will also be placed at Keweenaw Point and Sault Ste. Marie, Mich. R.

Rocky Mountain States.

Salt Lake City, Aug. 11.—R. J. Decker of this city has been awarded the contract for electrical equipment in the Carrizal Gold Mining Company's property in the state of Michoacan, Mexico.

The Goldfield Electric Light and Power Company proposes to install an electric-light plant at Goldfield, Nev. A. C. Eisen is president of the company and S. Forman vice-president and general manager.

The owners of the Continental-Alta mines at

Alta, Utah, will soon begin the installation of an electric plant and the construction of an up-to-date mill. Henry M. Crowther is president and general manager of the company.

The citizens of Springville, Utah, have instructed the City Council of that place to grant to B. Mahler of Toledo, Ohio, and his associates a franchise through the city for the proposed electric railroad from Logan to Payson. The council has granted the franchise.

The Salt Lake and Utah Valley railroad has become the property by purchase of J. G. Jacobs of Salt Lake City, representing eastern capitalists. The road was originally built by Mr. Jacobs, and extends to the western suburbs of the city. It is the intention of the new owners to extend the electric system as far as Bingham, a prosperous copper-mining camp about 21 miles from this city. Work on the extension of the line will be commenced in a few weeks and pushed to an early completion. The road was originally known as the West Side Rapid Transit Company.

The organization of the Cascade County Rural Telephone Company, with a capital stock of $50,000, has been effected at Great Falls, Mont., and work on the system, which will connect that city with rural districts, will be begun without delay.

Headquarters for this territory of the Postal Telegrahp-cable Company have been secured in Salt Lake City, and the company will be established here shortly. Crews of men are now at work stringing wires between Laramie, Wyo., to this city, and the company, represented by General Superintendent E. J. Nally, has made application to the council for a franchise to operate in Salt Lake. G.

Pacific Slope.

San Francisco, August 10.—The Century Electric Corporation will shortly remove to a large building it has leased further down Second Street. A heavy stock is now being ordered and will be placed in the new quarters upon its arrival.

The electricians are now busy upon the many illumination schemes for the Knights Templar conclave to be held here next month. A large court of honor is being suspended over the street from the skyscrapers at Third and Market Streets, and a large force of men is placing long strings of incandescent lamps across the streets from the ferry to Eighth Street. Much of the material has been used before, being the property of the Joshua Hendy Machine Works, whose electrical department has done similar work on two previous occasions.

The fine new residence of Charles Carpy, in course of erection in this city, is being wired and fitted with electrical appliances by the Martland Electrical Company.

The residence of S. H. Boardman is being wired by the National Electric Company, which makes a specialty of fancy residence work.

Another survey has been made for the electric road between Vacaville and Winters, and an attempt will be made to get rights-of-way over private land. This road, according to Mr. Goucher, the chief promoter, will be operated from a single-phase transmission line, and the cars will be capable of running at a speed of 60 miles an hour.

The supervisors of Santa Clara County, Cal., will receive bids until September 19th for a franchise to erect telegraph and telephone lines, in connection with pipe lines, for transporting oil and petroleum, along the roads of Santa Clara County, as applied for by the Coalinga Oil Transportation Company.

An ordinance has been adopted by the council of Los Angeles, Cal., granting to H. C. Whitmer the right to construct and operate a double-track electric railway over certain streets in Los Angeles.

The electric-light plant at Enterprise, Ore., has been destroyed by fire. The plant was owned by William Makin. A new dynamo had just been installed. The loss will be about $1,500. It is said the plant will be rebuilt.

H. E. Huntington's Fresno Traction Company is completing a second survey for an electric road from Fresno to Wawona, Cal., and a selection from the two surveys will soon be made and the building of the line commenced shortly afterwards. The road will cost, it is said, in the neighborhood of $1,000,000, and will be about 79 miles in length.

R. B. Morgan, representing a syndicate of capitalists of Grand Fork, B. C., has made a proposition to the City Council of Chilliwach to construct an electric-light and power plant there, using the Vedder Creek as the supply for water power. This will include a street railway running from Chilliwach to New Westminster, B. C.

Engineers are in the field surveying the proposed route of the Portland Southern Electric Company. The first construction work of the new road will be done between Salem and Oregon City, Ore.

The Sierra Nevada Water and Power Company has opened offices at 514 Mission Street, San Francisco. This concern has a project on foot to establish a power plant in the Blue Lakes region near the Standard's plant.

The California Gas and Electric Corporation, which will furnish the motive power for the Petaluma and Santa Rosa railroad, is now at work on the new transmission line for that purpose.

The promoters of the electric railway up Mount Hamilton to Lick Observatory, in Santa Clara County, Cal., have decided to incorporate a company with $20,000 capital, to make the preliminary surveys, estimates of cost and secure franchises. After the necessary work is done, an effort will be made to sell bonds for its construction. A.

PERSONAL.

Mr. A. J. Corriveau of Montreal, formerly prominent in electrical enterprises and well known to electrical men in the United States, is dead. His death was due to an automobile accident on August 6th.

Wilfred J. Tompson, who was formerly with the Westinghouse Machine Company, has gone to Manchester, England, where he will engage in turbine work for the British Westinghouse Electric and Machine Company.

Isaac A. Smith, chief engineer of the Southern Illinois Electric Railway Company, has been made general manager of the road. At a stockholders' meeting at Mount Vernon, Ill., the capital stock of the company was increased from $2,000,000 to $2,500,000.

The General Incandescent Arc Light Company of New York city has appointed Mr. E. L. Nash district manager for its branch office in Philadelphia. Mr. Nash has been connected with the Jandus Electric Company in the capacity of eastern sales manager for the last nine years.

Volney W. Foster, one of Chicago's successful business men, died suddenly of apoplexy on August 15th. Mr. Foster, in addition to many other business enterprises, was interested with others in the projected Chicago, Kenosha and Milwaukee Electric Railway Company. Of late years he devoted much attention to the development of a scheme for the establishment of a national arbitration tribunal for the settling of strikes and all labor difficulties. He was 57 years of age.

Mr. James W. Lyons announces his resignation as manager of the power department of the Allis-Chalmers Company. His resignation took effect on August 13th. Mr. Lyons has taken this step in order to accept the appointment as consulting engineer to the Elgin Watch Company of Elgin, Ill., which will erect new and extensive works under his supervision. Mr. Lyons will also engage in other consulting work, and his headquarters will be at Chicago. Mr. Lyons takes with him the good wishes of all his former associates in the Allis-Chalmers Company.

Roscoe Cornell has been appointed manager of the branch office which the Allis-Chalmers Company has just opened in El Paso, Texas. Mr. Cornell goes to the Allis-Chalmers Company from the Mine and Smelter Supply Company of Denver. He is a graduate of the Michigan College of Mines, and is well known as a mining and mechanical engineer. He has held a number of prominent positions as a mining engineer and as a smelter and mine superintendent. His acquaintance is extensive, and he is thoroughly qualified to fill the important position to which he has just been appointed.

ELECTRIC LIGHTING.

The city of Joplin, Mo., has voted an issue of bonds for the erection of the proposed electric-light plant.

H. G. Saddler & Co. have been granted a franchise by the city of Booneville, Ark., for the construction of an electric-light plant.

The Hartford (Conn.) Electric Light Company is issuing additional capital to the amount of $200,000 for extensions and improvements.

An electric-lighting system is to be installed at Fort Ethan Allen, Vt., under the direction of Captain Thomas H. Slavens, quartermaster, U. S. A.

Work has been commenced on the electric-light contract at the Rockford (Ill.) Mitten and Hosiery Company's plant. The new system calls for 1,500 lamps.

The plant of the Consumers' Electric Company at Little Falls, N. Y., has been destroyed by fire, together with the McCaulley shoddy mills, involving a loss of $25,000.

The City Council of Chattanooga, Tenn., has voted to receive bids for the supplying of the city with lights, estimated to be furnished for terms of two, three, five and 10 years.

The board of trustees of the Confederate Soldiers' Home at Pew Valley, Ky., have let the contract for the proposed improvements to cost $54,000. A new lighting plant is to be installed.

The Meredosia (Ill.) Light, Heat and Water Company has been incorporated with a capital of $20,000 to operate a heat, light and water plant. C. M. Skinner and W. J. Skinner are interested.

A Kansas City fisherman is reported to have rigged up a miniature electric light on the float of his fishing tackle so that he can pursue the sport at night. A small storage battery supplies the current.

The electric-light plant owned by Saal & Sinter at Amite City, La., has been acquired by the Amite Light and Power Company, recently incorporated, with a capital of $30,000. C. S. Stewart is president of the new company. The old plant will be enlarged and improved and the company will make arrangements for constructing an ice plant and system of waterworks.

The property of the Oshkosh (Wis.) Electric Light and Power Company, which has been for the last 18 months in the hands of a receiver, has been sold at public auction for $215,000 to W. H. Whitney of Boston.

The Ramsey Manufacturing Company has secured the contract from the city of Front Royal, Va., for the erection of the proposed electric-light plant on North River. The Lessell Water Wheel Company will install the necessary turbines for the operation of the plant.

Patents have been secured by James F. McElroy, representing the Consolidated Car Heating Company of Albany, N. Y., for a new system of electric car lighting. This system has been tried with success for two months on a couple of cars on the Delaware and Hudson railroad.

The mayor of Baltimore, Md., it is said, is considering the advisability of the city establishing an electric plant to supply light, heat and power to the new piers and docks, market houses, City Hall and other public buildings. It is believed that the cost of such a plant would be about $150,000.

The Cherokee Development and Manufacturing Company, which is to build a large power plant on the Tallapoosa River and furnish electric power to the city of Birmingham, Ala., has increased its capital stock from $50,000 to $100,000. The headquarters of the company will be located in Montgomery, Ala.

The plant of the Edison Electric Light Company at Paterson, N. J., was much damaged by fire recently. Lighting and power circuits were interfered with for two or three days, and in the silk mills using electric machinery, operations were suspended. Pending repairs to the cables the local trolley lines were driven from the mains at Newark.

The City Council of Covington, Ky., has amended the original ordinance providing for the issue of bonds for a municipal light plant so that the bonds are to be dated January 1, 1905, and run 20 years. The ordinance was passed some years ago for this purpose, but all action was delayed by litigation, the Supreme Court approving the ordinance some weeks ago.

John D. Rockefeller is said to have signed a contract with a local lighting company to light his large estate, consisting of about 5,000 acres, at Pocantico Hills, Tarrytown, N. Y. It will require 800 incandescent lamps to light the mansion, grounds and private park. Mr. Rockefeller put in a private lighting plant about a year ago at an expense of $10,000, but after operating a short time it is said he discovered the new system was costing more than electricity supplied by the lighting company. The private plant will be sold as soon as the new service is installed.

A suit was commenced on August 5th in the United States Circuit Court for the Northern District of Illinois, southern division, against the Moline Incandescent Lamp Company of Moline, Ill., by the Edison Electric Light Company for manufacturing incandescent electric lamps in alleged infringement of letters patent No. 444,530 granted to Thomas A. Edison. This patent relates to the leading-in wires of incandescent lamps and covers the feature of sealing into the closed portion of the glass stem leading-in wires of different metals. Suit was also commenced on July 23d in the United States Circuit Court for the Eastern District of Missouri, eastern division, against the E. C. Van Nort Electric Company of St. Louis, Mo., for alleged infringement of the same patent by handling as a dealer lamps of alleged infringing manufacturers.

ELECTRIC RAILWAYS.

The New York Central railway, it is said, has acquired two parcels of waterfront property north of Yonkers, as the site for another power house, to be used in connection with its terminal improvements in New York city. The land purchased is said to be that adjoining the holdings of the Trevor estate.

Articles of incorporation have been filed by the Omaha and Nebraska Central railway. The names of the incorporators are Anthony Texter, Charles J. Heim, Charles H. Deeter, Frank J. Helm and Anthony G. Buski. The authorized capital of the company is $1,500,000. It is the purpose to construct and operate an electric railway from Omaha to Hastings.

The County Court of Union County, Ore., has under consideration an application for a franchise for an electric-belt railroad to connect all towns of the county—Hot Lake, Union, Cove, Island City, Lagrande, Alicel, Imber, Summerville and Elgin. The power of the line will be secured from a big dam, 10 miles east of the Cove and Morgan Lake, near Lagrande.

The Lorain Steel Company of Philadelphia has commenced suits in the United States Circuit Court for the New Jersey District against the Wireless Electric Railway Company of the District of Columbia and the Central Passenger Railway Company of New Jersey. It is alleged in the bills of complaint filed in these suits that these companies have infringed certain patents owned by the Lorain Steel Company relating to the surface-contact electric rail-

ways, and it is understood that the alleged infringement complained of has occurred in the installation and operation of the surface-contact system at Atlantic City on the road of the Central Passenger Railway Company.

The employes of the Consolidated Railway Company of New Haven, Conn., have voted to accept the compromise proposition of the company made in response to the trolley men's demands for an increase in wages, recognition of the union and new regulations regarding extra men and pay for overtime work. The action of the meeting was enthusiastic and it closed with a cheer for the management. The request for recognition of the union was refused.

Earnings of the Chicago and Milwaukee Electric Railroad Company for the month of July continue the excellent increases shown by the road since its formation. For the month of July the gross earnings increased from $29,529 in 1903 to $52,227, and the net earnings from $21,007 to $33,719. The gross earnings for the seven months ended July 31, 1904, were $215,478, compared with $123,249. The operating expenses for the seven months were $91,095 and $48,369, respectively.

Special classes have been organized for the instruction of motormen to be employed on the New York Rapid Transit subway. It is said that the number of motormen required will ultimately number 3,000. The work in these training classes is said to be extremely thorough. Candidates for positions must already have some knowledge of railroading, and they must learn all the details of the mechanism in such a manner that in the event of emergency the motorman will know exactly what to do.

A new electric-railway company has been formed in Kansas City, Mo., with General Nelson A. Miles at its head. The company will be known as the American Investment and Development Company and, besides General Miles, who will be the president, the officers are: Vice-president, P. H. Coney of Topeka; secretary, F. R. Waters of Kansas City; treasurer, J. R. Mulvane of Topeka. The company expects to build an electric railway from Kansas City to Jefferson City, thence to Springfield, and then back to Kansas City. The company will be incorporated under the laws of the District of Columbia for $500,000.

On August 10th during a severe thunderstorm in Brooklyn a Gates Avenue trolley car was struck by lightning. The passengers were huddled in the two front seats to get away from the rain. The bolt struck the trolley pole and burned a hole through the roof of the car. It struck the back of one of the seats in the middle of the car and ran down the side of the seat to the steps and into the ground. The vivid flash and the thunder crash following it caused a panic among the passengers, and one woman fainted. Two others jumped off the swiftly moving car, which was then stopped. The women were picked up, suffering only from a few bruises.

A portion of the proceeds from the recent new stock issue of the Westinghouse Electric and Manufacturing Company is to be used, it is said, for further investment in the Lackawanna and Wyoming Valley electric railway, an illustrated description of which was printed in the Western Electrician of August 29, 1903. There are now 20 miles of double track of this system in operation between Scranton and Wilkesbarre, Pa., and an extension of 17 miles from Scranton to Carbondale is now under construction. The most important engineering work on this extension is a tunnel 4,700 feet long in Scranton. This tunnel will not be completed until next year. This electric road has been built by the Westinghouse interests as an object lesson in electric traction, and engineers regard it as one of the finest pieces of electric-railway construction ever attempted. The Westinghouse people have great faith in the possibilities of electric traction on steam railways, and they wish to show on this line what can be done.

PUBLICATIONS.

De Laval steam-turbine and electrically driven centrifugal pumps are illustrated and described in a recent bulletin issued by the D'Olier Engineering Company of Philadelphia.

The Nernst Lamp Company, Pittsburg, Pa., has republished in neat booklet form the illustrated article on "Street Lighting by Nernst Lamps in Berwyn, Ill." from the Western Electrician of May 7, 1904.

A neat booklet published by the Jeffrey Manufacturing Company of Columbus, Ohio, has some fine halftone pictures of the Jeffrey grab bucket, showing it in operation. This bucket will work in ore, coal, broken limestone, gravel and sand and will also excavate in clay and earth of any nature. The booklet also illustrates the power-house equipment of the Scioto Valley Traction Company, where the grab bucket is used in handling coal.

A fine 32-page bulletin, printed in two colors, with beautiful illustrations, has been issued by the Sprague Electric Company of New York to show the industrial applications of Sprague direct-current motors. All sorts of light and heavy machinery, pumps, hoists, printing-presses, machine tools, etc., are shown connected to motors, and the applications are very interesting, demonstrating anew the usefulness and adaptability of the electric motor. The booklet itself is a fine piece of work and is a credit to the advertising department of the Sprague company.

"A Chunk of Protector History" is cleverly written after the style of George Ade's "Fables in Slang." It purports to give the history of the controversy in relation to telephone protectors and is evidently presented from the point of view of the American Electric Fuse Company.

A carefully prepared booklet, with an original and striking front-cover design, is distributed by the Northwestern Storage Battery Company, 281-283 East Madison Street, Chicago. Prices are quoted and numerous practical suggestions, valuable to storage-battery users, are given. The booklet will be mailed on request.

That the B. F. Sturtevant Company of Boston, which has recently moved to its new office and works at Hyde Park, Mass., is to press the sale of its economizers is evidenced by the new economizer catalogue which the company has recently issued. This catalogue contains the details of the Sturtevant standard and pony types of economizers in comparison with those of other makes, the advantages, sizes, weights, accessibility, repairing, etc. It also treats of the subject of mechanical draft and natural draft and is of interest to all steam users. It may be obtained by anyone interested in the subject.

The Electric Appliance Company of Chicago has just published two catalogues—No. 22 and No. 23. The former covers principally overhead railway and insulating material and is additional to the railway material in general catalogue No. 20. Numica commutator rings and segments and mica are also given several pages, and there are illustrations and descriptions of the Eaco portable railway telephone, Whitney bond tester, Adams-Bagnall arc lamps for railway circuits of 450 to 600 volts, and Packard incandescent lamps. Catalogue No. 23 is of electrical supplies for gas and gasoline engines and automobiles.

TELEGRAPH.

Lieutenant Alfred T. Clifton, United States Signaling Service has been ordered to proceed to Seattle, Wash., for duty pertaining to the Alaskan telegraph system, replacing Lieutenant James S. Butler.

The first telegraphic message ever sent across Alaska was that received recently by General Greely, chief signal officer of the United States army. It was sent from Nome to St. Michaels, a distance of 107 miles.

The cable which the United States steamship Burnside has been laying from Sitka, Alaska, south, is completed to within 150 miles of Cape Flattery. The Burnside has returned to Seattle for cable enough to complete the line. Colonel James Aller, who is in charge of the work, says with favorable weather the cable can be finished in two days after the Burnside picks up the buoyed end.

MISCELLANEOUS.

The B. F. Sturtevant Company of Boston is fitting up quarters in its big plant to be used for an emergency hospital, in case of accident to employes. The hospital is to be equipped with all the appliances known to medical and surgical science for the proper care of the men who may get injured in the discharge of their duties until they can be removed to their homes. A graduate nurse and medical student will be in charge and a local doctor will attend to all surgical cases.

Edward J. Conklin, an electrician of Wichita, Kan., has an exhibition of fine house wiring at his office which is very attractive. In the large window Mr. Conklin has placed a miniature house with the front side open showing four rooms handsomely furnished. Wherever a light could be used throughout the house is placed a miniature electric bulb to which the wiring connections are made in a workmanlike manner. A clockwork attachment extinguishes the lights at a predetermined time. It is a difficult piece of work and displays considerable skill.

The Cudahy Packing Company of Kansas City reports that it has had another flood in its plant, similar to the one described in the article on "The Rehabilitation of a Flooded Power Plant" in the Western Electrician of December 5, 1903, and that both the 350-kilowatt and the 200-kilowatt Crocker-Wheeler generators have come through this unusual test successfully. It was found necessary to retape the series fields in the smaller generator, but no other repairs had to be made. Two submersions certainly constitute a severe test for standard and not submarine types of machines.

Returns made to the United States Geological Survey show that the United States has again exceeded all previous records in the production of coal. The forthcoming report on the country's coal production, which Mr. E. W. Parker, statistician, will soon make, will show that the total output of the coal mines of this country in 1903 amounted to 359,421,311 short tons. This is an increase of 57,830,872 short tons, or 19 per cent., over the production of 1902, which amounted to 301,590,439 tons. The production of 1903 was nearly double that of 1893, and more than three times the output of 1883. The increase of production in 1903 over 1902 was equal to the total production of all kinds of coal in 1878, only 25 years ago.

Persons visiting the big engine in Machinery Hall at the World's Fair, where the Allis-Chalmers-Bullock 5,000-horsepower, steam-electric unit is shown, will have an opportunity of seeing beside it the smallest operating steam engines in the fair. These little fellows, which are made with an accuracy and finish like clockwork, stand in a glass case, just across an aisle from the big engine, in the space occupied by the International Steam Pump Company. There are two of them now operating, each working a direct-connected pump and throwing their tiny streams into a copper tank which stands between them.

It is reported that overhead transmission lines for the work in and about New York city will be recommended by the New York Central electric-transmission commission. A careful consideration was given to the relative reliability and cost of overhead and underground transmission lines for high voltage, on existing lines. An underground conduit for the electric conductors in that locality would have to be blasted out of solid rock and the cost would be seven or eight times that of the overhead line. It is intended to maintain two 11,000-volt three-phase lines, either of which could in an emergency keep the road in operation.

While considering plans for lowering the river tunnels in Chicago the engineers have discovered that the seven-foot southwest water tunnel which supplies the Harrison Street and Central Park Avenue pumping stations passes beneath the south end of the La Salle Street tunnel. The water tunnel is 52 feet below the surface of the street, but the engineers say if a 26-foot channel is provided over the new tunnel its bottom will be only five feet above the top of the water tunnel. The engineers declare this is too close to the water conduit for safety. The water cannot be shut off to permit a change in the course of the conduit, because it furnishes the Southwest Side with water. Methods of overcoming the difficulty will be considered by City Engineer Ericson and George W. Jackson, engineer of the local transportation committee.

TRADE NEWS.

The Warner Arc Lamp Company, with headquarters at Muncie, Ind., has been incorporated, with a capital of $50,000. W. F. Warner and J. H. Rawlins are among the incorporators.

J. F. Smith has opened up an electrical supply house in Weiser, Idaho, which is a branch of the Idaho Electric Supply House of Boise. The business is located on Idaho Street. Mr. Smith is an experienced electrician and goes to Weiser well recommended.

It was J. G. White & Co., Limited, of London, and not J. G. White & Co. of New York, that carried out the work described in a recent illustrated article in the Western Electrician entitled "A Record of Tramway Construction in London." The two companies are distinct organizations.

J. C. Cain of St. Joseph, Mo., who has been superintending the electrical contract of the G. H. Sethman Electrical Company of Denver at Fort Russell, has purchased a complete stock of electrical supplies, with which, it is stated, he proposes to install an electrical supply house in Cheyenne, Wyo.

The employes of the North Electric Company, Cleveland, Ohio, expect to give their annual field day and outing at Silver Lake, near Cleveland, on August 27th. There will be a ball game for the shop trophy, races of various kinds, bowling matches, dancing, etc. All friends and patrons will be accorded an enthusiastic welcome.

The Cataract Electric Supply Company of Buffalo, N. Y., has opened a handsome store at Nos. 11 and 13 West Swan Street. The store is finely equipped and has on hand a complete line of supplies. The directors of the company are Charles R. Huntley, William B. Rankine, William R. Huntley, Daniel T. Nash and DeLancey Rankine. D. F. Potter is general manager of the store.

At a meeting of the board of directors of the Bullock Electric Manufacturing Company, held recently, Mr. W. H. Whiteside, general manager of sales of the Allis-Chalmers Company, was appointed general manager of sales of the Bullock Electric Manufacturing Company, so that he will have entire charge of the sales departments of both the Allis-Chalmers and Bullock organizations.

The Fort Smith Light and Traction Company of Fort Smith, Ark., will shortly undertake extensive improvements and extensions to its electric-light, gas and street-railway properties. The Oklahoma Gas and Electric Company, Oklahoma City, Okla., will also make extensive improvements and extensions to its gas and electric properties. H. M. Byllesby & Co. of Chicago will be the engineers for both projects.

The Chicago Journal of August 13th says that the Manufacturers' Junction railway, a Western Electric Company corporation, has taken title to a large tract of land in the southwestern part of the city. The property comprises 260 by 125 feet at the southwest

corner of West Sixteenth Street and Forty-second Avenue, and 300 contiguous lots. It is reported the railroad will establish switching yards on the tract and eventually erect warehouses there.

The Electric Storage Battery Company of Philadelphia has brought suit against the Edison Electric Illuminating Company of Topeka, Kan., for damages to the amount of $50,000 for alleged infringement of a patent, the invention of C. O. Mailloux, owned by the former company. The suit is said to be an outgrowth of the contract recently secured by the Gould Storage Battery Company for a large storage-battery installation for the Topeka company.

A petition in bankruptcy has been filed against the Anders Push Button Telephone Company of 136 Liberty Street, New York city, by Henry W. Sykes for the creditors. The company was incorporated on November 21, 1901, as the American Push Button Telephone Company, with a capital stock of $300,000, and the name was changed to the present style in May last. Considerable money was spent on developing the instruments of the company. Mr. Sykes said that the liabilities exceed $15,000. The assets consisted of stock, materials, machinery and fixtures, $4,500; outstanding accounts, $2,000, and patents, value unknown. Judge Thomas has appointed Joseph H. Adams receiver, on the application of W. J. Murdock & Co.

Dodge & Day, engineers, Philadelphia, have completed their plans and specifications for extension to the plant of the Victor Talking Machine Company. They contemplate the use of 600 horsepower in horizontal tubular boilers, in four units each 18 feet long by 72 inches in diameter, with a working pressure of 125 pounds; natural draft; two horizontal automatic high-speed engines, 160 and 240 horsepower, respectively, direct-connected to a 100-kilowatt and 150-kilowatt generator; 15 electric motors, ranging from five horsepower to 75 horsepower; two elevators; heating system; fire, feed-water and vacuum pumps; switchboard and wiring; sprinkler system, water tanks, etc.

BUSINESS.

The General Incandescent Arc Light Company, 529 West Thirty-fourth Street, New York city, has been awarded the contract for a large quantity of G. I. arc lamps (110 volts direct current) for John Wanamaker's New York store after severe competition.

The Central Electric Company, Chicago, announces that it is prepared to quote prices on repairing burned-out transformers of the core type of any make and assures its customers that any orders will receive prompt and careful attention. The company, as general western agent for the Pittsburg Transformer Company, also announces that it is prepared to furnish boosters of Pittsburg make. As the demand for these is continually growing, the company anticipates a very good business and states that it can make it worth while for any lighting plant in need of these boosters to write for prices.

Since securing the contract for furnishing the entire fuse equipment of the Manhattan elevated railway, New York city, the D. & W. Fuse Company of Providence, R. I., has been favored with the contract for furnishing the entire fuse equipment for the rapid-transit subway, which is also a part of the Interborough Rapid Transit Company's system. The engineers of the subway division have made tests on their own account of these large-capacity fuses, and the company was called upon to submit fuses as large as 800 amperes to be tested on a dead short-circuit. The D. & W. fuse proved capable of fulfilling the conditions imposed upon it.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued (United States Patent Office) August 9, 1904.

766,806. Individual Selective System. Benjamin Brooks, Springfield, and Howard F. Metcalf, Holyoke, Mass. Application filed February 28, 1903.

The system is dependent for action upon a step-by-step motion and electrical pulsations, and consists of a ratchet, an armature actuated by the pulsations, a retaining pawl or detent for the ratchet and a ponderable body normally supported by and in direct contact with the armature and detent and adapted to be actuated by the former. The ponderable body, when at its point of normal rest, throws the detent out of engagement with the ratchet and so retains the detent, but while in motion allows the latter to engage the ratchet and an independent or separate receiver on to which such body is impelled by the armature when actuated.

765,810. Electric Hammer. Joseph Chambers and Corydon L. Cole, Minneapolis, Minn. Said Cole assignor to George J. Backus, Minneapolis, Minn. Application filed April 25, 1904.

A pair of axially alined solenoids are in combination with a hammering plunger working axially therethrough, the plunger being constructed of magnetic metal and subject to the solenoids. The circuit connections to the solenoids include a switch, which is magnetically actuated by the plunger and operates to cut the solenoids into and out of circuit in alternate order.

766,811. Portable Automatic Boat-leak Detector. William F. Cogan, Hoboken, N. J. Application filed November 17, 1903.

A boat or vessel having suitable deck and a watchman's station on the deck is provided with an electric indicator circuit and an indicator at the watchman's station. A fixed tube or passage extends vertically from the deck to a point in the hold near the bottom, and a portable, perforated, tubular section is movable within the tube or passage. Insulated electrical contact points fixed at the upper end of the section, a movable circuit-closer within the section, a float upon which the circuit-closer is supported, a flexible suspending device for the section, marked by divisions representing linear measure and means for separably connecting the contact points in the section with the indicator circuit near the upper end of the tube or passage are the other features.

766,815. Primary Battery. Thomas A. Edison, Llewellyn Park, N. J., assignor to the Edison Manufacturing Company, Orange, N. J. Application filed November 18, 1903.

A negative electrode for primary batteries employing a compressed mass of black oxide of copper io excessively finely divided condition is described.

766,821. Telephone Transmitter. Auguste Gamache, East Clifton, Canada. Application filed June 21, 1902.

In a compound microphone transmitter are combined a compound vibratory electrode comprising a disk of insulating material and electrically connected plates of conducting material on either side of the disk. In a chamber within which the electrode vibrates is pulverulent conducting material, partially or wholly filling the chamber. A pair of stationary electrodes is located opposite to and at a short distance from the vibratory electrode, and means for vibrating the electrode in accordance with sound waves are provided.

766,824. Regulator for Alternating Series of Arc-light Systems. Josef H. Hallberg, New York, N. Y., assignor to the General Incandescent Arc Light Company, New York, N. Y. Application filed January 29, 1902.

The regulator consists of an enclosing case, a body of oil, a solenoidal magnet located within the case, a movable core for the magnet and a buoyant device floating in the body of oil and adapted to support and overcome the normal weight of the core. (See cut on next page.)

766,856. Electromagnetic Traction Device and Brake. Charles A. Wells, Chicago, Ill. Application filed December 10, 1903.

In connection with traction wheels and a wheel-brake mechanism is a suspended helically wound magnetizable member provided with a magnetizable shoe normally proximate to but out of direct contact with the rail, and forming one of the poles of the magnet. The wheel-brake mechanism is connected to the shoe and the shoe is capable of a movement relative to the rail when moved into contact therewith, whereby the wheel brakes may be applied substantially simultaneously with the energizing of the magnet to increase the traction between the bearing wheels and rails.

766,864. Electrical Street and Station Indicator. Lewis C. Allen, Pittsburg, Pa. Application filed December 7, 1903.

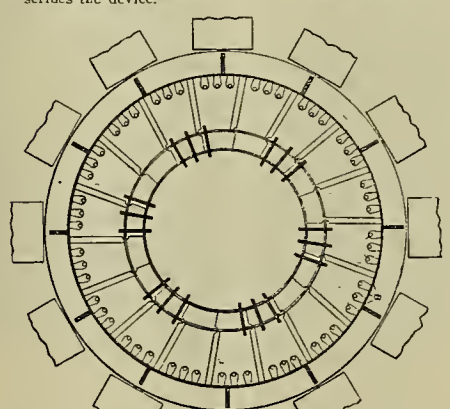
The combination consists of an indicator having a movable belt provided with signs and a motor adapted to move the belt. An electromagnet operates directly, when energized by the movement of its armature, to close momentarily the motor circuit to start the motor. Devices independent of the magnet proper are provided for maintaining the closure of the motor circuit until the sign has been changed.

766,865. Locking Device for Electromagnets. William Baxter, Jr., Jersey City, N. J., assignor to the Otis Elevator Company, East Orange, N. J. Application filed September 22, 1903.

In combination with a number of electromagnets having movable cores or armatures is a locking bar having a number of angular slots. Pins are connected to the cores or armatures adapted to coact with the slots to move the locking bar or to be engaged by the slots upon a movement of the locking bar. There are means to return the locking bar after it has been moved.

766,891. Suspension Means for Axle-driven Dynamos. Roger M. Newbold, Louisville, Ky. Application filed April 27, 1904.

A truck bar, supported from an end sill and disposed without the truck frame, a cross connection between the bars, a dynamo-supporting cradle, adjustably suspended between the cross connection and the end sill, and a dynamo pivotally mounted in the cradle substantially describes the device.



NO. 766,977.—VARIABLE-SPEED DIRECT-CURRENT SHUNT MOTOR.

766,929. Telephone Attachment. Frank H. Chamberlin and Raymond H. Coleman, Cleveland, Ohio. Application filed March 10, 1903.

The attachment consists of a bracket, a rod projecting therefrom, a spool journaled on the rod, a casing composed of a tubular member surrounding the spool and having a longitudinal slot extending from its inner end, a flexible strip secured to the spool and passing through the slot, means for turning the spool to wind up the strip within the casing, and means carried by the rod for removably securing the casing in place.

766,935. Controller for Trolley Poles. Herman R. De Long and Rector Seymour, Warren, Pa. Application filed May 25, 1904.

Claim 1 describes a weight provided with an annularly reduced portion, a clutch member engaging the annularly reduced portion of the weight, a trip lever connected with the clutch member for operation thereof, and an operating cord connecting the weight and the trolley pole and operably connected with the trip lever.

766,945. Selective Telephone-call Mechanism. Henry I. Hawxhurst, East Oakland, Cal. Application filed September 5, 1902.

A selective call mechanism for party-line telephone comprises a main-line circuit, an electromagnet in the main-line circuit at each of the several stations, a secondary or local circuit at each station, and a call or signal device operated in such local circuit by the closing of the same. There is a switch in the secondary or local circuit for closing the same, the switch being adapted to stand normally at and to return to open-circuit position, the contact pieces with which the switches respectively co-operate in the several circuits being at different positions relatively to the open-circuit position of the switch. A mechanism is operated by the electromagnet at each station for moving the switch step by step at successive impulses of the magnet, and there is a device for automatically locking it after each step. Another device which normally stands at a position of stable equilibrium has means by which it is disturned from that position at each impulse of the magnet, the device being adapted, at its position of stable equilibrium, to hold the locking device out of action, whereby the rapid repetition of the step-by-step impulse of the magnet keeps the device out of the position of stable equilibrium, and the same returns to the position and releases the locking device only upon the cessation of the step-by-step impulses.

766,952. Electrical Contact Device for Intermittently Establishing Circuits on Moving Cars. Jefferson D. Keen, Cincinnati, Ohio, assignor to the Electric Indicator Company, Louisville, Ky. Application filed March 18, 1904.

Contact pieces are located exterior to the car and pivoted arms are carried by the car. Metallic brushes are mounted in the arms and are adapted to make contact with the contact pieces in the travel of the car. Insulated wires extend into the arms and are in electrical contact with the brushes, the wires being arranged to establish a circuit when the brushes engage the contact pieces.

766,977. Variable-speed Direct-current Shunt Motor. Charles P. Steinmetz, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed March 20, 1902.

In a multipolar electric motor are combined an armature winding divided into open-circuited sections and means for varying the speed of the motor by connecting adjacent sections in separate groupings. A pair of commutator brushes are provided for each pair of poles, and there are means for connecting the armature sections between the brushes of each pair. (See cut.)

766,991. Propelling Railway Cars by Synchronous Electric Motors. Alexander Churchward, New York, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed October 11, 1902.

A synchronous alternating-current electric motor has an exciter mechanically connected therewith and electrically connected with the field circuit thereof, an automatic regulator being in the field circuit of the exciter. A storage battery is in shunt to the field circuit of the motor and a switch in the motor field circuit is adapted to be closed with the closing of the motor armature circuit.

767,002. Lightning Arrester. Charles T. Mason, Sumter, S. C. Application filed April 9, 1904.

A wire coil having a line connection, and a grounded core of conducting material encircled by the coil are combined with an insulating jacket interposed between the core and the coil, the jacket being omitted or cut away at intervals so as to leave the core exposed at such intervals to the coil.

767,015. Electric Therapeutic Machine. Harry A. Slaughter, Los Angeles, Cal. Application filed October 22, 1903.

The machine comprises a battery, an induction coil having a current interrupter electrically connected thereto, a vibrator electrically connected in multiple with the primary of the induction coil and with one side of the secondary of the induction coil, and an electrode connected to the other side of the secondary of the induction coil.

767,018. Trolley Stand. Bruno Stenvall, New York, N. Y. Application filed November 10, 1903.

A block, a trolley pole hinged thereto, a combination of levers hinged to the block and pole and a spring carried by the block, so connected to the levers as to exert the same tension on the pole when the pole is in its different angular positions are the features.

767,025. Trolley Base and Pole or Arm Therefor. George Volker, Albert W. Goerlitz and August Goerlitz, Buffalo, N. Y. Application filed October 16, 1903.

The device consists of a base, a revoluble member, a trolley pole having connection to the revoluble member and a number of sets of bearings between which the revoluble member is rotatably supported. One of the sets has rollers, which are arranged in approximately horizontal position.

767,033. Telephone Central-exchange Installment. Richard M. Beard, New York, N. Y., assignor to the International District Telephone Company, New York, N. Y. Application filed December 15, 1903.

Included in the installment are an operator's telephone circuit, twin-wire cords arranged in pairs and the cords

of each pair normally connected with each other, a double contact plug in which each cord terminates and a signaling key for each cord. A device is provided for disconnecting the two cords of a pair from each other and simultaneously connecting the operator's telephone to either one of the cords while maintaining it disconnected from the other, said device consisting of a two-way listening key, two of whose terminals on one side are connected to one of the cords through one of the signaling keys, two to the other cord through the other side of the listening key and the other signaling key, and the remaining two to the operator's telephone circuit, the terminals on the other side of the listening key being likewise disposed and connected with reference to the other cord.

767,050. Electric Lock. Adalbert Haesner, Munich, Germany. Application filed July 1, 1903.

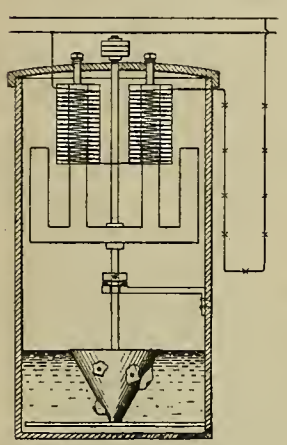
The combination consists of an electromagnet, means for supplying currents of opposite polarity to the electromagnet, a polarized armature operated by the electromagnet, a detent arranged to hold the door, and mechanism operated by the polarized armature and arranged to lock and unlock the detent.

767,052. Electric Switch. Arthur E. Handy, Providence, R. I., assignor to the Rhode Island Elevator and Machine Company, Providence, R. I. Application filed August 29, 1903.

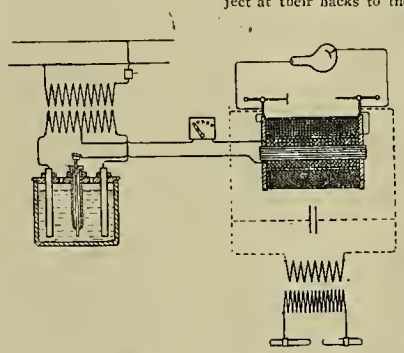
In a compound electric switch are combined a reversing arm, a controlling arm, an electrical contact or connection between the arms, means whereby the controlling arm may be moved to stop and start the car while the reversing arm remains at rest, and means for engaging and moving the reversing arm to make the connection with its contact pieces in advance of that made by the controlling arm, only when it is desired to reverse the motor.

767,103. Electrical Converter. William B. Churcher, Cincinnati, Ohio, assignor to Kennon Dunham, Cincinnati, Ohio. Application filed September 21, 1903.

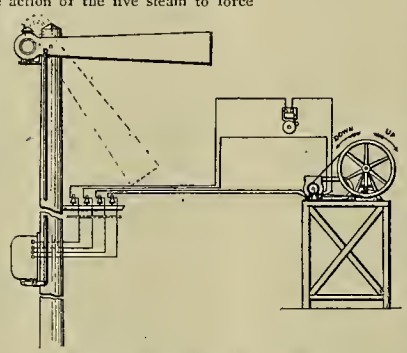
In combination with a source of alternating current is an electrolytic cell having a number of electrodes through which current of one polarity passes. An electrode exposes



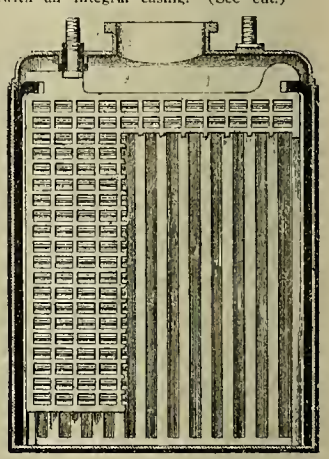
NO. 766,824.—ALTERNATING CURRENT SERIES ARC-LIGHT REGULATOR.



NO. 767,103.—CONVERTER.



NO. 767,256.—SEMAPHORE SIGNAL.



NO. 767,323.—INSULATED BATTERY CELL.

a restricted surface to the electrolyte and is adapted to rapidly interrupt the current. (See cut.)

767,105. Magnetic Separator. Myron Dings, Milwaukee, Wis. Application filed August 7, 1903.

The device consists of an electromagnet having a substantially vertical axis, a cup-shaped lower pole-piece partially inclosing the magnetic winding, an upper pole-piece covering the magnet and projecting marginally therefrom, a non-magnetic ring of less diameter than the upper pole-piece but connected to the latter and arranged to cover the upper edge of the lower pole-piece, and a conical distributing shield covering the upper pole-piece except at its marginal edges.

767,110. Method of Making Magnetic Materials. Robert A. Hadfield, Sheffield, England. Application filed June 18, 1904.

This method of producing a magnetic material of high permeability and low hysteresis action consists in alloying a magnetic substance with silicon, reducing the alloy to a thin body, heating the thin body to a temperature below its melting point, allowing it to cool, reheating it to a temperature above that first employed, and again allowing it to cool.

767,128. Sewing-machine Motor. Homer J. Young, Toledo, Ohio. Application filed September 8, 1903.

An electric motor for attaching to the sewing machine comprises a bracket adapted to be rigidly secured to the table of the machine and provided with a standard, an armature mounted concentrically upon the sewing machine shaft and a field member rigidly and adjustably connected with the standard of the bracket with its field-pieces concentric with the armature.

767,154. Means for Regulating Electric Motors. Johan G. V. Lang, London, England, assignor of one-half to Edward Hibberd Johnson, London, England. Application filed January 20, 1903.

In an electric motor the combination consists of means for producing a series excitation only when the machine is acting as a motor, and means for producing a compound excitation when the machine is acting as a generator.

767,155. Means for Regulating Electric Motors. Johan G. V. Lang, London, England, assignor of one-half to Edward Hibberd Johnson, London, England. Application filed February 1, 1904.

In a number of electrical motors are combined means for changing the field windings to render the motors operative either as series-wound motors for propelling and accelerating, or as compound-wound or shunt generators for braking or retarding. Means are provided for keeping the current from the power circuit uninterrupted while the aforesaid changes in the condition of the field windings are being effected.

767,163. Electric Switch Box or Case. George E. Neilberth, Newark, N. J. Application filed October 3, 1903.

An improved switch box or case comprises a body open at the front and rear. The body has at its ends openings to receive the conduits, and is provided interiorly with bearings for clamping screws. The clamping screws extend from the bearings into a rear plate, and the rear plate is adapted to be moved within the box to and from clamping relation with the conduits.

767,190. Electrical Signaling Device for Railroad Crossings. Joseph F. Weinschenk and Clifford H. Blodgett, Durand, Mich. Application filed January 14, 1904.

In an electric signaling device for railroad crossings, a signal bell, electromagnets placed in circuit with the rails on each side of the crossing, a swinging arm secured to each armature of the electromagnets and an arm hinged to each of the swinging arms and provided with a contact point to overlap the contact point of the arm first operated, are described. An arm provided with a suitable contact point to close the circuit to the signal bell through the contact point of the hinged arm, and springs engaging the swinging arms to break the circuit through the contact points of the hinged arms when the train passing the crossing breaks the circuit through the electromagnets are the other features.

767,195. Apparatus for Purification of Water by Electrical Means. James S. Zerbe, New York, N. Y. Application filed May 2, 1904.

An electrical chamber has electrodes therein and immersed in the treated water and connected up with a source of electricity. An ozonating chamber, an ozone receiver and a filter are connected together co-operatively.

767,206. Insulated Rail Joint. Edward A. Condit, Jr., Newark, N. J., assignor to the Continuous Rail Joint Company of America. Application filed January 27, 1904.

A railway rail-joint connecting plate has a lower portion adapted to engage the base flange of a rail.

767,207. Rotary Motor. Milton M. Conger, Linneus, Mo. Application filed September 1, 1903.

A casing has a working chamber and valve-controlled inlet ports and suitable exhaust ports. The surface of the chamber presents curves adjacent to the inlet ports and longer curves beyond and adjacent to the first-named curves presenting outward and inward inclines. A rotary piston has sliding valves, the valves being subject at their backs to the action of the live steam to force them outward against the mentioned outward inclines of the casing, whereby to tend to force the piston forward, the smaller curved surfaces of the casing having channels therein.

767,216. Apparatus for Vacuously Depositing Metals. Thomas A. Edison, Llewellyn Park, N. J., assignor to the New Jersey Patent Company, Orange, N. J. Application filed August 1, 1903.

In a vacuous deposit apparatus is combined an exhausted chamber with metallic electrodes therein and means for effecting an electrical discharge between the electrodes. Supports within the chamber and between the electrodes are arranged for sustaining a number of objects to be coated, and means are provided for simultaneously rotating the objects.

767,256. Electric Semaphore Signal Mechanism. Bruno O. Wagner, Amsterdam, N. Y., assignor to the Magneto Electric Company, Amsterdam, N. Y. Application filed May 7, 1903.

A semaphore blade has means for raising and lowering the blade, the means including an electric motor. An alarm in circuit with the motor is adapted for operation when the semaphore blade has passed its signaling position. Means are provided for automatically returning the blade to its signaling position at predetermined times. (See cut.)

767,268. Machine for Covering Wire with Rubber or the Like. Conrad Felsing, Jr., Coepenick, Germany. Application filed March 15, 1902. Renewed June 8, 1904.

In grooved rollers for covering wire with rubber or the like are two lateral flanges and a series of grooved disks disposed between the lateral flanges, each individual disk being formed of a projecting annular surface, to each side of which is adjacent an annular congé or concave quarter-round.

767,273. Insulating Rail Joint. Percy Holbrook, New York, N. Y., assignor to the Weber Railway Joint Manufacturing Company, New York, N. Y. Application filed November 13, 1903.

Details are described.

767,284. Central-energy System. William M. Kelly and Geary E. Truxell, Greensburg, Pa. Application filed May 20, 1903.

A movable member is disposed at each subscriber's station and is free to occupy normal and abnormal positions. Normal-contact mechanism and abnormal-contact mechanism connect with the movable member and are controllable by the position thereof, another member being connected with the movable member and controllable momentarily thereby while moving from one of its positions to the other. A power circuit is connected with the last-mentioned contact mechanism and is provided with an electric return. There are lines separate from the power circuit and connected with all of the contacts, the power circuit being also connected with the central station from which it is energized.

767,303. Telegraphic Transmitter. Horace G. Martin, Brooklyn, N. Y. Application filed May 7, 1904.

A circuit controller capable of making and breaking a circuit at a uniform rate has a key normally engaging the controller and preventing it from operating. There is a contact for the key, the key being capable of two movements from its normal position, one of which withdraws it from engagement with the controller, while the other brings it into engagement with its contact.

767,316. Safety Device for Electrically Propelled Vehicles. James H. Spencer, New York, N. Y. Application filed April 13, 1900.

The device comprises a circuit, a motor, a switch and a contact device, the contact device being normally in an inactive position to hold the circuit open, and being adapted to be actuated by the operator to close the circuit. The contact device comprises spring-pressed members, one of which has electrical connection with the switch and the other with the source of electricity, one member being held by its springs normally out of contact with the other member.

767,322. Printing Telegraph. James D. White, London, England. Application filed January 2, 1904.

An axially oscillating shaft bearing has a circular series of type-facets. Means for imparting a variable throw to the shaft and type-facets consist of a series of electromagnets with separate circuits, a series of armature-levers acted upon by the electromagnets, a series of pulleys and a series of lines, one for each pulley, passing around the same and each attached to its armature-lever at one end and to the axis of the next pulley above at the other end. A printing and feed machanism for the paper comprises an electromagnet and circuit. An armature-lever bears a hammer-face and an intermittently acting feeding device.

767,323. Insulated Battery Cell. Vincent G. Apple, Dayton, Ohio. Application filed November 9, 1903.

The cell comprises a containing-casing composed of metal with an exterior covering of insulating material susceptible of vulcanization, and vulcanized thereto to constitute therewith an integral casing. (See cut.)

767,350. Method of Regulating Electric Motors. Johan G. V. Lang, London, England, assignor of one-half to Edward Hibberd Johnson, London, England. Original application filed January 20, 1903. Divided and this application filed April 19, 1904.

The method of regulating regenerative electric motors consists in imparting thereto a series characteristic when they are to act as motors for driving and accelerating, and in imparting thereto a shunt or compound characteristic when they are to act as regenerative brakes for retarding or stopping.

767,351. Method of Regulating Electric Motors. Johan G. V. Lang, London, England, assignor of one-half to Edward Hibberd Johnson, London, England. Original application filed February 1, 1904. Divided and this application filed April 30, 1904.

The field-windings are made capable of acting alternatively as series windings when the motor is propelling and accelerating and as compound or shunt windings when the motor is performing its braking or retarding function. The current from the power circuit is kept uninterrupted while the change in the character of the field windings is being effected.

EXPIRING PATENTS.

Following is a list of electrical patents (issued by the United States Patent Office) that expired on August 10, 1904:

368,190. Art of Converting Chemical Energy into Electrical Energy. W. E. Case, Auburn, N. Y.
368,191. Galvanic Cell. W. E. Case, Auburn, N. Y.
368,195. Electrical Piano. G. F. Dieckmann, New York, N. Y.
368,212. Electric Lock. T. B. Hornaday, Indianapolis, Ind.
368,217. Printing Telegraph. J. H. Linville, Philadelphia, Pa.
368,221. Circuit Changer. C. W. McDaniel, Kansas City, Mo.
368,265. Electromechanical Brake. G. T. Woods, Cincinnati, Ohio.
368,284. Electric Wire-clamp Insulator. J. R. Fletcher, Dayton, O.
368,315. Means for Dissipating Electricity for Printing Machines. Lewis E. Bathrick, Brooklyn, N. Y.
368,321. Battery Connection for Electric Conductors. P. Bowe, Jersey City, N. J.
368,342. Telegraph Key. D. Kunhardt, Aix, Germany.
368,405. Electric Rock Drill. H. N. Marvin, Syracuse, N. Y.
368,406. Electric Rock Drill. H. N. Marvin, Syracuse, N. Y.
368,411. Synchronal Motor for Electrical Typewriters. J. F. McLauchlin, Philadelphia, Pa.
368,450. Telegraphic Transmitter. W. H. Bloom, Galt, Ill.
368,541. Printing Telegraph. H. Mahaken, Brooklyn, N. Y.
368,546. Electric Belt. Alva Owen, St. Louis, Mo.

WESTERN ELECTRICIAN

EVERY SATURDAY

Vol. XXXV. CHICAGO, AUGUST 27, 1904 No. 9

Space Telegraphy at the St. Louis Exposition.

Among expositions the Louisiana Purchase Exposition may be characterized as the first to present in an adequate and comprehensive way the art of space telegraphy. While much work has been successfully accomplished in transmitting messages over water, very little has been done to investigate the conditions which obtain on land. The World's Fair has made St. Louis a center for all that is new in electrical apparatus, and for this reason the city, although far inland, is now the location of the largest and the greatest number of space-telegraph stations.

An effort is making to communicate by "wireless" from Chicago to St. Louis with good prospects of success. Already the De Forest people are maintaining a service between St. Louis and Springfield, Ill., and it is said that a large and powerfully equipped station is under construction in Chicago. The long-distance station in St. Louis (see Fig. 1) is located on Art Hill, the highest point in the World's Fair grounds. A wooden mast 210 feet high has been erected and properly guyed. The arrangement of antennæ at this station is interesting. Strung along a 40-foot cross-arm hangs a horizontal wire, from which 20 verticals are suspended. (These are lost in the picture.) These antenna wires average 250 feet in length and are bowed out from the mast a great distance by means of cord spreaders. The antennæ enter the roof of the building in two halves of 10 wires each. The receiving antennæ are entirely distinct from this. Within the building, which is 20 by 40 feet, the visitor sees only the operating table, the relay keys and receiving instrument. The capacious transformer, condensers and other paraphernalia are concealed in a separate room. Through a window in the partition, however, one may see the dazzling brilliancy of the enormous spark which accompanies every signal. This spark has been so successfully muffled as to be scarcely audible outside of the building, but when the doors of the muffler are opened one hears a roar which rivals the cannonading at the Boer War Show near by.

Messages have already been sent from this station to Springfield, Ill., where the signals are heard in the telephone with a sound which one operator describes is "like the rattling of stones in a tin pail." Overland service with Chicago and Kansas City only awaits, it is asserted, the completion of similar masts at those two cities.

The De Forest Company has on the World's Fair grounds 10 operative sets of instruments, representing seven distinct and separate stations, aggregating an outlay for exhibition purposes alone of over $100,000. Most prominent of all and taller than any other structure upon the grounds stands the De Forest Observation Tower at the entrance to Orleans Plaza. This tower (shown in a night view in Fig. 4) is 300 feet in height and equipped with two express electric elevators. The elevators are in constant operation and a steady stream of visitors to the top of the tower shows the keen popular interest in space telegraphy as well as an appreciation of the magnificent opportunity which the De Forest Company has given the public for obtaining a birdseye view of the main picture of the fair.

The space-telegraph station on this tower is placed upon the 100-foot platform far above the building tops and overlooking the beautiful expanse of Forest Park. The walls of this station are made entirely of glass, and visitors there are afforded a fine view in the direction of St. Louis over the distant building tops, where, lost in the maze of the city smoke, are the masts of the two downtown newspaper stations, whither wireless press dispatches are being continuously sent. The St. Louis Post-Dispatch and the St. Louis Star receive regular news service from this station. From 3,000 to 5,000 words of "press" are transmitted daily at the rate of 25 to 35 words per minute, detailing such World's Fair news as the newspaper reporters can collect upon the fair grounds. The downtown operators are located in the composing rooms of the newspapers and are said to hand the copy "hot from the wireless" directly over to the linotype operator.

In this station the antenna wires lead up to a gaff extending from the roof of the tower, a distance of 200 feet. The power supply at the tower is 500 volts direct current. A 70-horsepower motor-generator transforms this to 240 volts direct current, which is supplied to the elevator motors. On the 100-foot platform a 240-volt motor drives by belt a two-kilowatt, 60-cycle, 110-volt generator. This voltage is used for the wireless transmitter. It is astonishing to note the speed with which the ordinary Morse key of the transmitter can cut up this 60-cycle current into the dots and dashes of the telegraph code. A speed of transmission fully equal to any attained on land wire is said to be maintained at this space-telegraph station. Notwithstanding the fact that the steel structure of this tower renders it not at all well suited for space-telegraph transmission, yet messages have been received from this station as far as Springfield, Ill., an air-line distance of 105 miles, entirely overland. Were this tower of wood, Dr. Lee De Forest says, a considerably greater distance could be attained. The wireless tower is covered with incandescent lamps, over 3,500 being used in its decoration. At night its tall and graceful outlines stand out conspicuously far above all the other buildings, even overtopping Festival Hall. That it adds much to the beauty of the illumination may be noted from the picture, which shows the tower and its surroundings at night.

The De Forest Company makes three exhibits in the Government Building. It is significant that out of nearly 800,000 patents which have been issued by the United States Patent Office, but seven were chosen to be represented at the World's Fair. Of these seven space telegraphy probably commands the most popular interest, as demonstrated by the throngs around the De Forest exhibit. The key, the transformer, the Leydon jars, the helix, the spark gap and the antenna cable are all shown in the exhibit, which is illustrated in Fig. 3.

In the Government Building the original source of power is 25-cycle alternating current. The De Forest coil, being of open cord type, will not operate satisfactorily on this low frequency. A Wagner motor-generator of one kilowatt capacity is therefore used, transforming from 25 to 60 cycles, 110 being the voltage in each case. Through the transformer the voltage is raised to 20,000, which is in series with a condenser having 0.013 microfarad capacity, the spark gap, the helix and the antennæ. In the same building the United States Signal Corps has two De Forest sets in operation and messages may be received either from the tower or the Patent Office station.

In addition to the above-mentioned stations the De Forest Company exhibits in the Transportation and Electricity Building wireless-telegraph automobiles, one of which is shown in Fig. 2. These have been used successfully in sending stock quotations from the New York curb (Wall Street) to the brokers' offices near by. All in all, one will seek far to find a new invention which has been demonstrated and exhibited more thoroughly and conscientiously and with so lavish an expenditure of money as is the De Forest space-telegraph system at the Louisiana Purchase Exposition.

Fig. 1. Long-distance Station on Art Hill.

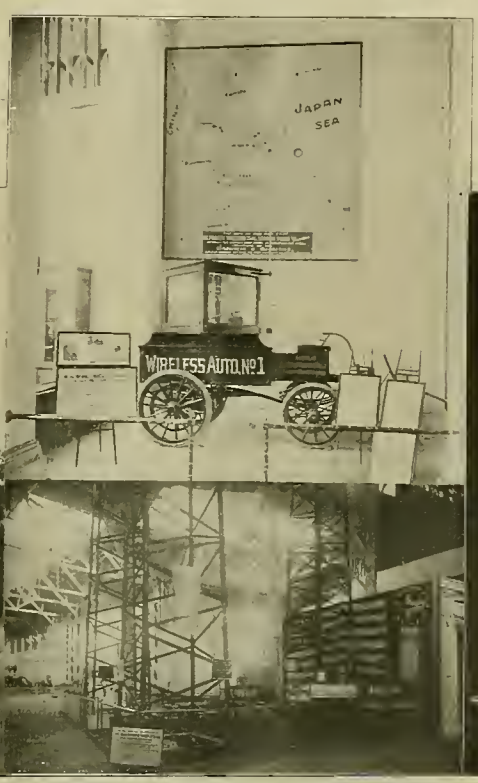


Fig. 2. "Wireless" Automobile.
Fig. 3. Exhibit of Apparatus.

Fig. 4. "Wireless" Observation Station at Night.

SPACE TELEGRAPHY AT THE ST. LOUIS EXPOSITION.

It is said that the largest station for space telegraphy yet erected will be completed at Pisa, Italy, in September. The buildings will be entirely of stone. As it will take some time to put the machinery and apparatus in place, the station will probably not be ready for transmitting and receiving messages before the beginning of next year. The station will be called Coltano. It is designed to establish wireless telegraphic communication from there with Great Britain, Holland, the United States and Canada, as also with vessels in the Mediterranean, the Baltic Sea, the Red Sea and the Atlantic and Indian oceans. Lately two Marconi stations have also been completed on the coast of Montenegro and are now in working order.

Alternating-Direct Working with Compensated Motors on Ballston Electric Railway.

Almost exclusively electric railways are operated by direct-current motors with a trolley voltage of about 550 to 600 volts. For heavy service and extended systems the cost of copper required at this voltage becomes a serious item, and for some time there has been felt the need of a higher trolley voltage. The possible use of alternating current for the trolley would admit of a higher voltage than is possible with direct current, as the voltage could be reduced by a transformer on the car to the potential required by the motors. The development of large power stations and transmission systems has been principally with alternating current, requiring rotary converters or other transforming devices for changing the alternating current into direct current suitable for the operation of electric railways. Obviously there would be a great advantage in a railway-motor equipment that could be operated from an alternating-current high-voltage trolley and without the necessity of intermediate-commutating devices. Such an alternating-current equipment would offer a further advantage if it could be operated both on alternating extensions of existing systems and also on the direct-current trolley where the latter is already installed.

For several years electrical engineers, both at home and abroad, have been working on this problem. One type of alternating-current equipment suitable for general traction work, developed by the staff of the General Electric Company, is of particular interest and is described herewith.

The activity displayed in Europe in adapting the three-phase alternating-current motor to the conditions of railway service has never been fully shared by American engineers, due to the limitations of the multiphase-induction motor. The development of the single-phase commutator motor and its inherent fitness for traction work has created wide attention among railway interests, and work of a practical nature has been actively pushed on both sides of the Atlantic. Considerable interest therefore attaches to the operation in regular service by the Schenectady Railway Company of single-phase alternating-current motors on its Ballston extension. This is the first instance in this country, it is believed, of

FIG. 1. COMPENSATED A. C. MOTOR USED ON BALLSTON RAILWAY.

an alternating-current road in regular service carrying passengers, and its commercial possibilities are largely due to the fact that the motors operate with alternating-current power outside city limits and with direct-current power within the city limits.

The alternating-current motor as developed by the General Electric Company and installed on the Ballston line is of the "compensated" type, so named on account of the character of the field winding, which fully neutralizes or compensates for the armature reaction. Both the compensated motors and control are adapted for operation on the 2,000-volt alternating-current trolley between cities and the standard 600-volt direct-current trolley in Schenectady. This ability of the compensated-motor equipments to run over tracks equipped with either alternating-current or direct-current trolley makes their field of application very broad, as the cars can secure all the benefit of running over existing city tracks without in any way sacrificing their running qualities upon suburban sections equipped with alternating-current trolley.

The alternating-current motor with its inherent advantages of high-voltage distribution is particularly adapted to replace the steam locomotive on either high-speed passenger or heavy-freight haulage work; and as the compensated type of motor is perfectly adapted to operate on both alternating-current and direct-current trolley, the alternating-current motor must be considered a large factor in future suburban-railway systems. The compensated motor (Fig. 1) is essentially a variable-speed motor, differing in this respect from the multiphase-induction motor, whose constant-speed characteristics proved so serious a handicap to its successful adoption in railway work. The speed-torque characteristic of the compensated motor is very similar to that of the direct-current series motor, while its commutating qualities and method of control prove equally satisfactory.

On the Ballston extension of the Schenectady railway advantage is taken of the ability of the compensated motor to operate with either alternating or direct current. The extension is 15.5 miles in length, including 3.9 miles of city running in Schenectady

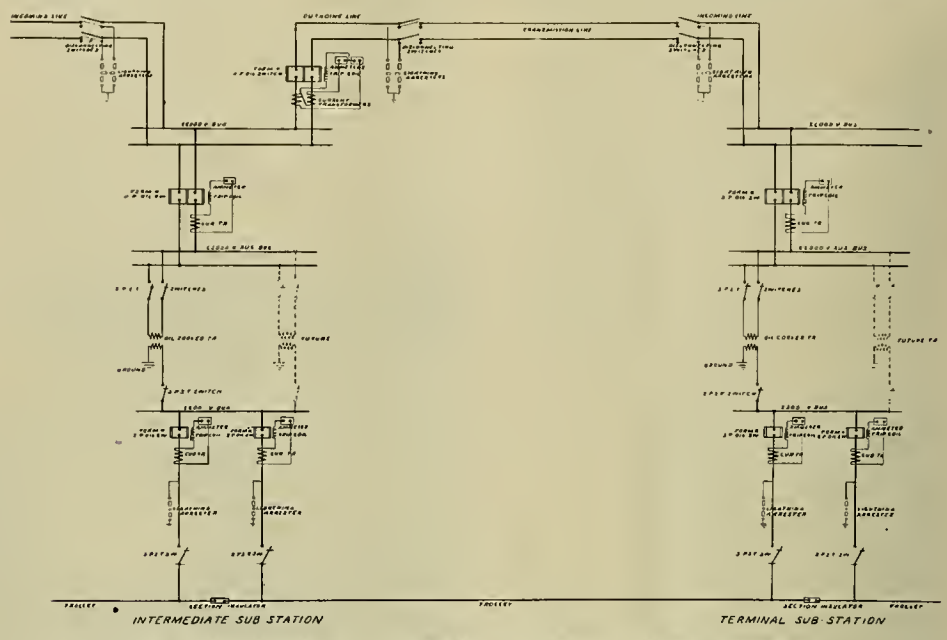


FIG. 2. SINGLE-PHASE RAILWAY DISTRIBUTION WITH SINGLE-PHASE TRANSMISSION.

over tracks equipped with direct-current trolley. The interurban section is double-track on private right-of-way 60 feet wide, laid with 75-pound T rail, gravel-ballasted, with maximum grade of 1.8 per cent. Special attention has been given to the high-speed possibilities of the road and no curve exceeds 4¼ degrees.

Center-pole bracket construction (Fig. 3) is used, there being two brackets supporting the two 600-volt direct-current trolley wires and a cross-arm supporting the two 2,200-volt alternating current trolley wires. The Ballston extension has been operated for several months with direct-current equipments, and their operation being continued in part necessitated an additional set of trolley wires for the alternating-current equipments which would not interfere with the direct-current trolleys. The center poles are 34 feet high and are spaced 100 feet apart, the alternating-current and direct-current trolley wires being No. 000 grooved section, with no feeders for the alternating-current trolley and with a 500,000 circular-mil feeder reinforcing the direct-current trolley. The direct-current trolley conforms to standard bracket construction and presents no unusual features, while the alternating-current trolley wire is suspended from a three-eighth-inch steel catenary. The alternating-current trolley is clipped to the catenary midway between poles and the catenary in turn is hung over porcelain insulators on wooden cross-arms, the whole forming a construction of great flexibility, with the further advantage of providing excellent insulation with standard porcelain insulators and eliminating the span wires adjacent to the trolley wire, thereby preventing the pole catching should the trolley wheel leave the wire. This method of trolley construction is well adapted to high-potential high-speed work in both its electrical and mechanical features.

With the alternating-current system using a trolley and track return there is an inductive drop in the trolley and rails with an additional loss in the latter case, due to eddy currents and hysteresis. Measurements made upon the Ballston line indicate an apparent trolley resistance of 1.3 times the ohmic resistance and a rail resistance of 6.55 times the ohmic resistance.

COMPARATIVE ALTERNATING-CURRENT AND DIRECT-CURRENT RESISTANCE OF TROLLEY AND TRACK PER MILE OF CIRCUIT.

	D. C. Resistance.	A. C. Resistance 25 Cycles.	Ratio A.C.÷D.C.
Two trolleys in series	0.318 ohm	0.417 ohm	1.31
One trolley and double track	0.167 ohm	0.259 ohm	1.55
Two trolleys and double track	0.088 ohm	0.155 ohm	1.76
Double track alone	0.0174 ohm	0.114 ohm	6 55

The resistance of the alternating-current trolley wire is somewhat reduced by the steel catenary in parallel with it. The alternating-current trolley wires are five feet apart and 16.5 feet above track, while the four 75-pound track rails are tied together every 1,500 feet. The increased resistance with alternating current is a serious factor in low-voltage alternating-current city systems, but since the compensated motor operates well with the direct current of city systems no general necessity appears to exist for a low-voltage alternating-current trolley.

The form of alternating-current trolley adopted for the Ballston line is well adapted to the requirements of steam roads where the local service is taken care of electrically and through passenger and freight handled by steam locomotives pending a complete change to electrical operation. The trolley wire and insulators being off-center are not exposed to the gases of the locomotive exhaust with consequent deterioration, and furthermore a catenary construction placed off-center can be hung much lower than a standard-center wire without interfering with brakemen on freight cars. A low-running trolley at the side of the car is also preferable in main-line operation, as it conforms better to the clearance diagram of such roads without calling for too great a change in height of the trolley wheel or bow. The trolley suspension adopted on the Ballston line therefore affords valuable experience with a form of construction adapted to the requirements of electrically converted steam-operated lines.

The present sub-station of the Schenectady railway is temporarily located at Ballston Lake. This sub-station is operated from the distributing system of the Hudson River Power Company, but owing to the fact that this system operates at 40 cycles, it became necessary to introduce a frequency-changing device, and an inverted converter operated from the sub-station direct-current bus bars afforded the most ready means of obtaining 25-cycle current. The permanent sub-station will be erected at Ballston

FIG. 3. A. C. AND D. C. OVERHEAD CONSTRUCTION ON BALLSTON RAILWAY.

and the inverted converter will be replaced by a motor-generator set which will give better regulation than can be obtained from an inverted rotary converter. The sub-station feeds directly into the trolley circuit at 2,200 volts, with no outside transformer sub-stations.

Owing to the fact that 25-cycle three-phase generators are almost universally used to supply rotary converters in existing interurban-railway systems, the General Electric Company has adapted both the design of the compensated-motor and the alternating-current distributing system to operate from existing 25-cycle generating stations. As the alternating-

Fig. 4. A. C. Motor Car

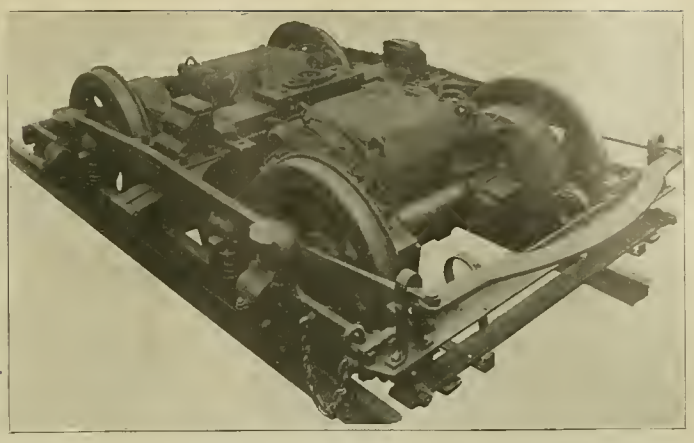


Fig. 5. Truck Equipped With Two Compensated A. C. Motors.

ALTERNATING-DIRECT WORKING WITH COMPENSATED MOTORS ON BALLSTON ELECTRIC RAILWAY.

current motor is single-phase, a single-phase generating and distributing system commends itself on account of its simplicity. The step-down transformers may be tied together on the low-tension side through the trolley with consequent reduction in amount of copper required. Each sub-station acts as a reserve to the adjacent one and a transformer may be cut out without shutting down a trolley section. A standard sub-station layout is given in diagrammatic

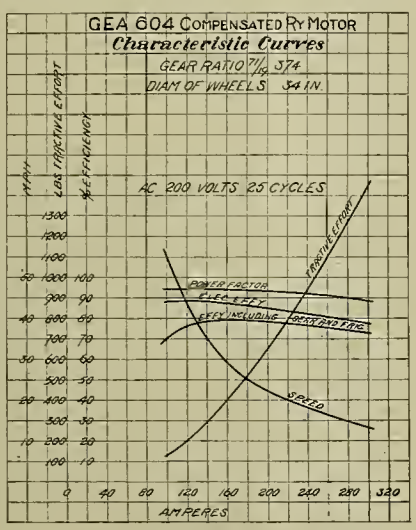


FIG. 6. CHARACTERISTIC A. C. CURVES OF COMPENSATED MOTOR.

form in Fig. 2, showing both an intermediate and terminal sub-station fed from a single-phase source of power.

When it is desired to make use of or install a three-phase generator to take care of the operation of rotary converters, induction motors, etc., the preferred arrangement to balance the load at each sub-station is to install three-phase two-phase transformers, connected two-phase on the secondary side and feeding separate trolley sections from the two phases.

The car (Fig. 4) equipped with the compensated motors weighs 30.4 tons total, without passengers, and is geared for a maximum speed of about 43 miles

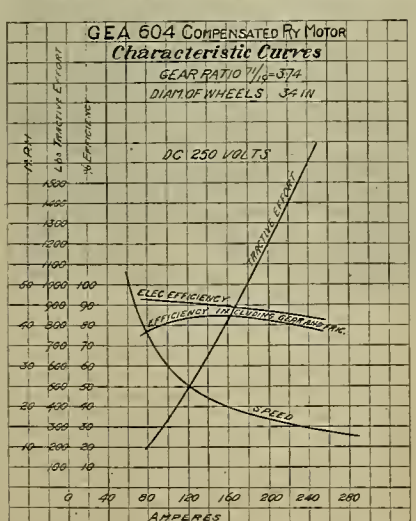


FIG. 7. CHARACTERISTIC D C. CURVES OF COMPENSATED MOTOR.

an hour on the level. It has a 32-foot body, is 43 feet over all, with a seating capacity of 44 passengers. The body is mounted upon Brill No. 27 trucks having six-foot wheel base, each truck carrying two compensated motors, each motor equivalent to a 50-horsepower direct-current motor, standard railway rating. (See Fig. 5.)

The General Electric alternating-current compensated motor consists of an annular laminated-iron field, with a distributed winding similar to that of an induction motor, and an armature provided with a commutator similar in general mechanical construction to a direct-current railway-motor armature. These motors are wound for 200 volts, are permanently connected two in series, and are fed from the 400-volt secondary of an 80-kilowatt air-blast step-down transformer carried on the car. The distributed character of the field winding fully compensates for the armature reaction, so that power factors are relatively high throughout the range of

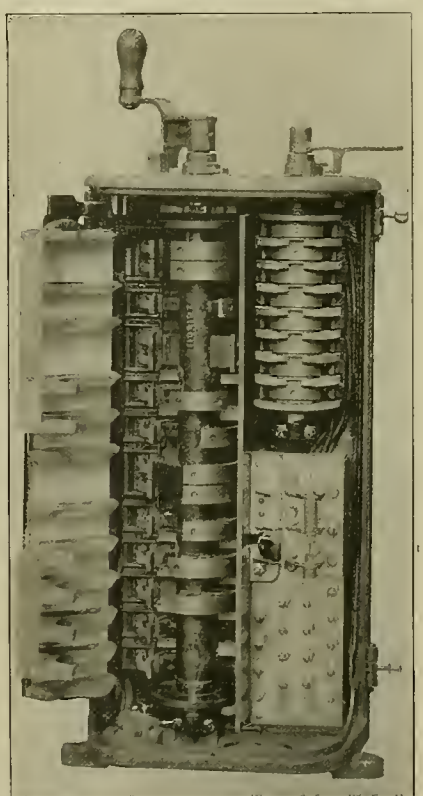


FIG. 8. CONTROLLER (WITH FRONT CASING REMOVED) USED ON BALLSTON RAILWAY.

operation. This type of motor is so designed that at the free running speed of the car, which is the condition most frequently met with in suburban work, the power factor and efficiency are nearly at their maximum values. A high power factor is desirable, as it reduces the capacity and cost of the generating and distributing systems, and more especially affects a material improvement in the regulation of the alternating-current generators. Unlike a direct-current system, which has a practically constant potential at the sub-station bus bars, irrespective of the load, the drop in an alternating-current railway system is accumulative up to and including generator and engine regulation. It is desirable, therefore, to maintain as good a power factor as is consistent with good motor design, in order to limit the total drop of the system to a reasonable amount.

A set of motor characteristics is shown by Figs. 6 and 7 for both alternating-current and direct-current running. It will be noted that the speed-torque characteristics for alternating-current running are equal to direct-current running in meeting the requirements of railway work. Unlike the multiphase induction motor, with its practically constant-speed characteristic, the compensated alternating-current motor varies its speed with the load, and is thus better adapted to operate trains over an irregular profile. The commutation of the compensated motor is said to be equally satisfactory when running alternating current or direct current, and this good commutation is attributed to careful electrical and mechanical design, without resorting to high-resistance leads or other expedients liable to give trouble in case of sustained heavy overloads.

City railway systems have so expanded and cover such a large territory as to make it objectionable, both on the score of first cost and complication, to install a separate alternating-current trolley at reduced potential in order that cars equipped with alternating-current motors may benefit from running over city streets at termini and en route. There is a comparatively small additional expense required to adapt alternating-current equipments to run either alternating current or direct current, and in the case of the Ballston line this is accomplished with the use of a standard K-28 direct-current series-parallel controller (Fig. 8), used in connection with a commutating switch to change field connections, cut out step-down transformer, change line fuses, etc. The time required to operate the commutating switch is but a few seconds. The scheme of connections, both in diagrammatic form (Fig. 9) and for the complete car wiring (Fig. 10), is shown in accompanying drawings.

The commutating switch is interlocked with two main oil switches, one being in the high-tension alternating current and the other being in the direct-current circuit, this interlocking being so arranged that only one switch can be closed at a time and the commutating switch can only be thrown when the oil switches are in the off position. Owing to the fact that the alternating-current trolley construction is off-center, while the standard city and suburban trolleys are directly overhead, it has been necessary to provide double sets of trolleys, one for alternating current and the other for direct current, hence the necessity of interlocking the oil switches and commutating switch to prevent trouble should both trolley poles accidentally be up at the same time. Where center-wire construction is used on both the city and suburban sections, the alternating-current and direct-current trolley wires may be overlapped for a short distance to facilitate changing from one trolley to the other.

With equipments operating with both alternating-

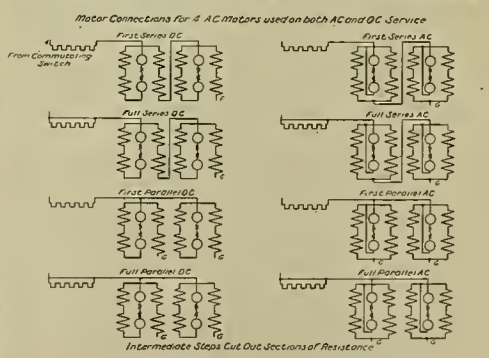


FIG. 9. D. C. AND A. C. CAR-MOTOR CONNECTIONS ON BALLSTON RAILWAY.

curent and direct-current power, it is preferable to utilize the standard series-parallel controller, in order to minimize weight of controlling apparatus. Such a method of operation will not give quite so high efficiency when accelerating with alternating current as could be obtained with potential control. This difference in efficiency, however, is very small, due partly to the infrequency of stops occurring upon those sections of the road equipped with alternating-current trolley, but principally due to the flexible character of the speed-torque curve of the alternating-

current motor, which gives a high efficiency of acceleration with series-parallel control.

With modern suburban cars, especially those equipped with train control, air brakes, air compressors, etc., there is some difficulty in suitably locating the proper apparatus, even when equipped for direct-current running only. With cars equipped for both alternating-current and direct-current running, using series-parallel controller, there will be required but slightly more space and weight than for direct-current running only. Should, however, advantage be taken of the slightly better efficiency of alternating-current potential control, such cars must be operated alternating current upon both suburban and city sections with the resulting disadvantages, or the installation of two separate controlling systems must be considered, necessitating a considerable increase in weight and difficulty in providing room for the necessary apparatus.

The efficiency of the potential control is not over two or three per cent. higher than that of the series-parallel control, but the use of the latter, permitting operation both alternating and direct current, secures the advantage of the higher efficiency of the motors when running direct current over city streets.

For locomotive or other service, where no necessity exists for operation over city direct-current systems, the potential method of control may offer advantages sufficiently great to warrant its adoption.

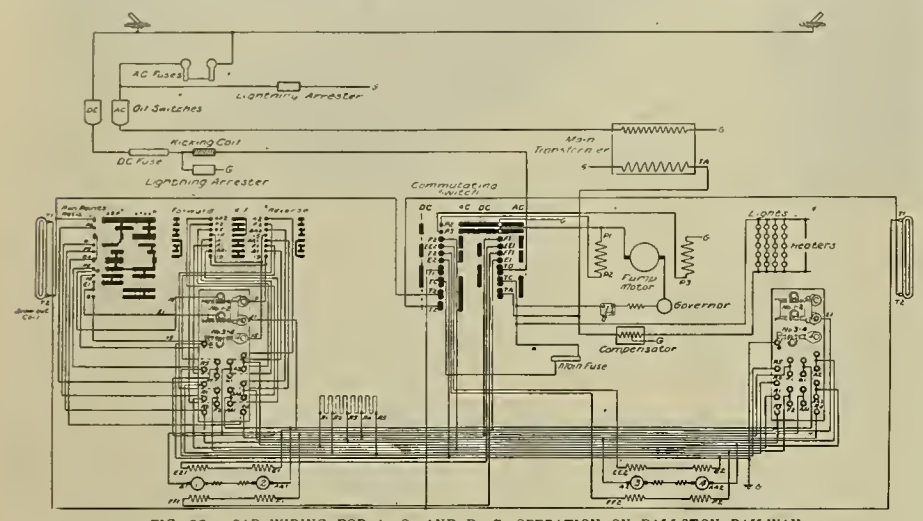


FIG. 10. CAR WIRING FOR A. C. AND D. C. OPERATION ON BALLSTON RAILWAY.

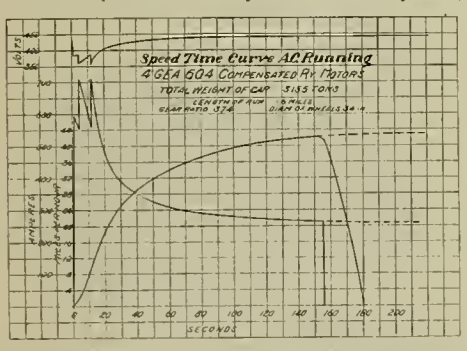


FIG 12. SPEED-TIME CURVES ON BALLSTON RAILWAY.

The 80-kilowatt step-down transformer (see Fig. 11) is air-cooled, forced draft being obtained by motion of the car itself. The transformer is suspended below the car floor, and all primary leading-in wires are carried in brass tubing, which is grounded. Car lighting and heating is effected from the direct-current trolley in the standard manner, and from the alternating-current trolley from the secondary of the transformer. Trolley poles and wheels are of standard design, the alternating-current trolley pole being somewhat shorter, as this wire is lower than the direct-current trolley. The base of the alternating-current trolley is treated with vacuum compound and further insulated from the car body by composition insulators. The air compressor for the brakes and whistle is operated by a compensated motor which operates from both alternating-current and direct-current circuits.

It is instructive to compare the performance of the compensated-motor equipment when operated with alternating current and direct current. A set of speed-time runs is shown in Figs. 12 and 13, taken over the same stretch of track with alternating current and repeated with direct current. The direct-current speed-time and ampere-time curves are typical and require no particular comment. The alternating-current run taken under exactly similar conditions over the same track illustrates what can be expected from series-parallel control with compensated motors. The rate of acceleration is somewhat lower in the alternating-current run, hence requiring the application of power up to and moment of braking. The shape of the speed-time curve also is characteristic of alternating-current motor work, that is, a comparatively short time on the controller with a large amount of motor-curve acceleration. The short period of fractional voltage running of alternating-current motors makes the method of their control of secondary importance and largely minimizes the economy of potential control over series-parallel control.

All speed-time runs taken on the Ballston line were made over a distance of 1.6 miles on tangent level track at an average speed of 32 miles per hour, or a schedule speed of 29.5 miles per hour, including 15-second stops. The compensated-motor equipment has thus demonstrated its ability to make as high-schedule speed as any suburban road now operating direct-current equipments under like conditions. The following constants apply to both sets of runs:

COMPARATIVE ALTERNATING-CURRENT AND DIRECT-CURRENT RUNS.

	D. C.	A. C.
Length of run	1.6 miles	1.6 miles
Weight of car	31.55 tons	31.55 tons
Time	180 seconds	180 seconds
Average current power on	229 amperes	346 amperes
Average voltage	666	425
Volt amperes full speed on level	98	110
Volt ampere-hours per ton-mile of given run	86.3	125.5
Average speed	32 m. p. h.	32 m. p. h.
Schedule speed including 15 seconds stop	29.5 m. p. h.	29.5 m. p. h.

The lower volt-ampere-hours per ton-mile of the direct-current run is partly due to the better efficiency and power factor of the compensated motor when run direct current, and partly due to the somewhat higher rate of acceleration, permitting some coasting, and resulting in a more efficient speed-time curve. The difference in volt-amperes between alternating current and direct current depends upon the length of a given run, and the values approach each other more nearly with a run of greater length. It will be noted that the compensated motors run the car at practically the same speed with 200 volts per motor alternating current and 300 volts direct current. This uniform speed is obtained by series-paralleling the fields, as shown in the diagram of connections.

The operation of the Ballston compensated-motor equipments will be watched by railway engineers with much interest, as their success will demonstrate the fitness of the alternating-current motor for heavy suburban and interurban mixed service. The compensated motor, having demonstrated its fitness for traction work, opens up possibilities in converting main-line steam roads which were closed to the direct-current motor and rotary-converter combination on the score of first cost and cost of operation. The form of trolley suspension used on the Ballston line is capable of being operated at more than 2,000 volts, which, together with its excellent mechanical construction, helps to solve the question of current collection of heavy units at high speeds. The commercial development of the alternating-current motor is opportune, as steam-railroad managements throughout the country are displaying great activity in acquiring competing electric roads and in electrically equipping portions of their systems now operating at a loss with steam locomotives. The compensated motor is well qualified to meet the conditions of local passenger service, as demonstrated by its operation on the Ballston line, and holds out the promise of much larger possibilities in the direction of direct competition with the steam locomotive in main-line work.

DATA OF BALLSTON ALTERNATING-CURRENT-DIRECT-CURRENT RAILWAY.

Total length of line—15.5 miles.
Length city running—3.9 miles.
Length interurban portion—11.6 miles.
Width private right-of-way—60 feet.
Weight of rail—75 pounds, T; double track.
Maximum grade—1.8 per cent.
Maximum curvature—4¼ degrees.
Height of center poles—34 feet.
Spacing between poles—100 feet.
Size trolley wire alternating current and direct current—No. 000.
Alternating-current trolley suspended from three-eighths-inch steel catenary.
Ohmic resistance trolley per mile circuit—0.318 ohm.
Apparent resistance trolley, 25 cycles—0.417 ohm.
Ohmic resistance one trolley and double track—0.167 ohm.
Apparent resistance one trolley and double track, 25 cycles—0.259 ohm.
Distance between alternating-current trolleys—five feet.
Distance between trolley and track—16.3 feet.
Potential of trolley, alternating current—2,200 volts at sub-station.
Total weight of car without passengers—30.4 tons.
Maximum speed alternating current and direct current—43 miles per hour.
Length of car body—32 feet.
Length over all—43 feet.

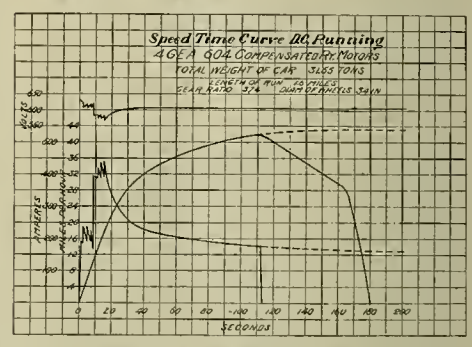


FIG. 13. SPEED-TIME CURVES ON BALLSTON RAILWAY.

Seating capacity—44 passengers.
Length wheel base—six feet.
Style truck, Brill—No. 27.
Equipment—four G. E. A.-604 compensated motors.
Each motor equivalent to 50-horsepower direct-current motor, standard rating.
Voltage per motor—200 volts alternating current, 300 volts direct current.
Motors connected permanently two in series.
Type of controller—K-28 standard series-parallel controller.

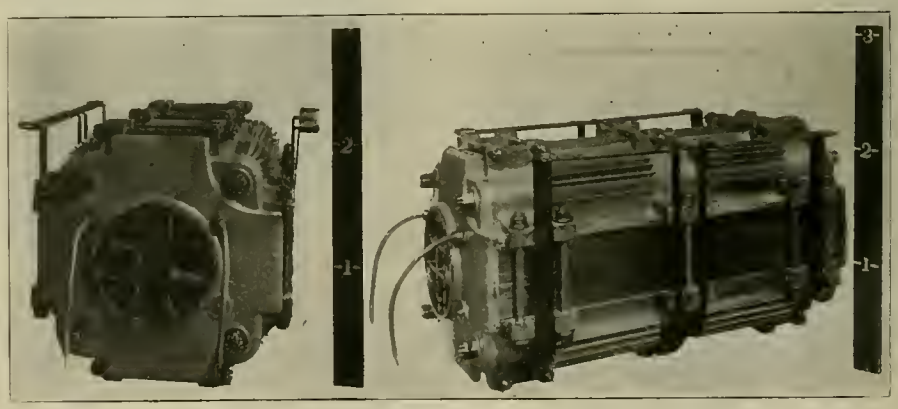


FIG. 11. VIEWS OF STEP-DOWN TRANSFORMER AS USED ON CAR OF BALLSTON RAILWAY.

Two alternating-current and two direct-current trolleys per car.
Length of specimen run—1.6 miles.
Average speed, not including stops—32 miles per hour.
Volt-ampere-hours per ton-mile—direct current, 4,350; alternating current, 6,330.

The compensated-motor equipment of the Ballston division of the Schenectady railway described in the foregoing article was exhibited to a party composed largely of technical journalists on August 19th.

The visitors were first taken from New York to Schenectady in a special car attached to the 8:45 a. m. train on the New York Central. They were then given a ride from Schenectady to Ballston and return on a car having the new alternating-direct equipment. An interesting demonstration was given of how the compensated-motor system permits of changing from a direct current within city limits to an alternating current without the slightest inconvenience, or interference with the movement of the car. Indeed, without being told of it, no one would know that such a change had been made.

The New York party was in charge of E. H. Mullin of the General Electric Company and J. K. Le Baron, editor of the Four-track News of the New York Central Railroad Company. It consisted of the following-named gentlemen: H. W. Blake, Street Railway Journal; John Goodell, Engineering Record; A. S. McAllister, Electrical World and Engineer; W. H. Brown, Electrical Review; Angus Sinclair, Locomotive Engineering; John Hill, Power and American Machinist; M. L. Godkin, Western Electrician; A. V. Wright, Locomotive Engineering; C. Ducas, Railroad Gazette; F. H. Fayant, Wall Street Journal; S. E. Cole, The Engineer; F. E. Schmidt, Engineering News; C. B. Fairchild, Jr., Street Railway Review; Isaac White, New York World; C. J. Allen, New York Globe; Harry Voght, New York Commercial; L. R. Pomeroy, General Electric Company. At Schenectady the newspaper men were joined by additional representatives of the General Electric Company, including General Eugene Griffin, first vice-president; Professor C. P. Steinmetz, electrician; William B. Potter, engineer railway department; J. G. Barry, W. I. Slichter, A. H. Armstrong, E. H. Anderson, E. F. Peck, and Messrs. Priest and Green.

The Steam Turbine and Its Uses.[1]

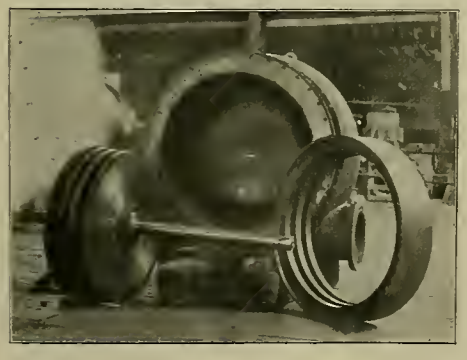
By E. C. Crocker.

The value of the steam turbine is based not only on its efficiency but also on the first cost as compared with the engine to do a like service, the minimum amount of floor space required, light foundations, the minimum amount of attention and the simplicity of its operation.

The turbine which I shall describe is built on the principle of expanding steam in a diverging nozzle down to a given pressure where it impinges on the first set of blades or buckets fastened to a revolving disk. It is then received by a stationary set of guides which further expands the steam and directs the flow on to a second set of blades or buckets fastened to a second revolving disk, and so on successively until the steam is delivered to the exhaust in nearly a stationary condition.

After a number of experiments on making nozzles to get as nearly a true expansion as possible, following the curve line of the steam, I decided that the best method was to cast a solid bronze ring and cut the diverging nozzles out of the face of this ring. Thus, instead of a nozzle with straight walls, we have one which, while following the expansion of steam, at the same time follows the circle of the ring, thereby following very nearly the natural curve line of expanding steam. An automatic machine has been made for cutting these nozzles, and after this operation has been made and the ring turned off another solid bronze ring is shrunk on to the outside, thereby closing up the side of the nozzle and making it complete.

This nozzle ring is then set into a circular steam

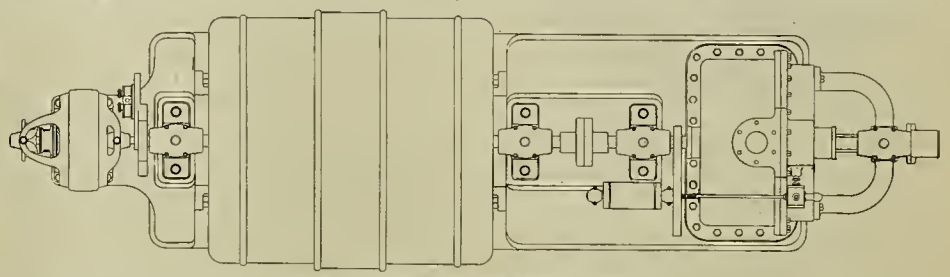


WARREN-CROCKER TURBINE.—CASE OF TURBINE, WITH DISKS MOUNTED ON SHAFT AND GUIDE RINGS ASSEMBLED.

chamber, forming one of the walls of the chamber, and it is so arranged that when the steam discharges from the chamber it blows on to the buckets arranged around a circular disk, and as these nozzles follow each other around the complete circle the entire set of buckets is filled with steam, when the turbine is working at its maximum load. An automatic arrangement is provided whereby one or more nozzles are automatically cut on or off, as any variation of the load may require, thereby giving the turbine an efficiency at part load which is very nearly equal to the full-load efficiency. By this method of control the steam is never throttled except on the nozzle that the governor is operating on, the rest of the nozzles being either entirely closed or doing a maximum amount of work. It is very essential to get the correct shape of nozzles in order to get the highest degree of efficiency from the turbine, and it is also essential that the buckets and guide vanes should be made of the proper radius and angle, and they should be so proportioned that the reaction of the steam shall counterbalance the end thrust due to the difference of pressure between the first set of buckets and the exhaust end of turbine. These should be so proportioned that there should be a slight amount of thrust, which a good thrust bearing can easily take care of.

The speed of the turbine is regulated by a centrifugal governor, which forces a pin against a cut-off valve connected to the exhaust chambers of a small steam cylinder. This cylinder has a piston which is directly connected to a cut-off ring inside of the steam chest of the turbine. This cut-off ring is held against the face of the inlet side of the nozzle and has holes in it of different lengths, whereby any movement of the cylinder cuts on or off certain nozzles, according to the direction of the movement of the piston. So close a regulation is secured by this method that two per cent. is guaranteed, and it can be controlled so that it may operate with two to six per cent., as the conditions under which the turbine is to operate may require. This cut-off ring, however, is only used on the smaller sized turbines, from 100 to 300 kilowatt capacity; on the larges sizes the steam enters a governing receiver which acts in the same manner. This receiver has a hollow balanced port valve. This port valve controls the opening to different sections of the steam chest of the turbine, and one or more openings are made or closed according to the load in the same manner as on the smaller turbines.

The whole turbine is complete in every detail. It is mounted on an iron sub-base and has a pump for forcing lubrication through all the bearings. As no oil is used in connection with the internal parts of the turbine, the condensed steam may be returned direct to the boilers without the use of a separator. The oil used in the bearings returns again to the pump and is used over and over again, very little being wasted. The buckets of this turbine are made of drop forged steel and dovetailed into steel disks,



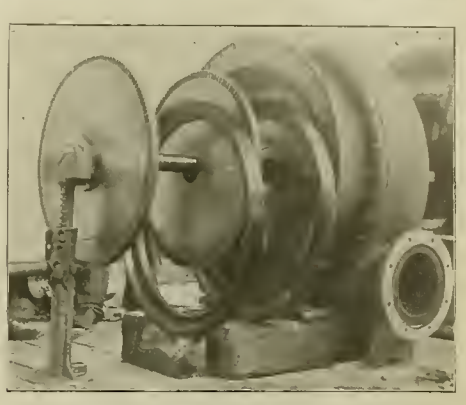
PLAN OF WARREN-CROCKER STEAM TURBINE.

the whole being finished by grinding before it is assembled.

The development of the steam turbine in the last 25 years is due more to the development of the electric-light and power work than anything else, although the advantage of steam turbines for driving rotary pumps is appreciated by builders of this type of apparatus. The development of the electric stations has been wholly within the period of the last 25 years, and the value of a direct coupling of dynamo to its source of power is well recognized. The dynamo is essentially a high-speed machine, and the attempts to couple direct to reciprocating engines has developed a dynamo, the size of which is far in excess of that required by good economy and low cost of maintenance. To operate a dynamo at low speed it must be either at the expense of efficiency or an excessive increase of material in its construction. The reciprocating engine on the other hand is essentially a slow-speed machine, and in bringing the two successfully together has been a very costly practice. The combination of the steam turbine and the dynamo is the solution of a good many difficult problems in engineering, the result of which is a unit, the value of which for central-station work is, I believe, already recognized by the majority of engineers throughout the country, and is destined to become the power producer for all electric stations where steam is used. I am not one of those who believe that the steam turbine will relegate the reciprocating engine to the scrap heap, as I believe that each type has its own field, but I do believe that for electric power the reciprocating engine within the next few years will be considered obsolete and will not be considered for future extensions by producers of electric power. The huge generating plants of the past, I believe, will not be considered, as the public comes to understand the value of the turbine in its practical operation.

There have been three distinct types of steam turbines commercially developed. One depends on extremely high-bucket velocity, using a single wheel. In another the bucket velocity is reduced by using a large number of buckets and guides on a cylinder, transforming the steam into velocity as it flows through the successive number of guides. The last, and what I consider the best, and on the lines of which I believe the steam turbine of the future will be developed, is the one described in this paper. Each successive set of bucket wheels bears buckets of increased size, each wheel in turn extracting a part of the velocity of the steam. By increasing the size of each set of buckets we provide for the increased volume of the steam. The Warren Electric Manufacturing Company has acquired the sole right to manufacture this turbine and is now building it with gratifying success.

To get the highest economy from the steam turbine it is necessary to run condensing, and as high



WARREN-CROCKER TURBINE.—DISKS AND GUIDES SLIPPED OUT OF SHAFT.

a vacuum as possible should be secured, though they may run noncondensing with practically the same results as can be gotten from a reciprocating engine.

Discussion.

After reading his paper, Mr. Crocker was subjected to quite a cross-examination by F. W. C. Bailey and E. E. Schmid. When asked by one speaker as to what would happen in case of boiler priming and water getting into the turbine, he replied that it would not do to use wet steam continuously, as it would wear out the buckets and decrease the efficiency. Priming of a boiler would work no bad effects in particular, except to slow down the machinery. In reply to further questions by Mr. Bailey, Mr. Crocker stated that his company was building 300-kilowatt machines at present, the largest size, and had one in use at its factory on the testing block, geared to a shafting for testing the belted machines. The guaranteed steam consumption of a non-condensing turbine of 300-kilowatt capacity is, at 150-pound steam pressure, 28 pounds of steam per brake horsepower. The friction on a turbine amounts to very little. On a one-fourth load this will not exceed by two pounds what it is on full load, and on overload will be a trifle better than at full load. Twenty-eight inches vacuum can be carried, but the turbines generally run at 26 inches.

Thomas F. Clohesey asked if the speaker recommended the operation of his turbine at about 150 pounds pressure, and an affirmative answer was given. The pressure on the exhaust would be practically nil, just enough to overcome the atmosphere. The regulation was two per cent. He did not claim that under the highest conditions of a Corliss that he could compete with it in economy, but said that there are other advantages that make a turbine much more desirable than a Corliss engine for electric work; it is much more economical in space, uses less cylinder oil and has less wearing parts than a reciprocating engine.

In answer to Mr. Schmid's question, whether, owing to the small cross-section of the vanes, liability to accident would not result by the introduction of foreign material into the working parts, Mr. Crocker said that such liability did not exist; that it is practically impossible to break a vane unless purposely done. They are constructed of drop forgings and dovetailed into a disk and are butted together on the rim of the wheel and form almost a part of the solid disk. If anything should happen a piece could be taken off on the side of the disk, the vane moved out of its dovetailing and a new one slipped in. Mr. Schmid also asked if some of the guide-vanes were broken out in between the rotating parts it would not cause trouble. The reply was that there was an inch and a half space underneath the wheel that the bucket would fall into and do no damage.

When asked by Mr. Schmid what provision was made for taking care of the side stress on the ends of the buckets, the speaker said that the bucket, being made in separate pieces, allows them to ex-

1. A paper, slightly abridged, read before the Ohio Electric Light Association, on August 17, 1904. The turbine described is new and is known as the Warren-Crocker steam turbine.

pand, so that the stress due to centrifngal force will do no damage. The end thrust is taken care of by getting the proper angle on the buckets so that the reaction of the steam takes care of it. There is a pressure of about a pound that is taken care of on the small turbine with a small thrust bearing which runs in oil; on the larger turbines a thrust is employed, made after the pattern of a Trump thrust-bearing, submerged in oil.

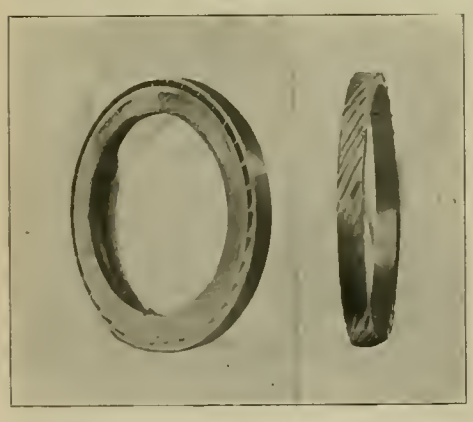
Mr. Schmid asked if the high speed of a turbine was not difficult to adapt on an induction type of alternator, to which the speaker replied that inductor alternators were not used with the turbine. In answer to Mr. Bailey he stated that the peripheral velocity of the 300-kilowatt turbine is about 400 feet per second. The speed of the steam entering the turbine on 150-pound pressure, with a vacuum of 28 inches, was about 4,000 feet; when entering the exhaust was very nearly stationary. The turbine should not be run at 3,600 revolutions per minute. For 25 cycles a slower speed may be obtained by using a different number of disks.

Further information about the new Warren-Crocker turbine is given in the following extract from a letter written by Mr. Crocker to a gentleman who had addressed an inquiry on the subject to the manufacturing company in Sandusky, Ohio:

"We do not build a 125-kilowatt turbine set, but build a 100 and 150. This set we make in 2,300 volts, 60 cycles, and guarantee for 33 1-3 per cent. continuous overload without injury. The efficiency of generator at one-quarter load would be 79 per cent., 87 per cent. at one-half load, 90½ at three-quarter load, and 92 per cent. at full load; at 1¼ load, 90 per cent., and at 1½ load 85 per cent. The speed of this outfit would be 3,600 revolutions per minute; consequently a two-pole machine. Floor space would be about three by 10 feet. It would be shipped all in one piece and weigh about six tons. The turbine running with 150 pounds steam pressure and 28-inch vacuum we would guarantee to give you brake horsepower with 16 pounds of steam and 12 per cent. better results with 150 degrees superheat.

"We would guarantee that the turbine would not use more than two pounds steam more per horsepower at one-quarter load than at full load. The regulation would be two to four per cent., as required. The generator will be so proportioned that with constant separate excitation and 100-per cent. power factor, the load will be varied from full to no load and the voltage will rise approximately eight per cent.

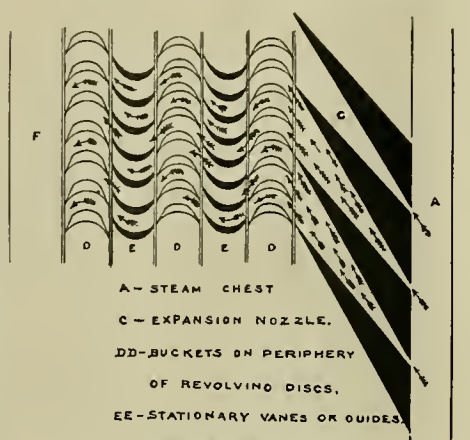
"You will note that the generator, exciter and turbine are all mounted on one substantial sub-base, with a pump to force lubrication of the bearings and the whole outfit complete in every detail. The turbine is built on the principle of expanding steam in a diverging nozzle and in utilizing the steam, as shown in the nozzle diagram. By this method the steam is expanded completely in the first set of nozzles within one or two pounds absolute before being impinged on the first set of buckets. In this manner the velocity of the steam is used before bringing it to a standstill or in any way impeding its progress, except in so far as the buckets extract the velocity as it passes through. To carry part load the expansion in the nozzle is not changed in this turbine, but as the nozzle forms a complete circle all the way round, and there being a large number of nozzles, automatic arrangement is provided whereby any nozzle is cut off as the load drops off, or vice versa, as the load come on. By this method all nozzles that are working are working at full load, the ratio of expansion not being changed either by throttling the steam or in any other way. It might almost be said that by this method there is no part-load deficiency to the turbine; that is, it is at all times practically working at full load; or, in other words, the nozzles that are doing work are working at maximum economy, the rest of them being cut off and thereby causing no loss in the operation of the machine at part load.



Nozzle Ring With Outside Ring Shrunk On. Nozzle Cut Out of the Face of Bronze Ring.

PARTS OF WARREN-CROCKER STEAM TURBINE.

"Our method of getting this control of the nozzle ring is very simple and very interesting. A small steam cylinder with a piston enclosed has steam at full pressure at both sides of the piston. The piston rod is attached to the cut-off ring, with slides against the face of the nozzle having corresponding holes in the nozzle inlets. A valve is provided for use on the exhaust port of the cylinder, this valve being connected directly with the governor stem. Now, if the speed increases one per cent. the exhaust port of the cylinder at one end of the piston is opened, thereby relieving the pressure; the full boiler pressure, being on the other side of the piston, moves the piston, which is directly connected to the cut-off ring, thereby forcing the ring ahead and covering or opening as many of the nozzles as may be required to bring the speed back to its normal point again. This governor is very sensitive and may be adjusted so as to give a regulation anywhere from two to six per cent., as the conditions under which it is to operate may require. The whole turbine is complete in every detail and has very few working parts and no moving parts on the pressure."



NOZZLE DIAGRAM OF WARREN-CROCKER STEAM TURBINE.

Joint Use of Poles by Public-service Companies.[1]

By D. L. Gaskill.

The question of the joint use of poles by public-service companies is one which in the next few years must receive considerable attention from electric-light, telephone, telegraph and street-railway companies.

Under the drastic ruling of our courts in relation to the use of public streets by such companies and the sentiment growing all the time in communities against disfiguring the streets by a multitude of pole lines, the question will have to be considered and met, whether the public-service companies so desire it or not. As long as such companies were limited to one telephone company with one electric-light company, and possibly one line of telegraph wires in a community, the burden imposed upon our streets was not cumbersome, but with two or more telephone companies in nearly every city, with telegraph companies carrying not only wires for their transmission for telegraphy, but also wires for clock service, and with street-railway companies using heavy poles with high and low-tension feeders, together with their own telephone system, the burden of our public highways has reached an extent that will eventually arouse public sentiment to a point that will require some joint action on the part of these companies.

In large cities, where heavy receipts will justify underground construction, the question is easily but expensively solved, but in at least 60 of our 71 cities in the state such construction is impossible, by reason of its high cost to the public-service companies in those cities.

We need not expect to wait very long before there will be some legislation upon this subject, and I feel it is highly desirable that the initiative in such legislation should be taken and the control thereof be kept by the public-service companies themselves. If it is left to the legislator or to the general public to construct this legislation, it is evident, from past experience, that the result will be unsatisfactory in its operation and highly detrimental to the operation of the public-service companies. While I agree that it is desirable to occupy your own poles entirely and be free from the interference of any other company, there is no doubt but that such construction can be made as will permit the joint use of poles.

It is not my purpose at this meeting to take up the question of how such construction should be made or to lay down any rules which should be followed, but I believe that the time has come when this association should appoint a committee to consider this question and formulate, if possible, a series of rules that will protect all public-service companies in the joint use of such property.

I would suggest that the use of the streets by telephone companies be under such restrictions as to require the use of armored cable when over a limited number of wires are installed upon any one street and that the distance between high-tension wires and the poles be specified, together with the distance between the cross-arms of the respective companies.

I would further suggest that the question of the insulation of the high-tension wires at or near these poles be given consideration and that the different companies so occupying the same poles should have their rights and their duties clearly defined by uniform agreement, which would not be subject to misinterpretation and doubt as to liability.

I would recommend that the matter be referred to a special committee, to consider and report to the association at its next annual meeting. This will give time for the preparation of such legislation as is needed should the committee deem that it is advisable to have any enacted covering this subject.

[The author's recommendation for a committee was agreed to by the association.]

1. A paper read before the Ohio Electric Light Association, at Sandusky, O., on August 18, 1904. The author is president of the Greenville (O.) Electric Light and Power Company.

Mutual Insurance Companies Formed by Ohio Electrical Interests.

Prominent electric-railway men of Cleveland and other Northern Ohio cities have incorporated two mutual fire-insurance companies to insure electrical properties. The Electric Mutual Insurance Company will carry electric-light and power plants and the Traction Mutual Insurance Company car barns, cars, warehouses, motors, dwellings and similar property owned by the companies. The incorporators of both companies are the same, as follows: Horace E. Andrews, president of the Cleveland Electric Railway Company; Henry A. Everett, president of the Northern Ohio Traction and Light Company; Luther Allen, president of the Toledo and Western Railway Company; Fred T. Pomeroy, president, and A. E. Akins, vice-president of the Cleveland and Southwestern Traction Company; Warren S. Bicknell, president, and Fred W. Coen, secretary of the Lake Shore Electric Railway Company; Henry J. Davies, secretary of the Cleveland Electric Railway Company; George T. Bishop, receiver of the Eastern Ohio Traction Company; Charles W. Wason, president of the Cleveland, Painesville and Eastern Traction Company, and Henry N. Staats, manager of the factory mutual insurance companies at Cleveland.

Representatives of stock companies say that their experience with car barns, warehouses and cars has been unfortunate, and that they were compelled to increase rates. If these buildings are equipped with sprinklers, however, there will be a great improvement, although they are not certain that fire in the bottom of a car would not gain such headway before giving heat enough to open the sprinkler heads that water would not have much effect. The roofs of cars would also prevent the sprinklers being as effective as they otherwise would be. Electric-light plants and power houses are considered good risks and have been sought by the stock companies.

Henry N. Staats will be the manager and underwriter for the companies, but there is much detail work to be done before they can be put in operation. It is the intention to include a wide scope of territory when they begin business. For the present a permanent organization will not be formed, as it is desired that at least $20,000,000 insurance be secured before business is begun actively. Until permanent officers are chosen the business will be in the hands of five trustees, as follows: H. E. Andrews, H. A. Everett, A. E. Akins, Henry N. Staats and Warren S. Bicknell. Temporary officers will be chosen within a few days.

Technology Club of Syracuse.

The Technology Club of Syracuse was organized at Syracuse, N. Y., on January 6, 1904, with a charter membership of 129, including engineers, architects, analytical chemists, metallurgists and geologists. The object of the organization is the promotion of professional and social intercourse among the members. The headquarters of the club are located at No. 707 Dillaye Building, where rooms have been suitably furnished for library and social purposes. Meetings are held monthly, except during the months of June, July, August and September. The annual election of officers takes place at the October meeting. The following-named officers were elected at the organization meeting: President, Prof. John E. Sweet; first vice-president, Dean William Kent; second vice-president, Henry C. Allen; directors, Edward N. Trump, John H. Barr, Edmund L. French, James A. Randall,; treasurer, Alexander T. Brown; secretary, A. Frederic Witmer.

The club took a trip on June 4th over the Auburn and Syracuse electric railway to Auburn, N. Y., where several large manufacturing plants and the power house of the railway were visited. These visits to manufacturing plants are to be made one of the special features of entertainment and instruction.

Telegraph and Telephone Extensions in Russia.

At the beginning of the present year the sum of 1,900,000 rubles [a ruble is equivalent to 51 cents] was assigned for the development of telegraphy and telephony in Russia. About 1,400,000 rubles was set aside for the construction of new telegraph lines, while 500,000 rubles has been used to meet the growing demand for telephone communication.

The surplus of 700,000 rubles, as compared with the expenditure of the preceding year, was spent for the establishment of telegraphic lines along the Trans-Siberian railroad. There is at present under construction a line from Moscow to the station Mandjouria, via Omsk, and another from the station Oussouri to Vladivostok. Besides joining the stations Mandjouria and Pogranitchnaia, the new telegraph line will be connected with the wires placed on the poles of the East China railroad line. The remainder of the sum, viz., 700,000 rubles, will be used for the extension of the lines already existing.

The loan granted for the development of the telephone service amounts to the sum of 500,000 rubles. Some 200,000 rubles has been set aside for the connection of new subscribers to the telephone circuits owned by the government; 30,000 rubles is for the reorganization of the telephones in the city of Saratof, and 270,000 rubles is for the equipment and the construction of the new lines between Kieff and Odessa and between Tiflis and Bakou. The line between St. Petersburg and Moscow, constructed at a cost of 460,000 rubles, is said to have been very profitable. The cost of construction of the two new lines has been estimated at 790,000 rubles; the work will last two years.

The question of establishing a telephone line between Berlin and Moscow was first raised by the German Department of Posts and Telegraphs, in 1895, while it was considering a general scheme of telephonic communications throughout the whole empire. It was decided at that time to establish in the German territory a line between Berlin and Königsberg, the latter being an important center of administration and commerce and the nearest to the Russian boundary. But in order to complete the project it was necessary to construct on the Russian territory a line passing through the frontier station Eidkunen, of a total length of about 900 kilometers, at a cost of 400,000 rubles. At the time the project was under consideration the demands were not of such an importance as to justify that expenditure and the project was abandoned. It was recently taken up by the administration of the Russian Post Department, which wanted to erect the telephone lines of Berlin-Moscow, Berlin-Warsaw and Berlin-St. Petersburg. However, Moscow, which has already a telephone communication with St. Petersburg, will be put in connection with Berlin by utilizing the lines which will be established between St. Petersburg, Königsberg and Berlin. It would be necessary in that case to construct only one additional line, for Warsaw, which line would have to cross the boundary and be connected to the German telephone circuits.

Municipal Ownership in England.

The recent meeting of the Industrial Freedom League brings into prominence once more the question of municipal trading [municipal ownership] and its effects upon the national industries. As Lord Avebury pointed out, the local indebtedness of the country bids fair, at the present rate of increase, to eclipse the national debt. One of the most extraordinary features of the subject is the confusion of ideas as regards "debt" and "capital" which reigns in the minds of the advocates of municipal trading. For example, our estimable contemporary, the Municipal Journal, commenting upon Lord Avebury's speech, complains that he regards the money spent by a municipal authority as so much "debt." If a company had spent the same sum for a similar purpose, he would call it "capital." Quite so! When one invests one's own money in an undertaking, of course it is capital. But when one pledges one's credit, and invests someone else's money in one's own business, what can that be but debt? Our contemporary goes on to say that the municipal authority is repaying the money every year, and in time every penny will be returned "to the persons from whom it was borrowed." To say that an individual or corporation which has borrowed money is not in debt to that extent is a contradiction in terms. Apparently, municipal finance has a language of its own, as indeed it has a peculiar system of accountancy, unknown in any other commercial circle.—London Electrical Review.

New German Astatic Wattmeter and Frequency Meter.

The accompanying illustration (Fig. 1) shows the construction of a new German electrodynamic instrument suitable for current, pressure and power measurements on both direct and alternating circuit, while the instruments noted in Figs. 2 and 3 is a new German type of frequency meter with 32 reeds.

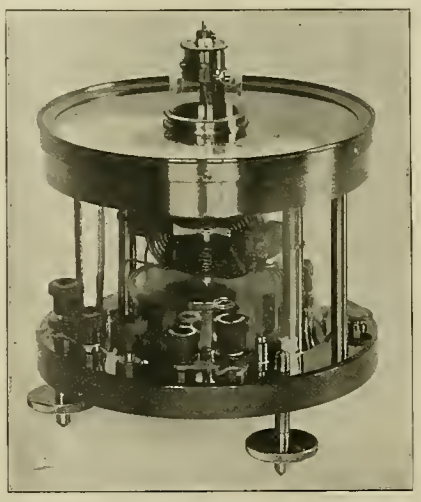


FIG. 1. NEW GERMAN ASTATIC WATTMETER.

In the construction of the wattmeters a moving system of flat oval coils, bent to a peculiar shape, gives a turning moment independent of their position throughout a wide range, and the influence of external magnetic circuits is as far as possible avoided by means of astatic pairs of moving coils. The moving parts are suspended on strong silk fiber, opposed by a flat spiral spring, and the readings of the instruments are unaffected by the periodicity of the circuit, while, owing to the air damping, they are said to be practically dead-beat. The astatic wattmeter noted in Fig. 1 weighs about five kilograms and is direct-reading, with equal scale through the range and for any desired maximum current from one to 25 amperes and pressure from 25 to 200 volts.

The frequency meter indicated in Figs. 2 and 3 is of the Kempf type and is composed of a series of steel reeds which can be set in audible vibration by an audible-current magnet. As the reeds are exactly tuned and mounted to correspond with scale, the frequency, if within the range of the apparatus, can easily be determined by rotating the reeds in front of the magnet; the reed corresponding to the frequency of the circuit will vibrate both visibly and

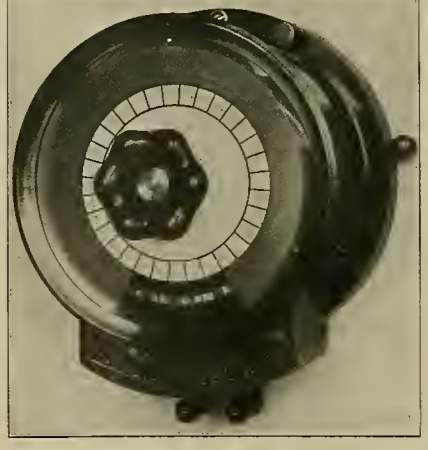


FIG. 2. NEW GERMAN FREQUENCY METER WITH INDICES REMOVED.

audibly, and the attained frequency can be directly read on the pointer of the instrument in periods. The readings are independent of the character of the current curve, and are therefore applicable to intermittent direct current with induction coils and breaks.

The reeds are mounted in a circle, which, by means of the handle, can be turned as required in front of the poles of a laminated magnet. The distance between the poles can be varied so as to include three or five reeds within the gap, the reed in the center, corresponding to the normal frequency, is then quiet, and the vibration of either of the neighboring reeds calls attention to a variation in the frequency. Combined with the instruments is an adjustable resistance for use on circuits from 80 to 130 volts, but it can be arranged for use with lower pressures if required.

A separate series resistance is used for higher pressures. The series of 32 reeds can be arranged to suit any requirements. For instance, from 65 to 96 or from 79 to 110 alternations in steps of one alternation; from 60 to 122 alternations in steps of one period; that is, from two to two alternations; from 59-60-61, 69-70-71, 79-80-81, and then from 88-122 alternations, rising from two to two alternations. The instruments have, so far, been supplied from a minimum range of 12.5 to a maximum of 70 periods, or from 25 to 140 alternations.

In order to determine higher frequencies, such as 280 alternations, it is said to be advisable to use a set of reeds of half the tone value up to 140 alternations and to double the scale value of these by adding a few turns of direct-current winding to the magnet. A current strength of one ampere, from, say, two accumulators, is amply sufficient for this purpose. By these means each instrument can be used for the double value of the scale range, and the entire range of frequencies employed in ordinary alternating-current stations can be dealt with by two instruments with great accuracy, though one instrument would

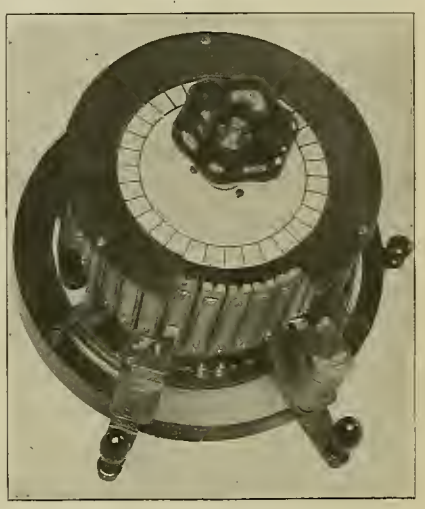


FIG. 3. NEW GERMAN FREQUENCY METER OF KEMPF TYPE.

suffice to cover it if less accuracy be permissible.

The frequency meter noted in Figs. 2 and 3 has 32 reeds for normal pressures of 80 to 130 volts, and its weight is about 7.2 kilograms. P.

The Stone Space-telegraph System.

No less than 36 patents were issued to John S. Stone of Cambridge, Mass., on August 16th, for various methods, apparatus and details of his space-telegraph system. The dates of application range from January 23, 1901, to May 3, 1904. The oldest patent in date of application is assigned to the Stone Telegraph and Telephone Company of Portland, Me. One is unassigned. All the others are assigned to William W. Swan, of Brookline, Mass., as trustee. The following claim from one of the patents seems to give the basic idea of the system: "In a system of space telegraphy a transmitting system comprising a source of electrical energy, an elevated-transmitting-conductor system and a group of circuits, each attuned to the frequency of the electromagnetic waves to be transmitted by said elevated-conductor system, interposed between said source of energy and the elevated-conductor system, the said circuits being connected inductively in series by means of transformers arranged to transform in the same direction and to impress the energy of said source upon the elevated-conductor system at increased potential." An interesting claim relating to selective receiving, in another of the patents, reads as follows: "In a system for receiving the energy of electromagnetic signal-waves of one frequency to the exclusion of the energy of like waves of different frequency, an elevated conductor, an electric translating device, and a resonant circuit or group of resonant circuits, interposed between said elevated conductor and said electric translating device, said resonant circuits being attuned to the frequency of the waves the energy of which is to be received, in combination with a local circuit including in series said electric translating device and an electromagnetic device provided with means mechanically attuned to respond to the group or wave-train frequency of said electromagnetic signal-waves and a source of electrical energy associated with said local circuit."

WESTERN ELECTRICIAN

EVERY SATURDAY.

PUBLICATION OFFICES:
510 Marquette Building, · CHICAGO.
TELEPHONE, MAIN 1746.

Eastern Office, 193 Times Building, New York.
Telephone, 3806J Cortlandt.

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted. This paper is entered at the Chicago postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the **old address** as well as the new should be given.

CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—**the only general electrical paper published in the West**—thoroughly covers a territory *exclusively its own.* THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be furnished on application.

REMITTANCES.—All checks, drafts and other remittances should be made payable to the order of the publishers, the **Electrician Publishing Company,** and addressed to the offices of publication, Suite 510, Marquette Building (204 Dearborn Street), Chicago, Illinois, U. S. A.

CONTENTS OF THIS NUMBER.

Space Telegraphy at the St. Louis Exposition. Illustrated 147
Alternating-Direct Working with Compensated Motors on Ballston Electric Railway. Illustrated..148, 149, 150, 151
The Steam Turbine and Its Uses. By E. C. Crocker. Illustrated. With discussion. (Ohio Electric Light Association) 151, 152
Joint Use of Poles by Public-service Companies. By D. L. Gaskill. (Ohio Electric Light Association).... 152
Mutual Insurance Companies Formed by Ohio Electrical Interests 152
Technology Club of Syracuse 152
Telegraph and Telephone Extensions in Russia..... 153
Municipal Ownership in England..... 153
New German Astatic Wattmeter and Frequency Meter. Illustrated 153
The Stone Space-telegraph System..... 153
Editorial 154
Ohio Electric Light Association. (Annual convention at Sandusky, August 16-18, 1904).....155, 156
President Perkins' Address 155
Attendance 156
Convention Notes 156, 157
The McMurtie Electric Timing Clock..... 157
Gladstone-Lalande Battery. Illustrated..... 157
Knife for Cutting Cable Sheath. Illustrated..... 157
Philadelphia Rapid Transit Plans..... 157
A New Lightning Arrester. Illustrated..... 157
The Telephone in Canada 158
Ohio Telephone Notes 158
Telephone News from the Northwest..... 158
Southeast Kansas Telephone Association..... 158
Independent Telephone Association of the United States. 158
Private Telephone Systems for Government Departments in Washington Suggested 158
Northern Pacific to Use Telephones for Train Orders.. 158
Ohio District Telephone Meetings..... 158
General Telephone News 158
Manufacturers and Dealers 158
Office Methods and Accounting. By Frank W. Frueauff. With discussion. (National Electric Light Association) 159, 160
Homely Advice for the Embryo Engineer 160
Government Report on Space Telegraphy..... 160
"This Wonderful Agent, Electricity"..... 160
Electric Railways in Connecticut..... 160
The Place of the Supply House 160
World's Fair Visitors of Last Week..... 160
Recent Tariff Changes in Mexico and Italy..... 161
Customs Classification of Porcelain Insulators..... 161
Electric-railway Development Along the New York Central 161
A Notable Week at the World's Fair..... 161
Bombay to Have Electric Lights..... 161

DEPARTMENTS.

Correspondence 161, 162, 163
Great Britain 161
New York 161, 162
Dominion of Canada 162
New England 162
Ohio 162
Michigan 162
Southeastern States 162, 163
Northwestern States 163
Pacific Slope 163
Personal 163
Electric Lighting 163
Electric Railways 163, 164
Power Transmission 164
Publications 164
Societies and Schools 164
Space Telegraphy 164
Miscellaneous 164
Trade News 164
Business 164, 165
Illustrated Electrical Patent Record.....165, 166

DATES AHEAD.

Association of Edison Illuminating Companies, Hotel Wentworth, New Castle, N. H., August 30th and 31st.

Minnesota Telephone Association (convention), Minneapolis, August 31st and September 1st.

Northwestern Electrical Association (mid-year meeting), Forest Park University Hotel, St. Louis, Mo., September 12th to 16th.

International Electrical Congress, Coliseum, St. Louis September 12th to 17th.

International Association of Municipal Electricians (annual meeting), St. Louis, September 13th and 14th.

New York State Street Railway Association (annual convention), Butterfield House, Utica, N. Y., September 13th and 14th.

American Electrochemical Society (mid-year meeting), St. Louis, September 13th and 15th.

American Institute of Electrical Engineers (annual convention), St. Louis, September 14th, 15th and 16th.

American Electrotherapeutic Association (annual convention), St. Louis, September 13th to 16th.

National Electrical Contractors' Association (annual convention), St. Louis, September 14th to 16th.

Colorado Electric Light, Power and Railway Association, Colorado Springs, September 21st to 23d.

Independent Telephone Association of the United States (annual convention), Inside Inn, World's Fair grounds, St. Louis, September 21st, 22d and 23d.

Michigan Electric Association (annual meeting), October 11th.

American Street Railway Association (annual meeting), World's Fair grounds, St. Louis, October 12th and 13th.

Kansas Gas, Water and Electric Light Association (annual meeting), Leavenworth, Kan., October 18th and 19th.

AMONG the applications of the alternating current to railway work, the "compensated motor," permitting the use of both direct and alternating current, bids fair to take an important place. This new and highly interesting system is in use on the Ballston line of the Schenectady railway, and last week it was exhibited in operation. An article of some length in this issue gives a careful description of the apparatus and connections, and it is well worth the thoughtful attention of all interested in any branch of railroad work.

VISITORS to the Louisiana Purchase Exposition at St. Louis who are interested in electricity or electrical literature are cordially invited to call at the booth of the Western Electrician, which is in Block 1 (Section 13) of the Palace of Electricity, just west of the main northern entrance to the building. Here will be found copies of the current issue of the paper, bound volumes of the Western Electrician from the first number, a careful selection of electrical books exhibited by the Electrician Publishing Company, and other objects of electrical interest. Chairs are provided for weary sight-seers, and an attendant will extend a hearty welcome to all readers or friends of the paper.

ELECTRICITY is so largely used on the modern warship that naval officers have exhibited some concern lest there be deterioration of the metallic hull and framework from electrolysis. It would seem that by avoiding "grounding" on the hull and by high-class insulation this apprehension would be allayed, but in some quarters the fear continues to exist. In consequence of it the Russian Admiralty has determined on a curious experiment. For reasons beyond its control, the czar's government is rather short on war vessels just at present, and seven torpedo boats are now building for service in the Far East. The Elektritcheski Viestnik—an esteemed contemporary—reports that one of these will be fitted exclusively for oil lighting, while the others will be lighted by electricity. Thus, in a very practical way, an opportunity will be given to observe the alleged deleterious effect of the existence of electric current on shipboard. But the experiment will be rather hard on the officers and crew of the oil-lighted ship. Further, notice of the test should be given to the gentlemanly Japs, that at least one of the electric-lighted boats and the oil-lighted boat be protected, by amicable agreement, from the projectiles of rapid-fire guns, which are even more dangerous than electrolysis.

AFTER the war is over, after the fighting is done, after the censor's effacement, after the last sound of gun, we hope that authentic accounts of just what was accomplished by the use of space telegraphy will be given to the world by the Japanese and Russian officers. We hear that the mikado's admiral in the Korean Straits was informed by wireless messages from Admiral Togo's ships near Port Arthur that the Russian squadron had made a sortie and that it would be well to keep an especially keen lookout on the ocean highway leading to Vladivostok. On several other occasions the dispatches have mentioned instances where apparently the use of space telegraphy has been of the greatest value to the sea forces of Japan. On their side, the Russians seem not to have forgotten that the ether responds as readily to impulses sent by the countrymen of Popoff as to those far-flung by the up-to-date Japs. It is the islanders themselves who make the charge. "Shortly after the investment and isolation of Port Arthur a system of wireless telegraphy was installed between the beleaguered fortress and the Russian consulate at Chefoo. The system is still in operation, notwithstanding the repeated protests of the Japanese government." This is from a public statement given out by the Japanese government in Tokyo on August 20th. The statement is made unequivocally and has not been contradicted. An account of the operation of this system—which apparently the Japanese were unable to break up by their "wireless"—would be most interesting. Private journalistic enterprise, too, has won a signal triumph in the London Times' space-telegraph service, which is said to have been efficient up to a distance of 200 miles. The vexed questions of speed, reliability and interference must have been tried out pretty thoroughly at the seat of war in the rude school of practice, and impartial accounts of the results by competent observers would be of great value.

IT IS a pity that the central-station men of Ohio did not turn out in greater force to attend the electric-light convention in Sandusky last week. The Ohio association stands high among the state associations of the country. Many good papers have been presented to its members, and the meeting of 1904 was no exception in this respect. But the attendance of men actively engaged in the electric-lighting business was far too small. The manufacturers and supply men were well represented. They came to tell of the latest inventions, the newest methods, and in many cases to make interesting exhibits. But the station men, who established the organization and who should receive the greatest good from it, made a poor showing in numbers; the quality of the central-station attendance was excellent. Ohio has at least 150 electric-lighting companies. A dozen of these are large concerns and should send two or more delegates each. But the attendance of central-station men at Sandusky was 30. A "Symposium on Central-station Heating," which should have been an important and timely feature, had to be abandoned altogether, because the gentlemen down on the programme did not appear. This is not a creditable showing, either to the state of Ohio or to the central-station industry. We trust that the downward bend in the load curve of the useful Ohio Electric Light Association is only temporary, and that the record of 1905 may show a towering peak, all the more conspicuous by reason of the depression of this year.

A SPECIAL dispatch to the New York Times from Newark, N. J., dated August 14th last, contains the pleasing intelligence that a telautograph instrument, "a new device for the transmission of messages," has been installed in the offices of an insurance company of Newark, which, no one should need to be told, is the greatest city in a great state. The reporter describes the invention with some care: "The messages are written with an ordinary pencil, to which are attached by a sort of toggle joint two wires of about the thickness of darning needles, and are simultaneously reproduced in ink on a roll of paper attached to a receiver, the reproduced message being a facsimile of the handwriting of the sender." With this guide, the reader can recognize the telautograph whenever it is his good fortune to encounter one.

New Jersey casts an air of distinction on whatever may be found within its borders. Twelve years ago a dispatch similar to that now emanating from Newark would have been interesting under any date-line, for the telautograph was then new. Now the news is important, for Dr. Gray's instrument has at last made its way into New Jersey, which is honor enough for any invention. In describing the telautograph as a new device, the writer meant new to New Jersey, of course. New Jersey is sufficient unto itself. Absolutely new the telautograph is not, for it was publicly exhibited at the World's Fair in Chicago in 1893 and privately shown at Elisha Gray's laboratory in Highland Park a few years before that. Nine or ten years ago the instruments were connected with wires laid under the English Channel, and a great to-do was made over the electrical transmission of handwriting between London and Paris. Now a connection has been effected between the cashier's office and the policy-loan department in a stately building in Newark, N. J. New Jersey is not rash; it does not hurry itself; but when it nods its dignified head it means something. The telautograph will now take on a new lease of life.

OHIO ELECTRIC LIGHT ASSOCIATION.

The tenth annual convention of the Ohio Electric Light Association, held at Sandusky, Ohio, on August 16th, 17th and 18th, added another to the always interesting meetings held by this association. A large number of the older members, from various causes, were unable to attend, but their places were filled, to some extent, by newcomers, while the supply men and manufacturers were out in full force.

J. H. Perkins, general superintendent of the Youngstown Consolidated Gas and Electric Company, elected last year as vice-president, presided over the sessions, the president, S. M. Rust, formerly of the Piqua plant, but now with the Hobart Electric Manufacturing Company of Troy, Ohio, having resigned his office of president upon leaving the ranks of active membership. S. S. C. Ayres, superintendent of the Greenville Electric Light and Power Company, in the absence of Secretary Gaskill, filled his place. Much regret was expressed that Secretary Gaskill, owing to the serious illness of Mrs. Gaskill, was kept away, as his large acquaintance and familiarity with municipal and legislative conditions throughout the state make his presence very valuable, aside from personal considerations of good fellowship.

One interesting and novel feature of the convention, particularly in the minds of some 27 candidates, were the pomp and ceremony attendant upon the "rejuvenation" of the Sons of Jove, the new secret society among electrical men. The first rejuvenation north of Mason and Dixon's line was held at Sandusky during this convention, and was accounted highly successful. Pharaphernalia from the grand lodge was imported for the occasion, and every accessory that would add zest to the initiatory services was called into play. The official roster for the installation of new candidates was Jupiter, Frank Warren; Neptune, W. D. Packard; Pluto, P. R. Boole; Assistant Pluto, W. J. Hanley; Vulcan, Philip Cass; Mercury, E. E. Schmid; Hercules, Clarence A. Delafield; Mars, E. E. Kuhlman; Assistant Mars, J. A. Muir; Apollo, W. W. Lovell; Avrenim, T. Bailey Whipple.

The first session of the convention proper was begun at 2 p. m. on Tuesday, the 16th, the morning being given to registration. The following-named new members were elected: Gallipolis Gas and Electric Company, Mt. Gilead Water, Light, Heat and Power Company, Cardington Electric Light, Heat and Power Company, New Lisbon Gas Company, Delta Electric Light Company, Crestline Illuminating Company, Bellevue Light and Power Company. S. M. Rust and W. J. Hanley were appointed sergeants-at-arms, and C. M. Hart of the Sandusky Gas and Electric Company was made generalissimo of the ladies' entertainment committee. He was assisted by Mrs. H. B. Warren, chairman, Mrs. W. Beupel and the Misses Bernice Warren and Lenhart.

President Perkins' Address.

President Perkins, who has established a reputation as a close student of details looking to greatest economy of operating expense, in his address pleaded for greater attention to the matter of full records of operating data from all departments. Among other things he said:

I wish to make a plea in the interests of better records and further detail knowledge in the operation of electric-light and power properties. To me it seems a subject of greatest importance, not to a few but to all of us, no matter whether you operate a direct or an alternating system, whether you are large or small.

We have argued as to whether there is two or 2½ watts loss in the shunt coil of a meter. We have talked the incandescent lamp down to 3.1 watts per candle, and for lack of further discussion someone suggests that we go back to four watts and begin over. We have discussed transformers until the iron is tired of aging, and there is practically no iron loss left.

I do not say that we should not test and discuss these different classes of apparatus, nor do I think that our time has been wasted in this way. On the other hand, I am a firm believer in the testing and comparison of apparatus. But we have passed with very little attention one of the most important subjects, that of statistics.

In general, very few of us have had figures or records to show the relative effect of different items of expense on the whole; to show whether it was advisable to spend $100 in teaching a fireman how to fire your boilers or to spend the same amount in changing a transformer system.

Without statistics and operating records, it is impossible to know what we are doing and impossible to determine where we can save the largest amount for a given effort, much less can we compare with others to determine whether or not we can better ourselves, and in what direction.

In order to increase or even keep up net earnings we must accomplish one of two things: First, an equitable advance in rates, or, rather, an advance in the average rate per kilowatt received, or, second, we must reduce our operating expenses.

I am not here to discuss the rate question. Fortunately, we have on our programme a paper on this subject; but to raise rates with no reaction is easier said than done.

In years past it was, and I am sorry to say it is at present, to some extent, the common practice for electric-light and power companies to fix their rates by comparison; that is, a manager finds with several companies an average rate of 10 cents per kilowatt and an average cost of coal of $2.25 per ton. He then concludes that, since coal costs him $2 per ton, he should make a rate of nine cents per kilowatt-hour. How absurd such a process of reasoning! The plant or plants from which he has obtained his figures may operate on four pounds of coal per kilowatt-hour and 35 pounds of water per kilowatt-hour, while if he actually knew his own conditions, he might find that he was burning nine pounds of coal per kilowatt-hour and his engine-room efficiency was 60 pounds of water per kilowatt-hour. He puts his reasoning into effect and then wonders why it is so hard to make both ends meet, while the other plants are thriving. He did not look into the matter far enough.

It is absolutely impossible to fix rates for current unless you know how much it costs you to produce that current, and how can you find out except by records? To know how much it costs you it is not only necessary to have a good and well-subdivided system of accounting, but it is necessary to have full record of operating data from every department of your system. If we wish to increase net earnings by decreasing operating expenses, how can it be done except by knowing the efficiency of operation from records of operating data? How would you know where to start in the reductions, or in which direction you could get the largest return for a given effort, if you did not use operating records as a basis? In any event, comparison must be made, either with what we know ought to be good practice or with what someone else is doing under comparable circumstances.

The superintendent of a near-by plant, on being asked how much coal he was using per kilowatt, said nine pounds, and he was evidently satisfied with that figure. On being informed that others were using from four to six under similar circumstances he became more interested and began to investigate and compare. The result was a reduction in his coal bill. He was fortunate in being one among a few who already have such records. He simply lacked the comparison. What could he have done without the records?

Another plant recently concluded, from tests, that they were not working their boilers hard enough to get good efficiency. Figures were made up from every-day records, which gave the pounds of coal per kilowatt-hour and the average rate at which the boilers had been run. The efficiency, for the days taken, was found to vary with the load on the boilers, and the two extreme days in one month revealed a difference in coal economy amounting to $40 per day for this plant. That is, $40 per day could be saved if the boilers had been operated as shown by the best day. This information could not have been obtained except from everyday records.

It is surprising how few operating records the average central station keeps, and it is no wonder how little we sometimes know of what we are doing. A recent investigation of 22 plants in and near Ohio territory for certain operating information revealed the fact that only two of these 22 knew how much coal they were burning per kilowatt, and only three of them kept a record or knew their kilowatt output per day or per month. How can such plants expect to reduce operating expenses in any department if they do not keep even these simple records? Just make a start, and the remainder will come easy. As one superintendent has said, "It is surprising how greedy one becomes when you have a few figures and start in such work. You always want a little more, as conditions reveal themselves."

With some, who have operating information, there seems to be a feeling that there is danger in giving out such information and that it is a stock in trade, but I believe among the companies themselves enough can be given personally to satisfy any of us. Make a start on such a system of records as you think your plant will stand and systematically compare these with what ought to be accomplished. Go to your next-door neighbor and talk it over, but be sure you apply the golden rule and go to him with the understanding that you are to give as well as receive.

Some managers may claim that their situation will not justify the expense. Make a start, and I think you will be convinced that you can do more than you are at present without sacrifice. I think that those who have tried it will bear me out in saying that any investment which they have made has shown a good return.

Tuesday's Papers.

The first paper read was that by Lehman B. Hoit of the Wagner Electric and Manufacturing Company on "A Day Load as a Factor in Central-station Earning Capacity," followed by a brief discussion, participated in by Messrs. Jackson, Kuhlman, Gwynn and Randall.

The paper by S. E. Johanneson of the Westinghouse Electric and Manufacturing Company on "Transformer Testing for Central Stations" was read by Mr. Randall. In the discussion President Perkins asked Mr. Conn of Lynn, Mass., to offer comment. Mr. Ayres and Mr. Gilmartin also made a few remarks.

P. R. Boole of the Electric Appliance Company, Chicago, read a short paper entitled "Relation of the Supply House to the Central Station," which treated the subject in a practical and convincing manner.

H. W. Hillman of the General Electric Company, Schenectady, N. Y., read his paper on "The Relation of Electric Heating Devices to Central Stations." The paper was printed and circulated in the meeting, and was extensively illustrated with cuts of the devices of the class referred to. In connection with the presentation of the paper on this timely subject many of the utensils themselves were on exhibition in the display made by the General Electric Company. An abstract of this paper and of the discussion which followed it will be given in a future issue of the Western Electrician.

Wednesday's Proceedings.

The first paper read was by H. W. Hillman of the General Electric Company, Schenectady, on "The New Luminous Arc Street System." This referred to the magnetite arc lamp. In the discussion following Mr. Hillman explained some points in connection with the details of construction not made plain in his paper.

K. C. Randall of the Westinghouse Electric and Manufacturing Company of Pittsburg followed with his paper on "Notes on Incandescent Street Lighting." The discussion was brief.

E. H. Haughton of the Chicago office of the Bryan-Marsh Company then gave his "Notes on the Incandescent Lamp," which was listened to with interest. In connection therewith the writer called attention to the beautiful exhibit by Mr. W. J. Hammer at the St. Louis Exposition, showing the origin and evolution of the incandescent lamp down to the present time.

The "Symposium on Central-station Heating" which had been arranged, owing to the absence of the participants at this time, was postponed to a later session, and finally altogether abandoned, the speakers not showing up. Messrs. Hayler and Field sent letters of regret and excuse for inability to attend.

T. Bailey Whipple asked if anyone present could state offhand about what the lamp renewals were per thousand per kilowatt-hour in the central stations represented at the meeting. Mr. Haughton answered that he had some data from Mr. Van Ness, with the McMillan interests, to the effect that with lamps at 16 cents each, taking 420 hours as their life to smashing point, renewing every 70 days, the cost of lamps per kilowatt-hour is $0.76; cost of renewing per kilowatt-hour, $0.071. For a 3½-watt lamp, 750 hours to smashing point, 120 days as the period of renewal, cost of lamps per kilowatt-hour is $0.38; cost of renewing per kilowatt-hour is $0.36. Mr. Willcox, the writer continued, of the General Electric Company, advocates the use of a lamp even higher in efficiency than three watts per candle, and that a 3.1-watt per candlelamp at least should be supplied in central-station service. Mr. Van Ness assumes a 3.1-watt lamp to have a life of 420 hours and a 3.5-watt lamp to have a life of 750 hours. His conclusions, Mr. Haughton stated, are based, not on the results of actual practice, but is an estimate, which the speaker thought might be accepted, because of the fact that Mr. Van Ness made the life of a lamp seemingly short, 420 hours being a moderate estimate for 3.1 watts per candle. Mr. Whipple asked if the speaker (Mr. Haughton), when selling to a central-station man a 3.1-watt lamp, would guarantee him more than from 6,300 to 6,500 candle-hours? Mr. Haughton replied that his company guaranteed 8,500 candle-hours on a 3.1-watt lamp of double-filament type, and 7,500 candle-hours on oval-anchor type. Mr. Whipple thought that to guarantee 600 hours life on a 3.1-watt lamp was promising an impossibility, and that lamp people should be more conservative in their guarantees. The discussion became somewhat heated, and was brought to an abrupt conclusion, an adjournment being taken at this time.

The afternoon session of Wednesday was opened by a paper on "The Steam Turbine and Its Use," by E. C. Crocker of the Warren Electric Manufacturing Company, Sandusky, Ohio, which was listened to with close attention, some of the central-station men present having availed themselves of a convenient opportunity between sessions of the convention to inspect the operation of the last constructed turbine at the Warren company's plant. There was an animated discussion of the paper. This paper, with an abstract of the discussion, is given elsewhere in this issue.

Frank Conrad of Pittsburg read a paper on "The Instrument Equipment of a Testing Department." The fine line of instruments of precision on exhibit by the Westinghouse company at this convention was peculiarly appropriate in connection with Mr. Conrad's subject.

"Graded Costs of Electric Supply" was the title of a paper read by M. E. Turner of the Cleveland Electric Illuminating Company, which held the earnest attention of the central-station men. Mr. Turner showed the fallacy of the methods adopted in the past by some central stations in computing their costs. Messrs. Perkins, Dusenberre, Bechtel, Jackson, Ayres and others discussed the paper, and President Perkins congratulated the association on receiving such a valuable contribution to this important subject.

The closing paper of the afternoon was that by G. Brewer Griffin of the Westinghouse Electric and Manufacturing Company, entitled "Points for Consideration When Purchasing Series Alternating-cur-

rent Arc Lamps." This paper will be given in the Western Electrician later.

THURSDAY'S SESSION.

The Thursday morning session closed the convention. At this session a paper was read by W. E. Richards of the Toledo Railway and Light Company, on "Unaccounted-for Current." There was a good discussion.

President Perkins presented for consideration the following question, which had been passed up: "I should like to know of some inexpensive and reliable way of testing a Thomson recording wattmeter without taking it out of service and moving to the testing room or laboratory at the central station." Mr. Bailey suggested that he had seen that pretty well described in some of the manufacturers' literature. Mr. Turner took the ground that meter inspections should not be made on the premises; if the object was to make a cheap test, the testing could be done at less expense in the testing room than on premises; there was greater percentage of error in testing on the premises, and, acceding to every trivial request to test a meter on premises had the effect of destroying confidence in meters, which have now reached such a high degree of accuracy and reliability that they are as accurate or more so than meters for any other form of public service. His experience was that a man at the central-station laboratory could test on an average 25 meters a day, as against eight or 10 on premises, and do it much more satisfactorily, including necessary repairs and adjustments. Inspection bureaus were going around offering to test customers' meters, and if tests are made by the companies at residences or places of business it tends to encourage the belief that such testing is an easy matter, and anybody can do it properly, which is far from the truth. Meters tested at the Cleveland office had been found accurate within two per cent. Mr. Gilmartin asked if a commutator meter in process of being transported to place after testing at central station, would stay in the same condition that it was after the test had been completed at the central station? Mr. Turner thought that, with proper men employed in this branch, the meters would be handled properly and be subject to no difficulties from jar in moving back to premises. Mr. Gilmartin wished to learn whether afterward the meter was inspected to see if it had suffered no harm, and was again properly installed. Mr. Turner replied that the plan they followed was for the man placing it back in position to turn on a small load and see that everything was O. K., and that no condition existed which would prevent its running nicely.

In the absence of Mr. Gaskill, his paper on "Joint Use of Poles by Public-service Companies" was read by Mr. Perkins, and after a discussion of some of the points contained in it in executive session, the recommendation to appoint a special committee was concurred in.

ELECTION OF OFFICERS.

After hearing in executive session reports of officers and special committees, the association elected the following-named officers:

President—M. E. Turner, Cleveland.

Vice-president—F. E. Valentine, Piqua.

Secretary-treasurer—D. L. Gaskill, Greenville.

Advisory committee—D. L. Gaskill, Greenville; Samuel Scovil, Cleveland; E. J. Bechtel, Toledo.

Executive committee—J. H. Perkins, Youngstown; C. M. Hart, Sandusky; J. F. Bendure, Lima; M. C. Hull, Columbus; W. E. Miller, Mt. Gilead.

Finance committee—C. E. Inman, Warren; N. Way, Lisbon; W. P. Engel, Defiance.

The new president, Mr. Turner of the Cleveland Electric Illuminating Company, has been a regular attendant upon the meetings of this association for some years, and has contributed many valuable papers and discussions to its proceedings. His attention has been largely directed to a close study of the details of operating expense and economy, and under his leadership it is expected that this department of the work of the association will receive on its programmes the consideration its importance justly merits. In his speech of acceptance President Turner, after thanking the members for the unexpected compliment paid him, adverted to the valuable work done by the retiring president and by Secretary Gaskill, in whose capable hands most of the detail work of the association must necessarily remain. He congratulated the members upon the evident increase in membership and interest from year to year, and attributed to Mr. Perkins great credit for the way in which he had presided over the present meeting.

A special vote of thanks was extended to ex-President Perkins, and to Secretary Gaskill, the former on motion of Mr. Valentine, the latter on motion of Mr. McKnight.

On motion, also of Mr. McKnight, resolutions of thanks were adopted to the Warren Electric Manufacturing Company, the Sandusky Gas and Electric Company (Mr. C. M. Hart, manager), the ladies' entertainment committee and to the technical and daily press.

THOSE IN ATTENDANCE.

The following-named gentlemen were in attendance representing central stations: Bellevue, G. Cathcart; Bellaire, E. L. Booth; Cleveland, M. E. Turner, J. T. Kermode; Columbus, M. C. Hull; Defiance, W. P. Engel; Delaware, E. F. Gwynn; Delta, C. S. Longnecker; Gallipolis, C. L. Steenbergen; Greenville, S. S. C. Avres; Kenton, Frank Espy; Lima, J. A. Bendure; Lisbon, N. Way; Mt. Gilead, W. E. Miller; Middletown, E. H. McKnight; Mt. Vernon, W. B. Wilkinson; Piqua, F. E. Valentine, Fred. W. C. Bailey; Sandusky, C. M. Hart; Toledo, E. J. Bechtel, John Gilmartin, W. E. Richards, C. N. Jackson; Warren, C. E. Inman, S. F. Messer; Washington, G. N. Clapp; Wauseon, W. F. Hubbell; Youngstown, J. H. Perkins, E. H. Beil; Springfield, Ill., E. G. Schmidt.

Following is a list of supply men and visitors who were at the convention: Banner Electric Company, N. L. Norris, Youngstown, Ohio; F. Bissell Company, Frederick Bissell, E. E. Beam, C. M. Hamilton and V. I. Gray, Toledo; Bryan-Marsh Company, E. H. Haughton, Chicago, and F. W. Godfrey, Cincinnati; Buckeye Electric Company, F. W. Bliss, Cleveland; Bullock Electric Manufacturing Company, F. C. Colwell, Cincinnati, and F. Wharton, Cleveland; Central Electric Company, Allen S. Pearl, Chicago; Cleveland Electrical Supply Company, H. H. Cudmore, Cleveland; Crouse-Hinds Company, Nathan Shute, Cincinnati; Doubleday-Hill Electric Company, Elliott Reynolds, Pittsburg, Pa.; Duncan Electric Manufacturing Company, William H. Sinks, Lafayette, Ind.; Electric Appliance Company, Phillip Cass, Columbus, Perry R. Boole, Chicago; Electric Candy Machine Company; T. G. Goodwyn, Nashville, Tenn.; General Electric Company, W. J. Hanley, H. C. Houck and A. S. Hertz of Cincinnati, H. W. Hillman and F. G. Vaughen of Schenectady, Robert E. Russell; General Incandescent Arc Light Company, H. B. Coles of Cincinnati, and E. E. Schmid of Cleveland; Hobart Electric Manufacturing Company, S. M. Rust, Troy, Ohio; Thomas Emery's Sons, Cincinnati, Louis T. Kaiser; Kuhlman Electric Company, E. Kuhlman, Elkhart, Ind.; W. G. Nagel Electric Company, E. J. Paradis, Toledo, Ohio; National Carbon Company, N. C. Cotabish, Cleveland; Nernst Lamp Company, E. R. Roberts and Max Harris of Pittsburg, J. C. Wright of Cleveland and Charles F. Case of Detroit; New York and Ohio Company, W. D. Packard, Warren, Ohio; Post-Glover Electric Company, Charles S. Kuntz and E. L. Van Winkle, Cincinnati; John A. Roebling's Sons Company, W. W. Affleck and J. W. Brooks, Cleveland; Rumsey Electrical Manufacturing Company, George A. Rumsey, Jr., Philadelphia; Sanderson & Porter, Leo A. Phillips, New York; Sawyer-Man Electric Company, T. H. Bailey Whipple, New York city; Standard Electric Company, G. C. Kuntz, L. T. Milnor and P. J. Williams of Cincinnati; Stanley Electric Manufacturing Company, Thomas F. Clohesey, Cincinnati; Stanley Instrument Company, F. J. Alderson, Great Barrington, Mass.; The Engineer, J. B. Shaw, Jr., Chicago; Wagner Electric Manufacturing Company, Dean Emerson of Cincinnati, and Clarence E. Delafield and L. B. Hoit of St. Louis; Warren Electric Manufacturing Company, H. B. Warren, J. A. Muir, E. C. Crocker, Frank Warren and W. M. Lenhart of Sandusky; Westinghouse Electric and Manufacturing Company, W. W. Lovell, G. B. Dusinberre and E. W. Word of Cleveland. J. W. Schrantz of Cincinnati, Wesley P. Jend of Columbus, R. L. Rathbone of Detroit, R. W. Beebe of Cleveland, G. Brewer Griffin, K. C. Randall and F. Conrad of Pittsburg; Western Electrician, Charles W. Forbrich, Chicago.

CONVENTION NOTES.

F. W. Bliss represented the Buckeye Electric Company of Cleveland.

Allen S. Pearl looked after the Central Electric Company's interests.

Nathan Shute of the Cincinnati office of the Crouse-Hinds Company was on hand.

W. W. Affleck and J. W. Brooks of the Cleveland office of the John A. Roebling's Sons Company, looked after Roebling products.

The Stanley Instrument Company of Great Barrington, Mass., delegated F. J. Alderson to represent it.

N. L. Norris, general manager of the Banner Electric Company of Youngstown, Ohio, was on hand to talk Banner specialties.

The General Incandescent Arc Light Company was represented by H. B. Coles, manager of the Cincinnati office, and E. E. Schmid, assistant manager of the Cleveland office.

E. Kuhlman, the popular transformer man of Elkhart, Ind., and a charter member of the Sons of Jove, a popular fraternal organization, was, of course, on hand to talk Kuhlman transformers.

Perry R. Boole, the popular general sales manager of the Electric Appliance Company, Chicago, and Phillip Cass, Ohio representative, looked after this company's interests with their usual skill.

L. B. Hoit, manager of the Cleveland office of the Wagner Electric Manufacturing Company, C. E. Delafield of the St. Louis office and Dean Emerson looked after the Wagner company's interests.

The Stanley Electric Manufacturing Company was represented by Thomas F. Clohesey, district manager of the Cincinnati office. It was announced that after September 1st Mr. Clohesey would be assistant manager of the western office, with headquarters in Chicago.

An exhibit which attracted wide attention was an electric candymaking machine made by the Electric Candy Machine Company of Nashville, Tenn. This machine spins sugar into candy without the use of water. The sugar is put into a head, which revolves 2,200 times per minute. A high-resistance ribbon is used, which melts the sugar, which is spun into gossamer-like filaments by centrifugal force. The exhibit was in charge of T. G. Goodwyn. These candymaking machines are making a great hit at the St. Louis Exposition.

The Duncan Electric Manufacturing Company of Lafayette, Ind., manufacturer of the well-known Duncan meters, was represented by William H. Sinks. A sample line of meters in a conspicuous location in the convention headquarters, attracted wide attention.

N. C. Cotabish, sales manager of the National Carbon Company of Cleveland, took advantage of the opportunity to renew acquaintance with his many customers and friends. Mr. Cotabish said that his company would shortly place a new battery on the market.

Franklin Wharton, district manager of the Cleveland office of the Bullock Electric Manufacturing Company, and F. C. Colwell, the Cincinnati manager, looked after the Bullock interests. The company's well-known trademark and other literature were everywhere in evidence at the convention headquarters.

The F. Bissell Company of Toledo was ably represented by President Fred Bissell, E. E. Beam, C. M. Hamilton and V. I. Gray. The company exhibited its most important specialties, including Jandus arc lamps, Kuhlman transformers, Cutter arc-lamp pulleys, Chapman voltage regulators and Bissell sign flashers.

E. H. Haughton and F. W. Godfrey (the latter of the Cincinnati district office) looked after the Bryan-Marsh Company's interests. Mr. Haughton's paper on "Incandescent Lamps" was well received. Mr. Haughton also received congratulations from his many friends on his appointment as general manager of the Bryan-Marsh Company, with headquarters in Chicago.

The Nernst Lamp Company was on hand with its usual quota of able representatives. The West House, Sandusky, where the convention was held, was lighted by Nernst lamps, and favorable comment could be heard on all sides. The following-named gentlemen looked after the company's interests: Max Harris, general sales manager; E. R. Roberts, J. C. Wright of the Cleveland office and C. F. Case of the Detroit office.

S. M. Rust, formerly president of the Ohio Electric Light Association, represented the Hobart Electric Manufacturing Company of Troy, Ohio, maker of direct-current dynamos and motors. Mr. Rust was one of the most popular men at the convention, and did much to make Hobart apparatus even better known than it now is. The Hobart company has recently doubled its capacity and is doing a very satisfactory business.

The Warren Electric Manufacturing Company of Sandusky made a host of new friends through its considerate treatment of delegates and visitors. Upon entering the hotel each delegate was given a ticket which entitled him to a yachting cap, a ride on the steamer to Cedar Point, the popular summer resort, and admission to the theater. The company's representatives were indefatigable in looking after the welfare of the delegates, and the attention shown was greatly appreciated by those in attendance at the convention. The Warren company was represented by H. B. Warren, chief engineer; Frank Warren, W. M. Lenhart, auditor, E. C. Crocker, turbine expert, and James A. Muir. It was a matter of regret that President C. C. Warren was unable to be present.

The General Electric Company made a very interesting exhibit. Its line of electric heating and cooking devices, including dining and kitchen tables with the necessary attachments, was carefully inspected. Its mercury arc lamps, operated from a mercury arc rectifier, together with its monochrome mercury lamp, orthochrome lamp and its new luminous arc lamp, attracted wide attention. In the operation of the orthochrome lamp six incandescent lamps are used to act as ballast resistance; also to supply the red rays, which are lacking in all mercury lamps. The company also showed its factory-type mercury lamp. W. J. Hanley was in charge of the exhibit, assisted by H. W. Hillman, R. E. Russell, H. C. Houck and F. G. Vaughen.

The Westinghouse Electric and Manufacturing Company made a most complete exhibit, consisting of its new line of precision and portable instruments, which are designed to excel anything ever brought out in this line. It is claimed that these instruments are the nearest approach to the Kelvin balance made in this country. The company guarantees the calibration of these instruments and will recalibrate them at any time free of charge. The Westinghouse prepayment wattmeter is adjustable for any rate. Before placing this meter on the market the company made a two-year test, during which time 250,000 quarters were dropped into the meter by a boy. The Westinghouse instruments have removable covers. The new Westinghouse alternating-current series arc lamp also attracted wide attention. It is asserted that this lamp has no iron parts, and only a few parts. The company also exhibited its safety coil, having a capacity of one to 12 lights, and applicable to indoor lighting; also its M. P. lightning arrester for alternating or direct current. The following staff representatives were present: G. Brewer Griffin, assistant manager detail and supply sales department; K. C. Randall, electrical engineering department; R. W. Beebe, W. E. Word, W. W. Lovell, J. R. Downs and G. B. Dusinberre of the Cleveland office, and Frank Conrad of the engineering department.

The McMurtie Electric Timing Clock.

A new electric timing device, invented by A. L. McMurtie of Baltimore, Md., was used for the first occasion for the timing of the automobile races at Long Branch, N. J., on August 15th. The McMurtie electric clock is an ingenious arrangement of comparatively simple electromagnetic mechanism, the merit of the machine being in the peculiar sequence of its movements rather than in the utilization of any strictly new device. The whole apparatus is mounted on a board about three feet square. Under the operator's left hand is an ordinary telephone connection, and at the right are five stop-watches in a row in front of a similar number of plungers fitted with hard-rubber heads. The rest of the board is occupied by three relays, the distributing device, a timing key and switches, the necessary batteries being stowed away beneath. The manipulation of a key at the starting point, which may be at any distance from the recording apparatus, so long as a circuit can be established, starts all the watches simultaneously, and any watch, according to prearrangement, can be stopped when the car passes the quarter mile, the half, the kilometer, the three-quarter and the finish, or any other distances that may be selected along the circuit wire, only one circuit being needed for any number of successive observation points. If desired also, 10 watches can be used instead of five, or the board could be arranged for an unlimited number of competitors.

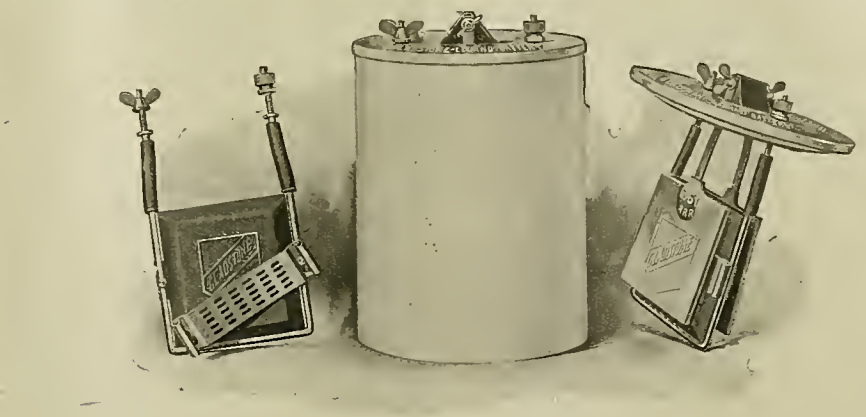
Patents are pending for the distributing apparatus, which, therefore, cannot be described in detail. Enough can be said, however, to demonstrate the ingenuity of the device. The distributor is essentially a brass wheel about 10 inches in diameter, placed horizontally in a small box. The spokes of this wheel, if spokes they may be called, are each pierced with 10 contact holes, into which fit movable brass plugs, and the plugs can be arranged in a great number of possible combinations, according to the number of the observation stations and the number of stop watches. In fact, the application of the principle is limitless if a larger wheel is used. Assuming that the conditions of a race are as indicated above, one of the spokes is fitted with five plugs and the signal from the starting point of the race sends to the distributor an electric impulse which moves the wheel forward, flows through the plugs and starts the watches. It will be seen later that the distributor accomplishes more than this. When the operator at the quarter-mile sees the leading car approaching he presses his key. This key operates the distributing relay on the board and brings forward a second spoke, on which is a plug corresponding with the first watch. This movement of the wheel closes a circuit which operates a second relay and in turn sets the spring of the watch plunger. As the car passes the mark at the quarter-mile the observer lifts his finger from the key and breaks the circuit, which in turn releases the plunger spring and instantaneously stops the watch. The signals are given in the same manner at the other distances. The plungers act with the speed of a rapid photographic-exposure shutter, and the accuracy of its record is only limited by the accuracy of the watch. A third relay is attached to the apparatus and can be used for firing a pistol, so that timing can be accomplished by the older method. When the pistol relay is used it is desirable, though not essential, to have a complete duplicate timing clock at the starting point, the two instruments synchronizing absolutely. With the necessary battery current any number of complete clocks could be installed, not only on the course but even in a distant telegraph or newspaper office. For the Long Branch tests an ordinary telephone circuit was used for the timing signals. The telephone was used for speaking all the time the signals were being given and the results were telephoned back from point to point the instant the watches gave their indications.

An additional attachment to the apparatus is a steel tape, which can be stretched across an automobile track about three inches from the ground. The tape is kept steady by a set of special springs and a movement of one-sixteenth of an inch will cause the tape to close a recording circuit, so that when the tape is used the timing of a race is absolutely automatic as far as the leading car is concerned; but, as at present arranged, the time for the second or any succeeding car can only be taken by resetting the distributor after any particular watch is stopped. In automobile races the time for the leading car is, of course, the most important, and the times of the following cars could be quite easily taken by hand from point to point with independent watches, started simultaneously with the sending of the recording signal.

The McMurtie clock marks a great advance upon the Mors timing clock, the only other electric timer that has so far been used in the United States. The Mors clock is a French invention and was used last year for the automobile races on the Florida beaches. The Mors timer uses only one watch and cannot be worked on a telephone circuit. D. W. W.

Gladstone-Lalande Battery.

The new battery, herewith illustrated, is put forth as an improvement on the original Lalande battery, invented by De Lalande and Chaperon, and of which there are several modifications on the market at the present time. In the Gladstone-Lalande battery the negative electrode is composed of a plate of agglomerated oxide of copper, having its surfaces reduced to the metallic state. This copper oxide plate is carried in a supporting hanger, made of copper rod, formed into a U-shaped frame, the two free ends of which are threaded to receive clamping nuts, by which the hanger is fastened to the porcelain cover of the battery. The supporting hanger is provided with two perforated flat spring copper clamps attached to the opposite sides of the hanger. One of these spring clamps is riveted at each end to the hanger and the other is detachable, having slotted eyelet holes at each end which fit over the two rivet heads on the sides of the hanger, the clamp being locked in position by being pulled slightly in a downward direction. The copper oxide plate is placed in the hanger so that one of its flat surfaces bears against the fixed spring clamp. The detachable spring clamp is then locked to the hanger, as described above, so that it bears against the other flat surface of the oxide plate, which is held firmly between the two spring clamps.



GLADSTONE-LALANDE BATTERY.

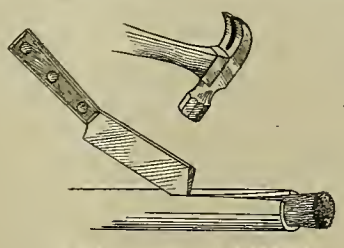
When the battery needs to be recharged the exhausted oxide of copper plate can be removed from the hanger and a new one substituted with the least possible loss of time and without soiling the fingers. The wide surfaces of contact presented by the perforated spring clamps render it unnecessary for any cleaning or sandpapering of these parts when recharging.

The positive electrode consists in all cases of two flat plates, composed of an alloy of zinc and mercury, which are suspended from the cover. In some models these flat zinc plates are cast on an inverted U-shaped hanger having a threaded extension which passes through a hole in the cover, to which it is clamped by a suitable nut. In other models (as shown in the illustration) the two zinc plates are cast on separate stems, having a hole at the upper extremity, which allows them to be bolted to the projecting knob on the top of the cover, which is provided with a horizontal hole to receive a threaded bolt for this purpose.

The electrolyte in all cases is a 20-per cent. solution of the highest grade of caustic soda and a layer of pure mineral oil is poured on the top to prevent evaporation and creeping. These batteries are manufactured by the Battery Supplies Company, Avon and Jeliff Avenues, Newark, N. J., the proprietor of which, J. W. Gladstone, is the inventor.

Knife for Cutting Cable Sheath.

The cable-sheath-cutting knife shown in the accompanying illustration is a brand new thing on the market and fills a want not heretofore supplied. Its general practicability and simplicity of operation will appeal strongly to telephone men and all those who have to do with the laying of cables, in which the cutting of the sheath is so often an important item. This simple little instrument does the work quickly and neatly. The picture shows how the knife is to be used and tells practically the whole story. The device was designed by the F. Bissell Company, 226-230 Huron Street, Toledo, Ohio, which is now ready to place the knife on the market.



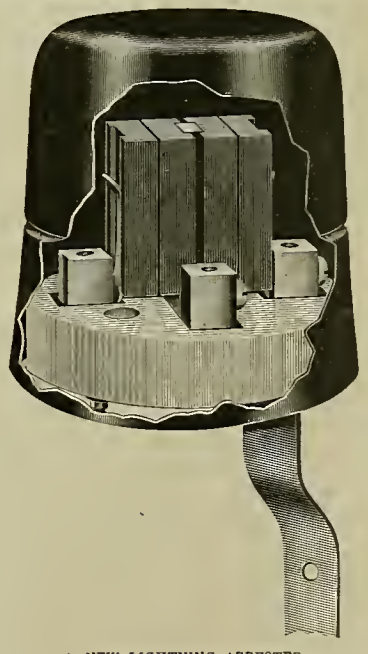
KNIFE FOR CUTTING CABLE SHEATH.

Philadelphia Rapid Transit Plans.

The plan of the Philadelphia Rapid Transit Company to issue six tickets for 25 cents on and after September 1st, as announced some time ago, has been practically abandoned, nothing in that direction being done at the recent meeting of the directors. It was stated that the scheme had met with considerable opposition from the public and that there would be considerable of a muddle in the abolition of the exchange system. The report of the president showed an increase of 2,000,000 in the number of passengers over the previous year; the total receipts were $16,000,000. The work on the subway and extension was reported to be progressing satisfactorily. The subway, it was estimated, would be completed to Sixteenth Street by next spring, at which time the bridge annex will also be completed. President Parsons further reported that with the completion of the subway from the Schuylkill River to Sixteenth Street it was planned to have the elevated railroad west of the Schuylkill River ready for business. The construction work on the elevated road will be begun within the next 60 days; the contracts for the material have all been placed.

A New Lightning Arrester.

A new lightning arrester, known as "No. 402," has been placed on the market by the American Electric Fuse Company of Chicago. It is designed to be used out of doors, especially on the outside of a house or upon a pole where the subscriber's line drops off. It can be used all along a toll line, placed at intervals of a half mile, or at the points of transposition. The arrester, illustrated herewith, is equipped with a fuse, but is a lightning arrester altogether. Between the carbons there is an air space 0.010 of an inch wide. The dielectric is so arranged and constructed that the carbon dust, caused by lightning discharges, falls out easily at the bottom of the carbons.



A NEW LIGHTNING ARRESTER.

The block has three binding posts, two for line and one for ground, and when the lines are connected up the carbons are looped in on the line. These binding posts are hollow; the wires pass from the bottom and are then fastened with screws. The block is mounted on a porcelain base and put together very strongly. It is a very serviceable arrester and has a galvanized-iron hood that protects the entire block, the block being supported by a galvanized-iron brace. This protector can be used on any kind of a telephone line.

The Telephone in Canada.

The Ontario Independent Telephone Company has applied to the council of Walkerville, Ont., for a franchise, and as the Bell telephone franchise there expires in November next, a warm fight is anticipated. The Independent company is seeking to have a service in Windsor, Walkerville and Sandwich. It will give connections with the co-operative company in Detroit, Mich.

A representative of a telephone manufacturing company in Chicago has been in Windsor, Ont., looking for a Canadian site for a factory. He says that a factory for the manufacture of all kinds of telephone supplies will be erected in the city of Windsor within a short time, and that the company will employ 150 hands at the outset. The factory will be run in connection with the Ontario Independent Telephone Company which is bidding for franchises in Canadian cities and towns. The Bell company has an exclusive franchise in Windsor which has yet two years to run, but the Independent company will contest the right for an exclusive franchise.

The financial committee of the City Council of Kingston, Ont., has set aside a proposal to grant a five-year telephone franchise to the Bell Telephone Company on terms of $30 for office and $25 for house telephones, under the improved system, and to pay the city $700 per annum. The committee's counter proposal was $25 for office and $20 for house telephones, fitted with the all-metallic system; for two-party lines $18 each; three or more, $15 each; the franchise to run for five years. The company, it is said, has refused the offer, and the Independent Telephone Company is in the field with a proposal.

There are now 14,700 telephones in use in the city of Montreal, as shown by the new telephone books just being issued to subscribers of the Bell Telephone Company. The increase of subscribers over last year was 500, and the increase the year previous was 600, thus indicating that the demand is steadily growing. With the big gain that Montreal has made, that city has now about 4,000 more telephones in operation than Toronto.

A new phase in the fight against the Bell Telephone Company in the city of Brantford, Ont., may give an entirely new turn to the ultimate outcome. The Independent Telephone Company, doing business in the United States and some parts of Ontario, is ready to compete with the Bell in Brantford. If given a competitive franchise this company will give business telephones for $25 a year and residence telephones for $15 a year, with party lines of four for $12 each. It will also give the city a number of free telephones and $200 a year. There will be a full-metallic circuit, with a copper-metallic circuit for the business houses. The central energy system will be in use. The wires will be underground in the main streets, with one duct provided for municipal electric-light or fire-alarm wires. W.

Ohio Telephone Notes.

The Central Union Telephone Company is placing a switchboard and toll stations at the state fair grounds at Columbus. Either of the local stations may be called up, or long-distance lines used from these stations. The lines will also connect with the police station and emergency hospital.

The City and Suburban Telephone Company of Cincinnati has reduced the rate from 15 to 10 cents from that city to a number of points in the southwestern corner of the state.

The switchboard of the Stark County Telephone Company at Alliance was burned out a few days ago by wires coming in contact with a trolley wire. This makes the second time this accident has happened within a short time.

Miss Nannia Francis, chief operator of the Citizens' Telephone Company at Fostoria, received 550 volts from a trolley wire a few days ago. While moving an electric fan on her desk her hand came in contact with a wire that had been charged. Two fingers were burned to the bone and several others badly injured. C.

Telephone News from the Northwest.

The council of Anoka, Minn., has refused admission to the city for the wires of the Consolidated Telephone and Telegraph Company. Only a toll station was proposed, but the council took the position that it will be followed by a request for a local exchange. It is stated that the company will put in a station regardless of the council's action.

The Farmers' and Citizens' Mutual Telephone Company is installing a local exchange at Springfield, Minn.

It is reported that there is a merger to be made of the new Independent telephone exchange at Yankton, S. D., the new Citizens' exchange at Sioux Falls, S. D., the Independent at Sioux City, Iowa, the Bruce lines and the Ward lines, also several smaller lines between these towns. The new company will build telephone lines to Mitchell, Aberdeen, Watertown, Brookings and other towns.

The Ridgeway, Jonesdale and Hollandale Telephone Company of Hollandale, Wis., has been incorporated with $2,000 capital.

George Kelson and Albert Jasperson of Tyler, Minn., propose a telephone system for Ivanhoe, Minn., with connections with Wilno, Arco, Hendricks and Minnesota.

The Nicollet County Telephone Company and the St. Peter (Minn.) Telephone Company are to be consolidated and placed under one management, the former purchasing the latter. The system is to be enlarged and extended.

The application for a temporary injunction against the Farmers and Merchants' Telephone Company at Shakopee, Minn., by a competitor was withdrawn upon coming to a hearing, and the request for the permanent injunction will be heard in October. In the meantime the new company is hurrying work to get its system completed.

The Tri-state Telephone and Telegraph Company has awarded a contract for the erection of a central building at Grand Forks, N. D.

The Manning (Iowa) Telephone Company has been incorporated with a capital of $21,000. W. B. Swaney is president and P. Zerwas secretary.

The Farmers' Mutual Telephone Company of Johnson County, Iowa, has increased its capital stock from $4,500 to $9,000.

The Hahne Telephone Company of Turin, Iowa, has been incorporated.

The Mitchellville (Iowa) Telephone Company has increased its capital from $10,000 to $25,000. R.

Southeast Kansas Telephone Association.

The second convention of the Southeast Kansas Telephone Association was held in Galena, Kan., on August 17th. There were members present from all quarters of the territory covered by the association, which comprises Chautauqua, Wilson, Montgomery, Neosho, Labette, Crawford and Cherokee Counties in Kansas, and Indian Territory. Among those present were E. W. Dow of Baxter Springs, G. H. Spangler of Chetopa, Fred H. Brown of Parsons, John Rings of Oswego, Harry Farris and P. J. Sheppard of Chicago, G. W. Cooper of St. Louis, J. K. Williams of Galena, L. C. Adams of Cedarville, James A. Plotner of Kansas City and M. L. Robeson of Galena.

The adjustment of the toll-line service rates and difficulties associated with that department of the business formed the chief topics of discussion. It seems a double rate has existed and the meeting was for the purpose of making rates equitable and harmonious throughout Southeast Kansas and Indian Territory. The operators came to an agreement on most points of difference. The officers of the organization are: President, G. H. Spangler of Chetopa; vice-president, E. W. Dow of Baxter Springs; secretary and treasurer, M. L. Robeson of Galena.

Independent Telephone Association of the United States.

This year's annual convention of the Independent Telephone Association of the United States will be held in St. Louis, on September 21st to 23d. Headquarters will be at the Inside Inn, located within the grounds of the World's Fair, and the meetings will be in the assembly room of the hotel. There will be a number of addresses on interesting subjects by representative men, but the main feature is to be a free and open discussion and general exoression of opinion upon the future of Independent telephony. The convention is to be a sort of primary to consider the interest of the movement as a whole.

Reservations on the European plan for 500 delegates have been made by the secretary at the Inside Inn at rates ranging from $1.50 to $3.50 a day (admission fee to the exposition of 50 cents a day included). Frank G. Jones, 50 West Jackson Boulevard, Chicago, is the secretary of the association.

Private Telephone System for Government Departments in Washington Suggested.

The advisability of the government installing its own telephone system in Washington, D. C., was discussed at a recent Cabinet meeting. Within the last few days contract blanks have been presented by the local telephone company to the heads of the government departments, and these blanks fix the charges at a considerably higher figure than has been charged in the past. In view of this proposed raise in rates some of the officials think it would be cheaper for the government to construct and operate an interdepartment telephone system. The matter, it is said, has been placed in the hands of Secretary Morton for investigation.

Northern Pacific to Use Telephone for Train Orders.

It is reported from St. Paul, Minn., that the Northern Pacific Railroad Company is preparing to place the telephone in general use on its system for the transaction of the railroad business and for the operation of trains. During the last two years the company has subjected the telephone to severe use for the purpose of giving a complete test in several places upon the system with such success that it has now been decided to use the telephone for the main line between St. Paul and Portland, Ore. The telegraph will also be used as a secondary means of communication.

Ohio District Telephone Meetings.

Sixty-five officers of telephone companies attended the first meeting of District No. 1 of the Ohio Independent Telephone Association at the Euclid Hotel in Cleveland on Tuesday of last week. Vice-president J. B. Hoge presided. In his address he outlined the plan adopted by the state association and said that this can be extended to the entire United States if it meets with the approval of the telephone men generally. One of the main points brought out at the meeting was the necessity of standardizing the equipment of telephone companies in order to render interchange of service more easy. It is said that in no other public utility is there such a diversity of equipment as in the telephone business. Methods of conducting the business generally were discussed with the idea of securing a general standardization of management and accounts. The meeting was an interesting one, as it brought out a number of good ideas. The subjects of general interest that are brought up at these meetings will be taken to the state associaion for discussion and decision. The point is to have the Independent companies of the United States operate as a unit. C. O. Norton of the United States Telephone Company was chosen secretary of the district organization.

The meeting of the seventh district took place at Lima. Vice-president George H. Matheany presided and D. A. Clark of St. Marys was chosen district secretary. The subjects discussed at this and the district meetings held at Toledo were much the same as at Cleveland.

GENERAL TELEPHONE NEWS.

It is reported from Utica, N. Y., that a movement is on foot to merge the Independent telephone companies in Central New York under the name of the New York Independent Telephone Company.

The moving of a barn and the cutting of a telephone cable has brought on a fight between the city of Hillsdale, Mich., and the Michigan State Telephone Company. It is said that Mayor Goodrich gave permission to cut the wires upon the refusal of Manager Farnum of the telephone company to raise the cable.

The fight between the Michigan State Telephone Company and the Union (Independent) Telephone Company at Owosso, Mich., continues. Alderman C. E. Rigley succeeded in having the telephones of the Union company taken out of the city offices and Bell telephones installed, but the council has voted to have the companies put on an equal footing, by submitting bids for telephone service. A number of rich citizens are stockholders in the Union company and they are using every effort to down the Bell interests.

MANUFACTURERS AND DEALERS.

The Stromberg-Carlson Telephone Manufacturing Company of Rochester, N. Y., and Chicago has recently closed contracts for switchboards with the Pfister Vogel Leather Company, Milwaukee, Wis.; Davis & Means, Delmar, Iowa; Fayette County Telephone Company, Fayetteville, Texas, and the Shelby Telephone Company, Shelby, Mo.

The International Telephone Manufacturing Company of Chicago is reported as having an exceptionally good demand for this time of the year for its small village-exchange and rural party-line apparatus, having recently secured, outside of its regular trade, contracts for equipment for Holdrege, Neb.; South McAlester, I. T.; Fayetteville, Winamac and Grass Creek, Ind.; Pierre, S. D.; Svea, Minn.; Malvern and Tabor, Iowa; Baldwin, Kan.; Devine, Tex., and Hartland, N. B.

The Eureka Electric Company of Chicago and Genoa, Ill., has now in press (ready for distribution on September 1st) a telephone work containing valuable information, statistics and data for telephone men. The book is entitled "Independent Telephone Practice," and was compiled by Mr. I. J. Kusel and Mr. A. E. Dobbs, two well-known telephone men in the Independent field. The work will be distributed by the Eureka Electric Company and will be sent upon application.

An excellent illustrated description of the well-known Leich four-party selective telephone system is given in a booklet recently published by the American Electric Telephone Company of Chicago. It is asserted that this is the only four-party line system that can operate without springs for the governing and operation of the bells, and, further, that it is the only four-party system in which it is possible to put condensers in the circuit, which can be operated at ordinary safe voltages. The company has recently received a contract to furnish for East Liverpool, O., a large central-energy board, together with a complete supply of selective telephones, and this switchboard for East Liverpool has one four-party selective key in every cord circuit. All the central-energy switchboards recently furnished by the company are thus provided with four-party keys in every cord circuit, and the saving occasioned thereby is said to give excellent results. A few of the recent installations of this kind are at Ft. Worth, Tex.; Kewanee, Ill., and Ann Arbor, Mich. The four-party telephone situation has become so urgent that the booklet referred to should be of general interest.

Office Methods and Accounting.[1]

By Frank W. Frueauff.

To cover this subject properly one must consider office methods and accounting to embrace all the records and reports used in each department of the business, as from these records and reports all the final results are obtained.

The writer believes that to an incomplete system of records, or to a loose handling of a good system, much of the trouble of management, many of the complaints of consumers and the public, and the failure to secure satisfactory earnings may be traced. The company loses much in not securing the best efforts of its employes through failure to know just what they are accomplishing, and can make many savings in operation and great increase in its profitable business by knowing through complete accounting records the cost of results secured in each department and from each class of service. The failure to go into the accounting end of the business to a minute degree has resulted in many companies not knowing where they were drifting in the matter of taking on of new business and has kept them in the dark where an accurate statement of operating results would show an opportunity to make a big saving by some slight expenditure in the proper place.

I shall make no attempt to go over the systems in use in each department, but will attempt to show briefly some of the newer methods employed and the benefits from them.

The lighting companies throughout the country are all making an effort to increase their sales of current either to present users or new consumers, or by taking on business that was formerly done by isolated plants or other forms of power. These conditions have necessitated a much closer study of costs and receipts and have resulted in a much finer separation of the items entering into the cost of production for any particular class of current or for consumers using service in an unusual way. The usual method of grouping all expenses under the three arbitrary heads of manufacturing, distribution and general expenses, and making separation under them for different subdivisions desired, has only given average costs and must therefore be misleading for purposes of figuring for new business to be secured or for analyzing present results in order to know the profitable from the unprofitable business.

The plan of apportioning the costs of operation to the class of current made and of separating fixed and variable costs has therefore come to be a necessary part of a company's report of operations. This plan is now in operation among a number of companies with marked success.

The expenses occasioned in manufacturing and distribution for any one class of current are kept distinct from those incurred in another, so that the actual cost of manufacturing and delivering arc, power or alternating current is known, separately. These costs for any one class are also separated to show the costs that are fixed as distinct from those that are variable. For example, station foreman, meter department, shop expenses, etc., are practically a fixed expense; that is, they are an expense resulting from the size and running of an electric business, and do not noticeably vary as the business may increase or decrease. Some expenses depend upon the amount of current made and sold; that is, they vary with the output. For example, boiler fuel, firemen, lamp renewals, carbons, and so on. A third class of expenses is made up of those that vary with the number of consumers supplied or number of meters in use. Under this head may be included meter repairs, arc-lamp repairs, service repairs, meter-reading expense, collection and office salaries.

With the cost of current for any class of current separated into these three divisions it is possible to know just what results are being obtained. You may then know whether or not your output expenses are increasing at a greater rate than the output, and if the expenses proportioned to consumer are increasing faster than the number of consumers. In figuring rates to be made to secure new business this plan of separating costs is particularly valuable. For example, in figuring to take on a long-hour burning consumer you know from the figures of costs that the fixed costs will not be materially increased, nor will the consumer expenses, and that only the output cost will be increased. You may therefore assume that this business can be secured at a very low figure and still show a much larger margin of profit than business that will add to your expenses of capacity or consumers while only showing a small amount of current used.

Complaints.—The electric companies are now realizing as never before that a satisfied consumer is one of their best assets. To make or hold these satisfied consumers requires constant and careful watching. A department of the business is established where these complaints are received and adjusted. They must be systematically followed up or great dissatisfaction will result. One plan in use is to record all complaints as received, showing the date, name, address, time complaint was received and nature of complaint. From this record typewritten orders in duplicate are made on a three-by-five slip, the original being sent to the inspection department immediately and the duplicate being held to insure the return of the original. The order is given to an inspector, who attends to complaint as carefully as possible. He notes on the order the result of his investigation and signs it, when it is returned to the order or complaint department. The date of execution and name of man is entered on the record and the duplicate taken from the pack of outstanding orders. A reply postal card is then made out from the order, stating that complaint had been made of certain trouble and asking if our inspector had attended to it satisfactorily, these cards being sent in answer to all complaints. The reply cards do not all come back, but we are sure that if the investigation or work has not been satisfactory the consumer will be sure to reply. If an unfavorable reply is received an order is sent to the inspection department calling attention to unfavorable report, and when work is again completed another reply card is sent. The original order is then sent to the filing room, where all orders of every class are filed by dates under the street number, this file being used for reference from time to time and giving a complete history of all work done by the company at any house connected to our system.

A daily report is made from the order record, showing the number of complaints received, separated by classes, and showing the number of each class for same day of previous year and the accumulative number received during the past month. This report is sent to the general manager each day and enables him to keep in touch with the troubles coming up. At the close of each month a statement is prepared showing the number of complaints handled by each inspector and the number from which "unsatisfactory" reports were received on the reply cards, also showing the per cent. of satisfactory work done. This report, after being inspected and signed by the general manager, is posted in the inspection department where all men can see it. This plan of compiling the efficiency of the men has a splendid effect in stimulating them to careful and thorough work on all orders, and means a saving of time and money to the company and better feeling on the part of the public.

Bureau of Information.—A new departure in the office is the establishment of a "bureau of information." This bureau is located in the most conspicuous point in the office and is in charge of a clerk thoroughly posted on all general matters of the company. His duties are to direct any and all inquirers to their desired point, such as application window, teller's window, manager's office, appliance department, etc. He has charge of the list of desirable vacant houses in the city, and upon request directs the inquirer to the real-estate agent who has the property in charge. This list of houses includes only those along the company's lines or mains and only those that are equipped to use the company's service. By this plan we are able to get newcomers to the city, or those intending to move, to occupy houses where we can supply them without further investment. The list is revised each day by reports made from the soliciting and application departments of houses connected and disconnected. In connection with the bureau of information, bulletin boards have been placed at each plant, shop and department of the company. Upon these boards any announcements of changes of regulations, special inducements, information of particular importance to employes and copies of all new advertising matter being sent out are posted in order that the employes in every branch of the business may be kept in touch with what is going on, and may be in position to talk intelligently if questioned when attending to their duties or after hours.

Meter Reading.—One of the most important requirements for satisfactory relations with consumers is the necessity for accurate meter reading and billing. The coupon system of meter-reading cards, originated by Mr. S. J. Glass, seems to be the best and safest method in use. Under his plan a slip with 12 coupons attached is made for each meter; each coupon bears an identifying number, corresponding with the account on the consumer's ledger. After the meter has been read and bill made the coupon used is detached and filed for reference. The meter reader then has only the meter number and house number to direct him when he next takes the reading. By this plan no readings can be averaged or readings put down without actually seeing the meter, and as the man has no previous reading to assist him, he must use unusual care to get the correct figures.

By keeping the same men reading each month and throughout the month and not picking up extra men each month to take statements a considerable saving can be made, as men familiar with the routes can make much faster time and will not have to go back to get meters skipped or read wrong on the first trip. The plan of posting a list of all mistakes made by the meter readers will also increase the efficiency of this department. At the close of each month a list is posted in the department showing the number of meters read by each man and the number of errors discovered. A bonus is paid to each man who makes no mistakes during the month. One month's records show 13 men read 32,000 meters with a total of but eight errors made by all these men.

Office Mistakes.—The plan of recording and then posting a list of all errors made by the consumers' bookkeepers is followed. In this list appear any errors or omissions made by them, including errors in extensions or calculations, failure to send bill to proper address, omission of balance owed for previous period, and so forth. This posted list has the same stimulating effect as the lists of errors made by the meter readers and trouble-men.

In the general office a Dey registering time clock is used. All office employes are required to register as they come into and leave the office. From this record the office time is kept. We find it of particular value in impressing promptness upon all employes; and as clerks are on duty from 7 a. m. to midnight, it is possible to know the time they arrive and leave without requiring the chief clerk or a timekeeper to note their movements. A list is posted each morning of any who have registered late in arriving or who have overstayed the hour off for lunch. At the close of each month a list is made of those who have been prompt and punctual throughout the month.

Card Records.—The use of card index records in offices is constantly growing and is satisfactory for most purposes. We are now using a house record index in our application and order department. A card was made for each house connected, and as orders were taken to connect, disconnect, or change meter, arc lamp, etc., a posting to this effect was made on the house card; after the order had been executed the date of execution was entered on the card, so that we constantly have a record of our standing at each house. This has done away with all duplicate or wrong orders. Under the old plan of listing orders in a book or books we frequently send men to re-read meters for a new tenant when we had just ordered the meter returned on instructions from the old occupant; but with the house card to refer to before sending order to shop for execution, a wrong order is detected and a new one submitted to cover the latest development, or the order previously sent out is ordered recalled.

Visible-writing typewriters with card-holder attachments are used on all orders of every description. We find by their use fewer errors in copying or reading addresses and that names of consumers, being more legible than when written by hand, are correctly carried through the records and to the addressing machine.

The filing cabinet referred to before is also a feature in the card system. A guide card is placed for each street and number, and back of it are filed all completed orders for setting or removing of meters, complaints, connections of appliances, etc. If it is desired to refer to any original order, it is readily located by this plan.

For the record of stock of materials carried, a loose-leaf system is in use. One sheet is arranged for each article, showing amount on hand and received in one column, the amounts sent out in another, and a column to show the running balance of materials on hand. This record is kept to show both the quantity and value of each article in stock, and is kept up each day from the storekeeper's reports of materials received and sent out.

Accumulative Reports.—After the monthly report is complete the records therein shown are transferred to loose-leaf sheets containing columns for every item on the report; these figures are carried on an accumulative basis and always show the results for the last 12 months, this being done by adding or deducting the difference between the last month and the corresponding month last year from the previous yearly total. These accumulative figures show much more clearly any real increase or decrease, and are not misleading, as the results for any one month might be. From these accumulative sheets a year's report can be made without any trouble or delay.

Receipting Machine.—We use a Boettscher & Knecht machine in the teller's cage for receipting all bills. This machine is driven by an electric motor. The bill is placed in front of the machine by the teller, who then touches a spring; this releases the lock and sets the machine in motion, the bill is drawn under the roller, the coupon cut off and dated and dropped in a drawer below and the receipted bill forced out to the front of the window, where it may be picked up by the consumer.

Adding Machine.—We are now using an adding machine made by the Universal Adding Machine Company of St. Louis, which has an electric-driving attachment. Instead of pulling down a lever, as with the usual adding machine, a spring is touched which sets the machine in motion and performs the same office as the lever.

Self-adding Sheets.—These sheets are a simple arrangement used in tabulating results, such as number of meters or consumers gained or lost, and so forth. The sheets are ruled for units and every tenth space is so marked. When all marks are down the number of vertical spaces times the number of horizontal spaces used shows the total desired.

Slide Rule.—The slide rule frequently used in engineering work can be made to play an important part in modern office methods. Clerks can be easily instructed in its use and calculations requiring multiplication or division worked out in much less time than by the old methods.

The Thatcher Calculator.—This machine, made by the Keuffel & Esser Company of New York, we have found the greatest labor saver yet tried. All costs and receipts are worked out on the reports on a basis of current made or sold. With several hundred separations, it will require a couple of days' time to do the division required. By the use of the calculator the results may be set down as fast as one can read the numbers on the machine. This machine is unique in construction and easily understood. Where a constant multiplier or divisor is used the results are shown more quickly than with any of the other calculating machines. This feature therefore makes it particularly valuable in use on monthly reports.

Tube System.—A tube system, such as is used in

1. Abstract of a report presented to the National Electric Light Association at Boston on May 26, 1904. The author is connected with the Denver Gas and Electric Company.

department stores, has been of great benefit to us. We have connection at all windows in the accounting office direct with the bookkeeping and collection rooms. If a copy of a bill is desired or explanation required, the detail can be secured in much less time than by going to consult the books and leaving the consumer waiting. We are able to do all bookkeeping work on another floor of the building, which is away from all the disturbance of the public office. We find that by this plan our bookkeepers are able to handle more accounts and with fewer interruptions.

Tabulating Machine.—We are installing a Hollreith electric tabulating machine. This machine is now in successful operation in a number of railway accounting offices, in some large factories, and was used by the United States Census Bureau in compiling its statistics. The equipment consists of two parts. The punch, into which properly printed cards are set, transfers the information by punching a hole in the proper space. When all information has been transferred to the punched cards they are set in the tabulating machine, which sorts them into several kinds and then compiles the information. It is our intention to use this machine to tabulate our records of all consumers, to show the possibilities of each class of business, and to use it in making up the payrolls. Use will also be made of it in our engineering department in keeping track of our current made, sold and lost, of the various types and efficiencies of transformers and meters.

Discussion.

Paul Doty, St. Paul: I desire to say for the benefit of the association that Mr. Frueauff has described a very complete and modern method of keeping office work and office accounting. His system is practically the Denver system, and, as most of you gentlemen know, some good things come out of Denver. It represents a great deal of careful work on Mr. Frueauff's part, and I am sure the association is indebted to him for his care in the presentation of this report.

A. S. Knight, Boston: I am very sorry Mr. Frueauff is not here, because I am afraid in his absence the discussion will not be especially profitable. I was anxious to ask him in reference to his method of distributing his expenses. He recites what appears to be a rather novel system of proportioning his expenses and one which seems to me to be rather difficult to apply to large companies, and if there is anybody here representing him I should be glad to know more of the details in regard to the method. He appears to classify them differently from the usual custom, applying to each class of his business a certain portion of each of the expenses.

Mr. Doty: Mr. Irvin Butterworth, the president of the Denver company, is here. Perhaps he can answer.

Mr. Butterworth: I do not think I can go into that subject sufficiently to make it of interest, but the system can be explained in private conversation with any of the gentlemen at any time. The system at Denver follows the system employed in all the gas and electric companies of which Mr. McMillan is the head. These interests appointed a committee to devise a system of accounting, and that committee perfected the system which we are all following. There is no difficulty in following it, and we think the results obtained are very satisfactory.

Douglass Burnett, Baltimore: I inquire of Mr. Butterworth whether the committee of which he speaks took into account this question which recently arose in a case in which I am interested. We have been dividing our expenses into general expenses, cost of manufacture and cost of distribution. It occurs to me that it is rather important to divide that cost of distribution so as to separate the cost beyond the customer's meter; that is, beyond the customer's meter from the central-station company's standpoint. I should divide these costs as follows: Cost of generation, cost of distribution, cost of bringing the current to the meter, and then the cost of application, which would include the cost of maintenance, trimming of arc lights, renewals furnished free to the customer, and any special wiring done to secure the customer's business, installation of electric signs, etc. Is it desirable to separate the cost of application from the cost of distribution as customarily known?

Mr. Doty: I will say for the information of the gentleman that the four general heads into which operation expenses are divided are manufacture, distribution, collection and general expense; and in addition the collection expense and distribution expense are proportioned to the customer's charge and the meter charge in order to determine what we call the proportion of fixed and variable operating expenses. There is a separate account for promoting new business, to which is charged the expense incurred in securing the business.

According to a paper read by A. Brochet and J. Petit before the Académie des Sciences, the usual view that frequency exerts a considerable influence upon the electrolytic reactions given by an alternating current, and that the amount of the products recovered at the electrodes decreases greatly as the frequency rises, is not generally true. Frequency only plays a small part in the process in a few special cases, such as the dissolution of iron and platinum in potassium cyanide, and of lead in sulphuric acid. With nickel and cobalt the effect of altering the frequency of the current is very conspicuously in the opposite direction to that which has hitherto been held to be the case.

Homely Advice for the Embryo Engineer.

In the Electrical Engineer of London there is in course of publication a series of "Letters from an Old Hand to a Young One." The second relates to the method of training, and the following is part of it:

"If you don't get some theory banged into you now, you'll never absorb it. So you had better go to a technical college for a couple of years. And I humbly pray that patience and a saving sense of humor may be granted to your teachers. Of course, if your pater could afford it, the ideal plan would be to send you to college for, say, six months in the year, to a works as pupil for the other six, and to keep this up for three years. This would cost something, however; and I expect you would begin to grouse about losing your holidays! The ordinary college terms leave a good many gaps in the year. Why not try to get a job as odd man in a shop to fill up the time?

"Fortuitous advantages may arise; you may have someone in tow who can pitchfork you into a place where experience may be gathered in armfuls. If so, haul on the towrope. (But don't think I'm on the other end of the line. I have no vacancies for beginners, and personally I think you will be a better man if you go through the rough fair and square with all the rest of them.) Don't use your influence to get salary or position. If it is a job where you are supposed to do what you can't do, don't touch it! There is no need to be a fool artificially; you have quite enough natural aptitude (speaking again as a friend).

"Be careful not to specialize too soon. You have a lifetime before you; a long-bore gun carries farther than a short-bore. If you can spend eight years in learning with disregard for salary, so much the better for you later on. Pocket again!—the longer you can hang on to poor salary and rich experience the better in the long run. Become a general engineer first—an electrician after. Electrical engineering can be far more easily studied from books than mechanical practice. Rub your nose into the practice while you are young; there is plenty of time later on to wear white shirts.

"As a relief from engineering, study finance. An engineering firm may turn out beautiful engines, but if it doesn't pay, the shareholders will grumble. While you are in the shops study the economic aspect of speeding up lathes and working double gangs. If you get into a supply [central] station, try to understand the maximum-demand system. It is worth an engineer's while to study for some of the Institute of Bankers' exams., if he can find time.

"One thing more! Don't be haughty to men of inferior education who are slogging their own way up. Engineering, above all other professions, makes a constant appeal to fact. Education and influence don't count if a man's work is not right. A fool is found out quicker in engineering than in anything else. If a man has genius it is not safe to sneer at him, even if he drops all his aitches and says 'and et cetera.' Every engineer carries the baton of command in his knapsack—if he has the right knapsack."

Government Report on Space Telegraphy.

A report has been published by the United States Navy Department on the general subject of space telegraphy, a special board having been appointed by the president to investigate the matter. The board unanimously recommended that all space-telegraph systems along the coasts of the United States, the island possessions and the Panama Canal zone be controlled by the navy. The recommendation was adopted by the president. In the conclusions of the board it was stated that:

"When interference seems probable between the Navy and War departments the question involved shall be mutually settled by representatives of the two departments."

"That the wireless stations of the Navy Department shall, without charge to the Agricultural Department, receive and promptly transmit to the ocean or to islands or to other places where the information can be useful the storm warnings of the Weather Bureau."

"In asking for legislation on this point the board invites attention to the fact that where wireless-stations are needed for the merchant marine, as a rule, the navy will also require them. The board believes it to be in the interest not only of governmental but of public economy and efficiency to permit the naval stations to handle the public service, for in the present state of the art but one station is desirable for the public interest in such places."

"This Wonderful Agent, Electricity."

In a recent article in the Independent on the "Electrical Theory of Solution," by Professor Svante August Arrhenius, the widely known professor of physics in the University of Stockholm and the government delegate from Norway and Sweden to the coming International Electrical Congress in St. Louis, occurs this interesting passage: "The ionic theory has explained a large number of the important facts of chemistry, and consequently is generally accepted. It has a particular meaning for physiological chemistry, for the fluids of the body consist of aqueous solutions of substances which to a great extent are dissociated into ions. The ionic theory has added a new form of matter to the forms already known, this being characterized by a combination of electricity and matter. This new form plays the principal role in chemical processes. It is marvelous to observe in each additional investigation into natural phenomena how this wonderful agent, electricity, is found to govern them all. The phenomena of light are, according to Maxwell, nothing but the manifestations of electrical force, and in chemical processes electricity plays a principal part."

Electric Railways in Connecticut.

Some figures recently published concerning two large public utilities of Connecticut—the Consolidated Railway Company and the Connecticut Railway and Lighting Company—are of interest.

The Consolidated Railway Company, a subsidiary of the New York, New Haven and Hartford Railroad Company, now controls eight street-railway systems in Massachusetts and Connecticut for which it has paid approximately $10,000,000 and guaranteed four per cent. bonds amounting to $1,500,000. The company's stock amounts to $9,700,000, all of which is in the New York, New Haven and Hartford Railroad Company's treasury.

The company now controls 263 miles of electric railway, the largest amount controlled by any company in Connecticut. For the year ending June 30, 1903, the companies owning these railways reported surplus after charges amounting to $266,001, or only 2½ per cent. on the Consolidated Railway Company's outstanding stock. The floating debt of these companies aggregated $2,474,000 on June 30, 1903. For the month of July, 1904, the Consolidated company's income was $15,000 less than the income received from the same roads in July, 1903, although more passengers were carried this year. This decrease was caused by the large number of free transfers and the counterfeiting of transfers.

The Connecticut Railway and Lighting Company controls 175 miles of electric railway in Connecticut. Its roads cover a territory containing 500,000 people and 19 cities and towns. For the year ending June 30, 1904, the company's surplus after charges was $46,335, or only a little over three-tenths of one per cent. on the company's capital of $15,000,000. It is reported that the Consolidated Railway Company is negotiating for the purchase of the Connecticut Railway and Lighting Company's properties.

The company recently increased the wages of its employes. All regular men who have worked for the company one year will receive 21 cents per hour—an increase of one cent per hour—and men who have worked less than a year will receive 20½ cents per hour—an increase of one-half cent per hour. The pay for overtime has been increased five cents per hour. The company estimates that its expenses will be increased $20,000 per year by the new wage schedule which was adopted.

The Place of the Supply House.

In a paper on "The Relation of the Supply House to the Central Station," read before the recent meeting of the Ohio Electric Light Association, P. R. Boole, general sales manager of the Electric Appliance Company of Chicago, said:

"It was some 20 years ago that electrical supply houses first sprang into existence. At that time practically the only items carried in stock were underwriters' wire, sockets, wood rosetes, wood-base cutouts and wood cleats. At the present time it is necessary for a supply house either to carry in stock or be able to get at a moment's notice about 16,000 different items. There are 182 different pieces in Edison-base material alone. All of these 16,000 items are articles that a central station uses. It is easy to be seen that it is not only more convenient, but cheaper, for a central station to buy from a supply house, rather than from different factories direct. A supply house gathers in its stock from hundreds of different factories. When a central station places an order for a dozen or more different items, the order is shipped at once complete, unless some of the material has to be made up on special order. If, instead of placing this order with a supply house, the central station had placed the order with a dozen or more different factories, there would be a dozen different freight or express bills, and the goods would not be billed at a lower price than the supply house would have furnished them."

World's Fair Visitors of Last Week.

Among those registered last week at the booth of the Western Electrician in Electricity Building at the St. Louis Exposition were the following-named: M. O. Bolser, New York; S. C. Bragg, Little Rock, Ark.; John O. Rielly, Fort Worth, Texas; Fred W. Baldwin, Hastings, Okla.; W. J. Mead, Carbondale, Kan.; D. M. Sparks, Jefferson, Ind.; M. S. Chase, Everett, Wash.; Fox Henderson, Troy, Ala.; John B. Phelps, Willoughby, Ohio; C. H. Tyndall, Mt. Vernon, N. Y.; A. M. Lane, Fort Collins, Colo.; J. H. Barns, Aullville, Mo.; E. J. Davis, Shreveport, La.; Karl Davis, Middletown, Ind.; R. B. Scrafford, exhibit of Lombard Governor Company, Machinery Hall; C. F. Ziegler, Chicago; Leroy F. Taylor, San Marcos, Texas; Hermon Hanson, Paxton, Ill.; Harry S. Hill, Paxton, Ill.; George K. Westervelt, Brooklyn, N. Y.; W. C. Jenkins, St. Joseph, Mo.; G. H. Kerney, Dunmore, Pa.; Jno. Cook, St. Louis, Mo.; Albert Price, Joplin, Mo.; J. W. Richey, Chicago; M. Shibusawa, Association of Japanese Exhibitors, Fair Ground; J. A. Blake, St. Louis; D. D. Wright, Terre Haute, Ind.; W. A. Johnson, Louisville, Ky.

Recent Tariff Changes in Mexico and Italy.

The new supplemental tariff for Mexico makes a number of important changes, and among them the following: Copper in pigs or grains, free; wire of copper, brass, bronze or white metal covered with any material, five cents per kilogram, gross weight; bare wire of copper, brass, bronze or white metal, not exceeding two millimeters in diameters, eight cents per kilogram, gross; the same exceeding two millimeters in diameter, five cents per kilogram, gross weight; cables of copper, brass, bronze or white metal covered with any material, but without a metallic sheath, and uncovered cables of the same metals, of all diameters, five cents per kilogram, gross weight; insulated cables with metallic sheath, free. (By sheathed cables are understood electric conductors which have for their better preservation in addition to the insulated coverings one or more metallic coverings over the inner or the outer portion of the insulating substance as well as the conductors, which, in addition to the nucleus of copper, have an interior or exterior covering of iron wire.) Posts, cross-arms and pins of iron or steel for overhead electric wires are assessed $1.50 per 100 kilograms, gross weight; calcium carbide, four cents per kilogram, gross weight; storage batteries and other electrical batteries, free; extinguishers, incandescent electric lamps, commutators, contacts, including spigots, fuses including those that are mounted, cut-offs, rosettes and safety fixtures, 10 cents per kilogram, gross weight; electric arc lamps, 5 cents per kilogram, gross weight. (This last entry refers to lamps for electric arc lights, incandescent lights in the open air, or any other system other than that of lamp chimneys. The glass globes for protecting the lamps in question or for softening the brilliancy of the light, are not included in this classification, but are dutiable as worked glass, according to their classification.)

The tenth supplement of the Italian tariff, recently issued, provides several new classifications, among them being one for "electric power meters provided with clocks." These meters are classified as instruments of copper, etc., thus making them dutiable at $5.79 per 100 kilograms. The clocks fitted in the meters are to be classified as "clocks with cases," dutiable at 96½ cents each, this in addition to the duty on the meters in which they are included. Under another recent decision it is provided that "electrochronometric meters not working like clocks" are also dutiable under paragraph 243a at $5.79 per 100 kilograms. Insulators for electric wire consisting of "a kind of iron wrapper with corresponding lid containing ebonite" are to be classified for the assessment of duty under paragraph 358, making them dutiable at $11.58 per 100 kilograms.

Customs Classification of Porcelain Insulators.

The question of the correct classification for the assessment of duty on porcelain insulators has been brought to the attention of the United States Board of General Appraisers in the matter of a protest entered with that body by George W. Davenport against an assessment of duty on an importation of these articles by the collector of customs for the port of Niagara. The insulators covered by the protest were found to be each 6¾ inches in height, to weigh 8¾ pounds, and although made in one piece were in the form of two truncated cones superimposed, the top thereof being a mushroom-shaped head 3½ inches in diameter, slotted to support a heavy conductor for electric current. The diameter of the upper cone across its base was given as seven inches, that of the lower one at 6½ inches. The base of the insulator was concave, and centrally extended upward through both cones was a cylindrical hollow, molded on the interior surface of which was a female thread. These insulators were coated with a single glaze for the purpose of preserving them from disruption by frost, as they are intended for outdoor service on tall poles in situations where they are exposed to the action of the weather. In the character of this glaze they were found, by the board, to be identical with the carmelite ware previously passed upon by the board, and held to be dutiable at 55 per centum ad valorem under provisions of paragraph 96, of the present tariff. On the authority of that decision the board ruled, in the present instance, that the collector was incorrect in assessing duty at 60 per centum ad valorem, and that the protest asking for an assessment at 55 per cent. was to be sustained.

Electric-railway Development Along the New York Central.

Both electric and steam-railway men are watching with interest the developments in the reported plans of the New York Central railroad in equipping its branch roads with electricity and acquiring the electric roads that now parallel its steam lines, thus forming a subsidiary electric system to work in conjunction with its main lines. Besides the electric lines previously mentioned as having been acquired by the New York Central, it is reported that this company and the Delaware and Hudson railroad have secured the control of the Schenectady railway, held by the General Electric Company. It is also rumored that John J. Stanley of Cleveland is to be the operating head of the electric-railway interests of the Vanderbilts, as soon as detail matters have been gotten out of the way to some extent. Horace E. Andrews will doubtless be the executive head of the enterprise. This will take two of the most prominent members of the Andrews-Stanley syndicate. A number of other Cleveland (Ohio) men are interested with them in the development of the New York trolley roads.

A Notable Week at the World's Fair.

Machinery day at the St. Louis Fair, Saturday, September 10th, will be of great interest to all who are interested in electricity, steam engines, steam turbines, gas engines, machine tools, woodworking and abrasive machinery, and the myriad other appliances shown in Machinery Hall. The week which follows will be the most important and most interesting in many ways of all the weeks of the fair. Not only will every power unit in the 40,000-horsepower end of Machinery Hall be in operation all day, but arrangements have been made to have special demonstrations carried on in various portions of the building. Barrel-making machines will show how it is possible to make a flour or sugar barrel out of the rough wood for less than three cents each; grinding machines throwing out live fire amid fountains of water will show how they can cut steel as rapidly as a lathe tool, while in lathes and planers, tools of the new self-hardening steel will demonstrate their ability to take off steel chips an inch thick at a rate of 100 feet an hour or so.

Across the aisle from the big engine, the biggest ever shown in an exposition, stands a case containing the smallest engines to be seen in St. Louis. Those tiny engines are working and they present a curious contrast to the big one. The big engine with its 5,000 horsepower stands about 40 feet high above the floor. It weighs 720 tons. Its whole power is required to furnish electric current for the incandescent lamps which decorate the exposition buildings and grounds. The little engines are small enough to hold in the palm of one's hand. They are models of pumping engines, and a pair of them are engaged in pumping water into a copper tank.

Leather belts successfully operating in water, submarine mines ready to blow up warships, wooden pulleys as high as a two-story house, dredge scoops that take up a couple of tons at a bite, conveyors for packing boxes and for coal, an automatic electric elevator are some of the features to be seen in the building. Many of the exhibitors will hold special receptions on that day and there will be music all day, with music, refreshments and dancing in the evening.

On Sunday, September 11th, the members of the American Institute of Electrical Engineers, with hundreds of electrical engineers as guests from England and the Continent, will arrive at St. Louis for the electrical congress, which will continue through that week.

Electricity day will be celebrated on Wednesday of that week. Every exhibitor in the Electricity Building is preparing some special "stunt" for that day, and jointly they will have water and land parades with illuminating effects never before shown on the fair grounds. St. Louis day follows September 15th. This will be probably the most notable day of the fair for attendance. To the special attractions which will be provided for its celebration will be added those prepared for electricity day, for these will be again shown on St. Louis day. Many bodies of engineers and other prominent persons from home and abroad are expected to visit the fair during that week.

Bombay to Have Electric Lights.

The work of installing electric-light and power service in Bombay, India, is nearing completion and, it is said, electrical energy will be available by October. The system of distribution to be used is one suited to a large and straggling area where the demand will be chiefly around certain well-defined points. Current will be generated at the central station in Wari Bunder at a pressure of 6,000 volts, three-phase, and will be transmitted to sub-stations at the chosen centers, where it will be transformed by means of rotary converters to direct current at 230 volts, and distributed around the centers by means of a low-tension network of three wires laid solid after the Callender system. The work now being carried out is the transmission line to Tata's Hotel, where the first sub-station will be situated. Afterward another sub-station in Apollo Street, near the Great Western Hotel, will be equipped.

CORRESPONDENCE.

Great Britain.

London, August 10.—Some interesting information is to be gleaned at present concerning the various railway companies which have either adopted or are adopting electric traction. For instance, the large generating station at Neasden, which will supply the Metropolitan railway system (not Mr. Yerkes' company) is now completed with the exception of the installation of the turbo-generators. Experimental runs with this portion of the equipment are, however, expected to take place within a month. The conversion of a large mileage of track has taken place and the sub-station machinery is practically all in place. Seventy cars of the corridor type have been delivered. The Metropolitan District Company (Mr. Yerkes' company) hopes to be running electrically by the beginning of next year, when the new system of "zone" fares will be introduced. The huge power station at Chelsea is to all intents and purposes completed, a large portion of the permanent way has been equipped with the electrical conductors, and there only remains the machinery to be installed in the sub-stations. The Northeastern Railway Company, which, as is known, has been running its Newcastle local lines electrically for a few months, is well satisfied with the general results up to date. A large increase has taken place in the number of trains run upon the electrical lines, and there is every indication that the results, both as regards revenue and working expenses, will be satisfactory. The Barry Railway Company, a company working a mineral line in the south of Wales, has been investigating the question of electric traction, but the conclusion has been come to that, under present conditions, the application of electric power to railways which deal with a heavy mineral traffic, is impossible.

An invitation has been received by the London County Council from the rapid-transit railroad commissioners of New York, to send a representative to attend the opening of the New York subway. At the meeting on Tuesday it was resolved to delegate Mr. J. Allen Baker, chairman of the highways committee of the London County Council to undertake this duty.

A new scientific body is now being formed in Great Britain, with the title of the British Science Guild. The objects of the guild are to bring together as members all those throughout the empire interested in science and scientific methods, in order to convince people of the necessity of applying the methods of science to all branches of human endeavor, and thus to further the progress and increase the welfare of the empire. To bring before the government the scientific aspects of all matters affecting the national welfare. To promote scientific education by encouraging the support of universities and other institutions where the bounds of science are extended or where new applications are devised. It is proposed to attain these objects by publications, meetings, conferences, lectures, and by deputations. All British subjects are eligible as members, both men and women. An organizing committee has been formed consisting of, among others, such well-known scientists as Professor W. E. Ayrton, Sir Norman Lockyer, Professor Perry, Professor Meldola, Sir William Ramsay, Professor S. P. Thompson and Dr. Augustus Waller. This committee has elected Sir Norman Lockyer as president. It is the intention to form branches of the guild which will meet at the direction of their respective chairman. The guild is entirely disconnected from party politics.

The Postoffice telephone department has opened a new exchange in connection with its London system, at Hampstead, in the Northwest. In the east of London the Leford urban District Council is considering the advisability of equipping a municipal exchange system. G.

New York.

New York, August 20.—The system of electric traction to be adopted on the New York Central railroad will be an uncovered third rail. The rail will not extend across grade crossings.

On Wednesday night, at about 10 o'clock, amid much secrecy, an electric express train was run through the subway from City Hall to Harlem. The train consisted of three cars and the passengers were all employes of the Interborough company. The distance was covered in about 15 minutes, or at the rate of about 30 miles an hour.

Yesterday's quarterly report on the traffic over Brooklyn bridge shows that the total number of trolley cars making the round trip over the bridge was 337,331, apportioned among the months as follows: April, 109,827; May, 114,193; June, 113,351. These returns imply a daily average of 3,707, or more than 154 cars per hour for every hour of the day and night.

The annual report of the Brooklyn Rapid Transit Company, as issued today, shows a surplus on June 30th of $1,594,189.72. The gross earnings were $14,738,709.34.

The Brooklyn Rapid Transit Company is experimenting with a system by which telephonic communication can be maintained with its moving trains. This is to be accomplished by laying an additional insulated contact rail outside the existing power rail, and a few inches above its level.

Yesterday's City Record, the official publication of the Board of Aldermen, contains details relative to the tax of corporation franchises. The largest return

in Manhattan is that of the Manhattan Railway Company, whose special franchises are valued at $46,700,000. Other special franchises are: Metropolitan Street Railway Company, $18,480,000; Third Avenue Railroad Company, $10,300,000; New York Edison Company, $11,515,000; Consolidated Gas Company, $21,900,000; Brooklyn City Railroad Company (the Brooklyn Rapid Transit and the Brooklyn Heights Railroad Company), $11,260,000; Brooklyn Union Gas Company (with subsidiary companies), $10,565,000; Brooklyn Union Elevated Company, $5,984,000; the Edison Electric Illuminating Company (and subsidiary companies in Brooklyn), $3,644,000, and the Nassau Electric Railroad Company, $5,205,000.

The New York Edison Company has installed an electric fire pump at the Hudson Theater. This pump automatically keeps the water tank filled at a minimum level.

The Metropolitan Street Railway Company has ordered 150 new trolley cars from the J. G. Brill Company of Philadelphia. These cars will be 28 feet long, with seating capacity for 40 persons and standing room for more.

Patrons of the Public Service Corporation's trolleys between Hoboken and Hackensack, N. J., have to transfer six times for comparatively short distances. This is mainly due to difficulties with the crossings of the Erie railroad, and Hackensack residents are getting up a petition on the subject.

D. W. W.

Dominion of Canada.

Winnipeg, Man., August 19.—The Manitoba Water Power Electrical Company, with a capital of $5,000,000, has ben incorporated. Hon. H. J. MacDonald, K. C., Sir Daniel McMillan, Hon. R. P. Roblin, John McKenzie and Dr. J. A. Macdonell, all of Winnipeg, and W. Peyton Mason of Minneapolis are the directors. Power will be generated at Winnipeg River, and it is claimed that they will supply power to Winnipeg at less than half the present cost. This will materially help the growth of the city and give more manufactories, which are badly needed.

The street-railway company of Toronto is installing eight new boilers of 2,000 horsepower capacity each, and by exhibition time, September 1st, all the dynamos will be in place. In addition the company expects within two months to have a second new dynamo of 16,000 horsepower installed. When completed there will be 30,000 horsepower more than last winter.

The power house at Beamsvill, Ont., connected with the Hamilton street railway, was struck by lightning a few days ago and burned.

Ten thousand barrels of cement are on the way to Fort Francis from Superior for the work on the big waterpower plant now under construction. The timbers for the cofferdam are now being placed in position.

The Montreal Light and Power Company has secured the contract for lighting St. Louis, Que. The terms are the same as those made with the city of Montreal, and the franchise is for 25 years. The lights will be placed where directed by the engineer, and will cost $75 for each light up to 70 lamps.

An electric power station to cost $100,000 has been begun by the Toronto and Niagara Power Company at Toronto. A duplicate station is being erected at Niagara and a power house is being built there at a cost of $500,000.

Fred Nicholls, vice-president and general manager of the Canadian General Electric Company, and also of the Toronto and Niagara Power Company, and E. R. Wood, general manager of the Central Canada Loan and Savings Company, have obtained the controlling interest in the Niagara Falls Electric and Gas Light Company. This company's franchises extend to Niagara Falls, N. Y., along the La Salle River, and it is hoped to extend the line into Buffalo.

It is stated that a contract has been entered into by the Canadian General Electric Company to supply $2,000,000 worth of machinery to the new power company at Niagara Falls, Ont. The contract includes all of the plant for the Ontario company.

The Bell Telephone Company has secured an extension of an exclusive three-year franchise in London, Ont., but must pay the city $2,500 a year. This is an increase of $1,500 over the old franchise.

The mayor of Toronto is calling for bids for the installation of a telephone system in that city. Bids close on October 1st. Specifications may be had from the mayor or from the city clerk.

The new water supply company at Calgary has made an offer to light the town, agreeing to furnish 85 lights of 1,200 candlepower at $85 each per year, provided that the contract will extend over 16 years.

The electrical car shops at New Westminster, B. C., were burned recently, with a loss of $30,000; covered by insurance.

The Toronto street railway is the only line in Canada having wide gauge, being four feet 11 inches wide. This will be changed to standard, as an interchange of cars is impossible, and through connections cannot be made with the radial lines.

The British Columbia Electrical Railway Company is equipping its line in Vancouver with air brakes and whistles. These are being installed by the Canadian General Company, Canadian agent for the Christensen Engineering Company of Milwaukee.

H.

Ottawa, Ont., August 19.—The first annual report of the lighting and power system of the city of Guelph, Ont., under municipal ownership, shows a profit of $10,146, after providing for maintenance, interest on debentures and depreciation of plant. The expenses of management were $500 less than the average of five years under company operation.

In order to carry out the big project of acquiring and operating all the lighting, power and tramway companies of Rio de Janeiro, Brazil, a group of Canadian capitalists have formed a company called the Rio de Janeiro Tramway, Light and Power Company, with a capital of $50,000,000, and have secured a Dominion charter for the same. Owing to the very high price paid for coal in Brazil, the company has secured the only water power within a practicable radius of Rio de Janiero for transmission. This power property is situated about 75 miles in a straight line from that city. It is proposed to establish an electric-lighting and power plant and electrify all the present mule roads. Four different tramway systems, comprising 130 miles of track, are being secured. Equipped with electricity, it is estimated that the companies could earn $4,102,000 a year, which, after paying five per cent. on bonds, would leave a surplus of $2,850,000 for the stock of the company.

Such good progress is being made with the Dominion Observatory Building, now in course of erection at Ottawa, that in all probability the big 15-inch telescope may be mounted by October. The steel framework of the revolving dome is being set up, and will be sheathed with wood and covered with copper. When the whole work has been completed and the electrical and other astronomical apparatus installed, it will form one of the most complete observatories.

H.

New England.

Boston, August 20.—Five people were seriously injured on the Boston and Northern line in a head-on collision near the town of Lynnfield last Wednesday night. A "jumbo" 13-bench car, conveying 52 members of an outing party of firemen from Wakefield, encountered a regular car bound in the opposite direction, smashing the front part of the smaller car into kindling wood. There were no passengers on the wrecked car.

The "west side" line of the circuit road between Springfield, Mass., and Hartford, Conn., on both sides of the Connecticut River, is practically completed, and will be in operation, it is anticipated, next week.

Options on necessary rights-of-way are being obtained for the projected Woodbury and Waterbury street railway in Connecticut, chartered by the last Legislature, with an authorized capital of $200,000.

A connecting link of trolley line between Central Village and Norwich, to be built by the Consolidated Railway Company of Connecticut, will complete a 60-mile stretch of electric road from Worcester to New London. Use will be made of the New York, New Haven and Hartford steam road's tracks from Plainfield to Lisbon and thence to Norwich. The route will run through Jewett City and Versailles.

The borough of Groton, Conn., has voted to purchase the Groton Electric Light Company, owned by a holding corporation known as the Groton Securities Company. This corporation also owns the water supply company, which will likewise be acquired by the borough.

The Windsor Locks Electric Light Company has been purchased by Thomas C. Perkins of Hartford, Conn. The steam and waterpower plants will be enlarged, it is stated.

B.

Ohio.

Cleveland, August 20.—R. A. Harman of Cleveland is chairman of a committee that will have charge of the work of fitting the Miami and Erie Canal for the haulage of canal boats by trolley, as soon as the debts are paid and the troubles of the company cleared up. Those interested in the company say they believe that money can be made by hauling freight in this way, and they will give it a thorough test.

It is reported that the Pennsylvania railroad is contemplating the purchase of the Scioto Valley traction property. These lines parallel the Hocking Valley railroad from Columbus to Lancaster and the Norfolk and Western to Circleville. Both steam roads are Pennsylvania properties. Some time ago it was reported that a portion of the Norfolk and Western would be equipped with electricity, but it seems that the owners have taken another tack.

A number of the employes of the Cleveland Electric Railway Company will be sent to the fair in St. Louis to study the electrical exhibits and improvements as well as to gain a knowledge of how the local roads are operated under such pressure as the attendance at the fair requires.

The Stark Electric Company of Canton has opened its electric railway from that place to Salem for operation. The road has been under construction for two years. Arrangements have been made by which the Lima-Fort Wayne road will secure its current from the power plant of the Western Ohio Railway Company at St. Marys. Six sub-stations will be built along the lines of 60 miles. The steel has been laid from Lima to Elida, and will reach Delphos within a few days.

The Commercial Club at Dayton is endeavoring to secure the plant of the National Electric Porcelain Company of East Liverpool for that city. It is necessary that it take $35,000 bonds of the company to secure the location of the plant there.

A contract for the construction of an extension of the Toledo and Indiana from Wauseon to Bryan has been let to the Hirsch Construction Company, and the work is to be completed this fall.

Interurban roads entering Toledo are said to be considering independent terminal facilities again. Most of them enter over the tracks of the Toledo Railways and Light Company, and pay something like $60,000 a year for the privilege. It is said the plan contemplates centering as many roads on Huron Street as possible at the point where they now reach the freight station to Orange Street. The right-of-way for a terminal line has been secured, it is said, and work on it may begin soon.

The City Council of Zanesville has passed an ordinance authorizing a contract with the Zanesville Street Railway, Light and Power Company for street lighting at the rate of $65 a light per year. The contract is to continue one year. The company asked $72.50.

The Columbus Railway and Light Company has refused to accept the ordinance making a five-cent rate for private lighting, and proposes a sliding scale, running from five to 10 cents, according to the amount of current used.

O. M. C.

Michigan.

Detroit, August 20.—W. L. Patterson of Flint has been awarded the contract for the completion of the Detroit, Flint and Saginaw electric road from Bridgeport to Frankenmuth. The power house will be located at Bridgeport.

It is understood that the limited service which the Detroit, Ypsilanti, Ann Arbor and Jackson electric railway will inaugurate between Jackson and Detroit will be of the finest, and it will combine the attractions of the best drawing-room and parlor cars which are used on electric and steam roads. These cars will stop at Grass Lake, Chelsea, Ann Arbor, Ypsilanti, Wayne and Dearborn only. Several new sidings will be put in and an entire new schedule will have to be arranged. This company was recently consolidated with the Jackson city lines.

The aldermen of Detroit are now after Manager Brooks of the Detroit United Railway for better protection on open cars, and ask that some form of a gate be placed on them so as to prevent people from getting out on the wrong side. As a result of the council's order to equip all cars with a better fender than is now in use, this company has ordered samples of all the different fenders which have been gotten out up to the present time; these will be put on cars and tested.

A resolution has been introduced in the Bay City council providing that future franchises for street-car companies shall require the paving of a part of each street occupied, and that three-cent fares be given. Both propositions will be incorporated in the new franchises.

It is understood that Caro will soon have an electric railway to compete with the Michigan Central. Tuscola, a town now without railway facilities, has raised a bonus for the extension of the Detroit, Flint and Saginaw line from Frankenmuth to that place. This will bring that line within five miles of Vassar, from which place it is proposed to parallel the Michigan Central railroad to Caro. Tuscola is the only town in the county now without an electric or steam railway.

Pontiac is liable to be in darkness if the injunction of J. G. Hoffman of Detroit prevails, in the matter of the council granting him the city lighting franchise and afterward reconsidering its action and giving the contract to the Pontiac Standard Lighting Company. The present contract will expire on October 26th next, and this leaves but a short time to settle the matter in the courts.

The Grand Rapids and Chicago Electric Railway Company has changed its name to the Grand Rapids and Kalamazoo Valley Railway Company and has filed amended articles with the secretary of state accordingly.

C. G. W.

Southeastern States.

Charlotte, N. C., August 20.—The town of Gainesville, Ga., will have a new lighting system as soon as the transformers and lights are installed. Current will be supplied by the North Georgia Electric Company. The old lighting system has become inadequate to the demands upon it.

The town of Springfield, Tenn., has let contracts for a $40,000 water and light plant. The electrical supplies will be furnished by the General Electric Company and the boilers by the Braid Electric Company of Nashville. The Union Machine Company of Nashville claims that contracts had been awarded to it previously under a $25,000 bond issue and says it will carry the matter into court.

There is a plan on foot to construct an electric railway from Decatur, Ala., to Trinity Mountain, seven miles away, where J. L. Echols and others may establish a summer resort.

The Tracy City Electric Light Company, it is said, is taking bids looking to an extension of its plant so as to include the town of Monteagle, Tenn.

The Athens, Ga., street railway has received the machinery for the new electric lighting system at Athens. The system will be thoroughly modern and furnish light at a less cost per lamp than heretofore.

The new electric-lighting system at Charlotte,

N. C., put in and operated by the Catawba Power Company of Fort Mill, S. C., has been successfully put into operation, giving entire satisfaction. About 323 miles of wire were used .

The De Forest Wireless Telegraph Company has been granted permission to erect poles for a space-telegraph station in the town of Brunswick, Ga. L.

Northwestern States.

Minneapolis, August 20.—All bids for building an addition to the electric-light plant at Madison, Minn., were rejected as being too high.

The Pacific Electric Company of La Crosse, Wis., has sold its entire business and plant to Holbek & Burton. The transfer means the revival of the business of the electric company.

The City Council of Lake City, Minn., is considering enlarging the municipal light plant by the installation of an alternating system.

The Minnesota and Iowa Electric Railway Company has organized with H. R. Wells of Preston, Minn., as president and S. A. Langum secretary. The company will be bonded and preliminary work will begin at once. The road will run from the Twin Cities to Decorah, Iowa. There is also talk of building a line from Rushford to Winona, Minn.

Legal proceedings have been begun to prevent the City Council of Marshfield, Wis., from buying a waterworks and electric-light plant for $150,000.

The Omaha and Council Bluffs Street Railway Company will build a line from South Omaha, Neb., to Fort Crook.

The St. Paul (Minn.) Gas Light Company has been granted permission to extend its electric-light system to the Merriam Park district.

The Crowley Electric Company of Duluth has asked for an electric-light franchise at Browns Valley, Minn., and purposes to install a plant to cost about $15,000. R.

Rocky Mountain States.

Salt Lake City, August 19.—A contract to purchase the Salt Lake and Utah Valley railroad, formerly known as the West Side rapid transit, has been secured by J. G. Jacobs of Salt Lake, Utah. Mr. Jacobs states that the road will be operated by electricity and will probably be extended to Bingham, Utah.

The Nez Perce Water and Power Company, composed of Z. A. Johnson, Stephen Johnson and others of Nez Perce, Idaho, has purchased the Nez Perce electric-light plant and the Lolo power plant.

An electric-light and power company will soon install a plant at Goldfield, near Tonopah, Nev. A. C. Eisen and S. Forman are interested in the project.

The City Council of Laramie, Wyo., has granted the application of D. H. McCutcheon and J. D. Boyles of Pittsburg, Pa., for an electric-light plant, and construction will be commenced within 30 days. A contract has been entered into for the lighting of the city for a period of 10 years. The plant is to be ready for operation by January of next year.

Lightning struck the power line between Logan and Provo, near Ogden, Utah, during an electric storm a few days ago and burned two transformers in the concentration station. The cities were in darkness and the street-car system inoperative for a number of hours.

The power which will be available upon the completion of the government reservoir on the Shoshone River in Idaho will be utilized for the generation of electrical energy by capitalists of Cody, Wyo., and New York.

The building of an electric railroad between Libby, Mont., and the mines to the southward is contemplated by F. M. Barrett of Wisconsin and Joseph Plastina of Spokane, Wash. Surveys have already been made for the building of the line and the establishment of a power plant. G.

Pacific Slope.

San Francisco, August 18.—The A. J. Nicoll Elevator Company has contracted to install two electric elevators for H. H. and M. G. Bancroft in a building on Sutter Street, for $5,320.

The Interurban short line from San Jose to Los Gatos, Cal., has finally been decided upon and rails have been ordered by President Hale. Grading will commence within a few days.

The Malheur Water Users' Association, with a capital stock of $2,700,000, will put through a big irrigation scheme in Malheur County, Ore. It is the intention to expend $10,000 per year in improvements. Electric power will be developed on a large scale. Emery Cole, Fred Gellerman and N. C. Long are interested in the project. The headquarters of the association are at Vale, Ore.

Judge E. O. Potter of Eugene, Ore., W. J. Wilsey of Prescott, Ariz., and George H. Andrews of the Southern Pacific company, have been in Corvallis, Ore., recently, for the purpose of laying before the Benton County Court the matter of constructing an electric railway between Corvallis and Eugene, Ore.

The trustees of Los Angeles, Cal., have adopted an ordinance granting to the Edison Electirc Company of Los Angeles the right to construct and maintain an electrical transmission line across certain property in that city, the line to be suspended from steel towers, to be constructed upon foundations of cement.

The large transformers of the Northern San Joaquin Electric Company at Lodi, Cal., have been installed and the system is now connected with the lines of the American River Electric Company.

The Redding Gold and Copper Company intends to install an electric plant to operate its extensive mines near Redding, Cal.

George J. Leonard, electrical engineer of Corona, Cal., is superintending the opening of the old tin mines at Temescal.

M. Machado and J. H. Cameron have appropriated water in the Santa Marguerite River, and will generate electric power for transmission to Fallbrook, in San Diego County, Cal.

W. L. Bechtel, superintendent of the Nevada Electric Power, Light and Water Company, was in San Francisco last week.

The Mount Hamilton Exploitation Company has been incorporated by J. D. Radford, J. L. Benepe and others of San Jose, Cal., for the purpose of exploiting and doing the preliminary work for the construction of an electric railway between San Jose and Mount Hamilton, in Santa Clara County. The capital stock is placed at $20,000.

The trustees of Suisun, Cal., will receive bids until September 26th for a franchise to construct and maintain poles and string wires for the purpose of transmitting electric power along the streets of Suisun, as applied for by Leonard Prior.

The H. H. Buhne Company of Eureka, Cal., has received the contract for wiring and installing electrical fixtures in the new City Hall at Eureka.

F. M. Clough, representing the Butte County Light, Power and Water Company, has requested the supervisors of Butte County to award a franchise to him for constructing and maintaining electric transmission lines in the vicinity of Stirling City, for the purpose of furnishing that place with light and power. The supervisors will receive sealed bids until September 12th for this franchise. A.

PERSONAL.

John Aamoth of Kensington, Minn., has been appointed superintendent of the electric-light plant at Alexandria, Minn.

C. A. Rold has been succeeded as superintendent of the electric-light plant at St. James, Minn., by J. M. Kirschbaum.

George C. Chadwick, who has for some time been connected with the United Railroads of San Francisco as engineer, has been appointed chief engineer of the Santa Cruz electric-railway system.

Harry Kemp, superintendent of the Standard Electric Company of Norfolk, Va., died of typhoid fever in Norfolk on August 9th. Mr. Kemp had been superintendent of the Standard company since 1900. He was 37 years of age.

At the directors' meeting last week the following-named associates of the American Institute of Electrical Engineers were transferred to the grade of member: Louis A. Ferguson, second vice-president of the Chicago Edison Company; Thomas L. Miller, consulting engineer, Liverpool, England; H. H. Barnes, Jr., traveling engineer for the Stanley Electric Manufacturing Company, Pittsfield, Mass.; Ernest Gonzenbach, electrical engineer, Youngstown, O.

Many friends will learn with regret that Willard C. Candee, assistant secretary of the Okonite Company of New York, was severely injured on August 18th in a collision between an ice wagon and a trolley car in Brooklyn. Mr. Candee was riding on the front seat of the car and when the collision came was struck by the pole of the wagon and thrown to the street. He was taken unconscious to the Seney Hospital, suffering from a fractured skull, and at first it was thought he could not recover, but at the last report he was improving. Four other persons were also injured. Mr. Candee is the son of Captain Willard L. Candee, who, as everybody knows, is one of the managers of the Okonite Company. Young Mr. Candee was married only recently to Miss Burnett of Newburg, N. Y.

David E. Evans, the new president of the Maryland Telephone and Telegraph Company of Baltimore, is a Welshman who came to this country and located in Cleveland, Ohio, in 1880. Soon after he accepted a position with the Brush company to take charge of the erection and testing of the electric-light machines then being installed for the first time. He was appointed as expert in charge of the installation of electric-light plants, and erected one of the first in Chicago at the Palmer House. He was sent to the Brush company in Baltimore in 1882 as its superintendent. Shortly afterward the duties of chief engineer were added to his work, and he held this position seven years. In 1889 he was appointed superintendent of the Baxter Electric Motor Company, one of the pioneers in the manufacture of railway and stationary motors.

Arthur Hartwell, who has been connected with the Westinghouse Electric and Manufacturing Company for the last 15 years, recently as sales manager, has resigned his position. Early in 1899 Mr. Hartwell succeeded Mr. Maurice Coster as manager of the Chicago office, having before that been manager of the Pittsburg office. In February, 1902, he was advanced to the position of sales manager and returned to Pittsburg.

ELECTRIC LIGHTING.

The city of Ocala, Fla., has voted to issue $45,000 of bonds for an electric-light plant and debt liquidation.

At Woodville, Miss., recently the election resulted in favor of $75,000 bonds for waterworks and an electric-light plant.

Gates & Co. of New Orleans have been awarded the contract for installing a new system of arc lights in the city of New Iberia, La.

An electric-light company has been incorporated at Edinburgh, Ill., with a capital of $30,000, by I. E. Swigert, Reuben Herrington and others.

A bond issue of $20,000 has been voted by the city of Bainbridge, Fla., with which to purchase the electric-light plant owned by Nussbaum Bros.

The town of Plaquemine, La., has granted a franchise to the Ewing-Merkle Electric Company of St. Louis, Mo., for the erection of an electric-light plant in the town.

By a vote of 65 to one the town of New Albany, Tenn., has decided to issue $20,000 worth of bonds for the establishment of an electric-light plant and waterworks system.

The City Council of Kalk Bay Station, Cape Colony, has been empowered to issue bonds for such amount as it may need to erect a municipal electric-light and power plant.

The City Council of East Retford, a place of over 10,000 inhabitants in Nottingham County, England, is contemplating the building of a municipal electric-light and power plant.

The municipal council of Rochdale, a borough of about 75,000 inhabitants in Lancashire County, England, is planning to spend a sum which will exceed $200,000 in enlarging and improving its electric plant.

It having been practically decided to enlarge its capacity, the management of the electric-light and power plant of Christiania, Norway, will soon have to purchase electric machinery and cables for transmitting electric energy.

Japan, according to Walter J. Ballard of Schenectady, N. Y., has six electric-light and electric-railway corporations, with a total paid-up capital of $2,500,000, on which dividends varying from five to 17 per cent. are earned.

Rudolph Claybolt was the successful bidder for putting in the proposed municipal-lighting plant at Penn Yan, N. Y. Mr. Claybolt, however, has refused to take up the contract on account of the time limitations that the bonds imposed.

The Muskogee Electric Company of Muskogee, I. T., which has been incorporated with a capital of $100,000 for building an electric-light plant, has elected Ira L. Reeves, president; J. A. Connolly, vice-president; A. C. Trumbo, secretary, and N. A. Gibson, treasurer.

The royal Belgian Ministry of Railroads will award contracts for wiring and equipping for electric lighting the Quaregnon-Central, Jemappe, Warquignies, and Flenu-Central railroad stations. Further information regarding these contracts may be obtained from the Cahier des Charges, No. 534 Musée Commercial, Rue des Augustins 15, Brussels, Belgium.

The municipal authorities of Barcellos, a small place on the Cavado River, about 25 miles north of Oporto, Portugal, are willing to grant a 30-year concession to a company for the erection of an electric-light and power plant. One of the stipulations which will be exacted of such a company will be that it furnish the municipality with 160 16-candlepower incandescent lights and six 50-candlepower lights for the sum of 1,500 milreis [$1,620] per annum.

ELECTRIC RAILWAYS.

It is reported in Monterey, Mexico, that A. W. Liliendahl of Saltillo has purchased the street-car system in that city and will change the motive power to electricity.

The Canton Electric Traction Company has been incorporated under the laws of New York state with a capital of $20,000. The incorporators are G. Mazacorati, R. L. Stotts and P. M. de la Chesnaye, all of New York city.

In Baltimore, Md., recently, a colored woman boarded a street car of the United Railways and Electric Company and, finding no vacant seat, deliberately sat down in the lap of Miss Carrie V. Horner, a passenger on the car. Now Miss Horner has sued the company for $2,000 damages.

Officials of the Joliet, Plainfield and Aurora Electric railway have made an arrangement with the Aurora City company to bring their interurban cars into the city over its Fifth Street line if the company is allowed to do so by the city. If the Aurora company finds it impossible to do this a transfer station will be built at the city limits and the passengers transferred each time at that point from a suburban to a city car, and practically through service will be given. In the meantime the work of push-

ing the line to completion is going along rapidly. Grading is under way between Wolf's Crossing and Aurora and rails are laid beyond Normantown.

The Sociedad Tranvias de Saragossa, Spain, has requested the City Council to grant it a concession to make several extensions of its present system of tracks. Rumor has it that the concession will be granted, in which case the street-railway company will have to make purchases of steel rails and additional rolling stock.

The Marseilles (Ill.) Register has it from "good authority" that the Rock Island Railroad Company is about to construct an electric railway through the Illinois Valley to compete with the Illinois Valley Railway Company, and that all local trains will be taken off the main line. It is stated, further, that there is a squad of men now on the ground making estimates.

The Consolidated Railway Company (otherwise the New York, New Haven and Hartford railroad) is planning a trolley line from Central Village to Norwich, Conn., thus completing a continuous trolley line from New London, Conn., to Worcester, Mass., in direct competition with the New London and Northern electric railway, which is the only independent line in Connecticut not controlled by the New York, New Haven and Hartford railroad.

The Underground Railway Company of London, comprising the Central London, City and South London, District, Metropolitan and Waterloo and City railway companies, has issued a statement for the half year ended June 30, 1904, showing total revenue of £1,073,883 and expenses of £463,187. After paying ordinary charges and dividends the surplus was £81,818. The total revenue for the corresponding period last year was £1,037,733.

It is reported from Cumberland, Md., that Pittsburg capitalists operating the Meyersdale and Salisbury (Md.) street railway have acquired an option on the Cumberland and Westernport electric railway. Ex-Judge R. H. Koch of Pottsville, is president of the latter road. A mortgage for $1,500,000 is reported to have been placed on record at Somerset by the proposed purchasing syndicate. It is stated that only the controlling stock in the road is desired.

The Electric Street Railway Company of Genoa, Italy, has decided to extend its present system of lines and to purchase a considerable quantity of rolling stock—electric motor cars for the most part. It is proposed to build an electric railroad between Aquila and Teramo, cities which are located in the Abruzzi e Molise Compartimento, Italy, about 35 miles apart. Detailed information about this road may be obtained from Cav. Camerini, mayor of Aquila.

It is rumored in Wall Street that a basis has been reached on which the Belmont-Interborough traction syndicate and the Ryan-Metropolitan interests have agreed to consider consolidation negotiations. According to one authority, the Metropolitan Securities Company, which now leases the Metropolitan street railway, is to become a nolding company of all lines. It is said the Belmont interests are disposed to sell a large block of stock of the Interborough company to the Securities company. In this way the Ryan-Metropolitan party would obtain representation in the directorate and a strong voice in the affairs of the Interborough Rapid Transit Company, which is the corporate name of the subway system.

POWER TRANSMISSION.

The interests of the Roanoke (Va.) Water Power Company have been purchased by M. J. Camp of Florida, who has let a contract for the building of a dam across the Roanoke River, where he will erect a 30,000-horsepower electric plant at a cost of about $200,000, for furnishing power to manufacturing plants of Roanoke.

The Belton Power Company of Belton, S. C., has let the contract to the J. F. Gallivan Building Company for the construction of a dam on the Saluda River to furnish the waterpower for its proposed electric plant. The dam will be of concrete and stone, 600 feet long, 32 feet high and 35 feet wide. About 5,000 horsepower will be developed, and it is proposed to transmit the electricity to Belton.

The Mt. Hood Electric Company has been incorporated for the purpose of supplying Portland, Ore., with electricity for commercial uses, and it is stated to be also the intention of the new company to build a trolley line to the base of Mt. Hood. The power is to be obtained on the Sandy River, about 25 miles distant. The company is capitalized at $1,000,000. The incorporators are C. W. Miller and G. W. Waterbury of Portland, and Edwin D. Whitney of Chicago.

The firm of A. A. and F. B. Piatt, which has been engaged in the heating and power business in Lansing, Mich., has organized a stock company under the name of the Piatt Power and Heating Company, with an authorized capital of $500,000. The officers of the company are: President, A. A. Piatt; vice-president, Robert H. Ingersoll; secretary and treasurer, F. B. Piatt. Messrs. Piatt have recently acquired the title to the Dimondale waterpower which has been in litigation. They are now erecting a big dam in Lansing, making it wholly of cement. The waterpower at Dimondale will next receive their attention, and the energy will be transmitted to Lansing to be used in connection with their power plants there.

The Potomac Electric Power Company of Washington, D. C., has been reorganized with $5,000,000 capital by George Truesdell, S. L. Shober, Jr., George H. Harriss, James B. Lackey and associates.

PUBLICATIONS.

A neat 16-page booklet published by the Wellman-Seaver-Morgan Company, Cleveland, Ohio, sets forth in detail the merits of the Sargent complete-expansion gas engine. The booklet is well illustrated, showing the general design of the engine to be symmetrical and pleasing to the eye.

Type S standard direct-current dynamos and motors, manufactured by the C. & C. Electric Company, New York city, form the subject of Bulletin No. 151, issued by the company. The bulletin thoroughly describes all the parts, and the various styles of machines, together with the component parts, are well illustrated.

The Cutler-Hammer Manufacturing Company is distributing a quantity of perforated cards, suitable for filing, which describe a variety of the Cutler-Hammer product, such as self-starters and switches for elevators and dumbwaiters, drum controllers, interlocking dimmers, resistance units, outfits for motor-driven pumps, machine-tool controllers, compound resistances, etc.

SOCIETIES AND SCHOOLS.

The annual convention of the New York State Street Railway Association will be held this year at Utica, N. Y., on September 13th and 14th. The headquarters of the association will be at the Butterfield House and all the sessions will be held in the auditorium. The programme will consist of addresses, papers, discussions, etc. Ample entertainment for the delegates is being provided, especially as many of the members will be accompanied by their wives. The arrangements for the meeting this year are in the hands of officials of the Utica and Mohawk Valley Railway Company. E. G. Connette, vice-president and general manager of the Syracuse Rapid Transit Railway Company, is president of the association.

SPACE TELEGRAPHY.

Arriving in New York on the Kronprinz Wilhelm the other day, H. M. Stevenson of Chicago was met at the pier by a cab which he had ordered by a space-telegraph message, sent when 200 miles out at sea.

A company is in course of formation in Madrid to introduce the Marconi system of space telegraphy into Spain. For the present it is only proposed to establish coast stations for communication with passing steamers. The first stations will probably be at Finisterre, Tarifa and Palos.

Secretary of Agriculture Wilson announces that as a result of his second trip, plans are in progress looking to the establishment of a space-telegraph system of fire alarms in the various forest reserves under the control of the government. The idea is to construct an automatic service which will give the alarm when contact is made with the flames or excessive heat. Prof. Willis Moore, chief of the Weather Bureau, will go to the Black Hills reservation to make a thorough examination of the country and report on the proposition.

MISCELLANEOUS.

The Board of Review has cut the $3,000,000 assessment on the property of the Illinois Tunnel Company to $485,000. President Wheeler of the tunnel company appeared before the board and declared that the property is not a source of income to the stockholders at the present time and that the whole concern is as yet in an undeveloped state. City Electrician Ellicott favored the declarations of the company, and upon his recommendation the assessment was reduced.

The sum of $2,376,000 is needed for Missouri River work during the next two years, according to the annual report of Maj. Chittenden, United States engineer at Sioux City, in charge of Missouri River improvements. One of the most important recommendations is that $475,000 be appropriated for work on the Missouri and Kaw Rivers in the vicinity of Kansas City, of which $75,000 is for repairs on existing work and $400,000 for projected work required to protect that city from floods like those which have caused so much damage to electric plants and other industries in the past.

The erection of a fine new $10,000 clubhouse has just been completed in East Pittsburg, Pa., by the Westinghouse Electric and Manufacturing Company for the use of the fire department of the big shops. The basement has a gymnasium, pool and billiard tables, the first floor is used as a lounging room and library and the second and third floors contain the sleeping quarters and hospital. All modern conveniences are provided throughout. W. M. Chambers, assistant engineer of works for the electric company, is fire marshal. There are 26 members of the company, one chosen from each department of the works, and they live continually at the club quarters. The fire-fighting apparatus consists of the latest appliances.

Important experiments with a view to determining the practicability of preserving coal by submerging it in the sea were resumed at Portsmouth, England, recently. About a year ago 21 tons of coal were selected from a stack for experimental purposes. Ten tons were placed in heaps at the coaling station and each one covered with a tarpaulin, while another 10 tons were placed in five crates, each holding two tons, and these were submerged in No. 2 basin. The remaining ton was burned at the time and careful observation was made of its calorific and evaporative qualities. One of the submerged crates will soon be raised. It is to be weighed and burned at one of the boiler houses, together with one of the covered heaps from the coaling point. Observations will be made of the calorific qualities of the submerged and non-submerged coal.

TRADE NEWS.

The Schaffhausen-Schleitheim electric street railway of Schaffhausen, Switzerland, is reported to be in the market as a purchaser of rolling stock.

Frederick Wiener has been appointed receiver for the McCreary Electric Company on the application of Charles E. Hathaway, who obtained a judgment against the company for $145.

The Swedish General Electrical Company of Vesteras, Sweden, has established an agency at Monterey, Mexico. A. E. Larsen, with headquarters in the City of Mexico, has been appointed agent.

Bids are invited upon three three-ton electric cranes and two electric locomotives which are intended for the use of the London Electric Works, at Greenwich. Detailed information may be obtained at the County Hall, Spring Gardens, London, S. W., England, upon depositing the sum of $9.73.

D. C. Durland of New York city, Marshall D. Barr of Pittsfield, Mass., and F. S. Hunting of Fort Wayne, Ind., are associated as directors in the newly-organized New York incorporation known as the Electrical Manufacturers' Export Company, capitalized at $10,000.

Frederick F. Shipp of St. Louis and C. H. Blanchard and James A. Howze of Webster Groves, Mo., have incorporated the Electrical Heating and Manufacturing Company, to manufacture and deal in electrical heaters, etc. The capital is $50,000 and the headquarters are in St. Louis.

W. H. Jacob, the popular sales manager of the Triumph Electric Company, Cincinnati, left this week on a business trip to the Pacific Coast. Mr. Jacob expects to be gone about a month and will stop at Portland, Seattle, San Francisco and intermediate points in the interests of the Triumph company.

BUSINESS.

The Commerce Electric Company of Chicago, organized to general electrical work, has been incorporated by H. C. Turner, J. H. Lundberg and F. M. Garthwait. The capital is $2,500.

The Sprague Electric Company has sold to the Hammerschlag Manufacturing Company, Newark, N. J., an additional order, consisting of one 150-kilowatt generator and 12 motors, ranging from one to 50 horsepower. These are for use in the Hammerschlag wax-paper plant, which is one of the largest of its kind in this country.

The factory of the Thresher Electric Company, Dayton, Ohio, is one of the busiest in the state. President A. A. Thresher says that his force is obliged to work overtime to meet the demand for Thresher products. The company is just finishing a complete electrical equipment for the U. S. warship Virginia, now building at Newport News. Mr. Thresher introduced many new features in the design and construction of this class of apparatus, as well as in its operation and method of control. The Thresher company is also building 33 electrically operated deck winches for use on United States warships. The Thresher company has a large and excellently equipped factory and is well prepared to do a large business.

Mr. James McLaughlin of Chicago, the well-known pioneer inventor and expert in arc lighting, railway and power, is now devoting himself to consulting electrical and mechanical engineering and the manufacturing and sale of his commutator compound, which has been on the market for 14 years and given continued satisfaction. This compound does away with the sandpapering of commutators, keeps them bright and clean and prevents blacking and sparking, makes a positive contact between brushes and commutator and prolongs the life of both. The inventor is a practical electrician and guarantees results by furnishing a free sample to all who send their address to him at 53 River Street, Chicago.

An official pumping-engine test, which was recently made at the Park Avenue pumping station, Chicago, shows some very good results. The engine is of the Worthington, duplex, reciprocating, triple-expansion type, having semi-rotary steam valves, but no fly-wheel. The latter is replaced by compensating cylinders, so arranged that their pistons retard the motion of the main piston during the first part of the stroke, but assist it toward the close, giving a uniform resultant thrust. The capacity of the engine is about 22,000,000 gallons a day, against a total head of slightly over 121 feet, and 660.9 horsepower was indicated in the test. The duty obtained was 174,735,801 foot-pounds per 1,000 pounds of steam used, corresponding to an economy of 11.32 pounds of steam per net horsepower delivered in water lifted, or 10.01 pounds of steam per indicated horsepower. The steam pressure was 144.45 pounds per square inch, with 154 degrees Fahrenheit superheat at the throttle, the steam cylinders being provided with jackets and reheaters.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued (United States Patent Office) August 16, 1904.

767,408. Starting Device for Vapor Electric Apparatus. Peter C. Hewitt, New York, N. Y., assignor to the Cooper Hewitt Electric Company, New York, N. Y. Application filed May 28, 1903.

In a gas or vapor device are combined a container and a negative electrode of conducting material within the container. A re-entrant portion of the container is arranged to enter the negative electrode, and there is a starting band within the re-entrant portion.

767,424. Card or Ticket for Actuating the Mechanism Controlling Electric-light Signs. Mortimer Norden and Lucien S. Crandall, Brooklyn, N. Y. Application filed March 13, 1902. Renewed May 7, 1904.

A device for operating electric-light signs comprises a card or ticket carrying a number and having perforations arranged in groups with at least one perforation in each group for each digit of the number for actuating the mechanism controlling the sign. A detachable check end with a number thereon corresponds to the number upon the card or ticket.

767,437. Self-soldering Fuse Post. Claude R. Pitrat, Chicago, Ill., assignor to Frank B. Cook, Chicago, Ill. Application filed February 25, 1903.

In a cut-out or protector for telephone and telegraph lines is a resistance body for inclusion in the electric circuit and a rotary detent electrically connected with the resistance body and acted upon by a force tending to break the circuit, the detent being provided with teeth or points. Means are provided for exerting a force on a tooth or point of the detent to turn it and break the circuit, and a spring co-operates with another of the teeth to properly position the detent and prevent overthrow thereof. A cementing material for holding the detent against rotation under normal circuit conditions is adapted to be fused or softened under abnormal circuit conditions to permit the detent to turn and the circuit to be broken by the force acting on the detent.

767,453. Watchman's Time-recorder. Jesse Summers and Herbert E. Summers, Indianapolis, Ind., assignors to the Indianapolis Watchman Clock Company, Indianapolis, Ind. Application filed March 20, 1903.

The combination consists of a number of electrically operated recording mechanisms, an electromagnet in circuit with some of the operators of the recording mechanisms and a switch-carrying armature therefor. A resetting electromagnet is adapted to cause the resetting of the switch-carrying armature and means operated by the train close the alarm circuit at predetermined times.

767,463. Sectional Electric Conduit. Charles E. Wilson, Philadelphia, Pa. Application filed December 14, 1901.

A composite conduit formed by the juxtaposition of conduit sections of substantially square cross-section has longitudinal grooves coincident with the median lines of each of the four sides. Alinement pins are interposed at promiscuous intervals along the length of the grooves, each of the alinement pins engaging simultaneously the sides of the two conduit sections between which it is placed.

767,465. Soldering Apparatus. John A. Wirth, Pittsburg and Jacob Beech, Wilkinsburg, Pa., assignors to the Westinghouse Electric and Manufacturing Company. Application filed October 22, 1902.

767,472. Method of Soldering Armature Leads to Commutator Bars. Jacob Beech, Wilkinsburg, Pa., assignor to the Westinghouse Electric and Manufacturing Company. Application filed October 22, 1902.

The two foregoing patents relate to apparatus designed for soldering armature leads and commutator bars in the manufacture of dynamos and motors.

767,477. System of Electrical Distribution. Josef H. Hallberg, New York, N. Y. Application filed October 16, 1903.

The method of effecting current regulation by the proposed means consists in opposing to a current phase a current derived from a separate source, but corresponding in phase, and automatically varying the phase relation of the two currents, transmitting the resultant current to the distributing conductors.

767,489. Telephone Support and Switch. Frank R. McBerty, Evanston, Ill., assignor to the Western Electric Company, Chicago, Ill. Application filed December 1, 1902.

In combination with the back plate are a pile of contact strips mounted upon the plate one above the other, a telephone hook and an actuating finger moved thereby. Arrangement is made to engage one of the contact strips to move it. A cover fits over the back plate and a push-button is loosely mounted in the cover in position to register with one of the contact strips of the pile to move the same.

767,495. Prepayment Mechanism for Electricity Meters. Barker North, Manningham, England. Application filed July 7, 1903.

Upon completion of a supply of a predetermined amount of electricity a balanced switch, having electromagnetic means in the shunt circuit, is adapted to actuate the switch to open both main and shunt circuits with a sharp break under a slight magnetic pull upon closure of the shunt circuit by a contact device. A catch is adapted to hold the switch in open position and a prepayment mechanism is adapted upon insertion of a coin to be moved by hand to mechanically force the catch off the switch and allow it to close.

767,497. Multiple Secondary Transformer. John S. Peck, Pittsburg, and Charles Le G. Fortescue, Wilkinsburg, Pa., assignors to the Westinghouse Electric and Manufacturing Company. Application filed August 8, 1903.

A transformer having a number of secondary windings, the coils of which are symmetrically disposed with reference to the primary coils and to each other to avoid interfering leakage magnetic fields has means whereby a variation in load on one of the secondary circuits has substantially no effect on the voltage of another secondary circuit.

767,503. Earth Shield for Transformers. Charles F. Scott, Edgewood Park, Pa., assignor to the Westinghouse Electric and Manufacturing Company. Application filed September 16, 1903.

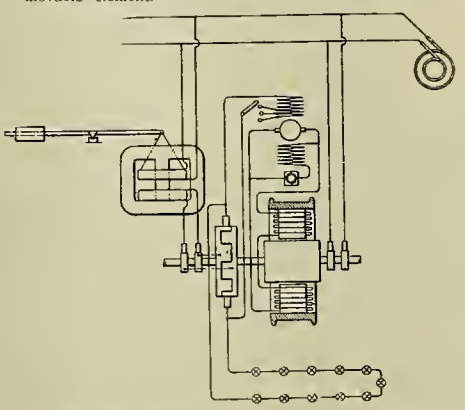
Grounded sheets of high-resistance conducting material are placed between adjacent coils, the resistances of the sheets being such as to reduce the eddy currents therein to a safe value.

767,525. Electric Recorder. Francis C. Osborn, Detroit, Mich., assignor of two-thirds to Samuel J. Wilson, John M. Sweenev and Oscar B. Marx, Detroit, Mich. Application filed August 3, 1903.

An electrically controlled escapement is connected to a printing wheel and to a platen. A lug on the driving shaft presses the platen against the printing wheel.

767,534. Conductor for Electric Railways. Arthur Whittier, Wollaston, Mass. Application filed September 8, 1903.

A car having an element connected thereto for sliding movement transversely with reference to the car has an element pivotally connected to the transversely movable element for horizontal angular movement. Magnets and track-engaging devices are carried by the angularly movable element.



NO. 767,759.—RECTIFIER FOR PERIODIC CURRENTS.

767,554. Method of Rendering Storage-battery Gases, Non-explosive. Thomas A. Edison, Llewellyn Park, N. J., assignor to the Edison Storage Battery Company, Orange, N. J. Original application filed November 28, 1902. Divided and this application filed June 13, 1904.

The process consists in passing the gases through a contracted vent and in thereafter spreading, diffusing and attenuating the gases.

767,573. Party-line Ringing Device for Telephone-switchboard Circuits. Jacob W. Lattig, West Bethlehem, and Charles L. Goodrum, Philadelphia, Pa., assignors to the Eastern Telephone Manufacturing Company, Westchester, Pa. Application filed June 6, 1903.

A subscriber's line and bells are connected to the opposite limbs thereof, to be actuated by current over one or the other of the limbs. A ringing key is adapted to make connection with the line, a selective master-key and a generator. The master-key is connected and arranged to complete the circuit of the generator in direct or reversed relations with the contacts of the ringing key. Means are provided to lock the master-key when set and means actuated by the ringing key control the locking means.

767,584. Telephone Hook Switch. Charles T. Mason, Sumter, S. C. Application filed April 9, 1904.

The combination consists of a pivoted hook lever, insulated circuit-changing springs, the outer springs tending to move toward the intermediate spring, and means for positively limiting the movement of the outer springs toward the intermediate spring. The intermediate spring is connected to the hook lever and moves therewith to engage the outer springs alternately and establish signaling and talking connections respectively.

767,599. Electrically Operated Apparatus. Charles E. Sedgwick and Walter H. Abbott, Cleveland, Ohio. Application filed September 17, 1903.

A device for automatic signaling on electric railways comprises a shell having a reversely inclined bottom with its highest point at its center. An electrical winding is placed about the shell extending across both sides of its center, and a free rotatable member in the shell is adapted to be electrically drawn from one side of the shell to the other across its center.

767,625. Electric Circuit Closer for Fire Alarms. John E. Bemiller and Emery C. Weisensale, Hanover, Pa. Application filed May 7, 1904.

A tube having a bulb adjacent to its lower end contains an expansive fluid and an electric wire projecting into the expansive fluid and insulated from contact with the fluid except at one end. A similarly insulated electric wire extends into the upper end of the tube.

767,681. Lamp Cluster and Switch. Reuben B. Benjamin, Chicago, Ill., assignor to the Benjamin Electric Manufacturing Company, Chicago, Ill. Application filed May 7, 1903. Renewed May 2, 1904.

A supplemental base is supported in position in front of and parallel to a main base, and a number of lamp-holding devices have associated contacts, located between the bases. All the elements of a switch are mounted upon the supplemental base for controlling the contacts of the lamp-holding devices.

767,691. Motor Control. John D. Ihlder, Yonkers, N. Y., assignor to the Otis Elevator Company, East Orange, N. J. Application filed May 5, 1902.

In combination with a motor having an armature is a step-by-step controlling means comprising an actuating mechanism for each step dependent for its action upon the potential and current of the motor armature.

767,692. Motor Control. John D. Ihlder, Yonkers, N. Y., assignor to the Otis Elevator Company, East Orange, N. J. Application filed May 8, 1902.

A controlling magnet operated at line potential has means controlled by variations of motor current for varying the ampere turns of the controlling magnet.

767,703. Automatic Electrical Regulator. Emanuel Levison, Mansfield, Ohio, assignor to the Phœnix Electric Manufacturing Company, Mansfield, Ohio. Application filed January 18, 1904.

A compound-wound regulator magnet has a coil in shunt to a motor armature and a coil in series with the armature and with a series of resistances. A number of magnet armatures control the resistances.

767,751. Means for Controlling Movements from a Distance. Max R. Hanna, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed January 18, 1904.

The device has a series of stationary contacts with means for selectively energizing any one of the contacts. Movable contacts moving with a movable member and in circuit with the motor are adapted to coact with the stationary contacts whereby the motor is stopped when the movable contacts are in a given position relative to the stationary contact that is energized.

767,753. Telephone Transmitter. Charles W. Harper, Malden, Mass. Application filed September 12, 1902.

With a frame provided with an annular knife edge is combined a clamping member adjustably mounted on the frame and provided with an annular knife edge of the same diameter as the knife edge on the frame and directly opposed thereto. A diaphragm is clamped between the annular knife edge on the frame and the annular knife edge on the clamping member. An electrode controlled by the diaphragm, a fixed electrode and an adjustable resilient finger acting on the diaphragm are other features.

767,757. Electric Lock. Edward B. Jacobson, Pittsfield, and Ernest Blasser, Boston, Mass. Application filed November 21, 1902.

The improvement consists of a part moving in unison with the knob spindle, the electromagnet and the divided armature having the sections or halves thereof constructed to mutually engage with the moving part.

767,759. Rectifier for Periodic Currents. Alexander D. Lunt, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed January 6, 1900.

A constant current transformer fed from alternating-current mains has means for causing leading current to flow in the mains of a value varying inversely with variation of load on the transformer. (See cut.)

767,761. Control of Alternating-current Motors. Maurice Milch, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed December 9, 1903.

The method of controlling a number of alternating-current motors having primary members and secondary induced members consists in connecting the primary members to a source of alternating current, connecting the secondary members in a local closed circuit and varying the series-parallel relations of the primary members.

767,764. Power-factor Indicator. Lewis T. Robinson, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed November 5, 1902.

A number of electromagnetic motor elements and a movable element within the inductive influence of the motor elements are constructed so as to present portions of varying conductivity to the inductive influence of one or more of the motor elements as the movable element is moved relatively thereto. (See cut on next page.)

767,773. Power Transmission. William Stanley, Great Barrington, Mass. Application filed November 30, 1903.

This system comprises a main multiphase generator, a motor having multiphase windings on stator and rotor and a local low-frequency multiphase exciter. One set of motor windings is adapted to be supplied with low-frequency currents by the local exciter, and the other set is adapted to be supplied by currents of normal frequency from the main generator. (See cut on next page.)

767,777. Electrically Heated Tool. Tycho Van Aller, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed December 14, 1903.

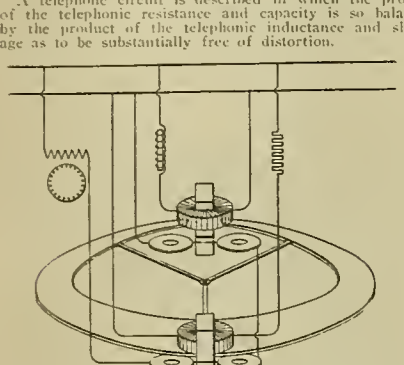
Details are described.

767,787. Commutating Dynamo-electric Machine. Eddy R. Whitney, Lynn, Mass., assignor to the General Electric Company, Schenectady, N. Y. Application filed December 30, 1903.

A machine having an armature with a toothed core, a main winding placed thereon and a series of short-circuited windings surrounding the core teeth is described.

767,818. Telephone Circuit. William W. Jacques, Boston, Mass. Application filed April 18, 1904.

A telephone circuit is described in which the product of the telephonic resistance and capacity is so balanced by the product of the telephonic inductance and shuntage as to be substantially free of distortion.



NO. 767,764.—POWER-FACTOR INDICATOR.

767,828. Electric-connection Rosette. Mortimer Norden, New York, N. Y., assignor to the Norden-Bittner Electric Company, New York, N. Y. Application filed January 12, 1903.

Combined with a base of suitable insulating material are means for connecting the same to a support. A head portion of corresponding material coacts with the base, and between which parts there are apertures providing for the entrance of main conducting wires. The head has a central aperture for the wires passing to an incandescent electric lamp, and the inner ends of which are connected to the devices secured to the head.

767,833. Electric-current Regulator. Frank E. Phillips, Hydepark, Mass. Application filed April 13, 1904.

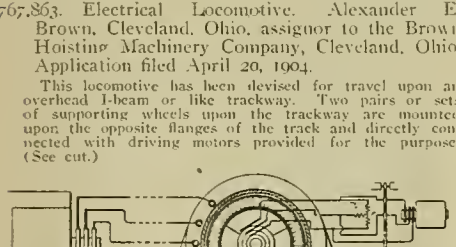
The regulator comprises a liquid receptacle with the terminal mounted therein and submerged in the liquid. A second terminal is movable within the receptacle. Other features are a rack-bar connected with the second terminal, a rack-adjusting shaft, a pawl-and-ratchet mechanism for holding the shaft, and a binding post in electrical communication with the terminals.

767,846. Base for Electrical Fixtures. Louis Steinberger, New York, N. Y. Application filed June 1, 1903.

The base portion is provided with a number of metallic members, each partially embedded therein, the metallic members each being provided with a slot for engaging the substance of the base portion, thereby preventing rotation of the metallic members. Each metallic member is further provided with a channel for engaging a wire, the channel being completely inclosed by the substance of the base.

767,863. Electrical Locomotive. Alexander E. Brown, Cleveland, Ohio, assignor to the Brown Hoisting Machinery Company, Cleveland, Ohio. Application filed April 20, 1904.

This locomotive has been devised for travel upon an overhead I-beam or like trackway. Two pairs or sets of supporting wheels upon the trackway are mounted upon the opposite flanges of the track and directly connected with driving motors provided for the purpose. (See cut.)



NO. 767,773.—POWER TRANSMISSION.

767,865. Brake for Overhead Electrically Driven Locomotives. Alexander E. Brown, Cleveland, Ohio, assignor to the Brown Hoisting Machinery, Company, Cleveland, Ohio. Application filed April 20, 1904.

A suitable braking apparatus for use with an overhead truck is described.

767,875. Electric-lamp Attachment. Henry D'Olier, Jr., Philadelphia, Pa. Application filed July 15, 1904.

In combination are a terminal carrying member, a number of lamps supported thereby and rotatable with respect thereto, and a rotatable shade for each of the lamps.

767,889. Electric Switch. Charles F. Hopewell and Charles H. Morse, Cambridge, Mass. Application filed December 31, 1903.

A circuit-controlling device, operating mechanism therefor, and an actuator connected with the operating mechanism are parts of the device. A frame or bar extends lengthwise of and in close proximity to the trolley wire and is adapted to turn on an axis in parallelism therewith.

767,900. Insulated Conductor and Process. John C. Lee, Brookline, Mass., assignor to the American Telephone and Telegraph Company. Application filed April 10, 1902.

This process of insulating electric conductors consists in applying to the conductors a liquid adherent coating thinned with a volatile solvent. The coating is fixed by drying out the solvent, and a hot-air blast is directed upon the conductors while being wound directly upon a reel.

767,916. Rheostat. Irving B. Smith, Philadelphia, Pa. Application filed December 3, 1903.

A number of switch-contact segments are mounted on a switch base and provided each with an extension. Resistance material is wound substantially normal to the extensions and is electrically connected thereto at intervals. (See cut.)

767,930. Safety Appliance and Speed-controlling Apparatus for Elevators. Theodor Eskilsson, Astoria, N. Y., assignor of one-half to Axel Magnuson, New York, N. Y. Application filed June 6, 1904.

An elevator provided with a dynamo or magneto-electric machine operatively connected to the car is in combination with electromagnetic means connected in circuit with the dynamo and means controlled thereby for causing the car to stop on attaining a predetermined or abnormal speed.

767,939. Trolley-pole Head. John E. Greenwood, Utica, N. Y. Application filed August 29, 1903.

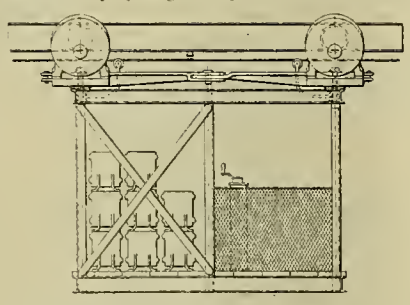
Horizontal oppositely disposed collector-carrying members are pivoted to the cap piece, and flat springs are secured at their central portions to the cap piece, the end portions of the springs engaging opposite sides of the members to maintain them in longitudinal alinement.

767,948. Insulator. Fred M. Locke, Victor, N. Y. Application filed August 30, 1902.

Details are described.

767,952. Block Signal. Charles H. Morse, Cambridge, Mass., assignor to the Uni Signal Company, Cambridge, Mass. Application filed May 22, 1903.

A danger signal and a safety signal and circuits therefor, and a signal-controlling switch are at each end of the block. A lighting magnet and a put-out magnet also at each end of the block have mechanical connections between the armatures of the magnets and the switcharm, whereby the switcharm is positively moved in opposite ways by the magnets, and the armature of the de-energized magnet is positively retracted. Means are provided for operating the put-out circuit and for simultaneously opening the signal circuit.



NO. 767,863.—ELECTRIC LOCOMOTIVE.

767,953. Telephone System. Frederick R. Parker, Chicago, Ill. Application filed December 14, 1903.

The system in combination with a telephone line consists of a source of electricity, a double armature relay connected from one limb of the line to the source, an impedance coil connected from the other limb of the line to the source, a signaling device adapted to be operated by the relay and a second signaling device placed under control of the relay when connection is made with the line. Means are provided whereby the circuit of the source is closed through the relay and impedance coil, thus operating both armatures of the relay, and there are means for shunting the relay when connection is made with the line, and thereby releasing one armature of the relay.

767,954. Trolley Wheel. Elijah W. Potts, Detroit, Mich., assignor to the Detroit Trolley Wheel and Electrical Equipment Company, Detroit, Mich. Application filed January 12, 1903.

767,955. Self-lubricating Trolley Wheel. Elijah W. Potts, Detroit, Mich., assignor to the Detroit Trolley Wheel and Electrical Equipment Company, Detroit, Mich. Original application filed January 12, 1903. Divided and this application filed February 8, 1904.

These two patents have reference to a trolley wheel in which the rim has interior short projecting lugs and the hub has exterior short projecting lugs, the two sets of lugs having complementary faces fitting into each other and securing both to form smooth outer surfaces. Partitions extend from the axle bore to the outer walls and divide the space into annular chambers or reservoirs substantially circular in cross-section, and a duct leads from each chamber or reservoir to the axle bore.

767,964. Electrolytic Apparatus. William J. Schweitzer, Whiteplains, N. Y. Application filed July 31, 1903.

An electrolyzing apparatus comprises positive and negative comblike electrodes alternately arranged in series, the teeth of the alternating combs in the series being relatively staggered, thereby affording tortuous passages for the material to be electrolyzed without appreciably retarding the flow thereof.

767,970. Apparatus for Simultaneously Transmitting and Receiving Space-telegraph Signals. John S. Stone, Boston, Mass., assignor to the Stone Telegraph and Telephone Company, Portland, Me. Application filed January 23, 1901. Renewed December 22, 1902.

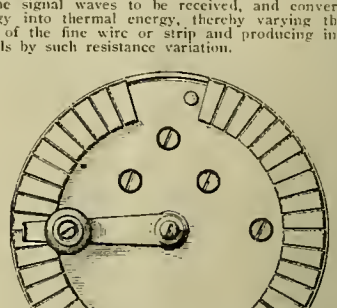
Means for developing electric vibrations in an elevated transmitting conductor are situated in a plane equidistant at all points from two or more receiving elevated conductors, and there are means for conveying the energy of the vibrations from the receiving conductors to an associated electrical translating device, whereby the branch containing the electric translating device or receiver is rendered conjugate to the transmitting conductor or conductors.

767,971. Wireless-telegraph Receiving Device. John S. Stone, Cambridge, Mass. Application filed August 11, 1902.

In a bolometer for detecting oscillatory currents is a resonant circuit, comprising the fine wire or strip of the bolometer and attuned to the frequency of the oscillatory current to be detected.

767,972. Method of Receiving Space-telegraph Signals. John S. Stone, Cambridge, Mass. Original application filed August 11, 1902. Divided and this application filed September 10, 1902.

The method of receiving wireless or space-telegraph signals consists in receiving the energy of the electromagnetic signal waves in an elevated conductor, conveying the energy to a resonant circuit, including the fine wire or strip of a bolometer and attuned to the frequency of the signal waves to be received, and converting the energy into thermal energy, thereby varying the resistance of the fine wire or strip and producing intelligible signals by such resistance variation.



NO. 767,916.—RHEOSTAT.

767,973. Method of Increasing the Effective Radiation of Electromagnetic Waves. John S. Stone, Cambridge, Mass., assignor to William W. Swan, trustee, Brookline, Mass. Application filed October 30, 1903.

This method consists in increasing the natural electrical conductivity of the surface of the earth surrounding the conductor for a radial distance equal approximately to a quarter-wave length of the transmitted wave and in maintaining the surface in a constantly conducting state by artificial means.

767,974. Apparatus for Increasing the Effective Radiation of Electromagnetic Waves. John S. Stone, Cambridge, Mass., assignor to William W. Swan, trustee, Brookline, Mass. Application filed October 30, 1903.

An elevated conductor for radiating electromagnetic waves is conductively connected at its lower end to a material of greater electrical conductivity than that of the earth, the material being in electrical contact with the earth and extending outwardly in all directions from the lower end of the conductor for a radial distance equal approximately to a quarter-wave length of the transmitted wave.

767,975 to 768,005. Space Telegraphy. John S. Stone, Cambridge, Mass., assignor to William W. Swan, trustee, Brookline, Mass. Applications filed November 24, November 25, December 8 and December 23, 1903, and January 15, February 13, February 15, February 23, March 23, April 11 and May 3, 1904 (Some applications were renewed on June 20, 1904.)

This is a series of 31 consecutive patents covering the Stone system of space telegraphy. It is an elevated-conductor system for developing free or unguided simple harmonic electromagnetic signal waves of a definite frequency, with a fundamental which has a period equal to the period of the waves to be transmitted and means for developing forced simple harmonic electric vibrations of corresponding frequency. Many details are described.

EXPIRING PATENTS.

Following is a list of electrical patents (issued by the United States Patent Office) that expired on August 23, 1904:

368,576. Conduit for Electrical Railways. F. Euphrat, Boston, Mass.

368,596. Electrical Resistance. W. H. Knight, New York, N. Y.

368,608. Secondary Battery or Accumulator. A. E. Peyrusson, Limoges, France.

368,628. Telephone. H. L. Todd, Washington, D. C.

368,650. Stop-cock for Electropneumatic-brake Systems. J. F. Carpenter, Berlin, Germany.

368,654. Electric Hose Coupling. E. H. Crosby, Boston, Mass.

368,674. Electrical Apparatus for Voiding Water Pipes. J. W. Kent and R. Orr, Brooklyn, N. Y.

368,692. Printing Telegraph. R. J. Sheehy, New York, N. Y.

368,745. Process of Tanning by Electricity. J. W. Aborn and J. Landin, Stockholm, Sweden.

368,765. Safety Catch for Electrical Circuits. W. J. Hammer, Boston, Mass.

368,766. Support for Electrical Conductors. M. J. Hart, New Orleans, La.

368,796. Portable Electric Propeller for Boats. G. Trouve, Paris, France.

368,804. Electrical Resistance Coil. C. D. Baker, Chicago, Ill.

368,809. Combined Electric Receiving and Transmitting Device. F. S. Carter, Burlington, N. J.

368,857. Electric Safety Lamp for Use in Mines. M. Settle, Snow Hill, Darcey Lever, near Bolton, County of Lancaster, England.

368,858. Printing Telegraph. R. J. Sheehy, New York, N. Y.

368,859. Printing Telegraph. R. J. Sheehy, New York, N. Y.

368,907. Fire-alarm Telegraphic Repeater. C. Burgher, Boston, Mass.

WESTERN ELECTRICIAN

EVERY SATURDAY

Vol. XXXV. CHICAGO, SEPTEMBER 3, 1904 No. 10

Neepsend (Sheffield) Turbo-electric Station.

By Frank C. Perkins.

The first steam turbine used for the Sheffield (England) system was installed in Sheaf Street generating station and is shown in the illustration on page 169 (Fig. 5). Two of these turbines were installed, each operating at a speed of 3,000 revolutions per minute, one having a capacity of 300 kilowatts and the other having an output of 500 kilowatts. They were built by C. A. Parsons & Co. and were operated in addition to several reciprocating engines, of the compound and triple-expansion condensing type, ranging in capacity from 300 to 900 kilowatts.

Fig. 1. General View of Works.

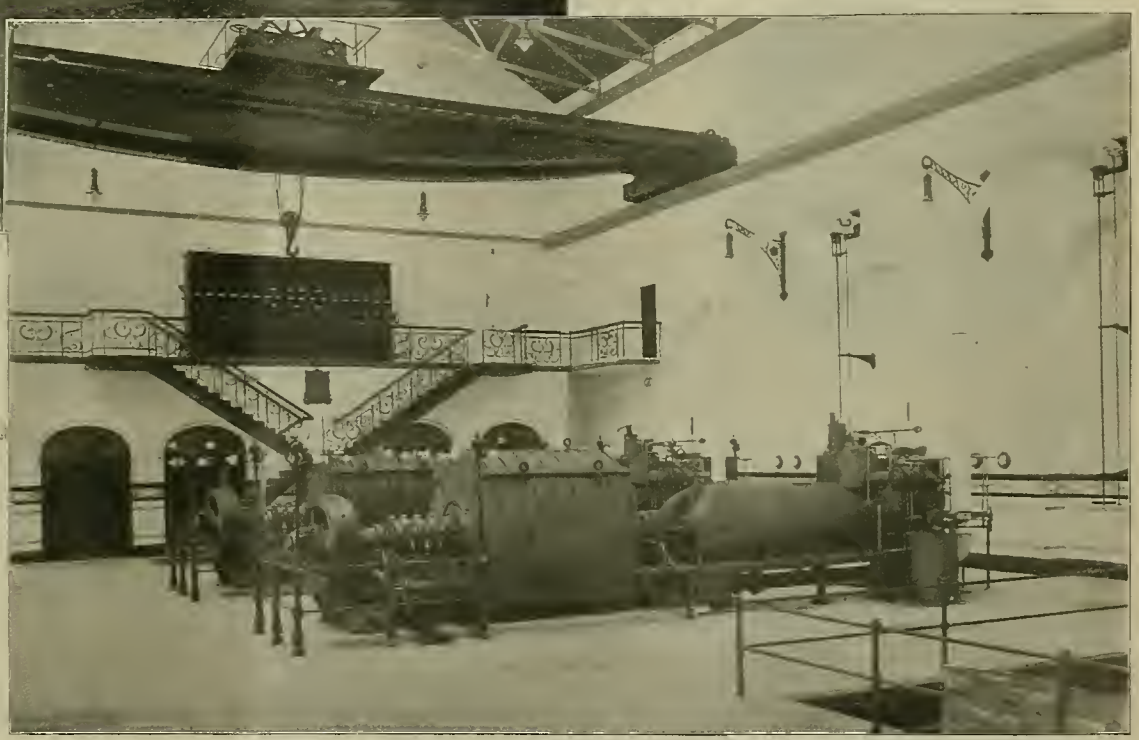


Fig. 2. Interior View In Turbine Room.
NEEPSEND (SHEFFIELD) TURBO-ELECTRIC STATION.

The new power house of the corporation of Sheffield is located at Neepsend, as shown in the accompanying illustration, Fig. 1, and drawings, Figs. 3 and 4. The present new station is located at the northern end of the site, which consists of 10 acres near the river bank. The power house will accommodate machinery for 6,000 kilowatts, half of which has already been installed. The interior of the new engine room is shown in Fig. 2. The turbo-generators in this room were built by Parsons & Co. of Newcastle-on-Tyne, each having an output of 1,500 kilowatts. These turbines are of the parallel-flow type and are equipped with safety governors for entirely cutting off the supply of steam, should the speed become too high for any reason, as well as the regular mechanical governors for regulating the speed. They are arranged for working under steam pressure of 190 pounds to the square inch at the stop valve and are bladed for running condensing, while the steam is to be superheated about 150 degrees Fahrenheit. Each turbine is directly coupled to the alternator by a flexible coupling, the exciters also being connected on the same shaft, which has a speed of 1,500 revolutions per minute.

The alternating-current generators are of the two-phase type, each having four poles with revolving armatures and fixed field magnets, the latter being of circular pattern with coils mounted on laminated pole-pieces projecting radially inward. These alternating-current armatures are of the tunnel-wound type, the windings being led through holes drilled below the surface of the core, in a direction parallel to the axis of the armature shaft. The generators supply current at 2,200 volts' pressure and a frequency of 50 cycles per second.

The exciter dynamos are of the four-pole type, supplying a current of 85 volts' pressure, only about one-half of one per cent. of energy being used in exciting the large alternators. The turbo-generator units in this plant each have a height of about nine feet and occupy a floor space 7½ feet wide and 34½ feet long. The bed plate of each unit weighs about 14,000 pounds, the main armatures 16,000 pounds and the field magnets 35,000 pounds. The lower half of the cylinder weighs nearly six tons, the spindle or shaft a trifle over three tons and the top of the cylinder 4½ tons.

The high-tension switchboard is shown in Fig. 2 mounted in the gallery, and consists of a steel framework, with panels of enamel slate. The switchboard panels, nine in number, consist of two groups of three feeder panels and two generator panels, together with one interconnector panel, all of which are equipped with horizontal edgewise instruments and automatic oil switches of the British Thomson-Houston type. The high-tension apparatus is arranged with series transformers for exciting all instruments and automatic attachments, which are in this way isolated from the high-tension circuit.

A motor-generator set of 50-kilowatt capacity has been installed. It consists of a direct-current generator of a pressure of 100 volts, coupled direct to a two-phase induction motor of 50 cycles per second and a pressure of 200 volts, the speed of the outfit being 750 revolutions per minute. The accompanying illustration (Fig. 6) shows one of the 500-kilowatt single-phase Burnard transformers installed in this plant, with the outer casing removed.

The trunk-feeder cables consist of two pairs of concentric cables working at a pressure of 2,000 volts, the distance between the two stations being about two miles. The total weight per mile of the cable is 47,640 pounds, the weight of copper per mile in the cable being 20,550 pounds, and the weight of lead 22,470 pounds. These cables are drawn into four-inch cast-iron pipes, and are of the Diatrine paper lead-covered type. They were tested for conductivity, the standard being 0.0512 ohm per 1,000 yards, with a 2½ per cent. variation allowed for the outer conductor.

A view in the boiler room at this station is shown in Fig. 7. The boiler room is 109 feet long and 70 feet wide, the total height from the floor to the roof being 63 feet. The coal and ash plant is so arranged that the fuel is discharged from the railroad cars or from the storage room directly into the steel coal chutes, which are fitted with breeching and measuring chambers, the coal falling by gravity into the stoker hopper, the valves being so arranged that each charge is measured automatically and the amount of coal registered on the hopper. A two-phase alternating-current motor operates an elevator, consisting of a series of buckets carried by an endless steel chain. The buckets overlap each other to prevent the mechanical and chemical action from destroying the steel chain by their contact. Dumping cars are used for taking the ashes from the boilers, a tunnel being provided below the elevator into a storage bin, from which the trucks are loaded.

There are at present installed two Stirling boilers of five-drum type, each of which has 6,210 square feet of heating surface, with a superheater capable of dealing with 30,000 pounds per hour, which is the full output of steam at full load. The efficiency

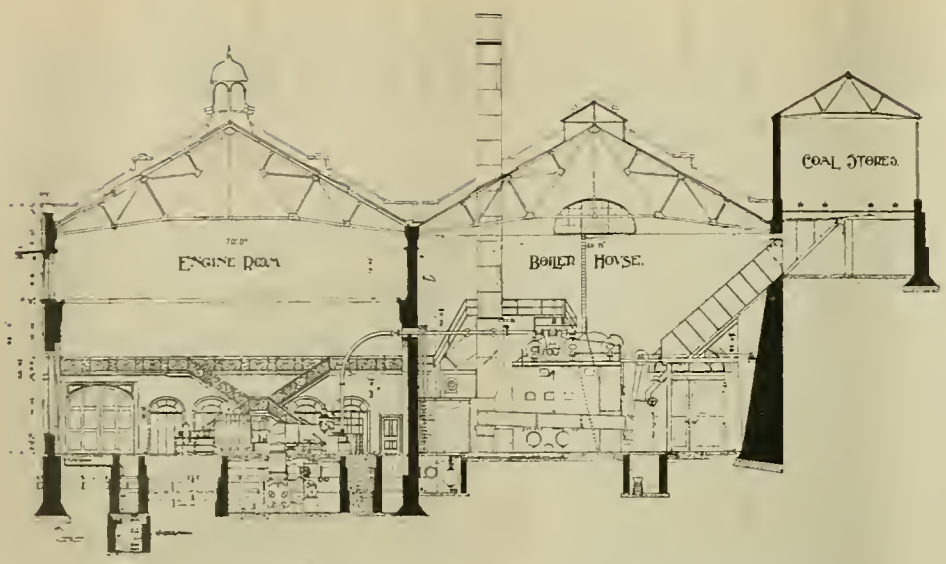


FIG. 3. TRANSVERSE SECTION OF NEEPSEND (SHEFFIELD) TURBO-ELECTRIC STATION.

of these boilers is said to be above 80 per cent. Each boiler has two mud drums three feet in diameter and three steam drums, each 3½ feet in diameter, connected by four banks of tubes of weldless steel, having an outside diameter of 3¼ inches. The stokers are driven by two-phase alternating-current electric motors for each boiler, each having a capacity of 2½ horsepower. Each boiler is supplied with air by a Sturtevant fan operating at a speed of 580 revolutions per minute and capable of discharging 45,000 cubic feet of air per minute against water pressure of 2¼ inches.

Two two-phase motors of 35-horsepower capacity each are used for driving the fans, each motor being provided with a starting rheostat and a speed-regulating rheostat for six speeds. There are three feed pumps installed of the Worthington long-stroke vertical double-acting type, two being capable of feeding all of the boilers, which will ultimately be four in number, with one pump held in reserve.

S. E. FEDDEN, MANAGER OF SHEFFIELD ELECTRICAL PLANT.

The accompanying illustrations, drawings and data were supplied by Mr. S. E. Fedden, general manager and engineer of the Sheffield Corporation Electric Supply Department, whose portrait accompanies this article. Mr. Fedden is to visit the St. Louis Exposition and expects to arrive in this country this month to attend the International Electrical Congress.

Space Telegraphy Across Lake Baikal in Siberia.

Upon a suggestion of Prince Khilkoff, who is the present minister of roads and communications in Russia, a space-telegraph system across Lake Baikal has been started between the stations of Baikal and Tankha. It was intended at first to use the Popoff system, but at length it was decided to employ the Slaby-Arco-Braun system, which is exploited by Siemens & Halske of Berlin.

The apparatus of that system has been tried at a distance of 75 kilometers, at which the transmission of messages proved very satisfactory. The distance across the lake being only 40 kilometers, competent officials expect to obtain the best results.

The expense of the construction will be supported by the administration of the railroad at Zabaikal and Krougobaikal (behind the lake and around the lake).

A German engineer of the company as well as some of the apparatus have just arrived on the site of the Baikal station. Two antennæ, each 45 meters high, connected with a steel wire 65 meters long, will be placed behind the railroad station; the wireless station will be situated between the antennæ. The electric current will be supplied by the central station, which was started some time ago for lighting purposes. Another wireless station, similar to the first, will be erected on the opposite shore of the lake.

Space-telegraph Operators Back From the Far East.

H. J. Brown and H. E. Ahearn, two space-telegraph operators who successfully installed and operated the De Forest stations at the seat of the Russo-Japanese war, which supplied news to the London Times and the New York Times, are now back in this country. The stories which they relate of their experiences are interesting.

These two young men are typical young Americans. Mr. Brown is a little over 30 years old and Mr. Ahearn but 21. During the time of their service Mr. Brown was in charge of the apparatus aboard the Haimun, the little vessel which gathered the news first-hand, and Mr. Ahearn was the operator in the shore station at Wei-hai-Wei. Great difficulty was experienced in getting the equipment in place, but when once started the service went on regularly up to the time of the capture of the Haimun by the Russian cruiser Bayan. Then came the edict of Russia and the refusal of the Japanese government to permit the Haimun to gather news except in a limited zone, which made necessary the dismantling of the ship and the abandonment of the service.

Some extracts of the experiences of these operators as printed in the New York Times will be of interest. On January 16th at noon the two young men were employed in their usual duties at the De Forest offices in New York, when they were told to get ready to leave for Japan within 24 hours. This they did, and in 24 hours they and their apparatus were started on their long journey. They arrived at Shanghai, where the Haimun had already been chartered. Here they encountered delay in getting their goods through the custom house, as it was the beginning of the Chinese new year, which is celebrated for several weeks, and no Chinaman wants to work at that time.

The Haimun was tied up in a shipyard, putting the topmasts on each of her masts, which were essential in the stringing of the aerial wires. The timbers for the topmasts had already been secured. One was of Chinese pine, the other of bamboo. As it turned out, neither wood would do, for the party had barely made a good start for Wei-hai-Wei when the masts broke off short in the rough sea which was encountered.

At Wei-hai-Wei things were in pretty bad shape. It had been arranged to establish the shore station for the receiving end of the work on the top of the hill on the island of Liao-Kung-Tun, which is about 350 feet above the sea. There it was necessary to erect a pole 170 feet in height for the receiver. There was a miscellaneous lot of flagpoles and masts from which to piece the pole together. This work was completed, after one disastrous attempt, by the aid of about 100 sailors from nearby British cruisers, the pole being erected in two sections. The engines and apparatus were then housed in shacks built for the purpose.

In the meantime the Haimun had returned to Nagasaki, where an Oregon pine topmast was put in place. The transmitting apparatus was easily rigged up. Captain James (the London Times' correspondent) was on the Haimun, accompanied by Captain Tonami, the Japanese censor detailed to accompany the vessel on her cruises, and see that the news she sent was all right. This Japanese officer was very lenient throughout the time the ship was engaged in service, allowing nearly all the messages to be transmitted as written.

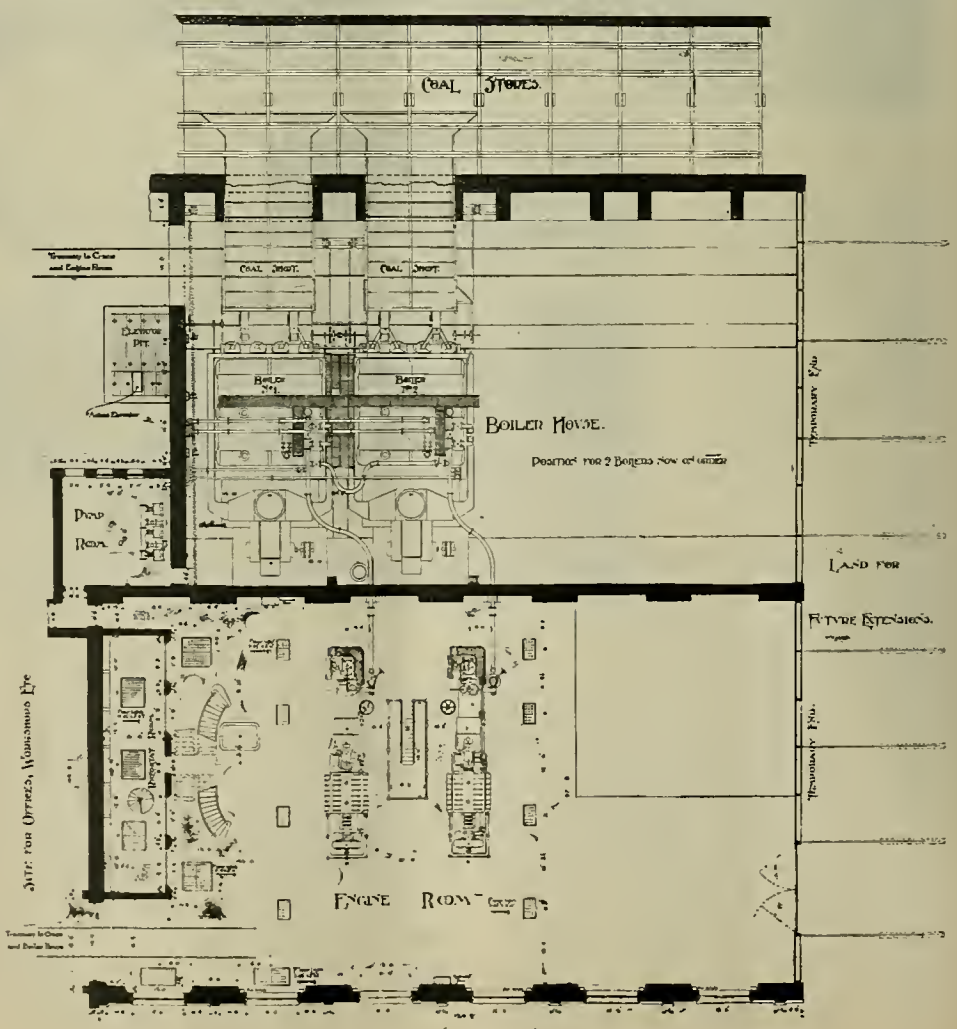


FIG. 4. PLAN OF NEEPSEND (SHEFFIELD) TURBO-ELECTRIC STATION.

Once the pole at the shore station was blown down by a typhoon and had to be put up again. Sometimes messages were received from distances of over 200 miles—once, it is said, from a point over 240 miles away. Every day the news came right from where things were happening, and as fast as received was taken over to the office of the Eastern Extension Telegraph and Cable Company, a mile and a half over the hill, by a Chinese runner, who would cover the rough journey in about 12 minutes, and worked for $4 a month in American money. There was thus but little delay. In less than half an hour after a message started, and it started as soon as anything developed, it was on its way by cable.

Mr. Ahearn did not make any cruises on the Haimun. He was ready for duty day and night at the shore end, but the thrills of the game came to Mr. Brown, who was in the very thick of every adventure in which the vessel figured.

The second bombardment of Port Arthur, in which the Haimun was with the Japanese fleet, was a spectacle of inspiring grandeur. The little ship

FIG. 5. ORIGINAL STEAM TURBINE IN SHEAF STREET STATION, SHEFFIELD.

was right there all the time from the firing of the first gun until after the bombardment was over, and was still in plain sight of Port Arthur when the Petropavlovsk came out of the harbor and ran into the mine which put an end to its career.

After cruising about for a few days subsequent to the bombardment there came a message from Mr. Ahearn in Wei-hai-Wei saying that the Russians had announced that those on board would be treated as spies if captured. It is hardly necessary to say that the ship's course was changed, for it was at the time pretty close to Port Arthur and drawing closer.

There followed a long series of negotiations regarding the privileges of the correspondents so far as the Japanese were concerned, and finally orders were issued forbidding them to go any further north than a line between Chefoo and Chemulpho. Personal appeals at Tokio made no difference, and it was at length determined to dismantle the shore station and return the Haimun to her owners.

From London come these further details, which are of interest: Wireless telegraphy has established itself as an indispensable adjunct to naval warfare. It has proved invaluable to the Japanese, who use it on all their warships. The Russians also have made excellent use of it, but with not so much success. Wireless telegraphy played an important part in the engagement on April 13th, when the Petropavlovsk was sunk. It was a wireless message from a Japanese ship, intercepted by the Russian Vladivostok fleet, that enabled the Gromoboi to sink two Japanese transports. Again, wireless messages from Togo warned Kamimura of the escape of the Port Arthur fleet.

Later the cruiser Tsushima, after its fight with the Russian cruiser Novik, was able to summon the cruiser Chitose to its assistance.

The correspondent of the Times, whose dispatch boat, the Haimun is [or was] equipped with wireless-telegraph instruments, gives an interesting record of his experience with the system in the present war. With a wire mast 102 feet high he has been able to transmit messages to the land station at Wei-hai-wei from a distance of from 100 to 210 miles at sea. One message of 1,000 words was sent and received without a bungled word. The Times correspondent on the Haimun always received both Russian and Japanese messages, but as they were in cipher he never understood them, but they enabled him to estimate the approximate distance of the vessels of either belligerent.

One operator on the Haimun became so expert that he could tell if a Russian ship was at sea by listening for the answering communication from the shore. He could also detect whether Japanese messages were being transmitted by relay to the naval base or whether Togo's fleet itself was at sea. On April 9th messages from Bundegi Island to Wei-hai-wei, 180 sea miles, were sent and acknowledged. During the engagement on April 13th, wherein the Petropavlovsk was sunk, the Times' boat did not use the wireless till the battleships engaged with the batteries, as its use would have interfered with the wireless instruments on both the Russian and Japanese warships, which the Haimun could hear. The Russians kept repeating the alphabet over and over in order to "queer" the Japanese instruments. The Times' correspondent believes that this fact prevented Togo from coming up in time to catch Makaroff outside. It was only when the Russians stopped the "queering" process in order to receive a message from the cruiser Bayan that the Japanese decoy squadron was able to send its message. The Haimun receiver took both the Japanese and the Bayan messages.

Thawing Ice in Water Pipes by Electricity.

A reader of the Western Electrician asks where literature may be found upon the subject of thawing ice in water pipes by electricity. This is a question which has frequently come up for discussion, especially within the last year, though the method was successfully demonstrated some years ago. The Western Electrician of March 4, 1899, contained an article on "Thawing Ice in Buried Pipes by Electric Heat," describing the alternating-current method of Mr. Francis H. Soden of Chicago. A similar system appears to have been applied about the same time, and independently, by Professors D. C. Jackson and R. W. Wood of the University of Wisconsin. Since that time various articles have appeared in this and other journals relative to the subject. Among recent references in the Western Electrician are a contribution from E. Peterson (March 26, 1904, p. 253); "Thawing Ice in Water Pipes by Electric Heat" (April 2, 1904, p. 265), and a short discussion at the meeting of the Iowa Electrical Association (reported in the issue of April 30, 1904, p. 350). In the "Wrinkles" of the last National Electric Light Association convention Edward S. Goldthwaite of Suffield, Conn., and H. A. Fee of Adrian, Mich., contributed data on the subject. In the Question Box presented at the same convention there were 12 answers to a request for information on this subject. Among those who gave answers were William R. Gardener of Pittsfield, Mass., the Fair Haven (Vt.) Electric Company, Little Falls (Minn.) Water Power Company, Light, Heat, Transit and Public Service Company of St. Cloud, Minn., Fred B. Hubbell of the Westport (Conn.) Water and Electric Light Company, H. B Gear of the Chicago Edison Company, Sherbrooke (Ont.) Power, Light and Heat Company, E. P. Coles of the Philadelphia office of the General Electric Company, Edgar B. Greene of the Altoona (Pa.) Edison Company, and the New York Edison Company.

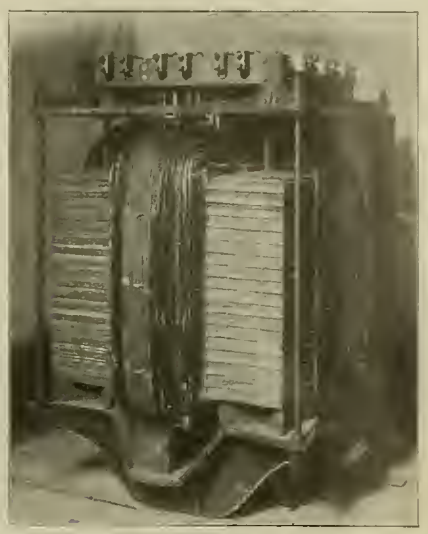


FIG. 6. NEEPSEND (SHEFFIELD) STATION.—500-KILOWATT TRANSFORMER WITH T CASE REMOVED.

The Price of Rubber.

A prominent rubber merchant in Berlin asserts that the recent advance in the price of Para rubber is not due to a scarcity of the material, as the production has slowly increased, but it is solely to be attributed to manipulation on the part of the English raw-rubber merchants. There are 10 prominent firms in the English market which, it is said, completely dominate the market, and which maintain prices on a high basis. To some extent these firms, the Berlin representative is further reported to have been informed, seek to produce an artificial scarcity of material by the accumulation of stocks, especially at Liverpool.

The growing of Para rubber in the Malay states, according to investigations made by O. F. Williams, United States consul-general at Singapore, is not only proving successful, but in the future is likely to command the world's attention. The growth is continuous, and, when the trees are cared for, is amazingly rapid, as heat is perpetual and rains frequent. As the Philippine Islands are in the same latitude and have superior soil, Mr. Williams suggests that everything be done to encourage the development of rubber plantations in those islands.

It is also reported that vast areas of hitherto-unknown rubber trees have been recently discovered in the interior of Brazil.

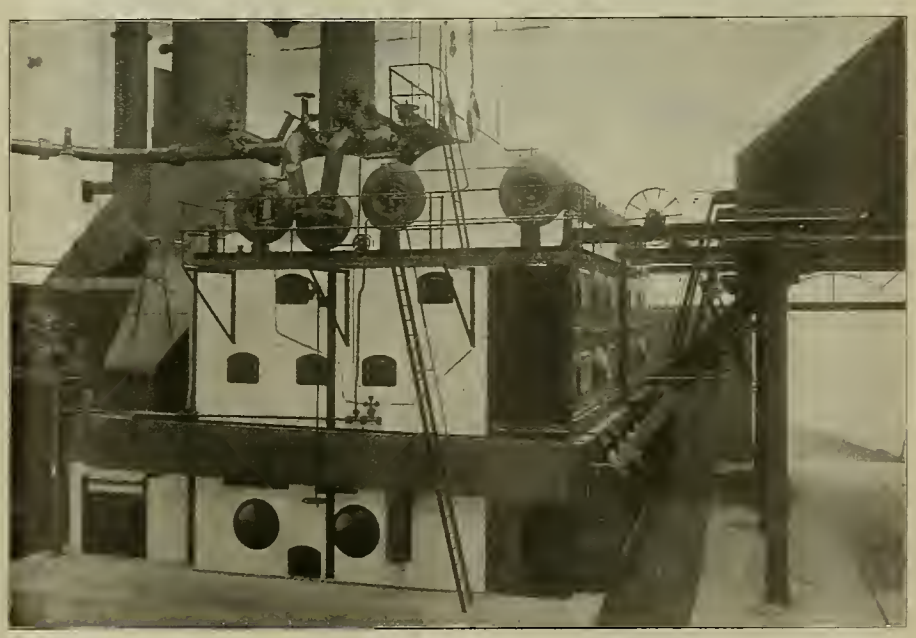


FIG. 7. NEEPSEND (SHEFFIELD) BOILER EQUIPMENT.

Relation of Electric-heating Devices to Central Stations.[1]

By H. W. Hillman.

It will be my purpose in this paper to set forth the many ways and means by which this new department will begin and continue to grow; and to emphasize particularly the relation of electric-heating devices to the central stations. In order to avoid all confusion in considering the paper I divide the subject into two parts: First, lighting-circuit devices; second, heating-circuit devices.

Lighting-circuit Devices.

1. Variety and extent of devices for lighting circuits.—There is almost an endless list of convenient devices of surprising variety; from the coffee percolator in the dining room to the heating pad in the sick chamber; from the bread toaster in the kitchen to the hot-scotch heater in the den, and egg boilers and water heaters of all sizes and kinds.

Fig. 1. Suspended Unit.

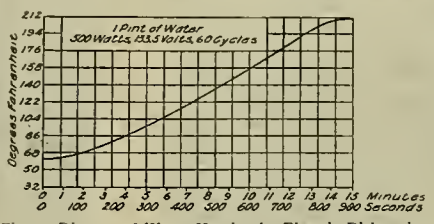


Fig. 2. Diagram of Water Heating by Electric Disk and Kettle.

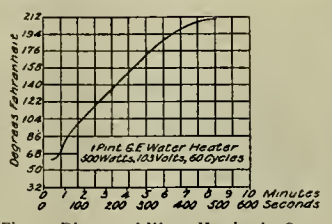


Fig. 3. Diagram of Water Heating by Suspended Unit.

Fig. 5. Kitchen Heating Table with Utensils and Oven.

ELECTRIC-HEATING DEVICES.

Fig. 1 illustrates a form of the General Electric "suspended-unit" heater, which transforms an ordinary utensil into an individually heated one. So extensive is this line of devices that the dishes purchased from the five and 10-cent store will be as available for use with electric-heating units as the nickel and silver-plated cooking utensils have been in the past. Every household with electric-lighting circuits will demand these convenient devices. They will be so commonly known and will become so indispensable as a household utensil that additional residence customers will quickly follow. When the people once appreciate the benefits derived from such devices they will demand them as a common household utensil.

FIG. 4 HEATING TABLES ELECTRICALLY EQUIPPED.

2. Edgewise winding and durability of heating unit.—In describing the edgewise winding used as a heating unit, particular attention is called to its simple construction. With this design the dishes are so made as to afford perfect ease in disassembling for repair. The units are the same dimensions, the dishes being suitable for either 250-watt or 500-watt units. Thus standardization is effected and utmost simplicity assured. This is an essential point in favor of extensive use.

3. High efficiency of new heating devices.—The liquid [in a "centrunit" heater] immediately surrounds the unit and the heat must necessarily dissipate itself through the liquid. Lightning "impartivity" of the heat to the liquid is thus secured. Even imagination cannot conceive of a more perfect design with respect to high efficiency. The diagrams (Figs. 2 and 3) show the rapidity with which water can be heated with the "centrunit" heater compared with the disk stove and an ordinary cooking utensil. Suffice it to say that the use of the disk stove should be confined to toasting bread and should forever disappear as a utensil for heating water. The pint water heater in the bathroom is a source of utmost convenience for hot drinking water and for shaving water.

4. Cost of operation.—The egg boiler is likewise a "centrunit" device. It accommodates six eggs, and with a 500-watt winding will cook three-minute eggs in 10 minutes' time. At 10 cents per kilowatt-hour the cost of boiling six eggs, with the "centrunit" egg boiler, is eight mills, or approximately one mill per egg.

1. Abstract of a paper read before the Ohio Electric Light Association at Sandusky, Ohio, August 16, 1904.

The coffee pot, the coffee percolator, the baby-milk warmer, water heaters and all other such devices are of the "centrunit" type, insuring minimum cost of operation. To heat a pint of water for shaving costs but two-tenths of one mill. To boil coffee for breakfast for a family of the average size costs but eight-tenths of one cent.

The initial cost to the people for the new heating devices is well within the reach of all. The central station has now arrived at a period when initial cost and operating cost of electric-heating devices will be no more considered by the people than a five-cent fare on an electric-railway car. In making this statement I have in mind those cities and towns where I know the central station will purchase the devices and sell them to the people at cost, because they are current-consuming devices.

When a department store secures an article or a new line which it is believed will appeal to the people the utmost vigilance is exercised in its introduction and to promote sales. The same relation exists between the central station and the people in respect to electric-lighting devices and the extension of industrial motors. It is common knowledge that central stations do advertise and aggressively promote the use of devices which consume current, but I desire to emphasize the point that now the time has arrived when electric-heating devices should be advertised, introduced and extended by the central stations among their residence customers.

5. Electric-heating tables in furniture stores.—One of the first mediums for advertising the words "electric heating" is offered in connection with tables. Fig. 4 illustrates four such tables—one for the kitchen, two styles for dining room, and a nursery or invalid's stand for the bedroom. The furniture and department stores are ever anxious to introduce a fad. Electric tables are novel and offer excellent opportunity for attractive advertising. A window display of electric-heating tables, with a few devices in operation from the common lighting circuit, would draw customers who would purchase other commodities.

6. Electricity versus gas, etc.—The baby-milk warmer offers a convenience in the bedroom which is not possible with any other method of heating. The coal range never provided such a convenience. A gas range located in the kitchen is useless in the bedroom. Where bedrooms are piped for gas it is necessary to have the gas burning continuously or else to light a match whenever heat is wanted.

The electric flatiron offers a splendid illustration of a convenience that cannot be secured with gas. To do the average family ironing at a 10-cent rate it costs the residence customer the nominal sum of 22 cents, yet the annual income to the station is more than $5,000 for 500 irons only. Each iron will earn about $11 annually, or nearly one-third of the income from the average residence customer for lighting. This refers to simply one electric-heating device. These devices may appear insignificant to you, but when introduced in all residences and taken collectively they present an extensive current-supply business. It is not a waste of time to dwell on such matters. You cannot possibly induce a residence customer to turn on an incandescent light during the numerous pleasant summer days, while hot water and other such conveniences are both demanded even on such days. The baby must eat regardless of season. On a Sunday morning you cannot induce customers to operate motors; nor at 11 o'clock at night. On the other hand, the chafing dish is demanded for entertaining purposes and heating devices are convenient even on Sunday.

Heating-circuit Devices.

From the foregoing it follows naturally that every one of the central-station employes should commence to study this subject and should become acquainted with electric-heating devices. The subject differs from industrial motors with respect to personal trial. It is more like incandescent lighting. The trial should not end with lighting-circuit devices, but should extend to cooking, baking and ironing devices. An assortment of utensils comprising such an outfit is shown in Fig. 5.

In an average family of five, with a servant of ordinary intelligence, with a five-cent rate, and with no attempt at economy, it will cost an average of $6 per month to cook, bake, iron, turn on the air heater occasionally, and use the chafing dish now and then for evening entertainment. It is my opinion that cooking, baking and ironing can be accomplished for an average of $4 per month at a five-cent rate for a family of four or five persons after devices have been operated longer and are better understood. Gas stoves have been introduced so extensively and the electric-cooking and baking outfits are so little known even by central-station people that it will require strenuous effort to build up a large business.

When the motor business confronted you several years ago there were many obstacles to be overcome. It did not become a successful business in a day. When the gas companies commenced to realize the value of the heating load to their business there were obstacles to be overcome, but they have been boldly and effectually surmounted, with the result that a magnificent business was established.

In the next six months your investigation will prove that electric-heating devices possess remarkable merit. Then the same aggressive methods adopted by the gas companies and by your motor department will produce wonderful results. The devices are attractive to the people, and no other branch of your business will be more interesting or easier to promote successfully.

Rates of charge will become an easy problem to solve. Today the motor rate may not be exactly the same as the lighting rate. In the sale of current circumstances require variation in rates of charge. It is common for gas companies to make a lower rate for heating than for lighting. It frequently happens that the rate for current in one city varies from that in an adjoining town. The central station has met with an easy problem in establishing a motor rate, and it will be no more difficult to establish a heating rate. Surely enough has been said and written in connection with rates of charge so that every central-station manager is fully informed on the subject.

Explanation of instantaneous electric water heater.—This device will be of great assistance to central stations. It is proposed to make it small in size; to be screwed to any threaded water faucet; to be installed in connection with any washbowl without materially disturbing existing plumbing, and to be placed on any shower bath and furnish water of any temperature without a special water mixer for cold and hot water. For new houses a "one-faucet, one-pipe electric system" will be the cheapest, most convenient and latest hot and cold-water system yet known. One heater in the kitchen, one in the laundry, one over the bathtub and one over the washbowl, would complete the residence equipment. Instead of heating 30 gallons of water in a tank, together with 100 feet of piping, to secure a little hot water for breakfast dishes or for bathroom use, the instantaneous electric heater will furnish a half gallon of water per minute at 100 degrees temperature. It will flow a faster stream at lower temperature, or a slower stream at higher temperature. The intermittent service harmonizes with household practice and maintains operating expense at a minimum. For an average house the hot-water piping and tank alone requires an investment of $150 to $250, depending upon the class of material used. The instan-

FIG. 6. ELECTRIC AIR HEATERS.

taneous electric water heater will not only be more convenient and have higher efficiency, but will effect an economy in first cost of installation.

Electric-air heaters.—Three styles of heaters are shown in Fig. 6. Service shows that they are practical devices for auxiliary heating in the spring and fall seasons. In the North, East, South and West there is certainly a large demand for air heaters, and the new era in connection with heating devices should popularize and extend the use of electric air heaters. Operating costs and the initial cost of heaters should be made known so that individuals building houses can intelligently consider them.

Special wiring and contracting engineering.—It is well to cover this point fully, as it is frequently mentioned in discussing heating devices. The central-station manager will find his company in the same position as the gas companies when gas stoves and heaters were presented to the public. A campaign is necessary on the subject of wiring. Let us encourage the contractor to advertise his own business. Let him issue monthly flyers illustrating how easily special wiring can be done. Every gas customer secured might have been a customer for the contractor and the central station! Where is the contractor's catalogue? Why not show plans of wiring; a good-sized print; red lines for lighting wires; blue lines for heating circuit? Why not make photographs of certain attractive features of house wiring which represent excellence of design and skilful work? Why not make a profession of contract engineering? Why not show the circuit and outlet for the flatiron? This whole subject means a campaign of education among the people and the electrical contractors. It will not be long before the wiring of residences affords double the income to the contractor. Every house will be wired with a circuit to the kitchen for the cooking and baking outfit, just as a chimney has been always furnished with the house for a stove. Every owner will vie with other real-estate men to have the latest and most-improved accommodations for electric-heating devices. Almost all houses nowadays are wired for lighting. The time has come for central stations and for electrical contractors to advertise and promulgate the best and latest methods of house wiring. Let us all strive to have every new house wired for heating as well as lighting devices. Figs. 7 and 8 illustrate this at a glance.

Discussion.

J. H. Perkins thought that in order to insure its adoption by people generally, cooking apparatus using electrical current must appeal to the pocketbook of the consumer in economy of current; also, that it might be well to devise either a double wiring that would provide for two classes of use, as is the case with fuel and illuminating gas, or some means to offset the disadvantages met with in the cooking for one meal at least being done at the peak load.

E. F. Gwynn stated that the electric oven when tried in his household had not proved satisfactory to the culinary department because of the slowness of the oven. He thought if electric cooking were generally adopted most stations would have to greatly enlarge their capacity. Mr. Hillman, on the other hand, had not found this difficulty in his experiments. The oven should be heated in advance to the requisite degree before placing the loaves in it, and he had seen excellent results obtained. Mr. Hillman kept a careful record of current consumed in his home for cooking purposes, and the results showed that 56 per cent. of the current so used was taken between 10:30 a. m. and 2:00 p. m. during the day, and 36 per cent. of it was taken betwcen 6:30 and 10:30 a. m., and only 11 per cent. taken between 4 p. m. and 8 p. m. That would be an ideal situation, but he hardly thought it was fairly representative, and that probably in the average case more cooking and baking would be done on the peak of the load of the central station.

Thomas F. Clohesey asked what Mr. Hillman thought as to the reliability of the various forms of heaters and ease of restoring fuses without causing any alarm on the part of the servant, improvement in which respect he thought would speed the day when electric heaters would be generally adopted. In reply, Mr. Hillman gave as an example of what could be done, the recent improvement in flatiron construction. This improvement is such that, when attached to a chandelier, if the iron is carelessly dropped by means of an appropriate spring attachment it was impossible to break the contacts out. It was only within the last two or three years, the speaker admitted, that heating units have become reliable.

M. E. Turner asked how the central station can be reasonably expected to give a lower rate at noon than at six o'clock in the evening? He granted that the heating load would earn a lower rate, just as the motor load had earned a lower rate, but in neither case should this be on account of the time of the maximum load buf because of the length of time used. Almost all these devices cross the maximum load on the station, because, especially in winter, in the cities the maximum starts up on dark days along about 2:30 or 3 p. m. As the motor and heating load is built up the load curve will flatten. Users should be charged for their proportion of standing charges, whether their maximum comes at 12 noon or six at night. Some sort of cooking is done almost all day long during the summer months.

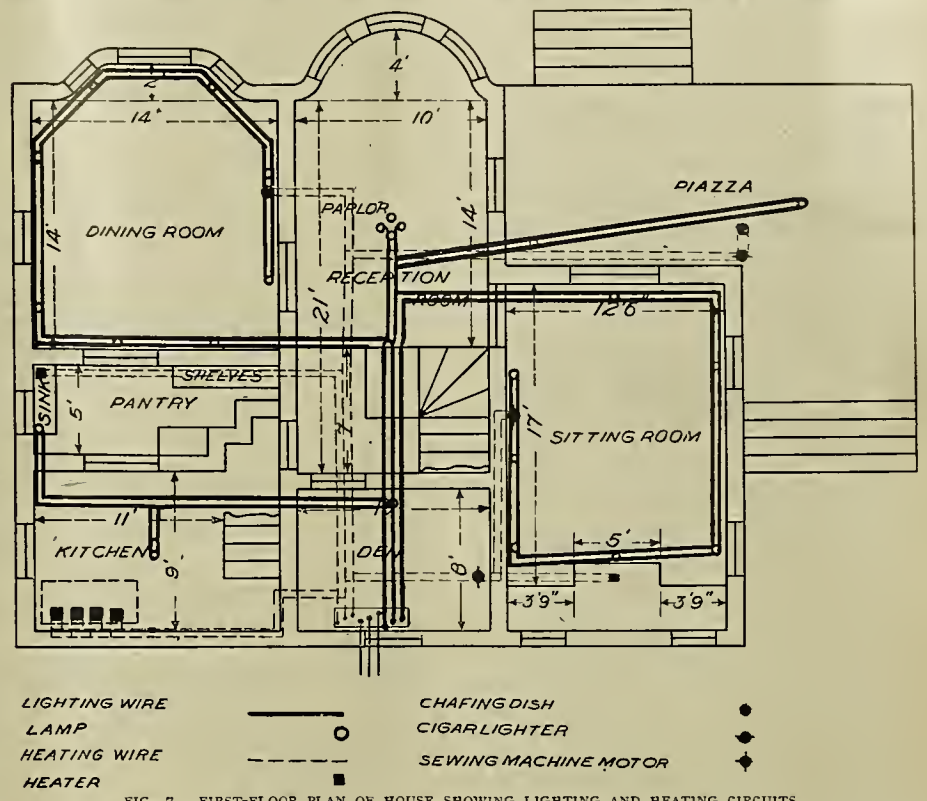


FIG. 7. FIRST-FLOOR PLAN OF HOUSE SHOWING LIGHTING AND HEATING CIRCUITS.

Mr. Clohesey seemed to think that the question of "peak" has been made too much of a bogy in the past, and that when business developed at any time of day in sufficient amount requisite machinery and equipment would be developed to take care of it; he was rather concerned with the question of the reliability of heating and cooking devices, and the other phases of the matter, so far as the distribution of the load, would take care of themselves, and also the question of rates for such service. If people, by means of the reliability and convenience of these new electric devices, can be induced and will adopt them gladly, the demand will be established and station men will find a way to meet it. As to what could be done in the way of educating a demand, he gave as an instance the work done in Cincinnati by the local plant there in establishing a school for demonstration of gas stoves and the success that had attended that enterprise. Heating and cooking electrical devices will be adopted many times not because of their economy alone, but because of their desirability and convenience when reliable in action. It is "up to" the manufacturer to make them so within reasonable limits. He predicted in the next five years an extraordinary development along these lines.

S. S. C. Ayres agreed with Mr. Clohesey that perhaps too much stress had been laid on the peak of the load proposition in the last few years. In his city (Greenville) they had a system which took care of that question very nicely. There are a large number of costs to the central station that are in no way dependent upon the amount of current produced, but are measured by the size of the station or its capacity to produce a maximum amount. Such are officers' salaries, dividends, and a large number of costs of that kind. In his city the central station is divided into two general heads. The figures are taken from the books of the secretary showing actual expenditures for all classes and are placed under one or the other of two columns, in one column being placed all costs that do not vary with the amount of daily consumption of current, but vary simply with reference to the size of the station; and in the other column all costs that vary with the amount of current produced. As a result, after examination and deductions were made it was found that the cost per kilowatt per month of connected load, provided it was turned on at all times, was $3. Accordingly consumers are charged $3 per kilowatt per month of connected load, and in addition a charge is made at a uniform rate for hours turned on, which latter charge varies with the amount per month consumed. Both the consumers' and the company's interests are served and the rates are mutually satisfactory. The consumer finds his bills are more uniform throughout the year, which suits him better than a meter basis, and the company is likewise protected because the arrangement is an equitable one.

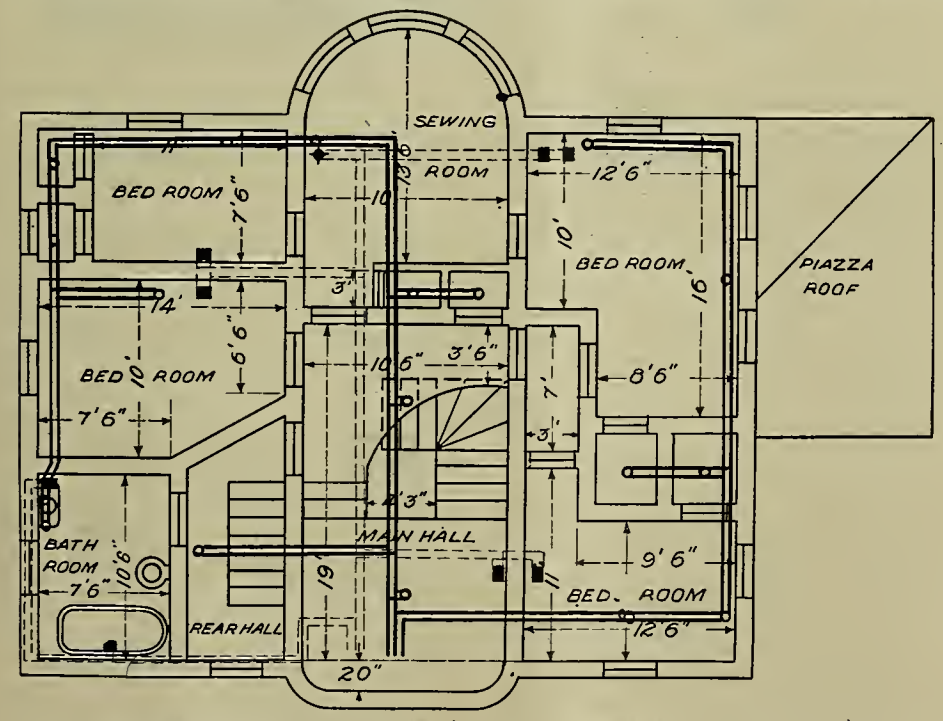


FIG. 8. SECOND-FLOOR PLAN OF HOUSE. (CIRCUITS AND DEVICES AS INDICATED IN FIG. 7.)

WESTERN ELECTRICIAN

EVERY SATURDAY.

PUBLICATION OFFICES:
510 Marquette Building, • CHICAGO.
TELEPHONE, MAIN 1746.

Eastern Office, 193 Times Building, New York.
Telephone, 3806J Cortlandt.

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted. This paper is entered at the Chicago postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the old address as well as the new should be given.

CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—**the only general electrical paper published in the West**—thoroughly covers a territory *exclusively its own.* THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be furnished on application.

REMITTANCES.—All checks, drafts and other remittances should be made payable to the order of the publishers, the **Electrician Publishing Company**, and addressed to the offices of publication, Suite 510, Marquette Building (204 Dearborn Street), Chicago, Illinois, U. S. A.

CONTENTS OF THIS NUMBER.

Neepsend (Sheffield) Turbo-electric Station. By Frank C. Perkins. Illustrated 167, 168, 169
Space Telegraphy Across Lake Baikal in Siberia 168
Space-telegraph Operators Back from the Far East.. 168, 169
Thawing Ice in Water Pipes by Electricity 169
The Price of Rubber 169
Relation of Electric-heating Devices to Central Stations. By H. W. Hillman. Illustrated. With discussion. (Ohio Electric Light Association) 170, 171
Editorial 172
Procopius Diviss, a Neglected Scientist. By Dr. J. Rudis-Jicinsky. Illustrated 173
Electrical Jurors of Award at St. Louis 173
Entertainment of Foreign Electrical Engineers 174
Northwestern and Municipal Associations at St. Louis.. 174
Franchise of the New York, Westchester and Boston Railway Company 174
Standard for Checking Service Meters 174
World's Fair Visitors of Last Week 174
Typewriter Said to Be Actuated by the Spoken Word.. 174
Edison's Apparatus for Vacuously Depositing Metals. Illustrated 175
New Members of the Institute 175
Ohio Men to Form Express Company for Electric Railways 175
Chicago Street-railway Situation 175
Street-railway Merger in Monterey, Mexico 175
What Is a Run of Stone? 175
Copper Market 175
Ohio Telephone Notes 176
Telephone News from the Northwest 176
Extensions and Improvements 176
Recent Developments in Service Meters for Telephones. Illustrated 176, 177
British Pacific Cable Not a Paying Investment 177
Bell Telephone Output for July 177
New Companies 177
General Telephone News 177
Possibilities of Single-phase Currents in Electric Power Transmission. By A. A. Bullard and Sidney Sprout. (Pacific Coast Electric Transmission Association).. 178, 179
Starting Devices for Mercury-vapor Lamps. Illustrated. 179
Electrical Progress in New Zealand 179
Points for Consideration When Purchasing Series Alternating-current Arc Lamps. By G. Brewer Griffin. Part I. (Ohio Electric Light Association) 180, 181
Novel Experiments in the Reproduction and Transmission of Sound 181
N-rays 181

DEPARTMENTS.

Correspondence 182, 183
Great Britain 182
New England 182
New York 182
Ohio 182
Michigan 182, 183
Texas and Mexico 183
Northwestern States 183
Rocky Mountain States 183
Pacific Slope 183
Personal 183
Electric Lighting 183, 184
Electric Railways 184
Automobiles 184
Power Transmission 184
Publications 184
Telegraph 184
Miscellaneous 184
Trade News 184, 185
Business 185
Illustrated Electrical Patent Record 185, 186

DATES AHEAD.

Minoesota Telephone Association (convention), Minneapolis, August 31st and September 1st.

Northwestern Electrical Association (mid-year meeting), Forest Park University Hotel, St. Louis, Mo., September 12th to 16th.

International Electrical Congress, Coliseum, St. Louis September 12th to 17th.

International Association of Municipal Electricians (annual meeting), St. Louis, September 13th and 14th.

New York State Street Railway Association (annual convention), Butterfield House, Utica, N. Y., September 13th and 14th.

American Electrochemical Society (mid-year meeting), St. Louis, September 13th and 15th.

American Institute of Electrical Engineers (annual convention), St. Louis, September 14th, 15th and 16th.

American Electrotherapeutic Association (annual convention), St. Louis, September 13th to 16th.

National Electrical Contractors' Association (annual convention), St. Louis, September 14th to 16th.

Colorado Electric Light, Power and Railway Association, Colorado Springs, September 21st to 23d.

VISITORS to the Louisiana Purchase Exposition at St. Louis who are interested in electricity or electrical literature are cordially invited to call at the booth of the Western Electrician, which is in Block 1 (Section 13) of the Palace of Electricity, just west of the main northern entrance to the building. Here will be found copies of the current issue of the paper, bound volumes of the Western Electrician from the first number, a careful selection of electrical books exhibited by the Electrician Publishing Company, and other objects of electrical interest. Chairs are provided for weary sight-seers, and an attendant will extend a hearty welcome to all readers or friends of the paper.

DR. J. RUDIS-JICINSKY of Cedar Rapids, Iowa, contributes an interesting article on Procopius Diviss, which we print in this issue. The author of this tribute to a neglected scientist is a Bohemian, and he may be over-enthusiastic in advancing Father Diviss' claim to fame, proudly dwelling on the merits of one who is no doubt regarded as a fellow countryman. Nevertheless, the recital of Diviss' accomplishments is well worthy of attention and is of much interest. Whether the Moravian priest really antedated Franklin in demonstrating that atmospheric electricity is identical with that of the Leyden jar, there is no doubt that Franklin was entirely original in his own work. Franklin, too, was practical; Diviss appears to have been philosophical. The difference in their methods is shown by the lightning conductors of each, allowing the claim that is advanced for the gentle-spirited ecclesiastic. Franklin also made several other useful inventions. But we are glad to publish Dr. Rudis-Jicinsky's plea, for the heroes of science are entitled to a homage which has nothing to do with the boundary lines of nations. We do not assume to say what position is to be assigned to Diviss on the roster of fame; there is no need of that. But at any rate the merits of this practically unknown physicist are worthy of a hearing.

SUBMARINE BOATS are not likely, by their numbers, to swell the demand for storage batteries and electric motors to an appreciable extent. So far as the outside public is aware, they are not used at all in the war in the Far East, although, if they constituted an effective weapon of offense, it would be expected that the Japanese or Russians would make use of them. At the conclusion of the recent British naval maneuvers in the Irish Sea an officer who has had much experience with submarines in England as well as in America expressed the opinion that the submarine boat is a much over-estimated weapon, its capacity for offense having been proved small. Indeed, the fact has been demonstrated that the submarine had a limited range of action. It is of little or no use fact has been demonstrated that the submarine has stricted radius of action and by the necessity for accompanying it by a nurse in the shape of an above-water boat. The submarine is virtually a dirigible mine, but it is by no means clear that a dirigible torpedo operated from a boat showing only a little of its superstructure above water might not prove a still more effective weapon. It appears to be likely that the submarine will be relegated to that branch of the naval museum which contains the dynamite cruiser Vesuvius and the ram Katahdin. The demand for electrical machinery and fittings on shipboard is constantly and properly increasing, but the prospects are that only an insignificant proportion of such apparatus will be stowed away in the hulls of the slow, uncomfortable and dangerous submarines.

AT A recent electrical convention the question was asked, "What is the best way to educate the public to a realization of the fallacy of municipal ownership?" One gentleman answered: "Persistency in bringing to the notice of the public, through the daily papers, the failures in this line, the reasons for the same, and any discussion brought about in this connection, is bound to help our cause." Another said: "Analyze carefully the detailed reports of any municipal plant and compare the distribution of costs with similar reports of supply company. The fallacy of municipal ownership is usually self-evident on such investigation." A third gave this suggestion: "The best way to show the public the fallacy of municipal ownership is, first, to give the best service possible and charge only enough to net a reasonable return, and, second, to show failures on the part of the municipalities that have installed their own plants." Of these the last is perhaps the best.

Industrial enterprises can be carried out most efficiently by private persons or corporations, for in private service there is an initiative, a spirit of emulation, a desire for excellence and advancement which is largely lost in the routine of public service. This would be true even if the baneful effect of politics, with its distracting and sometimes corrupting influence, were absent, which is, of course, not the case in our American cities. But the natural desire for profit on the part of the private corporation, which is such a fine incitement to zeal, must not be suffered to go to the extent that exorbitant rates are charged or inferior service given. Then the grantors of the franchise will have just cause for complaint. Let the public-utility work be done by private enterprise under reasonable regulations and supervision on the part of the public authorities.

THE British Association held its seventy-fourth annual meeting at Cambridge this year, beginning on August 18th. In point of attendance this meeting was a record-breaker, as 2,700 persons were enrolled. Several hundred were turned away for lack of seating accommodations in the hall. The proceedings were opened by the presidential address of the Right Hon. A. J. Balfour, prime minister of the United Kingdom. Addresses were also made by the presidents of the several sections. Conspicuous among these was the plea of the Hon. C. A. Parsons, president of section G [engineering] for the better treatment of the British inventor. The British Patent Office does not render to inventors the assistance and protection that it should. For years Mr. Parsons labored upon his steam turbine under the most trying circumstances only to find his patent expired when the true value of the invention was realized.

In Mr. Balfour's address upon "Reflections Suggested by the New Theory of Matter" we find a comprehensive and at the same time an eloquent exposition of the electrical theory of matter as it is understood today. We are led carefully, step by step, along the trail of events which leads from the earliest conceptions of electricity to the present elaborate theories of sub-atoms and monads which are not electrified matter but electricity itself. To quote:

When the sudden appearance of some new star in the telescopic field gives notice to the astronomer that he, and, perhaps, in the whole universe, he alone, is witnessing the conflagration of a world, the tremendous force by which this far-off tragedy is being accomplished must surely move his awe. Yet not only would the members of each separate atomic system pursue their relative course unchanged, while the atoms themselves were thus riven violently apart in flaming vapor, but the forces by which a world is shattered are really negligible compared with those by which each atom of it is held together. In common, therefore, with all other living things, we seem to be practically concerned chiefly with the feebler forces of nature, and with energy in its least powerful manifestations. Chemical affinity and cohesion are on this theory no more than the slight residual effects of the internal electrical forces which keep the atom in being. Gravitation, though it be the shaping force which concentrates nebulæ into organized systems of suns and satellites, is trifling compared with the attractions and repulsions with which we are familiar between electrically charged bodies; while these again sink into insignificance beside the attractions and repulsions between the electric monads themselves. The irregular molecular movements which constitute heat, on which the very possibility of organic life seems absolutely to hang, and in whose transformations applied science is at present so largely concerned, cannot rival the kinetic energy stored within the molecules themselves. This prodigious mechanism seems outside the range of our immediate interests.

Mr. Balfour went on to say that scientific opinions are generally understood to be founded on experience. Yet when closely analyzed these experiences are in reality illusions which have been employed to explain certain phenomena, but which science forbids us to believe. Therefore a series of problems is touched upon which in reality should be dealt with by inductive logic. Men of science are, and properly, occupied in making discoveries, not in the analysis of the fundamental presuppositions which the very possibility of making the discoveries implies.

Procopius Diviss, a Neglected Scientist.

By Dr. J. Rudis-Jicinsky.

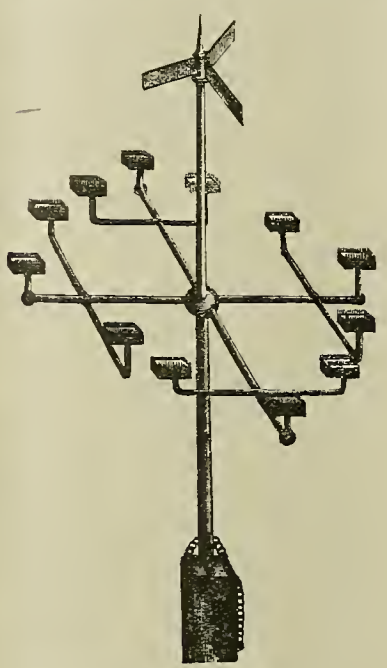
Procopius Diviss. Who is he, and why should we be reminded of him? Allow me to answer these questions. Diviss was a great man, but he has been forgotten, even by the profession to which he gave the first hints in electrotherapy, forgotten by all of us, who have believed that Franklin was the first man who drew the lightning from the heavens, giving us, also, the first actual steps in our knowledge of the practical application of electrical phenomena, traced slowly from the early time when the Greek philosopher Thales first observed that a piece of amber rubbed with various substances was capable of attracting light objects.

Diviss made his first electrical experiments in 1728, and he thought at that early day that an electric spark might be a good stimulant for certain lesions or diseased tissues of low vitality. After many efforts, on June 15, 1754, he built his first lightning con-

ductors for protecting houses, asserting, several years before Franklin, that the lightning and electricity are the same. He wrote about his discoveries, six years before Franklin, to the president of the Academy in Berlin, Germany, the well-known scientist, Professor Euler, but he never received an answer. He wrote that the frequency is the highest in a pointed conductor, but his contention was not understood; it was laughed at. It took an energetic man of affairs like the great American, Franklin, to prove to the scientific world the same theories, really discovered, however, on the other side of the ocean. It is not my intention to belittle the discovery by Franklin, nor to dispute the priority, but to give credit, also, to another who deserves well of his fellow men.

Procopius Diviss, doctor of philosophy and theology, was born in Zamberk, Moravia, September, 1696. (See "Osveta," 1880, by Prof. Dr. D. Albert of Vienna.) He studied at the Latin school in Znojmo, and prepared for the priesthood at the Institute of Premonstrants in Luce. After his ordination Diviss was appointed professor of natural philosophy in Luce, and distinguished himself before his classes in physics by experiments and demonstrations, showing the pupils not only the theories, but actual facts. After the lapse of one year he lectured at the university in Salzburg, and remained there in constant study and research until 1735, when he received the title of doctor of theology. Later he was sent to preach to his countrymen at the small village of Primetice, near Znojmo, and, having not very much to do as a priest, he again resumed his studies, researches and experiments, and found leisure to pursue his scientific investigations with electricity. In 1741 he was appointed as the superior of the Institute for priests in Luce, on account of the war with Prussia, but after the war he at once returned to his little village to prove beyond the doubt "that the electrical stream, not being exactly a fluid, was identical with the lightning."

Emperor Francis, being very enthusiastic about all discoveries in physics, called Diviss to Vienna, and asked him to repeat all his experiments and discoveries with electricity, before him, his suite and the Empress Maria Theresa. Both the emperor and the empress gave Diviss gold medals for his work and distinguished efforts. To show his ability, we may narrate the story of Father Francis, who tried to give Diviss some illustrations of his experiments. Diviss at once grasped the opportunity to demonstrate his results, and, with the quickly conceived idea of an effective experiment, he concealed a few iron nails in his abundant hair. Bending his head toward the electrical machine, as the story goes, he took up the whole stream of the electricity, which went through his body to the ground. Franklin had his kite, Diviss his own body in experimentation in the same line and for the same purpose, both not knowing of each other. Franklin's renown was spread over the whole civilized world, and honors were heaped upon him by the various learned societies of Europe. Diviss wrote an article showing how to grasp at the lightning from the clouds and bring it through suitable pointed conductors to the ground. This was done in 1753, when Richman



LIGHTNING ROD BUILT BY DIVISS IN 1754.

in St. Petersburg was killed by lightning in experimentation. This article was sent to the German Academy in Berlin, as before, but without response.

Diviss' lightning-rod, built June 15, 1754, was constructed in the following way: An iron rod four centimeters in thickness and about 24 yards high, was provided at the upper part with four horizontal arms, made out of iron also. (See cut.) These had again smaller arms at their ends with little boxes covered with iron plates and having at the edges many iron nails pointing toward the sky. There were 12 boxes, each with 27 nails. The main iron rod was fastened to a heavy pole of wood, but there was a complete connection with iron chains from the iron pole down to the ground. On the main rod, under the topmost point, was a little windmill to chase the birds away from the apparatus. The effect of all the 324 nails during an electric storm was striking. The lightning was divided, the sparks showing beautifully on all the points of the nails, acting as conductors. After the lapse of a few hours, when Diviss had completed his first lightning rod, the expected storm came up, and the discoverer had the pleasure to watch, with many people around, his achievement. He wrote about it to a German paper in Prague, wrote again to Berlin and Vienna, but with the same sad result, being laughed at all around. His friend and old teacher, Marci, told him to have done with such nonsense, and gave him this terrible warning in his letter of advice: "Blasphemant quæ ignorant."

When, in 1756, there was a very dry and hot summer, the farmers in the vicinity of Primetice were of the opinion that the lightning rod of Diviss was altogether to blame for the drought, and destroyed the apparatus, with the sanction of the government. Diviss took the pieces and sent them to Brnk, where even now the first lightning rod can be seen and examined at the museum of that place. He was greatly cast down by this occurrence; he stopped all the scientific correspondence which he had with others: and there ensued the remarkable spectacle of a cultivated mind, with a vivid imagination, with all its therapeutical studies of electricity and possibilities, lying dormant. He laid his all on the steps of the altar of his country.

At one time, trying to relieve the suffering of sciatica with the electrical stream, as he called it, Diviss devised an apparatus which he called denysdor, showing that he was a man of benevolent mind with intense desire to promote the well-being of his fellow men.

The works of this man did not receive the recognition of the so-called authorities of that time. Let us give him the recognition now, without authority, but without prejudice. Diviss died in peace on December 21, 1765. His name is not in encyclopedias; it is not always mentioned in the scientific and historical essays, but nevertheless it should not be forgotten. (See further "Kronika Prace," by Pokorny of Prague.)

Electrical Jurors of Award at St. Louis.

Following is a list of the names of the domestic jurors in the Electricity Section of the International Jury of Awards of the Louisiana Purchase Exposition at St. Louis:

Group 67. Machines for Generating and Using Electricity.—

W. V. N. Powelson, assistant general manager, Union Electric Light and Power Company, St. Louis.
H. B. Smith, professor electrical engineering, Worcester Polytechnic Institute, Worcester Mass.
M. H. Gerry, chief engineer of Missouri River Power Company, long-distance transmission plant, Canyon Ferry, Mont.
O. T. Crosby, consulting electrical engineer, New York city.
C. W. Wason, president, Cleveland, Painesville and Eastern electric railway, Cleveland, Ohio.
J. P. Jackson, professor electrical engineering, Pennsylvania State College, State College, Pa.
G. F. Baum, professor electrical engineering, Stanford University, Cal.
P. O. Keilholtz, general manager, United Electric Light and Power Company, Baltimore, Md.
E. P. Roberts, consulting electrical engineer, Cleveland, Ohio. (Formerly professor of electrical engineering, Cornell University.)
R. B. Owens, professor electrical engineering, McGill University, Montreal, Canada.
G. F. Sever, professor electrical engineering, Columbia University, New York city.
J. W. Esterline, assistant professor electrical engineering, Purdue University, Lafayette, Ind.
H. H. Norris, assistant professor electrical engineering, Cornell University, Ithaca, N. Y.

Group 68. Electrochemistry.—

Carl Hering, consulting electrical engineer, Philadelphia, Pa.
Dr. Samuel Sheldon, professor electrical engineering, Brooklyn Polytechnic Institute, Brooklyn, N. Y.
C. F. Burgess, professor electrical engineering, University of Wisconsin, Madison, Wis.

Group 69. Electric Lighting.—

F. E. Drake, president Lanyon Zinc Company, St. Louis.
E. L. Nichols, professor physics, Cornell University, Ithaca, N. Y.
Paul Anderson, professor electrical and mechanical engineering, Kentucky State College, Lexington, Ky.
G. D. Shepardson, professor electrical engineering, University of Minnesota, Minneapolis, Minn.
C. A. Adams, professor electrical engineering, Harvard University, Cambridge, Mass.
Henry Floy, consulting engineer, New York city.
B. V. Swenson, assistant professor electrical engineering, University of Wisconsin, Madison, Wis.
Warren E. Weinsheimer, Chicago.

Group 70. Telephony and Telegraphy.—

A. E. Kennelly, professor electrical engineering, Harvard University, Cambridge, Mass.
W. J. Hammer, consulting electrical engineer, New York city.
F. B. Herzog, New York city.
J. C. Kelsey, professor telephone engineering, Purdue University, Lafayette, Ind.
A. S. Langsdorf, professor electrical engineering, Washington University, St. Louis.

Group 71. Various Applications of Electricity.—

C. R. Cross, professor physics, Massachusetts Institute of Technology, Boston, Mass
Dr. William J. Morton, New York city.
E. B. Rosa, Bureau of Standards, Washington, D. C.
Lieut-Col. Samuel Reber, United States Army, Washington, D. C.
F. A. Wolff, professor physics and electrical engineering, Columbian University, Washington, D. C.
Frederic Bedell, assistant professor physics, Cornell University, Ithaca, N. Y.
Captain M. C. Buckey, War Department, Washington, D. C.
Dr. K. E. Guthe, Bureau of Standards, Washington, D. C.

Entertainment of Foreign Electrical Engineers.

Before starting upon the "circular tour" which has been outlined in the Western Electrician the foreign electrical visitors to the International Electrical Congress will be entertained at a banquet given by the American Institute at the Waldorf-Astoria in New York on September 5th. The English engineers will number about 100 members, with ladies, and a party of over 40 officers and members of the Associazione Ellettrotecnica Italiana will be present, besides other foreign electrical engineers en route to St. Louis. The "circular tour" will be the only excursion to St. Louis, as it has been found inexpedient to organize a trip direct from New York

Immediately after leaving Niagara Falls each member of the party will be presented with a formal invitation to be the guest of the local reception committee of the Institute while in Chicago, together with a programme of the Chicago events, printed in pamphlet form, and an electrical handbook of Chicago.

Arriving in Chicago at the Illinois Central Depot, at 7:30 a. m. September 10th, the visiting engineers and their ladies will be conveyed immediately to the Auditorium Annex, where the entire parlor floor has been reserved for their exclusive use.

The general tour for the forenoon will include a visit to points of particular interest to electrical engineers. All persons desiring to join this tour will leave the Michigan Avenue entrance of the Auditorium Annex at 9 a. m. The party will proceed first to the Fisk Street station of the Commonwealth Electric Company. After an inspection of about one hour, the party will travel past the Western Electric Company's factories and one of the Chicago Edison Company's distributing sub-stations, to the Chicago Telephone Company's building at Washington and Franklin Streets, where an inspection of the main exchange will be made.

Special tours to points of particular interest to parties of three or four or to individuals will be arranged for.

Luncheon will be served at the Auditorium Annex from 1 to 2:30 p. m. The general tour for the afternoon will consist of a short cruise on Lake Michigan on board the U. S. S. Dorothea along the west shore of Lake Michigan, giving an excellent view of the city, its water front and lakeshore drives. All persons desiring to join this tour will leave the Michigan Avenue entrance of the Auditorium Annex at 3 p. m. sharp, and be conveyed by buses to the Chicago Yacht Club, where they will be taken on board the ship. After the cruise the party will land at the same place and be conveyed back to the Annex by buses arriving at about 7:30 p. m.

The special tour of the afternoon will consist of an automobile trip through the South Side park system. All persons desiring to join this special tour will enter automobiles at the Michigan Avenue entrance of the Annex at 3 p. m. and return about 7:30 p. m.

The local reception committee for Chicago consists of the following-named gentlemen: Samuel Insull, chairman; H. M. Brinckerhoff, H. S. Carhart, George A. Damon, C. E. Freeman, Louis A. Ferguson, T. P. Gaylord, A. S. Hibbard, Marcellus Hopkins, D. C. Jackson, George W. Jackson, Peter Junkersfeld, W. A. Kreidler, Richard McCulloch, E. J. Nally, S. G. Neiler, E. C. Noe, Frederick Sargent, C. E. Scribner, B. E. Sunny, F. H. Tubbs, A. L. Tucker, P. B. Woodworth.

Northwestern and Municipal Associations at St. Louis.

The Northwestern Electrical Association, which will meet in St. Louis on September 13th to 16th, will have headquarters at the Forest Park University Hotel. Arrangements have been made for all those from the Northwest who will attend to connect with the special Chicago and Alton train, which will leave Chicago at 11:25 a. m. on September 12th. A rate of one cent a mile for coach tickets, with seven days' limit, has been secured from all points. A rate of 1 1-5 fare for 15-day tickets will be given. A special car will be provided at Milwaukee on the morning of September 12th by the Chicago, Milwaukee and St. Paul if a sufficient number is present. President Grover requests all those who expect to attend to notify him at once at Fond du Lac, Wis., so that provision can be made for hotel accommodations.

The International Association of Municipal Electricians will hold its convention in St. Louis on September 12th and 13th. The Grand View Fraternal Hotel, situated conveniently to the south side of the exposition grounds, has been selected as official headquarters. Members should notify the management of the hotel at once if they wish to have rooms reserved. The association has selected three delegates to represent it at the International Electrical Congress and on September 15th a joint session of the association with Section G of the congress will be held.

A meteor or large aerolite taking a northerly direction struck the earth somewhere near Concord Station, 35 miles east of Meadville, Pa., on the line of the Erie railway, a few nights ago. A terrific explosion accompanied the impact with the earth, followed by a high wind, lasting 15 seconds. The explosion is said to have shook the buildings in Titusville, 20 miles away.

Franchise of the New York, Westchester and Boston Railway Company.

The franchise just granted to the New York, Westchester and Boston railway by the city of New York for the privilege of operating a four-track electric line within the city limits in the Borough of the Bronx, contains a number of provisions interesting to electrical engineers. The line is to be considered in all respects as a modern electric railroad. Following is an abstract of all the sections of the grant:

1. Authority to cross streets, and to construct and operate a "four-track railway, with all connections, turnouts, switches and cross-overs necessary for the . . . operation of said railway, by means of electricity . . . in, upon, and across the following-named streets, . . . and such other streets . . . as it may be necessary to cross in order to make connections with any other railway within 1,000 feet of said routes. . ."

2. Maps to be filed and railroad law to be complied with. The franchise to be for 25 years, with renewal at fair valuation, said valuation not to include "any valuation derived from the ownership, operation or control of any other railroad." Notice of renewal in 24th year. Disinterested appraisers (not arbitrators) to be appointed.

The company to pay $8,000 per annum for the first 10 years, and $16,000 for the next 15; and 40 cents and 80 cents, respectively, per annum per linear foot of single track on the public streets. Renewal terms to be not less than the sum payable in the twenty-fifth year.

The franchise not to be sublet in whole or in part without consent, and the assignees and lessees to be responsible for the above payments, etc., as well as the purchaser under a foreclosure. The mortgagor not responsible.

No grade crossings. Viaducts at least 16 feet above the crown of the road, and heads of tunnels at least four feet below.

Superstructures of 75 feet or less to be of a single span, and not more than 60 feet wide. Structures shall be of steel, concrete or masonry.

The roadbed shall be ballasted with either blast-furnace slag or broken trap rock. No dirt, sand, gravel or cinders.

Roadbed shall be watered daily when the temperature is above 35° Fahrenheit. Penalty, $50 a day.

Track to be fenced throughout.

At least 10 stations on the main line and three on the branch within the city limits.

The railway to be "operated by electrical power, except the overhead-trolley system, or any other mechanical motive power that may be lawfully employed upon the same, except locomotive steam power." Steam may be used for shunting and switching when specifically consented to by the city.

All power wires must be in conduits, and the conduits shall be made to carry three cables for the use of the police, fire and ambulance services of the city, without charge.

The company shall not have power wires, except for the operation of its railway.

At least 60 trains a day each way, with a maximum of 30 minutes' headway. During first five years not essential to run trains between 1 a. m. and 4 a. m. unless so ordered after public inquiry.

Cars shall be heated when the temperature is below 50° Fahrenheit. Penalty, $50 each car per day.

Cars to be vestibuled and adequately lighted.

The fare shall not exceed five cents for a continuous ride within the city limits. Freight rates shall be "reasonable," and when fixed, after discussion, shall be binding on the company.

No precedents shall be based on the terms of this franchise.

Letter carriers, policemen and firemen in uniform shall travel free.

The city shall supervise the construction and operation of the road.

3. Forfeiture of grant in case of failure to remedy violations after 10 days' notice.

4. This franchise does not confer a monopoly along its route.

5. Construction to be commenced within one year, and the main line from city limits to Westchester Avenue shall be completed within five years. At least $1,000,000 shall be expended on construction within two years. Accounts must be audited. The entire route to be completed within seven years. Failure to complete the main line subject to penalties (not specified). Extension of time may be granted.

6. The company liable for damage to private property.

7. Certain specified portions of the right-of-way shall be ceded to the city without cost, subject to the company's easement, if the city determines to make new streets.

8. If the city makes new streets other than as above, the company shall pay rentals per foot as above mentioned.

9. The cost of changes to superstructure consequent upon the act of the city to be divided between the company and the city. (Nothing said about changes affecting tunnels.)

10. If the city alters its street plan on account of the location of the railway, the company shall acquire, at its own expense, such additional streets that bound its right-of-way.

11. The company shall bear the cost of altering sewers, etc.

12. Ordinary street traffic shall not be substantially interfered with during construction, and streets must be restored within a reasonable time.

13. No advertising, except in the interior of the cars and stations. Penalty, $50 a day.

14. Deposit of $20,000 as security for annual payments.

15. Daily penalty of $250 for failure to give efficient public service, or to maintain crossings in good condition.

16. The company shall accept the ordinance within 10 days.

17. The ordinance takes effect immediately.

The ordinance was passed by the Board of Aldermen on July 26th.

Standard for Checking Service Meters.

Wattmeters when properly tested are checked under different loads, from one-fiftieth to 1½ times their rated full-load capacity, and the range thus covered so greatly exceeds that of the portable standard instruments in general use that ordinarily three of these standards are required to check one service meter. In the scale of the ordinary portable checking instruments the divisions grow narrower as the ends are approached, and the first and last divisions are little if any wider than the indicating pointer or the lines between the divisions, while the proportion represented by each division may be greatly increased, making it almost impossible to read the indications accurately.

To facilitate rapid checking of integrating wattmeters and to insure accurate results the Westinghouse Electric and Manufacturing Company has designed a special precision wattmeter. It has the same general characteristics of high accuracy, freedom from influences of external fields, the closeness with which observations may be made, and ease of manipulation of the other Westinghouse instruments of precision, and has a special provision by which connections may be made for three different currents, of five, 20 and 100 amperes maximum capacity, respectively. The Precision resistance or multiplier is used in connection with this instrument, which, with resistance in circuit suitable for 100 volts, will measure accurately quantities of from 10 to 10,000 watts, and proportionate amounts at other voltages.

This instrument is easily manipulated. The construction of the binding posts facilitates making quick connections and insures good contact. When current is passed through the circuits the sight wire moves to the right and is brought back to zero by turning to the left a central knob, which moves a vernier head along the scale. A fine adjustment is obtained by a knob at the side. Readings are made in tenths of a division without estimation, giving, in the instrument shown, 2,000 readable deflections on a five-inch circular scale.

In designing this instrument the intent has been to provide a single checking standard that will cover the entire range of all the service wattmeters used in the ordinary installation, and thus to avoid the use of several standards with the accompanying disadvantages and inconvenience in handling.

World's Fair Visitors of Last Week.

Among those registered last week at the booth of the Western Electrician in Electricity Building at the St. Louis Exposition were the following-named: William L. O'Connell, Buffalo, N. Y.; Eugene L. Muffat, Detroit, Mich.; J. W. Rodgers, Cincinnati, Ohio; T. M. Shedd, Norton, Kan.; W. G. Conger, Harrisonville, Mo.; William F. Rasche, Milwaukee, Wis.; A. H. Cain, Roadhouse, Ill.; Thomas Hamil, Fredericktown, Mo.; E. H. Cobb, Wellston, Ohio; E. B. Rouse, Sullivan, Ind.; Aid Ludlow, Denevaux, Mich.; Oscar Blykes, Springport, Mich.; Guy Cook, Andover, Ohio; E. J. Pratt, Philadelphia, Pa.; Edgar Hochstetler, Labetha, Kan.; Wood Pitts, Austin, Texas; C. C. Doolin, Fulton, Mo.; E. A. Ekem, exhibit of Ontario Power Company, St. Louis; J. W. Clear, Girard, Ill.; R. W. Beaty, Galveston, Texas; E. B. Crabb, Chicago; C. A. Fister, St. Charles, Mo.; W. D. Boyle, St. Louis; B. H. Wilson; Frank R. Schmidt, Ferguson, Mo.; J. Sharenberger, Nashville, Tenn.; B. F. B. Sewell, Chrome, N. J.; L. E. Frank, Buffalo, N. Y

Typewriter Said to Be Actuated by the Spoken Word.

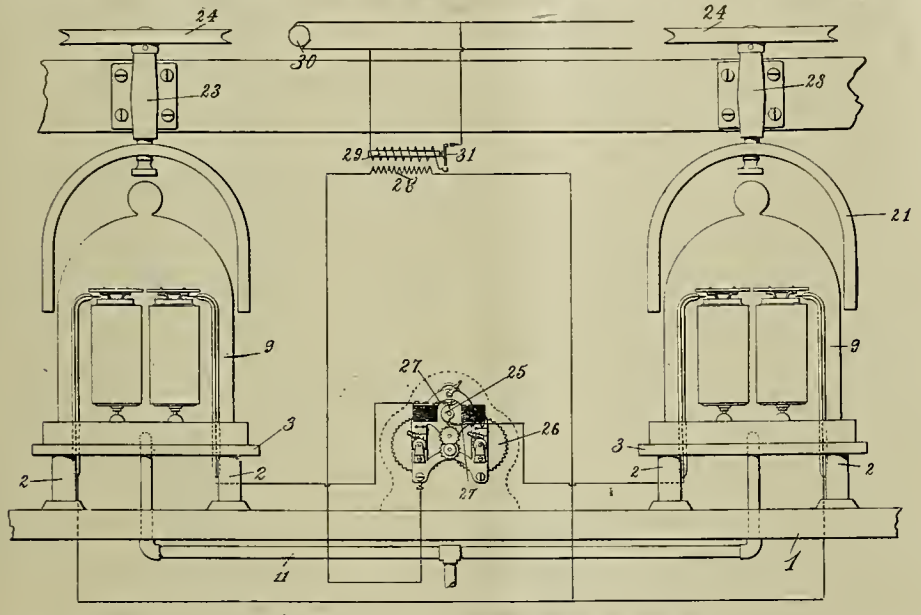
Joseph A. McCall of Cincinnati says that he has invented an electrical attachment for a typewriter that will make it possible for the machine to record words that are spoken into a receiver. The description of the apparatus is not very lucid, and whether the scheme is more than a visionary one is doubtful. Any language, it is asserted, may be used. The instrument is made sensitive to 2,500 words, which is about the ordinary vocabulary used. The word spoken into the receiver "acts as a key on a small copper disk, and this in turn actuates the letters that make up the word." There are as many of these disks in the machine as there are words to be used, in this case 2,500. The impression is first made on paper in small pinholes, something on the style of mechanical piano players. The record comes in contact with small copper points, which, passing through the holes, close an electrical circuit so arranged as to work the proper keys of the typewriter.

Edison's Apparatus for Vacuously Depositing Metals.

The deposition of a minutely thin film of vaporized metal upon an object, to act as a foundation for a heavier electroplated deposit, is often found desirable in different kinds of work, particularly for depositing a thin film of metal on phonograph records. This is done in order that a matrix or mold of the record may be secured. Thomas A. Edison has recently secured a patent for an apparatus which allows of several records being coated at once in a vacuum chamber by means of an electric discharge.

It has been found in the practical operation of the process that if the electrical discharge is maintained continuously between the metallic electrodes, and particularly if the latter are very thin, as is preferable, the electrodes become objectionably heated and may in time actually melt, so as to destroy their utility. This objection could, of course, be overcome by periodically interrupting the current, so as to permit the electrodes to cool; but, as it is preferable that the induction coil and other electrical apparatus, as well as the mechanical and magnetic appliances, should operate continuously, the desired result is secured by employing a pair of exhausted chambers in which the depositing takes place alternately. During the time that metal is being deposited on the object or objects in one chamber the electrodes of the other chamber are permitted to cool.

The accompanying illustration is a front view of the apparatus. The base is provided with supports, on which are mounted the base plates (3), made, preferably, of glass. Extending up through the base



EDISON'S APPARATUS FOR VACUOUSLY DEPOSITING METALS.

plates are glass tubes, carrying circuit wires. Depending from the ends of these conductors are electrodes, made of the metal which is to be deposited, and preferably in the form of thin strips of foil. For the coating of the phonograph records gold is best, owing to the fact that it may be highly comminuted and also because of its non-oxidizable character. The best results are secured and the most even coating obtained when the electrodes are perfectly flat.

Mounted on the plate (3) is a metal rim, within which is placed a glass bell or jar (9), having a flanged lower end resting on the plate. A layer of paraffin or similar wax-like sealing material in molten condition is now flowed into the space within the rim, so as to make a perfectly tight joint. Air from within the glass jar is exhausted through a pipe (11), connected with a vacuum pump.

The phonograph record or other object carries at its top a guard or shield, which fits within the top of the record and is supported thereby. This guard may be of any material, brass being preferably used. The guard receives the metal which would ordinarily be deposited within the interior of the record, and when made of brass it appears to deflect the electrical discharge in a downward direction against or toward the outer surface of the record. The guard thus prevents the metal from depositing on the inside of the object and causes the metal to deposit evenly on its edge with a clear line of demarcation, so as to permit a uniform electroplating.

Mounted outside of each of the vacuum chambers is a magnet (21), removably carried at the lower end of a shaft, mounted in the bearing (23) and rotated by a belt wheel.

In order to operate the vacuum chambers alternately to permit the electrodes within one to cool while the depositing is taking place in the other, a switch (25) is used, driven by a clockwork mechanism (26) and making contact alternately with contact springs (27). These springs are connected each with one of the electrodes of the two chambers, as shown. The other electrodes (one in each chamber) are connected to one side of the secondary circuit (28) of an ordinary induction coil. The other side of this secondary circuit connects with the switch (25) through the clockwork mechanism. The primary circuit (29) of the induction coil is connected in multiple with the source of supply and includes a circuit-breaker. In operation a proper vacuum is created in the two chambers, and by means of the switch the induction coil will be connected alternately, first with the electrodes of one chamber and then with the electrodes of the other chamber. The discharge is so regulated as to secure between the electrodes a silent or brush discharge. This discharge causes the metal composing the electrodes to be vaporized and deposited on the objects. The magnets (21) are simultaneously rotated, so as to rotate the objects, whereby a perfectly uniform film will be deposited.

New Members of the Institute.

Among those elected to associate membership in the American Institute of Electrical Engineers at the directors' meeting in New York on August 17th were the following-named:

H. Allcock, Manchester, England; J. I. Beggs, Milwaukee Electric Railway and Light Company, Milwaukee, Wis.; T. W. Bevan, Sao Paulo Tramway, Light and Power Company, Sao Paulo, Brazil, S. A.; J. F. Card, Three Rivers Electric Company, Three Rivers, Mich.; Louis Cassier, Cassier's Magazine, New York city; H. P. Hill, Bullock Electric Manufacturing Company, St. Louis, Mo.; A. C. Holtby, S. Newman & Co., Johannesburg, S. A.; W. Hoopes, Pittsburg Reduction Company, Pittsburg, Pa.; Torsten Holmgren, Stockholm, Sweden; S. R. Inch, Missoula Light and Water Company, Missoula, Mont.; A. S. Kalenborn, Puget Sound Power Company, Tacoma, Wash.; C. J. Kiefer, Cincinnati, Ohio; A. J. Kohler, Lynchburg Traction and Light Company, Lynchburg, Va.; X. A. Kramer, Magnolia Electric Light and Power Company, Magnolia, Miss.; A. S. Lindstrom, Department of Electricity, World's Fair, St. Louis, Mo.; F. W. Linebaugh, Ames Municipal Electric Light and Water Works, Ames, Iowa; R. E. Martinez, Abner Doble Company, San Francisco, Cal.; W. N. McAnge, Jr., Nansemond Telephone Company and Atlantic Coast Construction Company, Suffolk, Va.; T. L. Morrill, Bisbee Improvement Company, Bisbee, Ariz.; P. T. Owen, Melbourne, Australia; E. B. Paine, Stetson University, De Land, Fla.; J. C. Parker, Niagara Construction Company, Niagara Falls, N. Y.; A. P. Peck, National Electric Company, Milwaukee, Wis.; G. E. Quinan, Columbia Improvement Company, Electron, Wash.; W. E. Richards, Toledo Railways and Light Company, Toledo, Ohio; J. A. Scott, Westinghouse Electric and Manufacturing Company, St. Louis; J. A. Shaw, Montreal Light, Heat and Power Company, Montreal, Can.; A. B. Storms, Iowa State College, Ames, Iowa; D. M. Swink, Durham Traction Company, Durham, N. C.; C. E. Warner, Allegheny County Light Company, Pittsburg, Pa.; Thorsten von Zweigbergk, Dick, Kerr & Co., Southport, England.

Ohio Men to Form Express Company for Electric Railways.

An effort will be made by Columbus, Ohio, men to organize the Interstate Express Company, to operate on the trolley lines throughout the state. It is said that the officers of the Scioto Valley Traction Company are active in the promotion of the company, and in some of the towns business men are circulating petitions asking the patronage of citizens for the light-freight and express business. The headquarters of the company are to be in Columbus, and it is said that 70 out of the 88 counties in the state can now be reached by it. The Northern Ohio roads are already operating a light-freight and express business.

Chicago Street-railway Situation.

Further negotiations between the City Council and the Chicago City Railway Company dealing with the franchise-extension problem depend upon the disposition made of the tentative ordinance prepared by the local transportation committee of the council. It is probable that when the council convenes in October the ordinance will be passed, and this without the referendum. Advocates of immediate municipal ownership object to the passage of the ordinance without popular approval and declare that they could show a majority against the ordinance. As the time is short and the expense heavy, it is not likely that a petition for a referendum will be circulated.

While many of the aldermen elected at the last city election pledged themselves to a referendum on any franchise ordinances, and while it is true that the voters have declared for immediate municipal ownership, yet the sentiment of the council in favoring a vote on the ordinance without the referendum is not arousing the storm of opposition that might be expected. When the voters declared for immediate ownership by the city it was not supposed that the railway companies would be able to substantiate any of their 99-year-act claims. Since then the courts have passed upon these claims and instead of the terminating, as assumed at that time, of most of the important franchises on July 30, 1903, and a few extending to 1912, 1915 and 1919, the street-car companies have been given possession and legal rights on certain important streets up to 1964. To gain municipal ownership by an attempt to prove that these rights are not well founded would require years of tedious litigation and a large sum of money. In the meantime the railway systems would not be improved by the companies fighting for an existence, and in the end should the city be successful it would be compelled to pay a big price for a worn-out property. When the court decision granting the companies certain rights under the 99-year act was handed down the whole situation changed and the question at once became, What is the best bargain that can be struck with the street-railway companies for the purpose of terminating their possession of the streets? The present tentative ordinance, which averages up all grants, makes city ownership possible within 13 years without any litigation, secures compensation to the city, and provides for the reconstruction of the systems along the most modern lines seems—at first blush, at least—to be a good bargain.

Street-railway Merger in Monterey, Mexico.

It is announced that the long-pending deal for the sale of the two street-railway systems of Monterey, Mexico, to an American syndicate has been consummated and that the new owners have taken possession of the two properties. The purchasing syndicate is composed of Edward F. Walker, C. W. Reeve, George D. Howell and others. The two systems will be merged and operated under the name of the Monterey Electric Street Railway, Light and Power Company. It is understood that the company will also take over the valuable concession which Frank H. Dillon and E. S. Mackin of Monterey obtained from the state and municipal governments about a year ago for the sole rights to construct and operate a system of electric tramways from Monterey to different suburban towns. The two existing systems were known as the Empresa and Slayden lines. The Empresa system embraced 14 miles of track. It also owns a blanket franchise granted it by the city, giving it the sole right to occupy all streets and plazas not occupied by the Slayden line. The Empresa company has for the last seven years paid an annual dividend of 24 per cent. on a capital stock of $540,000. The new owners of the consolidated system will convert the several lines into electric traction and make many other important improvements. They will be in the market for a large amount of machinery and construction material.

What Is a Run of Stone?

A Michigan subscriber of the Western Electrician asks the following: "Will you kindly advise us what is understood to be the amount of power conveyed by a 'run of stone'? You are undoubtedly aware that in the past a good deal of property rights in waterpower have been conveyed from time to time under the description of so many 'run of French buhr millstone and the necessary machinery,' and we would like to get the best and clearest statement of the amount of power which engineers agree on as being covered by such a term."

Perhaps some of the readers of the Western Electrician can answer this question.

Copper Market.

Dealings in copper have recently increased and the demand has been stimulated by attractive prices made by several sellers. One producer of Lake copper lowered the price of his product last month to 12⅝ cents a pound, disposing of a considerable quantity. Electrolytic has sold at 12½ cents a pound, though some sellers have stood out for 12¾ cents for electrolytic wire bars. The trend of events points to greater consumption and prices will be effected perhaps more next year than this.

Ohio Telephone Notes.

The first meeting of the fifth district of the Ohio Independent Telephone Association was held at the St. Charles Hotel in Hamilton on August 24th. The managers and officers of most of the companies in the district were present. A meeting was also held at Alliance a few days ago and matters concerning the organization were discussed.

The Salem Township Rural Telephone Company, organized some time ago, will connect with the Columbiana County telephone lines at Leetonia. The territory is being developed.

Work has been commenced on the telephone lines that will connect the Pittsburg and Allegheny telephone system with Wheeling, W. Va., thus giving the United States Telephone Company a line to the East.

Material is arriving for the construction of the Central Union Telephone Company's plant at Painesville. A common-battery multiple system will be used.

Improvements will be made by the Central Union Telephone Company at Youngstown, where nine miles of new cable will be put in. An exchange will also be installed at Lowellville that will have free service with Youngstown.

Probate Judge Jones of Hamilton has decided that the Middletown Home Telephone Company has a right to maintain an action against the city of Middletown, through which it seeks a franchise in that municipality. The City Council failed to act upon the application of the company under the terms desired. C.

Telephone News from the Northwest.

The Albert Lea Telephone Company of Albert Lea, Minn., has decided, it is said, to discard the automatic system and replace it throughout with a complete central-energy system.

The storm which passed through the Twin Cities on the night of August 20th wrecked pole lines and wires of telephone and electric-light and telegraph companies. The telephone systems suffered severely, as entire pole lines were put out of business. The Northwestern Telephone Exchange Company estimates its damage in a rough way at $40,000 to $50,000. The Twin City Telephone Company lost a great many wires and lines. Both companies called in road crews from the country to get their systems straightened out.

The Farmers' Mutual Telephone Company of Cerro Gordo, Minn., has been incorporated with a capital stock of $20,000.

The Northwestern Telephone Exchange Company announces new toll rates between Winona, Minn., and the Twin Cities. The day rate is 25 cents for three minutes, and the night rate 15 cents.

The Black Hawk and Grant Township Telephone Company has been organized at Reinbeck, Iowa. Fred Schriber is president.

A franchise has been granted at Brewster, Minn., to the Minnesota Valley Telephone and Telegraph Company.

The Badger Telephone and Telegraph Company will have its new toll line from Racine, Wis., to La Crosse completed by November 1st. R.

EXTENSIONS AND IMPROVEMENTS.

M. T. Sherman of Joplin, Mo., will install a new telephone system at Jennings, Okla.

The Mutual Telephone Company of Billings, Mont., will build telephone lines covering most of Carbon County.

A movement is on foot to build a telephone line from Whitmore, Cal., to Redding, connecting with the Sunset company there.

New telephone circuits have been comoleted from Wheeler, N. Y., to Kanona and Prattsburg, thus opening up a new agricultural district.

The Granbury (Texas) telephone exchange and long-distance lines have been purchased by Walter Juliff and Earl Cogdell. The new owners will extend the line from Bluff Dale to Stephenville, Texas.

The Board of County Commissioners of Victoria County, Texas, has granted a franchise to citizens of the town of Victoria and of Mission Valley for the construction of a telephone line between the two places.

The City Council of El Paso, Texas, has under consideration an application from R. A. Wooldridge and C. F. Wren for a franchise to establish a new telephone system in El Paso. Messrs. Wooldridge and Wren agree to put in a complete system at a cost of not less than $100,000.

The Southwestern Telegraph and Telephone Company will erect two exchanges in connection with its proposed improvements at Dallas, Texas, one at Oak Cliff and the other at East Dallas. Plans for the former, which will cost $50,000, are now being prepared. J. E. Farnsworth is general manager.

C. J. Curtis, J. W. Talbot, Dr. C. C. Talbot and others have formed a corporation for the purpose of conducting a public telephone system at Seaside, Ore. Telephones will be put in cottages and stores and a connection made with the line to Astoria and Portland, Ore. The company has a capital stock of $10,000.

Recent Developments in Service Meters for Telephones.

Inventors are still hard at work on the telephone service meter, and much ingenuity is shown in the devices of this kind which are patented from time to time. Among the most recent of the inventions along this line are one by Charles E. Scribner and Frank R. McBerty of Chicago, and another by James L. McQuarrie of South Orange, N. J., both assigned to the Western Electric Company. A third patent has also been issued to Harold D. Stroud of Chicago and assigned by him to the National Measured Service Company of the same city. The following de-

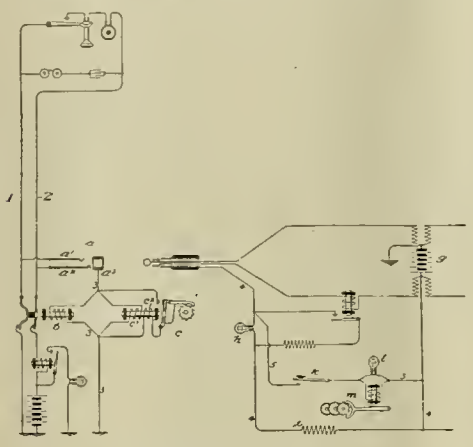


FIG. 1. SERVICE METERS FOR TELEPHONES.—APPARATUS OF SCRIBNER AND M'BERTY.

scriptions give an idea of the essential features of these devices.

The apparatus devised by Messrs. Scribner and McBerty includes a connection register of the general type in which a counting train is actuated by the movement of the armature of an electromagnet, the winding of the magnet being included in a circuit with a source of current and means for controlling the circuit. The magnet is, however, provided with two windings, the main winding being preferably of high resistance and adapted for connection directly in the operating circuit and the auxiliary winding being of low resistance in a shunt about the high-resistance winding. The shunt is controlled by switch contacts closed by the armature of the register in its operation.

Fig. 1 shows a telephone line extending from a sub-station to a central-office switchboard, having at the sub-station of the line the usual telephonic and signaling apparatus, with a switch-hook controlling the circuits, and at the central office the type of line-signaling apparatus which characterizes the so-called "common-battery relay board."

A spring jack (a) is provided for the telephone line, the spring jack having two line springs, connected, respectively, with the limbs of the line, and a third contact or test ring (a^3), which is connected to ground by a conductor through the winding of the cut-off relay (b). The main winding of the connection register is, in the system shown, of high resistance, preferably 500 ohms, and is connected in a permanent shunt of the cut-off relay in the conductor (3). The auxiliary winding (c^2) of the register is preferably of low resistance and is connected in shunt of the main winding (c'). The third contact of the operator's answering plug, which engages with the test ring (a^3), forms the terminal of a conductor (4) of the plug circuit, which is connected to the free pole of a grounded battery in the usual manner. A supervisory-signal lamp (h) and a resistance are included in this conductor, so that unless the lamp and resistance be shunted, as heretofore explained, the current traversing the conductor (3) will be insufficient to excite the connection register, although sufficient to cause the operation of the cut-off relay (b).

A shunt conductor (5) is provided about the lamp (h) and resistance (i), with a switch (k) controlling the shunt. This shunt conductor contains a responsive device of low resistance which will serve to indicate the operation of the connection register, being unresponsive when the current in the circuit is cut down by the high-resistance winding of the connection register, but being adapted to respond when the high-resistance winding is shunted by the low-resistance winding (c^2).

Another responsive device—that is, a connection register—is shown in parallel with the lamp (l), so that when the connection register (c) is operated the lamp (l) will be lighted and a record made by the register (m). The central office operator or attendant brings about the operation of the service meter (c) by closing the switch (k) upon the completion of a connection.

The windings (c') and (c^2) of the connection register are so proportioned to one another and to the battery and the devices in the external circuit that when the shunt containing the winding (c^2) is closed the number of ampere-turns around the core of the magnet will be approximately the same as before the closure of the shunt. To so proportion these windings in any given case is simply a question of engineering, depending upon the conditions met with, and is one of the important features of the invention. If the winding (c^2), instead of being wound upon the magnet core, should take the form of a mere resistance, the chances of the connection register failing to operate properly would be increased, since its operation is dependent upon a mere margin of current. If, for example, the register in closing the shunt about its high-resistance winding should decrease the ampere-turns on the magnet to such an extent that it could not overcome the tension of the opposing spring attached to the armature, the armature would be caused to flutter or vibrate instead of simply moving up and staying quietly and firmly in its attracted position.

In a system equipped in accordance with the invention of Mr. McQuarrie, the subscriber may purchase a certain number of calls. Each call will be counted, and when the allotted number has been made, mechanism—such, for example, as a signal transmitter—will automatically be brought into action.

At the subscriber's station a counting train is adapted to be advanced step by step by a pawl-and-ratchet mechanism actuated by a manual push-button. A gear train is provided in association with the service meter to be advenced step by step as the counting train is advanced. The push-button is connected to operate a lever, which carries pawls for advancing the counting train and gear train, respectively.

A gong is provided, in association with the service meter, with a tapper for striking it. The tapper is arranged to be actuated through the agency of a pawl, which is in position to be moved by the teeth of the ratchet wheel in its rotation. Each time the button is pushed in, therefore, the counting train is advanced one step, the gong is struck to sound a signal, and the gear wheel is advanced through a certain definite arc.

The apparatus may be associated with a telephone line in the manner illustrated in Fig. 2. The service meter is intended to be mounted at the sub-station in proximity to the subscriber's transmitting telephone. A buzzer (m), associated with the service meter, is connected serially in the circuit of the telephone line. The contacts (g g') control a normally closed shunt or short-circuit (6) around the buzzer, and a second shunt or short-circuit (7) around the buzzer is controlled by the contact springs (h h').

The apparatus at the central office is of the usual type and needs no particular description. It in-

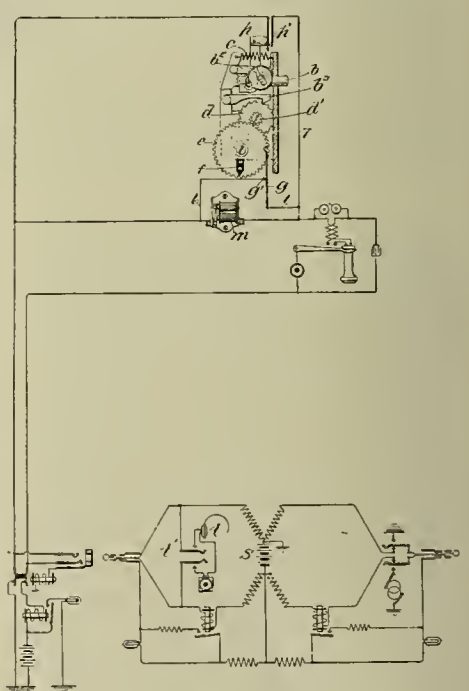


FIG. 2. SERVICE METERS FOR TELEPHONES.—M'QUARRIE SYSTEM.

cludes the usual operator's telephone, which is adapted to be brought into circuit with the telephone line through the agency of a plug and spring-jack switch and the usual listening key (t'), associated with the plug circuit. The system shown is a central-battery system in which the source of current (s) at the central office is connected in a bridge of the plug circuit, and so with the line when connection is made therewith.

In the operation of the system the subscriber is required manually to operate his service meter to record each call at some stage in the course of the connection, usually upon the response of the called party. When the service meter is actuated, the gong is sounded, which, being near the transmitter, is heard in the operator's telephone at the central office. The operator, after directing the subscriber to push

the button of his service meter, knows from hearing the sound of the gong in her telephone, that the registration has been duly made. When a certain allotted number of calls have been registered—that is, when the stud (f), carried by the gear wheel (e), is advanced until it engages the spring (g)—the shunt (6) is opened. Now when the button of the service meter is pressed both shunts (6 7) will be opened and the buzzer (m) will be included directly in the circuit. The buzzer being tranversed by current will rapidly interrupt the circuit, and so transmit a signal which will be heard in the operator's telephone as well as by the subscriber. This signal will indicate that further service will be in excess of the allotted number of calls previously determined upon.

Fig. 3 is a diagram of Mr. Stroud's apparatus showing also the connections. A description of the several operations involved in the use of the register and the tracing of the circuits concerned in the operations will make clear the special circuit connections and the operation of the mechanism. Assuming that the subscriber wishes a connection, he calls central by removing the receiver in the usual manner, which closes the circuit, including the annunciator (111). Central then instructs him to register his call, which he does by depressing the push-button (28), which operation closes a circuit through the buzzer (115) and sets up a disturbance on the line, which transmits the signal to central that the call has been registered by the subscriber.

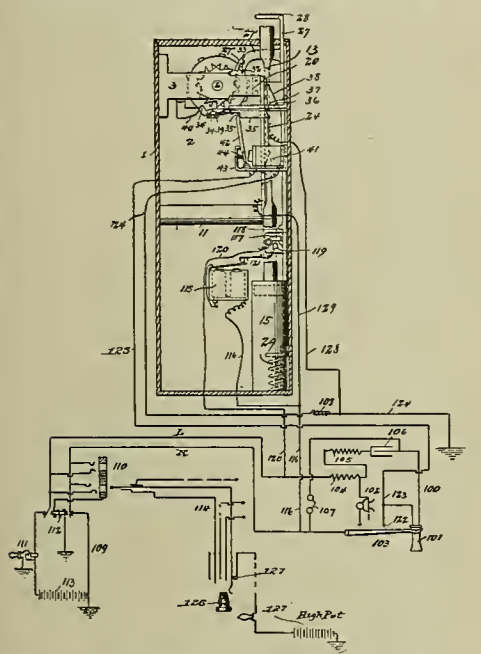


FIG. 3. SERVICE METERS FOR TELEPHONES.—STROUD'S METER AND CONNECTIONS.

The circuit through the buzzer may be traced as follows: From the right main line a conductor (116) leads to and through the coils of the buzzer, from thence to a back contact or anvil (121) of the buzzer, and thence to a shiftable contact device (117), which is frictionally held in either position to which it is moved and is upon the depression of the actuating rod (27) engaged by a shoulder (118) upon the actuating rod and forced downwardly into electrical contact with a fixed anvil (119). From the latter a conductor (120) leads back to the left main line, thus completing the circuit, which is, of course, closed and supplied with energy at central. During the depression of the push-button and actuating rod upon which the latter is mounted the units disk of the register is stepped forward by the engagement of the pawl (27"), thus registering the call upon the instrument. The central operator having received the signal for a connection plugs into the subscriber's answering jack and inquires what connection is wanted, and then proceeds to try and make the connection in the usual manner. In case, however, she finds that it is impossible to make the proper connection with the subscriber wanted, she sets back the calling subscriber's register in the following manner: When the subscriber lifted his receiver from the switch lever (103) in the usual manner, a circuit was closed leading through the right line from central to and through the magnet (41) of the subscriber's register and thence to ground, this circuit being from the switch lever (103) to the back contact (122), thence by a conductor (123) to and through the magnet (41) and back to ground by a conductor (124). Inductive resistance (108) is interposed in this conductor (124) leading to ground. The central operator is provided with a key and connection to ground through a battery, as indicated at (126), (127) and (127'), which are employed when she desires to set back the register.

The completion of the circuit from ground to ground over the right line wire closes the circuit through the magnet (41) and draws down the armature of the latter, thus drawing the shiftable member (35) and the pawl connected therewith to the right and returning the units disk to its former position, or setting it back one step. The central operator having thus restored the register or thrown off the toll, notifies the subscriber that the connection wanted cannot be had, and that she has set back the register. It is to be noted in this connection that the shiftable member, which was actuated to set back the register, remains in the position to which it has thus been shifted until the subscriber again calls for a connection and actuates his push-button, whereupon the inclined cam surface carried by the actuating rod (27) engages the correspondingly inclined end of the shiftable member and restores it to its normal position.

The object of this provision is to prevent the operator at central from collusively or inadvertently setting back the register more than a single step at one time, it being obvious that the vibration of the armature (42) of the magnet (41) will be ineffective until the shiftable member has been restored manually by the subscriber. Another circuit is provided for taking a reading of the accumulated calls upon the register from central, this feature, however, of the mechanism forming no part of the invention.

From the foregoing it will be understood that, by means of the construction and arrangement shown, the subscriber's toll instrument may be made to keep accurate count of those calls only which he should be charged for, without necessitating any personal inspection on the part of the telephone company. At the same time, it will be seen that the subscriber is absolutely powerless to manipulate the register (it being understood, of course, that the register will be kept locked), but, on the contrary, must leave the matter of rebating or throwing off calls entirely to the central operator. On the other hand, the subscriber will not be given a connection with another subscriber until he has registered his call, and the central-exchange operator cannot throw off more than a single call at a time. The arrangement which prevents the register from being set back more than once at a time is also an important safeguard against the possibility of the register being set back a number of steps by accidental closing of the circuit through the magnet controlling it—as, for example, by a charged wire becoming broken and swinging against the line wire repeatedly.

British Pacific Cable Not a Paying Investment.

Figures furnished Parliament show that the net message revenue of the British Pacific cable during the year ended March 31st last was £79,824, while the actual expenditure during the same period was £54,825. The actual expenditure was thus £25,000 less than the gross receipts. As, however, the board of directors set aside £35,500 as a renewal fund, and as it had also to pay an annuity of £77,545 to meet interest on capital and to replace the whole capital in 50 years, the real deficit is over £88,000, and this sum has to be provided (in the agreed proportions) by the contributing governments. The number of messages and words transmitted during the year was approximately 176,351 and 2,095,573, respectively, of which 107,747 messages and 1,226,460 words were intercolonial. In January, 1904, the Fiji government opened telegraph communication (partly overland and partly by cable) between Suva and Levuka, the cable having been brought from England and laid in the previous June.

Bell Telephone Output for July.

The July instrument report of the American Telephone and Telegraph Company gives the following figures for the month and the first seven months of the year compared with corresponding periods in previous years:

	1904.	*1903.	*1902.
July:			
Shipments	80,348	69,194	59,935
Returned	42,842	44,116	34,054
Net output	37,506	25,078	25,881
Since January 1:			
Shipments	672,032	669,258	649,044
Returned	290,032	279,257	260,321
Net output	382,000	390,001	388,723
Iostruments in use	4,161,517	3,540,321	2,914,735

*Month eoded July 20.

NEW COMPANIES.

The Junction City (Texas) Telephone Company has been incorporated by T. B. Phillips, M. E. Blackburn and T. J. Barley.

The Northeastern Telephone Exchange of Foss, Okla., has been incorporated with a capital of $5,000 by S. H. James, O. H. James and associates.

The Lincoln County Rural Company of Tryon, Okla., has been organized with a capital stock of $5,000 for the purpose of constructing and operating telephone lines in that section.

The Franklin (N. C.) Telephone and Electric Company has been chartered with a capital of $15,000 by J. S. Trotter of Franklin, N. C., and others, who will establish a local telephone and lighting plant.

The Star Line Telephone Company of Lawrenceville, Ill., has been incorporated with a capital of $100,000. The articles of incorporation state that the company is to conduct a telephone and telegraph business. H. H. Knipe, J. S. Abbott and A. L. Maxwell are the incorporators.

GENERAL TELEPHONE NEWS.

The Star Telephone Company of Jersey City has removed its chief office from Jersey City to Camden, N. J.

The Dryden Telephone Company of Dryden, Okla., has been incorporated. J. S. Campbell and L. D. Perry head the incorporators.

C. N. Sandbeck of the Standard Telephone Company at Preston, Minn., has accepted the management of a local exchange at Spencer, Iowa.

W. W. Collier is said to have sold the telephone exchange at Bainbridge, Ga., to local capitalists for $15,000. The new owners will operate the system.

F. B. Elce has sold the telephone system at Mitchell, S. D., to the Dakota Central Telephone Company of Aberdeen. C. E. Reeves will be the local manager.

Harry Brownlee, manager of the telephone company at Reno, Nev., is arranging to improve the telephone system in that city. A new pole line will be constructed.

Rand & Waters have applied to the City Council of El Paso, Texas, for a franchise to operate a telephone system, which they propose to construct at a cost of about $85,000.

A site has been purchased at Greensboro, N. C., by the representative of the Southern Bell Telephone Company, and it is reported that a modern five-story exchange will be erected soon.

The Guatemalan government is considering the advisability of making a considerable extension of its present telephone and telegraph system, and the indications are that it will do so.

John Stark of Quincy, Cal., states that a contract for the construction of a telephone line in Indian Valley will soon be let. It is expected that the line will later be connected with Greenville and Crescent Mills.

The Board of Supervisors of Humboldt County, Cal., will receive bids on September 13th for a franchise to erect and maintain telephone poles in the Mattole and Petrolia sections, as applied for by G. A. Cummings and others.

Three police telephones have been placed along a highway near Lawrence, L. I., for the purpose of reporting the speed of automobiles. If the speed limit is exceeded when passing the first station, the driver is arrested at the other end.

The receiver has been discharged in the bankruptcy case of Mrs. Anna M. Brett, who has for several years been promoting the establishment of an Independent telephone system in El Paso, Texas, and it is announced that that system will now be completed as fast as possible.

The Pilesgrove (N. J.) Rural Telephone Company, recently organized, has disbanded and the incorporators have purchased stock in the People's Rural Telephone Company of Swedesboro. Salem County, will be covered with a network of telephone wires, with great convenience to farmers.

Jose Sitzenstatter of the City of Mexico has obtained from the Mexican government a concession for the installation of a new Independent telephone system in that city. It is stated that Mr. Sitzenstatter represents a Swedish syndicate in which the firm of L. M. Ericsson & Co. of Stockholm is largely interested.

Arrangements have been completed by the New Westminster and Burrard Inlet Telephone Company and the International Telephone Company, the latter of Bellingham, Wash., for laying a telephone cable from Vancouver, B. C., to Bellingham. This will give the former city direct telephone connections with all the Pacific Coast cities.

The will of Charon Briggs, which was made by telephone, was filed in the Probate Court in Belleville, Ill., recently. The instrument was made over telephone for the reason that the testator was confined in the St. Clair County Contagion Hospital with smallpox. Mr. Briggs telephoned his wishes to the matron of the county farm, where they were taken down in writing and attested by the attendant. He died two days later.

Receivership proceedings against the United Telegraph, Telephone and Electric Company, which principally does an Independent telephone business in Hyde Park, Chicago, have been begun by the Chicago Title and Trust Company on the assertion that the interest on the $174,400 worth of outstanding bonds of the company is long overdue. A few years ago the company sought a franchise covering the entire city of Chicago, to compete with the Chicago Telephone Company, but the application was not granted.

The Interior Department is inviting sealed proposals until September 22d for the construction and completion of a telephone system about 28 miles in length, in connection with the Uncompahgre Valley reclamation project, near Montrose, Colo. Specifications, forms of proposal and full particulars may be obtained by applying to A. L. Fellows, United States Geological Survey, Chamber of Commerce Building, Denver, Colo., to the engineer of the Reclamation Service at Montrose, Colo., or to the chief engineer of the Reclamation Service, Washington, D. C.

Possibilities of Single-phase Currents in Electric Power Transmission.[1]

By H. A. Bullard and Sidney Sprout.

The old saying "Be not the first by whom the new is tried nor yet the last to lay the old aside" represents a conservative idea well to follow out, and in this article we shall propose something not altogether new for trial, nor yet the laying aside of much that is old.

Single-phase was first in the attempts to make alternating currents commercial, and the exploiting of multiphase was the result of the development of a satisfactory multiphase motor which came forward much in advance of the successful single-phase motor. That the single-phase motor is now practicable, and that there is no limit to the sizes in which it can be built, seems to eliminate at least the oldest objection to the use of single-phase, and we propose to show that practically the only claim which multiphase has upon the consideration of engineers is the large amount of such apparatus in use.

As to the quantity of multiphase apparatus now in use, this article has little to do, except as we may hereafter show that many multiphase lines may be considerably increased in working capacity by the adoption of single-phase in the manner suggested.

A prime consideration in determining the character of plant to be installed for the electrical transmisson of power is efficiency in its broadest sense, namely, economy in first cost, economy in operation and economy in transmission. We propose to show that a single-phase plant for the purpose of generating, transmitting and distributing a given amount of energy may be installed cheaper than a multiphase plant under the same general conditions, and that economy will be found in operating expenses in favor of single-phase. Having shown this, of course, certain deductions follow, namely, with same cost and same loss we have greater capacity; with same loss and same capacity we have less cost; with same capacity and same cost we have less loss. We recognize that these are broad possibilities to suggest.

"Long-distance high-potential electric transmission of power" is more or less indefinite, and for the purpose of this article we shall draw a line by the following rule, namely, anything shall be considered wherein the distance is considerable and the amount of energy to be transmitted, coupled with the voltage determined upon and the allowable loss in transmission, determines a size of wire appreciably larger than that actually required to carry the current in amperes over a short distance under conditions where the line loss in any event would be negligible. To make this more clear, we would state that there is probably not a long-distance high-potential transmission line in operation today where the size of the wire selected was determined only for conducting the amperes, but was made much larger in order that the allowable line loss should come within the range dictated by commercial conditions.

We take up the various parts of a plant in order, excepting line construction, which, being the most important, will be the last discussed.

1. Prime Movers.—It is obvious that waterwheels and steam or gas engines, or other prime movers, would be the same regardless of the number of phases adopted, and the efficiency of the prime-mover plant would be in no wise affected on their account.

2. Foundations, Buildings, etc.—Weights and dimensions of all apparatus would be much the same, regardless of the number of phases, and no material gain or loss would become apparent in foundations and buildings, except wherein single-phase, by simplifying the arrangements, might simplify the construction of the buildings, such as power house and sub-stations.

3. Dynamos or Generators.—Dynamos of modern and accepted construction, and of any make, have a smaller capacity single-phase than when the same frame is arranged for multiphase, the theoretical difference being as 58 is to 100. However, in actual conditions of operation the range is from 60 per cent. in small generators to 80 per cent. in large generators. The price of single-phase generators is usually about five per cent. less than for the same frame multiphase, hence the price per kilowatt is greater for single-phase, ranging from 58 per cent. greater in small machines to 32 per cent. greater in large generators. As we are dealing with large units of power, we can assume that single-phase generators of the required capacity will cost 32 per cent. more than multiphase generators to do the same work; but all know that the actual money invested in generators is a very small item in the entire cost of equipment, and in the light of the savings we expect to show throughout the rest of the equipment this extra cost sinks into insignificance.

Generally, the line voltage required will demand step-up transformers, which takes us out of the range of possible high initial electromotive forces on the generator windings themselves, and an objection to the use of single-phase generators which may come to the minds of some is thus eliminated. We refer to the advantages of star and delta connections. A 15,000-volt initial generator potential three-phase may be obtained by an 8,070-volt winding connected in "star," whereas the same potential single-phase would require a 15,000-volt winding. This, however, is only an apparent advantage, since both machines should be insulated for 15,000-volt conditions, and this insulation is the real expense, or source of trouble, as the case may be.

4. Switchboards.—In the usual modern and accepted switchboard, complete in every detail, we find a condition favoring single-phase in first cost, simplicity, and, because of this simplicity, a great economy in operation. It must be admitted that the average station attendant will more readily comprehend single-phase conditions than the complicated conditions often incident to three-phase, and one matter alone, called to attention, will suffice to illustrate, namely, the synchronizing of generators, or stations, wherein, with three-phase, great care must be exercised that the relation between phase is always correct.

The current for single-phase is always greater than for multiphase, all other conditions being equal, and this adds to the capacity required in switches, instruments and wiring; but this is an added cost per leg only, and the fact that single-phase requires but two legs, against three or four, represents an actual saving of far more than the extra cost for copper. The one ammeter of large capacity costs less than the two or three ammeters of smaller capacity, and the same idea applies equally well to wattmeters, main and feeder switches and automatic protective devices. The number of voltmeter transformers will be less, and the labor item of erecting and wiring the board will represent a considerable saving. A single-phase switchboard for any given conditions will cost about 25 per cent. less than a three-phase board for the same work. Economy of space is also gained, and this is often of some importance.

5. Station Wiring.—While it is admitted that the cost of copper for a single-phase station will be 33⅓ per cent. more than for three-phase, on a strictly theoretical basis, yet it is a fact that in actual practice it will seldom be found more than 15 per cent. greater, and this is more than offset by the saving in labor required to wire the station for single-phase, which saving will be 22½ per cent. in every case. Here the matter of extreme simplicity becomes of great importance.

6. Step-up and Step-down Transformers.—There seems to be practically no limit to the size of power transformers which the manufacturers are willing to build, and the price per kilowatt, other conditions being equal, is reduced somewhat as the size is increased; hence it is obvious that one large transformer will be cheaper in the first cost than three smaller transformers which, combined, will give the same total capacity. However, this saving is so slight as to be negligible, and doubtless the more important consideration would be the selection of the total capacity in transformers subdivided into such number and size of units as would assure practically uninterrupted service. It is safe to say that in the adoption of single-phase the cost of step-up and step-down transformers would not in any wise be increased, but could be somewhat decreased.

7. Distributing or Lighting and Motor Transformers.—For lighting and motor transformers there is quite a saving in price for the one large transformer, single-phase, against the three smaller transformers aggregating the same capacity three-phase. The difference will vary from 50 per cent. in very small units to 15 per cent. in the largest lighting and motor transformers.

8. Lightning Arresters.—In connection with lightning arresters and kindred apparatus, it is merely necessary to point out that only one-half of the multiphase equipment is required for single-phase; hence one-half of the first cost and one-half of the troubles which sometimes occur in connection with the use of lightning arresters, static interrupters and apparatus of like nature.

9. Rotary Converters.—The rotary converter will undoubtedly be eventually eliminated, since its primary purpose is the conversion of alternating current to the uses of direct-current railway service. However, in cases where a rotary converter must be used, a single-phase rotary will be found quite as cheap and satisfactory as a multiphase rotary.

10. Lamps for Lighting.—All kinds of lamps are essentially single-phase; hence nothing is to be gained or lost in this respect except in so far as single-phase distribution for such purposes would be found simpler than multiphase.

11. Synchronous Motors.—Single-phase synchronous motors will be found quite as satisfactory in operation as multiphase synchronous motors; but it is true their cost will be increased. The cost, however, is borne by the consumer, and it is probable would never assume the proportions of a serious item in any case.

12. Induction Motors.—As pointed out in the beginning, the single-phase motor is a commercial product, and the instant that the demand is created they will be supplied in any sizes required and the present limit to small sizes eliminated. It is not the purpose of this article to discuss the relative merits of single or multiphase motors, but suffice it to say that the first cost is approximately the same, the efficiency approximately the same, and the single-phase motor more closely resembles the characteristics of the direct-current motor in its diversity of application than does the multiphase—wherever a multiphase motor will do the work required a single-phase motor will do it equally well.

13. Street-railway Motors.—In connection with street-railway motors, it is merely necessary to point out that practically all the efforts being put forward to the end that alternating-current railway work may become commercially successful point to the adoption of single-phase motors as the motive power, and if a three-phase plant be used to supply an alternating-current railway, the phases will have to be separated before the current can be used on the cars; that this will prove complicated as compared to a straight single-phase system, no one can fail to appreciate.

14. Line Construction.—The transmission line is of extreme importance, and there are three different constructions which can be used, namely, plan No. 1, a complete metallic circuit consisting of two wires strung overhead; plan No. 2, one single wire overhead and a return circuit obtained by another wire not strung on the poles, but buried in the ground in any convenient location along the right-of-way; plan No. 3, one single overhead wire and a ground return, the latter accomplished by sinking more or less deep shafts in the nature of artesian wells at all generating and sub-stations and thereby obtaining the necessary ground return.

Before going further we wish to give a few figures adopted for the purposes of this article, some being averages of results available and attained on certain Pacific Coast transmission lines.

Average cost per crossarm	$ .75
Average cost per pole set in place	8.50
Average cost per insulator	1.25
Average cost per wooden pin	.15
Maximum cost per iron pin	.40
Average for stringing three overhead wires per mile	40.00
Average for stringing two overhead wires per mile	34.00
Average for stringing one overhead wire per mile	20.00
Average for stringing one overhead wire and one underground wire per mile	27.50

The usual triangulation of the three wires of a three-phase circuit necessitates from three to five feet greater length of pole than would be required if all wires were in the same plane, and hence the wires of a single-phase circuit could be kept the allowable distance above ground with greater sag, or shorter poles, or greater distance between poles, and the latter arrangement we have adopted, since there is no danger of the two wires swinging together. The use of metal pins with the present strong insulators gives substantial construction with ample factor of safety.

The usual practice of 40 poles to the mile gives spans of 132 feet each, and with single-phase there will be no trouble in keeping the wires the allowable distance above the ground with spans of 250 feet, or 22 poles per mile.

The following table gives the cost per mile for each of the various types of single-phase line construction compared with the cost of three-phase three-wire, the copper item being purposely omitted. We have assumed a $5,000 artesian well for ground in every 50 miles of line as a fair average, and believe we are well on the safe side.

Comparative Cost of Lines Per Mile Exclusive of Copper.

Item.	Three-phase Three-wire.		No. 1. Single-phase Two-Wire Overhead.		No. 2. Single-phase One Overhead and One Underground wire.		No. 3. Single-phase One Overhead Only.	
	No.	Cost	No.	Cost.	No.	Cost.	No.	Cost.
Well for ground							One to Every 50 Miles.	$100.00
Poles	40	$340.00	22	$187.00	22	$187.00	22	187.00
Crossarms	40	30.00	22	16.50				
Insulators	120	150.00	44	55.00	22	27.50	22	27.50
Pins	120	18.00	44	17.60	22	8.80	22	8.80
Labor		40.00		34.00		27.50		20.00
Total		$578.00		$310.10		$250.80		$343.30

Taking single-phase two-wire as requiring 100 per cent. of copper, the three-phase three-wire would require 75 per cent., and the single-phase, with one overhead and one underground wire, would require 100 per cent., assuming no value for any actual ground return there might be. Further, assuming the artesian-well ground return to have a resistance equal to that of the overhead wire (it would probably be less, however), the single-phase, with one overhead wire only, would require 50 per cent. of copper. Taking the table, these figures and copper at 18 cents per pound, the following is readily deduced:

Two hundred and sixty-seven dollars and ninety cents, the difference between three-phase and single-phase (plan No. 1), would purchase 1,488 pounds of copper, which is the extra copper that could be put into the single-phase before that line would equal in cost the three-phase for same loss and load. Hence, a three-phase line requiring three wires, each 93,200 circular mils in area, would cost installed, the same as a single-phase line (as per plan No. 1) requiring two wires, each 186,400 circular mils in area. Hence,

1. A paper presented to the eighth annual convention of the Pacific Coast Electric Transmission Association, June 21, 1904.

two-wire single phase (as per plan No. 1) is cheaper than three-wire three-phase whenever the three-phase line requires a size of wire smaller than No. 1, or when the single-phase requires a size of wire smaller than No. 000.

Three hundred and twenty-seven dollars and twenty cents, the difference between three-phase and single-phase (plan No. 2) would purchase 1,818 pounds of copper; hence a three-phase line requiring three wires, each 114,000 circular mils in area, would cost, installed, the same as a single-phase line (as per plan No. 2) requiring two wires, each 228,000 circular mils in area. Hence, two-wire single-phase (as per plan No. 2) is cheaper than three-wire three-phase whenever the three-phase line requires a size of wire smaller than No. 0, or when the single-phase requires a size of wire smaller than No. 0000.

Since single-phase (plan No. 3) requires only two-thirds of the copper required for three-phase, it is at once obvious that there is no possible condition wherein three-phase could ever become as cheap as single-phase (plan No. 3).

It is easy to conclude that single-phase, with one overhead wire, is the cheapest, and that the return circuits should be obtained by either plan No. 2 or 3, or a combination of both.

Having shown that single-phase may be cheaper than multiphase for transmission purposes, we want to point out some possibilities, as follows:

The feature of the grounded return would not increase the cost of insulators, as might at first seem likely, for an ideal condition is obtained, namely, a single insulator on the top of a single long pin—the pole. Nor would it increase the cost of insulating the main step-up and step-down transformers, since this very ground would be their protection by eliminating practically all sources of insulation breakdown.

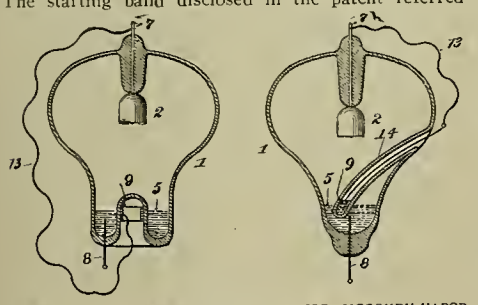
All static accumulations on the line would be done away with and the effects of capacity, reactance, inductance, etc., would seem to be neutralized or utilized as the case may be, and to an extent eliminating many of our present troubles on three-nhase lines; 120 insulators should give about three times the trouble that 44 would, and one wire would certainly cause much less trouble than three—bad boys, accidents and the elements considered. Distributing or lighting and motor transformers would not necessarily have one side grounded, though it might be wise to connect one leg to the grounded leg of the main step-down transformers.

Present three-phase lines can be left as they are and used for single-phase and the capacity of the line increased, as, for instance, by sinking artesian wells and thus making a ground. The three-phase generators would give 80 per cent. of their capacity on any one phase alone, and the capacity of the line would be increased by 50 per cent.; this of course would call for an addition to the generator capacity of 62½ per cent.

The various advantages in favor of single-phase, as brought out in the above, would seem to be worthy of the careful consideration of this association, and we hope for an earnest and thorough discussion.

Starting Devices for Mercury-vapor Lamps.

In connection with the gas or vapor-electric apparatus which was patented by Peter Cooper Hewitt, September 17, 1901, there was described what was called a "starting band" in proximity to the negative electrode. This starting band may assume various forms, as is now well understood. The starting band disclosed in the patent referred



FIGS. 1 AND 2. STARTING DEVICES FOR MERCURY-VAPOR LAMPS.

to was located outside the container, within which both the positive and negative electrode of the apparatus were inclosed.

Mr. Hewitt has since found that the function of the starting band will be performed whether it is located outside or inside the material constituting the negative electrode, and he has accordingly patented a device embodying a starting band which is internal with respect to the negative electrode. The invention is illustrated in the accompanying diagrams.

Figs. 1 and 2 are vertical sections of different forms of the invention. Naturally the apparatus may assume many forms, and those illustrated are simply given as typical.

In the diagrams (1) is a container, within which are electrodes (2) and (5), connected, respectively, with leading-in wires (7) and (8). The positive electrode (2) may be of iron or some other suitable substance, while the negative electrode (5) may conveniently be of mercury or some material which will undergo disintegration by the action of the electric current, which disintegrated portions will eventually return and re-form as the electrode.

In proximity to the negative electrode and usually projecting somewhat above the level of the upper surface is placed a starting band (9), which in Fig. 1 is represented as a strip of metallic foil or may consist of a metallic paint either in the form of a complete ring or in the form of one or more strips of foil or paint.

The starting band (9) in Fig. 1 is internal with respect to the material of the negative electrode by reason of the fact that the container is made of re-entrant form at the bottom, and the starting band is applied to the inner side of the re-entrant portion in substantially the position indicated in the diagrams.

In Fig. 2 is shown a tube (14) running in from the outer wire of the container (1) and dipping slightly below the surface of the mercury or other material constituting the other electrode (5). In this instance the starting band is in the form of a drop of mercury in the bottom of the tube (14), it having been found that this form of starting band operates well in practice.

Electrical Progress in New Zealand.

The annual report of the Post and Telegraph Department of the New Zealand government for the year ended March 31, 1903, just issued by J. G. Ward, postmaster-general and electric telegraph commissioner, contains some interesting facts concerning the telegraph and telephone in that country. The report also briefly refers to electric lighting and to space telegraphy. The business of the department as a whole continues to expand very satisfactorily.

For the year covered by the report the revenues, as a result of the general prosperity of the colony, increased over $275,000. The telegraph and telephone-exchange branches of the service show a growth which would, were it not overshadowed by the postal business, stand out more clearly. An increase of 405,893 in the number of telegrams forwarded produced over $45,000 more revenue, and about an equal sum was derived from 1,472 additional telephone-exchange subscriptions. The total telegrams handled reached the record number of 4,965,197, for the transmission of which $812,485 was the net amount received. Telephone-exchange connections numbered on March 31st 12,105 and the subscriptions totaled $355,140. The number of miles of telegraph line at the close of the year was 7,779, carrying 22,920 miles of wire. The expenditure on telegraph extension amounted to $236,135.

Telegraphs.

The total value of the telegraph and telephone business for the year ended March 31st last, including miscellaneous telegraph receipts and government telegrams, was, in round numbers, $1,309,700, as compared with $1,289,600 for the previous year.

The telegraph receipts for the financial year, including telephone-exchange subscriptions, private-wire rents, etc., amounted in round numbers to $1,187,800, compared with $1,112,400 in 1902-03—an increase of $75,400.

The expenditure was about $1,279,300, as against about $1,141,800 for the previous year—an increase of $137,500. The increase is largely due to the Pacific-cable subsidy paid for the first time.

The average value of each ordinary telegram was 16.5 cents, and of each urgent telegram 31 cents. The value of each press telegram averaged 19.88 cents, as against 18.92 cents in 1902-03.

Telegraph-cable Service.

The great improvement in the cable services, coupled with the reduction in the cost of cabling, due to the inauguration of the Pacific cable, has materially popularized the cable system, as may be gathered from the fact that the colony's cable business increased 25 per cent. during the year. The average time of transmission of cable messages generally has further improved. Messages from the United Kingdom, via Pacific, frequently reach the colony within 30 minutes of the time of presentation, and from America and some of the Australian states in some cases in 15 minutes.

The working of the Pacific cable, as well as the Canadian land lines and the Atlantic service, has been satisfactory. The land line between Bamfield and Alberni, which had given so much trouble, has been replaced by a sea cable, the laying of which was completed on July 28th last year.

New Zealand's proportion of the deficit of $452,590 on the first year's working of the Pacific cable amounted to $50,285. Against this the colony secured an improved oversea-cable service, and the users of the cables saved over $250,000 a year. The relatively large deficiency gave rise to comment; but the position is not serious when it is remembered that, besides the ordinary items of expenditure usually charged against cable-working expenses, a terminable annuity payment of $387,725 a year is made, which not only provides for interest but also for a sinking fund as well, which will in 50 years repay the whole of the $10,000,000 sunk in the cable. In addition, there is a cable-reserve fund of $125,000 a year for the purpose of replacing the original cable, if necessary, in 40 years.

A conference of delegates representing the Pacific-cable partners is to be held in London shortly in reference to the commonwealth's agreement with the Eastern Extension Telegraph Company and other important matters affecting the Pacific cable. Among the questions for consideration is one to be submitted by this government that local honorary boards should be appointed in Melbourne, Sydney and Brisbane, to whom representatives of the board would look for advice in the matter of canvassing and business matters generally. Sir Sandford Fleming, formerly engineer-in-chief Canadian railways, and who has taken a marked interest in the Pacific cable, will represent the government at the conference.

The cable between Honolulu and the Philippines, via Midway Island and Guam, which has been laid by the Commercial Pacific Cable Company, was opened for traffic on July 25th last. This gives San Francisco direct cable communication with China, Japan and other points in the East. The Pacific Cable Board, by arrangement with the German Transatlantic Cable Company, has been able to reduce the rate to Germany to 72 cents a word. It is hoped that a similar reduction may be possible later on to other places in Europe.

Telephone Exchanges.

Twelve new telephone exchanges were opened during the year and 1,472 new subscribers were added to the exchanges throughout the colony, bringing the total connections up to 12,105, an increase of 14 per cent. for the year. Of the total increase, 709 were added at the four chief centers. It will be necessary to make considerable additions to the Wellington exchange, all the space available for the switchboard being now taken up.

In consequence of the growth of the larger exchanges and the introduction of electric tramways in the four principal centers, the installation of metallic circuits has been decided upon to eliminate cross-talk and induction from the tramways. These are now being installed at Auckland, and the material for Wellington and Dunedin, now under order, is expected to arrive shortly, when the work will be put in hand at once. There were on March 31st last 27 central and 54 sub-exchanges.

On March 31st last there were 7,779⅛ miles of telegraph and 721½ miles of telephone lines in the colony, these lines having 22,920½ and 9,834⅛ miles of wire, respectively. These figures are exclusive of the lines maintained by the Railway Department.

Following up the satisfactory results attained by superimposing telephones on telegraph and combined telegraph and telephone wires, thereby giving a metallic circuit for the telephone, circuits have been so arranged between Pahiatua-Woodville, Palmerston North-Feilding, Palmerston North-Marton, Marton-Wanganui, and Palmerston North-Foxton. In each case a telegraph circuit works over the closed circuit, the telephonic communication being effected by means of transformers. The results have in all cases been very satisfactory, induction being practically eliminated. A telephone metallic circuit has been established between Palmerston North and Woodville.

Electric Lighting and Power.

The rapid increase in the use of electricity for lighting and power has thrown a considerable amount of work on the department, which, acting for the electric telegraph commissioner as the Board of Control, has dealt with regulations in connection with the construction of tramways in the city of Christchurch. A number of applications for licenses under "The Electric Lines Act, 1884," have been received from boroughs and dealt with.

Space Telegraphy.

During the last session of Parliament an act was passed giving the governor the right to establish stations for the purpose of receiving and transmitting telegraph messages within New Zealand, or between New Zealand and parts beyond New Zealand, by space telegraphy, and preventing any person erecting, constructing, or establishing any station or plant for the purpose of receiving or transmitting communications by space telegraphy without having first obtained the consent of the governor in council. No progress has been made in the direction of introducing space telegraphy into this colony, negotiations which were commenced with the Marconi company having fallen through. Inquiries are now being made as to the desirability of testing another system, but advancement in the direction of making space telegraphy a commercial success appears to be slow.

The official bulletin of the Italian Postoffice Department gave in its latest issue interesting details of the invention of Signor Cattani, which he calls the teledattilograph. It is an instrument by which one is able to utilize a writing machine in order to send or receive messages over the telephone. If the person sought for should not be at the receiver the machine, left in contact, will write the messages, moving the corresponding keys of the typewriter as in the sender's machine. Messages can be sent to several persons at once.

Points for Consideration When Purchasing Series Alternating-current Arc Lamps.[1]

By G. Brewer Griffin.

Part I.

So much has been said and written regarding the advantages of enclosed arc lighting over the open arc that there is very little left to be added. The comparative lighting effects of the two lamps have been carefully covered by many well-known engineers and writers; therefore, in preparing this paper for presentation before this association the writer will merely touch on a few of the points regarding comparative illumination and confine himself to those which will, in a way, be applicable to argument and the theories advanced in this paper regarding the selection of the best apparatus.

Illumination.

In considering a change in a street-lighting system from the open direct-current, constant-current lamp to the enclosed alternating-current constant-current lamp, the first question that arises in the mind of the lighting committee appointed by the municipality or by the central-station management is in regard to the comparative available light from the two different systems, in order that an intelligent and satisfactory installation of the new series alternating-current lamps contemplated may be made.

It is a well-known fact in optics that images are distinct on the retina within a large volume of illumination provided the source of light remains at a constant value. Very slow fluctuations or variations in the light cause little or no eye fatigue or distress, owing to the natural protection exerted by the optic nerves. That is to say, the eye is protected from strain by a condition sometimes referred to as "visual inertia." A greater or less quantity or volume of light outside of this fixed range, within which visual inertia exists, or an intermittent fluctuation of light within the range, causes a marked visual effort of the optic nerves in the normal eye, causing the observer to pick out details in groups or singly, and thus mentally combine them into what would represent a normal instantaneous view of the whole were the light of the proper intensity, volume or quality, as the case might be.

A steady light of low volume is, therefore, better than an unsteady one of higher brilliancy or volume. Hence, it is advisable to shade, choke down or break up the brilliant rays in the arc with light opal, semi-sand-blasted or some similar pattern of inner bulb, thus increasing and improving the field of vision, although reducing the available brilliancy of illumination.

In the past it has been the practice to refer to a 9.5-ampere, 52-volt arc of the open type as a 2,000 (commercial) candlepower lamp. Speaking in a general way, such a lamp can be replaced successfully by alternating-current series constant-current arc lamps of 7.5 amperes, with a marked improvement in the lighting effect and a greater addition to the field of vision. The minimum illumination between lamps will be found to remain about the same. The bright zone of the open arc disappears and, while the average illumination over the area is somewhat less, the visual usefulness, the vital test of value of an illuminant is distinctly greater.

Alternating-current lamps of low amperage are not, in the estimation of the writer, satisfactory to use or successful for street illumination, unless carbons of greater density and reduced cross-section are used and the lamps hung quite closely together. This is owing to the strong bluish or violet light given with the standard one-half-inch carbons and shorter life and increased number of annual renewals of carbons per lamp.

Most authorities agree that for surface lighting of streets the open arc has a decided advantage over the enclosed arc up to 100 feet away from the source of light. At 150 feet and over the difference in favor of the alternating-current series enclosed lamp is greater than the reverse value of the direct-current open arc at 100 feet.

Considerable argument has arisen at different times as to how high series alternating-current enclosed-arc lamps should be hung above the level of the street to give the best general results. In the writer's experience, 6.6-ampere lamps should be hung 18 feet above the street level and 7.5-ampere lamps not to exceed 25 feet above street level, measuring from the center of the bulb to the street. At these heights the following observations seem to be correct. At 55 feet away from the pole the direct-current open, the direct-current enclosed and the alternating-current series enclosed with reflector are equal in intensity. At 125 feet away the alternating-current series lamp shows a greater intensity than the others, the open lamp being about 50 per cent. less and the constant-current direct-current 25 per cent. less.

At this point it might be well to consider the efficiencies of glassware. A paper prepared in January, 1900, by Messrs. Williamson and Klinck, and presented before the Franklin Institute, showed a considerable depth of research into this question. The following efficiencies were given:

Holophane	87 per cent.
Ground glass	79.3 per cent.
Plain opal glass	68.5 per cent.
Slightly opalescent	90.2 per cent.
Flat opal glass	86.8 per cent.

From the writer's observations, he would be inclined to recommend the adoption of a slightly opalescent inner bulb and a clear outer globe.

Authorities differ as to the watt energy required to properly illuminate certain surfaces. The average opinion would lead an investigator to believe that 450 watts for every 300 square feet of street space would be the most satisfactory. Watts per candlepower in series alternating-current arc lamps for six amperes and 70 volts, operating at a power factor of 80 per cent., figured to give about 1,600 candlepower for 100 hours, is about 0.21 watt.

The question of proper operative voltage at the arc for series alternating-current arc lamps is one which requires careful attention by central-station operators, in order that the best results may be obtained. Speaking generally, lamps should operate at 70 volts arc as a minimum (a lower voltage arc with successful operation is possible should carbons be treated with potassium or sodium salt) and 75 volts as a maximum during the life of a trim of carbons. The reasons for this, I feel, are not thoroughly understood by users of enclosed-arc lamps. Having this opinion, I may be pardoned for going slightly into detail regarding it.

The temperature of the electric arc is supposed to be the boiling point of carbon. A certain percentage of carbon is vaporized under the high temperature induced by the arc, and to obtain proper combustion of this vapor the proportion of oxygen admitted to the arc must be carefully calculated, in order that the bulb may be luminous over its entire surface, that it be not blackened during the life of a trim of carbons, and that the life may not be unduly lengthened or shortened. The necessities of these precautions are as follows:

Blackening of inner bulbs may be traceable to the following causes: Insufficient ventilation of the inner bulb causes a blackening of the inner surfaces, owing to the want of proper arc ventilation or admixture of oxygen with the carbon vapor. While the ventilation of the inner bulb may be properly proportioned by the manufacturers, this condition may exist through the carbons being of too great a diameter, causing them to fit too tightly in the gas-cap bushing, thus causing the arc to burn in a condition which soon approaches vacuum. This condition of blackening may not be noticed when the lamp is first started, owing to the fact that the oxygen in the inner bulb is not immediately consumed. As soon as the oxygen enters into chemical combination with the carbon vapor the blackening begins. The pressure on the inner bulb at this time is raised considerably above normal, causing cracked bulbs. This same blackening is caused at times by low arc voltages, while the ventilation of the bulb may be normal. If the carbon is vaporized rapidly by either the high-voltage arc or an average-voltage arc with proper enclosure, the carbon vapor produced, by the arc is burned so rapidly that it does not reach the walls of the enclosing bulb. Thus it is readily seen that, with a short arc, or low voltage or with a tight enclosure, practically all the vapor generated by the arc cools in transit to a temperature below that required for its proper chemical combination with oxygen, and thus condenses on the walls of the arc chamber. With the latter-named condition existing, the actual light efficiency is reduced in proportion to the amount of deposit on the bulb. As before cited, a light opalescent bulb had best be used, although the clear inner bulb, after the second night's operation, will serve nearly as well, owing to the very slight deposit of carbon by-products which will take place on the inner surface, however carefully the ventilation of the bulb is calculated.

Another point to be considered is that this by-product will always deposit on the coolest point adjacent to the arc. The use of brass, gun metal or similar compositions in the enclosing chamber should be frowned upon, as metals of these and similar alloys add depth to the color of the deposit, varying from a brilliant yellow to a light brown.

It is therefore advisable to use some form of gas cap made of material which will offer a high resistance to the heat in respect to its resisting disintegration under high temperature and which will still dissipate quite rapidly the heat generated by the arc. The advantage of this will readily be seen; the gas cap being cool, the bulk of the deposit attaches itself to it instead of on the inner surface of the bulb, thus giving a considerably better light efficiency after 50 per cent. of the carbon has been consumed than would be obtained from a lamp having some form of metal gas cap, which, being hotter than the walls of the enclosing bulb, causes it to deposit on the latter, thus lowering the light efficiency.

A chemical analysis of the deposit shows it to consist of ferric oxide and silica, mainly silica. It has been variously estimated that from 20 per cent. to 30 per cent. of the available light is lost after 50 hours' operation, caused by the deposits on the inner bulb, where iron, brass or other metal gas caps are used. The material used for this purpose by the company with which the writer is connected seems to be the ideal substance for the purpose. By actual measurement of the deposit, compared with that of a lamp of the same type and current consumption, burning the same number of hours, it was found that the weight of the deposit on the bulb was a trifle less than one-third of that on the bulb of the lamp having the metal gas cap, both lamps using same grade and amount of carbon. Still further to prove that the difference did not exist in the quality of the carbon, the deposit was carefully removed from the gas cap, side rods and carbon holder of each lamp and weighed, and, when added to the weight of the deposit washed out of the bulb, the total weight of the deposit from each lamp practically agreed.

Great stress has been laid upon efficiencies of all types of apparatus, and station engineers are anxious to obtain even a gain of one-half of one per cent. in efficiency in the almost-perfect generator or engine, but few pay any marked attention or give any thought to percentages gained or lost in an arc-lamp mechanism, and fewer still to light efficiency gained or lost by proper or improper engineering methods. It is only within the last few years that the station man has awakened to the necessity of carefully considering the performance of what is known to the trade as "detail apparatus." Today, on account of this awakening, the central-station man is demanding and receiving better and more efficient transformers, meters, incandescent lamps; and why not arc lamps and other similar apparatus of the same class?

Another cause of trouble in the operation of arc lamps is the moisture on the inner surface of the bulbs, or in the carbons, which causes the arc to be unsteady at the start, cuts down the light to a large extent, shortening the length of the arc to about one-sixth of its normal, and so remains until the moisture has been dissipated. Therefore, the necessity of having an arc lamp which is thoroughly waterproof and practically moisture-proof, is a point to which station men should insist upon, if they wish to be free from the "complaints of the City Fathers."

With this preamble the writer will proceed to take up points for consideration when purchasing a series alternating-current arc-lamp equipment. For convenience, you should first consider the lamp itself. The following are the main features, in the order given:

Differential Mechanism.

First of all should be considered the type to be adopted. The higher energy losses in the differential mechanism, in comparison with the shunt, is not to be considered when its superior operation is taken into account. The construction of the differential lamp is so well known that its details need not be entered into here. There are, of course, variations in the type. The armatures may be mounted so that they enter the magnets from the bottom or from the top, or where the pairs of magnets are superimposed they may enter from the bottom of one pair of magnet coils and the top of the other pair. However, the essential details of operation are alike; a pair of series coils, operating against a pair of shunt coils, with a rocker arm or armature connected to the clutch rod. The differential lamp strikes the arc with the carbons together, and the weight of the moving parts acts to hold the carbons apart when no current is passing through the lamp. Therefore, troubles and outages caused by the carbons slipping through the clutch do not exist as in the shunt lamp. A lamp of the differential type is, to an extent, self-regulating as to the current taken, which is of direct assistance in the operation of the circuits, and, by so doing, makes the service good; this is not true of the shunt lamp.

Case and Trim Parts.

The first consideration is the material used. The weight, strength, quality and rigidity should be carefully investigated. It is generally considered that a high-grade copper case, not under 18 gauge, should be preferred. It should be corrugated to give it stiffness and strength, and, incidentally, add to the artistic merit.

2. Accessibility of the Mechanism.—Preferably, the case should be provided with a door, which is so constructed as to be watertight, and hung on substantial hinges and provided with a good heavy locking device. Preferably, the door should take up about one-third of the lamp case, and the renewable parts should be easily reached with the door open.

3. Interchangeability of the Parts.—In this connection, a prospective buyer will see to it that wherever screws and nuts are used, they are of standard dimensions and have standard threads, thus making it possible to obtain duplicates from any hardware store.

4. Method of Ventilation.—The lamp should be well ventilated and still be bug and water proof. By having a good ventilation it naturally follows that the operating temperature will be low and the life of the insulation and windings be materially increased.

5. Inner Bulbs and How Supported.—The closed-base inner bulb is now generally recognized by manufacturers and consumers as best meeting the special requirements for street arc lighting, there being only one air seal, which is taken care of by the mouth of the bulb resting against the surface of the gas cap. There will be practically no shadows thrown from side rods where this type of bulb is used, or from the supporting device which, in this case, is a light wire stirrup or bail, which supports the close dinner bulb. In addition, there is an advantage in that there are no gas caps, so that the lamp may be readily trimmed with one hand.

6. Outer Globes and How Supported.—The selection of an entirely closed or open-bottom outer globe is one that is largely a matter of personal choice. With some types of lamps the open-bottom or outer globe is almost essential, on account of these lamps using 18 inches or 20 inches external reflectors, which are supported by the same device which holds the globe in place. This makes it difficult for the trimmer to handle the globe and shade. Where suitable

1. A paper read before the Ohio Electric Light Association at Sandusky, O., August 17, 1904.

inner reflector is used the closed-bottom outer globe should be preferred, the life per trim being somewhat longer with it.

7. Reflectors; Where and How Supported.—As just mentioned, large external reflectors are frequently attached to the same device which holds the outer globe. It goes without saying that any form of reflector on an outdoor arc lamp is a nuisance and a source of expense and detracts from the trim appearance of the lamp, and causes the lamp to "sail" in the wind and pack up with ice and snow during the winter (not referring to the tropical countries) and dirt in the summer, thus adding increased weight to the hanger cables and supports, and it also provides a roosting place for the fowls of the air.

8. Lamp Cap, Hanger Loop and Terminals.—A lamp cap made of copper is, of course, preferable to the one constructed of iron or other corrosive metal. The terminals should be substantial and placed as far apart as possible and provided with heavy and substantial screws to hold the leads in place. The terminals should be mounted on petticoated porcelain insulators, and all parts of the lamp cap should be strictly watertight, and no part exposed to the weather should be made of any material other than gun metal, brass, phosphor bronze, copper or similar material. Thus the periodical refinishing and painting of street arc lamps is avoided.

MECHANISM.

The next group of features to be considered should be the mechanical construction of the mechanism.

1. Number of Different Pieces.—These parts should be reduced to the lowest possible number, in order that repairs may be quickly and easily made, and a large stock of supply parts unnecessary. The writer well remembers the time when no two screws in an arc lamp (of which there were, with a slight exaggeration, hundreds) were of the same threads or length. In those days the arc-lamp manufacturers made more money by selling repair parts than on the sale of the lamps themselves. There are many parts of an arc lamp where the same screw can be used, and a modern lamp should show a careful consideration of this possibility.

2. Assembly of Parts.—The parts of the lamp should be readily detachable one from the other without dis-assembling the entire mechanism. Preferably, all parts should be mounted on a spider attached to the central tube, which tube should be especially heavy. This method of construction would allow the entire mechanism to be removed from the lamp case with the central tube. The central tube should, however, be readily detached from the rest of the mechanism. This method of mounting would preserve the alignment of the lamp under all conditions, as the tube would screw into a substantial cross-bar in the top of the lamp and line up with bushings in the base frame, so that it would be practically impossible to reassemble the lamp and have it out of alignment.

3. Methods of Adjustment.—Easy and rapid methods of adjustment should be provided. One of the adjustments most used is necessarily the cut-out weight and contacts. Some method should be provided so that close adjustment of the arc can be readily obtained without the weight sliding back and forth on the bar as the rocker arm is tilted.

4. Quality of Material.—Central-station buyers should insist on a high grade of material throughout. The first cost might be slightly more, but the decrease in annual maintenance charges would be marked and the depreciation charges on the apparatus could be reduced as the valuable life of the lamp should be increased in the ratio of the quality of the material used.

5. Switch Construction.—The switch, preferably, should have no moving leads attached to it. The contact parts should be well made and the handle projecting on the outside of the case preferably metal.

6. Magnet Spools.—The use of metal spools covered with paper or any similar material of this kind, while used to a great extent by some manufacturers, is not to be considered the best practice in alternating-current arc lamps. A magnet spool should preferably be molded in one piece from some of the well-known insulating materials, preferably vulcabeston. All spools should be interchangeable one with another. The windings should show careful workmanship, the layers being smooth and the leads attached and connected where necessary with two screw-wire sleeve connectors

7. Cut-out Device.—The cut-out should be so constructed that it is only necessary to bridge one contact to cut out the lamp. This contact should be faced with coin silver, which metal will not lump up should there be any tendency for the cut-out to arc, and its oxide is a good conductor. The arms should be readily renewable and be so attached that they are rigid when put on.

ELECTRICAL PERFORMANCE.

1. Breakdown Tests.—The best engineering practice today demands that a series alternating-current arc lamp should be able to withstand a breakdown test to ground, without damage to the insulation, of 7,000 to 8,000 volts, alternating current, applied for one minute. Careful buyers are insisting that some guarantee be given as to what tests lamps of this character will withstand.

2. Losses in Mechanism. (Difference between true watts at terminal and true watts at arc).—If a differential lamp is carefully constructed, electrically and mechanically, the loss should not exceed 22 watts per lamp. The efficiency varies somewhat with the carbons used. The figures above given should be the average with a number of pairs of carbons. The ideal way to make such a test is to select from 25 carbons those which gauge between 0.505 and 0.520 of an inch. Re-sort them after gauging, and select by weight those which come between the heaviest and the lightest, or, in other words, the average-weight carbon. Twenty readings should be taken at five-minute intervals with each pair of carbons, after first allowing the arc to establish itself and burn not less than one-half hour before taking the first reading. Take the same number of readings on the other six pairs, then break them on the holder ends, so that the arc will form one-third down the inner bulb. Again break them to a point one-half the way down, taking the same readings. At two thirds the way down the same readings should be taken. The average results obtained under these conditions will be extremely accurate, and with some differential lamps the writer has obtained a loss as low as 19 watts average.

3. Power Factor.—The power factor does not appreciably vary with the location of the arc in the enclosing chamber, but will vary with the quality of the carbon. Many central stations, lamp men and manufacturers erroneously estimate that the power factor of a pair of carbons without intervening mechanism is 100 per cent. Actually the power factor under these conditions is about 90 per cent. This percentage must, therefore, be taken as the ideal condition as to maximum power factor obtainable with the alternating-current arc lamp. The ratio between the true and apparent watts will give the correct power factor of the lamp. The prospective buyer should insist that the manufacturers provide him with a written-performance specification, in which there is stated what results will be obtained and what will be guaranteed by the manufacturer. Competitive specifications should be carefully analyzed.

4. Arc Voltage Regulation.—Through a 12-hour run the variation in arc voltage should not be over five volts, and the variation from the pick-up to point of feed should not be over 15 volts. By having a lamp which will regulate within these limits a much steadier and much more satisfactory light will be given. A peculiar phenomenon occurs in the series alternating-current lamp in respect to a close arc regulation. For instance, two lamps being selected, one showing regulation within the above limits, the other showing regulation outside the above limits, the life per trim of carbons will be greater with the lamp having the poorest arc regulation, but with a considerably poorer quality of light than that given by the arc with the better regulation, which goes to show that arc lamps should not be selected solely on the showing made on a life test per trim.

5. Temperature.—The longevity and the value of the insulation is increased by low temperature. The copper-shell lamp usually maintains a cooler mechanism than does the iron-case lamp, owing to the high heat conductivity of the copper. For this reason, after the lamp has been burning for a number of hours, the case made of copper will feel hotter than will the iron one, but an actual thermometer test on the windings will usually prove that the mechanism is cooler than it would be in the iron case. The temperature of the mechanism should not be in excess of 45° C. after 12 hours continuous operation. However, it goes without saying that 60° would not damage the insulation, although the life of the material would be shorter than on a lamp operated at 45° rise.

[*To be concluded.*]

Novel Experiments in the Reproduction and Transmission of Sound.

One of the members of the Russian Physico-medical Society in the city of Tamboff, Mr. N. V. Goriunoff, showed recently some interesting experiments relative to the reproduction and transmission of sound. A microphone receiver of the sound was placed on the second floor at a distance of about 45 meters from the hall. The sound was transmitted to the receiver in four ways, as follows:

1. By a glass bottle containing some liquid, the experimenter using his body as one of the conductors. The investigator walked back and forth along the hall, holding in his hands a dish with the bottle, which reproduced the sound. As soon as the bottle was placed upon a chair the sound ceased.

2. By two german-silver wires placed on both sides of a burning candle.

3. By a Crookes tube, in which the emanations did not stop during the experiments.

4. By a special condenser constructed for that purpose by Mr. Goriunoff, and based on the principle of sound transmission by metals.

In all these cases, except the third, the audience could hear the music very clearly; the human voice was transmitted with less success.

During his experiments the lecturer used an induction coil which gave a spark 20 centimeters long.

At the end of this very interesting entertainment Mr. Goriunoff repeated also some of the experiments of sound transmission by the flame, using for that purpose a special arrangement of his own.

A movement is now on foot to organize a company for the purpose of building an electric railroad at Rosario, a city of about 122,000 inhabitants, in the province of Santa Fé, Argentina.

N-rays.

After having spent two centuries in laboriously emancipating itself from Newton's conception of light, physical science has undergone one of those periodical oscillations which seem inseparable from human progress. Corpuscular theories hold the field in cathode-ray phenomena and in radio-activity. Since Paschen showed recently that even the undeflected γ-rays of radium convey an electric charge, the undulatory hypothesis has been relegated to pure light and to Roentgen rays. Thanks to that most brilliant and fruitful of modern conceptions, the electron theory of electricity, magnetism, light and electrochemistry, we are now becoming familiar with processes which until lately even advanced thinkers only dared to refer to in bald mathematical terms of studied generality. Electrical theories have become more and more corpuscular. Except for purposes of wireless telegraphy and dynamo design, our pioneers have largely withdrawn their attention from the medium to which Faraday and Maxwell so masterfully directed it, and have concentrated it more and more upon the matter which is capable of freely conveying the ultimate material of electricity, upon that "hole bored through a solid rock of air," the wire which gives a comparatively free passage to the negative electron. At such a time, and amid such preoccupations, Blondlot's discovery of the N-rays came as somewhat of a shock. It came on February 2, 1903. Unlike Roentgen's sensational photographs of the bones of the living hand, Blondlot's results remained practically unnoticed. Even at the present day, when the literature of the subject comprises some 65 papers, nearly all physicists and journals outside France maintain an attitude of rigid scepticism or studied indifference. The reasons are not far to seek. The observed effects are slight. They require a careful training of the eye. There have been many failures to repeat the experiments; and, lastly, the practical utility of the results, apart from physiology, is by no means obvious. Yet the theoretical interest of these investigations is very great, and the theoretical interest of today is the practical interest of tomorrow. We have apparently to deal with light of extremely minute wave-length, a wave-length of the order of the size of a molecule, and about one-fiftieth of that of visible light. This means an enormous extension of the known spectrum in the violet direction, and is a worthy counterpart of its Hertzian extension in the red direction. Nor can we complain of a lack of definiteness in the manner in which these discoveries have been presented. Mr. Blondlot's 15 papers are models of lucidity and scientific precision, and, in spite of the intricacy and difficulty of this species of research, he never has had occasion to withdraw or modify any of his results once published. Moreover, they have been confirmed by Bichat, Charpentier, Meyer, Colson, Broca, Zimmern, Rothé, J. Becquerel, and a number of other physicists of repute. Not a week passes without two or three new works on the subject. Becquerel especially has accomplished valuable additional work, and has done much to unravel the knotty points and establish new relations with older phenomena, while Blondlot himself, confronted with the many failures of colleagues, has devised improved means of observation.

It may be a little premature at present to assign their proper place to the N-rays in the structure of physical science. But it seems clear that their discovery will lead us far into the unknown recesses of matter. Like two tunnels bored from each side of a mountain, radium rays and N-rays enable us to penetrate the unexplored interior of the atom. They will, no doubt, meet before long. Becquerel's latest results show an intimate connection between the two forms of radiation, the former corpuscular, the latter ethereal. In radium rays we deal with the projection and impact of electrons. In N-rays we probably have the ether disturbances which accompany those processes. If, as Becquerel suggests, all N-rays imply a convection of negative electrons and a lateral projection of positive electrons, the intimacy of the connection between these forms of energy is apparent. But the most fascinating of all possibilities is that held out by Becquerel's provisional announcement that the α-rays mixed up with N'-rays have the same magnetic curvature of path as the β-rays, only in the opposite direction. This would mean that we were at last brought face to face with the uncombined positive electron. So far, however, the only corroborative testimony we can find is Meyer's observation of N'-rays which are capable of penetrating one millimeter of lead or 10 centimeters of water, a feat to which polonium rays have proved quite unequal. The next few months will probably bring us some announcements of surpassing interest. Meanwhile, the confirmed sceptic may remain satisfied with the thought that, whatever happens, we shall know much more about the objective value of the human eye as an instrument of observation at the end than we did at the beginning of N-ray research.—From the London Electrician of August 12, 1904.

The Aurora, Elgin and Chicago Railway Company shows a good gain in traffic on its third-rail line for July. The gross receipts for the month were $58,517, compared with $47,182 for July last year. The operating expenses were $27,131 and $25,598, respectively.

CORRESPONDENCE.

Great Britain.

London, August 17.—The space-telegraph bill which has been introduced by the government has passed through its second stage. In moving that the bill be read a second time, the postmaster-general, on behalf of the government, said that two principles were embodied in the bill, viz., that safety for the nation in time of danger should be secured by the government being allowed to exercise control over space-telegraphy, and also that a big monopoly should not be allowed to grow up which at some time the state might have to purchase. It will be remembered that the bill prevented anyone from even experimenting with space-telegraphy without a license. An amendment has now been made which gives absolute freedom in this direction, registration being all that is now required. The bill is to be limited in its operation to two years in order that it might then be amended in the light of experience. The postmaster-general promised that the bill, if it became law, should be administered as liberally as possible. There appears, however, to be some impatience felt that a measure of such importance should be introduced so late in the session, and if certain members have their way obstructionist tactics will be indulged in

With reference to the desire of the government that a monopoly in wireless telegraphy should not be allowed to grow up, it is quite clear that the National Telephone Company was in the mind of the government when this statement was made. The question of the purchase of this company's undertaking has been before the public a good deal lately, and only a few days ago the official announcement was made that negotiations with this end in view were still in progress, but that it was undesirable to make any statement at present as to the nature or terms of the arrangement under discussion. As a matter of fact, no statement regarding this matter will be made by the government this session. Should any agreement be arrived at, however, there is a definite promise to place it open for public discussion before it is finally ratified.

The company which was formed a year ago for the purpose of exploiting a system of electrically converting peat into a fuel of more or less high calorific value has just held its statutory meeting. The patents which this company has acquired have not received the best attention of the electrical press, nor have the financial prospects of the concern been joyously hailed by the financial press. The experts who are advising the company, however, are, as they should be, optimistic as to the results, and they place the calorific value of the electro-peat fuel at 13,000 units. It is also stated that recent perfections of the machinery have enhanced the possibilities of the production of the fuel.

The electric trains on the Lancashire and Yorkshire railway have now been running a sufficiently long time for a few figures to be given. The only portion of the line running electrically is the 30 odd miles between Liverpool and Southport, and the new service commenced in April. Since then the service has been increased from 25 to 110 trains per day. During June 113,000 additional tickets were taken as compared with the previous year, and during July a still further increase of 57,000 tickets were taken.

Mention may also be made of an extension, now in progress, of the Liverpool Overhead railway, which, when completed, will allow of a through service over the electrified portion of the Liverpool and Southport line.

The question of local authorities actually undertaking the work of wiring premises for the electric light is again being resuscitated. Two years ago some vigorous opposition on the part of local contractors succeeded in dispelling this idea.

A feature of electric supply in Great Britain at present is the tendency for small local authorities either to transfer their powers to a company or else to take electrical energy "in bulk" from one of the big power-supply companies. The Local Government Board, which sanctions municipal loans, favors the policy. Generally speaking, a broader-minded view of municipal trading is now being taken than has hitherto been the case. Experience has probably not a little to do with this. G.

New England.

Boston, August 27.—A franchise has been granted to the Blue Hill Street Railway Company to construct a trolley line on the new Neponset River parkway from the Blue Hill reservation to St. Paul's Bridge, Readville. When the line is finished there will be connection with Boston via the Boston Elevated Railway Company's system.

Four conductors of the Boston and Northern and Old Colony railway systems were arraigned in court last Tuesday, charged with fraudulent manipulations of transfer checks. The modus operandi was simple but effective in the victimizing of the company. The men are said to have arranged a system of exchange, of transfer checks supplied to them for use on their routes, with conductors on other routes. The checks, passing direct to conductors, and not through the medium of passengers, punched and validated in proper form, were turned in by the conductors who got them in exchange in lieu of cash fares. Twenty checks thus handled would divert a dollar from the company to the dishonest conductor. The cases were continued to August 30th.

A committee of the Board of Trade of Greenfield, Mass., has been appointed to consider the matter of electric-railway connection between Greenfield and Northfield. The project is favored by many of the Greenfield business men. Other trolley plans are in contemplation in the same section of the state. One is for a line from Miller's Falls to Orange and Northfield. The Brattleboro (Vt.) railway officials are also considering the practicability of operating a line to Hinsdale and Northfield, which would enhance the value of the Greenfield scheme. B.

New York.

New York, August 27.—The opening of the subway has been again postponed, and the best promise of the actual date of opening that can now be made is that the Interborough Railway Company will give the mayor at least six weeks' notice when the time comes to make a final declaration. The delays are due to labor troubles. Three thousand men are in process of being engaged as motormen, conductors, ticket sellers, etc. The wages for motormen is at the rate of $3 a day, and as a result of labor agitations it is expected that preference will generally be given to men at present employed on the elevated lines. Besides the copper-sheathed cars received some months ago and which have been in use temporarily on the elevated lines, some all-steel cars have been received this week. These cars are constructed entirely of metal, with the exception of the seats, the flooring and the window sashes. While running, the corridors will be kept closed, so that in the event of fire the flames cannot spread.

Plans are under way for an electric-car service from City Hall to Port Chester, via the elevated lines, to Harlem. Members of the Rapid Transit Commission are said to be not enthusiastic over the scheme.

The Board of Education, during its financial year 1903, spent $100,623.80 for electrical work upon the various schools in Greater New York. Electrical equipment to the approximate value of $2,000 is to be put into the two new upper stories of Public School No. 130, Brooklyn. Peet, McAnery & Powers have been awarded a contract, valued at $5,583, for installing electric-light wiring, fixtures and electric-bell systems at Public School No. 47, Brooklyn, and Oberg & Blumberg have on hand a similar contract for Public School No. 183, Manhattan, at $3,765.

As briefly stated last week, the net surplus earnings of the Brooklyn Rapid Transit Company for the year ended June 30th amounted to $1,594,189.72. The gross earnings were $14,738,709.34, an increase of over 10 per cent. on the previous 12 months. On the basis of a five-cent fare, which is practically universal for any distance, this sum represents a total of 294,000,000 passengers. The operating expenses amounted to $8,760,438.99, and there were sundry other items of income and expenditure for advertisements, taxes, etc. A sum of $383,706.38 was appropriated for improvements. During the year under consideration the electrification of the tracks was completed, and there were added to the car equipment 200 new surface cars, 26 gondola cars, etc. By the end of 1905 it is expected that the whole of the rolling stock will have been converted for electric traction, so as to provide for the elevated lines, 270 closed trail cars and 357 standard motor cars equipped for the multiple-control system. There are also on order for delivery 100 new elevated cars.

A three-story brick sub-station is to be built on Atlantic Avenue, near Napier Avenue, Long Island City, for the service of the Long Island Railroad Company.

The Astoria Light, Heat and Power Company is putting up a new building on Winthrop Avenue and Barclay Street, Long Island City.

Electrical Expert Charles R. Barnes of the State Board of Railroad Commissioners, has ordered derailing and other safety devices to be put in at a point on the Sea Beach line to Coney Island. The express trains on this route are now dependent only upon the personal watchfulness of the switchmen on approaching the drawbridge over the Coney Island Creek.

The Long Island railroad is said to have purchased this week at East Jamaica, L. I., a 16-acre tract of land for terminal-enlargement purposes.

The directors of the Kings County Electric Light and Power Company have decided to issue the remaining treasury stock, $1,250,000, to the stockholders at par. The company has been doing good business of late, and it is thought that the money is to be applied to increasing the plant at the power stations.

The New York and Queens Electric Light and Power Company claims the sum of $50,868.48 for electric light furnished to the city in Queens from January 1st to March 31st.

The New York Edison Company has obtained the contract for operating and maintaining electric lamps on the Williamsburg Bridge from the Manhattan end to the center. The other end of the bridge is to be lighted by the Edison Electric Illuminating Company of Brooklyn.

The Brush Electric Illuminating Company has been awarded, under a court order, the sum of $10,971.52 for light and power furnished to the various city departments of New York during the month of March, and the United Electric Light and Power Company an amount of $10,359.08 for similar services in the same month.

The Safety Insulated Wire and Cable Company has been awarded the contract to supply electric conductors to be placed underground for the New York city Police Department at a cost of $53,983. The other bids were: The Standard Underground Cable Company, $74,945, and the Okonite Company, $83,326. The work of laying the cables has been commenced in Brooklyn.

The Gamewell Fire Alarm Telegraph Company has installed a fire-alarm system in the borough of Queens for the New York city Fire Department. D. W. W.

Ohio.

Cleveland, August 27.—The meeting of the stockholders of the Appleyard roads that was called at Springfield Wednesday for the purpose of combining all the properties under the ownership of the Ohio Union Traction Company, was postponed to September 5th. It is said that the consolidation will go through at that time. A consolidated mortgage for $750,000 will be issued.

A report from Wheeling, W. Va., is to the effect that John A. Howard of that city has purchased the Wheeling and Elmgrove electric road for $1,500,000 and that he is the active spirit of a syndicate that will take over the Wheeling Traction Company for $5,000,000, the property of the City Railway Company for $1,500,000 and the Panhandle Traction Company for $1,000,000. This would give the new company all the electric lines about Wheeling. The Panhandle will be completed to Steubenville and other towns. The plan includes an issue of bonds for improvement. The report indicates that the Flinns of Pittsburg are at the bottom of the proposed deal.

The Citizens' Light, Heat and Power Company of Sidney is arranging to build a plant something like the one at Piqua. Several options have been secured, but the site has not been decided upon yet.

I. C. Allen of Columbus has been granted a patent on a street or station indicator for street cars. It is operated by the lighting current of the cars and reverses when the car is run backward. It can be changed from one car to another without difficulty and is said to be a valuable invention.

A report from Findlay is to the effect that the Cincinnati, Hamilton and Dayton will equip a number of its short lines with electricity, the Findlay-Deshler branch being the first to receive attention.

An investigation of the franchises of the Cincinnati Street Railway Company has been completed and it is found that none of them expire before 1911 and most of them in 1914 and 1915. Attorneys believe that the decision of the Superior Court, holding the Rogers law unconstitutional, will not be affirmed by the Supreme Court. Should it be affirmed, the company may insist on its old grants of a renewal of franchise for 25 years after the expiration of the present franchises.

The Arcade Company of Cleveland will build a new power house on land adjoining the building.

Mayor Tom L. Johnson of Cleveland is one of the seven voting trustees in the reorganization of the Lehigh Valley Traction Company of Philadelphia. It is proposed to organize a new company to operate the properties.

The Cleveland, Painesville and Ashtabula Railway Company will build new shops and car barns this fall either at Geneva or Madison.

Money has been appropriated by the Cincinnati, Newport and Covington Light and Traction Company to extend its line from Lewisburg to Erelanger, Ky.

Secretary Edwin R. Sharp of the Scioto Valley Traction Company denies the report that the Pennsylvania Railroad Company is negotiating for the purchase of the traction property.

A form of interchangeable coupons has been agreed upon by the executive committee of the Ohio Interurban Railway Association, and Secretary Merril has submitted it to the various members. O. M. C.

Michigan.

Detroit, August 27.—The Detroit United Railway is now turning out a large number of new closed cars from its shops in Detroit. They are built largely with longitudinal seats, finely finished both inside and out, and are all equipped with air brakes. It is understood that the management of the street-car company will have 750 new closed cars on the tracks before winter. They are now being turned out at the rate of five or six cars a day.

The plant which furnished electric light for the city of Leslie was destroyed by fire last week, including the mill of L. J. Bickhart. The loss is about $20,000, with $10,000 insurance on the mill, but none on the lighting plant. The waterworks plant adjoining the lighting plant was saved.

The machinery which formed part of the local car-building plant in Detroit is being moved to the recently acquired plant by the American Car and Foundry Company at Memphis. Wooden-car building at one time in Detroit was an extensive industry, but the price in lumber has increased so that it is found more economical to get nearer the southern pine fields. There is said to be a difference of about $20 per car on the cost of lumber alone between Memphis and Detroit.

Jules G. Hoffman of Detroit, who was given the contract to furnish light for Pontiac by the council of that town and then deprived of the contract by the council's reconsideration, has obtained an injunction restraining the city officials from entering into contract with anyone else for the lighting of the

city. The penalty imposed by the injunction is $10,000. After the rejection of Mr. Hoffman's bid the contract was awarded to the Pontiac Standard Lighting Company.

A new automobile vehicle company has been organized in Detroit with a capital of $150,000 to be known as the Detroit Auto Vehicle Company. It will manufacture and deal in automobile supplies, as well as automobiles, delivery wagons and other vehicles, including a convertible runabout and delivery rig combined. F. H. Blackman is president, and H. H. Lind, secretary, of the company.

The following-named companies have been incorporated in this state recently: The Monroe County Telephone Company, Dundee, capital, $15,000; Wireless Battery Company, Detroit, capital, $15,000; Grand Rapids Terminal Railway Company, $50,000.

It is understood that the W. N. Coler Company, principal owner of the Jackson (Mich.) trolley lines, has become interested in the St. Joseph Traction Company, which is building an interurban system. The St. Joseph company has made surveys for a line from Elkhart, traversing Southern Michigan, connections to be made ultimately with the roads running out of Jackson and Kalamazoo. A million-dollar bond issue is being negotiated in the East.

C. G. W.

Texas and Mexico.

Austin, Texas, August 25.—Representatives of the business communities of Bonham, McKinney, Valdasta, Blue Ridge, Trenton and Randolph, Texas, have signed an agreement with H. Woodson of Chicago, Ill., representing a syndicate of capitalists, whereby the latter shall construct an electric railway between Bonham and McKinney, by way of the other towns mentioned above. The distance is 40 miles. The power house of the company will probably be located at Blue Ridge. The road will handle both freight and passenger traffic.

The Athens Loan Company of Athens, Texas, representing Chicago capitalists, is promoting the project of constructing an electric railway between New Braunfels and Gonzales. The route of the proposed road is down the valley of the Guadalupe River, passing through the town of Seguin. Citizens of the three towns have subscribed to a fund for making the preliminary survey for the proposed road.

A committee of citizens of Austin, Texas, and a special committee of the City Council are still working on the problem of rebuilding the great dam across the Colorado River at Austin and the re-establishment of the municipal water and light plant. There is a prospect of the work being done by a local company, which will be organized for the purpose.

It is practically assured that the Wichita Falls Water Works Company will install a new electric-light plant at Wichita Falls, Texas. R. C. Malone, manager, can give information.

The Leonard Electric Light and Ice Company of Leonard, Texas, has increased its capital stock from $15,000 to $20,000.

Preliminary steps have been taken at Graham, Texas, toward the installation of an electric-light plant there.

A local company is being organized at Sealy, Texas, for the establishment of an electric-light plant.

George Woodward of Port Arthur, Texas, and associates have obtained a franchise from the board of county commissioners of Jefferson County for the construction of an electric railway from Port Arthur to the Port Arthur deep-water docks, a distance of three miles. The proposed extension will reach the oil refineries and rice mill.

The Oaxaca Railway Company has placed an order for rails and other construction material for the line which it will build from Oaxaca, Mexico, to the fashionable suburban residence resort of San Felipe.

The City Council of Musquiz, Mexico, has entered into a contract for the installation of an electric-light and power plant.

The Federal District Street Railway Company of the City of Mexico has just received two palatial cars, which were constructed especially for President Diaz and other prominent officials of the Mexican government.

S. L. Pearce is at the head of a syndicate of American capitalists which is promoting the establishment of an extensive electric street-railway system for the city of Chihuahua, Mexico, having taken steps toward organizing the Chihuahua Traction Company, with a capital stock of $1,000,000, gold. Mr. Pearce, on behalf of the syndicate, has obtained options on the existing street-railway system in Chihuahua and on the Mineral railroad, a steam line which runs from Chihuahua to the Santa Eulalia mining district.

It is stated that John Douglas of Aguas Calientes, Mexico, and associates, who own the new electric street-railway system in that city, have purchased the competing system, which is at present operated by animal traction, and that the two systems will be merged into one. Electric traction will be substituted for mules on the acquired system.

Odilon Villanueva, a wealthy land owner of Mexico, has interested other capitalists in the establishment of a large electric power plant on the Tuxpam River. It is announced that about $300,000 will be invested in the enterprise and that electric power for operating sugar mills, mining machinery and for supplying the towns and ranches of that region will be generated. Mr. Villanueva owns the concession under which the project is to be carried out. Carlos Landero y Cos and Enrique Schondube, electrical engineers of the City of Mexico, are interested in the enterprise.

Ramon F. Lujan and Julio Muller, wealthy land owners of the state of Chihuahua, Mexico, who recently acquired the extensive ranch known as the "Unidos el Rio del Valle," in that state, the consideration being $700,000, have also purchased a concession for the installation of a large electric power plant on the property. This plant will be established at a natural waterfall on the ranch, and the power thus generated will be transmitted to the cities of Parral and Jiminez for municipal and commercial purposes.

H.

Northwestern States.

Minneapolis, August 27. The Marshalltown (Iowa) Electric Street and Interurban Railway Company has completed the survey for its new interurban line as far as Grundy Center.

Chicago capitalists propose to build an interurban line from Mason City to Osage, Iowa.

Swift & Co. and Armour & Co. have asked for a lighting and power franchise at Sioux City, Iowa. The new plant will cost $150,000, and, with the Sioux City Traction Company, now owned by the packers, will compete with the Sioux City Gas and Electric Company.

The new electric-light plant at Kilbourn, Wis., has been completed.

At a special election at Boone, Iowa, the proposition for municipal ownership of the electric-light plant was voted down.

The heavy electrical and windstorm at Minneapolis and St. Paul the night of August 20th killed eight people and did $2,000,000 worth of damage. The Twin City Rapid Transit Company's system was badly crippled, and it was not until August 22d that all the lines were again in working order. The company suffered a loss of $110,000. The General Electric Company of Minneapolis had a loss of about $15,000.

The proposed remodeling of the municipal electric-light plant at Lake City, Minn., has been voted down.

R.

Rocky Mountain States.

Salt Lake City, August 26.—The Electric Fixture and Supply Company has been incorporated at Boise, Idaho, with a capital stock of $10,000.

Epes Randolph, E. A. McFarland and others of Tucson, Ariz., have incorporated the Arizona and Colorado Railroad Company for the purpose of building a branch line to extend from Durango to Silverton and Dolores. The company will also build telegraph and telephone lines.

The Gallatin Power Company has been organized at Butte, Mont., for the purpose of establishing a power plant at Sheep Rock and to divert water from the West Gallatin River. E. J. Carter and S. A. Mendenhall are interested in the enterprise.

The Washington Water Power Company has a force of men at work between Wallace and Mullan, Idaho, setting poles for a new power line to operate a compressor plant for Larson & Greenough at Grouse Gulch.

Col. Judson Spofford of Lewiston, Idaho, expects to go East soon on business matters relating to the financing of the electric-road project of the Lewiston and Southeastern Electric Railway Company of which he is president.

The Oom Paul Mining Company of Wallace, Idaho, is figuring on installing an electric pump at its mine. An electric hoist is also under consideration.

A.

Pacific Slope.

San Francisco, August 24.—Jason R. Meek has filed a notice of water appropriation at Marysville, Cal., for 30,000 inches of Dry Creek to be conducted to the Oregon House Valley, where a reservoir will be constructed, thence into Township 16, where it will be used for the generation of power for electrical purposes and for irrigation. M. P. Vieira has filed a similar notice of appropriation of 20,000 inches from the same stream, a mile north of the Oregon House postoffice, to be used for the same purposes.

W. G. Clark of Seattle, Wash., manager of a new electrical company, states that over $20,000,000 will be expended by his company in the development of a big power-supplying business. It is the intention to carry power all the way to San Francisco and also feed various cities in the San Joaquin Valley and on the coast of Central California. The Mokelumne Ditch, as the watercourse is to be called, will be constructed from the junction of the north and south forks of the Mokelumne River, and will convey water to various drops, where turbine waterwheels will generate electricity.

The Northern California Counties Electric Railway and Steamer Line has been organized for the purpose of building an electric railway to connect Marysville, Oroville and Colusa, Cal., and establishing a line of steamboats to connect with the electric line for handling freight between valley points and San Francisco. F. E. Emlay of Oroville, Cal., is one of the promoters of the enterprise.

An electric plant, to cost not less than $250,000, and to be ready for operation by January 1, 1905, is being constructed on the Walla Walla River, about 10 miles from Walla Walla, Wash. Over 200 men are engaged in the work, and 300 more are wanted. The Washington and Oregon Power Company, composed of eastern capitalists, is back of the proposition, and valuable water rights have been secured. The company proposes to furnish power for the plant in Walla Walla, Pendleton, Athena, Weston, and perhaps other neighboring towns. A large waterpower is being developed on the Walla Walla River in an isolated section 15 to 18 miles from Walla Walla. Here a large dam is being constructed. Two lines of pipe will carry the water to the wheels which will operate the machinery.

A franchise has been granted to the Preston-Par Milling Company for an electric-light system at Weston, Ore.

The Eastern Oregon Development Company has secured a franchise to build and operate electric railways along the highways of Umatilla County, Oregon. W. E. Davidson of Pendleton, Ore., is secretary of the company.

Capitalists from Lincoln, Neb., who contemplate constructing an electric railway from Sumpter to Bourne, Ore., have been at Baker City, Ore., recently. P. A. Green, engineer, is now engaged in detail work regarding the project.

The Benton County Court has granted a franchise to the Willamette Valley Electric Railroad Company for the construction of electric lines from Corvallis, along the county road, through Monroe and Junction, Ore., to its Lane County connection.

The Chico Electric Railway Company has been incorporated by C. E. Waller, L. J. de Sabla and others of San Francisco. The capital stock is $25,000. San Francisco is the principal place of business of the company.

The engineer of the Chilliwack Power and Tram Company has been in Vancouver, B. C., selecting a site for an electric plant.

The Oregon Water Power and Railway Company has commenced work on its large electric generating plant on the Clackamas River near Cazadero. The plant will cost $500,000.

A.

PERSONAL.

Major Frank Greene, United States Signaling Corps, has been ordered to proceed to Juneau, Alaska, for temporary duty on the Alaskan telegraph system.

R. R. Hertzog has been appointed general superintendent of the Chicago Union Traction Company to succeed M. B. Hereley, resigned. Mr. Hertzog was formerly assistant to the general superintendent.

Frederick Sargent of Chicago, the well-known consulting engineer, has been chosen a member of the International Jury of Awards for steam machinery and steam appliances at the St. Louis Exposition.

Mr. Homer E. Niesz, assistant to the second vice-president of the Chicago Edison Company, has accepted President E. H. Davis' appointment as editor of the "Question Box" to be presented to next year's convention of the National Electric Light Association. This is a well-deserved compliment to Mr. Niesz's wide acquaintance and practical experience in the electrical field. Mr. Niesz has ability, thoroughness and tact, and his friends are confident that, with the co-operation of the members of the association, he will produce a volume that will be a worthy successor to Mr. Hartman's monumental book of the last convention.

In connection with the recent meeting of the British Association, which was held at Cambridge University, honorary degrees were conferred on August 22d upon the following-named gentlemen: Henri Becquerel, professor of physics in the Ecole Polytechnique, Paris; Julius Wilhelm Bruhl, professor of chemistry in the University of Heidelberg; Vito Volterra, professor of applied mathematics in the University of Rome; Sir Norman Lockyer, K. C. B., director of the Solar Physics Observatory, London; Major Percy Alexander McMahon, F. R. S., late Royal Artillery, formerly professor of physics, Ordnance College, Woolwich; Sir William Ramsay, K. C. B., professor of chemistry at University College, London; Arthur Schuster, F. R. S., professor of physics in the Victoria University of Manchester.

ELECTRIC LIGHTING.

The stock of the Buffalo General Electric Company has been increased from $2,400,000 to $5,000,000.

Bids will be asked about September 15th by the city of Searcy, Ark., for the construction of an electric-light plant to cost $21,000. Owen Ford, Security Building, St. Louis, is the engineer in charge.

The Anniston Electric and Gas Company of Anniston, Ala., has been incorporated by K. K. McLauren, W. H. Bradley and C. W. Perkins, all of Jersey City, N. J. The capital of the company is $250,000.

The city of Kissimmee, Fla., is ready to receive bids for the proposed improvement to its electric-light plant, for which bonds have been sold. Plans and specifications have been completed and about $20,000 will be expended.

A contract has been let for the construction of a power house in Andalusia, Ala., by the Andalusia Light and Power Company, which has just been

incorporated with a capital of $35,000. John McDavid and Frank Sutter are among the incorporators.

ELECTRIC RAILWAYS.

Among the "want ads" in a recent issue of a Philadelphia newspaper was the following: "I want a trolley road, complete or incomplete." This advertiser ought to be accommodated without trouble.

The Public Service Corporation of New Jersey has absorbed the Trenton and New Brunswick "Fast Line" Company's trolley lines, and thus completes a line of electric cars across the state of New Jersey, practically parallel with the tracks of the Pennsylvania railroad.

B. L. Dickinson of Lexington, Mass., has been appointed assistant general manager of the Penobscot Central railway in Maine. It is rumored that an extension of the road to Dover and Foxcroft, 12 miles, may be made. The road operates 26 miles of track from Bangor to Charleston.

Personal-property assessments of the Chicago Union Traction Company have been reduced $1,400,000 by the Board of Review. The company's schedules were adopted instead of the estimates of the board of assessors. The reduction was based on the valuation of the company's property made by Bion J. Arnold, to whom the board had referred the company's schedules for examination.

The plan of reorganization of the Lehigh Valley Traction Company system, including the Philadelphia and Lehigh Valley Traction Company, the Allentown and Slatington Street Railway Company, and the Coplay, Egypt and Ironton Street Railway Company, has been issued. Holders of the securities of these companies may become parties to the plan of reorganization. A new company is to be formed, which is to take over the properties and interest heretofore owned, managed, or controlled by the Lehigh Valley Traction Company and its controlled companies.

The first electric locomotive ever purchased by the Reading railroad has been delivered by the Westinghouse company and is now in service on the Cape May, Delaware Bay and Sewell's Point electric railway, which extends from Cape May Point, N. J., to Sewell's Point, Va. The engine is to be used exclusively for hauling freight over this line and is especially adapted for the service required. The locomotive is 23 feet long, weighs 40,000 pounds, and is designed to draw a maximum load of 450,000 pounds at a maximum speed of 10 miles an hour.

AUTOMOBILES.

It is said that the demand for automobiles from the manufacturers in this country during the last six months has been much in excess of the capacity of the plants, and nearly all the factories are behind in their orders. The importation of automobiles at the port of New York in the last six months is also said to be 100 per cent. in excess of that for the corresponding period last year.

POWER TRANSMISSION.

After three years of preparation the York Haven Water and Power Company has begun the transmission of electric energy from its $2,500,000 generating plant at York Haven to York, Pa., for actual use on the trolley lines and in the manufacturing establishments of York.

The financial report of the Niagara Falls Power Company for the year ended June 30, 1904, shows gross earnings of $1,126,423. Income from other sources amounted to $114,936. The operating expenses for the year were $214,530; charges, taxes, etc., $792,560; improvements and betterments, $74,331, leaving a surplus of $159,938. According to the general balance sheet the real estate, power house, etc., are valued at $15,251,811.

PUBLICATIONS.

A neat little booklet from the General Incandescent Arc Light Company of New York is descriptive of Paragon direct-current fan motors. The fans shown are desk fans and swivel and trunnion bracket fans. A price-list for 1904 fan motors is contained in the booklet.

A mailing card from the Wagner Electric Manufacturing Company of St. Louis calls attention to the fact that the company does not neglect the small power users and gives examples of the equipment for this class of trade which it puts out, such as small house pumps, dough mixers, etc.

The Abner Doble Company of San Francisco, in its bulletin No. 5, shows some types of its ellipsoidal-bucket waterwheels. These buckets are made of castings of selected and tested materials, cast irons, semi-steel, gun metal or steel, as required. The various forms are illustrated in the bulletin.

The Nernst Lamp Company of Pittsburg has issued a small circular upon the Nernst lamp for store lighting, in which attention is called to the adaptability of this kind of light to the examination of dress goods. The absence of "flicker" is also another point emphasized. In short, the general advantages of this method of lighting stores is explained for the benefit of the merchant to whom the circular is addressed.

An original and pleasing line of advertising literature has been hit upon by the Buckeye Electric Company of Cleveland. The first installment has just appeared. This consists of a well-executed brochure containing the tale of "Aladdin, or the Wonderful Lamp," well illustrated with pen sketches. The story is a straight reproduction of the old Arabian tale, the only attempt at advertising being a line at the bottom of each page—some well-turned phrase alluding to the subject matter on the page and aptly bringing in the Buckeye lamp. This brochure is the first of a half dozen, the remainder of which will follow in due time and will be looked forward to with expectancy.

"Quotations on the Spot" is the title of the new switchboard handbook No. 117, just published by the F. Bissell Company of Toledo, Ohio. This catalogue treats of boards of 2,500 amperes or less, complete or in part, and its prime object is to enable dealers and others to handle switchboards just as they would any other line of electrical supplies. By consulting the handbook one can arrive instantly at the exact cost of any kind of switchboard, thus avoiding delays in preparing, submitting and examining specifications. The company is prepared to make prompt shipments of the large and complete line of standard boards made at its Toledo factory, and shown in the catalogue, and is also prepared to furnish estimates and drawings for special work on short notice.

The "Book of the Four Powers" is a late production of the department of publicity of the Allis-Chalmers Company and is a thoroughly creditable piece of work. The book sets forth in brief the scope of the company, which embraces a multiplicity of products, including steam and electrical machinery of all kinds, gas engines, mining machinery and hydraulic apparatus. The book contains 44 pages and is handsomely illustrated. After a prefatory note it tells what the company is doing at the exposition. Then, under the four heads—steam, water, gas and electricity—are described the "four powers" of the Allis-Chalmers Company. The various classes of machinery coming under these four heads are enumerated and many interesting installations are pictured, among them some of the largest of their kind in the world. Under "steam" it is interesting to note that the company has built and sold steam engines aggregating 5,000,000 horsepower. Since the acquirement of the Bullock company a complete line of electrical machinery is included in the Allis-Chalmers Company's products numerous examples of which are illustrated and described in the book, including large direct-connected units, motor generators, motors, multiple-voltage balancers, etc. Arthur Warren, the manager of the publicity department of the Allis-Chalmers Company, is no doubt responsible for the crisp phrase, "Ours the four powers," which is so cleverly worked into the company's advertising literature.

TELEGRAPH.

The final splicing of the Seattle-Sitka government cable connecting the Puget Sound country and Alaska was made a few days ago in the harbor 10 miles out of Seattle. The cable touches at Sitka, Juneau and Skagway. From the latter point a telegraph line leads over White Pass. From the boundary the government has a line to St. Michaels, and the government space-telegraph system connects St. Michaels and Nome. The event was celebrated with an enthusiastic demonstration at Seattle.

The rates which telegraph companies may charge on government messages has been fixed by the postmaster-general as follows, exclusive of place from and date: For day messages of 20 words or more, 20 cents, not exceeding 1,000 miles, and one cent for each additional word, one-quarter of this rate to be added for each 500 miles or fraction thereof, but no rate on a message of 20 words to be more than 40 cents nor over two cents for an additional word. The rate between all points in any state or territory is fixed at 20 cents for 20 words and one cent for each additional word. The night rate for messages of 20 words is 15 cents for any distance within 2,000 miles.

MISCELLANEOUS.

Tracks are laid and the way is clear through the new tunnel in Boston under the streets and harbor from Scollay Square to East Boston, which will be open for traction purposes as soon as the power end of the undertaking can be finished. The rails of the tunnel tracks are paralleled all the way by guard rails, which top the wheel rails by more than an inch. This safety arrangement makes derailment impossible. Engineers say the tunnel ought to be ready for the running of cars before Christmas.

The Allan line steamer Victorian, the largest turbine vessel yet built, was launched at Belfast on August 25th. It is expected that she will be ready for service before the end of the year. The ship is 540 feet long, has 60 feet beam and her depth is 40 feet six inches. It is equipped with Parsons steam turbines. A special arrangement has been devised for the Victorian's machinery, whereby reversing power equal to that of the forward propelling power can be imparted to it, securing the almost instant arrest of the steamer's forward motion and speedy backing in case it is needed. The propellers are three in number, each on a separate shaft. The Victorian will be fitted with a space-telegraph system.

The recent railroad accident at Pueblo, Colo., in which a train was precipitated into a deep ravine by the washing away of a bridge not calculated to withstand the rush of water caused by a "cloudburst," has attracted a great deal of attention. A correspondent of the Chicago Daily News suggests that if a simple electric-alarm device had been installed at the bridge the accident might have been averted. By the arrangement of a small float in such a manner that a rise of water above a certain predetermined point would close an electric circuit and ring an alarm bell or display a light some distance up the track the engineer would have been warned of the danger and could have brought his train to a standstill.

Four telephones have been installed this season at the United States Army rifle range at Las Moras Mountain, near Bracket, Texas, between the targets and the firing points. It has been found by this means that at the 2,000-yard range the bullet takes 5.9 seconds on its flight, leaving the muzzle of the rifle at the rate of 2,300 feet a second and decreasing in velocity to 672 feet a second at the target. A listener at the target telephone after a shot has been fired hears two reports, one coming instantaneously over the wire and the other reaching the marking point through the air a fraction of a second before the bullet strikes the target. This demonstrates that a person exposed at a range of 2,000 yards would have time to dodge behind the breastworks after hearing the report of a shot.

Dr. B. Schultze recently read a paper before the Chemical Society of Breslau on the fixation of atmospheric nitrogen. Referring to the electrical methods of preparing nitric acid, he stated that in the works of the Atmospheric Products Company at Niagara, 2.5 per cent. by volume of the air treated is now being obtained as nitric oxide (NO), from which nitrogen pentoxide (N_2O_5) is being produced at the rate of 0.45 kilogram per seven horsepower-hours. In their experimental plant at Munich, Muthmann and Hofer are obtaining 3.6 per cent. by volume of NO, and in Vienna Dr. von Lepel has succeeded in recovering as much as six per cent. The cost of producing the nitrogen pentoxide, however, is so high that this method can hardly compete with the preparation of acid from Chile saltpetre; besides which, the acid is always contaminated with nitrous compounds.

TRADE NEWS.

Secretary W. R. Goodman of the Chicago Fuse Wire and Manufacturing Company has taken up his personal headquarters at the New York office of the company at 853 Broadway, from which point he says that company expects to do an increasing business in its familiar fuse wires, enclosed fuses and blocks.

The Universal Electric Equipment Company of Birmingham, Ala., with a capital of $60,000, has been organized to manufacture and introduce machinery for lighting railway trains by electricity. The officers of the company are: President, J. L. Parker; vice-president, A. W. Nelson; treasurer, G. G. Sharp. J. H. Thompson is chief engineer and David Rogan general manager.

E. R. Carichoff announces that he has opened an office at No. 20 Broad Street, New York, for the practice of general consulting engineering. A specialty will be made of electric elevators and motor control, Mr. Carichoff having had long experience in the design of such apparatus while employed with various large manufacturing companies. Examinations of inventions and patents will also be made.

Sealed proposals will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until 3 p. m., on September 21, 1904, for the installation of a conduit and electric wiring system for the United States custom house and postoffice at Nashville, Tenn., in accordance with the drawings and specifications, copies of which may be obtained at the architect's office, or at the office of the superintendent of construction.

In the United States Circuit Court, District of New Jersey, judgment has been rendered in favor of Pass & Seymour of Solvay, N. Y., for damages and costs against Duncan Mackenzie's Sons & Co., the proprietors of the Union Porcelain Works, Trenton, N. J., on the complaint of infringement by the latter of two patents covering the well-known attachment plugs made by Pass & Seymour, for several years. The complainant asserts that the Union Porcelain Works have been copying the Pass & Seymour plug and encouraging others to infringe, by supplying them with the porcelain.

It is expected that there will shortly be a demand for electric fans and other electrical apparatus in Bombay, India. At the present time hardly any of these articles are stocked in the city, owing to lack of current supply. But, as stated in the Western Electrician last week, a station is being erected by

the municipality of Bombay for the distribution of electric power, and a good opening for electrical goods will thus be created.

Much interest has been aroused in the steel trade regarding the recent order awarded to the American Bridge Company for the material for the Chicago South Side Elevated Railroad Company's extension. The contract, which has been placed, is for 22,000 tons for the Stock Yards extension. The aggregate tonnage for the two extensions—the second being the one to Englewood—will be between 30,000 and 35,000 tons.

The Yost Electric Manufacturing Company of Toledo, Ohio, is pleased at a recent decision handed down by Judge Hazel of the United States Circuit Court for the Southern District of New York, filed July 30, 1904. The suit was brought by the General Electric Company against the Yost company for alleged infringement of a patent. The court held that the Painter patent for insulating lining made of a single piece of fiber tubing was void for want of patentable novelty in view of the prior art.

BUSINESS.

The General Incandescent Arc Light Company furnished the Frank Adams Electric Company of St. Louis with all of the oil switches for the distribution of high-tension current at the various buildings of the St. Louis Exhibition. This order was of considerable magnitude.

The Knickerbocker Construction Company of 15 Cortlandt Street, New York, has been awarded the contract for the installation of 5,000 feet of underground cable for the Buffalo fire department. The cable is manufactured by the American Electrical Works of Philipsdale, R. I.

In the exhibit of the Continuous Rail Joint Company of America at St. Louis are shown various types of the company's standard rail joints for T and girder-rail sections; also insulated step and electric bonding joints. The exhibit is said to be the largest of its class and attracts much attention.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued (United States Patent Office) August 23, 1904.

768,026. Device for Recording or Checking the Movements of Watchmen or Others. Adolf Bopp, Berlin, Germany. Application filed May 31, 1902.

A number of signal boxes are each adapted automatically to make and break the signal circuit a distinct and separate number of times when actuated. A station-indicating wheel is actuated one tooth upon each making and breaking of the circuit to give the desired signal.

768,039. Telephone-exchange Apparatus. James S. Ford, Chicago, Ill., assignor to the Western Electric Company, Chicago, Ill. Application filed April 9, 1902.

Combined with a line signal, including a locking device and releasing magnet, is a relay and a signal-controlling key, with operator's apparatus, including sources of current. A momentary impulse of current displays the signal which is locked in position, and subsequently on making connection with the line current is directed through the releasing magnet to unlock the signal and cause it to be withdrawn.

768,048. X-ray-tube Stand. George R. Hogan, Chicago, Ill., assignor to the McIntosh Battery and Optical Company, Chicago, Ill. Application filed November 30, 1903.

A stand for supporting X-ray tubes is described. It is provided with electrical contact points for the attachment of the circuit terminals.

768,175. Connector for Electrochemical Apparatus. Oliver P. Fritchle, Denver, Colo. Application filed December 28, 1903.

An electric connector comprises a mercury cup, a coupler having an end which enters the cup, and a carrier of flexible, non-conductive material supporting the coupler with its end within but out of contact with the cup.

768,180. Galvanic Battery. Alex J. Jacobson, Hamburg, Germany. Application filed March 19, 1903.

The dry cells are provided at one end each with an opening or entrance capable of being locked or closed by a suitable cover. The rim or edge of the opening is furnished with a suitable insulating means, in order to admit of the filling in of the electrolyte shortly before the use of the battery and without effecting any short circuit by any overflowing electrolyte.

768,185. Telephone. John W. Kurtz, San Francisco, Cal. Application filed October 17, 1902.

Combined with two vibratory diaphragms are an interposed carbon plate, a set of multiple contacts with one diaphragm connected with the middle carbon diaphragm and a yielding connection between the carbon diaphragm and the outer diaphragm.

768,196. Lightning Arrester. Charles A. Rolfe, Adrian, Mich., assignor to the Rolfe Electric Company, Chicago, Ill. Original application filed April 21, 1902. Divided and this application filed January 21, 1903.

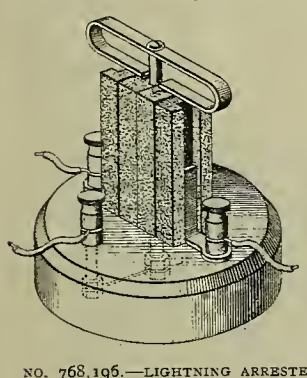
Line electrodes are arranged on opposite sides of the ground electrodes and separated therefrom by insulating material. A post extends up between the ground electrodes and is provided at its upper end with a spring which extends out and over the two line electrodes. Small quantities of softenable material are interposed between the ground electrodes and the spring to hold the latter normally out of contact with the line electrodes. (See cut.)

768,214. Electric Switch and Circuit-breaker. Charles E. Carpenter, New York, N. Y., assignor to the Cutler-Hammer Manufacturing Company, Milwaukee, Wis. Application filed January 16, 1904.

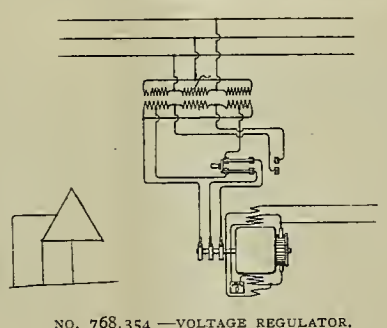
An overload magnet coil co-operates with a circuit-breaker. A magnetic blow-out for the circuit-breaker, an overload magnet, an armature which is operated by the overload-magnet coil and a common magnetic circuit for the overload magnet, the overload-magnet armature and the magnetic blow-out are other parts. Means are provided whereby the circuit-breaker is operated when the overload magnet armature is operated.

768,227. Electric Switch and Circuit-breaker. Albert J. Horton, Whiteplains, N. Y., assignor to the Cutler-Hammer Manufacturing Company, Milwaukee, Wis. Application filed January 16, 1904.

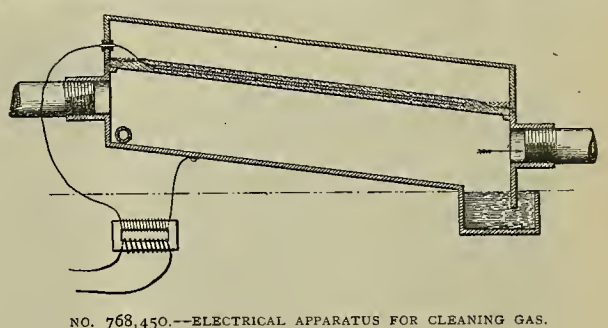
Associated with a hand-operated motor-starting switch is an electrically operated circuit-breaker and a motor-armature circuit containing the motor-starting switch and circuit-breaker in series. A relay magnet closes and holds the circuit-breaker in closed position, and a circuit for the magnet is connected to the same leads as the armature circuit and is independent of the armature circuit. An automatically operated latch engages the circuit-breaker when open.



NO. 768,196.—LIGHTNING ARRESTER.



NO. 768,354 —VOLTAGE REGULATOR.



NO. 768,450.—ELECTRICAL APPARATUS FOR CLEANING GAS.

768,054. Electric Furnace. Carl G. P. de Laval, Stockholm, Sweden. Application filed May 8, 1903.

An electric furnace chamber is provided with a horizontal feed opening, an escape opening and a focus of electric heat within the chamber and opposite the feed opening. The escape opening is located above the feed opening and between the feed opening and the focus.

768,065. Pyrotechnic Signal-alarm and Burning Torch. James C. Moore, Philadelphia, Pa. Application filed March 3, 1904.

A pyrotechnic torch for signal purposes is arranged to be ignited by means of an electric current.

768,109. Fluid-tank Indicator. Frank E. Ballard, Frank A. Rantz and George W. Collin, Bridgeport, Conn. Application filed March 10, 1904.

A portion of a fluid tank provided with a circular opening is closed by an imperforate non-magnetic cover. A perforated casing is removably attached to the cover, a movable magnetic portion mounted within the casing and a float connected with the magnetic portion to move it. A second movable magnetic portion physically unconnected with the first portion is mounted outside of the tank in juxtaposition to the inside portion. One of the portions consists of a magnet whereby the outside portion is caused to take positions corresponding to the positions of the inside portion and thereby indicate variations in the level of the fluid of the tank.

768,121. Self-oiling Trolley. Frederick Hachmann, St. Paul, Minn., assignor of thirty thirty-seconds to Frank L. Gazzolo, John R. Patty, Thomas Billingsley, Stuart B. Shotwell, Otto Muller and Charles Brenck, St. Paul, Minn. Application filed October 15, 1903.

The shaft of the trolley is hollow to contain oil and is supplied with a radial oil passage.

768,173. Filament Attachment for Electric Glow Lamps. Ferdinand Fanta, London, England. Application filed November 2, 1903.

Tubular metallic tips carried by the ends of the filament are secured to the platinum leads protruding from the lamp socket. The tubes extend beyond the platinum leads and are accurately secured thereto.

768,197. Switch Block. Irving B. Smith, Philadelphia, Pa. Application filed December 3, 1903.

In a switch block is a supporting plate or backing, a removable contact plate carried thereby and means independent of the contact plate for securing the block to a support.

768,198. Step Motion for Controller Levers. Irving B. Smith, Philadelphia, Pa. Application filed December 9, 1903.

A switch lever is adapted and arranged to move uninterruptedly and to be brought to rest at desired points. Automatic means are adapted to adjust the final points of rest of the lever to predetermined positions.

768,199. Rheostat. Irving B. Smith, Philadelphia, Pa. Application filed December 9, 1903.

In a rheostat are switch segments, a plate to which the segments are attached, each by a tongue-and-groove connection, and resistance units connected to the segments.

768,204. Apparatus for Moving or Shifting Railway Switches. Louis H. Thullen, Edgewood, Pa., assignor to the Union Switch and Signal Company, Swissvale, Pa. Application filed October 7, 1903.

Movement of the switch rails is accomplished by a motor and a mechanism connected with the switch rails and operated by the motor. The mechanism comprises an electric clutch.

768,205. Switch and Lock Movement. Louis H. Thullen, Edgewood, Pa., assignor to the Union Switch and Signal Company, Swissvale, Pa. Application filed December 19, 1903.

A motion plate is reciprocated by a motor. A pivoted yoke connected with the switch rails is rocked on its pivot by the motion plate.

768,206. Automatic Train Stop. Louis H. Thullen, Edgewood, Pa., assignor to the Union Switch and Signal Company, Swissvale, Pa. Application filed December 23, 1903.

Combined with a stop located adjacent a railway track are automatically operated means for moving it to and holding it in an operative position. The mechanism comprises an electric slot mechanism.

768,240. Electrical Indicator. Lewis H. Sanford and George H. Sanford, Augusta, Maine, assignors of one-half to William B. Taylor, St. Louis, Mo. Application filed November 10, 1903.

The apparatus is actuated by an electric motor.

768,242. Rosette. Albert P. Seymour, Syracuse, N. Y., assignor to Pass & Seymour, Solvay, N. Y. Application filed April 27, 1904.

In a rosette for electric wiring are a block of insulating material having recesses to receive the ends of the insulating tubes, terminals on the block for the attachment of the wires and a cap of insulating material to cover the block.

768,245. Trolley. Francis C. Sullivan, McKeesport, and Louis S. Harris, Pittsburg, Pa. Application filed July 22, 1903.

A hood is supported on the wheel shaft and extends around the trolley wheel. Wheels or rollers are journaled in the hood and adapted to extend across the trolley wheel.

768,260. Automatic Brake and Take-up Device for Trolley Cords. Edward H. Amet, Waukegan, Ill. Application filed June 6, 1904.

A spring-actuated member takes up the slack in the cord.

768,262. Controller. Harvey L. Bachman, South Bethlehem, Pa. Application filed May 31, 1904.

The controller comprises a dial, a casing, series of grid resistance coils suitably insulated, stepped terminal contact plates mounted upon the dial and a hollow boss projecting through the dial and having its inner end flanged.

768,272. Party-line Telephone System. Thomas C. Drake, Malta, Ohio. Application filed November 9, 1903.

In a party-line telephone system are a line circuit, two oppositely biased call bells connected therewith in their operative condition and means to selectively operate one of the bells to the exclusion of the other.

768,288. Interrupter. Edwin W. Kelly, Philadelphia, Pa., assignor to the Roentgen Manufac-

turing Company, Philadelphia, Pa. Application filed March 28, 1904.

A practically closed magnetic circuit has an exciting coil associated with it. A number of pairs of contacts are controlled by a movable portion of the magnetic circuit. The movable portion is subjected to practically maximum magnetic force when in position of rest.

768,301. Wireless Electrical Signaling. Michael I. Pupin, New York, N. Y. Application filed June 13, 1903.

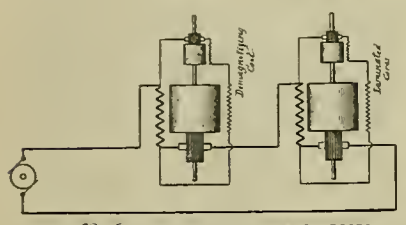
Transmitting apparatus includes a source of electrical energy and means for transmitting electrical waves to space. A local circuit comprises means suitably adjusted for giving electrical impulses of definite frequency. A transformer, through which energy is impressed on the local circuit, an induction coil through which energy is transferred from the local circuit to the means for transmitting electrical waves to space, and, at the receiving end, mechanical vibrating receiving apparatus in syntony with the frequency of the electrical impulses of the local circuit of the transmitting apparatus are the other features.

768,325. Trolley Restorer. Edward L. Calahan, Clifton, N. J., assignor of one-half to William M. Perkins and George H. Souther, Brooklyn, N. Y. Application filed November 6, 1903.

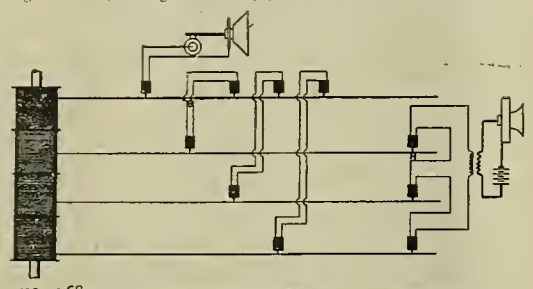
The trolley pole has a trolley with means for restoring the trolley to the feed wire, the means operable from the front of the car.

768,332. Contact Clamp for Carbon Rheostats. Carl W. Larson, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed September 4, 1902.

A self-alining clamp for an electric conductor consists of a sleeve having a convex surface on one side bearing against the base and a shank extending laterally from the convex side through the hole in the base.



NO. 768,467.—CONSTANT-CURRENT SERIES MOTOR.



NO. 768,541.—MEANS FOR INTENSIFYING TELEPHONOGRAPHIC RECORDS.

768,334. Breaker for Electric Circuits. William J. Lloyd and Gilbert Wright, Pittsfield, Mass., assignor to the Stanley Electric Manufacturing Company, Pittsfield, Mass. Application filed July 8, 1902. Renewed January 23, 1904.

Two contacts, one for each terminal, are connected by a brush. A carrier for the brush carries an auxiliary brush by a long arm pivoted on the carrier. A short arm engages with a stationary member so as to produce a great movement upon a small movement of its pivot.

768,337. Alternating-current Motor. Maurice Milch, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed December 21, 1903.

In conjunction with an alternating-current motor having its secondary member supplied with a commutator are means for impressing a variable voltage on the primary member. A set of brushes bear on the commutator on the line of magnetization of the primary member. A second set of brushes bear on the commutator and are displaced 90 electrical degrees from the first-named set.

768,343. Indicating Instrument. William B. Potter, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed November 25, 1898.

Associated with a coil are magnetic parts movable thereby, one part being inoperative until a predetermined current passes through the coil and the others being inoperative until the passage of successively higher predetermined currents through the coil. A register for each part is adapted to be operated thereby.

768,344. Means for Controlling Electric Meters. William H. Pratt, Lynn, Mass., assignor to the General Electric Company, Schenectady, N. Y. Application filed January 20, 1903.

A meter for a multiphase alternating-current circuit is provided with current and potential circuits and means for respectively opening or closing the potential circuits when the load on multiphase circuit falls below or rises above a predetermined amount.

768,350. Electromagnetic Switch and Signal. Samuel B. Stewart, Jr., Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed May 20, 1902.

In a sectional-conductor railway system a feeder is connected with a source of current supply, a section of a working conductor is connected to the feeder by an electromagnetic switch. A section of an auxiliary conductor, a switch-energizing coil and an electric signal connected in parallel between the section of auxiliary conductor and the return are the other features.

768,351. Electric Cut-out. Julius C. Tournier, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed January 21, 1901.

The cut-out consists of a yoke, a rocker rotatably journaled therein and having a beveled lug, a bar extending across the yoke, a plunger passing through the bar and engaging with the lug and a spring pressing on the plunger.

768,354. Means for Varying the Voltage of Alternating Currents. Jonathan E. Woodbridge, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed October 28, 1902.

Primary windings are symmetrically connected to the mains, and secondary windings are inductively related to the primary windings in series. A lead is permanently connected to the junction of two of the secondary windings, other leads co-operating with the first-mentioned lead. Means for shifting the connections between the secondary windings and all of the leads except the permanently connected lead so as to vary the electromotive forces between the leads without shifting the phases of the electromotive forces are provided. (See cut, page 185.)

768,357. Electric Track Brake. Fred B. Corey, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed September 27, 1902.

Electromagnetic means press a brake-shoe against the track-rail.

768,372. Electric Battery. Pierre J. Kamperdyk, New York, N. Y. Application filed October 14, 1903.

In a primary battery is a cell comprising a containing vessel, two or more porous cups therein and passages connecting the cups to allow the liquid to flow freely from one to the other to insure equal density in each.

768,392. Dynamo or Motor Suspension. Morris Moskowitz, New York, N. Y., assignor to the United States Light and Heating Company, New York, N. Y. Application filed May 23, 1904.

Mechanical details are described.

768,411. Block-signal and Track-switch Operating Device. Charles R. Van Trump, Wilmington, Del. Application filed April 30, 1904.

A signal system for railways comprises a series of blocks, a trolley circuit, a signal section in the trolley circuit at the end of each block and a return or ground circuit. A signal switch is supplied for the ends of each block, together with independent signal circuits connecting the signal switches of each block with each other.

768,421. Electric Striking Clock. Ragnar Carlstedt, Rällsa, and Bernhard Gustafson, Stockholm, Sweden. Application filed November 19, 1903.

Details are described.

768,450. Electrical Apparatus for Cleaning Gas. Charles G. Hardie, Hamburg, N. Y. Application filed November 12, 1903.

An apparatus for freeing gas of impurities comprises a casing having an inclined base, through which the gas flows, an electrode insulated therefrom, a suitable source of electricity, the terminals of which are connected, one to the insulated electrode, the other to the casing, and a perforated pipe by which water is caused to flow uniformly over the base. (See cut, page 185.)

768,467. Constant-current Series Motor. Maurice Leblanc, Paris, France, assignor to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Application filed February 26, 1903.

A motor in a constant-current line has a field winding in series with its armature. A dynamo is arranged to revolve at a uniform relative speed with the motor and to supply it with a current which practically neutralizes the motor field at a certain common maximum velocity, predetermined alike for all loads. (See cut.)

768,468. Method of Limiting the Speed of Constant-current Series Motors. Maurice Leblanc, Paris, France, assignor to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Application filed February 26, 1903.

The method of limiting the speed of a series-wound direct-current motor consists in feeding it with a direct current of constant strength, and practically neutralizing the magnetizing effect of the line current upon the motor at a given maximum speed predetermined for all loads.

768,474. Electric Snap Switch. Norman Marshall, Newton, Mass., assignor to the Marshall-Sanders Company, Boston, Mass. Application filed December 24, 1900.

Details are described.

768,479. Incandescent Electric Lamp. Dennis J. O'Brien, San Francisco, Cal., assignor to the O'Brien Reflector and Electric Tube Lamp Company, San Francisco, Cal. Application filed May 25, 1903.

In an incandescent lamp are combined a tube, a filament therein and means for constantly and automatically sustaining the filament in a straight line. The means comprise an anchor-conductor secured to one end of the filament and protruding exteriorly of the tube, the terminal end of the anchor-conductor within the tube extending substantially transversely to the walls of the tube and to the filament.

768,502. Automatic Train-signaling and Recording System. Frank R. Wood and Daniel F. Shamberger, Sparrows Point, Md. Application filed August 24, 1903.

The recording system comprises main-line wires, a time stamp and recording mechanism for each line wire located at a common place, and transmitter mechanisms for the main-line wires, adapted to be set in motion by the passing train.

768,511. Contact Device for Electric Clocks. Ragnar Carlstedt, Rällsa, and Bernhard Gustafson, Stockholm, Sweden. Application filed November 19, 1903.

An electromagnet and its armature are the actuating means for the apparatus.

768,541. Means for Intensifying Telephonographic Records. Elias E. Ries, New York, N. Y. Application filed November 3, 1903.

Magnetic record media and means for advancing it in synchronism are associated with means for impressing into the media like magnetic records, and means for superimposing in another record medium, moving at the same rate, like magnetic records of the first record media. (See cut.)

768,547. Telephone and Signal Apparatus for Railway Trains. Benjamin W. Speck, Uhrichsville, Ohio. Application filed February 11, 1904.

A coupling box carried by one car has conductive bushings. Plugs carried by the other car are adapted to be placed in the bushings of the coupling box. A cable connects the plugs and the last-mentioned car.

768,545. Electric Conduit Box. Dennis Shea, Chicago, Ill. Application filed August 20, 1903.

An electric conduit box comprises a base plate, a wall piece and fastening devices securing them together. These pieces comprise flexible strips having their end portions passed through openings in the base and bent reversely to bear on the wall piece.

768,549. Electromagnetic Switch. Samuel B. Stewart, Jr., Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Original application filed May 20, 1902. Divided and this application filed February 14, 1903.

In an electromagnetic switch are a solenoid, a core for the solenoid carrying main and auxiliary contact-makers adapted to engage fixed contacts, a blow-out magnet for each fixed contact having its poles embracing the fixed contacts, and insulating chutes along which the arcs which tend to form between the movable contact-makers and the fixed contacts are projected by the blow-out magnets.

768,557. Electricity Meter. Arthur Blanchet, Paris, France, assignor to Compagnie pour la Fabrication des Compteurs et Materiel d'Usines à Gaz, Société Anonyme, Paris, France. Application filed March 27, 1902.

Coils in a shunt circuit having a large self-induction are associated with a transformer, the primary circuit of which is traversed by the main current. A movable armature is acted upon by magnetism induced by the coils, and also by magnetism induced by the shunt circuit coils. An adjustable resistance is included in the secondary circuit of the transformer for regulating the time constant of the secondary circuit to correspond to that of the shunt circuit.

768,566. Electric Controller. Miner S. Horton, Rochester, N. Y. Application filed June 4, 1904.

Two main feeders, an armature and a rheostat having a movable switcharm connected in series between the main feeders are contained in the apparatus. A centrifugal governor is mechanically connected to the armature, and the switcharm connected to the governor and arranged to be operated thereby. An elongated final contact for the rheostat cuts out all the resistance from in series with the armature, the elongated contact being arranged to engage the switcharm at all times throughout the entire range of its movement caused by variations in the speed of the armature due to fluctuations in the load.

768,569. Telephone Transmitter. Arthur J. Mundy, Boston, Mass., assignor to the Submarine Signal Company, Waterville, Maine. Application filed April 23, 1902.

768,570. Sound Transmitter and Receiver. Arthur J. Mundy, Boston, Mass., assignor to the Submarine Signal Company, Waterville, Maine. Application filed April 23, 1902.

768,571. Sound Transmitter and Receiver. Arthur J. Mundy, Boston, Mass., assignor to the Submarine Signal Company, Waterville, Maine. Application filed April 23, 1902.

768,572. Sound Transmitter and Receiver. Arthur J. Mundy, Boston, Mass., assignor to the Submarine Signal Company, Waterville, Maine. Application filed April 23, 1902.

768,573. Submarine Sound-direction Finder. Arthur J. Mundy, Boston, Mass., assignor to the Submarine Signal Company, Waterville, Maine. Application filed April 23, 1902.

These five patents refer to apparatus for submarine signaling containing a transmitter and receiver, sound waves being transmitted through the water and received in the diaphragm of the receiver.

EXPIRING PATENTS.

Following is a list of electrical patents (issued by the United States Patent Office) that expired on August 30, 1904:

368,931. System of Synchonism for Telegraphy. G. A. Cassagnes, Paris, France.
368,948. Electromagnetic Dental Mallet and Plugger. P. Helmer, Clinton, Iowa.
368,955. Mast Arm for Hanging Electric Street Lamps. F. H. Lacey, Atchinson, Kan.
368,987. Conductor Tip. S. S. Wheeler, New York, N. Y.
369,034. Galvanic Battery. J. A. Seely, New York, N. Y.
369,091. Manufacture of Incandescent Electric-lamp Filaments. A. Bernstein, London, England.
369,121. Method of Making Impervious the Joints of the Lead Pipe of Electric Cables. William R. Patterson, Chicago, Ill.
369,122. Test Circuit for Telephone Cables. William R. Patterson, Chicago, Ill.
369,144. Manufacture of Electrical Conductors. J. J. Williamson, Boston, Mass.
369,194. Electric Arc Lamp. O. P. Loomis, Somerville, Mass.
369,219. Electric Generator. L. G. Wooley, Grand Rapids, Mich.
369,238. Joint for Telegraphic Wires. D. P. Emminger, Philadelphia, Pa.
369,256. Electric Speaking Telephone. M. Martin, Malden, Mass.
369,259. Insulating Telegraph Cables. William R. Patterson, Chicago, Ill.
369,267. Process of Treating Filaments for Incandescent Electric Lights. E. P. Thompson, Elizabeth, N. J.
369,280. System of Electrical Distribution. T. A. Edison, Menlo Park, N. J.

WESTERN ELECTRICIAN

EVERY SATURDAY

Vol. XXXV. CHICAGO, SEPTEMBER 10, 1904 No. 11

Government Delegates to the International Electrical Congress of 1904.

Up to September 1st the governments of the world which had officially sanctioned the St. Louis International Electrical Congress of 1904 by appointing delegates were Australia, Austro-Hungary, Brazil, India, Italy, Mexico, Norway and Sweden, Switzerland and the United States. No English, French or German official delegates had been named at the date mentioned, but it is possible that before the assembling of the Congress on September 12th there may be appointments from the three backward nations.

It is the province of the Chamber of Delegates to discuss, and, as far as may be, fix international units and standards. These conferences, held at irregular intervals and in various countries, have resulted, for instance, in the standard international ohm and other principal units of measurement, accepted in all civilized countries. Thus, while the weight of a generator may be expressed in kilograms in France and in pounds in this country, the unit of measurement for the current output, the international ampere, is the same in both countries and in all countries. While the fundamental units have been fixed by international agreement, others are in use or proposed, and await such action. Again, it may be found desirable to make slight changes in the absolute standards in the light of later researches. It is this important work that the official delegates of international electrical congresses are called on to perform. There was an important congress in Paris in 1881, another in Chicago in 1893, a third in 1900, again in Paris, and it is now assumed that sufficient material has been collected since 1900 to warrant the official action of the St. Louis Congress of 1904. More detailed information on "The Scientific Work of the International Electrical Congress of 1904" was given in Professor Carhart's article in the Western Electrician of April 16th last, and must still be fresh in the minds of the readers of this journal.

The United States is sending five government delegates to the Congress, more than any other nation, although doubtless the system of voting in the Chamber will not be based on numerical representation. These gentlemen, given in alphabetical order of names, are Professor Henry S. Carhart of Ann Arbor, Mich.; Dr. A. E. Kennelly of Cambridge, Mass.; Professor Harris J. Ryan of Ithaca, N. Y.; Professor S. W. Stratton of Washington, D. C., and Professor Elihu Thomson of Lynn, Mass. Of these, two—Messrs. Carhart and Thomson—were official delegates to the Chicago Congress of 1893. Portraits and brief biographical sketches will be of interest.

Henry Smith Carhart, the well-known professor of physics at the University of Michigan, Ann Arbor, Mich., stands in the front rank of American physicists. He was born on a farm on the Hudson River, near Albany, N. Y., in 1844. His collegiate education was obtained at Wesleyan University, from which he graduated in 1869. In 1893 his alma mater conferred on him the honorary degree of LL. D. Professor Carhart has spent his life in educational and research work and has made important contributions to the scientific thought of the day. He was a professor in Northwestern University, Evanston, Ill., from 1872 to 1886, and he has filled a chair at the University of Michigan since the latter date. He spent the year 1881-82 in Europe in travel and in study in Berlin. He was again abroad in 1899-1900, adding to his stock of knowledge. In 1901 he was a delegate of the American Institute of Electrical Engineers to the Glasgow International Engineering Congress. Professor Carhart has a notable exposition record. He was a member of the International Jury of Award at the Paris Exposition of Electricity in 1881, president of the Board of Judges for the Department of Electricity at the World's Columbian Exposition in Chicago in 1893, a member of the Chamber of Delegates at the International Electrical Congress of 1893, a juror at the Pan-American Exposition of 1901, and is now one of the United States delegates to the St. Louis Congress. Professor Carhart is president of the American Electrochemical Society, fellow of the American Association for the Advancement of Science, member of the American Institute of Electrical Engineers and foreign member of the (British) Institution of Electrical Engineers. In addition to being an official delegate, he is chairman of Section C (Electrochemistry) at the International Electrical Congress and chairman of Section *b* (Physics of the Ether) at the International Congress of Arts and Science, to be held in St. Louis a week after the Electrical Congress. Dr. Carhart is a hard worker and an enthusiastic student. His books comprise "Primary Batteries," "Elements of Physics," "High-school Physics," "University Physics" and "Electrical Measurements." With his knowledge and experience, he should be a most valuable member of the Congress.

Henry S. Carhart.

A. E. Kennelly.

Arthur Edwin Kennelly, past-president of the American Institute of Electrical Engineers, is professor of electrical engineering at Harvard. He is an adopted American, his birthplace being Bombay, India, and his parentage English. But if Dr. Kennelly were to the manner born he could not be more highly respected or thoroughly liked. He was born on December 17, 1861, and educated at the University College School in London. (His degree of D. Sc. was conferred by the Western University of Pennsylvania.) At 16 he became a submarine-cable telegraph operator and advanced himself within 10 years, by successive steps, until he became senior ship's electrician for the Eastern Telegraph Cable Company. In 1888 he came to the United States to be electrician in Edison's laboratory, establishing a cordial intimacy with the great inventor which has endured ever since. In 1895 Dr. Kennelly became connected with Professor E. J. Houston, the two opening offices in Philadelphia as consulting electrical engineers. The members of the firm also collaborated in the writing of books. Since 1902 Dr. Kennelly has been professor of electrical engineering at Harvard University. In that year, also, he was engineer in charge of the laying of cables in the Gulf of Mexico for the Mexican government,

Harris J. Ryan

S. W. Stratton.

Elihu Thomson.

GOVERNMENT DELEGATES FROM THE UNITED STATES TO THE INTERNATIONAL ELECTRICAL CONGRESS OF 1904

He is the author of many books, several in conjunction with Houston and one with Wilkinson. One of the most important of these is "Recent Types of Dynamo-electric Machinery." Dr. Kennelly's determinations of the carrying capacity of electrical conductors are also well known. Dr. Kennelly served as president of the American Institute of Electrical Engineers from 1898 to 1900. He is also a member of several other learned and technical societies and has written many monographs and articles in technical journals. He is general secretary of the committee of organization of the present International Electrical Congress and has lavished

S. A. ARRHENIUS, DELEGATE FROM NORWAY AND SWEDEN TO INTERNATIONAL ELECTRICAL CONGRESS.

his time and energy on the work with unselfish devotion.

Harris Joseph Ryan is professor of electrical engineering in Sibley College, Cornell University, Ithaca, N. Y. He was born at Powell's Valley, Pa., January 8, 1866. He attended the Philadelphia and Baltimore public schools, the Baltimore City College and Lebanon Valley College of Annville, Pa., and finally graduated from Cornell after a four-year course in electrical engineering. He has been identified with Cornell during his subsequent career. He was one of the electrical jurors at the Chicago World's Fair of 1893, and is a member of the American Institute of Electrical Engineers, of which he has been vice-president. He is a fellow of the American Association and a member of Franklin Institute. Professor Ryan has presented a number of valuable papers to the American Institute of Electrical Engineers on transformers and other alternating-current apparatus, dynamo design and other subjects. His latest, on "The Conductivity of the Atmosphere at High Voltages," was printed in the Western Electrician but a few months ago. Professor Ryan is a wideawake, progressive technical educator, and is highly regarded by his professional associates.

Samuel Wesley Stratton is the director of the National Bureau of Standards at Washington, D. C., and his appointment is therefore particularly apropos. He was born in Litchfield, Ill., July 18, 1861, and graduated from the University of Illinois with the degree of B. S. in 1884. From 1885 to 1892 Mr. Stratton served as instructor, assistant professor and professor of physics and electrical engineering at the University of Illinois. From 1892 to 1901 he was, successively, assistant professor, associate professor and professor of physics at the University of Chicago. He was appointed director of the National Bureau of Standards in 1901.

Elihu Thomson is one of the world's leading electrical inventors, designers and investigators. He was born in Manchester, England, in 1853, of Scotch-English parentage, but he was brought to the United States at the age of five, and is thoroughly Americanized. Settling in Philadelphia, he was educated in the public schools of that city and graduated from Central High School early in 1870. Immediately thereafter he entered the Iron Masters' Laboratory as analyst. His favorite studies in school had been physics and chemistry. He was soon appointed assistant professor of chemistry in the Central High School, and in 1876 was given the chair of chemistry in the same school. This position was held until 1880, when he resigned to enter the electrical field, in which he has continued since.

The study of electricity had always had a special fascination for Professor Thomson, beginning with the construction, when 11 years of age, of a frictional machine from the traditional wine bottle. This was supplemented by batteries, electromagnets, telegraph instruments, in some of which the bare copper was insulated by the laborious winding of thread by hand around the wire. Having a natural aptitude for construction and for the use of tools, the time spared from other duties was given to making such apparatus as he needed. In this way were built dynamos, motors, achromatic microscopes and other optical instruments; also a pipe organ. It was the rule of this aspiring young mechanician to construct everything, grinding the lenses, making of organ pipes, keys, etc. The outlet thus afforded for his mechanical tastes led naturally to invention and gave a most valuable training for afterwork. In recent years this taste has found an outlet in the construction of objective lenses for refracting telescopes, a 10-inch glass so made being mounted in the private observatory at Professor Thomson's house at Swampscott, Mass.

Leaving his professorship in 1880, he took charge of the development of the Thomson-Houston electric-lighting system, based upon his patents, some of which were joint with those of Professor E. J. Houston. The business had been begun in Philadelphia, in 1879, and removed to New Britain, Conn., in 1880. Mr. E. W. Rice, Jr., now third vice-president of the General Electric Company, accompanied him on the removal to New Britain, as assistant. The works established in New Britain were removed to Lynn, Mass., in 1883. Here it was that the great development of the Thomson-Houston Electric Company began, due in large measure to the enterprise of its managing heads, Mr. C. A. Coffin (now and for many years president of the General Electric Company) and others, and to the success of its engineering achievements. The company was merged, in 1892, with the Edison General Electric Company, and the General Electric Company formed, with its huge works at Schenectady, N. Y., at Lynn, Mass., and at Harrison, N. J., and its offshoots in Germany, France, Eng-

H F. WEBER, DELEGATE FROM SWITZERLAND TO INTERNATIONAL ELECTRICAL CONGRESS.

land and other countries, in connection with which the subject of this sketch is still actively engaged.

Professor Thomson has received about 600 patents for inventions in the United States alone, many of which are of great importance, having gone into extensive use in electric lighting, railways, power transmission, etc. The Thomson meter was given a prize in the Paris meter competition in 1890. His pioneer researches and inventions in the alternating-current field and his high-frequency work are well known. He is known as the inventor of electric welding, a process which is being more and more extensively applied in various metal manufactures.

He was decorated in 1889, for electrical inventions, by the French government, as Officier et Chevalier de la Legion d'Honneur; given the honorary degree of A. M., Yale, and Ph. D., Tufts; has received many medals and awards, among which is the Rumford medal, and was awarded Grand Prix at Paris expositions of 1889 and 1900. He is past-president of the American Institute of Electrical Engineers, fellow of American Academy of Arts and Sciences, member of the Institution of Civil Engineers, London, the American Chemical Society, the American Physical Society and of many other societies here and abroad, and was official United States delegate to the Chamber of Delegates, International Electrical Congress, in 1893, at Chicago. He has been for many years a fellow of the American Association for the Advancement of Science, serving as vice-president at the Columbus meeting, Section B, Physics, and is now vice-president of the American Physical Society. Professor Thomson has achieved fame and riches by his labors in the electrical field, but he retains an unaffected charm of manner which endears him to his friends.

Foreign government delegates to the Chamber of Delegates appointed at the last account available at this writing were: Australian Colonies, John Hesketh; Austro-Hungary, Professor Charles Zipernowsky; Brazil, Jorge Newbery; India, J. C. Shields; Italy, Professor Moise Ascoli, Professor L. Lombardi and A. Maffezzini; Mexico, Rafael R. Arizpe; Norway and Sweden, Professor Svante August Arrhenius; Switzerland, Professor Ferdinand Weber, Professor François Louis Schüle. Of these, perhaps Professors Zipernowsky, Ascoli, Arrhenius and Weber are best known in this country. Zipernowsky is professor at the Royal Hungarian Polytechnicum at Budapest. Ascoli is director of the physical cabinet in the Engineering School at Rome and also president of the Associazione Elettrotecnica Italiana. Arrhenius is professor of physics at the University, Stockholm, and a renowned scientist. Weber is consulting electrician, professor of physics and electrotechnics and director of the laboratories for scientific research and for the study of applied electricity at the Federal Institute of Physics in Zurich; he is one of the best-known technical educators on the Continent.

Method of Rendering Storage-battery Gases Non-explosive.

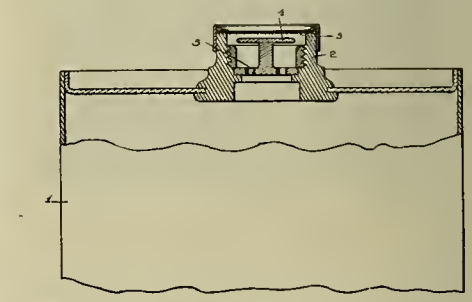
Instances have occurred in which the gases from storage batteries have caused explosions, though the conditions which are necessary to bring this about, such as the proportionate quantities of the two gases, their confinement in a closed space, the necessary fire for ignition, etc., render the occurrence rare. It is wise, however, to take suitable precautions, especially on board ship, where the battery room is generally a small air-tight compartment.

Thomas A. Edison has invented a method of rendering storage-battery gases non-explosive in which the escaping gases are passed through a cooling medium, reducing their temperature to a point which renders an explosion impossible. The accompanying diagram illustrates a sectional view of one of the improved storage-battery cans provided with means for carrying the method into effect.

The can is made of thin nickel-plated steel, is provided with a neck (2) having a perforated plug (3). Carried by this plug is a deflecting plate (4) for diffusing the gases escaping through the perforations. At the top of the neck is a suitable cooling medium, through which the gases pass and illustrated as a wire gauze (5).

When the apparatus is not provided with special means for effecting the separation of the mechanically entrained globules, the gases will escape continuously through the perforations in the plug (3), but if separating devices are employed, the gases will escape intermittingly through these perforations.

The escaping gases will be deflected outwardly by the deflector (4), so as to be comparatively attenuated, and they will escape through the gauze (5) in a highly rarefied condition. Even if they could ignite on the outside of the gauze the radiating



METHOD OF RENDERING STORAGE-BATTERY GASES NON-EXPLOSIVE.

capacity of the latter is sufficient to prevent its becoming hot enough to ignite the gas below it, so that no explosion can take place. This is especially true when the deflector is used, since otherwise there would be danger of a small stream of gas passing directly from each perforation through the gauze in a sufficiently concentrated condition to result in the gauze being dangerously heated.

Naturally, the invention is applicable for use in any type of storage battery, whether alkaline or acid, wherein gases are generated during use or during the charging operation.

The Chilocco-Winfield (Kan.) Interurban railway has been reorganized, and now the construction will go forward with a rush. The company has the contract for furnishing the power for the electric-light system at Arkansas City.

Association of Edison Illuminating Companies.

The twenty-fifth convention of the Association of Edison Illuminating Companies was held on Tuesday, Wednesday and Thursday, August 30th and 31st and September 1st, at the Hotel Wentworth, the beautiful seaside resort of Newcastle, N. H., overlooking Portsmouth Harbor. There were about 200 in attendance, and a number of the members were accompanied by members of their families. When not engaged in convention details, the golf links, seashore attractions, Portsmouth Navy Yard and automobile trips through the surrounding country afforded varied diversions for the visitors, and the convention week was spent pleasantly. The affair concluded with a grand ball at the hotel on Thursday evening.

President Joseph B. McCall of Philadelphia presided and during the session papers were presented as follows: "A Plea for Uniformity in Construction and Operation of High-tension Systems," Philip Torchio, New York, N. Y.; "Notes on Economy in the Production of Steam," W. F. Wells, New York, N. Y.; "Experiences with Automobile Charging Stations," Joseph W. Cowles, Boston, Mass.; "Vulnerable Points in Operation of High-pressure Alternating Transmission Supplying Large Distributing Systems," D. L. Huntington, Spokane, Wash.; "The Relative Efficiency of Electric and Hydraulic Elevators," W. C. L. Eglin, Philadelphia, Pa.; "Electric Heating and Cooking," H. W. Hillman, Schenectady, N. Y.; "Relations Between Length of Arc Voltage and Candlepower in Enclosed-arc Lamps and the Effect Upon Efficiency of Arc Lamps by Varying Size of Carbons," George N. Eastman, Chicago; "Gas Engines vs. Electric Motors," Fred M. Kimball, Schenectady, N. Y.; "Light and Illuminating Engineering," W. D'A. Ryan, Schenectady, N. Y.; "To What Extent Should Central Stations Make Investments?" John F. Gilchrist, Chicago; "Results Up to Date Obtained from the Use of the Wright Demand System of Charging," John W. Ferguson, Chicago; "Results Up to Date Obtained from the Use of the Wright Demand System of Charging," Arthur S. Knight, Boston; "Some Commercial Problems," Joseph D. Israel, Philadelphia; "Notes on European Testing Laboratories," Dr. Clayton H. Sharp, New York; "Measuring Instruments in Generating and Sub-stations," Caryl D. Haskins, Schenectady, N. Y.; "Troubles and Losses Between Generators and Customers' Services," Peter Junkersfeld, Chicago; "Some Data on Electric Power," Arthur Williams, New York.

President Charles L. Edgar of the Boston company extended an invitation to all the delegates to join in the reception to the foreign electrical engineers in Boston on September 2d and 3d. After the convention many of the delegates went to New York and enjoyed a trip to Coney Island as the guests of J. G. White.

The election of officers resulted as follows:

President—Joseph B. McCall, Philadelphia, Pa.
Vice-president—D. L. Huntington, Spokane, Wash.
Treasurer—Alex Dow, Detroit, Mich.
Secretary—E. A. Leslie, Brooklyn, N. Y.

Executive committee—Joseph B. McCall, chairman; D. L. Huntington, Alex Dow, E. A. Leslie, Samuel Insull and Louis A. Ferguson, Chicago; John W. Lieb, Jr., New York; Charles L. Edgar, Boston; E. L. Brine, Atlanta, Ga.

The attendance was the largest in the history of the association, the following companies being represented by the gentlemen named:

General Electric Company—C. A. Coffin, Eugene Griffin, New York; Elihu Thomson, Lynn, Mass.; J. R. Lovejoy, Schenectady, N. Y.; B. E. Sunny, Chicago; E. D. Mullen, Philadelphia; Fred M. Kimball, Boston, Mass.; Charles P. Steinmetz, William Le Roy Emmett, Caryl D. Haskins, Wallace S. Clark, Schenectady, N. Y.; Walter D'A. Ryan, Lynn, Mass.; George F. Morrison, A. D. Page, Francis W. Willcox, Harrison, N. J.; Sidney B. Paine, Boston, Mass.; George H. Stickney, Lynn, Mass.; Charles A. Mosman, A. L. Rohrer, W. S. Andrews, Schenectady, N. Y.; Clyde A. Houghton, Lynn, Mass.; Martin J. Insull, Pittsfield, Mass.; Harry J. Buddy, Philadelphia, Pa.; P. D. Wagoner, H. W. Hillman, E. E. Gilbert, H. C. Wirt, Schenectady, N. Y.; E. H. Mullin, New York; F. N. Boyer, Chicago; F. P. Cox, Lynn, Mass.; Theodore Beran, F. C. Bates, New York.

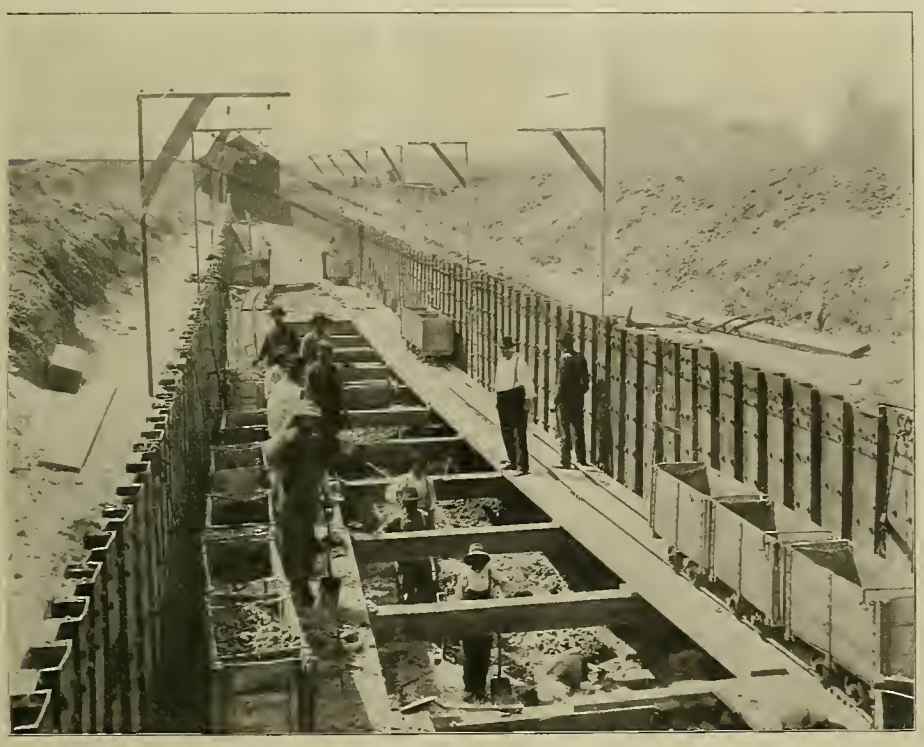
Edison Electric Illuminating Company, Boston—Charles L. Edgar, A. S. Knight, William H. Atkins, W. H. Francis, J. W. Cowles, Boston; Herbert A. Wagner, New York; Welles E. Holmes, Newton, Mass.; La Rue Vredenburgh, Sidney Hosmer, Charles H. Parker, Arthur G. Pierce, Leonard L. Elden, Gerhard M. W. Goettling, R. S. Hale, Charles H. Herrick, John S. Vogler, W. P. Hancock, Charles J. Hatch, Crawford R. Brown, F. Ellwood Smith, Boston.

Chicago Edison Company—Samuel Insull, Louis A. Ferguson, Walter M. Anthony, Peter Junkersfeld, George N. Eastman, Ernest Lunn, Robert C. P. Holmes, John W. Ferguson, Edwin J. Fowler, W. G. Carlton.

Edison Electric Light Company, Philadelphia—Joseph B. McCall, Joseph D. Israel, William C. L. Eglin, William F. Harrity, Charles J. Russell, John W. Meyer, P. H. Bartlett, Howard K. Mohr.

New York Edison Company—Thomas E. Murray, H. M. Edwards, Robert A. Carter, A. H. Ackermann, Arthur Williams, Walter F. Wells.

Edison Illuminating Company, Detroit, Mich.—Alex Dow, Hoyt Post, Samuel C. Mumford, John W. Brennan.



PROGRESS ON CHICAGO FREIGHT TUNNELS.—VIEW TAKEN ON LAKE FRONT INCLINE BEFORE ENCLOSURE.

Edison Electric Illuminating Company, Brooklyn—E. A. Leslie, W. W. Freeman.

New Bedford Gas and Edison Light Company—George K. Stetson, Charles R. Price, New Bedord, Mass.

Georgia Railway and Electric Company—G. W. Brine, Atlanta, Ga.

Birmingham Railway, Light and Power Company—Leon H. Scherck, Birmingham, Ala.

Chattanooga Electric Company—Byron T. Burt, Chattanooga, Tenn.

Beacon Electric Light Company—W. H. Johnson, Chester, Pa.

Cleveland Electric Illuminating Company—Mathias E. Turner, Cleveland, Ohio.

Des Moines Edison Company—J. H. Lovejoy, Schenectady, N. Y.

Erie County Electric Company—Thomas G. O'Dea, Erie, Pa.

Fall River Electric Light Company—Harry Bottomley, Fall River, Mass.

Indianapolis Light and Power Company—Charles C. Perry, Indianapolis, Ind.

Jackson Light and Power Company—James B. Foote, Jackson, Mich.

Citizens Light, Heat and Power Company—J. W. Reeves, Johnstown, Pa.

Louisville Lighting Company—A. M. Worthington, Louisville, Ky.

Peoria Gas and Electric Company—R. S. Wallace, Peoria, Ill.

Portland General Electric Company, Portland, Ore.—W. S. Barstow, New York.

Rockford Edison Company—M. A. Beal, Rockford, Ill.

Union Electric Light and Power Company, St. Louis (Missouri Edison Electric Company)—W. F. White, New York.

Edison Sault Electric Company—William Chandler, Sault Ste. Marie, Mich.

Seattle Electric Company—Dwight P. Robinson, Boston.

Edison Electric Light Company,—G. H. Edes, J. R. Lovejoy, Schenectady, N. Y.

Schenectady Railway Company—F. G. Sykes, Schenectady, N. Y.

Washington Water Power Company—D. L. Huntington, Spokane, Wash.

Toledo Railways and Light Company—E. J. Bechtel, Toledo, Ohio.

Potomac Electric Power Company—H. W. Fuller, Washington, D. C.

Edison Electric Illuminating Company—Ernest H. Davis, Williamsport, Pa.

Electrical Testing Laboratories—Wilson S. Howell, Clayton H. Sharp, W. F. Little, New York.

Electric Storage Battery Company—Herbert Lloyd, John R. Williams, Philadelphia; G. H. Atkin, Chicago.

Massachusetts Board of Gas and Electric Light Commissioners—Forrest E. Barker, Boston.

United States Navy Yard—T. F. Flanagan, Portsmouth, N. H.

Progress on the Chicago Freight Tunnels.

Since the date of the last illustrated article on the development of the freight-tunnel system under the business portion of Chicago, published in the Western Electrician on February 13, 1904, the Illinois Tunnel Company has been experimenting with various types of electric locomotives and has spent much time working out a system for operating these locomotives. The third-rail rack-and-pinion system described in the issue above mentioned was first tried and trains of three to five cars loaded to their full capacity were successfully operated. Before adopting this method, however, it was decided to experiment with the overhead trolley. Such a system, at 250 volts, is now undergoing test. Although the details of this plan are not given out at this time, it may be said that the system, though simple, is expected to give good results. If this method of operation is permanently installed, the entire 20 miles or more of tunnel will be equipped with the overhead trolley. The route will be divided into sections or blocks, and, by a special control system, it will be possible to cut out any block, should an accident occur, without affecting the other sections.

A comprehensive automatic system of switching and signaling is also being worked out, and, as all cars will be operated around loops, it is figured that delays at street intersections and basement connections will be reduced to a minimum, no matter how congested the traffic.

An outlet to the tunnel on the Lake Front at the foot of Harrison Street has recently been completed by the company. A picture of this outlet taken during construction is shown herewith. The steel retaining walls shown give a good idea of one of the uses to which the new interlocking steel sheeting, patented by George W. Jackson and August Simon can be put. The outlet extends under Grant Park, connecting with the main tunnel, on a nine per cent. grade, at the Jackson Street and Michigan Avenue intersection, and leading to the viaduct across the Illinois Central tracks. The walls and roof of this part of the tunnel are made of cement, the same as the main tunnel, and when completed the cut was filled in and sodded over, leaving no trace of the bore, except the necessary surface structure at the connection with the viaduct.

The main purpose of the outlet is for bringing the dirt from building excavations or tunnel extensions to fill in the portion of Grant Park east of the Illinois Central tracks—the portion reclaimed from Lake Michigan. A large number of all-steel dump cars has been added to the rolling stock for this purpose. A double track has been laid and the third-rail system is employed at present on the incline. When reaching the surface the cars are run across the Illinois Central viaduct and dumped.

That the Illinois Tunnel Company is preparing for an extensive freight-handling business is also evident from its recent large real-estate purchases, to be used as sites for warehouses, power house and freight yards. The Chicago Dock property on the west side of the South Branch of the Chicago River, extending 400 feet north of Taylor Street and 700 feet deep, has been purchased by the company and will be gradually improved with modern structures for warehouses and freight-handling purposes. The company has also leased for 99 years a nearby tract of 118,000 square feet on the river as a site for a power house. The lease provides for the expenditure of at least $100,000 within one year in the construction of buildings. The cost of the plant and equipment to be constructed by the company will approximate $500,000.

The Lake Shore Railroad Company is said to have decided to reconstruct its old warehouses and build a new one, with a view to connecting them all with the tunnels of the tunnel company, which are to connect with all the freight houses and yards in the city. The new warehouse is to be at Clark and Taylor Streets, and the old ones to be reconstructed are at Polk Street and Pacific Avenue. In the new construction the walls will be sunk to the lower level of the tunnels, and sidetracks and freight yards will be constructed under ground, to accommodate the tunnel cars.

The St. Louis and Springfield Electric Railway Company, which has interurban lines connecting Springfield, Decatur, Bloomington, Champaign and Carlinville, Ill., and is building south from Springfield to reach Edwardsville, says that construction work will be started in Edwardsville at once.

Electrically Controlled Track Switches on the Long Island Railroad.

The Long Island Railroad Company has recently installed on its Rockaway Beach division at Ozone Park a complete system of electrically controlled interlocking switches and signals which is of much interest. The double track of the Rockaway Beach division is in course of duplication, and the complete four-track line will begin at Ozone Park, which is the junction of the lines from Long Island City and Brooklyn. The four-track way is already laid and is in use from Ozone Park to the head of the trestle across Jamaica Bay. There are three distinct classes of passenger traffic through Ozone Park,

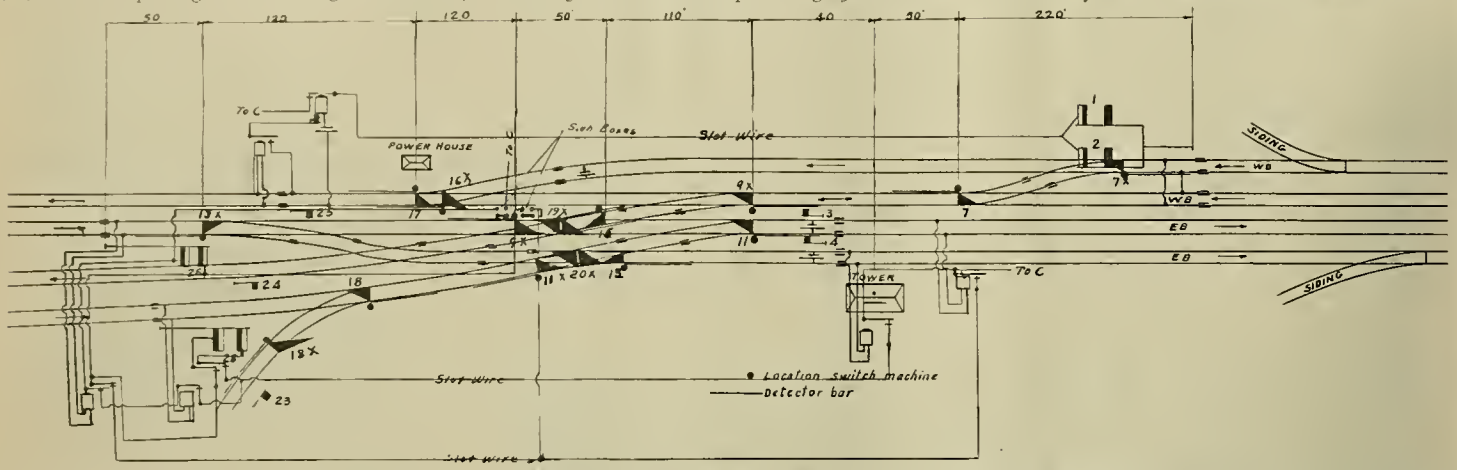


FIG. 1. ELECTRICALLY CONTROLLED TRACK SWITCHES ON THE LONG ISLAND RAILROAD AT OZONE PARK.

and on a busy Sunday as many as 300 trains are signaled during the working day. First, there are the regular Long Island trains from Long Island City to the Beach; second, the Long Island trains from the Flatbush Avenue and Bushwick terminals in Brooklyn, and, third, and especially during the summer season, the service of the Brooklyn Rapid Transit Company's elevated lines either from Broadway Ferry or Brooklyn Bridge. This is all steam traffic at present, but by the opening of the excursion season of 1905 it is anticipated that all trains will be propelled by electricity.

The diagram (Fig. 1) shows the eastbound (E.B.) and westbound (W.B.) tracks at Ozone Park station, the platforms being adjacent to the signal tower, and a grade crossing occurring a little to the left. On the left of the plan are the two independent eastbound and westbound tracks, the upper from Long Island City, and the lower from Brooklyn. It will be seen that these two double tracks emerge into a four-track system with the Long Island main lines in the middle and the Rapid Transit tracks outside. The handling of the traffic at this point is therefore complicated, and would have been difficult and dangerous had not interlocking devices been introduced. The electrically controlled switches, however, and their accompanying semi-automatic signals have reduced the working of the junction to a minimum of safety and celerity.

When an eastbound "elevated" train from Brooklyn wishes to pass it is necessary to reverse the signal lever, which lowers the upper arm of signal 28 to the "Proceed' position. The train then passes over switch 18, and through switch 11x, the movable point of frog 20x and switch 13, all set at normal. The reversal of the signal lever locks all switches over which the train must pass, as well as the signal controlling 13x, and the cars proceed along the outer eastbound track to the right. The signal lever cannot be unlocked until the train has passed beyond the track insulation near the dwarf signal No. 4.

For a Long Island train approaching from Brooklyn, switch 11x, is reversed, as well as the movable point of frog 20x. The lower arm of signal 28 is then set at "Proceed" and the operation of this lever in the tower locks all switches as before.

When a train approaches from Long Island City the lever of the upper arm of signal 26 is reversed, as well as that of a corresponding distance signal about 200 yards to the left, not shown on the plan. It is not necessary to operate any switches on this route, and the reversing of the signal lever automatically locks switch 13x at normal, and all crossovers and signals which command the eastbound main track.

With regard to the westbound traffic, a Rapid Transit train returning from Rockaway Beach necessitates the reversing of crossovers 7x and 9x. The lower arm of signal No. 1 is then set at "Proceed," but these operations cannot be completed unless switch 15 and the movable-point frog 19x are locked at normal position, and all the other signals are loocked at danger except those of the outer eastbound track.

In the case of a Long Island train from Rockaway Beach to Brooklyn, which comes along the middle westbound track, it is necessary to repeat the foregoing operations, except that No. 7 is not affected, but is locked, and the lower arm of signal 2 is lowered. This signal cannot be worked until switch 9x has been reversed, and the reversal of the signal lever locks all switches and signals as before.

For a train direct from Rockaway Beach to Long Island City, it is only necessary to reverse the upper arm of signal 2, and switches 7, 9x and 17 are locked at normal.

All the signals are slotted. A train passing along any track within the interlocking limits encounters a track insulation at the signal, as indicated in the diagram by means of double short lines on either side of the rails. At these points the metallic contact of the rails is disconnected, and a fiber insulation introduced. When the locomotive passes one of these insulations it opens a rail circuit in which is a magnet controlling the corresponding signal arm, and the signal is automatically put at danger. The rail circuit so closed by the passing of the locomotive and cars is not restored to its normal condition, and the signal cannot be lowered, until the last car has passed the insulation at the other end of that particular track circuit. Additional insulations are placed at crossovers to prevent the current getting away into another rail circuit, as shown between switches 11 and 13. The relays in the track circuits are protected against disintegration or fusing by means of magnetic blow-outs which snuff out any arc formed between the carbon contacts on the demagnetization of the relay. The magnetic blow-out works at 110 volts and five amperes. The slot-wire circuits, with the relays and signal connections, are all indicated clearly on the diagram, especially in connection with signal 28, the slot wire for which extends to the tower.

In order to prevent the accidental movement of a set of switch points beneath a train either moving or stationary detector bars have been installed to work in conjunction with the switch machines and the corresponding signal motors, a detector bar being moved by the switch motor in advance of the final movement of the points. The detector bars are indicated in position at various points on the diagram, and they are not essentially different from those used in other mechanical interlocking systems. The bars in each case are 50 feet long and lie alongside the track outside the rail in the immediate vicinity of the switch machines. They are directly connected to a lock which holds the switches in position and they must be moved every time a switch is opened or closed. No switch can be moved while any part of a train is over the detector bar, for the bars are longer than the longest distance between any two axle trucks.

All the switch and signal motors are operated by current from a 55-cell Chloride storage battery of 40-ampere-hour capacity, placed in the lower part of the signal tower. The cells are charged from a small Taylor dynamo of 1½-kilowatt output, driven by a five-horsepower gasoline engine, located in the power house near switch 17. In practice, the consumption of one gallon of gasoline supplies power for more than 2,700 switch movements. All the power cables and indication wires are laid underground in wooden casings, the top of the casing being easily removable for an examination of the wires. The men operating the installation belong to the ordinary signal staff of the railroad, and no special electrical knowledge is required of them, except that gained in a few days' instruction on the spot. The installation comprises 11 switches, two sets of movable-point frogs, eight movable signals and eight dwarf signals.

The reproduced photograph (Fig. 2) shows the movable-point frog 19x between switches 15 and 9x, and sundry switch machines in position. In the distance are the double-arm signals 26 and 28, and a single-arm distant signal commanding the main westbound track. This distant signal is operated from the next tower, and is not part of the electrical interlocking system.

In the tower there is an interlocking machine with 16 levers of the general type shown in Fig. 3, the whole being cased in and leaving only the locks in front and the terminals and fuses at the rear exposed. The lock handles are of different colors, according to requirements. A glass door on the top permits of access to all the enclosed parts, and, if necessary, the glass door can be locked to guard against tampering. Any lever, guide, controller, or magnet can be easily removed. All the wires terminate at the terminal board, where also every circuit is fused. This board is of slate, and with its three bus bars runs the whole length of the 16 levers. All switches are connected with the upper bus bar and all signals to the lower, the middle bus bar being for the indications which are common to switches and signals alike. In Fig. 4 the upper and lower bus bars are shown as one. The various incoming wires, together with those from the battery and the various magnets, as well as from the circuit

Fig. 2. Switches, Frogs and Signals at Ozone Park, Looking West.

Fig. 5. A Switch Machine.

ELECTRICALLY CONTROLLED TRACK SWITCHES ON LONG ISLAND RAILROAD.

controllers, terminate in binding posts, or fuse posts, as the case may be, and all are mounted in an orderly and systematic manner. Any wire may be conveniently disconnected for testing.

In Fig. 3, below the levers, will be seen the tappet bars, each of which assumes three different positions as it moves up and down as the lever handle is moved backward and forward, and operates the cam slot shown in Fig. 4. To the lever guide are attached the latch (L), the dog (P) and the cam (Q), and sundry springs, as shown in Fig. 4, but all concealed by the lever guide in Fig. 3. Beneath the guides are the indicating magnets, and in the case of a switch lever a second safety magnet is fixed below the first, as at (S), seen below lever 3, in Fig. 4.

The circuit controller, shown at the rear of Fig. 3 and diagrammatically on Fig. 4, comprises four brushes fixed to blocks of insulating material, the sliding contact, with contact strips above and below, being connected by means of a short rod with the lever in front. There are five different positions of the lever bar and the controller, acting in conjunction with the three different positions of the tappet bars.

In the case of switch levers, an indication selector is located beneath the controller and above the terminal board. This selector is operated by the working current and is so connected that it throws in one direction when the lever is reversed, and in the other when it is put at normal. The normal and reverse indication circuits are shown connected with lever 3. The function of the selector is to close only that indication circuit which corresponds with the position of the lever and to leave the other circuit open.

The means by which a lever is prevented from completing its stroke and thereby unlocking conflicting levers until the function controlled by the lever has assumed its new position can be understood by a study of Fig. 4. Take, for example, the switch lever No. 3, shown at full normal position. When the lever is pulled forward the tappet bar is raised by working in the cam slot from the first or normal position to the second. This operation locks all conflicting levers on the locking device on the front of the machine, so that no other tappet bar connected with a conflicting switch can be moved. In this movement, also, the forward projection on the underside of the lever engages the projection on the latch (L^3), and brings the other end of the latch ready to strike against the projecting stop at

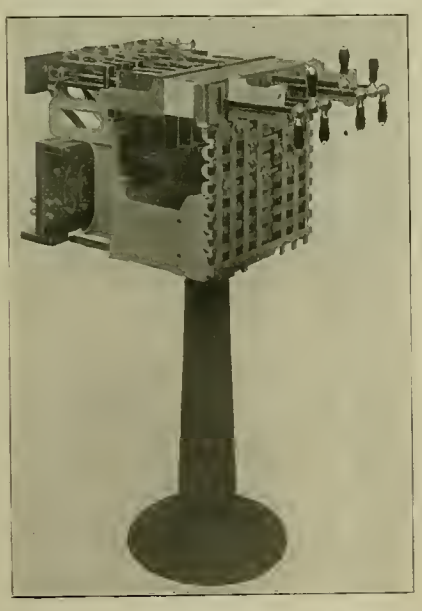


FIG. 3. INTERLOCKING MACHINE, SHOWING SEVEN LEVERS.

the rear end of the lever. As the lever continues to move forward at its third position the lever-stop pulls over the cam (Q^3) and causes the dog (P^3) to force the rear end of the latch against the lever-stop and locks it there temporarily in the fourth position of the cam movement. Meanwhile the sliding contact in the controller, formerly in contact with 3 and 5, closes the circuit across the pair of brushes, 4 and 6, and sends the battery current to the switch movement, throwing the switch and locking it in position. An indication current comes back through the magnet (I^3), lifting the armature (T^3), and, by causing the plunger to strike against the locked dog (P^3), releases the latch and allows the lever to be pulled right out into the fifth and final position. The end of the tappet bar is at the same time raised to the top of the cam slot, into its third position, and unlocks all levers which do not conflict with the reversed position of the lever and the functions it controls. In the first position, or at full reverse, the sliding contact in the controller remains in contact with the second pair of brushes, 4 and 6.

The safety magnet (S) is seen in position beneath the indication magnet (I^3). The indication armature (T^3) rests normally upon the poles of the safety magnet, through which any current that flows from the battery to the control wires is obliged to pass. In the case of a cross between the two wires the whole current, both that flowing out through the switch motor and that flowing back through the indication magnet, must pass through the safety coils, so that if by accident the whole current came back through the indication magnet the current in this magnet could not exceed the current in the safety magnet; and since the armature rests on the safety magnet and is a quarter of an inch away from the indication magnet, the latter is not strong enough to lift the armature. The safety coils are in series and a break in any part of the circuit wires, even

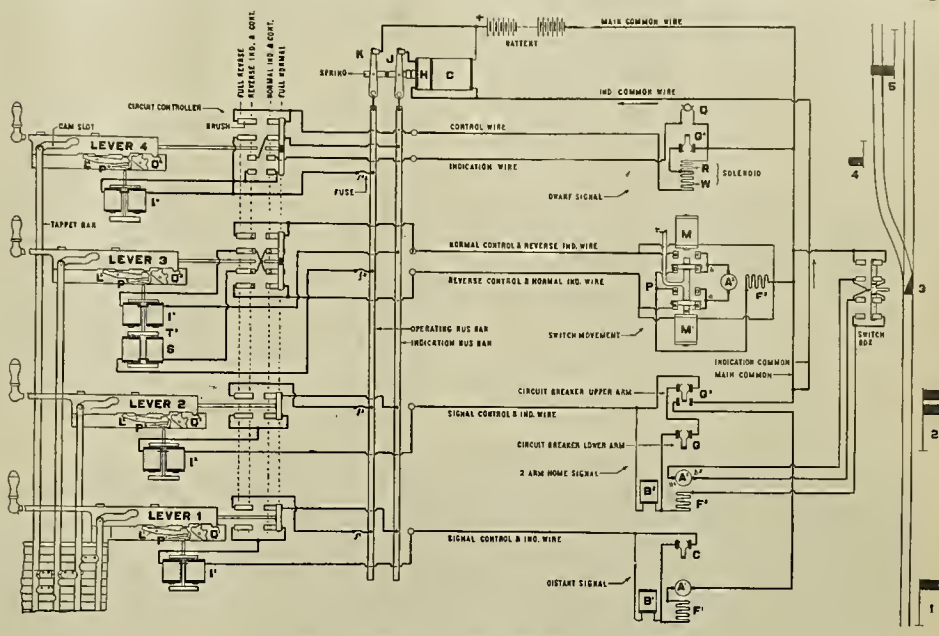


FIG 4. INTERLOCKING MACHINE CONNECTIONS.

in the safety coils themselves, would cut off the current. In the restoration of the switch lever to the normal position the switch movement is operated by the sliding contact reconnecting the brushes (3) and (5). The latch (L^3) is engaged as before, but the latch projections lock the lever in the contrary direction with respect to the operation of the cam (Q^3), and the releasing is effected by the indication current coming back over the other indication circuit through the instrumentality of the indication selector contacts Nos. 1, 7, 2 and 8, actually located beneath the sliding contact and the brushes, but shown above and below in Fig. 4. Each time a switch is moved the power current moving it passes through an ammeter in the tower and the operator can tell at a glance whether the switch is moving freely. If the ammeter indicates that more than the average power is needed to operate a switch the operator sends his assistant to find out the cause of the trouble.

The signal levers act in the same manner as the switch lever just described, except that the indication magnets are operated from the battery on the reversal of the lever and by the indication circuit on being restored to normal. The two-armed home signal, No. 2, is represented as being worked by one lever and by one operating machine, the upper or lower arm being reversed according to the position of the switch movement (3) acting through the selector in the switchbox. Thus, if lever (2) is reversed the contol wire is connected with the battery through the sliding contact and the indication magnet (I^2). The current then flows to the circuit-breakers (G^2) and (G), arranged in series in connection with the signal arms, the field coils (F^2) and one of the sliding contacts in the switchbox returning to the armature (A^2) through (a^2). If the switchbox is normal this current causes the armature to rotate and operate the mechanism that lowers the upper arm of the signal. When this is done the circuit-breaker (G^2) opens this circuit and at the same time clears the circuit of the distant signal, No. 1, which cannot otherwise be operated. The circuit-breakers are shunted by the brake magnet (B^2) and the current is reduced but not stopped entirely by the very high resistance of this magnet. When the magnet (B^2) is energized it brakes the armature shaft and holds the signal clear until the signal lever (2) is restored to normal.

In passing through the indication magnet (I^2), the current operating the signal motor merely releases the latch (L^2), permitting the subsequent full movement of the lever. This release of the latch is not, as was the case with the release of the switch-lever latch (L^3), an indication proper, and indeed no indication of the lowering of the signal arm is necessary, as no locking is released by the final movement of the lever, except that between the home and distant signals, and the circuit-breaker on the home signal provides for this. An indication, however, is provided when the signal is restored to the danger position, for when the lever (2) is returned to normal the circuit through the brake magnet (B^2) is broken at the controller and the control wire is put into connection with the indication common wire through the indication magnet and the indication bus bar. This releases the brake on the armature and the signal arm returns to normal by the action of a counterweight. The falling of the counterweight also drives the motor armature backward, the rotation tending to develop an electromotive force, and this current furnishes an indication in an ingenious manner. When the signal arm is nearly normal the circuit-breaker (G^2) becomes normal again and is closed against the armature current. The current therefore leaves the armature at brush (h^2), passes through the switchbox to the main and indication common wires, and so through the coil (H) and the indication bus bar to the indication magnet and back through the circuit-breakers (G^2) and (G) and the fields (F^2) to the switchbox, reaching the armature again at (a^2). Thus the indication magnet (I^2) effects the release of the latch of the lever for the full return movement, and incidentally the operator checks the rotation of the armature and acts as a cushion for the falling counterweight.

If, on account of the switch 3 being reversed, the switchbox is also reversed at the time the lever (2) is pulled forward, the lower arm of the signal is set at "Proceed" by means of the following operation: The current from the battery, after passing through the controller and the field coils (F^2), goes through the switchbox and enters the armature at (b^2) and leaves at (a^2), or in the direction contrary to that before described. The armature then rotates in the direction proper to clear the lower arm. When it is restored to normal the indication is sent to the indication magnet in the same direction and through the same wires as before, except that its direction through the armature and the switchbox is reversed. While the Ozone Park system was in process of installation it was found that the reversing of the current in the armature was not necessary when a bipolar motor was used, the field cores being of double strength and one at a time being used for the operation of the signal.

A dwarf signal, such as No. 4 in Fig. 4, is operated by a solenoid having two windings, a low-resistance working coil (W) and a high-resistance retaining coil (R). It has two circuit-breakers controlled by the signal arm—one, (D), for the indication circuit and closed only when the signal is normal, and the other (G^4), for the working circuit, open only when the signal is reversed. The dwarf circuit controller connected with lever 4 consists of eight fixed contact pieces and the usual pair of upper and lower contact strips. Two of these fixed contacts are long and connect with the movable strips during the preliminary and final movement of the lever, and the other two at each end are short so that they make contact with the movable strip only when the lever is stopped by the latch (L^4). The indication for the dwarf signal comes from the battery. The indication magnet has one terminal permanently connected with the positive pole of the battery, and the circuit-controller connections are such that when lever No. 4 is at the normal indication point the control wire is connected to the indication bus bar and the free terminal of the magnet (I^4) is connected with the indication wire. At the reverse indication point the control wire is connected with the positive pole of the battery and the free terminal of the magnet is connected to the negative pole of the battery through the indication and main common wires. In the full normal and reverse positions of the lever 4 the control wire retains the connection that it had at the corresponding indication points, but the indication magnet (I^4) is cut off to preventing heating of the coils and waste of current.

When the lever 4 is reversed the control wire is connected with the battery and the current flows

through the working coil (W) and the circuit-breaker (G') to the main common wire. This pulls the signal arm to "Proceed," the circuit-breaker opens and the retaining coil (R), which is in shunt with it, cuts in. The current in the retaining coil holds the signal in the clear position. The indication magnet is connected with the battery at the indication point for the purpose of releasing the lever latch (L'). As in the case of signal No. 2, this releasing of the latch is not an indication that the signal is cleared, but since there is no locking to be released by the final movement of the lever an indication is not needed. When the lever 4 is pushed back to normal the circuit of the retaining coil (R) is broken and the dwarf signal falls back to normal. When it reaches the normal position the circuit-breaker (D) connects the indication with the common wire at the signal, and since the movement of the lever to normal places the free terminal of the magnet (1') in connection with the indication wire the magnet is energized and the latch (L') is released, permitting the full return of the lever.

The bad effects of crosses between any of the wires are guarded against by the switches (J) and (K), Fig. 4. These are electrically independent and are normally held closed by the current in the coil (C). When the switch (K) is open the battery is cut off from all functions, and when (J) is open all wires are cut off from the indication common circuit. The coil (C) is energized from the positive pole of the battery, the current returning through the indication and main common wires. The low-resistance coil (H) is placed on the same core as (C) and is cut into the indication common circuit and forms part of it. All indication currents from the motors flow through in the direction shown by the arrow, and the currents passing through coil (H) help coil (C) in retaining the switches (J) and (K) against the pull of their respective springs. By this arrangement any current from the battery that might flow through coil (H) would be in the opposite direction to the indication currents, and, by neutralizing the current in the coil (C) would open the switches, and all the operative wires would be disconnected. The resistance of the return path through (H) is made less than that through a motor and the main common wire, so that in the event of a cross, the greater part of the current must flow back through the coil. The windings of the coils (H) and (C) are so proportioned that any cross-current strong enough to move a motor will throw the cut-out open and cut off all current from the crossed wires before it has time to move a motor.

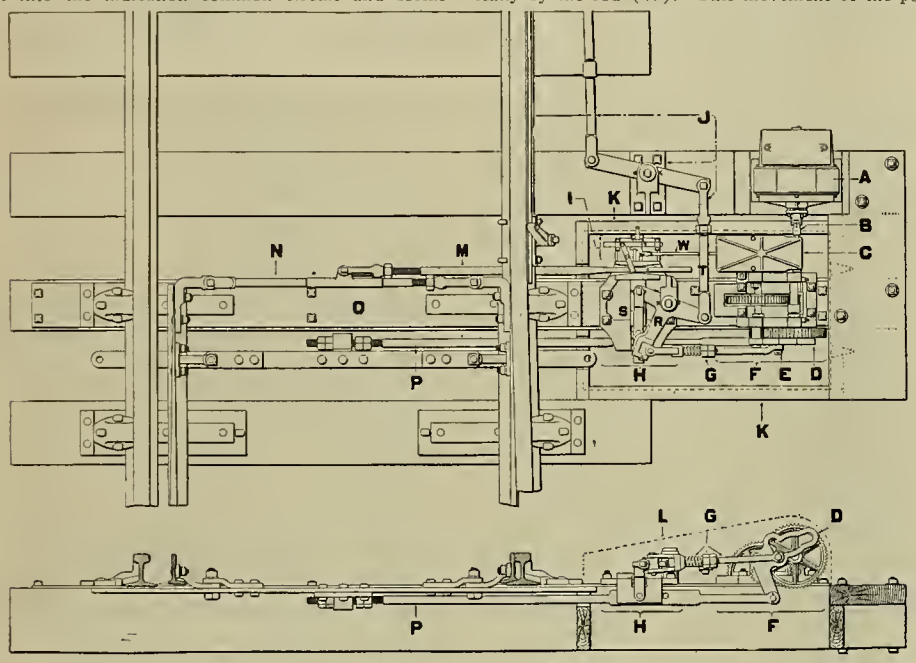


FIG. 6. ELECTRICALLY CONTROLLED TRACK SWITCHES ON LONG ISLAND RAILROAD.—PLAN AND ELEVATION OF SWITCH MACHINE.

Fig. 5 shows the switch machine controlling switch 13, with the cover turned back for inspection. The motor gearing, pole-changer and detector-bar link are the most visible objects and their relation will be understood by referring to the plan and elevation in Fig. 6 and to diagram of the switch movement in Fig. 4. The motor (A) (Fig. 6) is entirely waterproof and is of a type that is wound in such a way that a slight change in the internal connections can adapt it to the work to be performed in each individual case. The maximum power, for instance, was needed for the four points worked from one motor at switches 19 and 20. The switch machine consists of a connecting shaft (B), a gear frame (F), the lock movement (H) with its driving rod (G), the pole-changer movement (I) and the pole-changer (C). The cover (L) is indicated over the boxing (K). The circuit connections are seen in Fig. 4, where (P) is the pole-changer controlled by means of the magnets (M) (M'). Eight contact points are shown, two pairs being connected with the terminals (a) and (b). The armature is at (A^3) and the field coils at (F^3).

Returning to Fig. 6, the function of the gear-frame mechanism (F), worked from the shaft (B), is first to reduce the speed of the motor and increase its power, and second, to disengage the motor after the machine has entirely completed a stroke. Its working is entirely mechanical and it operates by disengaging clutches. When the stroke is completed the clutch moves sideways, leaving the motor rotating from its acquired momentum and sending an indication current to the indication magnet at the lever by the development of a counter electromotive force. The path of this indication current (Fig. 4) is through (a) and the pole-changer (P), and then through the field coils in the same direction that the driving current passed, finally operating the latch in the manner already described. The movements of the switch rods (P) and (N) over the tie-plate (O) of the director bar (J) and of the lock plunger are effected by the pin (E) attached to the main gear, which is directly connected with the lock movement by the rod (G) and to the switch by the engagement of the crank cam (D).

It is through the medium of the lock movement (H) that the lock plunger, detector bar and pole-changer are operated. Motion is transmitted to the crank (R) by the rod (G) to the lock plunger by link (S) and to the detector bar by link (T). It is thus seen that if there happens to be a train on the detector bar, neither the lock-plunger, the pole-changer nor the switch can be operated.

The lock-plunger operates the pole-changing movement (I) after it has passed on the movement of the crank (R) through a hole in the lock-rod (M), and the pole-changer (C) is then operated mechanically by the rod (W). This movement of the pole-changer cuts off the current from the motor, reverses the armature connections and completes the indicating circuit.

The pole-changer, besides being operated automatically by the lock bolt, through the rod (T) (Fig. 4) in the final part of its movement is, during all the intervening time, under the control of the lever by means of the magnets (M) and (M'). The magnet (M) has one terminal connected with the normal control wire and the other to the main common wire. The preliminary movement of the lever connects the normal control wire with the battery and the current flows through the magnet (M'). When the reverse control wire is connected the current flows through magnet (M'). These currents are powerful enough to shift the pole-changer whenever it is free from the lock bolt. It is free in fact to be moved by the magnets during the whole switch movement and during the time of the movement of the lock bolt, except at the beginning and end of the lock movement for the space of three-quarters of an inch. If the lever 3 is pulled out to reverse the switch, current is sent out through the reverse-control wire, through the switch motor in the proper direction to reverse the switch, and through the magnet (M'). The current through this magnet tends to hold the pole-changer in position so as to maintain the current in the motor. If for any reason it is thought desirable to put the switch back to the normal position before the reverse movement is completed, as, for instance, in the event of the rails being blocked by snow, it is only necessary to pull the lever back to normal and a current is sent out through the normal control wire to the magnet (M). The energizing of the magnet (M) shifts the pole-changer to the other side, and so into a position to send the current from the normal-control wire through the motor in the direction to replace the rail switch, at the end of which operation the pole-changer is shifted back again, and the indication is made that the switch is normal, enabling the return of the lever to normal to be completed. No current is sent through the indication magnet when the magnet (M) shifts the pole-changer, because the controller connected with the lever is in the wrong position, and no indications can be developed should the magnet (M) fail to work, for the reason that the connections between the armature and the field coils are not adjusted to develop it. They would have to be reversed for this to occur. When the switch is home and is locked in either position a simple circuit-breaker, not shown in the diagrams, cuts off current from the magnets (M) and (M').

The Ozone Park installation was put in by the Taylor Signal Company of Buffalo, a concern which a few weeks ago was amalgamated with the Pneumatic Signal Company under the new title of the General Railway Signal Company. The Taylor system of electrically controlled switches and signals was the invention of Mr. John D. Taylor of Chillicothe, Ohio, who worked at the improvement of his inventions from 1891 till 1900. In May, 1900, capital to develop the system was forthcoming, and since then Taylor signals have been installed on several lines of railroad both in America and Europe. The Ozone Park installation is the latest and improved form of the system. Mr. E. L. Weaver of the Long Island railroad drew up the original plans for the signal requirements at Ozone Park. The details were worked out in the Taylor company's office at Buffalo, and the actual work of putting the signals and switches in position was entrusted to Mr. E. O. Rogers. D. W. W.

The British Association at Cambridge.

The meeting of the British Association, which was held in Cambridge this year, August 18th to 24th, as mentioned editorially last week, was the largest in point of attendance in the history of the organization, there being 2,700 persons enrolled. Many leading physicists and mathematicians were present, including eminent European and American men. The proceedings were opened by the presidential address of the Right Hon. A. J. Balfour, prime minister of the United Kingdom.

The address of President Horace Lamb of section A (physics and mathematics) was warmly received and dealt principally with the evolution of mathematical physics, especially in connection with the work of Stokes. Among other things he said:

"One significant result of the modern tendency is that we no longer with the same obstinacy demand a mechanical explanation of the phenomena of light and electricity, especially since it has been made clear that if one mechanical explanation is possible there will be an infinity of others. Some minds, indeed, reveling in their new-found freedom, have attempted to disestablish ordinary or 'vulgar' matter altogether."

"We have traveled some distance from Stokes and the mathematical physics of half a century ago. May I add a few observations which might, perhaps, have claimed his sympathy? They are in substance anything but new, although I do not find them easy to express. We have most of us frankly adopted the empirical attitude in physical science; it has justified itself abundantly in the past and has more and more forced itself upon us. We have given up the notion of causation, except as a convenient phrase; what were once called laws of nature are now simply rules by which we can tell more or less accurately what will be the consequences of a given state of things."

Section G (engineering), of which the Hon. C. H. Parsons is president, also met on August 18th. President Parsons gave aerial navigation as an instance of what can certainly be achieved by the organized effort and research of a body of engineers. As a further illustration of what may be accomplished by such organized effort he gave a detailed design to show the possibility of penetrating 12 miles into the earth's crust at a cost of about £5,000,000. After the address Mr. Parsons was presented by Professor Schröter of Munich with the Grashof medal awarded to him at the Frankfort meeting of the German Society of Engineers.

Section A was in session at the same time as section G, and a number of abstruse papers on mathematics and mathematical physics were discussed.

On August 19th three papers were read before section G. They were: "Flame Temperatures in Internal Combustion Motors," by Dugald Clerk; "On the Specific Heats of Gases at High Temperatures," by Prof. H. B. Dixon, and "Exhaust Gas Calorimetry," by Prof. B. Hopkinson.

Saturday, August 20th, was spent principally on excursions, of which there were several, none of professional interest.

The first electrical paper on August 23d was by Prof. H. Rubens of Charlottenburg on "'Rest Strahlen' and the Optical Qualities of Metals." Several eminent physicians took part in the discussion. Later in the session Dr. Lummer of Charlottenburg started a discussion on N-rays. Unfortunately little time was given to this interesting subject, partly due to the fact that Professor Becquerel was temporarily absent from the room.

Section G was opened by a paper on the "Use of Electricity on the Northeastern Railway and Upon Tyneside" by Messrs. Merz and McClellan.

Mr. W. M. Mordey then read a paper on "Energy Losses in Magnetizing Iron," written by himself and Mr. A. G. Hansard.

A paper by Mr. Campbell Swinton on "Electricity from Waterpower" was, in the author's absence, taken as read. The paper gives some interesting statistics of existing hydro-electric plants and pro-

ceeds to sketch a number of schemes projected in England and the United States.

Other papers read at this session were: "The Distribution of Magnetic Induction in Multipolar Armatures," by Dr. Thornton; a paper by Dr. Sumpner and R. W. Weekes describing a modified Hopkinson method for testing induction motors, and a paper contributed by Dr. J. A. Fleming, in which he described the use of large bulb incandescent lamps as secondary standards of light. An interesting paper was also that of Clifford C. Paterson on "Some Investigations on the 10-candlepower Harcourt Pentane Lamp."

On August 23d papers on radioactivity and allied subjects were read. Professor Schuster read the first paper "On the Ionization of the Atmosphere."

Lord Kelvin remarked that in the dark ages of science, about the middle of the Nineteenth Century, the striking variations of the rate of leak of free ions in the atmosphere were well known, and were, in fact, studied exhaustively and given the name "electric frequency." He now had to express his sorrow that he then accepted the current notion that these variations were due to the varying prevalence of specks of dust and spherules of water, and had not more closely investigated the phenomena.

Lord Kelvin asked if it was possible that the radioactivity of radium salts was to any extent a surface effect. Sir Oliver Lodge declared that in the electric theory of matter all matter ought to be radioactive, and that it might almost be said that the burden of the disproof of that theory rested on its opponents. He asked, besides, if this radioactivity of ordinary matter might be the cause of fogging of photographic dry plates and films which had been kept a long time.

Dr. G. A. Blanc of Rome described the results of his experiments on the radioactivity of the sediments and floating matter of the hot springs at Aix-le-Bains. It drew from Professor Elster an account of some of his experiences with matter brought up from great depths by springs and volcanoes. There was no rule that such substances were always radioactive. Prof. J. J. Thomson told how the most highly radio-active natural water he had met with was that from the well of a certain brewer whose name he had sworn never to divulge; the radioactivity of his water would, this unenterprising brewer thought, prove no recommendation for his beer.

In the afternoon Professor Poynting gave an address of a popular character on "Radiation in the Solar System." He defined the radiation he meant to speak about as the stream of energy which passes continuously from the sun with the velocity of light, and proceeded to explain Stefan's law that the radiation from a black body varies directly as the fourth power of its absolute temperature. He showed how, mainly from this law, the temperature of the sun had been estimated as 6,250° C. (absolute), and computed the temperatures a small black body would assume if placed in space at the distance of the respective planets.

Wednesday, August 24th, was the last day and the attendance was thin. In section A Professor Fleming read a paper on "Electric Waves Along Spiral Wires and on an Appliance for Measuring the Length of the Waves Used in Wireless Telegraphy," which was followed by a paper by Mr. Field on eddy-current losses in the lead sheaths of three-phase cables, announcing that these losses go up as the sixth power of the diameter. The law requires some modification when skin effect is taken into consideration. Professor Knott then read a paper on "Magnetic and Electric Properties of Nickel at High Temperatures."

In section G during this period two papers on electrical subjects were read, one by Mr. H. Darwin on "An Electric Temperature Alarm;" the other by Prof. E. Wilson on "The Effect of Exposure to London Atmospheric Conditions on Aluminum Alloys."

The reading of three reports on live-rail accidents, issued by the Board of Trade, finished the proceedings.

Buffet Car for Aurora, Elgin and Chicago Electric Railway.

Buffet cars for electric railways are but another step in the advancement in interurban traffic which has been so marked in the last three or four years. Yet such a service will be from now on one of the features of the Aurora, Elgin and Chicago Railway Company's third-rail line, a combination buffet and parlor car having been built which operated successfully on the trial run which was made on August 30th.

The Carolyn is a car of handsome appearance, as will be seen by the accompanying illustration. It is of the same general type as the other cars on the line and is 55 feet long, which is about four feet longer than the regular passenger cars. Thirty people may be seated comfortably in the luxurious wicker chairs. Fig. 1 is a view of the exterior of the car and Fig. 2 is a picture of the interior arranged as a parlor car. The dining tables are not permanent, but can be quickly placed in position, one end hooking into the side of the car and the other supported by a single leg. In Fig. 2 at the rear end of the car two of the tables will be noticed ready for use.

The car is divided into three compartments, the one shown in Fig. 2 being the largest. At the opposite end of the car is a smoking compartment which will seat 10 people comfortably. Between the two compartments is the miniature kitchen in which the chef prepares the food by the aid of electric cooking apparatus.

The Carolyn is supplied with special trucks, the arrangement of the springs being such that the high speeds attained do not shake the car enough to inconvenience the diners. At present there are no motors on the car, it being operated as a trailer, but as soon as the work can be done the motors will be put in place, four of 125 horsepower each.

The interior is finished in Flemish oak, stained a dark apple-green color. The ceiling is done in canary yellow, which reflects the light to the best advantage.

The trial run mentioned was made on the night of August 30th, and it was a very pleasant affair, 30 people being present, including officials of the road and representatives of the daily and technical press. Through the courtesy of the Metropolitan West Side Elevated Railroad Company the car was run over the elevated tracks to the new terminal station at Fifth Avenue, though ordinarily it will only come into the Fifty-second Avenue station, where connections are made between the elevated road and the interurban line.

The run was first made to Wheaton, and from there to Aurora, where Mayor John M. Raymond of Aurora became one of the party. Here a short stop was made to visit the lodge rooms of the Elks. From Aurora the car went to Batavia, where the party was taken through the 15,000-kilowatt power house. The trip was then made around the triangle, i. e., from Aurora to Wheaton to Elgin and back to Aurora. Refreshments were served on the way out, and although a speed of 70 miles an hour was attained more than once, the jarring was not sufficient to cause inconvenience to those who were eating. Mr. Edwin C. Faber, general manager of the road, and Mr. Leon F. Reinhard, manager of the traffic department, were the hosts of the evening. Other officials of the Aurora, Elgin and Chicago Railway Company present were: Joseph O'Hara, superintendent of transportation; Charles Jones, chief engineer, and E. F. Gould, electrical engineer. Others who made the trip were John T. Huntington, general manager of the Elgin, Aurora and Southern Traction Company; H. M. Brinckerhoff, general manager of the Metropolitan West Side Elevated Railroad Company, Chicago; J. Morris Goodwin, London, England; Hymen Fridstein, engineer of construction, and R. R. Jarvie, superintendent of transportation of the Metropolitan West Side Elevated Railroad Company.

For the present special parties only will use the car, several having already chartered it for future trips. Later, however, it will be put into daily service, and probably others will be built. Many business men of Chicago live in suburbs along this line and may often find it convenient to take their morning or evening meals on the electric car.

Fig. 1. Exterior View.

Fig. 2. Interior Arranged as Parlor Car.

BUFFET CAR FOR AURORA, ELGIN AND CHICAGO ELECTRIC RAILWAY.

Electrical Exports for July.

Electrical exports from the United States for the month of July, 1904, amounted to a total value of $862,986, as compared with $908,584 for the corresponding month last year, a decrease of $45,598. The decrease is due to a falling off in the export of electrical goods classified as electrical appliances, which include telegraph and telephone instruments. This class of exports shows a decrease for July last, compared with July, 1903, of $66,393. As this amount is greater than the total decrease for the month, it is apparent that the other branch of electrical exports—machinery—must have increased to the amount of $20,795. The figures are as follows: Electrical appliances—July, 1903, $436,007; July, 1904, $369,614. Electrical machinery—July, 1903, $472,577; July, 1904, $493,372.

Comparing the first seven months of 1904 with the corresponding period last year an increase of $605,368 is shown in the total value of electrical exports; the amount for the seven months this year being $6,130,777, while that for a similar period last year was $5,525,409. The amount for the corresponding months in 1902 was $5,463,609. In comparing the figures on electrical machinery only, for the period above mentioned, the exports to Japan show an exceptionally large gain, quite out of proportion to the gain of other countries, as will be seen from the following figures for the first seven months of the respective years: 1902, $46,325; 1903, $113,559; 1904, $695,837. The United Kingdom, which is our largest buyer, shows a falling off for the same period as follows: 1902, $1,902,900; 1903, $1,156,044; 1904, $646,897.

The following-named countries were the principal buyers of electrical machinery from the United States for July, 1904: British North America, $156,093; United Kingdom, $104,723; Japan, $87,720; Mexico, $27,373; Chinese Empire, $19,525; British Australasia, $17,937; Brazil, $14,428; Germany, $11,455; British East Indies, $10,643; France, $5,150.

WESTERN ELECTRICIAN

EVERY SATURDAY.

PUBLICATION OFFICES:
510 Marquette Building, - CHICAGO.
TELEPHONE, MAIN 1746.

Eastern Office, 193 Times Building, New York.
Telephone, 3806J Cortlandt.

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted. This paper is entered at the Chicago postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the **old address** as well as the new should be given.

CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—**the only general electrical paper published in the West**—thoroughly covers a territory *exclusively its own.* THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be furnished on application.

REMITTANCES.—All checks, drafts and other remittances should be made payable to the order of the publishers, the **Electrician Publishing Company,** and addressed to the offices of publication, Suite 510, Marquette Building (204 Dearborn Street), Chicago, Illinois, U. S. A.

CONTENTS OF THIS NUMBER.

Government Delegates to the International Electrical Congress of 1904. With portraits of H. S. Carhart, A. E. Kennelly, H. J. Ryan, S. W. Stratton, Elihu Thomson, S. A. Arrhenius and H. F. Weber....187, 188
Method of Rendering Storage-battery Gases Non-explosive. Illustrated 188
Association of Edison Illuminating Companies. (Convention at Newcastle, N. H., August 30-September 1, 1904) 189
Progress on the Chicago Freight Tunnels. Illustrated.. 189
Electrically Controlled Track Switches on the Long Island Railroad. Illustrated 190, 191, 192
The British Association at Cambridge.....192, 193
Buffet Car for Aurora, Elgin and Chicago Electric Railway. Illustrated 193
Electrical Exports for July..... 193
Editorial 194
Programmes and Announcements for the International Electrical Congress in St. Louis Next Week.....195, 196
Electricians Are Pretty Good..... 196
Arrival and Entertainment of Foreign Delegates to the International Electrical Congress 196
World's Fair Visitors of Last Week..... 196
The International Electrical Congress of Chicago in 1893. Illustrated 197
September 14th is Electricity Day at the Fair..... 197
N. E. L. A. Likely to Meet in Colorado Springs Next Year 197
Points for Consideration When Purchasing Series Alternating-current Arc Lamps. By G. Brewer Griffin, Part II. 198, 199
Death of C. C. Haskins. Portrait..... 199
Death of Richard S. Waring. Portrait..... 199
Book Table.—Wilder's "Telephone Principles and Practice"..... 199
Sleeping Cars on Electric Railways..... 199
Turner Brass Works Enlarge. Illustrated..... 200
Gas-engine Unit for Private Lighting Plants. Illustrated 200
World's Fair Exhibits 200, 201
Northern Electrical Manufacturing Company. Illustrated 200
Electric Storage Battery Company. Illustrated...200, 201
Holophane Glass Company. Illustrated..... 201
Two-hundred-mile Transmission 201
Niagara-Toronto Power Transmission 201
Use of Instruments in Telephone Testing. Illustrated.. 202
Extensions and Improvements 202
Telephone Men 202
Telephone News from the Northwest..... 202
Ohio Telephone Notes 202
Southeastern Telephone Developments..... 202
General Telephone News 203
Gasoline Motors for Steam Railroads..... 203
Waterwheels for Drainage Canal Power Plant..... 203
Unaccounted-for Current. By W. E. Richards. With discussion. (Ohio Electric Light Association)..... 203
Graded Costs of Electric Supply. By Matthias E. Turner. (Ohio Electric Light Association).....204, 205
Condensing Outfits for Steam Turbines..... 205
German-Dutch Cable in the Far East..... 205
National Electrical Contractors' Association..... 205

DEPARTMENTS.

Correspondence 205, 206, 207
Great Britain 205
New York 205, 206
Dominion of Canada 206
Mexico 206
New England 206
Southeastern States 206
Ohio 206
Michigan 206, 207
Northwestern States 207
Rocky Mountain States 207
Pacific Slope 207
Personal 207
Electric Lighting 207, 208
Electric Railways 208
Publications 208
Space Telegraphy 208
Telegraph 208
Miscellaneous 208
Trade News 208
Business 208, 209
Illustrated Electrical Patent Record.....209, 210

DATES AHEAD.

International Electrical Congress, Coliseum, St. Louis, September 12th to 17th.
Northwestern Electrical Association (mid-year meeting), Forest Park University Hotel, St. Louis, Mo., September 12th to 16th.
International Association of Municipal Electricians (annual meeting), St. Louis, September 13th and 14th.
New York State Street Railway Association (annual convention), Butterfield House, Utica, N. Y., September 13th and 14th.
American Electrochemical Society (mid-year meeting), St. Louis, September 13th and 15th.
American Institute of Electrical Engineers (annual convention), St. Louis, September 14th, 15th and 16th.
American Electrotherapeutic Association (annual convention), St. Louis, September 13th to 16th.
National Electrical Contractors' Association (annual convention), St. Louis, September 14th to 16th.
Colorado Electric Light, Power and Railway Association, Colorado Springs, September 21st to 23d.
Independent Telephone Association of the United States (annual convention), Inside Inn, World's Fair grounds, St. Louis, September 21st, 22d and 23d.
Michigan Electric Association (annual meeting), October 11th.
American Street Railway Association (annual meeting), World's Fair grounds, St. Louis, October 12th and 13th.
Kansas Gas, Water and Electric Light Association (annual meeting), Leavenworth, Kan., October 18th and 19th.
Interstate Independent Telephone Association of America (annual convention), Chicago, December 13th, 14th and 15th.

VISITORS to the Louisiana Purchase Exposition at St. Louis who are interested in electricity or electrical literature are cordially invited to call at the booth of the Western Electrician, which is in Block 1 (Section 13) of the Palace of Electricity, just west of the main northern entrance to the building. Here will be found copies of the current issue of the paper, bound volumes of the Western Electrician from the first number, a careful selection of electrical books exhibited by the Electrician Publishing Company, and other objects of electrical interest. Chairs are provided for weary sight-seers, and an attendant will extend a hearty welcome to all readers or friends of the paper.

RECENT accidents again emphasize the importance of the use of the best possible braking apparatus on street-railway and interurban cars. No matter whether the car is operated by alternating or direct-current motor, from overhead trolley or from contact rail, occasional accidents will happen. At such times of emergency the existence of powerful brakes, capable of quick operation throughout the whole train line, may avert serious consequences. No question of expense should stand in the way of the employment of the very best apparatus of this kind, no matter how close the corners are cut elsewhere. The American Street Railway Association has already given attention to the subject of standard brakes, we believe, but the problem well deserves the constant attention of a standing committee, with a yearly report on the advantages, if any, of improved methods.

TRANS-MISSISSIPPI electrical men will be greatly pleased with the reported determination of the National Electric Light Association to meet in Colorado Springs, Colo., next year. Of late years the membership of the association in the states of the Mississippi Valley and the Missouri Valley has been greatly strengthened, and it is entirely fitting that the convention should go to Colorado, which is only two-thirds the way across this broad country of ours, after all. Some future convention, no doubt, will be held on the Pacific Slope. It is a long way from Boston and New York to Denver, to be sure, but no longer than from Denver to the eastern cities. This year's convention was held in Boston, and it is to be remembered, too, that all of the previous 26 conventions were held in Chicago, or points east of Chicago, with the exception of two—that of Kansas City in 1890 and of St. Louis in 1893. The time is ripe, therefore, for a far-western convention, and it should be a great success. Although the convention will not be held until next May, it is not too early for central-station men, East and West, to begin to make their preparations to attend it. Let all hands turn in to make the Colorado meeting a memorable one.

A FAMILIAR figure will be missed in Chicago electrical circles by the death of Mr. Clark C. Haskins. Most electrical men are young, or at least not old, but Mr. Haskins was nearly 77 years of age at the time of his death and knew all about the very beginnings of the first great practical achievement of electricity—the telegraph—by personal experience. The electromagnetic telegraph is 60 years old, and Mr. Haskins saw it develop over land and sea; he saw also the coming of the telephone, the electric light, the electric railway, the electrical transmission of power and all the varied ramifications of applied electricity and electrochemistry as we know them today. It is truly no mean thing to have lived in such an age, for one who possessed the trained observation of Mr. Haskins, who lived to be an old man, but kept his mind and heart young to the very last. Mr. Haskins was a thoroughly honest man. For many years he was an electrical inspector, and he stood for thorough and dependable construction. He possessed a considerable degree of inventive ability and always insisted that he was one of the inventors, if not the inventor, of the multiple telephone switchboard. He delighted in outdoor sports and enjoyed good literature. He was a fluent writer and was not without the saving grace of humor. He wrote a good book, "Electricity Made Simple," for non-technical readers and many articles for the Western Electrician and other journals. He was a man whom it was a pleasure to know and whose passing is sincerely regretted.

IN the volume of material presented to it the International Electrical Congress at St. Louis next week will exceed all previous gatherings of like character. No less than 170 papers have been promised, and on August 16th 77 were already in hand. The authors of these papers are among the most distinguished of electrical scientists and electrical engineers—such men as Arrhenius, Ascoli, Paul Drude, Violle, Prof. C. T. R. Wilson, Zeeman, Carl Barus, Carhart, Dr. Kennelly, Professor Nichols, Pupin, Professor Rutherford, Professor Trowbridge, André Blondel, Colonel Crompton, W. M. Mordey, Sir W. H. Preece, Prof. H. J. Ryan, Héroult, Ostwald, J. Swinburne, Maurice Leblanc, R. D. Mershon, Dr. Perrine, Steinmetz, Max Déri, Professor Lombardi, H. F. Parshall, Auguste Rateau, S. P. Thompson, W. L. R. Emmet, B. J. Arnold, F. J. Sprague, Louis Duncan, L. B. Stillwell, Dr. J. A. Fleming, V. Poulsen, de la Touanne, P. B. Delany, K. B. Miller, Dr. W. J. Herdman, Prof. Jacques Loeb and many others. The list of names and subjects, printed in this issue, is almost bewildering. The papers are divided between eight sections of the Congress, which will hold simultaneous sessions. This is a great mass of electrical literature—too much, of course, to be absorbed at once, and probably too much to be assimilated in its entirety by any one person. The Western Electrician will endeavor to give its readers, in subsequent issues, a general idea of the proceedings at the Congress, with abstracts of many of the papers. Each member of the Congress—there are about 2,000 of them—will receive the printed volumes of the Transactions of the Congress, and these can be studied at leisure.

In the number of those in attendance, too, the Congress promises to make a name for itself. At the Chicago International Electrical Congress of 1893 the total attendance was estimated at not exceeding 800. What will the figure be at St. Louis? Undoubtedly greater than 800. A thousand, two thousand, or more—how many? But the official character of the Chicago Congress was vested in a Chamber of Delegates of 19 men, representing seven governments. The government of the United States, at the petition of the committee of organization of the St. Louis Congress, has issued invitations to the various foreign governments to send official representatives to the Chamber of Delegates to be convened in St. Louis next week. Up to September 1st nine governments, including the United States, had responded, and 16 official delegates had been named. Great Britain, France and Germany had not at that time appointed government delegates, but it was hoped that they would do so later. In the '93 Congress the three dilatory nations were most creditably represented, and it will be regretted if they do not, at the last minute, take similar action now.

But, with or without official recognition, European nations, and notably England and Italy, are sending considerable delegations to this country to attend the Congress. Even as we write the foreign visitors are on a "circular tour" to points of electrical interest in the country, escorted by the American Institute of Electrical Engineers. They have received a hearty welcome in New York and Boston, and a reception no less cordial awaits them in Chicago on the date which is borne on this issue of the Western Electrician. When Elisha Gray made the closing speech at the congress of 11 years ago he bade the gentlemen from abroad to remember, when they reached home, not the smoke and noise and high buildings, but to think "of us over here as having warm hearts and as wishing you well." And it is in the spirit expressed by Dr. Gray that Chicago and the country welcome the visiting engineers.

Programmes and Announcements for the International Electrical Congress in St. Louis Next Week.

St. Louis will be the great center of electrical interest next week, for the International Electrical Congress of 1904 will be held there. Elaborate preparations for this important gathering have been made by a committee of organization, made up as follows: President, Elihu Thomson, Swampscott, Mass.; vice-presidents, Bion J. Arnold of Chicago (chairman of the executive committee), Professor H. S. Carhart of Ann Arbor, Mich., Professor W. E. Goldsborough of St. Louis, C. F. Scott of Pittsburg, Dr. S. W. Stratton of Washington, D. C.; general secretary, Dr. A. E. Kennelly of Cambridge, Mass.; treasurer, W. D. Weaver of New York city.

The congress will convene at the Music Hall of the Coliseum, St. Louis, at 9:30 a. m., on Monday, September 12, 1904. The Music Hall is situated at Olive and Thirteenth Streets, in the downtown district of St. Louis. All Congress members are invited to attend the meeting, which, unlike section meetings, will be open to the public. It is intended that after the opening ceremonies the convention will immediately divide into sections, the section halls being on the second floor of the same building. The Bureau of Information and the offices of the secretary and treasurer will also be in the Coliseum Building. On Tuesday, Wednesday, Thursday and Friday the sections will meet on the second floor of the Coliseum from 9 a. m. to 1 p. m.

The committee of organization of the Congress was appointed by the president of the St. Louis Exposition in June, 1903. The committee held its first meeting in July, 1903. In response to invitations to join the Congress, 1,956 acceptances had been received up to August 16th, of which 1,560 are from North America and 396 from other countries. Over 1,300 certificates of membership have been issued to persons who have already become members by forwarding their subscriptions. The committee of organization has issued, at the suggestion of the section officers, invitations to well-known electrical workers all over the world asking for papers to be read before the Congress. In response to these invitations about 170 papers have been promised for the Congress and 77 are already in hand.

The following are the preliminary programmes of the different sections, subject to interchange modification by section officers:

Section A.—General Theory—Mathematical, Experimental.

Chairman, Prof. E. L. Nichols; Secretary, Prof. H. T. Barnes.

Prof. Dr. S. Arrhenius—"On the Relation Between the Sun's Rays and Electromagnetic Disturbances on the Earth."
Prof. Dr. Moise Ascoli—"Systems of Electric Units." (A. E. Ital. paper.)
Prof. Dr. Paul Drude—"Metallic Conduction from the Standpoint of the Electronic Theory."
Prof. Dr. W. Jaeger—"Electrical Standards."
Prof. H. Nagaoka—"Magnetostriction."
Prof. J. S. Townsend—"The Theory of Ionization by Collision."
Prof. J. J. Thomson—"The Corpuscular Theory."
M. J. Violle—"Secondary Standards of Light."
Prof. C. T. R. Wilson, F. R. S.—"Condensation Nuclei."
Prof. P. Zeeman—"Recent Progress in Magneto-optics."
Dr. Carl Barus—"Atmospheric Nuclei." (A. Phys. S. paper.)
Prof. Howard T. Barnes—"The Mechanical Equivalent of Heat Measured by Electrical Means." (Roy. Soc., Canada, paper.)
Dr. L. A. Bauer—"The State of Our Knowledge Regarding the Earth's Magnetism and Recent Remarkable Magnetic Storms."
Prof. D. B. Brace—"Magneto-Optics." (A. Phys. S. paper.)
Prof. H. S. Carhart and Prof. G. W. Patterson, Jr.—"The Absolute Value of the Electromotive Force of the Clark and Weston Cells."
Prof. C. D. Child—"The Electric Arc."
Dr. K. E. Guthe—"Coherer Action."
Dr. A. E. Kennelly—"The Alternating-current Theory of Transmission Speed Over Submarine Telegraph Cables."
Prof. E. Percival Lewis—"The Electrical Conductivity of Gases."
Prof. J. C. McLennan—"Radio-activity of Mineral Oils and Natural Gases."
Prof. Louis T. More—"Electrostriction."
Prof. E. F. Nichols—"The Unobtained Wave-lengths Between the Longest Thermal and the Shortest Electric Waves Yet Measured."
Prof. E. L. Nichols—"Standards of Light."
Dr. H. Pender—"The Magnetic Effect of Moving Charges."
Prof. M. I. Pupin—"Electrical Impulses and Multiple Oscillators." (A. I. E. E. paper.)
Dr. E. B. Rosa and Mr. F. W. Grover—"The Absolute Measurement of Inductance."
Prof. E. Rutherford—"Radioative Change."
Prof. J. Trowbridge—"Spectra of Gases at High Temperatures."
Prof. A. G. Webster—"Report on Recent Developments in Electrical Theory." (A. P. S. paper.)
Dr. Frank A. Wolff—"The So-called International Electric Units."
Prof. J. Zeleny—"The Discharge from Points."

Section B.—General Applications.

Chairman, Prof. C. P. Steinmetz; Secretary, Prof. Samuel Sheldon.

Prof. E. Arnold and J. L. La Cour—"The Commutation of Direct and Alternating-current Machines."
M. André Blondel—"Calculation and Tests of Alternators."
M. Paul Boucherot—"Kinetic Variations of Electromotive Force in Dynamo-electric Generators and Its Influence on their Oneration in Parallel."
Dr. O. S. Bragstad—"Theory and Method of Operation of Repulsion Motors."
Col. R. E. Crompton—"Standardization of Dynamo-electric Machinery and Apparatus."
Profs. Drs. Elster and Geitel—"Concerning Natural Radioactivity of the Atmosphere and the Earth."
Herr Clarence Feldmann and Joseph Herzog—"The Distribution of Voltage and Current in Closed Conducting Networks."
M. Alexander Heyland—"Recent Developments in Compounded Alternators with Alternating-current Self Excitation."
W. M. Mordey—(To be announced.)
M. A. Nodon—"Rectifiers."
Sir W. H. Preece—"Electricity in Ancient Egypt."
Prof. C. A. Adams—"The Leakage Reactance of Induction Motors."
Mr. C. Day—"Electric Motors in Shop Service."
Mr. H. W. Fisher—"Sparking Distances Corresponding to Different Voltages."
Prof. E. B. Rosa, Dr. M. G. Lloyd and Mr. C. E. Reid—"The Influence of Wave Shape Upon Alternating-current Meter Indications."
Mr. D. B. Rushmore—"The Regulation of Alternators."
Prof. H. J. Ryan—"The Design of Insulators."
Dr. Clayton H. Sharp—"The Equipment of a Commercial Testing Laboratory."
Prof. H. B. Smith—"Very High-voltage Transformers."

Section C.—Electrochemistry.

Chairman, Prof. H. S. Carhart; Secretary, Mr. Carl Hering.

Geh. Reg. Prof. Dr. W. Borchers—"Electrometallurgy of Nickel."
Sherrard-Cowper-Coles—"Electrolytic Methods for the Rapid Production of Copper Sheets and Tubes."
Dr. F. Dolezalek—(Subject to be announced.)
J. Sigfrid Edström—"Electrical Extraction of Nitrogen from the Air."
Dr. H. Goldschmidt—"Alumino-thermics."
Prof. Dr. F. Haber—"Electrolytic Disturbances in the Earth."
Dr. P. L. T. Héroult—"Electrometallurgy of Iron and Steel."
Prof. Dr. Richard Lorenz—"Electrolysis of Fused Salts."
Prof. Dr. W. Ostwald—"Electrolysis and Catalysis."
Mr. J. Swinburne—"Electrolytic Smelting of Sulphide Ores."
Prof. W. D. Bancroft—"The Chemistry of Electroplating." (A. Electrochem. S. paper.)
Mr. A. G. Betts and Dr. Edward F. Kern—"The Lead Voltameter."
Prof. H. S. Carhart and Dr. C. A. Hulett—"The Preparation of Materials for Standard Cells and their Construction." (A. Electrochem. S. paper.)
Dr. A. E. Kennelly and S. E. Whiting—"The Present Status of the Edison Storage Batteries."
Dr. K. E. Guthe—"The Silver Voltameter."
Prof. L. Kahlenberg—"The Electrochemical Series of the Metals." (A. Electrochem. S. paper.)
Prof. J. W. Richards—"The Energy Absorbed in Electrolysis."
Prof. T. W. Richards—"The Relation of the Theory of Compressible Atoms to Electrochemistry."

Section D.—Electric Power Transmission.

Chairman, Mr. Charles F. Scott; Secretary, Dr. Louis Bell.

Sig. E. Bignami—"Electrical Transmission Plants in Switzerland."
H. M. Hobart—"A Method of Designing Induction Motors."
Mons. Maurice Leblanc—"Transmission of Alternating Currents Over Lines Possessing Capacity."
Prof. G. Mengarini—"Utilization of Hydraulic Powers in Italy."
F. G. Baum—"High-potential Long-distance Transmission and Control."
F. O. Blackwell—"Conductors for Long Spans."
H. W. Buck—"The Use of Aluminum as an Electrical Conductor."
V. G. Converse—"High-tension Insulators."
M. H. Gerry, Jr.—"The Construction and Insulation of High-tension Transmission Lines."
L. M. Hancock—"The Bay Counties Transmission System."
R. F. Hayward—"Some Practical Experiences in the Operation of Many Power Plants in Parallel."
J. F. Kelly and A. C. Bunker—"Some Difficulties of High-tension Transmission and Methods of Mitigating Them."
P. M. Lincoln—"Transmission and Distribution Problems Peculiar to the Single-phase Railway System."
Ralph D. Mershon—"The Maximum Distance to Which Power Can Be Economically Transmitted." (A. I. E. E. paper.)
P. N. Nunn—"Pioneer Work of the Telluride Power Company."
J. S. Peck—"The High-tension Transformer in Long-distance Power Transmission."
Dr. F. A. C. Perrine—"American Practice in High-tension Line Construction and Operation." (N. E. L. A. paper.)
Dr. C. P. Steinmetz—"Theory of the Single-phase Motor." (A. I. E. E. paper.)

Section E.—Electric Light and Distribution.

Chairman, J. W. Lieb, Jr.; Secretary, Mr. Gano S. Dunn.

Prof. André Blondel—"Impregnated Arc-light Carbons and Lamps."
Herr Max Déri—"Single-phase Motors."
Herr E. de Fodor—"Rates for Electricity Supply."
Sig. Ing. E. Jona—"Insulating Materials in High-tension Cables." (A. E. Ital. paper.)
Prof. W. Kübler—"Upon a Means for Compensating the Series Connection of Induction Motors."
Prof. L. Lombardi—"Stroboscopic Observations of the Arc." (A. E. Ital. paper.)
H. F. Parshall—"The Yorkshire and Lancashire Electric Power Companies."
Prof. Auguste Rateau—"Steam Turbines."
Herr Carl Roderbourg—"The Prussian System of Electric Train Lighting."
Sig. Ing. Guido Semenza—"Commercial Limits of Electric Transmission with Special Reference to Lighting Service."
Dr. G. Stern—"The Superiority of the Alternating Current for Distribution in Large Cities."
Prof. S. P. Thompson—(Subject to be announced.)
Dr. W. Wedding—"Measurements of the Energy of Light and Heat Radiation from Electric-light Sources."
Arthur Wright—"Recent Improvements in Electrolytic Meters."
B. A. Behrend—"The Testing of Alternating-current Generators."
Alex Dow—"The Continuous-current Distributing Systems of American Cities."
George Eastman—"Protection and Control of Large High-tension Alternating-current Distribution Systems." (N. E. L. A. paper.)
W. C. L. Eglin—"Rotary Converters and Motor Generators in Connection with the Transformation of High-tension Alternating to Low-tension Street Current." (Assn. Ed. Illg. Cos. paper.)
W. L. R. Emmet—"The Effect of Steam Turbines on Central-station Practice."
Louis A. Ferguson—"Underground Electrical Construction." (Assn. Ed. Illg. Cos. paper.)
Gerhard Goettling—"Storage Batteries." (Assn. Ed. Illg. Cos. paper.)
G. Ross Green—"American Meter Practice." (N. E. L. A. paper.)
Caryl D. Haskins—"Metering Efficiency on Customers' Premises."
Henry Noel Potter—"Nernst Lamps."
Dr. C. P. Steinmetz—"Luminous Electric Arcs."
Philip Torchio—"Distributing Systems from the Standpoint of Theory and Practice."
Herbert A. Wagner—"Electric Transmission and Distribution for Suburban Towns from a General Power Station."

Section F.—Electric Transportation.

Chairman, Dr. Louis Duncan; Secretary, Mr. A. H. Armstrong.

Ernst Danielson—"Theory of the Compensated Repulsion Motor."
Philip Dawson—"Electrification of British Railways."
Herr F. J. Eichberg—"Single-phase Electric Railways."
Prof. Dr. F. Niethammer—"Alternating vs. Direct-current Traction."
Prof. Dr. Rasch—"The Booster Machine in Railway Service and Its Most Suitable Control."
A. H. Armstrong—"The Electrification of Steam Lines."
B. J. Arnold—"Some Early Work in Polyphase and Single-phase Electric Traction."
Louis Duncan—"General Review of Railway Work."
J. B. Entz—"The Storage Battery in Electric-railway Service."
R. A. Parke—"Braking High-speed Trains."
W. B. Potter—"Electric Railways."
F. J. Sprague—"The History and Development of the Electric Railway."
L. B. Stillwell—"Notes on the Electrical Equipment of the Wilkesbarre and Hazleton Railway Company."
H. G. Stott—"Central station Economics and Operation."

Section G.—Electric Communication.

Chairman, Mr. F. W. Jones; Secretary, Mr. B. Gherardi.

Senor Don Julio Cervera Baviera—"Electric Communications in Spain."
Dr. J. A. Fleming, F. R. S.—"The Present State of Wireless Telegraphy."
John Hesketh—"A New Danger to Lead-covered Aerial Telephone Cables."
Herr Joseph Hollos—"Simultaneous Telegraphy and Telephony."
Saitaro Oi—"Telegraphy and Telephony in Japan."
V. Poulsen—"System for Producing Continuous Electrical Oscillations."
M. G. de la Touanne—"Theory of Telephone-exchange Development."
J. C. Barclay—"Modern High-speed Printing Telegraph Systems."
Dr. Lee De Forest—"Wireless-telegraph Receivers."
Patrick B. Delany—"Rapid Telegraphy."
Franz J. Dommerque—"The Telephone Problem in Large Cities."
Reginald A. Fessenden—"Wireless Telegraphy."
Hammond V. Hayes—"Loaded Telephone Lines in Practice."
J. C. Kelsey—"Features of the Dunbar Two-strand Common-battery Systems."
Dr. A. E. Kennelly—"High-frequency Telephone-circuit Tests."
Kempster B. Miller—Problem: "Automatic vs. Manual Telephone Exchange."
Dr. Louis M. Potts—"Printing Telegraphy."
Col. Samuel Reber—"Military Use of the Telegraph, Telephone and Cable."
Prof. George F. Sever—"Electrolysis of Underground Conductors."
L. W. Stanton—"Economical Features in Modern Telephone Engineering."
John Stone Stone—"The Theory of Wireless Telegraphy."

Section H.—Electrotherapeutics.

Chairman, Dr. W. J. Morton; Secretary, Mr. W. J. Jenks.

Prof. Dr. M. Benedikt—"A Contribution to the Radiodiagnostics of Diseases of the Head and of the Brain."
Dr. J. Bergonié—(Subject to be announced.)
M. le Docteur G. O'Farrill—"Some Improvements in Generator Apparatus of High-frequency Currents."
Dr. J. Rivière—"Physico-therapy of Neurasthenia."
Prof. S. Schatzky—"The Ionic Theory as Biological Basis for the Therapeutic Action of Electricity."
Prof. S. Schatzky—"Experimental Researches on the Treatment of Tuberculosis by Constant Current."
Dr. Carl Beck—"Recent Advances in Roentgen-ray Science."
Dr. Russell H. Boggs—"Diagnosis of Calculi by X-rays." (A. E. T. A. paper.)
Dr. Gordon G. Burdick—"Radiations in Therapeutics."
Dr. Margaret A. Cleaves—"The Nature of the Changes Established in Living Tissue By the Action of Oxidizable Metals at the Anode."
Dr. Charles R. Dickson—"Some Observations Upon the Treatment of Lupus Vulgaris by Phototherapy, Radiotherapy and Otherwise." (A. E. T. A. paper.)
Dr. Emil H. Grubbe—"X-rays and Radio-active Substances as Therapeutic Agents."
Dr. T. Proctor Hall—"The Principles of Electrotherapeutics."
Dr. W. J. Herdman—(Subject to be announced.) (A. E. T. A. paper.)
Dr. J. H. Kellogg—"Electrotherapeutics."
Prof. Jacques Loeb—"The Control of Life Phenomena By Electrolytes."
Dr. G. Betton Massey—"The Cataphoric Diffusion of Metallic Ions in the Destructive Sterilization of Cancer and Tuberculous Deposits."
Dr. W. J. Morton—"Artificial Fluorescence of the Human Organism as a Means of Treating Disease."
Dr. C. S. Neiswanger—"Static Electricity in Chronic Nephritis."
Dr. Clarence E. Skinner—"A Large Fibro-sarcoma Treated by X-radiance."
Dr. Wm. Benham Snow—"The Therapeutic Uses of Static Electricity."

The government of the United States, at the petition of the committee of organization, has issued invitations to the various foreign governments to send official representatives to the chamber of delegates of the congress. Up to the present time the following appointments have been announced:

Austro-Hungary—Prof. Charles Zipernowsky.
Italy—Prof. Moise Ascoli, Prof. L. Lombardi, Ing. A. Maffezzini.
Switzerland—Prof. Ferdinand Weber, Prof. François Louis Schüle.
Norway and Sweden—Prof. Svante August Arrhenius.
Australian Colonies—John Hesketh, Esq.
Brazil—Senor Jorge Newbery.
India—J. C. Shields, Esq.
Mexico—Señor Rafael R. Ariape.
United States—Prof. H. S. Carhart, Dr. A. E. Kennelly, Prof. H. J. Ryan, Prof. S. W. Stratton, Prof. Elihu Thomson.

The committee of organization has also issued invitations to the various electrical and physical societies all over the world to co-operate and to send delegates to the Congress. The following-named European societies have engaged to co-operate:

The Institution of Electrical Engineers—Delegates, Mr. R. Kaye Gray (president); Col. R. E. Crompton, C. B.; Prof. John Perry, F. R. S.; Dr.

R. T. Glazebrook, F. R. S.; Mr. H. E. Harrison, B. Sc., B. A.; Mr. W. Duddell, honorary secretary of delegation.

Associazione Elettrotecnica Italiana—Delegates, Prof. M. Ascoli (president); Prof. G. Grassi (vice-president); Prof. L. Lombardi (vice-president); Ing. E. Jona.

Oesterrichischer Elektrotechnischer Verein—Delgate, Herr Baron Wolfgang Ferstel.

La Société Internationale des Électriciens.

It is expected that joint meetings will be held by the Institution of Electrical Engineers and the American Institute of Electrical Engineers—with Section A at the Coliseum on Tuesday the 13th, and with Section F at the World's Fair on Wednesday the 14th.

In North America the following societies have engaged to co-operate with the Congress.

The Royal Society of Canada—Delegates, Prof. W. Lash Miller, Prof. Howard T. Barnes.

The American Institute of Electrical Engineers, to hold a simultaneous convention and joint sessions with several sections—Delegates, Mr. Ralph D. Mershon, Prof. M. I. Pupin, Prof. C. P. Steinmetz.

The American Physical Society, to hold a simultaneous convention and joint sessions with Section A, September 16th—Delegates, Prof. A. G. Webster (president), Dr. Carl Barus, Prof. D. B. Brace.

The American Electrochemical Society, to hold a simultaneous convention and joint sessions with Section C, 13th and 15th September—Delegates, Prof. W. D. Bancroft Prof. H. S. Carhart (president), Dr. Louis Kahlenberg.

The National Electric Light Association—Delegates, Mr. George Eastman, Mr. G. Ross Green, Dr. F. A. C. Perrine.

The Association of Edison Illuminating Companies—Delegates, Mr. W. C. L. Eglin, Mr. L. A. Ferguson, Mr. Gerhard Goettling.

The International Association of Municipal Electricians, to hold a simultaneous convention and joint meeting with Section G on September 15th—Delegates, Mr. W. H. Bradt, Mr. F. C. Mason, Mr. Walter N. Petty.

Pacific Coast Electric Transmission Association—Delegate, Dr. F. A. C. Perrine.

The American Electrotherapeutic Association to hold a simultaneous convention and joint meeting with Section H, September 15th—Delegates, Dr. Russell Herbert Boggs, Dr. Charles R. Dickson, Dr. James Herdman.

Major Samuel Reber of the general staff of the United States Army has been detailed to represent the War Department at the Congress. Major Reber is a Signal Corps officer, well known for his practical electrical knowledge.

The United States Navy Department has appointed as delegate to the congress Lieutenant-Commander Joseph L. Jayne, U. S. N.

The American Institute of Electrical Engineers has extended an invitation to the Institution of Electrical Engineers of Great Britain to visit the United States in September and to hold a joint meeting in St. Louis, in connection with the International Electrical Congress. A general invitation has also been extended by the American Institute of Electrical Engineers to the members of all European electrical societies, both individually and collectively, to join in the circular tour visiting principal cities and important industrial centers en route to and from St. Louis.

A copy of the Transactions of the congress will be forwarded to each member, at the address on his postcard or notice of application, unless a notice of change of address is received by the general secretary.

General Secretary Kennelly wishes it understood that persons who have not already joined the Congress may do so in St. Louis during the convention week.

A daily bulletin of the Congress will be printed.

Appropriate badges will be provided for members of the Congress. The Institution of Electrical Engineers (British) and the Associazione Elettrotecnica Italiana have handsome badges of their own. There is also a special "circular-tour" badge of the Institute.

Dudley Farrand, secretary of the National Electric Light Association, issues a notice to members of that organization calling attention to the Congress. The papers contributed by the association are those of Dr. F. A. C. Perrine (section D), George N. Eastman and G. Ross Green (section E). The members of the association are entitled to free admittance to the meetings in which the association is represented by these papers. For this purpose it will be desirable to wear the association badge.

Electricians Are Pretty Good.

The annual report of the New York Police Department for the year 1903, just issued, shows that among the persons arrested whose occupations were given there were 569 electricians, 60 linemen, 469 motorman, one switchboard operator, 106 telegraphers and four telephone operators. The total number of persons arrested was 175,871. The percentage of persons employed in the electrical industry was therefore about three-fourths of one per cent., and compares very favorably with the proportion of other trades. Clerks, for instance, numbered 8,072, or 4½ per cent. of the total, and tailors 2,454, or 1⅓ per cent. Bartenders numbered 5,062, and at the other end were 16 clergymen, 105 dentists, 101 editors and reporters, 93 photographers and 27 detectives.

Arrival and Entertainment of Foreign Delegates to the International Electrical Congress.

Boston was the city first to welcome the British delegates to the International Electrical Congress in St. Louis. The foreign engineers, accompanied by the wives and daughters of several of the members of the party, arrived in Boston on September 2d. Previous to this, on August 24th and 25th, the delegation of Italian engineers belonging to the Associazione Elettrotecnica Italiana arrived in New York city on the steamers Princess Irene and Deutschland. Those of the foreign party who landed in New York and wished to visit Boston were enabled to do so by taking advantage of an excursion which had been arranged by boat via Newport.

An hospitable reception was accorded the visitors in Boston. Chairman Charles L. Edgar and the other members of the Boston reception committee, together with President R. Kaye Gray and Secretary G. C. Lloyd of the British Institution, who had been in this country a week perfecting their plans, were on the dock to meet the party. Carriages were in waiting which conveyed the visitors to the Hotel Vendome, where a reception was held in the evening.

On Saturday morning, September 3d, automobiles were in readiness to take the party to various points of interest about the city. The first place to be visited was the L Street station of the Edison Electric Illuminating Company, where the big turbo-generator came in for its share of attention. About an hour was taken in the inspection of the station, when the automobiles were again brought around and the party proceeded to the headquarters of the American Telephone and Telegraph Company. Here half an hour was spent, after which there was more riding, this time out to Beacon Hill, through the park system, around Jamaica Pond, and thence past the Country Club to Soldiers' Field, with a short stop to examine the Stadium. From the Stadium the party was taken to Harvard Square, where it was met by Dr. A. E. Kennelly and other representatives of Harvard College. A visit was then made to some of the principal buildings of the college, followed by lunch and an informal reception held by Dr. Henry Walcott, representing the corporation of Harvard College.

At three o'clock electric cars were taken to Copley Square, where the visitors were received at the Rogers Building by Professor H. E. Clifford and others, representing the Massachusetts Institute of Technology, and shown through the various buildings of the institution. Finally, the visitors were taken by carriages to the Back Bay station of the New Haven and Hartford railroad, where a train was boarded for Fall River, from which point the Puritan conveyed the party to New York city, landing there at 6:45 a. m., Sunday, after a pleasant and uneventful trip down Long Island Sound.

Arrangements made for the reception of the visitors at the metropolis were perfect. Mr. J. W. Lieb, Jr., chairman of the reception committee of the American Institute of Electrical Engineers, and a number of other prominent New Yorkers were early at the pier, and as the members of the party stepped off of the steamer they were escorted to a number of electric automobiles in attendance and driven to their respective hotels. Many members of the party were still in their staterooms when the vessel docked, so that it was at least an hour before the last automobile got away, but there was an entire absence of confusion, and all the baggage of the party, to the total weight of several tons, was placed speedily on two huge electric trucks belonging to the New York Edison Company.

On Sunday afternoon, at the invitation of Mr. J. G. White of the firm of J. G. White & Co., the visitors boarded the steamer Richmond for a trip on the Hudson River, and in the evening were taken down the bay and on to "Dreamland," Coney Island.

A trip through the subway was scheduled for the first thing on Monday morning. Over 600 people, including, besides the delegates, many local members of the engineering profession, boarded the subway train at the City Hall. A regular eight-car train was completely filled. Alighting at the Fifty-ninth Street station, the party walked west to the subway power house, and after making an inspection of the plant, boarded the steamboat Nassau for a trip up the Hudson to Kingsbridge, visiting the power house of the New York City Railway Company. The return trip was made through the ship canal and the Harlem River, the party going to the power house of the Manhattan Elevated plant at Seventy-fourth street, and winding up at the Thirty-eighth Street station of the New York Edison Company.

In the evening a banquet was given at the Waldorf-Astoria to the English and Italian delegates by the American Institute of Electrical Engineers. Borough President Fornes welcomed the guests, in behalf of Mayor McClellan. Speeches were made by Bion J. Arnold, Robert Kaye Gray, Professor Moise Ascoli, Wilhelm von Siemens, Professor Elihu Thomson, Professor John Perry, C. A. Coffin and J. W. Lieb, Jr.

Two hundred and fifty-four guests were seated at the 33 tables. Besides the speakers, there were at the rostrum F. B. Crocker, Lieutenant-colonel R. E. Crompton, A. G. Echarte, Baron W. Ferstel, Dr. R. T. Glazebrook, R. Hammond, C. W. Hunt, G. C. Lloyd, Professor Luigi Lombardi, Amatore Maffezzini, T. C. Martin, Miguel Stamendi, Ralph W. Pope, Charles F. Scott, Frank J. Sprague and S. S. Wheeler. Other well-known men present were Charles Blizard, Samuel Insull, C. O. Mailloux and E. H. Mullin.

Not all the Italian engineers who arrived in New York went to Boston to join the main party. Those who did not were entertained by a special programme, including a reception at the Waldorf-Astoria by the American Institute on August 25th, a visit to Coney Island over the Brooklyn Rapid Transit system and other features. Several manufacturing and industrial plants were also visited during the stay. A visit was made to the New York shops of the Western Electric Company, to the Chelsea exchange of the New York Telephone Company, to the Edison Laboratory and the works of the Crocker-Wheeler Company at Ampere, N. J. At the last-mentioned place the party was entertained at luncheon and each member was given a souvenir, which was a photograph of what purported to be a leaf torn from the notebook of one of the party describing the trip. Following are the names of the Italian delegation:

Prof. Moise Ascoli, president; Prof. Guido Grassi, past president; Prof. Luigi Lombardi, vice-president; Camillo Albino Curti, member of council; Prof. Ferdinando Lori, member of council; Amatore Maffezzini, Edoardo Ambrosano, Prof. Uga Ancona, Giovanni Barosi, Carlo Barzano, C. Vincenzo Brazzola, Carlo Caminada, Alfonzo Carelli, Nicostrato Castellini, Filippi Danioni, Ascanio Dumontel, Dr. William Dunn, Edoardo Egger, Prof. Gino Fano, Luigi Galimberti, Dr. Ettore Gamba, Luigi Gianetti, Gian Teodore Giorgetti, Francesco Giudici, Emanuele Jona, Gerolamo Merlini, Aurelio Monteverde, Arnaldo Adazio, Augusto Pancaldi, Antonio Pesenti, Alberto Picchi, Luigi Pizzi, Eugenio Prandoni, Emilio Rava, Luigi Robbo, Alberto Rubini, Ulderigo Segre, Giuseppe Stramezzi, Gianfranco Tosi and Achille Venzaghi.

Among the British delegates and ladies were the following-named:

R. K. Gray, Lieut.-Col. R. E. Crompton, Prof. John Perry, Dr. R. T. E. Glazebrook, F. E. Gripper, H. E. Harrison and D. W. Duddell of London, A. F. T. Atchison of Birmingham, George Balfour and R. S. Ball of London, W. A. Barnes of Manchester, D. Bates of Liverpool, G. Conrad Blair of Paisley, John T. Connolly of Manchester, J. R. Dick of Brighton, James Edgar of Wrexam, R. S. Erskine, T. Fielden, J. A. Foster and W. Geipel of London, C. C. Hawkins of Bedford, M. Hayashi of London, son of the Japanese ambassador; Thomas Hasketh of Folkestone, F. Hope-Jones of London, M. Jennison of Manchester, F. C. Kidman of Wallsend-on-Tyne, E. H. Liebert of Rochdale, F. M. Long of Norwich, B. Longbottom and R. S. McLeod of Manchester, J. L. Marr and W. B. Marr of Sunderland, J. Marshall of Cheltenham, R. B. Matthews of Swansea, F. O. Mills of Manchester, Dr. D. K. Morris of Birmingham, J. T. Morris, L. G. E. Morse and F. H. Nalder of London, R. B. Perrin of Buton, W. G. T. Pope of Lisbon, A. P. Pyne of Gateshead, G. H. C. Risch of Johannesburg, W. H. Scott of Norwich, P. S. Sheardown of Dublin, C. D. Taite of Manchester, M. J. E. Tilney and R. Tree of London, H. G. Whiting of Cork, G. Wilson of Harrogate, E. B. Woolan of Tunbridge Wells, the Misses Perry and Stower and Hammond, Mrs. Bates, Mrs. Connolly, Mrs. Erskine, Mrs. Hesketh, Mrs. Pope and Mrs. Willis.

A description of the continuance of the interesting tour taken by the delegates on their way to St. Louis will be printed in the Western Electrician next week.

World's Fair Visitors of Last Week.

Among those registered last week at the booth of the Western Electrician in Electricity Building at the St. Louis Exposition were the following-named: S. S. Judd, Menomonie, Wis.; Henry Hand, Stanberry, Mo.; C. P. Peterson, Rock Island, Ill.; J. Rolson, Holdrege, Neb.; Dr. C. C. Davis, New Boston, Texas; Juan Rafecal, Faragoza, Spain; A. Valcuruela de la Foire, Faragoza, Spain; Arthur F. Childs, Del Rio, Texas; Harold Wilson, Rockdale, Texas; Sampson L. Weathers, Paoli, Ind.; J. C. Dettling, Purdue University; E. L. Ross, White Hall, Ill.; T. W. Banning, Wheaton, Ill.; Roger Wallace, Indianapolis, Ind.; J. W. Weis, Oklahoma City, Okla.; Howard I. Hanna, Waverly, Kan.; Harry T. Sullivan, St. Louis; Donald W. Smith, Bullock company, Cincinnati, Ohio; Carl H. Shertzer, Bloomfield, Ind.; Alvin Hansel, Edgemont, Nev.; E. C. Pokorny, Agricultural College, Michigan; H. G. Blakeney, Dallas Electric Company, Dallas, Texas; R. H. Woffett, Ames, Iowa; E. L. Usry, Ames, Iowa; C. R. Jones, Morgantown, W. Va.; Murice Citerne, Paris, France; D. M. Bunn, Pontiac, Ill.; G. W. Cole, Jr., Belton, Texas; William J. Hammer, New York city; P. R. Boole, Electric Appliance Company, Chicago; John C. Esler, Colfax, Ill.

A new trolley line has been opened connecting Hartford, Conn., with Springfield, Mass., by a route which runs on the west side of the Connecticut River. There has been for two years a line on the east side. The new line goes from Hartford to Windsor and thence by way of Suffield, Agawan and Mittineague to Springfield.

The International Electrical Congress of Chicago in 1893.

On the eve of the International Electrical Congress of 1904, to be held in St. Louis, it is interesting to recall the last International Electrical Congress held in this country, which was that of Chicago in 1893, during the progress of the World's Columbian Exposition. This congress held many of its sessions in what is now the Art Institute, and the group photograph reproduced in the accompanying picture was taken on the steps of that edifice on August 25, 1893. The gathering included a number of distinguished men, too many of whom, alas! have passed away. In the picture the faces are reduced to small size, but with close scrutiny the features of many well-known electrical men can be recognized.

The gentlemen seated, in the front row, beginning at the left, are Hospitalier of France, Violle of France, Ferraris of Italy, Mascart of France, Elisha Gray of the United States, Helmholtz of Germany, Preece of England, Rowland of the United States, Ayrton of England and Alexander Siemens of England. Of these four have since died—Ferraris, the gentle, lovable investigator of alternating-current phenomena; Gray, the distinguished inventor; Helmholtz, the greatest physicist of his time, and the impetuous Rowland, perhaps the greatest American physicist of his day. In the second seated row is Elihu Thomson of the United States (back of and between Siemens and Ayrton). Next to him, seated, is S. P. Thompson of England. Professor Nichols of Cornell is in the same row. Edward Weston can be seen standing next to Hospitalier. Back of him the tall man is Professor Jamieson of Scotland. Professor Cross of the Massachusetts Institute of Technology and Professor E. J. Houston of Philadelphia are standing back of Hospitalier and Violle. Back of Ferraris Thomas D. Lockwood and R. W. Pope are to be seen. At the right of the front row of sitting gentlemen is Steinmetz, with the inevitable cigar. Professor F. B. Crocker and Professor H. S. Carhart are standing, side by side, back of Ayrton. Near them is T. C. Mendenhall. A. E. Kennelly, who has had so much to do with the present congress, is in the group, and so is B. J. Arnold, now president of the American Institute of Electrical Engineers, and W. E. Goldsborough, now chief of the Department of Electricity at the St. Louis World's Fair. Other faces showing in the picture are those of F. B. Badt, Professor W. M. Stine, Professor R. B. Owens (then of Nebraska, now of Montreal), Carl Hering, N. S. Keith, F. W. Tischendoerfer of Berlin, Charles E. Emery, L. A. Ferguson and R. H. Pierce.

The Chicago congress was convened on Monday, August 21, 1893, and lasted through the following Friday. The honorary president was Dr. H. von Helmholtz of Berlin; temporary chairman, Elihu Thomson of Lynn, Mass.; permanent chairman, Dr. Elisha Gray of Chicago; vice-presidents, Edward Weston of the United States, W. H. Preece of Great Britain, Professor E. Mascart of France, Dr. Voigt of Germany, Professor J. Sahulka of Austria, Professor G. Ferraris of Italy, and Professor H. F. Weber of Switzerland; secretary, Professor F. B. Crocker of New York.

Beside a "Chamber of Delegates," the general congress embraced three sections. Section A, "Pure Theory," was presided over by Professor H. A. Rowland, with Professor A. L. Kimball as secretary. Section B, "Theory and Practice," had for its chairman Professor C. R. Cross and for its secretary Lieutenant (now Major) Samuel Reber, U. S. A. Section C, "Pure Practice," was in charge of Professor Edwin J. Houston as chairman, and E. P. Roberts as secretary. This arrangement was not a very satisfactory one, as there is both theory and practice in every branch of the electrical art, and it has been wisely abandoned in the classification of the congress of this year. A number of important papers were read at the three sections.

Sessions of the Chamber of Delegates were held behind closed doors. This was the official body in the congress, and it was made up as follows: France, Mascart, Hospitalier, Violle, de la Touanne; Germany, H. von Helmholtz, Dr. Lummer; Great Britain, W. H. Preece, W. E. Ayrton, S. P. Thompson, Alexander Siemens; Italy, Galileo Ferraris; Mexico, A. M. Chavez; Switzerland, A. Palaz, M. Thury; United States, H. A. Rowland, H. S. Carhart, Elihu Thomson, E. L. Nichols, T. C. Mendenhall. The Chamber reported to the general congress on the last day of the meeting. It defined the international ohm, the international ampere, the international volt, the international coulomb, the international farad, the joule, the watt and the henry. Its work was of much importance.

The total attendance at the Chicago gathering was about 800, and it was considered a most successful congress. Compared with the St. Louis programme the number of sections and papers was small, but the personnel of the Chamber of Delegates was of a high order, and truly international, and the report presented was of great value.

MEMBERS OF THE INTERNATIONAL ELECTRICAL CONGRESS HELD IN CHICAGO IN 1893.

The People's Hot Water Heating and Electric Company, the Capital Electric Company and the Springfield Light, Heat and Power Company, all of Springfield, Ill., have consolidated with a capital stock of $175,000.

September 14th Is Electricity Day at the Fair.

Each of the exhibit departments has been assigned a day by the Exposition Company to celebrate the advancement in its varied arts and industries. Wednesday, September 14th has been very properly set aside for "Electricity Day," which comes during the sessions of the International Electrical Congress and the several electrical conventions. It is the intention of the Department of Electricity of which Prof. W. E. Goldsborough is chief, to have special electrical displays and attractions which will appeal both to the electrical engineers and to the general public. The plans now contemplate more elaborate lighting effects about the Grand Basin and Festival Hall and decorative lamps placed in trees about the Palace of Electricity. On the north side of the building along the lagoon will be a high-tension line connected to a 100-kilowatt transformer with a secondary potential of 500,000 volts. This will be in operation, showing the spectacular effects of high-potential discharges.

In the Grand Basin adjoining the Palace of Electricity are to be anchored six floats with special electrical features. For example, one commemorates the twenty-fifth anniversary of the commercial development of the incandescent lamp; one shows a space-telegraph station; another an X-ray phenomenon, etc. The Palace of Electricity and the bridges leading to the island will be decorated with flags and special banners. In the evening there is to be an automobile parade. Inside of the building a reception is to be given the members of the International Electrical Congress and the visiting electrical engineers.

All the electrical demonstrations are to be repeated September 15th, which is St. Louis Day. If all circumstances prove auspicious it is probable that these two days will draw the largest attendance of any similar period during the exposition.

N. E. L. A. Likely to Meet in Colorado Springs Next Year.

Colorado Springs, Colo., is making an active effort to secure the 1905 convention of the National Electric Light Association, and it is likely that its missionary work will be crowned with success. The meeting is almost sure to be held west of the Missouri River, and it will probably be in Colorado Springs, which has good hotels and notable climatic and scenic attractions. The association has a large membership in the West, but of all its 27 conventions only two—that of Kansas City in 1890 and of St. Louis in 1893—were held in points west of Chicago. It is now the evident intention to compliment the western members, who were asked to go to Boston this year, by a location 500 miles west of the most western convention city of previous years. The twenty-eighth convention of the association will be held in May, 1905.

Points for Consideration When Purchasing Series Alternating-current Arc Lamps.

By G. Brewer Griffin.

Part II.

Commercial Performance.

1. Ratio of Life to Light.—Central-station men are apt to lose sight of the fact that extremely long life can only be obtained by operating lamps with either a low-voltage arc or with the barest possible amount of arc ventilation. Extravagant claims are made by some arc-lamp manufacturers regarding the life per trim of their lamps. It should be borne in mind that extreme life is usually obtained at the expense of light and power factor. With a 6.6-ampere series alternating-current lamp the most satisfactory rate of consumption is about one-tenth inch of carbon per hour, giving a life per trim (using 12-inch upper and seven-inch lower carbons) of about 100 to 105 hours. Either side of this line is apt to cause dissatisfaction, upon one side by the municipality and on the other by the central station.

2. Efficiency.—The efficiency of the alternating-current arc lamp depends largely upon the length and diameter of the carbons used, the current density and length of arc. This is usually calculated by the ratio between the true watts at terminals and the true watts at the arc. This ratio represents the loss in mechanism and C^2R losses. As before stated, a lamp carefully designed and free from undue friction in the parts, having the proper amount of iron in magnet cores should not show a loss of over 22 to 25 watts. Some buyers do not carefully consider this point. There are series alternating-current lamps on the market today which show a loss of 45 watts. The saving shown between this lamp and a properly designed one; namely, about 10 watts per lamp per hours, means a total saving on a 500-lamp installation, operating 11 hours per night, of 55 kilowatt-hours in the run, which would be three times the expense of recarboning the lamps (basing the selling price of the current at 10 cents per kilowatt), or, figuring that the lamps would burn at least eight nights, means that 440 kilowatt-hours of energy would be saved to the central station per trim of carbons.

3. Light Efficiency for 50 Hours.—The writer has previously referred to the advantage of having a cool gas cap and thereby causing the by-product of the carbon to deposit thereon rather than on the inner surface of the bulb. This point I have again brought up in regard to the light efficiency after 50 hours, or the available light attainable when the arc is half way down in the bulb. With a gas cap as recommended, the efficiency would be fully 50 per cent. greater than should some form of metal gas cap be used.

4. Distribution or Diffusion of Light from Arc.—Since it is necessary that all series alternating-current lamps should be fitted with some form of reflector for the arc, the buyer should see to it that the reflector serves the purpose with the least possible surface. It is well known that the series alternating-current lamp has a very pronounced upward angle of light near the arc, which must be interrupted at the proper degree above the horizontal. If a reflector could be so constructed that it would follow the arc down as the carbons are consumed, a reflector a trifle less than five inches would do the work successfully. Since this is not feasible, a reflector should be so designed as to interrupt the upward ray when the arc is at its average distance away from the reflecting surface. Working with this idea in view, arc-lamp designers should be able to design a lamp with a satisfactory reflector which would not be over eight or nine inches in diameter. The diffusion, as before mentioned, is aided by the means of a light opal inner bulb, properly proportioned, so as to be practically luminous over its entire surface.

5. Noise.—There should be little or no noise from a properly designed and well-made series alternating-current arc lamp if no loose parts exist. With a lamp hanging 15 feet above the street no noise should be noticeable. There is, of necessity, even in the very best lamp that could be designed, a very slight hum at the arc. This hum should be so slight as to require an effort to detect it.

6. Effects of Grounds.—With a series alternating-current system that has on its regulating end a transformer combined with a regulator, the effect of the ground does not, of course, extend further into the station. Where the transformer feature is not used the ground would, of course, come back to the generator, which would be unpleasant, to say the least. Intermittent grounds necessarily cause line surges and pumping of the regulator. It is therefore advisable to keep lines as free from grounds as possible. I say "as possible" advisably, having had some experience with tree wardens in various sections of the country. It is usually found that telephone companies will very quickly care for grounds that are caused by their wires. I call to mind one sad case where no attention was paid to the lighting station superintendent's complaint to the telephone company that its lines were crossing his and causing grounds, and when, two months later, a heavy sleet storm struck that vicinity, the alternating-current arc line of the central-station men burned out and totally destroyed 14 miles of lead-armored cable and 22 telephones for the neglectful telephone man. After which, the central-station man gleefully stated, he had no further troubles from this source. Any central-station man will hustle out and clear short-circuits caused by grounds rather than stand for the outage which it would entail.

Commercial Operation.

1. Amperage to be Used.—It will usually be found satisfactory to replace the nominally rated 1,200-candlepower open lamp with 6.6-ampere series alternating-current lamps, which consume about 410 watts at the arc. Where the so-called 2,000-candlepower lamps have been in use it is usually customary to replace them with 7.5-ampere series alternating-current lamps, using about 518 watts at the arc.

2. Height to be Hung from Street and Distance Apart.—This point the writer has previosly touched upon slightly, and recommend that 6.6-ampere lamps be hung 18 feet and 7.5 lamps not to exceed 25 feet above the street level. This shoud not be considered as a fixed rule, as everyone knows that no two locations demand exactly the same treatment. The natural objects surrounding the lamps should be taken into consideration; namely, whether they are reflective or absorptive and whether or not they interfere with the diffusion of light between the lamps. This, therefore, is a point that almost every central-station man has to decide upon to meet his own requirements and conditions.

3. How Best to Light Streets Having Heavy Foliage.—When the trees are comparatively small and have not attained growth sufficient to make it impracticable to light over their tops when lamps are placed on 20-foot poles, I should be inclined to recommend this method; but as the usual condition to be met is that the trees have attained growth much beyond this height, it would appear that the most satisfactory would be to trim out the limbs on the street side of the trees to a height of at least 20 feet from the ground. Set the poles in line with the trees, using long cross-arms well braced to the poles, putting the cross-arm so that practically its entire length will overhang the street, rather than endeavor to run the wires through the limbs; then hang the lamps on cable supports with pulleys and cord. Where municipalities or state tree wardens will not allow the trees to be thus trimmed, the old and troublesome way must of necessity be followed; namely, run the wires through the trees, endeavoring to keep them as free from grounds as possible, and hang the lamps low enough so that the light from them will not be obstructed by overhanging foliage. It is sometimes well to endeavor to impress upon the minds of tree wardens that it is better to allow a lighting company to trim up the trees than it is to run their wires through them and kill the trees by grounded wires, as sometimes happens.

4. Line Fittings.—This is a point which the writer does not care to go into to any great extent, in order that this paper may not be unduly lengthened. In general, would advise that nothing smaller than No. 6 line wire be used; No. 4 is preferable. Anything smaller than No. 6 has not sufficient tensile strength to prove entirely satisfactory, although it is sometimes used in certain sections of the country where there are few or no trees. Speaking of fittings, generally, it is usually good policy to buy those which are substantially constructed and made of good material. The use of an absolute hanger cut-out is advisable, although not deemed absolutely necessary by some engineers. The lamp trimmer can work much more rapidly when he knows that the lamp he is handling is dead from the binding post down, and it goes without saying that he stands much less chance of injury due to accidental crosses between the alternating-current day-service lines and the arc lines.

Method of Regulation.

The next point to be considered is the method of regulating the arc circuits. In checking over the installations of series alternating-current arc lamps throughout the United States it will be found that in the majority of cases there has been adopted a regulating transformer which is known as the repulsion-coil arc regulator or tub transformer. This device has met with universal approbation, and very few instances are on record where anything but highly successful operation has been given by it. This method of control has been adopted by the two leading electrical manufacturing companies of the world, after careful tests and consideration of other methods. The writer is one of the great majority who is in accord with the engineers who have decided upon this device as the most suitable. For this reason I will simply confine myself to a comparison of the air-cooled and oil-cooled types, with advantages and disadvantages of each.

In selecting a regulating transformer, the first consideration is the number of lamps to be operated from it. In the writer's opinion, an air-cooled regulating transformer is the most satisfactory for sizes of 25 and 50-light capacities, and 100 lights when the circuits in the transformer are entirely separate from each other. I think the choice applies quite as well for the 75-light regulating transformer where the secondaries are interconnected. As there is no great trouble experienced with the insulation at the maximum voltage obtainable, the air-cooled regulator has the better opportunity of operating at the minimum internal temperature than has the oil-cooled. Usually, the air-cooled regulator is very generously designed, having in its make-up a great amount of iron and copper, while in the oil-cooled these materials are cut considerably, as the oil is relied upon to dissipate a considerable proportion of the heat which would be generated by working the iron and copper up to their limits. A good air-cooled regulating transformer should be surrounded by a perforated metal case, or a wire-mesh case, which is readily removable, and which, when on, allows a complete view of all parts of the regulator. Air-cooled regulators are usually fitted with oil dashpots, while, with the oil-cooled, the coils working in the oil move so sluggishly that the dashpot is not necessary.

The air-cooled regulator usually regulates somewhat closer than does the oil-cooled, for the foregoing reasons. However carefully the case is made for the oil-cooled regulator there is bound to be some leakage of oil (it not being practical to make cast-iron cases), which is uncleanly and unsightly. The oil-cooled regulator is more difficult to inspect, and if, for any reason, a regulator coil burns out or becomes damaged, it is considerable more trouble to replace the coil than it would be in the air-cooled type. Both of the leading companies now use the vacuum process of impregnation, which entirely eliminates troubles which might possibly otherwise exist in air-cooled regulators; namely, absorption of moisture and loosening of the winding. In two-circuit, 150-light regulators, or two-circuit, 200-light regulators, or single-circuit, 100-light regulators, the writer would be inclined to select the oil-cooled type, owing to the high voltage incident to the operation of circuits of this size. The action of these regulators is so well understood that no extended description is necessary. Within operating limits repulsion between the moving and fixed coils is directly proportional to the square of the current flowing in them. By changing the amount of counterweights the current is changed. As the counterweight equals the weight of the coil, less the repulsion, the reduction of the counterweight increases the current, while an increase in the counterweight decreases the current. When current flows in the primary and secondary coils a mutual repelling force separates them until equilibrium is restored. When coils are adjusted with their counterweights for a predetermined current, the current will be maintained constant in the secondary coil, regardless of external resistance to which the coil is connected. When current is less than normal there is a diminution of the repelling force, and the coils approach each other until normal current is restored. When the current is above normal the opposite action takes place. These regulating transformers are so carefully designed that they maintain a constant current from full load to dead short-circuit, when the regulator is connected with the highest secondary tap. In regard to the tap referred to, I would say that it is now the practice to wind the coils with, usually, three taps made in each, so that the regulators are capable of operating at partial loads with practically the same power factor and a very slight change in efficiency. This is particularly handy to the central-station man who desires to purchase an equipment for use where he has 30 lamps in service and expects eventually to increase to 50 lamps. Thus he can purchase the 50-light regulator and operate it with practically as good economy as a 30-light regulator built for the purpose, and has immediately available excess capacity to take care of any additions made to his circuits.

In the matter of mechanical construction of regulators, the points to be considered are strength, accessibility, amount of friction in moving parts, adjustability to load conditions with maintenance of high efficiency and power factor, compactness and noise. While it is doubtful if repairs would ever be necessary, it is well to have the apparatus so designed that repairs may readily be made at the central station and by the central-station force. If the iron is laid up carefully and held securely in place there should be very little noise from the regulator. All parts of the framework should be solid and substantial, and the quadrants or wheels supporting the counterweights should, of preference, be mounted with ball bearings.

As to electrical construction of the regulators, the points to be considered are the coils—how insulated and how supported. Attention should be given to amount of space between coils and case, in order that breakdown voltages may be high, as well as space between floor and case, which should be great enough to prevent accumulation of dirt and dust under the regulator. The parts of the regulator carrying current should be guarded from accidental contact to the operators and attendants, and still be sufficiently open to allow good ventilation.

The purchaser should obtain from the manufacturer of the regulator guarantees as to what breakdown tests his apparatus will withstand; percentage of regulation through the range of action; efficiency and power factor on various percentages of load on each one of the various taps brought out from the coils. The question arises how best to start the circuits. Some stations make a practice of short-circuiting the regulators to start without any attempt to first block up the regulator, so that the coils stand in about the load position. This causes a momentray surge of current for the generator to carry and a drop of voltage on the line. It is advisable to use some form of a block in the regulator arm or spoke of the regulator wheel, which can be set during the day, when the regulators are inspected, and which will fall out by gravity when the load is thrown on to the regulator, thus avoiding the conditions previously mentioned. It is good practice to set the regulators in the station so that there will be ample space to walk entirely around them, so that no excuse

can be given by the attendant for allowing dust and dirt to accumulate on or about them.

It is good practice to have a dead-beat ammeter on each circuit, in order that at any time condition of operation may be noted, and troubles on the line observed as soon as they occur. A good double-pole, single-throw, oil switch is a convenient and useful thing to have on each circuit, in addition to the circuit plugs. Where two generators are used carrying both house-lighting and street-lighting services, it is well to have double-throw switches, so arranged that the entire load may be thrown on to one machine at an hour after midnight, when the load will admit of it. The use of fuses on each circuit, together with lightning arresters and choke coils, is advisable. It is usually customary to erect a panel in front of each regulator whose circuitis are controlled by it.

The system above laid out is the one best fitted to meet all the complex requirements and conditions surrounding central-station street-lighting services. Where a number of incandescent lamps are required to light courts and back streets or alleys, series incandescent street lamps fitted with parchment cut-out bases may be tapped in in series with the arc lamps, and highly successful operation obtained. It is understood, of course, that the amperage of the incandescent lamps should be the same as the arc circuits upon which they operate.

[*The end.*]

OBITUARY.

Clark Caryl Haskins.

Clark Caryl Haskins, a pioneer electrician, died at his home, 682 West Adams Street, Chicago, on Friday, September 2d, from a complication of diseases. Although not in the best of health for several years past, Mr. Haskins was active and energetic up to one month ago, when his doctor advised him to remain in the house. He gradually became weaker, but not until five days before his death was he confined to his bed. His end came peacefully, and he conversed cheerfully with his friends to the last. Mr. Haskins was very fond of fishing and a great lover of nature. When he returned to the city about the first of July from a six-week outing in Northern Wisconsin he looked robust and was apparently much benefited, but soon after he began to fail, and, owing to his advanced age of nearly 77 years, he was unable to rally from a complication of intestinal troubles.

C. C. HASKINS.

Clark C. Haskins was born in Buffalo, N. Y., on November 22, 1827. In 1844, when announcement was made that intelligence had been transmitted over a metallic wire, and a line was constructed between Lockport and Buffalo, N. Y., to demonstrate the discovery to a skeptical public, Mr. Haskins, then a boy, was placed in the Buffalo office, where he learned the duties of an operator, and in 30 days was placed in charge of an office, the line being extended to Toronto, Canada. He was one of the first operators to read by sound. He subsequently held many positions of a telegraphic nature, at one time being manager of the Bain line office at Troy, N. Y.

In 1878 Mr. Haskins was selected, from among several applicants, to represent Professor Elisha Gray's many electrical devices in telegraph and telephone development at the Paris Exposition. At the close of the exhibition, at the request of the English Society of Electrical Engineers, he exhibited and operated Professor Gray's apparatus, illustrating a paper by Major-general Weber of the British army. Returning to Chicago, he was made electrician and manager of the A. D. T. Company, under L. B. Firman, operating the Edison telephone system in opposition to the Bell company. While thus engaged, Mr. Haskins, associated with Charles H. Wilson, succeeded, after many discouraging efforts, in evolving three methods of multiple switchboards. The best of the three was selected and a patent applied for. Attempts were made to appropriate the invention, but the basic patent, which was issued and afterward sold to the Western Electric Company, was unassailable.

In the early days of electric lighting, Professor J. P. Barrett, head of the electrical branch of the Chicago Fire Department, induced the council to pass an ordinance requiring an inspection of all electrical plants and installations as a safeguard to life and property, which was menaced by the loose methods of construction then employed. Mr. Haskins was appointed the first electric-light inspector of Chicago soon after the passage of the ordinance in December, 1883, and held the position many years. The experiences incident to this position are told in a very interesting manner in "Reminiscences of an Electrical Inspector" written by Mr. Haskins and published in two parts in the Western Electrician of October 17 and October 24, 1903. Mr. Haskins has frequently contributed papers on electrical topics before electrical and insurance conventions, and is the author of "Electricity Made Simple," an excellent book treating the subject non-technically.

Mr. Haskins was married in 1853 to Miss Helen M. Smith of Monroe, Mich., who died three years ago. Besides a large circle of relatives and friends, Mr. Haskins leaves two sons, Frank C. Haskins of the Illinois Trust and Savings Bank, Chicago, and Dr. G. W. Haskins, also of Chicago. The funeral services were conducted at the Adams Street home on September 4th and interment was at Oakwoods Cemetery. The attendance at the funeral was large, including many of the former electrical associates of the deceased. Among the floral tributes was a handsome one from the electrical inspection department of the City Hall. Six cousins acted as pallbearers. Mr. Haskins was a Mason and a member of the Telegraphers' Mutual Benefit Association.

Richard S. Waring.

Mr. Richard S. Waring, formerly one of the most prominent citizens of Pittsburg, and the pioneer in the distinctive business of underground-cable manufacture in the United States, died on August 23d, at Elmira, N. Y., where he had resided for several years past.

RICHARD S. WARING.

Mr. Waring was born in Saratoga County, N. Y., in 1833, and came to Pittsburg to begin his business career in 1856 or 1857. He engaged in mercantile pursuits and became identified with the petroleum-oil business as far back as 1861, when the industry was comparatively new. As time went on Mr. Waring's energy and enterprise gave him a leading position in the oil business, and he was at one time one of the most prominent independent oil refiners of Pittsburg and one of the bitterest and most noted competitors of the Standard Oil Company. The business of his firms in the United States and abroad was very extensive and successful, so that Mr. Waring amassed quite a large fortune. On January 11, 1875, the suspension of Waring Bros. (O. T. Waring was the other member of the firm) was announced, and it was then asserted that it was due to discrimination in freight rates. The properties of Waring Bros. were absorbed by the Standard Oil Company.

Mr. Waring was also prominent in the social and political life of Pittsburg and was for a number of years chairman of the Republican county committee and was one of the close personal and political friends of the late Christopher L. Magee.

One of the largest and most enduring achievements of Mr. Waring, and which must always remain a monument to his genius and foresight, as well as to his energy and perseverance in the face of many difficulties and discouragements, was the establishment in 1882 of the Standard Underground Cable Company—a company which has become one of the most prosperous manufacturing corporations of Pittsburg and one of the most successful in its line in this country. Mr. Waring's knowledge of the oil business was extremely useful to him in perfecting his cable system, for it suggested to him, and enabled him to produce, a valuable insulating compound from petroleum products; and upon this insulating compound and many other features of cable manufacture, he promptly secured patents, both in the United States and in all important foreign countries.

Although there was no demand or market for underground cables in this country when Mr. Waring founded his company, and although for a number of years thereafter he had to contend with the opposition of the operating electrical companies, to which he must look for business, he nevertheless courageously and unstintedly spent his time and money in perfecting his cable system and its manufacture, and he lived to see the day when his company was firmly established in the business and its products considered an indispensable necessity.

In 1887 Mr. Waring went to England and founded the Fowler-Waring Cables Company, Ltd., for the manufacture of cables of the same type as were made by his American company. After remaining in London until 1890, he spent about two years in France, principally in Paris, and then returned to Pittsburg in 1893. He then interested himself in the Susquehanna Water Power Company, a project intended to utilize the waters of the Susquehanna River for electric power, but about five years ago he was obliged to retire from active business on account of failing health, and had since then resided at Elmira, N. Y.

Mr. Waring was a member of the American Institute of Electrical Engineers for a number of years. For many years he was a trustee of the Western University of Pennsylvania, a director of the Morganza Reform School of Western Pennsylvania and a trustee of the First Presbyterian Church of Pittsburg. He was a broad-minded man, of liberal attainments, kind-hearted and responsive to the appeals of worthy enterprises, many of which have reckoned him among their benefactors. He is survived by his wife, his son, Tracy D. Waring (assistant superintendent of the Perth Amboy cable works of the Standard Underground Cable Company), and daughter, Mrs. James Robinson, his brothers, O. T. Waring of the Standard Oil Company, and E. J. Waring of the Standard Underground Cable Company, and his sister, Malvina Waring of Plainfield, N. J.

The funeral services, held in the chapel of the Third Presbyterian Church in Pittsburg, on Thursday, August 25th, were largely attended by his former friends and acquaintances, and the remains were interred in the family lot in Allegheny Cemetery.

BOOK TABLE.

TELEPHONE PRINCIPLES AND PRACTICE. By George W. Wilder. Madison, Wis.: The Cantwell Printing Company. 1904. Pp. (5¼ by 7½ inches) 445, with 373 illustrations. Price, $2.

Telephone engineering is now, and rightly, recognized in the electrical field as one of those branches requiring not merely a good practical working knowledge of the apparatus, but also much theoretical and engineering ability of a higher order. To cover both the theoretical and practical sides of this subject in one volume is a difficult task, in view of the enormous growth of the telephone business within the last decade. How often the question is asked, "Where can I get a book on telephone practice which will cover the field both of exchange and line work?" Unfortunately, there are not many such, and a work such as the author now presents will receive a hearty welcome. The purpose of the book, as stated in the preface, is to give "An exposition of the fundamental principles of telephony and their application to telephone apparatus as designed, manufactured and operated today." The subject matter is divided into four sections: "Fundamental Ideas," "Telephone Apparatus," "Systems of Communication," and "Construction and Communication."

Principles of physics and electricity underlying the construction and operation of telephone apparatus are taken up in the first section, the author's extensive experience as a teacher of these subjects enabling him to embody in a few chapters such of those elementary ideas as are necessary for a good understanding of the principles of operation and at the same time not giving a mass of unnecessary detail to destroy the worth of the book as a practical work of reference. The chapters under the heads of "Telephone Apparatus" and "Systems of Communication" are an exposition of modern telephone apparatus and its working, two of special merit being "Selective Party Lines" and "Switchboard Circuits." Under "Construction and Equipment" the subjects of line construction, lightning protection and testing are discussed. The excellent illustrations are a feature of the book, the diagrams of connections especially being strong and well defined. The work deserves praise as a valuable addition to technical literature.

Sleeping Cars on Electric Railways.

Sleeping cars on trolley roads in Ohio are at last a reality, the first one having been placed in service on the Columbus, Newark and Zanesville line last week. This is a Holland combined parlor and sleeping car, and during the day will accommodate 24 people, the seats being handsome parlor-car chairs. At night the car can be made up into berths that will accommodate 20 people. There are five lower and five upper berths on each side of the car. Wooden curtains brought up through the floor divide the space into staterooms. Each room has three electric lights and there is ample space between the sides and the beds for dressing. A ladies' toilet room is located at one end of the car and a gentleman's room at the other. The car has a number of floorings and the spaces between are packed with mineral wool to prevent the noise of wheels and motors reaching the occupants. Four 150-horse-power motors supply the power. The crew of the car will consist of a motorman, conductor and porter.

Turner Brass Works Enlarge.

It is announced that the Turner Brass Works, Franklin and Michigan Streets, Chicago, have purchased from the White Manufacturing Company that portion of its business pertaining to blow torches, furnaces, brazers, ovens, etc., together with the trademark "Hot Blast" and all of the patents under which these goods have been manufactured. This large and well-known line, added to the torches and brazers already manufactured by the Turner Brass Works, places this progressive firm well in the lead among torch manufacturers. This company was the

FACTORY OF TURNER BRASS WORKS.

pioneer in the manufacture of mechanical-heat appliances, which branch of business has been carried on in connection with the manufacture of a number of other specialties, and it is said that fully 30 years ago it was among the first to manufacture a line of gasoline torches. The Old Reliable gasoline torches were introduced in the early days, when blow torches were little known, and readily met with favor among mechanics, in preference to other appliances, and are still regarded as excellent tools. In the palmy bicycle days the straight Turner gasoline brazing forge was exhibited as the first of its kind and considered a marvel for brazing bicycle frames and other similar work. These specialties met with great favor.

A radical improvement in torch construction was then brought out by the company, involving new ideas, and a line of torches introduced to the trade fitted with "double-jet" burners. The construction of these burners involved scientific principles, by the application of which the heat is more than doubled. In the Turner double-jet burners the supply of air and gas admitted into the combustion chamber of the burner is regulated independently, by means of two valves, and injected into the burner in two jets, so that a perfect mixture is secured, producing perfect combustion, and, as a result, the maximum degree of heat is obtained from the fuel. An illustration shows how burners are tested.

In order to meet the special requirements of jewelers, opticians, lead burners and others for a clean,

TESTING GASOLINE TORCHES.

non-oxidizing needle flame of high temperature suitable for fine soldering and similar work, this firm has recently applied the "double-jet" principle of construction to the use of wood alcohol as a fuel.

This line of high-grade appliances has formed the foundation of the Turner Brass Works torch business and has been added to from time to time to meet the requirements of the mechanical public, until a variety of over 80 torches, fire pots and brazers are now manufactured under one roof. Their six-story factory covers one-quarter of a block and is equipped with the latest types of improved machinery and special facilities for the manufacture of mechanical-heat appliances.

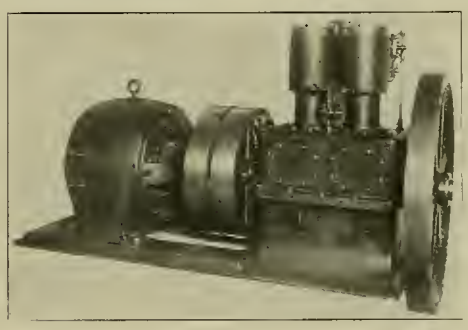
Gas-engine Unit for Private Lighting Plants.

The economy of fuel used and the simplicity of operating gas engines make them desirable for private-lighting plants, providing certain difficulties are overcome. Gas engines built in small sizes for driving dynamos satisfactorily must fulfill several very important requirements. The voltage regulation is the most important, as more than two-per cent. variation in the voltage will show in the light, which makes it not only undesirable, but the life of the incandescent lamp depends largely upon a steady voltage. In large engines any variation in the voltage is readily overcome, as the inertia of the heavy flywheels keeps the motion steady from one impulse to the next, but in small gas engines it is a different matter, as the efficiency of an engine depends largely on having flywheels the right proportion. If they are too large they not only lessen the efficiency but also the life of the engine.

Illustrated herewith is a gas-engine unit for a small lighting plant, which is being exploited by the Ideal Electric and Manufacturing Company of Mansfield, Ohio. The unit consists of a National Engineering Company gas engine direct connected to an Ideal generator.

The engine is designed especially to meet the requirements in every respect. On a varying load it will regulate within two per cent., and on a steady load within less than one-half of one per cent. The space occupied by the engine and dynamo is 40 by 78 inches, which makes it very desirable where economy of space is necessary. Natural gas, manufactured gas, or gasoline can be used as fuel. The base can be divided at the shaft line and by removing eight bolts the entire top of the engine can be raised up without removing the cylinder heads, valves, igniters or flywheels. This gives free access to the bearings when it becomes necessary to replace them. There are three bearings, all of which are adjustable. The cylinder heads, valves or igniters can each be removed separately without disturbing any other part of the engine.

The cylinders are constructed of a special grade of semi-steel, thus securing a close-grained, hard casting. The pistons are long and are provided with improved oil rings, which give perfect lubrication and at the same time prevent oil working past the piston. The mixing chamber valves and igniters are all in the same casting and free access to any of them is had by removing a cap. Valve seats are separate from the valve-chest casting and can easily



GAS-ENGINE UNIT FOR PRIVATE LIGHTING PLANTS.

be replaced in case of wear. The igniters are the "make-and-break" type and are located where the incoming charge tends to cool them and the exhaust to keep them clean.

An entirely new design of governor is used. The general make-up is the well-known flyball, but the action of the weights not only moves with the centrifugal force, but the entire governor is arranged to "float" against the force of gravity, and thus a very slight change in speed imparts a large movement to the valves in the mixing chamber.

As will be noted in the picture, the generator is built on compact and substantial lines. The magnet frame is made of cast iron of the highest permeability, cast round to insure the shortest magnetic circuit possible. Feet are cast on the frame for bolting to a sliding base or bed-plate.

Magnet poles are of forged steel of circular cross-section, cast welded into the magnet frame, thus insuring a perfect magnetic joint. The use of a round pole facilitates repairs in rewinding or replacing damaged coils. The blocks are machined in such a manner as to insure a cast welded joint and to prevent the blocks from becoming loose after the frame has been cast. They are also turned down for the reception of cast-iron shoes. These shoes protect and support the field winding. The effect of the cast-iron shoes is to reduce the density of the magnetic flux where it enters the armature and to break up the distortion of the fields.

Armature coils and slots are independently insulated. The cores are made from thin disks of special double-annealed electrical-quality steel sheets. These sheets are put through a process of oxidization, which prevents the flow of eddy currents, and consequent core losses.

The commutator is rigidly constructed. Solid V-end rings are used of the best mica, formed under hydraulic pressure, accurately gauged to give a perfect fit. The brushes operate through a milled trough of solid brass on the face of the brush-holder. They are of copper-coated composition carbon-graphite. The brush holders are adjustably mounted on heavy stems supported by quadrants and set at the proper point of sparkless commutation at which they are locked in position, no further adjustment being necessary, as the machines are sparkless between no load and 50-per cent. overload and without serious or injurious sparking at 100-per cent. overload momentarily.

WORLD'S FAIR EXHIBITS.

Northern Electrical Manufacturing Company.

The accompanying illustration shows the exhibit of the Northern Electrical Manufacturing Company at the exposition. The exhibit is made up of various types of motors and applications to machine-tool drive. It is located in the center of the west side of the Palace of Electricity, section 14, and is in

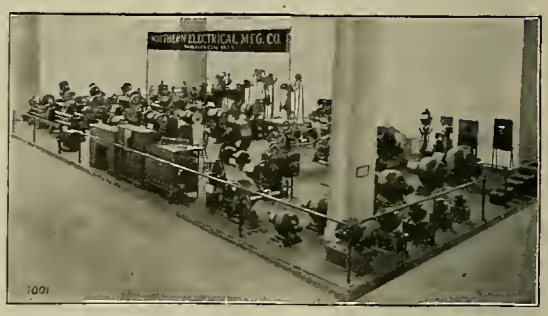


EXHIBIT OF NORTHERN ELECTRICAL MANUFACTURING COMPANY AT THE EXPOSITION.

charge of Mr. F. S. Culver. While essentially it is devoted to Northern products, it has the added interest of containing many types of machine tools which are adapted to motor drive.

In a neat little booklet which the company has issued, entitled "Points of Interest, Louisiana Purchase Exposition, St. Louis, 1904," are mentioned various types of Northern apparatus which are to be found in the exhibit and also in other buildings driving machinery of various kinds. The booklet will be sent to friends of the company upon request. Another neat method of advertising adopted by the company is a small colored map of the fair grounds, 5½ by eight inches, giving the dimensions of the principal buildings and some general facts about the expcsition.

Electric Storage Battery Company.

In section 20 of the Palace of Electricity, at the Louisiana Purchase Exposition, is located the exhibit of the Electric Storage Battery Company of Philadelphia. This is said to be the largest, most comprehensive and instructive exhibit ever made of storage batteries and apparatus used in connection with battery installations. A visit to this display will be of great interest to electrical engineers. The accompanying picture is a general view of the exhibit.

One of the prominent features is a large map of the United States, about 30 by 45 feet, on which is indicated, by means of colored "jewels," the location and character of the various installations of the Chloride accumulator. The exhibit includes a model battery house, in which is installed a model regulating railway battery, operating on a variable load. Five standard marble switchboard panels are shown, including the panels for controlling the model-railway battery. The other panels are an Edison central-station three-wire panel, panels for regulating combined lighting and power loads, railway feeder panels and panels for regulating railway power-house loads. Two motor-driven boosters are also shown, the smaller being used in connection with the model battery, and the larger a standard 100-kilowatt railway regulating booster.

Among the types of Chloride accumulators are three cells with a discharge capacity of 4,800 amperes for one hour, six cells type G-77, capacity 3,000 amperes for one hour, and type G-17 and F-17 cells, all being in standard lead-lined wooden tanks.

Smaller cells are shown in glass jars and in rubber jars for train lighting and yacht lighting. There is also shown a very complete set of Exide cells for automobiles, and Exide sparking sets for gas and gasoline-engine ignition. The Exide exhibit includes a large easel, showing in detail the various component parts of the Exide battery.

At one end of the space is a group of three large end-cell switches, operating from the Edison three-wire panel. Each of these switches is of 2,000-ampere capacity and is motor-driven, with electrical indicators. These end-cell switches are in actual operation and are so arranged that each switch may be driven by its own motor, or by means of clutches any two or all may be driven by any one motor. Clutches and hand wheels are also provided, whereby

the motors may be thrown out of gear and the switches operated by hand.

The model battery, with its booster and switchboard, forms a very interesting working exhibit. The battery is of type E-15, in lead-lined wooden tanks, and is mounted on white enamel brick tiers. The battery is in every particular an exact model in miniature of the larger railway installations, and is insulated from the brick piers by means of standard

ELECTRIC STORAGE BATTERY EXHIBIT AT THE EXPOSITION.

double insulation, consisting of vitrified bricks, then glass insulators, then prepared-wood stringers and another set of glass insulators.

On the switchboard controlling the model battery are the necessary battery and booster switches and automatic circuit-breakers, with their interlocking devices, a Bristol recording voltmeter and the Weston instruments, consisting of voltmeter, the 0-center battery ammeter, the generator ammeter and the total-load ammeter. The conditions under which the model battery operates are exactly similar to street-railway conditions. The generator delivers the average current required, and as a heavy external load is thrown on the system, the battery assumes the load, the needle of the generator ammeter remaining almost stationary. As the load is thrown off the battery automatically charges. The external load is caused by starting up the 100-kilowatt booster and by throwing on a bank of 80, 100-candlepower lamps. As an example of how well the battery regulates the load, it may be stated that the direct-current circuit supplying power to the exhibit is limited to 100 amperes. With the battery regulating, a load of 300 amperes is thrown on the system, causing a drop in the lighting or generator circuit of less than one volt in 110, and a rise in current in the line, or generator circuits, of less than 7½ per cent. of the total load. The action of the battery is automatically controlled by the small booster and its carbon regulator.

Holophane Glass Company.

The Holophane Glass Company's exhibit in the Electricity Building at St. Louis is among the handsomest on the fair grounds, and when lighted up at night forms a bright and most attractive center in the Electricity Building, owing to the fact that between 1,200 and 1,500 incandescent lamps of various colors are employed for lighting the outside of the exhibit. The accompanying illustration is a view of the exhibit at night.

The interior of the Holophane building is divided into three large rooms. The center one is fitted up as a handsomely furnished dining room, the ceilings and walls being of paneled oak. The main room is divided into two halves by a large curtain. Each side of the room has an equal number of electric lamps of equal power, placed on similar fixtures. The only difference in illumination is caused by the fact that one-half of the room uses Holophane glass globes over the lamps, while the other half uses ordinary glass globes, such as ground and opaline glass. The difference in illuminating results will be of interest to every electrical engineer interested in light and illuminating problems who may visit the fair.

The two other rooms are also fitted up as demonstrating rooms, but are divided into many small divisions intended to demonstrate the merits of Holophane globes as against different sorts of glass globes. The Holophane Glass Company's exhibit represents an outlay of over $25,000, and this whole exhibit was given with the direct intention of impressing on architects, the trade and the public in general the fact that Holophane glassware is a system of illuminators, or optical lighting appliances, and not merely a new sort of globe or reflector.

The magnificent new Astor Hotel, which is nearing completion, at the corner of Broadway and Forty-fifth Street, New York city, recently replaced over 2,000 ordinary glass globes and reflectors with Holophane globes and reflectors. This was only done after the management had carefully examined the relative illuminating merits of Holophane glassware as against the ordinary glassware.

The globes that were taken out of the Astor Hotel were of the best quality of ground glass. Some of these were used upright and others pendant. Where these globes were used upright they were replaced by Holophane globes; where they were used pendant they were replaced by Holophane reflectors (known as pagodas). Comparing the Holophane globe used as with the ground glass the following results were obtained by the New York Electrical Testing Laboratories:

Angles.	Lamp Alone.	Lamp with Ground Glass Shade.	Lamp with Holophane Globe.
0° (end on)	1.7	3.3	9.6
15°	4.3	6.9	12.5
30°	8.1	7.5	13.3
45°	12.2	9.4	12.8
60°	14.5	11.3	13.6

The comparison between the ground-glass shade used as a pendant and the Holophane (Pagoda) reflector is still more marked. The following are results of tests made by the New York Electrical Testing Laboratories, comparing the Holophane reflector and the ground-glass shade taken out of the Astor Hotel:

Angles.	Lamp Alone.	Lamp with Ground Glass Shade.	Lamp with Holophane Reflector.
0° (end on)	6.9	12.1	58.0
15°	7.5	12.8	45.4
30°	9.6	14.3	26.5
45°	12.0	15.8	20.6
60°	14.2	14.0	16.6

It is quite apparent from studying the results of these tests that the use of Holophane glassware, either in the shape of globes or reflectors, enables at least twice the useful illumination to be obtained that is obtainable with the ordinary or unscientific glassware now in general use.

After careful tests, covering in some cases over a year and made in the laboratories of the leading lamp manufacturers of this country, the following lamp manufacturers not only endorse the scientific merits of Holophane glassware but have decided to use exclusively the prism globes and reflectors made by the Holophane Glass Company: General Electric Company; Bryan-Marsh Company; Columbia Incandescent Lamp Company; Western Electric Company; Buckeye Electric Company; Fostoria Incandescent Lamp Company; Shelby Electric Company; Sunbeam Incandescent Lamp Company of Canada, Ltd.; Independent Incandescent Lamp Company; Warren Electric and Specialty Company; Colonial Electric Company; New York and Ohio Company; Brilliant Electric Company.

It is also said that the Allgemeine Electricitäts Geschellschaft of Berlin is now negotiating for the sole rights of handling the output of Holophane glass in Germany.

Two-hundred-mile Transmission.

A reader of the Western Electrician in El Paso, Tex., wishes to know if there is in operation or under construction a high-tension transmission line 200 miles in length or over, and if so, whether it is good practice and what voltage is necessary.

The operation of high-tension lines is now considered practical for distances as high as 200 miles and even more, as is shown by the system of the Consolidated Gas and Electric Company (San Francisco) in California, where there is a transmission of 232 miles, the voltage being 60,000.

Niagara-Toronto Power Transmission.

The Toronto and Niagara Power Company has purchased a right-of-way for a power-transmission line between Niagara Falls, Ont., and Toronto, Ont. The length is 86 miles, while it is 80 feet wide, which width is sufficient to accommodate the tracks of the proposed Toronto and Hamilton Electric Railway Company and also the pole line for power transmission. The cables will be strung on steel towers. The company is erecting a transformer station at the head of St. George Street, Toronto, while another transformer station will be erected on Yonge Street, Toronto. Cable towers have already been erected from the George Street station as far as Davenport. A branch line will be built from Islington to New Toronto, a distance of 3½ miles.

HOLOPHANE GLASS COMPANY'S BOOTH AT NIGHT.

Use of Instruments in Telephone Testing.

A subscriber of the Western Electrician in the state of Washington desires to know how to use a voltmeter, ammeter and galvanometer for testing trouble in telephone lines, both local and toll, and what additional apparatus may be needed to use any of the three.

The questioner does not state the kind of galvanometer that he has available, nor does he particularize the scale readings of the ammeter and the voltmeter. Briefly, however, the voltmeter may be used to measure the insulation resistance of wires by the simple addition to the voltmeter equipment of a source of current having at least 110 volts difference of potential. With the battery or other source of current supplied and a voltmeter having two scale readings, say, a 150-volt scale and a 15-volt scale, and the resistance of the 150-volt coil being assumed to stand at, say, 17,300 ohms, while the 15-volt scale measures 1,730 ohms, the tests usually accomplished with this class of apparatus may be performed.

Before proceeding with the description of the tests, it will be well to ascertain how high a resistance may be measured with the voltmeter by observing the smallest readable deflections. While it is possible to read smaller than 0.1 of a volt on the 150-volt scale, the 0.1-volt reading should be taken as a basis. Upon connecting the voltmeter in series with the 110-volt battery and obtaining a deflection of 0.1 volt, this low reading represents the fall of potential over its own resistance and will bear the same ratio to the 110 volts as the resistance of the voltmeter bears to the total resistance of the circuit being measured, plus the resistance of the voltmeter. Thus, we have the following:

$$17{,}300\left(\frac{110}{0.1}-1\right)$$

which, carried out, gives an insulation resistance of 10,012,700 ohms, it being through this resistance that the 0.1-volt deflection from the 110-volt battery was secured.

It will be observed that in order to make the insulation-resistance measurements with a voltmeter and battery, it is required to determine, first, the voltage of the battery; second, the resistance of the voltmeter; third, the deflection of the voltmeter through the resistance to be measured. Then, when the 110-volt battery is used and a deflection of five volts on the 15-volt scale is obtained, the five volts' deflection is first subtracted from the 110 volts original potential, which gives 105 volts. Noting that the resistance of the low-reading scale is 1,730 ohms, the proposition may be placed as follows: Insulation resistance

$$= 1{,}730\left(\frac{110}{5}-1\right) = 36{,}330 \text{ ohms.}$$

It will be observed that an insulation resistance of 36,330 ohms is obtained. It is further to be understood that after the insulation-resistance figure has been arrived at for a certain length of conductor, the term of insulation resistance must be expressed in a definite number of ohms per mile. Thus, when a cable two miles long is measured, and it is found that a two-pair conductor gives an insulation resistance of 500 megohms, this figure is then reduced to a mile basis by multiplying the 500 megohms by two, which gives an absolute insulation resistance of 1,000 megohms per mile. It may further be mentioned that in making tests the high-reading scale should always be used first. If a deflection of less than 10 or 12 volts is obtained transfer the connections to the lower scale, and it will be possible to read the deflections much closer.

In making measurements there are not many uses to which an ammeter may be put. However, if a Wheatstone bridge is obtainable, one of the uses to which the ammeter may be put is to determine the resistance of comparatively low-resistance conductors. This is done by connecting the ammeter in series with the line to be tested and a source of current. After observing the deflections of the ammeter (which should have a low-reading scale about one ampere clear across), and, noting the exact voltage of the battery, the following formula may be used in arriving at the resistance of the wire under test: $E \div C = R$, or $R = \frac{E}{C}$, E representing the voltage of the battery, C the current passing through the ammeter, and R the resistance of the wire under test.

Regarding the measurements which may be made with the galvanometer, they are, in the main, similar to those made with the voltmeter, with the difference that a great deal more expensive apparatus will be required, and in return a much higher degree of sensitiveness will be secured. Briefly, the following apparatus will be required in setting up a high-resistance reflecting-galvanometer equipment: One reflecting galvanometer, together with a graduated scale; one three-coil shunt box, for connections in parallel with the galvanometer coil; one 100,000-ohm resistance box, for taking the galvanometer constant, and one testing key. In addition, a 100-volt source of battery must be secured.

There are, however, few telephone exchanges supplied with so complete an equipment. As a rule, voltmeter tests are sufficient for determining the insulation resistance, and, as mentioned above, in lieu of a Wheatstone bridge an ammeter may be used in connection with the voltmeter for determining conductor resistance.

Fig. 1 represents the connections required to be made for making insulation-resistance measurements with a voltmeter, (E) representing the earth, (B) the battery, (V) the voltmeter, (W) the line wire and (L) the leakage from the line wire to the earth.

Fig. 2 shows the method adopted for taking a reading while using a reflecting galvanometer, the

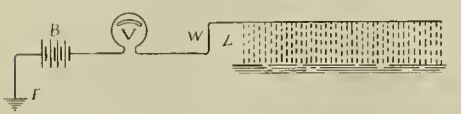


Fig. 1.

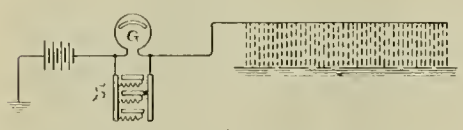


Fig. 2.

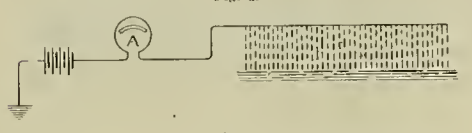


Fig. 3.

USE OF INSTRUMENTS IN TELEPHONE TESTING.

shunt coils (S) being used for reducing the deflections of the galvanometer. This is necessary, owing to the great sensitiveness of this class of instruments.

Fig. 3 shows the connections required to be made in taking a current reading, either for the purpose of measuring leakage from the conductor to earth, or, as was explained above, for permitting the calculation of conductor resistances.

EXTENSIONS AND IMPROVEMENTS.

Workmen are busily engaged putting in a telephone exchange in Stratton, Neb.

The Craig Telephone Company of Craig, Mo., has increased its capital stock from $1,500 to $10,000.

The Memphis Long-distance Telephone Company of Memphis, Tenn., has secured a franchise from the city of Holly Springs, Miss., for the construction of a telephone system in that city.

The Sunset Telephone Company is about to commence work on the reconstruction of its system in Nevada, including the lines between Reno and Sparks. New equipment is to be used throughout, and the improvements contemplated will cost about $30,000.

According to the monthly report of instruments installed by the Chicago Telephone Company, the net gain in instruments for the month of August was 1,018. The total telephones which the company now has in service in its system is 112,648, a new high record.

TELEPHONE MEN.

G. L. Sterns has been elected general manager of the Enterprise Telephone Company at Pipestone, Minn.

Jackson Lurvy, president of the local telephone company at Oakfield, Wis., died of apoplexy at Mayville, Wis., a few days ago. He was 58 years of age, and had gone to the neighboring town to attend a ball game, feeling in the best of health.

J. L. Grantham, former manager of the Michigan State Telephone Company at Mt. Clemens, has been appointed district foreman of that company. He will have charge of all the construction and repairs for the company in his district, which includes Macomb County and part of St. Clair.

The Michigan State Telephone Company has made two important changes in its Detroit force. On September 1st R. B. Watson took the position of local manager, succeeding G. S. Johnson, who will remain with the company in another capacity. Mr. Watson was formerly purchasing agent and will be succeeded in that capacity by E. C. Wetmore.

Telephone News from the Northwest.

The Farmers and Citizens' Mutual Telephone Company of Springfield, Minn., has contracted for 150 instruments from the Swedish-American Telephone Company.

The Badger Telephone and Telegraph Company announces that it has a right-of-way for a long-distance line from Racine, Wis., to the Mississippi River near Monroe.

The Independent Consolidated Telephone Company of Waupaca, Wis., denies the rumor that the Waupaca exchange is to be sold to the Bell company.

A telephone line is projected from Swiss through Weblake to Spooner, Wis.

Ivanhoe, Minn., has granted a franchise to the Lincoln County Telephone Company.

Miss Ina Leaguee of Crookston, Minn., chief operator for the Iron Range Telephone Company, has been appointed manager of the Northwestern Telephone Exchange Company at Inkster, N. D.

The Minnesota Central Telephone Company of Willmar, Minn., has amended its articles of incorporation extending the limit of indebtedness to $1,000,000. This is preparatory to a general extension of its lines.

The Albert Lea (Minn.) Telephone Company has increased its capital stock from $10,000 to $30,000.

Arrangements are being completed for the extension of a telephone line from Milaca, Minn., to the south shore of Mille Lacs Lake.

The Dwelle Telephone Company of Lake City, Minn., has arranged for connection with the Pepin and Union Telephone Company, covering much of Pierce and Pepin counties, Wisconsin.

The Sioux City (Iowa) Telephone Company has let the contract for the erection of its new buildings to the Payette Construction Company at $19,419.

The Iowa Telephone Company has installed a large new switchboard at Winterset, Iowa.

The Artichoke and Correll (Minn.) Telephone Company has been incorporated with a capital stock of $10,000. Charles Hanson heads the list of stockholders.

The Dakota Central Telephone Company has been incorporated at Aberdeen, S. D., with an authorized capital of $5,000,000. It is proposed to merge a number of northwestern lines. C. N. Herried, governor of the state, is one of the directors.

The Northwestern Telephone Exchange Company has been refused a conduit franchise at Winona, Minn.

The Twin City Telephone Company's exchange at Cambridge, Minn., was struck by lightning and burned. R.

Ohio Telephone Notes.

The management has planned to put $300,000 preferred stock of the Columbus Citizen's Telephone Company on the market within a few days. The proceeds from this sale will be used in paying for the improvements now being made and the new automatic switchboard that will be put in the exchange later. The lines of the United States Telephone Company and those of the Independents of Indiana have been connected at Richmond. This will give the patrons of the Ohio companies a big advantage in the western field. The Newcastle Telephone Company of Newcastle has been incorporated with a capital stock of $3,000 by J. W. Dillon, Abraham Horn, W. L. Berry, W. O. Wilson and W. S. Carter.

The Tuscarawas Telephone Company of Boliver, which has a capital stock of $2,000, has been incorporated by Earl D. Fisher, John W. Keil and others.

The Trotwood Home Telephone Company of Trotwood has notified the secretary of state of an increase of capital stock from $10,000 to $20,000. C.

Southeastern Telephone Developments.

W. H. H. Weaver, manager of the telephone exchange at Macon, Ga., says that when the new exchange building is completed the company will be able to give a much better service.

The Patrick County Telephone Company of Virginia, with 100 miles of lines, has no revenues under present rules and new regulations will have to be drawn up by the company before fees, rentals, etc., can be collected.

The Farmers' and Business Men's Telephone Company has been granted a franchise at Cordele, Ga. The system will be established as soon as possible and flat rates to all farmers within five miles of the town will be offered.

A telephone line has been built between Aberdeen and Hope Mills, N. C.

The Bell Telephone Company is dismantling the recently purchased system of the Charlotte (N. C.) Telephone Company. L.

The steamship Minnesota, the largest mercantile ship ever built in this country, contains what is said to be the largest telephone system ever placed on a vessel. A regular exchange system and a separate intercommunicating system are installed. The form is of the central-energy type, every stateroom being provided with a telephone, and also instruments in nearly every other part of the ship. The intercommunicating system contains 11 stations for the use of the officers and engine-room force.

GENERAL TELEPHONE NEWS.

The Waverly Telephone Company of Waverly, Ill., has increased its capital from $35,000 to $50,000.

The Arlington (Neb.) Telephone Company has been incorporated to operate lines in Douglas County. The capital stock is $10,000.

Schooler Bros. of Wilburton, I. T., have organized a telephone company and will construct a telephone system, investing about $50,000 in the enterprise.

Articles of incorporation have been granted to the Canastota Telephone Company, a concern with headquarters at Canastota, Madison County, N. Y., and with a capital of $25,000. The incorporating directors are C. J. Wood and T. H. Ferris of Utica and J. W. Souter of Canastota.

The Interstate Independent Telephone Association of America will hold its next annual convention in Chicago, as usual. At a meeting of the officers and executive board a few days ago the time for holding the convention was fixed at December 13th, 14th and 15th.

The Michigan State Telephone Company at Marshall, Mich., has a strong competitor in the Marshall Telephone Company (Independent). R. L. Trewin of Detroit has been sent to Marshall by the Michigan company in an effort to increase subscribers. The local exchange charges only $9 for residences and $18 for business telephones per year.

The International Telephone Manufacturing Company of Chicago, has recently installed a complete telephone plant connecting the various towns in Central Wisconsin, and offices along the lines of the Green Bay-Kaukauna interurban railway system and the Fox River Valley Electric Railway and Power Company's system. The telephone plant consists of an International self-restoring-drop switchboard, located at the main offices of the electric company, with long-distance bridging telephones at every branch of the business. Extensions are also being made at the town of Neepawa, Manitoba.

A collector for the Central District and Printing Telephone Company, in opening the money receptacles of the pay stations in four Allegheny (Pa.) drug stores discovered a number of coins of the same design as the ordinary penny, but of the weight and size of a dime. He reported the matter to Treasurer F. M. Stevenson, who summoned the secret-service operatives to his assistance. Examinations lasting over two days were made, and it was discovered that, instead of being counterfeits, the money was nothing more or less than copper cents which had been worked down to the size of dimes. Chemical tests showed that the result was attained by immersing the coin in muriatic acid until it was reduced to the desired size, the operation taking about 40 seconds.

Gasoline Motors for Steam Railroads.

As a means of counteracting the constantly increasing competition of electric-traction lines with local passenger service on steam roads and in connection with the announcement made some time ago that the Lake Erie and Western steam road had in mind the introduction of gasoline-motor cars on its line to Peru, Ind., which has as a competitor the Indianapolis Northern Traction Company, the Richmond (Ind.) Sun-Telegram says that Assistant General Superintendent Boomer of the Lake Erie denies the statement, saying that the company was considering the use of gasoline motor cars, but had not yet been convinced of their practicability. If they are proved practical, Mr. Boomer says, the Lake Erie will doubtless put them in service.

The Dunkirk, Allegheny Valley and Pittsburg railroad, owned by the New York Central, is also said to be conducting tests to ascertain the feasibility of gasoline motors in operating trains on steam roads. If the tests prove practicable it is hoped by this means to help further to solve the problem of running trains economically in competition with electric lines, as the "electrification" of steam roads would not be necessary.

Waterwheels for Drainage Canal Power Plant.

Turbine waterwheels capable of delivering 53,000 horsepower will be required by the completed Drainage Canal power plant of the Chicago Sanitary District. The total cost of this part of the plant will be between $200,000 and $250,000, as estimated by Chief Engineer Randolph. Bids are now called for on one-half of the turbine plant, the advertisements stating that the turbines are to be installed by January 1, 1906.

The entire plant will consist of eight units of six wheels apiece, and three exciter units of two wheels apiece, the total capacity being 53,000 horsepower. As previously published, the power which can be developed at Lockport is about 30,000. This figure is for continuous service, however. At times of peak load or any sudden and unusual demand on the plant all the turbines will be brought into play, and the 53,000 horsepower may be developed for a short time, which would, however, soon pull the available head down, so that all the wheels could not be operated.

Unaccounted-for Current.[1]

By W. E. Richards.

We are very often satisfied to assume that our station instruments are right, probably because it is quite difficult to make the necessary tests to verify their accuracy. Practice shows us that it is a satisfaction seldom experienced, upon checking to find them exact. We have found that a systematic cleaning and checking of our station instruments every 30 days gives results that show that they needed it. Of course we experienced no current loss at this point, but upon these instruments depends, to a certain extent, the indication of losses.

Then the distribution, while there are some losses by bad insulation, speaking of the overhead system, the greater loss occurs from improper design. It is true that here considerable latitude must be given, because it is hardly possible to maintain a fixed-load center, with its branches to remain in the same condition. Design for line loss cannot be followed by the usual formula entirely, but local conditions must be considered as well. Current losses will be considerable by reason of accidents, partly due to improper maintenance. To reduce the losses at this point to a minimum the lines must be kept in good repair and a systematic overhauling is necessary at least every three years. Care and judgment should be exercised in distributing transformers, as many consumers as possible should be fed from as few transformers as the condition will allow. The copper loss of the distribution, if properly designed, will be slight compared with total losses of individual transformers.

The final leak in a system and the most important of all occurs in the meter department. Excellent papers have been written describing this department, so I will endeavor to keep to the original subject and speak of the losses in a general way, giving experience and method of practice that we have found useful.

Meter losses may be divided into two parts. First, energy loss in potential circuit and the series fields. Second, loss by reason of meters being slow or failing to record 100 per cent., or the full amount of the energy passing through them.

The loss in the meter potential circuit depends upon the characteristics of this circuit, which varies in the different types and makes of meters; this also varies with the voltage and capacity of meters. In the most common type of direct-current wattmeters the potential loss amounts approximately from 35 to 175 kilowatt-hours per year, and in the induction type from 17 to 35 kilowatt-hours per year. These losses are in most cases going on continuously, as meters are seldom cut out of service during their installation. The loss of energy due to drop in the series field I think can be neglected, especially when the meters are tested by the common method, as, owing to the connections of the meter and instruments, the meter is calibrated to record this loss. Where the meter is tested by disconnecting the potential circuit from the series field, and the series field loaded by a storage battery, this loss then falls to the company, but as meters are on the peak load but a short time, and this loss depends on the load of a meter, I think it can be neglected, as in a good type of the commutator meter this loss will be one-quarter to one-half of one per cent., depending on the capacity of the meter. On sizes larger than 200 lights this loss will only be one-quarter of one per cent. In some types of small-size meters we have found a loss as high as one per cent. on full load, but this is exceptional.

Assuming the meters to run correctly when they are installed, the losses due to meters becoming slow depends on the type of meter, the load on which it operates and the attention given the meter. The following data taken from actual practice show the important loss or unaccounted-for current in commutator-type meters on residence lighting:

Length of Service.	1-20.	1-10.	1-4.	1-2.	Full.
5 months	77%	88.7%	95 %	98.5%	99.5%
8 months	70%	83.5%	92.8%	97.7%	98.5%
12 months	69%	83.5%	92.8%	97.7%	98.5%
21 months	63%	82 %	92 %	96.5%	97.8%

To a considerable extent the accuracy of the meter on light loads depends on the condition of the jewel, as the life of the jewel depends on the number of turns; some would wear them out faster than others. This and other causes would make individual meters differ widely from the above.

Our practice is to install meters of a capacity as near the burning load as possible. Even with this precaution the data show a loss of 12 to 18 per cent. on one-tenth load and five to eight per cent. on one-quarter load. Between these two points may be taken a greater per cent. of the business.

Data on the performance of meters in the business district show that there is considerable consumption recorded in large stores at one-quarter load, or less, of the capacity of the meter, such as basements, offices and corridor lighting, etc. Effort should be made to separately meter this service, which can nicely be done by working with the wiring contractor or architect on new buildings. As is usually the case, many of our stores are wired without this object in view, and in many cases it is difficult to change their system.

These losses in unaccounted-for current can be reduced to a minimum only by an intelligent effort of the meter department, as upon the care and up-keep of the meter depends at least 10 per cent. of the earnings of the company. From all records and data we have learned that it is practical to systematically clean and inspect the meters. The interval of such cleaning and inspection depends on the capacity and service.

To reduce the controllable losses on a meter system, of course, requires additional expense. Just where the balance of the additional expense and the reduction of the losses occur is a fine point to decide. If the meters are of the induction type, our practice is to give them attention every 18 months; but the commutator type requires an inspection every eight to 12 months.

An inspector can clean up 1,800 meters a year, besides the value of the information from a visit to the premises. We find it pays to keep constant check on large consumers as often as 90 to 120 days. This frequent inspection has a good effect not only on the reduction of meter losses but current lost from theft, which is also quite an item.

Discussion.

E. J. Bechtel of Toledo said that in that city they had two systems—one alternating-current and one direct-current—the downtown being entirely direct, three-wire design; they account for about 92 per cent. of that current and about 80 per cent. of the alternating current. F. W. C. Bailey of Piqua thought the showing particularly fine, in which J. H. Perkins of Youngstown agreed. Mr. Bechtel further stated that about three years ago the loss in the alternating-current district was about 60 per cent.; most of the loss had been found in the transformers, due to old and obsolete types of transformers, which have since been changed to modern types, oil-cooled. The feeder system was gone over to some extent, but had not proved so important an item; the feeder drop did not exceed five per cent., and upon the peak only.

C. S. Longnecker of Delta asked if any of the loss could be accounted for in any unsoldered joints, to which Mr. Bechtel replied in the negative, adding that he supposed that bad joints, if they existed, would occasion the loss of considerable current, especially in the secondary line, but no such element had existed. The largest transformer used is of 25 kilowatts. The largest interconnected secondary on alternating-current work has about 2,000 lines connected. The business district is entirely direct-current, and the secondaries on that cover about 2½ miles of street. A record is kept of all transformers on the line as an entirety. Mr. Bechtel agreed with Mr. Perkins when the latter said that the greater part of unaccounted-for current was in transformers and meters. Changes in transformers made at Youngstown had resulted in cutting down the core losses 66 2-3 per cent. Mr. Bailey thought the average copper loss very small in stations kept in anything like decent condition.

F. E. Valentine of Piqua asked Mr. Bechtel how he arranged for the balancing of his three-wire secondary-system circuits, to which Mr. Bechtel answered that this was more or less possible of accomplishment at time of connection with the consumer; and later on by inspection at times when visits were made to the premises for other purposes. Mr. Valentine asked whether, with the outlying districts where alternating-current lamps were installed, there was any trouble experienced with inductive drop; if so, how overcome. Mr. Bechtel said they had not many alternating-current lamps in multiple. When they had more than two they usually put on a separate transformer. The inductive drop did not amount to much in the primary lines, but was mostly confined to the secondary lines. Mr. Bailey stated that they had at Piqua about 300 incandescents and six arcs on separate transformers. The drop on the primary is about 12 per cent. The power factor of the lamps runs from 63 to 68. He intended to put in a booster transformer to compensate for that. Mr. Bechtel had tried this plan and found bad effects from it at times of light load unless the booster can be cut in and out as the load varies.

Mr. Bailey asked if the last speaker had ever tried using two halves on secondary winding, putting one in series like a series transformer and the other leg in series with the line. Mr. Bechtel said he had not. Mr. Perkins could not understand how Mr. Bailey could get a 12-per cent. drop in a primary lead on account of inductive current. Mr. Bechtel thought it did not look reasonable at 2,500 feet from the station, with 250 lights. Mr. Bailey stated the arcs referred to were on 20 to 30-kilowatt transformers, No. 4 primary-wire, high-frequency, 1,000-volt circuit, distance about 2,500 to 3,000 feet wound for a 10-to-1 ratio. The transformers ought to give 115 volts, but they only give 90. The speaker did not know if they paralleled any other circuit, but had the trouble in mind for investigation at a convenient season. Mr. Perkins suggested that the trouble might be due to some bad arrangements of other circuits on the cross-arms. We could not understand the drop of 12 per cent. Mr. Richards asked how Mr. Bailey arrived at the percentage—by what method of test. Mr. Bailey replied that he used a voltmeter run across the primary leads. On the switchboard there is a 10-to-1 potential transformer. He got the constant on the station and ran a voltmeter across the primary turns of the transformer; also took the secondary voltage. He had not yet had time to follow up all possible clews.

1. Abstract of a paper read before the Ohio Electric Light Association at Sandusky, on August 18, 1904. The author is connected with the Toledo (Ohio) Railways and Light Company.

Graded Costs of Electric Supply.[1]

By Matthias E. Turner.

In writing this paper I have hoped to interest all of the central stations in Ohio, and especially the smaller ones in accurately keeping their costs of electrical supply, and to emphasize to them the necessity of making these determinations individually before any schedule of tariff or rates can be satisfactorily put into effect, and be equitable to the supply company and its customers.

By determining costs I do not mean the simple operation of dividing the total expenses and fixed charges per annum by the total number of units distributed. This does give an average cost per kilowatt-hour at the station-load factor for all the business done, but is an absolutely inaccurate figure to base any schedule of charges upon. For a supply station's output is the resultant of the demand and use of all of the different industries, commercial business and residences, connected to its lines, and is made up of motor load, day users, night users, Saturday-night users, and a certain amount of use which is only called for at the peak of the load in winter.

In all stations that are operated for 24 hours a day there is some portion of the capacity which has a continuous output for 24 hours; there are other portions which operate for a lesser number of hours, according to the load curve, diminishing in operation down to the capacity which is kept for the peak of the load for Saturday nights in winter. This is a condition created by the resultant use made by all of the different consumers.

To illustrate, let us assume two instances:

(A) One kilowatt used 24 hours per day for 365 days in the year, equals 8,760 kilowatt-hours.

(B) One kilowatt used four hours each Saturday night for 52 Saturday nights in the year, equals 208 kilowatt-hours.

Let us assume that the average resultant cost, or the total expense and fixed charge divided by the total output equals 7.6 cents per kilowatt-hour. Then the cost for one kilowatt in the first instance will be $665.76 per kilowatt capacity per annum, and in the second instance the cost will be $15.80 per kilowatt capacity per annum.

In both cases cited there has been used the same amount of capacity—land, plant, machinery, lines, transformers, meters, etc., and therefore the gross interest and depreciation charge per annum is the same; the only difference in their cost is in those expenses which are known as running expenses, and these are proportional to the kilowatt-hours distributed in both instances.

In order to prove the fallacy of obtaining an average cost for the aggregate business, let us assume as in the previous figures, that the cost for 8,760 hours' service would be $665.76, and the cost for 208 hours' service would be $15.80. The only difference between these two examples is in the number of kilowatt-hours distributed. Therefore, any difference in the expense would be the cost of generating and distributing the excess number of kilowatt-hours in the first instance.

The figures with which we have been working assume an investment of $400 per kilowatt of capacity, so that in each case there is an investment of $400. The interest and depreciation in both "A" and "B" would be $48 per kilowatt capacity per annum. Deducting the fixed charge of $48 from what our average figure gives us for the total cost in "A" leaves $617.76 for the operating cost, or 7.04 cents per kilowatt-hour. Whereas, in "B" our average figure gives us a cost of $15.80, which is $32.20 less than the interest and depreciation charge, without any allowance for any operating charge for the 208 kilowatt-hours distributed. This is sufficient to prove the absurdity of this method of determining cost.

Any method of determining accurately the cost of electric supply must provide, first, for the same fixed charge per annum per kilowatt of capacity installed; second, as the apparatus of the company is operated for different periods of time per annum, the cost for the different periods must be determined, and must be divided into two classes, viz.: (a) Those expenses which remain about constant, irrespective of the output, changing only with an increase of the company's property. (b) Those expenses which change with the output, although not necessarily in direct proportion.

These propositions are the foundation of the following outlined formula for determining true costs, which costs are logically graded, as will be seen in the illustration to be taken up later, according to the number of hours the apparatus is used per day.

The classification of expenditures adopted by the National Electric Light Association in 1901 may be conveniently followed in this work.

(1) Manufacture includes all expenses incidental to the work in the plant, such as fuel, water, oil, waste and packing, removal or disposition of ashes, labor, repair and maintenance of engines, boilers, auxiliary engines and piping, electrical machinery, tools, building and incidental.

(2) Distribution includes all expenses of repair and maintenance of lines, inside wiring, tools and meters.

(3) General expense includes all expenses such as salaries of officers, superintendents, rent, taxes, insurance, legal, casualties and sundries.

(4) Fixed charges include interest on all outstanding capital and a depreciation item, which is an amount to be charged off against the life of the property.

The next step in this plan of graded costs determinations, is to arrange the various expenditures into either standing or running accounts. To do this intelligently, each item must be treated separately. In this article a number of items will be briefly discussed, sufficiently, however, to show the care and judgment necessary properly to classify each item of expense.

Under manufacture consider fuel. Fuel is proportional or nearly so to the kilowatts manufactured. To show this take the fuel account of a station for six summer or light months and for six winter or heavy months; also the kilowatts manufactured for the first period, then for the second period. Take the difference in money between the two periods and the difference in kilowatts manufactured, and it will be found that it has cost a certain sum of money extra to manufacture a certain number of kilowatt-hours. Dividing the money by this number of kilowatt-hours, the cost per hour of these extra kilowatt-hours will be the same, or very nearly the same as though the total money for the year were divided by the total kilowatt-hours, thereby showing that the extra kilowatt-hours manufactured cost as much per kilowatt-hour as a kilowatt-hour cost in summer.

There are some stations where the engines are more economically loaded at some periods of the year than at other periods in which the results reached above cannot be obtained and the extra kilowatt-hours will not cost as much per kilowatt-hour as a kilowatt-hour costs in summer. When this is the case part of fuel should be proportioned to standing charges. But generally fuel is altogether a running charge. The same formulæ may be applied to water account, and this item is found to be a running charge.

Oil, waste and packing vary more with the number of hours machinery is run than with the work done or kilowatts manufactured. It takes almost as much of these items to run engines light as it does to run them heavy, yet about half the expense is due to extra engines run at maximum. Therefore, these expenses are partly standing and partly running charges.

The removal of ashes being proportioned to the coal burned is consequently a running charge.

By the same course of reasoning, labor in station would be placed under the head of standing charges, but as a considerable part of the labor is used in handling coal and ashes and a part in handling oil, a portion of labor expense should be placed under the head of running charges.

The repairs to boilers come at irregular intervals, so the formulæ cannot be applied. By watching closely it will be seen that quite as much expense is caused by the length of time of use as by the output or power delivered. This is also true of the repairs to engines, steam piping, pumps, electrical machinery and the building.

Under distribution consider the repair and maintenance of overhead lines. An examination into the causes of the expense of this work will show that it is largely due to the breaking down of insulation from the pressure carried or from the weather, or by poor workmanship or faulty material, or by such other causes. This is also true with the meter accounts, the tool and instrument account and the service account.

General expense. All of this expense belongs in the standing account. Whether the plant operates under heavy or light load, the organization of the company must be maintained, insurance carried, taxes paid, and damages settled. The output might be doubled without increasing these expenditures, or might be cut in half without decreasing them. The same principle applies to the interest and depreciation charges, which are standing charges.[1]

The next step in this plan is to total all the standing and running charges, which should be the total expenses of one year's operation. Total standing charges are then divided by the capacity installed and again by the number of days in a year to determine the daily standing cost.

Total running charges are divided by the kilowatt hours sold, to determine the running cost per kilowatt-hour delivered to the customer.

Where the current sold is not metered it is then essential in these determinations that the output be measured and due allowance made for losses in transmission and metering. These losses in an alternating system will, as a rule, vary between 30 and 40 per cent.

Finally the daily standing cost should be divided by each hour of the 24 and to the result the running cost added. This final figure is the yearly cost per kilowatt-hour to the supply company for electricity delivered to a customer through any number of hours per day.

To illustrate this plan of graded costs determinations, I will assume a small central station, supplying alternating current by an overhead system. I will further assume a property account at the end of a year when the determinations are made for this station, and a year's operating expenses. The capacity installed in this station will be assumed to be 500 kilowatts, and the units sold during the year to be 450,000 kilowatt-hours. The expense figures assumed are not necessarily an approximation of the expenses of any central station, they are only inserted to more easily explain the accounting involved to arrive at the final scale of graded costs.

Formula Recommended.

Assumed construction account for plant, lines and property of all description	$200,000
Capacity installed, kilowatts	500
Investment per k. w. of capacity installed	400
Assuming 6 per cent. interest and 6 per cent. depreciation, on the investment per k. w. installed, gives a fixed charge per k. w. per annum of	48

Note.—(In figuring depreciation, each company should make up its depreciation item by allowing for the life of the different items going to make up their construction account.)

Assumed Totol Operating Expense, $25,500, Divided as Follows:

Items.	Total Expenses.	Classification.	Portion of Total Exp. Charged to Standing.	Portion of Total Exp. Charged to Running.
Fuel	$ 6,000	All to running		$6,000
Water	200	All to running		200
Oil, waste and packing	50	½ S., ½ R	$ 25	25
Labor in plant	4,000	6-10 S., 4-10 R	2,400	1,600
Ashes	150	All to ruuning		150
Incidental	100	All to standing	100	.....
Total repairs to plant.	1,500	8-10 S., 2.10 R	1,200	300
Total manufacturing.	$12,000		$3,725	$8,275
Maintenance lines and trans. and services.	3,000	2-3 S., 1-3 R	2,000	1,000
Maintenance improvements and insts	50	All to standing	50	.....
Maintenance meters	1,600	All to standing	1,600	.....
Stable expenses	200	½ S., ½ R	100	100
Stock room expenses	250	½ S., ½ R	125	125
Miscellaneous	400	All to standing	400	.....
Total distribution.	$ 5,500		$4,275	$1,225
General expenses	6,000	All to standing	6,000	.....
Taxes, insurance, legal and casualties	2,000	All to standing	2,000	.....
Total general	$ 8,000		$8,000	.....
Final total	25,500		16,000	$9,500

Summary of the Standing and Running Expenses.

	Total Standing Charge.	Standing Charge Per k. w. Installed.	Total Running Charge.	Running Charge Per k. w. Sold.
Manufacture	$ 3,725	$ 7.45	$8,275	1.84 Cents
Distribution	4,275	8.55	1,225	.27 Cents
General	8,000	16.00	.....	....
Int. and depreciation	24,000	48.00	.....	....
Total	$40,000	$80.00	$9,500	2.11 Cents

We have now a standing cost of $80 for each kilowatt of capacity installed, or in other words a cost to us of $80 per year, or 21.9 cents per day, for each kilowatt of capacity held at a customer's disposal, whether we generate for that customer current from this apparatus for one hour or for 24 hours a day; and a running cost of 2.11 cents per kilowatt-hour sold—which is derived by dividing the total running charge per annum by the 450,000 kilowatt-hours sold.

Dividing the fixed charge of $80 by 365 days and adding the running cost of 2.11 cents per kilowatt-hour gives the total cost per kilowatt-hour to this supply station for the electricity used any number of hours a day of the kilowatt capacity held at a customer's disposal.

Graded Scale of Costs for the Assumed Supply Station.

Hours Per Day	Cost in Cents Per K. W.-Hour.	Hours Per Day	Cost in Cents Per K. W.-Hour.
24	3.02	12	3.03
1	24.01	13	3.80
2	13.06	14	3.67
3	9.41	15	3.57
4	7.58	16	3.48
5	6.49	17	3.40
6	5.76	18	3.32
7	5.24	19	3.26
8	4.84	20	3.20
9	4.54	21	3.15
10	4.30	22	3.10
11	4.10	23	3.06

To prove the accuracy of the above scale of costs, take "A" and "B" in the illustration previously used to demonstrate the inaccuracy of an average cost to base any schedule of charges upon. As the scale here does not go below one hour a day, we will take for "B" 365 hours' service yearly instead of 208 hours.

Taking "A" for 8,760 hours' service and multiplying by the cost in the graded scale for this use, which is 3.02 cents, gives $264.55 as the total cost for this service. In like manner "B" for 365 hours' service at 24.01 cents, gives $87.64. Deducting $80, the standing cost in each case, leaves for "A" $184.55 and for "B" $7.64, the running cost. Dividing now the running cost in both cases by their respective hours' service, gives in both instances 2.11 cents, the running cost per kilowatt-hour.

In concluding, I wish to point out that no expenses for arc lamps, their care or maintenance, or the renewal of incandescent lamps, have been included in these figures. These are all expenses for extra services performed and do not properly belong in these tables. Also, that this table provides for the losses in transmission, metering, etc., and is a cost at the customer's premises of current as sold and metered by the company's meters.

Any company that bases its costs on the foregoing principles is safe in adopting any system of charges which follows its cost curve. Knowledge of these costs should prevent any station from being loaded

1. A paper read before the Ohio Electric Light Association at Sandusky, O., August 17, 1904. Mr. Turner is connected with the Cleveland Electric Illuminating Company.

1. Where a supply company has installed two or three systems, such as low-tension direct-current, series arc, and alternating, these determinations become somewhat more complex and proper care should be taken to keep, as far as possible, the investments and operating expenses of each system separate.

with business at a loss, and should enable it to obtain advantageous business.

As to a schedule of tariff, any system can be used which obtains the necessary income for the hours use of the capacity installed provided for in its costs, whether this system be a straight fixed charge of so much per annum and a small running charge, a system of discounts equivalent to hours use, or the two-rate system. The two-rate system is probably the simplest form and the easiest understood by the customer.

Condensing Outfits for Steam Turbines.

Two large steam turbines are on exhibition in block 51, aisle 1, and block 44, aisle 10 of Machinery Building, at the St. Louis Fair, one being shown by the Westinghouse Machine Company and the other by the General Electric Company. Economic utilization of the energy of steam requires its expansion to the lowest possible pressure, which in the turbine is accomplished without the usual losses due to the corresponding extremely low temperatures. In actual service the economy of the turbine is increased by approximately three to five per cent for each inch of vacuum higher than 26 inches. It is therefore of vital importance that all losses should be reduced to a minimum. The absence of oil from the steam renders the use of a surface condenser desirable in places where the saving of condensed steam is important. The fact that the final temperature of the condensing water must be comparatively low, necessitates the highest degree of efficiency in its use and the immediate and complete removal of all non-condensible vapors, whose presence would increase the absolute pressure and consequently reduce the efficiency of the turbine.

The steam from the Westinghouse-Parsons turbines is condensed in a 1,500-square-foot surface condenser supplied by Henry R. Worthington. The air is removed by a Worthington rotative dry-vacuum pump of the center-crank type, but similar in other respects to the horizontal pumps already described. An air cooler is interposed between the condenser and the vacuum pump, considerably increasing the capacity and efficiency of the latter. The condensed steam is removed from the condenser by a volute pump directly connected to an induction motor. The operation of this pump is very interesting, since it requires neither valves nor floats and is not subject to vapor binding, as are reciprocating pumps. The pump is placed below the level of the condenser, receiving the water by gravity, and its capacity is such that it runs ahead of the supply, so that the suction pipe is never full. The discharge pipe is, however, always full and pressing back against the pump, but so long as the latter is in motion there is no possibility of the water passing back to the condenser, so no automatic devices are needed. In another turbine plant a pump of this character returns the hot water directly from the surface condenser to the boiler against a pressure of 250 pounds.

The Curtis steam turbine, exhibited by the General Electric Company, is of the vertical type, and the Worthington condenser is placed in the base of the steam turbine. It contains 8,000 square feet of tube surface. The air is removed by a rotative dry-vacuum pump, similar, as regards the air end, to those heretofore described, but driven through the medium of a silent chain by an electric motor.

German-Dutch Cable in the Far East.

The German-Dutch syndicate, headed by the Dresdner Bank, which has for some time been engaged in promoting a company to lay the projected German-Dutch cable in the Far East, has now brought its negotiations to a successful issue, a company to be known as the German-Dutch Telegraph Company having been definitely formed, with its head office in Cologne. Its capital stock is placed at $1.632,000 in round numbers. The cable which this company proposes to lay and work will run from the Dutch settlements in the Celebes to the Island of Yap in the Pelew Archipelago, and thence to Shanghai and the Island of Guam, where it will connect with the Pacific Cable of the Commercial Pacific Cable Company. The company will receive an annual subsidy from the Dutch and German governments of $460,985. The sum of $3,524,675, which will be required for the laying of the cable, will not be provided for by drawing on the capital stock, but will be procured by the issue of bonds.

National Electrical Contractors' Association of the United States.

The National Electrical Contractors' Association of the United States will hold its next annual convention in St. Louis, September 14th, 15th and 16th. It is expected that the reports of the officers and committees will be extremely interesting. Plans for the work of the coming year will be discussed. During the last year the amount of work done by the association has been very encouraging, and it is hoped that a large attendance may be a feature of the meeting.

The Maryland Telephone Company has purchased a large tract of land in South Baltimore, near Ferry Bar., on which it will erect its $1,000,000 electric-light and power plant, previously mentioned. Estimates on construction are now being made.

CORRESPONDENCE.

Great Britain.

London, August 27.—The annual report of the postmaster-general, as usual, is interesting reading. With regard to the London telephone system, the number of instruments has increased from 9,122 to 15,632 during the year ended March 31st last. The new subscribers are being connected at the rate of from 100 to 200 a week. Three new exchanges have been opened during the year. It is anticipated that the accommodations at the central exchange (dealing with the city) will be nearly exhausted before March 31, 1905, and the construction of a second exchange having a capacity of 18,000 lines is in progress. Up to date the London system has involved the laying of 125,717 miles of wire. It is pointed out that, owing to the great extent of the London exchange, area and the number of local exchanges, the proportion of junction (trunk) lines required is probably greater than in any of the local exchange systems in the world, and this fact, the report continues, will always make the cost of the service comparatively high. Since last year the total cost of construction per mile of double wire has increased from £18 11s. 4d. to £18 16s. 10d, while including the cost of installation of telephone instruments and of exchange apparatus, the total cost of each subscriber's line has increased from £38 6s. 3d. to £41 9s. 8d. The total capital expenditure to March 31, 1904, was over $5,750,000. The excess of receipts over expenditure was about $165,250, which has to provide for interest on capital and depreciation. On the telegraph service there has again been a deficit of $5,000,000.

The party of members of the Institution of Electrical Engineers which will visit America and the St. Louis Exposition left on the 25th on board the steamship Republic.

A short while ago a deputation from a body called the Roads Improvement Association waited upon the Board of Trade with the object of protesting against the increasing number of tram lines on narrow thoroughfares, and also the erection of poles in the center of the roadways for tramway and lighting purposes. In a reply just made the Board of Trade points out that the prohibition of center poles would be impossible, although recognizing their danger in narrow thoroughfares. As a matter of fact, the board has hitherto exercised a wise discretion in these matters, and the association in question is naturally prejudiced, being, as it is, largely concerned with the motor-car industry. In the matter of the width of roads, a limit is laid down in the tramways act which is considered reasonable, and the reply of the Board of Trade on this point is that the representations made by the Roads Improvement Association will be borne in mind. G.

New York.

New York, September 3.—The date of the opening of the subway is still unsettled, but progress is reported, and on Thursday the current was turned on permanently into the third rail for the experimental training trains which are now running daily. From the mechanical standpoint everything is ready for operating the cars from City Hall both to the west side terminal at One-hundred-and-forty-fifth Street and to the present end of the east side spur at One-hundred-and-forty-second Street, where the eastern branch is destined to enter the tunnel under the Harlem River. Before passengers can be conveyed, however, much detail work has to be accomplished, the most important of which is the protection of the third rail and the completing of the arrangements for the entrance and exit of passengers. Besides the steel-clad cars which arrived last week the copper-sheathed cars which have been in use on the Second Avenue elevated line for the last few months have been put upon the subway tracks. There are in all about 800 cars in readiness for the opening day.

Discussions and conferences have been held all through the week as to the demand of the engineering unions for payment at the rate of $3.50 a day for the subway motormen. Since the motormen on the elevated lines receive these wages the men appear to have a very strong case, and by the almost unanimous vote of 3,031 to 31 the men have decided to stand by their formulated demand for $3.50 and a nine-hour day. A strike on the city traction lines would be very inconvenient just now, and probably will be averted.

The discovery has been made, especially by persons interested in real estate in other sections of the city, that the New York subway "doesn't go anywhere." The main part of the subway, indeed as extending along upper Broadway on the west side, does not serve a populous neighborhood, and there is no question but that certain politicians own the bulk of the undeveloped property in that section. At the same time the tunnel does go to Harlem, and the hundreds of thousands of Harlemites need improved transit facilities very badly.

There are altogether seven under-water tunnels in course of construction from Manhattan to adjacent shores and progress is reported with regard to most of them. The tunnel, 1,500 feet long, under the Harlem River, designed to connect the Lexington Avenue extension of the Rapid Transit subway with the Bronx, was completed on Monday, and the tracks are now in course of being laid within it. The expenditure on the work has exceeded $1,000,000. Good work is reported on the construction of the eastern section of the Pennsylvania railroad's tunnel between Manhattan and Long Island. An excavation 100 feet in length and about 30 feet wide has been already dug to a depth of 40 feet at Long Island City, and when this pit reaches a depth of 50 feet the four shafts proper for the actual tunnel construction will be commenced within it. The clearing of the adjacent property for the big car yard is also proceeding rapidly.

With respect to other tunnels plans have been prepared for an extension of the Flatbush Avenue subway in Brooklyn to Prospect Park. The Flatbush Avenue subway will connect the rapid-transit systems of Manhattan and Brooklyn by means of a tunnel now being constructed under the East River from the Battery to Joralemon Street, Brooklyn. A good part of the Flatbush Avenue section is being made beneath the existing surface tracks, which in their turn are beneath an elevated structure. It has been necessary in the course of this work to shore up the elevated pillars. The work of constructing the Long Island railroad tunnels in Brooklyn is so far progressed that there is a likelihood of electric trains running through them within a year. Tunnel No. 1, in Atlantic Avenue, is completed except for a length of 300 feet, and tunnel No. 3 is so far advanced that one track has been laid in it. Tunnel No. 2 will be completed, it is anticipated, before the end of October. Much difficulty in the replacing of sewers has been encountered by the engineers.

President Charles S. Mellen of the New York, New Haven and Hartford railroad has announced this week that his company will lay a six-track road between New York and New Rochelle. Four of the tracks are to be operated by electricity. The estimated outlay on this and other cognate improvements is $8,000,000. The cars will be of a type similar to those used on the New York elevated lines and power will be derived from a third rail.

Express cars are running this week between Mount Vernon and New Rochelle on the tracks of the Union Railway Company. The time from New Rochelle to Mount Vernon is scheduled at half an hour, but the journey has actually been accomplished in 23 minutes. At Mount Vernon passengers change to the ordinary elevated cars, and it is thus possible to travel from New Rochelle to City Hall for a 10-cent fare in not much more than the time occupied by using the New York, New Haven steam trains and changing to the elevated at the Grand Central depot. Many commuters, it is said, who have been disgusted by the recent policy of the steam railroad are patronizing the new route and save a fraction of a cent on their fare as the price of being not more than 20 minutes longer on the journey.

New plans for dealing with the traffic problem at Brooklyn Bridge during the rush hours are forthcoming on the average once a month. The latest suggestion now being considered by Police Commissioner McAdoo is to construct an inclined way from the Park Row entrance to enable passengers to reach the various loops more easily.

We were told quite definitely that shuttle cars would be running over the Williamsburg Bridge on October 1st, but this week the date has been changed to November 1st. As a matter of fact, the rails are laid over a good stretch of the bridge, but nothing at all has yet been done with regard to the electrical equipment, and there is indeed a good deal of civil engineering to be done on the bridge itself before car traffic can be installed. It is certain, however, that the Brooklyn Rapid Transit cars will be running long before the Metropolitan connections are completed.

Six of the New York to Boston express trains on the New York, New Haven and Hartford railroad are being equipped with electric lights by the Westinghouse Machine Company of Pittsburg, Pa.

The annual report of the New York city railway (formerly the Metropolitan street railway) shows a decrease of $64,539 in gross earnings for the year ended June 30th. The gross earnings were $21,485,006 and the operating expenses $12,127,855. Deducting interest and fixed charges there was a net deficit of $1,396,770. The total number of passengers carried was 432,475,170, a decrease of 1,133,354. President Vreeland attributes the decrease in receipts and increase in expenses to bad weather and an unusual number of claims for injuries. It is of interest to note that the company still employs more than 4,000 horses for its unconverted horse lines.

A plan to consolidate the three existing power plants that operate the many electrical devices in the Brooklyn Navy Yard has not found favor. As at present organized one plant can help the other in the event of breakdown, but with one central installation it is feared that the whole of the machinery of the yard would be stopped in the event of an accident.

On Wednesday evening, during the time that the entertainment at Luna Park, Coney Island, was in full swing an electric-lighting cable was fused in a manhole and the greater part of the park was plunged into darkness as well as a large number of local restaurants.

Four handsome bronze electroliers, a gift to the city from William Waldorf Astor, are being erected in front of the new Hotel Astor at Broadway and Forty-fourth Street. The electroliers are valued at $10,000 each.

About half a mile of electrical conductor was

stolen on Thursday on the New York and Long Island Traction Company's lines between Baldwin and Ocean Side, L. I. A reward has been offered for the detection of the thieves.

Residents at Flushing, L. I., and adjacent towns are agitating the placing of all wires underground. Flushing is noted for its beautiful shade trees, which, it is claimed, are being injured by the telephone and telegraph companies. D. W. W.

Dominion of Canada.

Winnipeg, Man., September 2.—The Winnipeg, Selkirk and Lake Winnipeg electric railway, 22 miles long, extending from the limits of the city of Winnipeg (connecting with the Winnipeg electric street railway) to Selkirk, was officially opened on August 26, making the trip in three-quarters of an hour. The fares have been arranged on a mileage basis, five cents for the first three miles and two cents a mile afterward, or 60 cents for the fare one way and 80 cents for the round trip. The company will carry both passengers and freight. The directors stated that it is their intention to extend the line to Stonewall and Stony Mountain and other suburban towns. The power will be generated from the Lac du Bonnet as soon as the work there is finished. In the meantime the government is allowing the company to use steam locomotives.

The Lord's Day Alliance is about to take action against the Kingston Electric Street Railway Company to stop the running of Sunday street cars.

An order in council has been issued under the seal of the secretary of state incorporating A. Rhodes, Hon. Thomas R. Black, C. T. Hilson and E. N. Rhodes, all of the town of Amherst, N. S., authorizing them to manufacture all kinds of electric and other cars to be used in connection with railways, street railways or tramways, also locomotives and other appliances used in connection with steam roads. The capital stock is to be $250,000 and head office in the city of Toronto, Ont.

The new three-phase alternating-current generator recently installed in Winnipeg, Man., has been started and proved a great success; it supplies the current for a large number of new enclosed arc lamps which have been placed in position for lighting the streets.

The contract for the electric-light and power plant at Red Deer, Alberta, has been let to Contractor Bowers of the same place for the building only. J. T. Moore has the controlling interest in the lighting franchise and will buy his plant in the United States.

The Blindman River Electric Power Company, Lacombe, Alberta, is constructing a dam and flume on the Blindman River near its junction with the Red Deer River. A turbine wheel will be installed and provision made so that the plant may be increased at any time as occasion may require. The company will furnish Lacombe with power, and if arrangements now pending with those holding the franchise for supplying Red Deer with light and power are not completed within the time specified the company will be in a position to furnish light and power also. H.

Mexico.

City of Mexico, September 1.—The Mexican government has granted a concession to Benjamin Barrios of this city to build and operate an electric railway between here and the city of Puebla, a distance of about 65 miles. It is stated that he is acting in the matter as the representative of a syndicate of German capitalists, who have investigated the situation carefully and are prepared to build the road as soon as the necessary preliminary arrangements can be made. The route of the proposed road is from the central part of the City of Mexico and runs by way of the towns of Amecameca, Ayopango and Cholula. It is to be used for carrying both freight and passengers.

Edward F. Walker of Philadelphia, Pa., and associates, who recently acquired the two existing street-railway systems in Monterey, Mexico, are preparing to extend the lines and convert them into electric traction. The Monterey Electric Street Railway, Light and Power Company, recently organized by the new owners of these properties, has also acquired a long-term lease on the health resort of Topo Chico, situated near Monterey at the terminus of one of the acquired lines.

The Tampico Electric Light Company has had plans prepared for additional improvements to its plant at Tampico, Mexico, to cost about $30,000. This company recently installed $70,000 worth of new machinery. Cecil Freston has been placed in charge of the plant as superintendent.

The Mexican Incandescent Electric Lamp Company, which recently established a plant in the City of Mexico for manufacturing electric lamps, is meeting with success, and it is stated that a substantial dividend on its capital stock of $100,000 will soon be paid. Mexican girls are employed chiefly. A. A. Chaillet is manager.

The City Council of Mazatlan, Mexico, has rescinded the contract with Escobar Bros. for lighting that city with electricity and has entered into a contract with Jose H. Rico and Andres Avendano for furnishing the city with lights and electric power. It is stated that Messrs. Rico and Avendano will organize a company to establish a new electric-light and power plant at Mazatlan.

Oscar Braniff of the City of Mexico has entered into a contract with the Guanajuato Electric Power Company of Guanajuato, Mexico, to supply him with electrical energy to the amount of 1,000 horsepower for use in the city of Leon. Mr. Braniff is owner of the electric-light and power plant at Leon, but with the introduction of the power by the Guanajuato plant he will abandon the Leon station. The power will be transmitted from the Zamora plant and besides being used for public and commerical lighting there are a number of important manufacturing concerns at Leon which will use the power.

The contract for the construction of the electric-light and power plant at Ixtlan del Rio, Mexico, has been awarded to Ugarte & Garcia of Guadalajara.

The Mexican Electrical Tramway Company of the City of Mexico has been receiving a large amount of new equipment from United States manufacturers recently. The company is preparing to inaugurate an express service on its lines, and for this purpose four 30-foot express cars are being equipped in its Indianilla shops and 12 express wagons have been ordered from the United States. Armand de Blanc will be superintendent of the express department of the company.

A number of capitalists of the City of Mexico have taken steps to organize a company for the purpose of establishing electric-light and power plants in all of the principal towns in the federal district in which the City of Mexico is situated.

S. Pearson & Son, the English contractors who have done a large amount of public work in Mexico, will establish a complete system of electric-traction lines in Vera Cruz. This firm now owns the existing street-railway system at Vera Cruz, which is operated by animal traction. This system is to be rebuilt, extended and converted into electric traction. J. N. Nixon has been appointed superintendent of the system. E. A. Worswick will be chief engineer of construction.

Capitalists of the City of Mexico are negotiating for the purchase of the street-railway system in Saltillo, Mexico. If the pending deal is consummated the system will be converted into electric lines. H.

New England.

Boston, September 3.—The Fall River and New Bedford automatic telephone companies are making preparations to consolidate and extend their services to Taunton and Brockton. Committees of conference have been appointed and stock is being subscribed for the Taunton project at the present time. The capital of the Fall River company is $135,000, and it has $65,000 bonds outstanding. The capital of the New Bedford company is $100,000.

The Boston Suburban Express and Parcels Companies, a voluntary association, capitalized at $500,000, with Hon. E. P. Shaw of Newburyport at the head of the concern, has been organized to engage in the suburban-express business, and 15 companies doing business in this line between Boston and surrounding cities have been absorbed at the outset by the new combine. E. P. Shaw is of the Shaw syndicate, which controls the Boston and Worcester, and other big electric railways, and it is assumed that the combination will endeavor to introduce the trolley-express service in and around Boston. A large building on Broad and Batterymarch Streets has been leased for the headquarters of the company, and development of its plans is awaited with much interest by those who are cognizant of the proceedings thus far undertaken.

Contracts for the new $75,000 car house of the Boston and Northern Street Railway Company in Salem have been awarded to J. N. and V. S. Peterson of Salem.

Plans for the new building that the Edison Electric Illuminating Company of Boston will erect at the L Street plant in South Boston contemplate a building 55 by 28 feet, constructed of expanded metal and plaster, to be used for a battery house.

On Wednesday night a South Boston car of the Boston elevated railway jumped the track and fell down an embankment on Dorchester Street, injuring more or less seriously 23 passengers. About a dozen of the injured received hospital treatment, but are not considered in danger. One serious case is reported, however, and fatal results are feared from the condition of Frank Farrell, who was taken to Carney Hospital in an unconscious condition. B.

Southeastern States.

Charlotte, N. C., September 3.—There is talk of an electric railway from Hampton to Yorktown and thence to Jamestown, Va., via Williamsburg. O. D. Jackson of Norfolk owns the franchise and the major portion of the right-of-way has been secured. A large power house is projected at Yorktown.

A movement is on foot to build an electric railway from Huntsville, Ala., to the top of Mt. Sano. The Huntsville Railway, Light and Power Company is interested.

The Florence (S. C.) Light and Power Company has been commissioned, with $50,000 capital. The incorporators are H. C. Case and William Measey of Philadelphia.

A sub-postoffice to be established at Athens, Ga., shortly will have the mails carried by the local electric railway.

The Catawba Power Company at Fort Mill, S. C., has the contract for lighting Elizabeth College, Charlotte, N. C., supplanting a private lighting plant.

The Greenville Traction Company of Greenville, S. C., has had surveys made for a three-mile loop to be constructed shortly.

The Westinghouse single-phase alternating-current electric-railway system will be installed on the new line between Atlanta and Marietta, Ga., for the Interurban Railway Company at a cost of about $100,000.

The stockholders of the Spartanburg (S. C.) Railway, Gas and Electric Company have voted a bond issue of $400,000. The issue will go partly into the treasury and partly to cover the value of the present property. Improvements may be made. F. H. Knox is secretary of the company.

The City Council of Birmingham, Ala., has been assured that the Railway, Light and Power Company will soon give transfers on all lines according to previous agreement. Hitherto transfers on parallel lines have not been granted. L.

Ohio.

Cleveland, September 3.—The Scioto Valley Traction Company will be under the necessity of purchasing some additional cars, it is said, to accommodate the large traffic that is coming to its lines from Columbus to Lancaster and Circleville. The management is now running trains instead of single cars, but is yet unable to accommodate the public satisfactorily.

Attorney T. H. Hogsett of Cleveland has deposited two bonds of $10,000 each with the state insurance department for the Traction Mutual and Electric Mutual Insurance companies according to the laws governing the organization of mutual fire companies. The companies may now solicit business, but can issue no policies until at least $500,000 insurance and $10,000 cash premiums have been received. The projectors of these companies are going right along and will have the companies in operation as soon as possible.

The Cincinnati Traction Company has opened a school of instruction for motormen at the Vine Street Hill car barn. William F. Needles, a man who has been in the employ of the company for 20 years, is in charge of the instruction. A car has been arranged in the barn with all the working parts exposed and new men are taught all about the entire mechanism from the time the current is taken from the trolley wire until it leaves the wheels. The car is raised on a platform so that the machinery may be operated without moving the car. The men are also taught how to make repairs.

Arrangements have been made to extend the street-car tracks through the center of Highland Park Cemetery at Cleveland so that the funeral car may be run closer to points of interment. Heretofore it has been compelled to stand some distance away. The demand for the car is increasing and it has become necessary to make some new arrangements for its use about the cemeteries.

The Chamber of Commerce committee at Toledo, which has been investigating the street-railway company's books in connection with the council committee on railroads in order to satisfy the people as to the cost of carrying passengers, has sent a letter to the council declining to serve further. As a reason they say they are not pleased with the manner in which the council committee is conducting the examination. Mayor Finch, A. Backus, R. A. Bartley and J. E. Knistley are the members of the Chamber of Commerce committee.

Manager Stebbins of the Appleyard interests states that the last year or two have seen only the beginning of the electrification of steam roads and that he expects to see more of this than ever in the future. The adaptation of the alternating current has made the power cheaper and it can now be used to better advantage than in the past. O. M. C.

Michigan.

Detroit, September 3.—The Common Council of Battle Creek will take action against the Michigan Traction Company under the provision in its franchise which provides that the company shall build a mile of new track each year, when ordered by the council. The road has not complied with last year's order, and it is claimed that the franchise has been forfeited on that account.

The Detroit United Railway Company is not lacking in courage in making big permanent improvements, notwithstanding that its franchise will expire between 1909 and 1913. It seems that they take it for granted that the franchises will be renewed.

A new electric line is proposed to run from Adrian to Ypsilanti. It is understood that the line will run via Saline to Ypsilanti. An effort is being made to secure the option on the old steam line between these points which was graded years ago, bridges and other accessories being built, but never utilized.

The village of Delray is again in an argument with the Detroit United Railway over street-car franchises and the question of paving between tracks. The street-railway company asks that the franchise, which now has 17 years to run, be extended 13 years, promising to pave and make other improvements. It is argued by some who expect the village will be annexed to Detroit, that should municipal ownership ever become a fact in Detroit, this 13 years' extension of franchise would mean so much of a setback for municipal ownership.

The Grand Rapids, Grand Haven and Muskegon electric railway, after a thorough trial of limited

cars running between Grand Rapids and Muskegon, has decided to discontinue this service as it is not a paying venture.

The village of Wayne will vote on September 12th on the proposition of bonding the village for $8,000 for the establishment of a municipal electric-lighting plant.

A party of prominent electric-railroad men are inspecting the Hawks-Angus-Boland system, piloted by J. D. Clark, general manager of the Consolidated interests, and Superintendent Merrill of Ypsilanti. They are making an inspection of the Ypsilanti-Ann Arbor road, looking over the matter of the new limited service which is contemplated. It is understood that the plan is to have the fast service running within the next two months between Jackson and Detroit. There will be but five stops made between these cities. C. G. W.

Northwestern States.

Minneapolis, September 3.—A new factory is in view for Minneapolis for the manufacture of electrical supplies and specialties.

A dam will be built on the Ottertail River at Detroit, Minn., for furnishing power and light.

Louis M. Ogden and others have been incorporated as the Bliss Electric Car Lighting Company at Milwaukee, Wis., with a capital of $100,000.

G. A. Bergold proposes to build a trolley line from Lansing to Waterloo, Iowa.

The Fargo (N. D.) and Moorhead (Minn.) Street Railway Company has decided to resume work and complete the construction of the street-railway system.

The Twin City Rapid Transit Company will extend the trolley line from Stillwater, Minn., to South Stillwater.

The Dyersville and Northern Railway Company has been incorporated with a capital of $75,000 for the purpose of building a trolley line from Dubuque, Iowa, to New Vienna. G. H. Hesselmann is president and B. V. Kerner secretary-treasurer of the company.

The interurban line from Kaukauna to Green Bay, Wis., has been completed and business has been begun. This completes a chain of electric railways from Fond du Lac to Green Bay, 75 miles.

Des Moines capitalists will be granted a franchise for a street-car line at Sioux Falls, S. D. S. C. Lee heads the new company.

Work on the new street-car line at Mankato (Minn.) will be commenced this fall. R.

Rocky Mountain States.

Salt Lake City, Sept. 2.—H. B. Holt of Las Vegas, N. M., is now at Santa Fe, N. M., and states that eastern capitalists are seeking investment in the Mesilla valley with a view to establishing a large central electric-power plant and establishing a colony. The Interior Department is soon to take up the construction of a diverting dam across the Rio Grande River near Fort Selden.

It is stated that Joseph Plastina of Spokane, Wash., and F. M. Barrett of Wisconsin are back of a project to build an electric railway from Libby, Mont., to the mines south of that place. The line as outlined would be 40 or 50 miles long.

Isaac Bailey of Bisbee, Ariz., has gone to London, England, for the purpose of forming a company to install a water system and power plant at Bisbee for electrical purposes.

D. E. McKinnon of the Amador Mining and Milling Company, says his company contemplates building an electric road from the town of Amador, Mont., to the mines.

The Boise Electric Supply Company of Boise, Idaho, has received an order from the Belle of Thunder Mountain Mining Company for equipment to be used in the construction of an electric-light plant in the famous mining camp.

Surveys for a proposed electric railway between Lewiston, Idaho, and Kendall have been completed and the organization of a company will follow shortly. The estimated cost of the road is $110,000, and the stockholders of the proposed company will be largely Lewiston capitalists.

Work has been commenced on the construction of the Montpelier (Idaho) Electric Light Company's power plant in Georgetown Canyon. The work outlined involves the construction of a stone power house and a transmission line 13 miles in length to Montpelier. The work will be pushed as rapidly as possible. The total expenditure will be about $20,000.

W. H. Patterson and Alvaro Evans of Reno, Nev., are the promoters of a project for the construction of an electric railroad between Fallon and Hagen, to be used by cattle firms for the transportation of beef.

A power plant to be operated by energy from Little Cottonwood and Big Cottonwood streams, within a few miles of Salt Lake City, Utah, is projected by James J. Chambers of New York. About 2,800 horsepower will be developed and will be used for the operation of mines and for electric lighting.

Idaho capitalists are at work in the East in an effort to raise the necessary funds for the construction of an electric system to be known as the Lewiston and Southeastern electric railway, which, if the scheme is consummated, will cover a total distance of over 100 miles. The route outlined traverses a rich agricultural region. The power will be derived from the South Fork of the Clearwater. The total cost of the proposed system is estimated at $2,500,000. G.

Pacific Slope.

San Francisco, September 1.—The John M. Klein Electrical Works of this city has just secured the contract for installing some heavy electrical mining apparatus. Mr. Klein of the company says that he finds business good, but owing to the rapid growth of competition contractors are forced to figure too close. The firm is the oldest of its kind in San Francisco, having been established in 1879.

The Bishop-Wilbur Company has opened offices in the Crossley Building, San Francisco, carrying such goods at Kuhlman transformers, Jandus electric fans and arc lamps, etc. Mr. Bishop has charge of the office.

The firm name of Dwight & Spencer, dealers in lamps and electrical specialties in this city, has been changed to Hutchins & Spencer, Mr. Dwight having disposed of his interests.

The Independent Electrical Construction Company has secured the wiring contract for a five-story building on Sutter Street belonging to J. Schwartz and S. Disbecker.

J. T. Hill is now in El Oro, Mexico, for the purpose of planning electrical machinery for the Esperanza Mining Company. It is the intention to abandon steam power for electric.

There has been a rumor for some time that one of the big power companies of San Francisco is engineering a deal by which it intends to consolidate all the smaller power companies in the vicinity of Santa Barbara, Cal., under one head. Eugene Watson, a San Francisco attorney, is reported to be negotiating the deal for the new company.

N. O. Bagge of Los Angeles, Cal., has purchased the Central and Little Emma mines, located at Amoloya, Mexico. A power plant is to be built at Dorado station on the Parral branch of the Mexican Central railroad, from which electric power will be transmitted to the mines.

J. Buntzen, general manager of the British Columbia Electric Railway Company, has been authorized to proceed at once with the work of rebuilding the car shops of the company at New Westminster, B. C., which were recently destroyed by fire.

The Cœur d'Alene and Spokane railroad contemplates building a branch line from its main line at Spokane, Wash., and to Liberty Lake.

The Portland City and Suburban Street Railway companies of Portland, Ore., are to be merged into one company under the name of the Portland and Suburban Railway Company.

C. F. Clark of Clackamas and other citizens of Oregon City, Ore., are promoting a project to build an electric railway from East Oregon City via Clackmas and Milwaukee to Portland, Ore.

The Eastern Oregon Development Company of Sumpter, Ore., has surveyors in the field in the Grand Ronde valley between Cove and La Grande, Ore. It is proposed to build an electric road to extend a distance of 41 miles.

The Standard Electric Company's plant at Electra, Cal., has been considerably damaged recently by the blowing out of its pipe line. The water rushed from the bursted pipe with such force that the dynamos in the plant of the company were damaged as well as other parts of the machinery. The damage is estimated at about $30,000. A.

PERSONAL.

W. P. Jackson of Bay City has been appointed master mechanic of the entire Bay City and Saginaw electric-light, gas and street-railway system.

George C. Rutledge, superintendent of public service at St. Cloud, Minn., has resigned, to accept a position as manager of the electric-light plant at Fargo, N. D.

George W. Knox of Chicago was recently made general manager of the Green Bay Traction Company of Green Bay, Wis., which is to take over the property of the Fox River Electric Railway and Power Company, consisting of street railways in Green Bay and the Green Bay-Kaukauna interurban line.

E. U. Harlan of Monterey, Mexico, has been appointed manager of the Monterey Electric Street Railway, Light and Power Company, which, as noted in the Western Electrician last week, has been formed for the purpose of converting the existing horse tramways in and around Monterey into electric-traction lines.

George W. Chandler, who has been connected with the Illinois Central electric railway since its inception, in the capacity of civil engineer, has been promoted to the position of general manager of the company. Mr. Chandler has been a resident of Canton, Ill., for some years past, and during nearly all of that period has been the city engineer.

George Mery Varela of Santiago, Chile, was in Schenectady recently inspecting the General Electric and American locomotive plants. Varela is a civil and electrical engineer, and has been commissioned by several South American governments to visit the great industries of Europe and America for the purpose of reporting to the governments and suggesting ideas that will be of advantage to them. He has completed his European travels and is visiting this country on his homeward trip. Mr. Varela says that the electric works in Schenectady are the most complete he has ever seen.

W. R. Whitney, professor of chemistry at the Massachusetts Institute of Technology, has resigned to take charge of the research laboratory of the General Electric Company at Schenectady.

Peter Valier has resigned as superintendent of the LaCrosse (Wis.) Street Railway Company, to accept a similar position with the LaCrosse and Southeastern Railway Company, which is building an electric railway to Viroqua.

The body of William G. Jones, formerly manager of the Western Union Telegraph Company at Philadelphia, Pa., was found a few days ago in the waters of Jamaica Bay, L. I. Mr. Jones was 55 years of age, a native of Pennsylvania, and had his home in Brooklyn. From 1897 to 1903 he was in the office of the Associated Press in New York city.

Sales Manager John W. Brooks of Pass & Seymour, Solvay, N. Y., visited Chicago last week. Mr. Brooks made only a stay of a day or two in Chicago, returned to Solvay, and thence left in company with General Manager Salisbury for the Electrical Congress in St. Louis. Messrs. Salisbury and Brooks will make their headquarters in all probability at the Forest Park University Hotel, where they expect to be during the period of the Northwestern Electrical Association convention.

ELECTRIC LIGHTING.

J. Y. Fiddler of Manson, Iowa, has sold his electric-light plant.

J. K. Fyfer has disposed of his electric-light plant at Centralia, Mo., to J. H. Bladridge.

The new electric-light plant at Brinkley, Ark., costing over $40,000, has been completed.

Oakland, Neb., will issue $7,000 worth of bonds for the installation of an electric-light plant.

A number of citizens of Omaha, Neb., are agitating the building of a municipal electric-lighting system.

The people of Utica, Miss., have voted a $10,000 bond issue to build an electric-light plant and waterworks.

The Madrid Electric Light and Power Company of Madrid, Iowa, has increased its capital stock to $15,000.

The city of Argenta, Ark., contemplates the establishment of an electric-light plant and system of waterworks.

Carrollton (Ga.) citizens have voted to issue $45,000 in bonds for building an electric-light plant, waterworks, etc.

The Home Light and Power Company has succeeded to the business of the Concordia (Kan.) Electric Light Company.

Contracts have been signed for a $50,000 electric-light plant at Wilburton, I. T., by the City Council and James Degnan of that city.

The new power canal for the electric-light plant at Ellensburg, Wash., has been completed. About 1,000 horsepower will be developed.

The city of Litchfield, Ill., has voted a 75-year franchise to D. Davis for the construction and maintaining of a gas and electric-light plant.

A council committee of the Grand Rapids (Mich.) City Council is considering the question of erecting an addition to the municipal lighting plant.

The Waterloo (Ind.) Water, Light and Power Company has been incorporated with $10,000 capital stock by C. L. Olds, W. J. Vesey and A. J. Vesey.

The Mt. Vernon Electric Light and Power Company of Mt. Vernon, Ind., has been incorporated with $5,000 capital stock by J. H. Purdy and H. R. Lynn.

At an election held in Capac, Mich., recently it was voted to issue $7,000 in bonds for the purpose of completing the electric-light plant and waterworks system.

The Southern California Electric Company of Los Angeles, Cal., has been incorporated with $25,000 capital by F. W. Peschke, J. L. Ruperd and J. C. Rendler.

Preparations are being made for the issuance of bonds by the city of Graceville, Fla., for the purpose of erecting an electric-light plant and putting in waterworks.

The contract for lighting the city of Peoria, Ill., for the next two years was awarded to the Peoria Gas and Electric Light Company on its bid of $65 per light a year.

The Echo (Ore.) Water, Light and Power Company has been incorporated with $10,000 capital stock and the company will soon begin the construction of an electric-light plant.

Frank P. Snyder has been granted a franchise at Danville, Ky., to operate an electric-light plant and a street railway. He will ask the Fiscal Court for a franchise for an interurban line from that place

to Junction City. Mr. Snyder represents a number of St. Louis capitalists who are planning to build the roads and operate the light plant.

Spring Lake, Mich., will soon vote on a proposition to establish an electric-light plant. It is proposed to put in a plant having 20 street arc lights, as well as facilities for commercial lighting.

The Borough Council of Northumberland, Pa., has adopted a resolution to submit to the taxpayers at an election to be held on November 8th, the proposition to increase the borough debt $15,000 for the purpose of building a municipal light plant for the village.

Indianapolis, Ind., it is said, within a year will be lighted with electricity brought a distance of 160 miles from the dams of the Indiana and Michigan Electric Company at South Bend. At a recent meeting it was decided to extend the transmission lines of the electric company to Indianapolis.

The North Shore Electric Company, which supplies electric light and power to the North Shore territory, including Evanston and Waukegan, has definitely decided to erect a big central power house on the lake front at Waukegan. The building will be about 125 by 214 feet, and will be one of the largest and best in the state. The company recently secured a franchise for Lake Bluff and is now running a line of poles to that point from North Chicago. A pole line will also be run to Libertyville. Thus Waukegan will soon supply both electricity and gas to this entire region. Samuel Insull is president of the company.

An effort is being made to consolidate the electric light and power company and the artificial ice company of Shenandoah, Iowa, with the idea of utilizing the franchise of the one and the plant of the other, and so install an all-day service and at the same time put in a steam-heating plant. The ice plant, which burned down recently, was operated under a long-term franchise. The franchise for the light company runs about eight or nine years. The intention of the promoters of the amalgamation is to recapitalize the ice company for about $75,000 and to rebuild the light plant and put in steam-heating pipes that will supply about 10 blocks of business houses. If the consolidation is effected the heating plant will be installed this fall.

ELECTRIC RAILWAYS.

Fire of an unknown origin almost completely destroyed the Omaha and Council Bluffs Street Railway Company's barn and storehouse in Omaha, Neb., recently. Twenty-four cars in the barn at the time of the fire were all destroyed and comprise the principal loss of the company. Their estimated value was $50,000. An unused power house of the company was threatened by the flames, but was saved.

F. T. Ley & Co. of Springfield, Mass., have been awarded a $100,000 contract by the Rochester, Syracuse and Eastern Railway Company for the construction of eight miles of the proposed new electric line connecting the cities of Rochester and Syracuse. The construction has been divided up into sections and awarded piecemeal to each successfully competing contractor. The road will be a high-speed suburban line.

Plans for changing the method of operating the suburban lines of the Southern Pacific railroad across the bay at San Francisco are being perfected upon the decision of the company to operate the Berkeley, Oakland and Alameda lines on a third-rail system, instead of the overhead trolley-wire system, by which the Santa Fe moves its Key Route trains. When the new system is installed there will also be improvement in the ferry service.

Advertisement is being made in Buffalo, N. Y., of the proposed extension of the Buffalo and Depew Railway Company's line from Depew to Rochester, preliminary to the application to the State Railway Commission for permission to build the extension. The proposed line will go eastward from Depew through Lancaster and Alden in Erie County, Darien, Pembroke, Batavia and Leroy in Genesee County, Caledonia in Livingston County, and Wheatland and Chili in Monroe County to Rochester, a distance of a little more than 60 miles.

It is asserted in Fallon, Nevada, that the United States government, through its engineers in Nevada, is figuring on the construction of an electric railroad between Fallon and Hazen, on the line of the Southern Pacific company. Fallon is the center of the big irrigation work now going on in Nevada. It will always be the center of the big farming country that is about to be developed there. The line is almost direct and for the 16 miles that intervene between the cities is a stretch of perfectly level country. The power is to be developed just above the big government dam in the irrigation ditch.

The Philadelphia Rapid Transit Company is prepared to begin work on its elevated road through West Philadelphia, and now is awaiting only the large bridge spans that will connect the elevated line with the subway. In view of the increased traffic that the completion of this line will bring to it the Philadelphia and West Chester Traction Company has purchased a piece of ground in Williston township, Delaware County, where it will erect a new $150,000 power house. Being located on the banks of Ridley Creek, the new station is expected to save 25 per cent. in the generation of power. Its erection will be completed by April 1.

PUBLICATIONS.

"Scenes from a Great Industry" are depicted daily in the beautiful little theater in the Westinghouse companies' exhibit at the fair, showing the development of the company from the beginning and biograph interior and exterior views. A little folder entitled "The Westinghouse Moving Pictures" tells all about this interesting feature of the exhibit.

Single-phase power motors are an important product of the Wagner Electric Manufacturing Company of St. Louis. In consequence the company has issued in pamphlet form the paper read by Mr. W. A. Layman at the Boston convention of the National Electric Light Association upon "Single-phase Power Motors for Electric-lighting Stations." The pamphlet will be distributed to the company's friends.

Small motors for domestic work, such as driving sewing machines, are manufactured by the Emerson Electric Manufacturing Company of St. Louis and described in an illustrated bulletin which has just been issued. These motors are made for either direct or alternating current, and when attached to the sewing machine are out of the way and present a neat appearance. Detailed description of the apparatus is given in the bulletin.

C. W. Hunt & Co. of New York have recently issued an illustrative catalogue on electric hoists, winches and capstans, which may be driven by either direct or alternating current. Much good information is contained in the catalogue in relation to apparatus of this sort in the way of tables and instructions as to the necessary data to be taken before designing electric hoists. Some excellent illustrations are given of machines of various types.

Miller's Electropneumatic Burglar Alarm Company of Estervile, Iowa, is sending out a little booklet containing a brief description of the apparatus and a few letters to show what people say of the device. The alarm works upon the closure of a circuit and is so adjusted that a slight change in current strength in a normally closed auxiliary circuit will close the main circuit and ring a gong continuously in the vault or safe. The company is considering propositions from commercial clubs for a location.

SPACE TELEGRAPHY.

Word has been received by the State Department from United States Consul-general Fowler at Chefu to the effect that the Russians have dismantled their space-telegraph station at that place.

The British government has decided to establish a space-telegraph station on the Marsden, about three miles from South Shields. The signal station will be erected on the edge of the cliffs, which command a view north and south for miles along the coast. The new station is to be primarily used for securing communication with passing warships.

For the use of the midshipmen and officers at Annapolis a number of additional sets of space-telegraph instruments will be installed there. Instead of establishing a school for space-telegraph operators at the naval proving ground at Indian Head, Md., as was at first intended, this school probably will be established at Annapolis because the latter point is more accessible.

The General Electric Company is proceeding with its plans, recently mentioned, for the establishment of a space-telegraph system with stations in Lynn, Pittsfield and Schenectady. A station at Pittsfield, Mass., where the Stanley works are located, will be used as a relay office between Lynn and Schenectady. The distance between Pittsfield and Lynn is 140 miles, and between Pittsfield and Schenectady 45 miles.

Plans for the signal towers have been made and ground secured in Wilkesbarre and Scranton, Pa., for the stations which will put to a practical test the space-telegraph system invented by Father Murgas of Wilkesbarre, and on which he has recently been granted patents. The American Electric Signal Company of Philadelphia will finance the project. Double-tower stations, 200 feet high, will be erected. At this height communication can be had with Philadelphia if the test is a successful one. The next station will then be erected in Philadelphia.

MISCELLANEOUS.

The Postal Telegraph-cable Company announces that it is now ready to accept business for Sitka, Juneau, Haines Mission and Skagway, Alaska, via the new government cable just opened between Seattle and Sitka.

The Union Switch and Signal Company has about completed the electropneumatic interlocking and switching plant for the St. Louis Terminal Association. This is probably the largest plant of its kind in the world, controlling all the traffic entering into and departing from the Union station in St. Louis. The plant consists of three towers, one of them operating 215 levers, with 65 single switches and 48 double slips with movable frogs. Seventy-nine levers alone operate 194 signals. The other two towers operate 59 and 47 levers, respectively.

When the large North Side intercepting sewer is completed in Lawrence Avenue, Chicago, it is probable the city will adopt electricity to operate the pumps. The city is having some difficulty with the Sanitary District officials over the size of the site for the station, and it is contended that with electricity as a motive power a smaller site will be necessary.

A fine new lake-excursion steamer to be known as the Turbine Queen is to be built, it is said, for the Dunkley-Williams Steamship Transportation Company by the Craig Shipbuilding Company of Toledo, Ohio. The new steamer will be equipped with turbine engines, the first in use upon the Great Lakes, and will have a guaranteed speed of 25 miles an hour. It will accommodate 3,500 passengers and will ply between Chicago and South Haven. Its length will be 275 feet, with 42-foot beam. It will cost over $300,000.

TRADE NEWS.

The Missouri Valley Electric Company has just been incorporated in Savannah, Mo.

The Webster City Electric Company has discontinued business at Webster City, Iowa.

It is reported in the daily press that the General Electric Company may absorb the National Carbon Company of Cleveland.

With a capital of $60,000, the Northwestern Manufacturing Company has been incorporated by William P. Harper, William S. Smith and John T. Harper for the purpose of manufacturing electrical motors and other machinery. The company will operate in Milwaukee.

The Anniston (Ala.) Electric and Gas Company recently incorporated, with capital stock of $250,000, will at once begin the erection of buildings to be equipped with machinery for manufacturing electrical supplies.

The Electric Storage Battery Company of Philadelphia announces that 584 cells of type G Chloride Accumulator have recently been installed on the system of the St. Louis Transit Company. This is said to be the largest individual installation of its kind in the world.

The American Electric and Controller Company of New York is introducing a new electrical patent—a controller for shunt and compound-wound motors by which a large range of speed control may be secured without the use of any resistance and without any special features on the motor. The device operates on the ordinary two-wire system.

In Mobile, Ala., the Gulf Electric Company, with capital stock of $20,000, has just been incorporated. The incorporators are all well-known business men of Mobile. The following were elected as officers and directors: C. W. Chase, president; Sidney Lowenstein, vice-president; R. W. Jones, secretary and treasurer; J. H. Wilson, C. W. Chase, R. W. Jones and Sidney Lowenstein, directors.

Sealed proposals will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until October 12th, for the construction (including plumbing, heating apparatus, electric wiring and conduits) of the postoffice at Fond du Lac, Wis., in accordance with the drawings and specifications, copies of which may be had of the supervising architect or at the office of the postmaster at Fond du Lac.

The Rolfe Electric Company has been incorporated. The company is formed with a capital stock of $150,000 in 1,500 shares for the purpose of manufacturing, selling and dealing in electrical apparatus, and will have its principal business office in Rochester, N. Y. The directors are Frederick Zoller, J. George Kaelber, John Nicum, George Koch, Arthur B. Enos, Rudolph Schmidt and George H. Harris of Rochester; Charles A. Rolfe of Adrian, Mich., and A. Miller Belfield of Chicago.

BUSINESS.

The Electric Storage Battery Company of Philadelphia is sending out neatly printed invitations to its friends to visit the company's exhibit at the fair, located in Section 20, Palace of Electricity.

The Sprague Electric Company reports an excellent business in the electric-hoist department. Among recent orders are eight electric hoists for the Davis & Thomas Company, Catasauqua, Pa., to be used in handling castings for the new tunnel of the Pennsylvania Railroad Company in New York city; 13 hoists for the same company's car-wheel foundry at Altoona, Pa., and 20 hoists for the new works of the International Steam Pump Company at Harrison, N. J.

The Trumbull Electric Manufacturing Company of Plainville, Conn., has now ready for delivery its new pendant switch, which is guaranteed to operate successfully 10,000 times without appreciable injury at its rated capacity, 10 amperes at 125 volts. There is only one button to push on the pendant switch. The company has also increased the capacity of its

line of type A switches from 300 to 600 amperes and has taken up the manufacture of panel boards and switchboards.

President A. C. Garrison of the Columbia Incandescent Lamp Company of St. Louis extends a cordial invitation to all visitors to St. Louis in connection with the meeting of the International Electrical Congress to visit the office of the Columbia company.

Stombaugh guy anchors are used to stay the great space-telegraph mast on Art Hill, St. Louis Exposition, described and illustrated in the Western Electrician of August 27th. Twelve anchors are used, of the eight, 10 and 12-inch size. W. N. Matthews & Bro. of 600 Carleton Building, St. Louis, are exclusive distributers of the Stombaugh guy anchors.

The Chicago Mica Company of Valparaiso, Ind., reports that it is running its plant day and night in order to keep up with its orders for Micabond. Under its new management this company has made great progress in getting its product established and known to the users of mica. Micabond is said to be of superior quality, nothing but the best ingredients being used and only skilled workmen employed, and although the company is only three years old it has already established itself as an important factor in the business.

Becker Bros. of Chicago, well known in electrical circles, have made rapid strides in their special lines. A short time ago the company moved into its new three-story and basement shops at 68 West Washington Street, giving the firm all modern facilities and enabling it to serve its customers quickly and satisfactorily. It may not be known that the firm makes 14 different kinds of brushes for motors and generators and, in addition, buys and sells second-hand electrical apparatus. It is also in a position to do all kinds of electrical repair work.

The Hemingray Glass Company of Covington, Ky., under the skillful management of Secretary and Treasurer Daniel C. Hemingray, so well and popularly known in electrical circles, says that it is doing an excellent business. The company manufactures the well-known standard screw glass insulators for all purposes. The Hemingray insulators are used on some of the longest transmission lines and have stood most severe tests. The company's product is in use by some of the largest consumers in the electrical and telephone lines.

The Northern Electrical Manufacturing Company of Madison, Wis., recently sold to Greenlee Brothers of Chicago, Ill., a 200-kilowatt generator for the equipment of its plant at Rockford, Ill. This is a representative sale of the company, and indicates the rapidly extending field of application of Northern apparatus in all sorts of industrial plants. The waterworks company of the city of Fond du Lac has also ordered a 90-horsepower vertical Northern motor for pumping service. This motor is to be used for driving a propeller type of deep-well pump.

The Pardridge Shade and Reflector Company of Chicago asserts that it has made great strides with its three electrical specialties in the last three months. The president, Albert J. Pardridge, expects to visit St. Louis during the electrical congress with the intention of introducing his specialties to those who have not already seen them. The new Pardridge Easy cord adjuster and Easy lamp changers that have been put on the market within the last three months seem to have been just what the users of electric lights wanted, as the sales on these two specialties have been much greater than was ever hoped for in such a short time. In the year that the Pardridge company has been in business it has placed on the market over 80,000 reflectors.

The B. F. Sturtevant Company of Jamaica Plain, Mass., wishes to emphasize the advantages of mechanical draft as an economical factor in the production of steam in paper mills, as has recently been illustrated in the installation of an induced-draft fan driven by a direct-connected vertical engine in the plant of the Chapin & Gould Paper Company of Huntington, Mass. Previous to the installation of this apparatus the company was using three boilers and all the steam that could be generated with a high grade of coal. Since the Sturtevant mechanical-draft apparatus was installed it has been using a much cheaper grade of fuel (which could not be used with chimney draft alone), and now, instead of using three boilers, it is only using two and has all the steam necessary.

The New England Motor Company of Lowell, Mass., is placing upon the market a line of storage batteries for stationary and vehicle work. The cells are of the pasted type. The oxides are applied to molded grids in the usual manner. The negative plates, after being formed, are subjected to considerable pressure, so as to consolidate the spongy lead and make it more adhesive. The positive grids are oxidized before being pasted. In the vehicle-type cells grooved wooden separators are used. The wood is treated by a special process to prevent the formation of acetic acid or gum-dextrin. The 150-ampere-hour cell at four-hour rate weighs complete 28 pounds. The grids are of such a form as to give great mechanical rigidity, so that the mechanical efficiency has not been sacrificed for weight.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued (United States Patent Office) August 30 1904.

768,581. Electrical Apparatus. Fred Burks and Charles Rohlfs, Buffalo, N. Y. Application filed January 28, 1904.

The apparatus embodies a container in the form of a dumb-bell, an electric current-generating machine arranged in one bead of the container, and a reciprocating motor arranged in the shank of the container. Connections are made between the motor and generating machine for operating the latter, and conducting means for the current poduced by the generating machine are supplied.

768,584. Automatic Synchronizing Apparatus. Milton C. Canfield, Cleveland, Ohio. Application filed August 3, 1903.

A phase-responsive device consists of two concentric elements, one of which is stationary, the other free to rotate about its axis. Each element carries a system of rotary magnetic field coils, with means for connecting the stationary element with the current derived from one of the sources. Means also connect the rotary element with the current derived from another source.

768,593. Turbine-generator. William L. R. Emmet and Oscar Junggren, Schenectady, N. Y., assignors to the General Electric Company, Schenectady, N. Y. Application filed March 24, 1903.

The turbine-generator set comprises a turbine casing, a bucket wheel inclosed thereby, a generator casing, an armature inclosed thereby, a projection or neck between the casings for uniting them and a shaft bearing carried by the projection.

768,606. Suspension of Trolley Wires. Martin T. A. Kubierschky and Paul E. Herkner, Berlin, Germany. Application filed March 7, 1902.

Combined with a supporting bar is a wire clamp carried at each end of the bar and adapted to move transversely and longitudinally, with means to limit the movements.

768,610. Electric Controller. John Lindall, Boston, Mass. Application filed January 13, 1904.

A rotatable shaft or spindle carries a sleeve mounted to revolve therewith and provided with lugs or projections. Contact segments are secured to the lugs. Spring-pressed contacts co-operate with the lugs.

768,614. Device for Protecting Carbon Filaments for Incandescent Electric Lamps. Albert W. W. Miller, South Orange, N. J., and George P. McDonnell, St. Louis, Mo., assignors to the American Electric Company, East Orange, N. J. Application filed July 3, 1903.

A tray for carbon filaments comprises a skeleton frame, upstanding tray-holding standards provided with free outwardly bent terminals, inbent offsets carried by the standards and secured to the frame and depending legs fixed to the offsets.

768,616. Circuit Interrupter. George P. McDonnell, St. Louis, Mo., assignor of 49 per cent. to Oscar E. Plochman and Richard F. Spencer, St. Louis, Mo. Application filed May 10, 1902.

Mounted on a rotatable shaft is a reversible disk carrying an unequal number of radially disposed contact faces on the opposite sides. Insulation material is disposed between the contact faces.

768,617. Supervisory Signal Apparatus for Telephone Switchboards. James L. McQuarrie, Chicago, Ill., assignor to the Western Electric Company, Chicago, Ill. Application filed January 2, 1904.

A connection terminal for the line has two line-contact pieces. A pair of link conductors are provided with a switch terminal having two corresponding contact pieces adapted for engagement with the line contacts. A signal-controlling magnet is placed in one of the link conductors and a branch is adapted to complete a circuit for the magnet, independent of the sub-station switch.

768,630. Electric Accumulator. Constantin de Sedneff, Paris, France. Application filed July 28, 1902.

A positive and negative plate each comprise conducting supports. Active material covers the supports, the metallic element of the active material being equivalent in weight for the two plates and the exposed surfaces of the two plates in area.

768,634. Electric-railway Brake. Levi L. Stamm, Almond, N. Y., assignor to Bartz, Wygant & Brown, Hornellsville, N. Y. Application filed December 8, 1903.

Co-operating with an electric motor and its shaft is a shaft forming part of the gearing to the brake shaft. Wheels are mounted on the contiguous ends of the shafts, one of the wheels having semicircle recesses and lugs on the other wheel traveling in the recesses. By this means the shafts are connected to permit a limited movement of the motor shaft in advance of the other shaft.

768,667. Electrical Counting Apparatus. John A. Kray, Lancaster, Pa., assignor of one-half to Daniel M. Rothenberger, Lancaster, Pa. Application filed December 31, 1902.

In an electrical counting apparatus is a counting wheel having upon the periphery a series of numerals. Mechanism adapted to rotate the wheel with a step-by-step movement consists of a ratchet disk secured to the wheel, an arm arranged to engage a tooth of the disk, a detent arranged to bear on the disk and provided with a device adapted to form a stop for one movement, and an armature to control the mechanism.

768,674. Trolley for Electric Cars. Lewis M. McBride, Denver, Colo. Application filed January 25, 1904.

The trolley pole carries two trolley wheels, one mounted behind the other.

768,687. Electric Sparking Igniter for Explosive Motors. Lucius J. Phelps, Stoneham, Mass., assignor to the Phelps Motor Vehicle Company, Stoneham, Mass. Application filed April 9, 1903.

In a make-and-break igniter for explosion engines is an electrode-actuating device and a trip dog acted on thereby. An electrode is operated on by the trip dog and is removable from operative position independently of the trip dog. A resilient connection between the trip dog and electrode normally holds the latter in operative position.

768,711. Controller for Electric Motors. Frank C. Watkins, Vallejo, Cal. Application filed November 20, 1903.

Associated with a motor circuit having a main switch controlled by a shunt circuit is a primary switch in the shunt circuit, oppositely acting electromagnets controlling the primary switch, and a pressure device having contacts arranged to close the circuit of either magnet, according to the predetermined maximum or minimum. Means actuated by the movement of the primary switch are provided to immediately break the circuit so closed at a point other than the contacts of the pressure device.

768,721. Electrode for Therapeutical Purposes. William B. Bassell, Columbus, Ohio. Application filed April 4, 1904.

Electrodes are described which are shaped like a clamp to apply current to the front and back of the head.

768,728. Electrically Actuated Gramophone. Theodore Birnbaum, Berlin, Germany. Application filed May 5, 1902.

The gramophone mechanism is operated by an electric motor.

768,738. Motor-generator. Gano S. Dunn, New York, N. Y. Application filed April 22, 1904.

The magnet frames are provided with transverse seats normal to the armature axis.

768,745. Electric Arc Lamp. Melville F. Goodrich, Newton, Mass. Application filed August 13, 1903.

Electrodes are provided, one of which is movable and controlled by an electromagnet having a clutch. A retarder has a movable member connected to retard the clutch on its initial electrode-separating movement. Means for automatically permitting a limited free movement of the clutch in both directions independently of the movable member of the retarder throughout the normal regulating action of the clutch, are other features.

768,754. Insulating Electric Conductors. Isidor Kitsee, Philadelphia, Pa. Application filed April 26, 1902.

The process of applying insulation to an electric conductor and drying the insulation consists in passing the conductor through a body of the insulation, passing a current of electricity through the conductor simultaneously with its passage through the insulation to deposit the insulation upon the conductor, and continuing the passage of the current through the conductor after the latter has emerged from the body of insulation to dry the latter.

768,755. Insulating Electric Conductor. Isidor Kitsee, Philadelphia, Pa. Application filed June 19, 1902.

Vulcanization of the insulating material is accomplished by the raising of the temperature of the conductor to the degree necessary for such vulcanization through the passage of an electric current through the conductor.

768,756. Insulating Electric Conductor. Isidore Kitsee, Philadelphia, Pa. Application filed October 7, 1902.

The insulating process consists in alternately carrying parts of the conductors through an insulating bath and then sending currents of electricity through those parts of the conductors which have been carried through the bath.

768,764. Resistance Sheet for Electric Heaters or Rheostats. George I. Leonard, Pasadena, Cal. Application filed September 9, 1903.

A sheet of non-conducting material has resistance sewn with a row of continuous stitches into the sheet.

768,772. Automatic Refrigerating Apparatus for Use in Connection with Fermenting Operations. Walter von Rougemont, Rittergut, Hohburg, Germany. Application filed May 29, 1903.

A thermostat controls an electric circuit, which in turn controls the valve admitting water to a cooling coil.

768,778. Wireless Telegraphy. Homer C. Snook, Philadelphia, Pa., assignor to the American De Forest Wireless Telegraph Company. Application filed October 23, 1902.

This system is provided with an imperfect contact receiver having one of its contacts formed of non-porous carbon.

768,783. Signaling System for Railways. George W. Watkins and Walter C. Bethel, Seattle, Wash. Application filed September 8, 1903.

A signaling system for electric railways embodies the line circuit, normally open main signal circuits having stationary circuit terminals arranged in close proximity to the roadway, a time recorder having electrical marking devices connected in the signal circuits, and circuit terminals adjustably mounted on the rolling stock relatively to the stationary terminals and electrically connected with the line circuit.

768,786. Weatherproof Lamp Socket. Reuben B. Benjamin, Chicago, Ill., assignor to the Benjamin Electric Manufacturing Company, Chicago, Ill. Application filed March 21, 1903.

Details are described.

768,787. Sub-base for Lamp Sockets. Reuben B. Benjamin, Chicago, Ill., assignor to the Ben-

jamin Electric Manufacturing Company, Chicago, Ill. Application filed May 7, 1903.

A sub-base is adapted to carry the main base upon which the lamp is mounted, and carries also the binding posts.

768,789. Trolley-pole Controller. Martin O. Doison, Los Angeles, Cal. Application filed December 23, 1903.

Pneumatic means raise and lower the pole. A trip lever on the pole is connected with the moving means, and arms projecting laterally from the trip lever engage the trolley wire and tilt the trip lever.

768,818. Cleansing Sheet Zinc. John Nelson, Peru, Ill., assignor to American Nickeloid and Manufacturing Company, Peru, Ill. Application filed April 30, 1903.

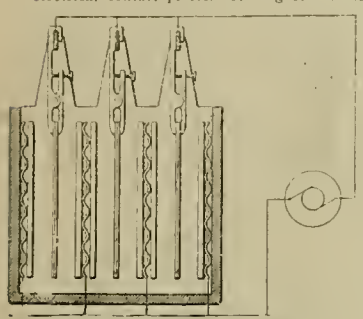
Sheet zinc is cleaned by immersing the sheets in an alkaline bath free from compounds from which harmful acids might be formed, connecting them with the negative pole of a generator and passing an electric current through the bath and sheets. (See cut.)

768,843. Armature. James Burke, Berlin, Germany, assignor to the Burke Electric Company. Application filed November 2, 1899.

Slots of the armature are arranged tangential to an inner circle for the reception of armature windings, the slots all being uniformly inclined.

768,847. Electric Lamp. Elias L. Elliott, New York, N. Y., assignor to the Illuminating Engineering Company, New York, N. Y. Application filed June 5, 1903.

A lamp is provided with a non-conducting base with electrical contact pieces. A ring surrounds the base and has contact arms, and a pawl-and-ratchet mechanism rotates the ring by a series of impulses.



NO. 768,818.—CLEANSER FOR SHEET ZINC.

768,863. Hanger for Trolley Wires. Augustus Neubert, Elizabeth, N. J. Application filed December 10, 1903.

A semi-tubular clencher head is adapted to be bent around a wire. Means lock the clencher head when thus bent and prevent it from opening and releasing the wire.

768,868. Automatic Electric Controlling System. Wilhelm Stockmeyer, Frankfort-on-the-Main, Germany. Application filed March 18, 1902.

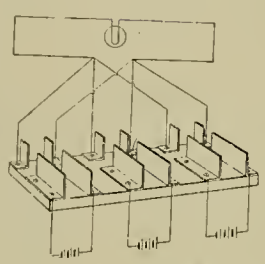
Two accumulators are connected by a lamp circuit between a main current generator and accumulators. A second current generator and lamp circuit are connected so that the accumulators may be charged by the main current generator and discharged into the lamp circuit alternately.

768,908. Electric Time System. David Perret, Neufchâtel, Switzerland. Application filed March 31, 1904.

In an electric time system and a main circuit, an electromagnetic circuit-breaking device and relays included in the main circuit associated with local circuits, each connected to a receiving clock or clocks corresponding to the relays. The electromagnet of the circuit-breaking device for the main circuit is included in one of the local circuits.

768,925. Plug Switch. James I. Ayer, Cambridge, Mass., assignor to the Simplex Electric Heating Company, Boston, Mass. Application filed June 11, 1904.

An electric plug switch comprises a plug which forms the terminals of a consuming circuit and a plug receptacle comprising contact terminals of both a current-supplying circuit and an independent signal circuit. Upon the insertion and removal of the plug in the plug receptacle the signal circuit is closed and opened simultaneously with the closing and opening of the current-consuming circuit. (See cut.)



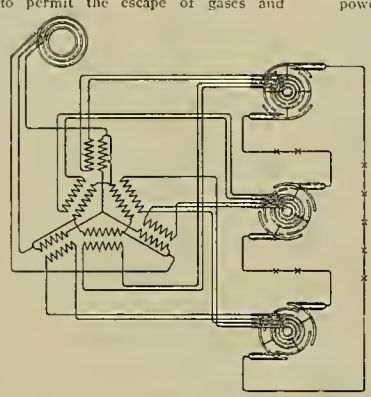
NO. 768,925.—PLUG SWITCH.

768,934. Metering System. Thomas Duncan, Lafayette, Ind. Application filed June 6, 1904.

In a summation-metering system the generators are operated by motors, a summation meter being supplied by generator circuit.

768,937. Apparatus for Rectifying Alternating Currents. Charles M. Green, Lynn, Mass., assignor to the General Electric Company, Schenectady, N. Y. Application filed October 25, 1900.

Two sets of interconnected three-phase transformer primary windings, one set connected in delta and the other in Y, are associated with a single set of supply mains for supplying energy to both sets. (See cut.)



NO. 768,937.—ALTERNATING-CURRENT RECTIFIER.

768,953. Recording Apparatus for Electric Waves. Lewis T. Robinson, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed November 11, 1901.

Apparatus for recording electric-wave forms comprises a contact device, means for moving it synchronously with the period of the wave, and a recording device connecting with the alternating-current circuit through an adjustable co-operating contact. Means are supplied for shifting the adjustable contact co-ordinately with the recording surface through an angular range corresponding to a required part of a wave period.

768,957. Electrical Measuring Instrument. Homer C. Snook, Philadelphia, Pa., assignor to the Roentgen Manufacturing Company, Philadelphia, Pa. Application filed June 17, 1904.

A winding is associated with means for producing a magnetic field. The winding is at the same potential with juxtaposed parts, a condenser being in shunt to the winding. Means indicate the extent of reaction between the magnetic field and the field produced by a current passed through the winding.

768,959. Trolley Wheel. Frederick Strail, Rochester, N. Y., assignor of three-fourths to Alfred Green, George W. Hooper and Charles L. Hooper, Rochester, N. Y. Application filed June 1, 1903.

A trolley wheel is provided with a peripheral groove adapted to receive the wire, the inner faces of the side walls of the groove being concaved.

768,982. Electric Meter. Thomas Duncan, Chicago, Ill. Application filed July 11, 1901.

A coulomb meter has a main armature winding subject to the current in the system, a supplemental armature winding subject to the pressure of the system, and means for producing a magnetic field within which the armature windings are located.

768,995. Electric Arc Furnace. Antoine H. Imbert, Grand-Montrouge, France, assignor to Société de Metallurgie Electrothermique, Paris, France. Application filed March 3, 1904.

Electrodes are mounted within a chamber with which charging channels communicate. Chimneys are connected with the channels to permit the escape of gases and vapors produced in the furnace, and throttle valves in the chimneys control the flow of the gases and vapors.

769,003. Manufacture of Electrodes of Arc Lamps. Maurice Lilienfeld, Berlin, Germany. Application filed March 3, 1903.

Process for producing electrodes of arc lamps consists in mixing with the binding agent luminiferous and light-coloring substances, heating the mixture while stirring to bring the binding agent to the consistency of a thin liquid, and forming the electrodes from the product thus obtained in admixture with powdered carbon.

769,009. Automatic Trolley-controlling Device. Horace W. Nichols and Samuel Briggs, Folcroft, Pa. Application filed January 4, 1904.

Details are described.

769,057. Electrical Choke Coil. George S. Carson, Iowa City, Iowa. Application filed March 30, 1904.

The choke oil is located in juxtaposition to the connection between a lightning arrester and the line wire, the choke coil forming part of the line wire. A direct connection is made between those portions of the line wire at each end of the choke coil.

769,070. Trolley. Lindey F. Forrester, Foxboro, Mass. Application filed January 16, 1904.

A trolley for electric railways comprises in its construction a frame, two trolley carrier wheels journaled to rotate upon the frame, and a trolley wheel supported upon the carrier wheels.

769,084. Contact for Telephone or Like Circuits. Walter A. W. E. Hjorth, Stockholm, Sweden, assignor to Elektromilitara Aktiebolaget, Stockholm, Sweden. Application filed July 17, 1903.

A switch for electric circuits embodies a contact device having a laterally rocking button and provided with lateral contact terminals in addition to the ordinary contact terminal of the device, the button being put into contact with the respective lateral terminals by a rocking movement of the button.

769,085. Trolley Retriever. William W. Hoffman and Francis W. Powers, West Lafayette, Ind., assignors to the Electric and Steam Railway Supply Company, Lafayette, Ind. Application filed October 19, 1903.

A winding drum spring actuated takes up the slack in the trolley cord.

769,086. Trolley Harp. William W. Hoffman, West Lafayette, Ind., assignor to the Electric and Steam Railway Supply Company, Lafayette, Ind. Application filed March 24, 1904.

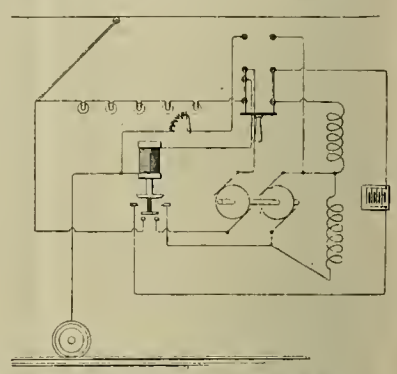
A trolley harp is provided at its lower end with a trough-shaped portion, with means for mounting the trolley wheel and discharging the drippings from the wire into the trough and away from the rope.

769,090. Revolving Field for Electric Generators or Motors. William A. Johnson, Toronto, Canada. Application filed March 5, 1903.

Combined with a drum and central flange having arc-shaped recesses in the periphery thereof are pole-pieces centrally held on the projections between the arc-shaped recesses.

769,094. Electric-lighting System for Cars. Herman Kreusler, Brooklyn, N. Y. Application filed November 28, 1903.

The system embodies a main circuit for normally supplying light, a motor generator for supplying light when the main circuit fails, and a storage battery for driving the motor generator. A circuit-closer controlled by the flow of current through the main lighting circuit completes the auxiliary lighting circuit and the circuit of the storage battery, when the main current does not pass through the lamp or lamps. A switch reverses the functions of the motor-generator sections, so that the motor generator will be operated by the main current to charge the storage battery. (See cut.)



NO. 769,094.—CAR-LIGHTING SYSTEM.

769,098. Starting Device for Alternating-current Induction Motors. Hans S. Meyer, Rugby, England, assignor to the General Electric Company. Application filed November 7, 1902.

The secondary member of an alternating-current induction motor is provided with an ordinary low-resistance winding adapted to be short-circuited on itself, and with a high-resistance winding adapted to be connected in circuit with the low-resistance winding at starting.

769,111. Lever-locking Device for Electric Starting Boxes. George W. Pierce, Butte, Mont. Application filed March 23, 1903.

Mechanical parts are described.

769,113. Fuse Plug. Howard R. Sargent, Rugby, England, assignor to the General Electric Company. Application filed March 11, 1903.

Combined with a tubular shell of insulation are metal caps secured to the ends. One of the caps is provided with a screw thread and the other is partially covered by insulation, a fuse connecting the caps. An absorbent powder fills the unoccupied space within the shell.

769,116. Electric Switch. George J. Schneider, Detroit, Mich., assignor to the American Electrical Heater Company, Detroit, Mich. Application filed August 4, 1903.

An electric switch comprises a supporting member, a guideway closed at one of its ends, a spring contact member within the guideway, a contact member slidably mounted within the guideway and a resilient member operatively associated with the slidable contact member, whereby its tension is exerted to actuate the contact member in opposite directions, and means on the slidable contact for engaging the closed end of the guideway for limiting the movement of the contact in either direction.

769,125. Telephone Sub-station Outfit. Ernest E. Yaxley, Chicago, Ill. Application filed December 28, 1903.

Telephone sub-station apparatus is provided with a signal-receiving bell with a sound dampener controlled by the telephone receiver.

EXPIRING PATENTS.

Following is a list of electrical patents (issued by the United States Patent Office) that expired on September 6, 1904:

369,320. Underground Electric Cable. J. H. Dalzell, Pittsburg, Pa.
369,349. Electric Lamp. O. P. Loomis, Somerville, Mass.
369,372. Lead-armored Conductor and Process of Making the Same. T. G. Turner, New York, N. Y.
369,376. Telephone. F. C. Watkins, Philadelphia, Pa.
369,377. Krotophone. F. C. Watkins, Philadelphia, Pa.
369,378. Krotophone Receiver. F. C. Watkins, Philadelphia, Pa.
369,379. Telephone Transmitter. F. C. Watkins, Philadelphia, Pa.
369,386. Electric Synchronizing Attachment for Clocks. E. F. Bard, New York, N. Y.
369,394. Electrical Conductor. H. F. Campbell, Concord, N. H.
369,400. Dynamo Electric Generator. R. Eickemeyer, Yonkers, N. Y.
369,432. Electrical Heating Apparatus. A. H. Buckelew, New Brunswick, N. J.
369,439. System of Electrical Distribution. Thomas A. Edison, Llewellyn Park, N. J.
369,441. System of Electrical Distribution. Thomas A. Edison, Llewellyn Park, N. J.
369,443. System of Electrical Distribution. Thomas A. Edison, Llewellyn Park, N. J.
369,447. Insulator. E. T. Greenfield, New York, N. Y.
369,456. Electric Arc Lamp. H. Lemp, Hartford, Conn.
369,505. Galvanic Cell. L. Drescher, New York, N. Y.
369,561. Apparatus for Lighting Cars by Electricity. S. H. Short, Denver, Colo.
369,568. Feed Mechanism for Arc Lights. W. W. Street, Springfield, Mass.
369,577. Printing Telegraph. W. B. Wood, Jersey City, N. J.
369,502. Manufacture of Bunched Electric Cables. J. H. Dalzell, Pittsburg, Pa.
369,593. Bunched Electric Cables. J. H. Dalzell, Pittsburg, Pa.
369,594. Manufacture of Diminishing Electric Cables. J. H. Dalzell, Pittsburg, Pa.
369,640. Arc Lamp. D. J. Hauss, Cincinnati, Ohio.
369,655. Regulator for Dynamo Electric Machines. E. Place, Chicago, Ill.
369,664. Carbonizing Mold for Incandescent Electric-light Filaments. Edward P. Thompson, Elizabeth, N. J.
369,665. Method of Testing Electric-light Filaments. Edward P. Thompson, Elizabeth, N. J.
369,666. Carbonizing Mold for Incandescent Electric-light Filaments. Edward P. Thompson, Elizabeth, N. J.
369,672. Electric Alarm Clock. A. G. Wooley, Cincinnati, Ohio.

WESTERN ELECTRICIAN

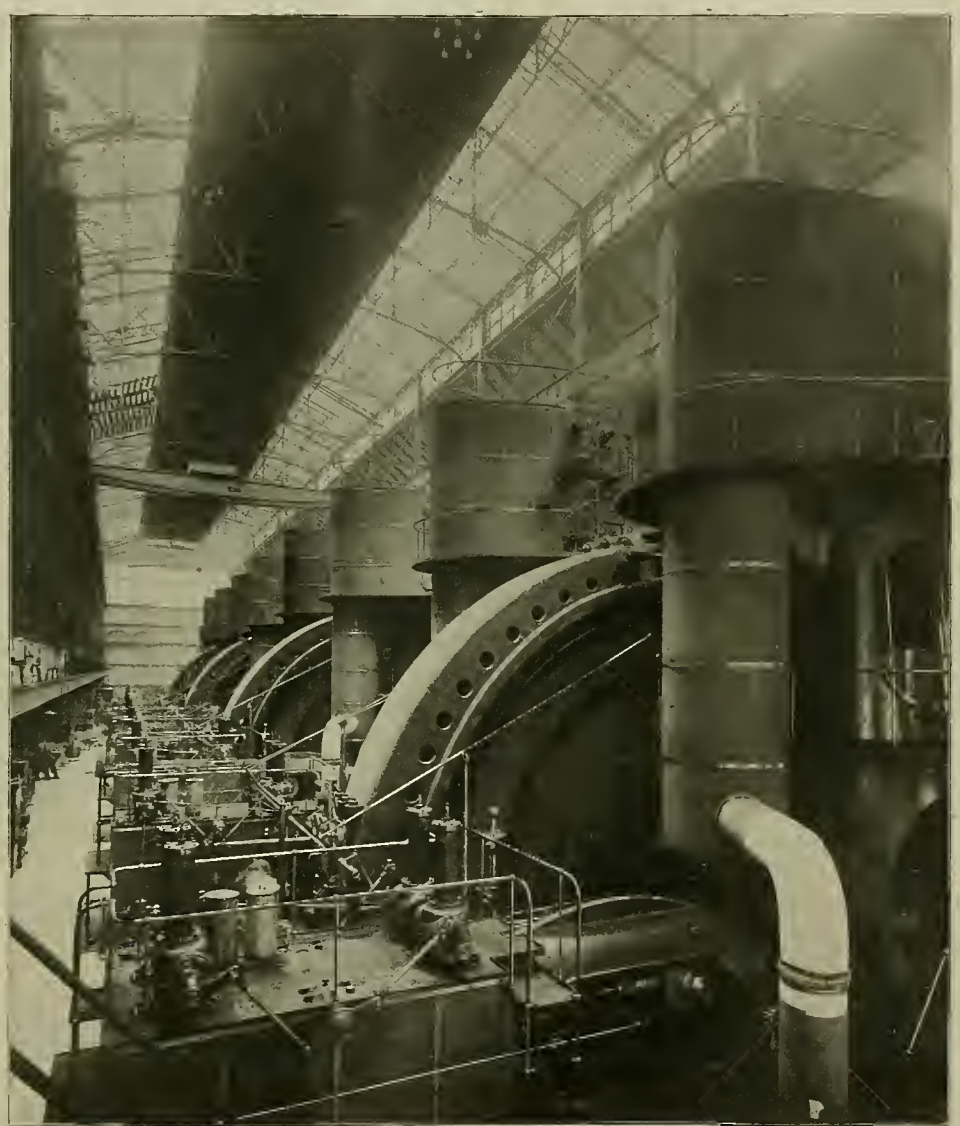
EVERY SATURDAY

Vol. XXXV. CHICAGO, SEPTEMBER 17, 1904 No. 12

Power Equipment of the Interborough Rapid Transit Company.

In the New Year's issue of the Western Electrician was presented a comprehensive description of the subway and rolling-stock equipment for the new underground-railway system of the Interborough Rapid Transit Company of New York city. At that time the power house and sub-stations were not in a sufficiently advanced stage of construction to warrant description, but at the present time, when the opening of the road is momentarily expected, it may be of interest to describe this plant, which possesses a number of new and interesting features.

The main power house, which is about 700 feet long and 200 feet wide, is located close to the west bank of the Hudson, between Fifty-eighth and Fifty-ninth Streets. The building is so arranged in the plat of ground which it occupies that it readily admits of future extension. The present building is designed to accommodate 82,000 rated horsepower, made up of 10 main units of 7,500 horsepower each, the remaining power consisting of four 1,250-kilowatt turbines and two 600-horsepower exciter engines. The overload capacity of the prime movers will increase the rated horsepower by 50 per cent. The arrangement of the interior of the plant has been made on the basis of a division into sections which are normally operated independently, each section consisting of two main engine units, six batteries of boilers and the necessary auxiliaries to insure operation.



ENGINES AND GENERATORS IN INTERBOROUGH RAPID TRANSIT COMPANY'S POWER PLANT.

The boilers are of the Babcock & Wilcox manufacture and are rated at 600 horsepower each, there being 6,000 square feet of heating surface and 100 square feet of grate surface per boiler. They are arranged on both sides of the boiler room in batteries of two each, with a wide aisle between the opposite rows. A few of the boilers are equipped with superheaters, both the Babcock & Wilcox and Foster types being used; also a few of the boilers are equipped with mechanical stokers, hand firing, however, being preferred by the designing engineer.

The coal supply is brought in to the plant from a pier on the river bank. It is unloaded at this pier from barges and is carried by means of a 20-inch Robbins belt conveyor to the power house, where it is received on another 20-inch inclined conveyor, which distributes it to the bunkers. The bunkers have a maximum capacity of about 14,000 tons, there being seven bunkers holding 2,000 tons each built above the boiler room and between the stacks. The coal is brought to the boilers through chutes which deliver on the floor in front of the fire doors. Each section of 12 boilers has its individual stack. Four circular flues are led from each battery and connect to a horizontal flue of rectangular cross-section, two of the latter flues serving for the three batteries of the section which are on the same side of the boiler room. These flues enter into a common uptake, which leads to the stack. The flues are lined with brick and are provided with slip expansion joints, and while the present equipment of the plant does not include economizers, provision has been made so that the gases may be passed through the economizers should they be installed in the future, or else may be delivered directly to the stack. The stacks have been designed in such a manner as to encroach upon the boiler-room space as little as possible and are carried on structural-steel columns, the bases of the stacks being at the level of the lower part of the coal bunkers. The stacks were built of brick, by the Alphonse Custodis Construction Company and weigh about 1,160 tons, the top, which is 15 feet in diameter, being 221 feet above the level of the grates. They are surmounted by an iron top and are provided with a gallery and well equipped with lightning arresters.

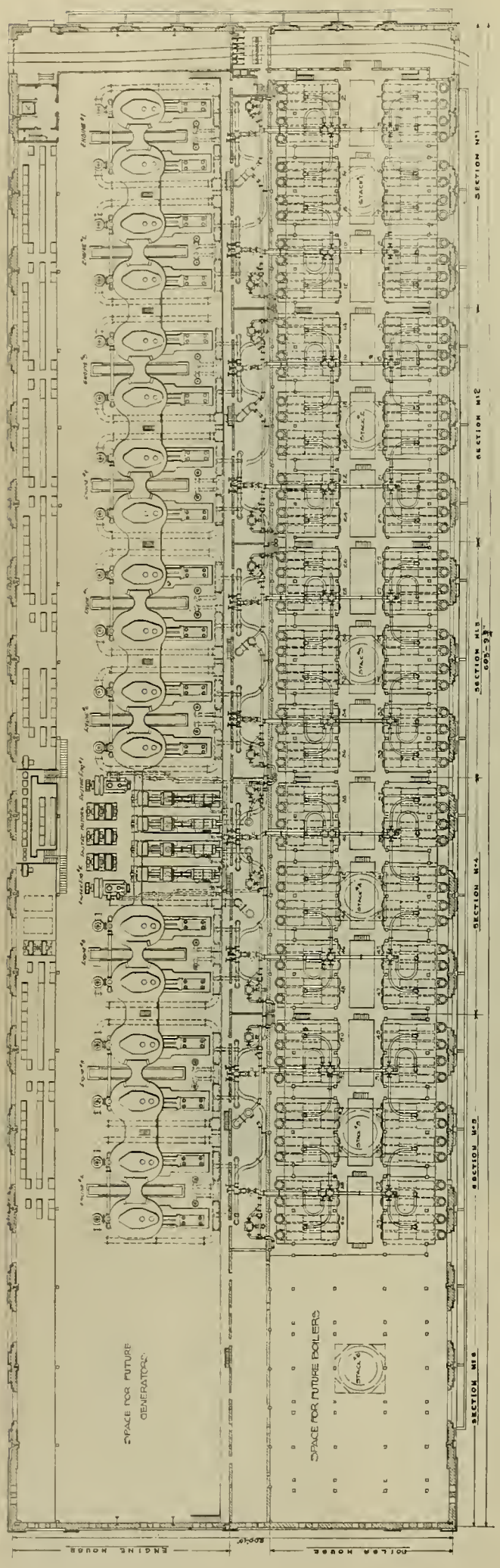
In the basement, under the boiler room, are four ash tracks, two under each boiler row. The ashes are discharged through hoppers into electrically driven cars by which the ash is conveyed to the pier at the river, where it is loaded upon scows for disposal. Under the aisle of the boiler room are located the water-storage tanks, which are filled from the city water supply. These tanks, which are 10 in number, are 46 feet long, 14 feet wide and 78 feet deep; the entire series is connected by a pipe line and the admission of water controlled by means of floats. The feed water for the boilers is drawn from these tanks through an eight-inch suction line and is delivered through a seven-inch discharge, either to the heaters or directly to the boilers.

Between the boiler and engine rooms is an areaway, in which has been located, as far as possible, all of the main steam piping, the lower part of this space serving for the pumps, and the heaters being carried on the raised floor of the areaway. Starting at the side of the boiler house away from the engine room, the three boilers of a section are connected by means of nine-inch pipes to a 14-inch header which crosses the boiler room, and is increased to 17 inches where the nine-inch pipes from the other three boilers of the section join. From this point the 17-inch header passes through the wall between the boiler and engine rooms and enters the pipe area, where it branches into two 14-inch lines which drop below the engine-room floor and turn with large bends and enter steam separators, from which a 14-inch pipe leads up to the throttle valve at the bottom of the high-pressure cylinder. In addition to this direct connection between the engine units and the boilers, three 12-inch headers have been provided, which are run throughout the length of the building. At the point where the 17-inch header divides into the two 14-inch lines leading to the engine, a manifold is provided to which the three 12-inch headers previously mentioned are connected and to which also is connected, by means of a by-pass, the 17-inch header from the six boilers. With this arrangement it is possible to serve any engine unit from any group of boilers, and thus the chances for interruption to the service are rendered as remote as possible.

The entire main steam piping is of extra heavy wrought iron with loose flanges of forged steel; no expansion joints of any kind have been provided in the steam lines, expansion being taken care of by means of long-radius bends. The location of valves in the lines has been such as to provide for easy and positive operation, and quick-closing valves have been used wherever necessary. The valves for controlling the operation of the manifold, and also the lines to the engines have their stems extended through the wall of the pipe area, and are arranged to be operated from a gallery above the engine-room floor.

The main engines are twin compound and are rated at 7,500 horsepower each. The high-pressure cylinders being 42 inches in diameter and the low-pressure 86 inches; the stroke is 60 inches. The high-pressure cylinders are equipped with poppet valves on the top of the cylinders, and the low-pressure cylinders with Corliss valves. The speed of the engines is 75 revolutions per minute, and they were designed and manufactured by the Allis-Chalmers Company.

Each low-pressure cylinder is connected by a short length of 30-inch pipe to an Allberger barometric condenser. These condensers are carried on a structural-steel support on the front of the engine. The circulating water enters at one side of the condenser through a 14-inch pipe, and, after being divided by means of a spray plate, is brought into



PLAN OF INTERBOROUGH RAPID TRANSIT COMPANY'S POWER HOUSE.

contact with the exhaust steam in the main body of the condenser. The discharge is carried by means of a tail pipe to a hot well in the basement, from which it is led to a discharge tunnel which empties into the river. The condensing water is obtained directly from the river through a second tunnel built under the discharge tunnel. The river end of the intake tunnel is provided with gratings and screens to prevent the entrance of foreign matter.

The circulating pump for the condenser draws the water through a 24-inch suction pipe and delivers it through an 18-inch pipe, which branches into two 14-inch pipes, each of which leads to one condenser of a unit. All the pumps, as previously stated, are located in the areaway under the piping and are so arranged as to be capable of being controlled from the engine-room floor. All pumps are steam driven. The two condensers of a unit are connected by means of a 10-inch equalizing pipe, and from each condenser a five-inch pipe leads to one eight-inch pipe which connects to the dry-vacuum pump for the unit.

One section of the present plant is equipped with four 1,250-kilowatt Westinghouse-Parsons turbines which are direct-connected to generators, three of the turbines being at present in place. The turbines are run condensing at a speed of 1,200 revolutions per minute and the generators, which are of the Westinghouse company's manufacture, are equipped with six poles and furnish three-phase current at 7,200 alternations and 11,000 volts. The output of these turbo-generator units is to be used exclusively for the purpose of lighting the subway, power house and stations on the system. In addition to the turbine units in this section there are five exciter sets, two of them consisting of 600-horsepower compound engines, direct connected to direct-current generators, the remaining three sets being motor driven and having a capacity of 300 kilowatts each.

The main generators are of the revolving-flywheel type and are mounted on the engine shaft. They have a capacity of 5,000 kilowatts each and generate three-phase current at 11,000 volts, 25 cycles per second. The revolving fields contain 40 poles and rotate at a speed of 75 revolutions per minute.

The entire electrical system of the plant, including the feeders to the various sub-stations, is controlled from an operating table, which is located in a gallery built above the engine-room floor, on the north side of the building, the operating table being located about the center of the power house and opposite the turbine section. The bus-bar system, which runs almost the entire length of the building, and the circuit-breakers and switches are all placed under the switchboard gallery and away from the operating portion of the engine room. Part of the electrical equipment is at the level of the engine-room floor and a part below, between the basement and engine room.

The switches are of the oil-break type, built in closed brick compartments, and are operated by motors which are controlled from the operating table in the switchboard gallery. The motors which drive the three exciter generators are furnished with current from step-down transformers which reduce the tension from 11,000 to 4,000 volts, at which pressure the current is furnished to the motors.

From the power house, underground cables are led through conduit to the nine sub-stations, eight of which are in New York and one in Brooklyn. The present equipment of the sub-stations consists of from four to six rotary converters of 1,500 kilowatts each. The current from the power house is stepped down from 11,000 volts by means of 550-kilowatt transformers to 400 volts, at which pressure current is supplied to the alternating-current side of the rotaries. On the direct-current side, the current is fed to the line leading to the third rail at a pressure of 625 volts. In addition to the rotaries, there is in each sub-station an exciter set, consisting of a 100 or 150-horsepower motor direct connected to a direct-current generator which furnishes exciting current. The motors of these sets also take their current from the transformers at tension of 400 volts. In addition to these machines, there is in each sub-station a 45-horsepower motor-generator set, the generator of which furnishes single-phase current for operating the signal and switching system.

The electrical equipment of this plant has been designed under the direction of Mr. L. B. Stillwell, whose name is coupled with the design of many of the most prominent plants in the country, notably that at Niagara Falls, while the mechanical and steam equipment has been designed under the direction of Mr. John Van Vleck, who is well known as the designer of some of the largest power plants in the world. The ultimate equipment of this plant means an output of more than 130,000 horsepower, thus making it the largest power plant of its kind in the world.

Ohio Interurban Railway Association.

The executive committee of the Ohio Interurban Railway Association has held a number of meetings through the summer and a great deal of work has been transacted. The next regular meeting of the association will be held on October 27th, the place to be selected later. The committee on standard rules for operation of railways and instruction to employes has prepared a draft of rules and submitted it to several members for approval. H. P. Clegg is the chairman of the committee. All members are requested to correspond with E. C. Spring, West Milton, Ohio, chairman of the subject committee, in regard to topics they would care to have discussed at the regular meeting. The old question of compensating newspapers for advertising will probably be brought up again.

Secretary J. H. Merrill and committees of the association are making every endeavor to increase the number of roads that will use the interchangeable coupon ticket which has recently been adopted. The following roads have already signed contracts to use the book: Cleveland and Southwestern, Lake Shore Electric, Western Ohio Railway Company, Dayton and Troy Electric Railway Company, Toledo, Fostoria and Findlay Railway Company, Cincinnati, Dayton and Toledo Railway Company, Dayton and Northern Traction Company, Dayton, Covington and Piqua Traction Company, Springfield, Troy and Piqua Railway Company, Springfield and Xenia, Dayton and Xenia Traction Company, and Dayton and Western Traction Company. Two roads out of Columbus and the same number out of Toledo have also assured the officers that they will soon enter the agreement. An order is now in the hands of the printers. The books will contain $12 worth of coupons and will be sold for $10. It is believed that many other roads will join the coupon bureau before long. The membership of the association now numbers 132. The delegates appointed to the American Street Railway Association convention are H. P. Clegg, E. C. Spring and F. J. J. Sloat.

Railroad officials and members of the State Railroad and Warehouse Commission met in Chicago on September 9th and discussed plans for compelling steam and electric railroads to install interlocking switches at every grade crossing in Illinois. The railroad officials expressed a disposition to do everything practicable in the interest of affording better protection to the public, but asked for time to consider methods. The conference adjourned without action until October 6th, when the railroad representatives will submit suggestions in regard to the plan to be followed.

Military Possibilities of Engineering Schools.[1]

By George W. Melville.

The gate to a commission in the navy should be opened wider, and I know of no better way of bringing such action about than by permitting the graduates of technological schools, who possess military aptitude and inclinations, to compete for commissions in the service. The curricula of at least a dozen scientific schools, from a scientific standpoint, is the equal, if not the superior, of the Annapolis institution.

The work of the modern naval officer is to a great extent technical, and surely such must be the case in the junior grades. The work of the ordnance and electrical expert in both army and navy is not widely separated from that of the mechanical. In fact, the measure of one's success in ordnance and electrical lines is simply proportional to his technical inclinations, study and training.

The question of utilizing the engineering colleges for the training of officers for the army and navy, and thus bringing both services in closer touch with the people, is not a new proposition. In writing upon this subject only a short time ago, I presented the following views, which received the cordial indorsement of General Miles, then commanding the army, and of General Corbin, executive officials whose military experience in both the Civil and Spanish-American wars particularly qualified them for giving expression as to the capabilities of the graduates of our engineering colleges to qualify for such work:

"The army and the navy will require for war purposes more officers than West Point and Annapolis can supply. It is hardly possible that Congress can be induced to enlarge these schools to the size demanded by the nation's requirements. As many competent officers must be secured for both the army and the navy from sources outside Annapolis and West Point, it is my belief that these military necessities can be met by calling upon the technological colleges to perform the duties which are within their power, and which in honor they are bound to undertake. In order to secure a sufficient and effective directing personnel for the army and the navy, it has been proposed to commission, from the graduates of the technological colleges, those young men who are able to complete successfully a course of technical and military instruction prescribed by officials of the government.

"The military question is in many respects an engineering question. There are a hundred scientific colleges in this country which are capable of giving instruction necessary to fit their graduates for important engineering duties; and it is not unreasonable to presume that a majority of these institutions could give military instruction if substantial inducements were offered for carrying on the work. During the Civil War some of the most valuable of the naval engineer officers were those who had been trained as civil engineers. The training of these men had been well grounded along engineering lines, and by observation and attention to duty, the work incident to a naval career soon became familiar to them.

"There are engineers in Europe, as well as in America, who are comorised in the entire personnel of the United States Navy. An engineering mind is an analyzing, directing and military mind, and it can be employed for the accomplishment of strategical and tactical movements. The rapidity with which an army corps can be moved may decide the destiny of a nation; and the success of this work, under existing conditions, is more likely to be dependent upon the superintendent of a railroad than upon a military commander. The executive ability of the managing engineers of our great industrial plants, in expeditiously furnishing munitions of war, may be of greater benefit than the enrollment of an army corps.

"The requirements of the army and navy, as regards commissioned officers, cannot be met by Annapolis and West Point. The work can be carried on only by many technological colleges of the land, under the direction of master minds acquainted with our military needs and having some knowledge of the power and influence of university work. Under the control of the secretary of war and of the navy, there should be efficient and thorough supervision of this scientific and military education; and the maintenance of all such educational courses should be carried on in a manner satisfactory to the government. If this were done, it would be a step in the direction of co-ordinating American universities and colleges. It would rase the standard of the inefficient institutions by stimulating emulation and encouraging a comparative study of different methods of instruction. Scientific instruction of a high grade is already provided by numerous technical institutions in many parts of our country. The range and quality of their work have immeasurably advanced within the last few years, and several now take rank with the best institutions of their kind in the world. These colleges have made wonderful strides along educational lines, and their faculties make the proud claim that their graduates are the equals in culture and intelligence of those sent out by the colleges of liberal arts.

"During the last 10 years I have discussed this question with distinguished educators, prominent statesmen, and able military leaders, and it seems to be the general opinion that the good of the nation demands that some such action should be taken. One distinguished southern educator declares 'such a measure would be founded upon patriotism and common sense.' The lamented General Francis A. Walker of the Massachusetts Institute of Technology, who was very earnest in his desire to have his institution perform some military duty for the nation, in writing to me upon the subject, said: 'Whether looked at from the point of view of one interested in the political, military or naval history of our land, the subject concerns the defense of the country.'

"At least threescore of college presidents have been consulted in regard to the general work of bringing their institutions to a clearer sense of their military obligations to the state. It is practically their unanimous testimony that the work is not only in the interest of sound technical education, but that the greatest beneficiary would be the national government. When such conservative forces are aroused to the necessity of this work, it must be manifest that it is of import to the nation. It is of marked significance that this proposition appeals most strongly to those college presidents and professors who were formerly identified with either the military or the naval service. These men, from personal experience and association, realize that mutual benefit must be secured by bringing all scientific institutions in closer touch with each other and with the military and naval authorities.

"It is, therefore, time for a plan to be formulated whereby the engineering institutions can render the important military duty to the nation that is within their power to accomplish, and that ought to be within their desire to perform. As it is to be expected that Congress will be more inclined to follow than to attempt to direct public sentiment upon this question, the matter must be taken in hand by the immovable sanity of military officials and scientific educators. A joint commission composed of two officers of the army, two of the navy, two representatives of the land-grant colleges, and two representatives of other scientific institutions, with some former secretary of war or the navy as chairman of the body, should be appointed. Within a year this commission could formulate a scheme whereby the scientific institutions of the United States could supplement the work of West Point and Annapolis, and whereby it would be possible to secure for the future a reserve of highly trained technical men who would receive at least the principles of a military education.

"Even to meet the issue of war with Spain, we had to increase our army tenfold. It is well known that, despite the enormous advantages that we possessed over our foe, we had to keep our troops for months in camps of instruction. In fact, it took so long to work these volunteer regiments into shape that the army which besieged Santiago was practically composed of a good part of the regular army, and but few regiments of volunteers. Such delay would have been, in part, obviated if our engineering institutions had done the military duty that was within their power, and if the nation had utilized the educational forces that were within reach.

"The national and state governments expend millions of dollars in training a volunteer force, and the primary purpose of establishing such an organization is to have in readiness at least a partly trained reserve for the needs of the nation. It is, therefore, necessary, as well as logical, to train a reserve of officers; and there seems no better way of securing this desirable result than by utilizing the great resources that are possessed by the educational institutions of the land.

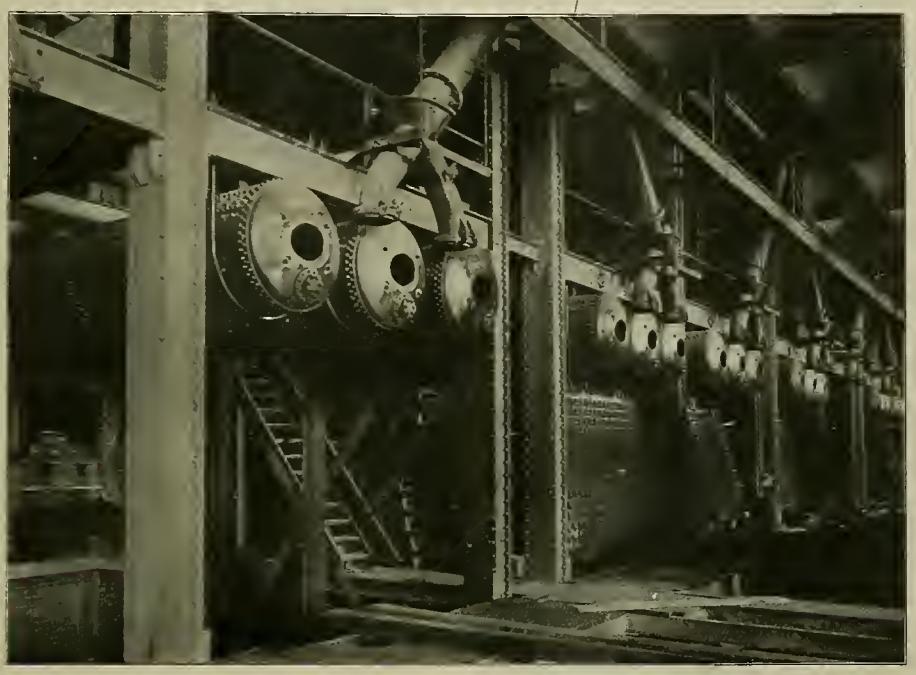
"If this proposition were fully understood, it would appeal to the young men of America now receiving instruction in the several colleges of mechanic arts and sciences. These young men are strong in their own self-respect and ambition, and are intense in their love of country; and, if necessary, their conscience would impel them to offer their all for the honor of the nation. Their education should be directed so that the best within them can be brought out, and I know of no better way of training them to become noble men and valuable citizens than that they should be made to realize that they are receiving a military as well as technical and liberal education for life's work, while in the glory and strength of young manhood."

The military call of the coming century will be a demand for the elect of those trained to executive technical work to qualify themselves so that when the call to arms comes they may be fitted to assume military responsibilities.

The nation has increased sixfold since the establishment of West Point, and threefold since the organization of the Naval Academy, and it will act as a spur and incentive to both institutions to have their work shown up with the best of the technological institutions.

Instead of calling upon all young men of the country to perform military service, as in the case of some continental countries, it should be our aim to compel every technological institution receiving direct or indirect national aid to perform the service of training leaders for the military necessities of the future. Where there is an abundance of leaders, there will be no difficulty in increasing the army greatly without, to a great extent, impairing efficiency.

1. Extract from a paper by Admiral Melville on "The Naval Strength of the United States," read before the Franklin Institute of Philadelphia, on June 15, 1904.



BOILERS IN COURSE OF ERECTION, INTERBOROUGH RAPID TRANSIT COMPANY.

World's Fair Visitors of Last Week.

Among those registered last week at the booth of the Western Electrician in Electricity Building at the St. Louis Exposition were the following-named: E. H. Grubbe, Chicago, Ill.; Lloyd McRoberts, Canton, Mo.; W. L. Templeton, Abbeville, S. C.; A. M. Henry, Abbeville, S. C.; E. C. Epperson, Canton, Ohio; A. J. Elfner, Deadwood, S. D.; Francis A. Singer, Milwaukee, Wis.; R. T. Turner, Spencer, Iowa; O. P. Cockerill, Washington C. H., Ohio; L. W. Klauk, Rose Polytechnic Institute, Terre Haute, Ind.; J. T. Osborn, St. Louis; F. L. Behrens, St. Louis; F. E. Behrens, Farmington, Iowa; George M. Weimer, Buena Vista, Ind.; Abe Weimer, Buena Vista, Ind.; G. A. Kelsall, Louisville, Ky.; Walter H. Inbusch, Milwaukee, Wis.; Dr. Oskar Junghaus, Schramberg, Wyttenberg, Germany; L. C. Frohrieb, Pyh, Pa.; C. H. Eisman, Detroit United Railway Company, Detroit, Mich.; Theodore M. Knoop, New Orleans, La.; L. C. Datz, New Orleans, La.; W. O. Hensgen, Terre Haute, Ind.; A. T. Wayde, Los Angeles, Cal.; Vincent Steck, Plankinton Light, Heat and Power Company, Milwaukee, Wis.; Howard H. Agee, Wooster, Ohio; Mr. and Mrs. J. Henry Steele, Baltimore, Md.; Mr. and Mrs. E. G. Eberle, Dallas, Tex.; B. Guy Kauffman, St. Louis; W. H. Sasser, London, Ky.; Richard Jermberg, Chicago, Ill.; Fred Clarke, Rock Island, Ill.; E. M. Dyer, Missouri and Kansas Telephone Company, Kansas City, Mo.; C. E. Lee; J. A. Templeton & Sons, Staunton, Va.; J. M. Deysdale, United States Patent Office, Washington, D. C.; W. A. Hill, Toledo, Ohio; J. George Keller, Rochester, N. Y.

Circular Tour of Foreign Delegates.

The circular tour which is being taken by the foreign delegates to the International Electrical Congress so far has been an unqualified success. An account of the arrival and entertainment of the delegates at Boston and New York was given in the Western Electrician last week, up to Monday night, September 5th.

On the morning of September 6th, at 8:45, a special train left New York over the New York Central and Hudson River railroad for Schenectady, N. Y. This part of the route was along the Hudson River, and the beautiful scenery of the Highlands of the Hudson and the Palisades was greatly enjoyed as was that of the Mohawk valley.

Arriving in Schenectady at 12:45 p. m., the visitors were entertained at luncheon by the General Electric Company, after which they were taken on a tour of inspection of the works. In the evening the party was taken by trolley cars to Albany, where dinner was served at the Ten Eyck Hotel.

The stay at Albany was short, however, for at 8:30 p. m. the train was again boarded, this time for Montreal, Can., which city was reached early on the morning of the 7th. After breakfast at the Windsor Hotel the day was spent in visiting the principal power plants for which the city is noted, a pleasant diversion being a reception at McGill University. In the evening guests were entertained at dinner by the Montreal local reception committee, of which R. B. Owens of McGill University, was the chairman.

Thursday, September 8th, was spent in sightseeing in the vicinity of Montreal, including Shawinigan Falls and the Lachine Rapids. At eight o'clock the party left for Niagara Falls, which point was reached the next morning. The scenery of the falls and of the gorge and rapids below was a source of keen enjoyment to the many who had never before had the opportunity of viewing it. Of course the "Gorge Route" trip was a feature of the day spent at this great resort. After luncheon the guests inspected the power houses of the Niagara Falls Power Company and the Niagara Falls Hydraulic Power Company and also some of the electrochemical industries which draw their power from these two sources.

At Niagara Falls the party which, with a few additions made en route, numbered about 150 persons, including 19 ladies, was met by Mr. C. E. Scribner of the Chicago office of the General Electric Company, member of the Chicago local reception committee, and Mr. Homer E. Niesz of the Chicago Edison Company. These two gentlemen extended to each member of the party a personal invitation to be the guest of the Institute while in Chicago, also presenting each with a pamphlet containing the Chicago programme and an electrical handbook on Chicago. On the back of each of the programmes was a detachable card with the different Chicago tours which might be taken, the guest marking with a cross the tours preferred. These cards were collected by Mr. Scribner and Mr. Niesz and the parties made up beforehand, so that all went off smoothly during the stay in Chicago, which was reached at 7:30 a. m., September 10th. Upon arrival the delegates were conveyed immediately to the Auditorium Annex, where breakfast was served.

Many men prominent in electrical affairs were to be seen among those clustered about the parlors of the hotel. Bion J. Arnold of the American Institute of Electrical Engineers, President-elect J. W. Lieb, Jr., and past-Presidents F. J. Sprague and Charles F. Scott were there, and Samuel Insull, chairman of the local reception committee, whose effective organizing had so much to do with the success of the entertainment in Chicago, appeared to be everywhere at once.

In the forenoon the general tour consisted of a trip to the Fisk Street station of the Commonwealth Electric Company to inspect the new 5,000-kilowatt turbo-generators, of which there are now three installed and in running order. At half-past nine o'clock automobiles were in readiness at the entrance of the Annex to convey the visitors to the Fisk Street plant and on such other tours as had been previously arranged; most of the party, however, went on the general tour. This trip, from the location of the station, was necessarily through a part of the city not very picturesque to say the least, or very bustling, and it was a source of comment among some of the English members of the party that Chicago wasn't so very "busy" after all.

DELEGATES AND GUESTS ABOUT TO START FOR THE YACHT CLUB.

At the station everything was in perfect order and the visitors expressed much appreciation of the economy of space and smooth running of the big units, two of which were in operation. After about an hour spent at the Fisk Street plant the party left for the main building of the Chicago Telephone Company, visiting the exchange and offices there and then returning to the hotel.

The special tours organized for the forenoon consisted of inspections of the automatic telephone exchange and underground tunnels of the Illinois Tunnel Company, the Western Electric Company's factory, the Chicago Edison Company's Harrison Street station and some typical sub-station, the Union Loop and elevated-railway system, the electric-elevator and general power-motor installations in Marshall Field & Co.'s retail store, and the Deering and McCormick branches of the International Harvester Company. By one o'clock everyone was back at the hotel and ready for luncheon.

During the luncheon at the Annex Lieutenant-Colonel R. E. Crompton of the British delegation was handed a telegram from the British ambassador at Washington, which conveyed the pleasing intelligence that the British government had appointed official delegates to represent it at the Congress. These delegates are Colonel R. E. Crompton, C. B., Dr. R. T. Glazebrook, F. R. S., and Prof. John Perry, F. R. S. Everybody was gratified at this action, which had been somewhat delayed, and congratulations were in order.

Spain sent two official delegates—Miguel Otamendi, C. E., and Antonio Gonzales, C. E. Both gentlemen reside in Madrid. They were very cordially greeted.

Another government delegate in the party was Mr. Jorge Newbery. This young gentleman, who is the general director of electrical works and public lighting in Buenos Aires, officially represents the Argentine Republic, and not Brazil, as was stated in the Western Electrician last week. A confusion of telegraphic date lines doubtless caused Brazil to be credited with Mr. Newbery's appointment.

Mr. Robert Hammond, honorary treasurer of the (British) Institution of Electrical Engineers, contributed to the spirits of all, over-sea visitors and Americans alike, by his unfailing supply of good humor and cheerfulness. Mr. Hammond's linguistic abilities were also in frequent demand. Mr. Hammond was accompanied by his daughter.

The general entertainment in the afternoon took the form of a short cruise on the U. S. S. Dorothea along the west shore of the lake, the party leaving from the Chicago Yacht Club. Captain S. E. Darby was courteous and attentive, and every one of the party, which numbered over 100, was soon made to feel at home, and the trip was much enjoyed. A special tour in the afternoon consisted of an automobile trip through the South Side Park System. All had returned by eight o'clock, when dinner was served.

Taking a night train on the Illinois Central, the foreign visitors and other members of the circular tour party awoke on Sunday morning in Springfield, Ill. Here they were welcomed and escorted about by a committee of local business men. After breakfast at the Leland Hotel, the travelers were ushered into trolley cars and transported to Oak Ridge Cemetery, which, as the site of the Lincoln national monument, is the mecca of many a pilgrimage, not only of Americans, but of foreigners, as well. A halt was made at the base of the monument, and speeches were made by representatives of the mayor and of the business men. Governor Richard Yates also made a speech, in which he dwelt on the genius and character of Abraham Lincoln. Brief but feeling responses were made by Professor M. Ascoli for the Italians, Mr. R. K. Gray for the Englishmen and Mr. B. J. Arnold for the Americans. All foreign members of the party manifested great respect for Lincoln and interest in his monument.

The party was taken directly from the cemetery to the train and arrived in St. Louis about 2 p. m. It was met at the station by representatives of the local reception committee and escorted to the Jefferson Hotel, which, during the afternoon and evening, was the scene of an interchange of greetings between electrical men of international prominence. Quite a number of ladies were present and added to the animation of the brilliant scene.

Geographers Send Signals Around the World.

A feature of the International Geographical Congress which opened its eighth annual meeting in Washington, D. C., on September 8th, was the flashing of time signals around the world. The preparations for these signals had been in progress for several months. Five minutes before midnight on the day of the first session the time-signal apparatus of the United States Observatory was connected by telegraph and cable with nearly every nation on the globe. Signals continued until 12 o'clock. By the co-operation of the various telegraph and cable companies signals were sent to all European nations, South Africa, Egypt, the East Indies, Australia, by through connections across the American continent to Honolulu, Japan, China and the Philippines. An exchange of greetings afterward took place between the officers of the congress and the observatories of Europe and elsewhere. Two signals—one by way of the Pacific cable and the other by way of the Atlantic—met, it is said, at Adelaide, Australia, just 14 seconds after being sent from the Naval Observatory in Washington.

The meeting was opened by Commander R. E. Perry, United States Navy, president of the congress, and there were present distinguished geographers of this and foreign countries. Dr. Charles D. Walcott, director of the Geological Survey, welcomed the congress to America. There was a programme of valuable papers and also a scientific programme.

Old-time Telegraphers' Reunion.

The twenty-fourth annual joint reunion of the Old Time Telegraphers' and Historical Association and the Society of the United States Military Telegraph Corps will be held in Atlanta, Ga., on September 21st, 22d and 23d. The headquarters will be at the Piedmont Hotel. A large number have signified their intention of attending, and Secretary Brant states that there is every promise of a successful meeting. A feature of the entertainment programme will be a typical southern barbecue at which Mayor Howell will extend to the visitors the hospitality of Atlanta. J. E. Scofield of the Postal Telegraph-cable Company, Atlanta, is chairman of the committee on hotels.

Submarine Sound Transmission.

Transmission of articulate speech and of danger signals through the medium of impulses or waves traveling through the water is not a new idea, but still it is one that has never been developed to any great extent. Elisha Gray, the noted electrical inventor, for more than a year previous to his death in January, 1901, had been at work upon a signaling device of this kind, which was described in the Western Electrician of September 12, 1903. Recently several patents for an apparatus dependent upon the same principle of operation have been granted to Arthur J. Mundy, a resident of Boston. One of these patents relates particularly to the transmission of articulate speech through the water.

It has been ascertained that an open body of water may be employed for receiving the vibrations of articulate speech and may transfer such vibrations and deliver them to an electrical transmitter submerged in the water, by which they may be transmitted electrically to a receiver located out of the water and at any desired distance from the submerged transmitter.

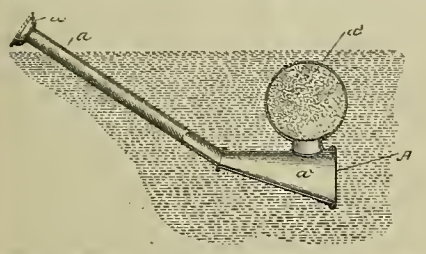


FIG. 1. SUBMARINE SOUND TRANSMISSION.—TRANSMITTING DEVICE.

In Mr. Mundy's invention the vibrations are delivered by a submerged vibratory diaphragm with which the transferring water is in contact, and the vibrations thus transmitted to the water are received by a transmitter of peculiar construction which is submerged in the water and which transfers them electrically to a receiver.

Fig. 1 is a view of the transmitting apparatus in partial cross-sectional elevation. Fig. 2 is a detail view, in cross-sectional elevation, of the receiving apparatus.

Referring to Fig. 1, (A) represents a vibratory diaphragm submerged in the water to any desired depth and upon one side in contact with the water. This diaphragm is vibrated by means of the sounds of articulate speech delivered to it through a speaking tube (a) provided with a mouthpiece. It is preferable to locate between the lower end of the speaking tube and the diaphragm an enlarged chamber (a^2), from which opens a chamber (a^3) filled with a sound absorbent and adapted to prevent excess of sound reverberation in the chamber (a^2). The chamber (a^2) has an enlarged end which is covered by the vibratory diaphragm, and thus permits of the employment of a diaphragm of any required size. The chamber (a^3) may not be used. The chamber (a^2) is somewhat in the nature of a megaphone, which acts to receive the sound and intensify it during its passage to its delivery end, so that the diaphragm is actuated with an increased intensity which this construction implies.

The water in which the vibratory diaphragm is submerged may be any body of natural water—such as a pond, river, or sea, or any other unconfined water—and the extent to which it will deliver the sound vibrations depends upon the intensity with which they are delivered to the water and the sensitiveness of the sound transmitter upon which the sound vibrations thus imparted to the water operate or come into contact.

The receiving apparatus (Fig. 2) consists of a sound-focusing shell. Within the shell is situated the receiving device, which really corresponds to the transmitter of an ordinary telephone. This part of the apparatus embodies a pair of diaphragms, as shown in the diagram. These diaphragms act in a similar manner to the diaphragm in an ordinary telephone transmitter and are electrically connected with a battery and receiving apparatus at the station, which may be on board of a ship, for instance.

It is desirable in submarine telephony not only to provide for the reception of sound signals or vibrations imparted to water, but also at the same time to ascertain as nearly as possible the direction from which the impulses or vibrations come. This is of special consequence when the sound impulses or vibrations are used for indicating danger points. In view of this fact, Mr. Mundy in one of his patents has specified a device which he calls a "sound-direction finder," a view of which is shown in Fig. 3.

The invention comprises a small compact apparatus, which includes upon one side a zone or section sensitive to sound vibrations and in operative conjunction with an electric sound transmitter and which upon the other side is non-receptive to such vibrations or substantially dead to them. The apparatus is mounted in a manner which permits it to be turned in the water to present all its sides in all horizontal directions. It is also connected electrically with a receiver above water and by means of which the sound vibrations which it receives are transmitted to the hearer. The user determines the direction in which the sound vibrations are traveling by the variations in the intensity of the sound signals transmitted to him through the receiver. These may be either the loudest or the faintest so received, or both may be employed in estimating the direction.

COMMUNICATION.

A Run of Stone.

To the Editor of the Western Electrician:

Having had considerable experience equipping burr mills with power, I will answer the question in the September 3d issue of the Western Electrician, under the heading, "What Is a Run of Stone?"

The millstones that were in general use in this country for making flour previous to the introduction of the roller system were 36 to 54 inches in diameter. The favorite size was 48-inch diameter, and burrs of that size were commonly used. The power required to drive such a millstone varied according to the amount that was ground and the texture of the burrs. Common practice for many years settled on six to eight bushels of wheat per hour as the limit that a burr would grind properly. About one horsepower per bushel ground per hour was required, so six to eight horsepower was the average expenditure of power for grinding for each run of burrs. The wheat cleaners, bolting machines, elevators, conveyors, etc., required usually about half as much power as the burrs. Ten to 12 horsepower per run of stone was the average power used in well-equipped merchant mills. No doubt there were instances where more than 12 horsepower per run was required, but they were due to exceptional circumstances.

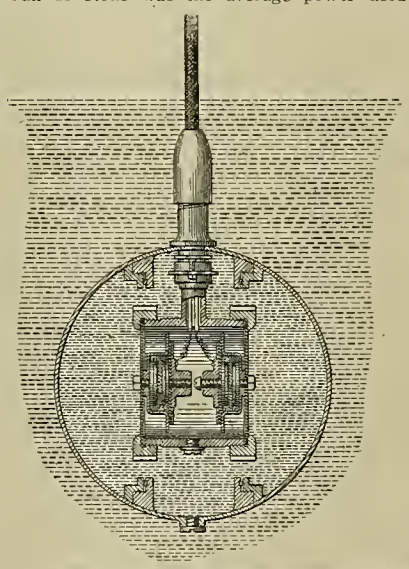


FIG. 2. SUBMARINE SOUND TRANSMISSION.—RECEIVING APPARATUS.

A lease conveying waterpower sufficient for so many run of stone may fairly be considered as conveying so many times 12 horsepower, although the quantity of water consumed would depend on the efficiency of waterwheels used. It was a very loose, indefinite method of conveyance, adopted before accurate methods for measuring water or determining the efficiency of waterwheels had been discovered.

T. W. GRAHAM.

Dubuque, Iowa, September 7, 1904.

What Is "District of Columbia Standard of Measure?"

A reader wishes to know what is meant by the term "District of Columbia Standard of Measure." In a measure recently passed by the City Council of a western city it was stated that every gas or electric meter placed within the limits of the city should be so constructed as to measure accurately and record the number of cubic feet of gas flowing through the meter, or, in the case of the electric meter, the amount of electric current passing through the meter, reckoned either in the number of 16-candlepower-hours or in watts. In the case of both the gas and the electric meters the measurements were to be made according to the "District of Columbia Standard of Measure."

The term is not a familiar one, but perhaps some reader of the Western Electrician will be kind enough to explain its significance.

Society of Chemical Industry Meets in New York.

The Society of Chemical Industry, an organization of British origin, but having members in all parts of the world, has closed its annual meeting in New York city, this being the first time the society has met in America. The meeting was for five days, beginning September 7th, at the conclusion of which many of the delegates went to St. Louis to attend the chemistry sessions of the International Congress. The delegates numbered nearly 100, among them being such famous chemists and scientists as Ira Remsen, Sir William Ramsay, Charles H. Nichols, Charles F. Chandler, Prof. Oscar Leprecht, Prof. Ostwald, Hugo Munsterberg and Dr. Hugo Schweitzer. The general council met in

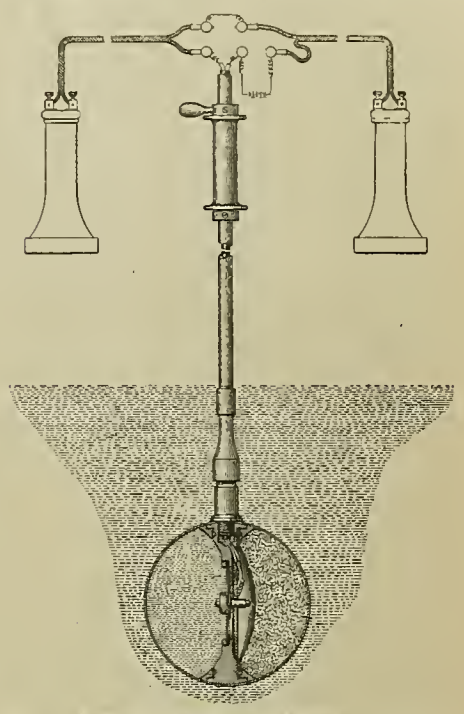


FIG. 3. SUBMARINE SOUND TRANSMISSION.—DIRECTION FINDER.

Havemeyer Hall, Columbia University, followed by a general meeting of the society in the university gymnasium. The papers and discussions were of a highly scientific order, particularly as applied to chemistry. A notable feature was the address of Sir William Ramsay, president of the general organization, who discovered argon and is one of the greatest authorities on radium, helium and the rarer elements, on the methods of teaching practical science. "The training of a bricklayer will never make a man an architect. Nor will the dry research of a grammarian train a new poet. It is the inventive faculty that must be cultivated," said he.

Sir William presented a medal to Prof. Ira Remsen, president of Johns Hopkins University, retiring president of the New York section of the Society of Chemical Industry. William R. Nichols of New York, who was elected president of the local branch to succeed Professor Remsen, promised that as an American he would do nothing to violate the traditions of a distinctly British society.

During the five days there were a number of entertainment features, including receptions, luncheons and smokers, the principal one being the reception given by the Chemists' Club of New York. Two days were spent by a series of commercial investigations, and on the last day there was an excursion up the Hudson. It was voted to hold the next meeting in London during the month of July, 1905.

British Civil Engineers Arrive.

About 90 noted engineers of England arrived in New York on September 10th, coming to this country at the invitation of the American Society of Civil Engineers to attend the International Congress which will open in St. Louis on October 3d. The members were met at the pier by a delegation of the American society, and Capt. W. J. Baxter, naval constructor in the navy, welcomed the party. They will remain in New York about a week and then be entertained on a trip, including Canada, for a week before going to St. Louis.

The party of Englishmen is composed of Sir William White, K. C. B., former chief naval constructor and deputy controller of the British Navy, president of the visiting society; Cuthbert Brereton, who has been connected with many important construction works; Chief Engineer Alexander Ross of the Great Northern railway; Prof. W. C. Unwin of the Central Technical College of London; Secretary J. H. Tudsberg; H. E. Jones, former chief engineer of the Commercial Gas Company of London; General Manager J. A. F. Aspinall of the Lancashire and Yorkshire railway, and others.

WESTERN ELECTRICIAN

EVERY SATURDAY.

PUBLICATION OFFICES:
510 Marquette Building, · CHICAGO.
TELEPHONE, MAIN 1746.

Eastern Office, 193 Times Building, New York.
Telephone, 3806J Cortlandt.

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted. This paper is entered at the Chicago postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the **old address** as well as the new should be given.

CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—**the only general electrical paper published in the West**—thoroughly covers a territory *exclusively its own.* THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be furnished on application.

REMITTANCES.—All checks, drafts and other remittances should be made payable to the order of the publishers, the **Electrician Publishing Company**, and addressed to the offices of publication, Suite 510, Marquette Building (204 Dearborn Street), Chicago, Illinois, U. S. A.

CONTENTS OF THIS NUMBER.

Power Equipment of the Interborough Rapid Transit Company. Illustrated 211, 212, 213
Ohio Interurban Railway Association 212
Military Possibilities of Engineering Schools. By George W. Melville. (Franklin Institute) 213
World's Fair Visitors of Last Week 213
Circular Tour of Foreign Delegates. Illustrated 214
Geographers Send Signals Around the World 214
Old-time Telegraphers' Reunion 214
Submarine Sound Transmission. Illustrated 215
A Run of Stone. (Communication) 215
"What Is District of Columbia Standard of Measure"? .. 215
Society of Chemical Industry Meets in New York 215
British Civil Engineers Arrive 215
Editorial 216
International Electrical Congress. (St. Louis Meeting). 217, 218, 219, 220
Hydroelectric Plants of the World 220
Rates of Electricity Supply. By Etienne de Fodor. (International Electrical Congress) 221, 222
The Relation of the Hypothesis of Compressible Atoms to Electrochemistry. By Prof. T. W. Richards. (International Electrical Congress) 222
Society for the Promotion of Engineering Education 222
Simultaneous Telegraphy and Telephony. By Joseph Hollos. (International Electrical Congress) 223
Denver Also Out for N. E. L. A. Convention 223
Artificial Loads for the Dissipation of Electric Power. By F. H. Davis. Illustrated 223, 224
The Storage Battery as Applied to Electric Railways. By W. E. Winship 224, 225
Some Views on Municipal Ownership 225
Defective Telephone Service in Paris 226
Ohio Telephone Notes 226
Telephone News from the Northwest 226, 227
Southeastern Telephone Developments 227
Interstate Independent Telephone Association of America. 227
General Telephone News 227
Extensions and Improvements 227
Indianapolis Street Railway Station 227
Three-phase Static Ground Detector 227
Two Thousand-kilowatt Rotary Converter for the New York Edison Company. Illustrated 227
Conductivity of Steel Contact Rails. By J. A. Capp. Illustrated. (American Institute of Mining Engineers) 228
Rust Water-tube Boiler. Illustrated 228, 229
Theater Switch. Illustrated 229
Wesco Supply Company's Exhibit at the Exposition. Illustrated 229, 230
Color-reflecting Show-window Light. Illustrated 230

DEPARTMENTS.

Correspondence 230, 231, 232
Great Britain 230
New England 230
New York 230, 231
Ohio 231
Michigan 231
Southeastern States 231
Northwestern States 231
Rocky Mountain States 231, 232
Pacific Slope 232
Personal 232
Electric Lighting 232
Electric Railways 232, 233
Societies and Schools 233
Publications 233
Miscellaneous 233
Trade News 233
Business 233
Illustrated Electrical Patent Record 233, 234

DATES AHEAD.

International Electrical Congress, Coliseum, St. Louis, September 12th to 17th.

Colorado Electric Light, Power and Railway Association, Colorado Springs, September 21st to 23d.

Independent Telephone Association of the United States (annual convention), Inside Inn, World's Fair grounds, St. Louis, September 21st, 22d and 23d.

Michigan Electric Association (annual meeting), October 11th.

American Street Railway Association (annual meeting), World's Fair grounds, St. Louis, October 12th and 13th.

Kansas Gas, Water and Electric Light Association (annual meeting), Leavenworth, Kan., October 18th and 19th.

Interstate Independent Telephone Association of America (annual convention), Chicago, December 13th, 14th and 15th.

To THE present somewhat limited field of space telegraphy an addition has been made by the installation in several cities of France of apparatus for the distribution of standard time. The present method of connecting all clocks to be driven in synchronism with a central standard clock, by electric wires, is at once complicated and expensive. The scheme of accomplishing similar results by the utilization of space-telegraph apparatus has suggested itself to the fertile brain of a Frenchman and is described in Comptes Rendus. A directing clock, opening an electric contact each second, commands a relay which in turn starts a current in the primary circuit of an induction coil furnished with an oscillator; the circuit induced by this coil thus furnishes an oscillating discharge of very short duration, which flashes regularly once a second. The two fine-wire poles of the coil are connected, the one with the earth, the other with an antenna several yards in length. By means of this antenna the sparks affect distant receivers of electric waves, and so all these receivers beat at an almost constant interval each second of the directing pendulum. Two different receivers were tried. The simplest is a radio-telephone of the Popoff-Ducretet system, in which may be heard very distinctly each second ticked by the directing pendulum. The second, which makes a record, is composed of one of the ordinary receivers used in space telegraphy. In order to have the signs more exact the Morse receiver was sometimes replaced by a chronograph with band and marker. With this chronograph, which feeds about 0.4 inch per second, the signs obtained are very clear, and the time of each of them can be depended upon to about 0.02 or 0.03 second.

THE International Electrical Congress of 1904 has opened a most successful session in St. Louis and at the time of the present writing the programme for two days has been carried out without a discord. The attendance at the Congress of 700 people, alone marks it, in size at least, as one of the greatest ever held, and with 170 papers to be presented by the best-known men in electrical science in the two hemispheres it cannot help but be great in effect as well as in mere numbers. Over 2,100 acceptances were received to invitations to join the Congress, and an attendance in the first two days of 33 per cent. of the total number of members is indeed encouraging. The action of England in appointing official delegates at the last moment came as a pleasant surprise. Colonel Crompton, Dr. Glazebrook and Professor Perry were the men chosen as the official delegates, and they are fully capable of sustaining the responsibilities of their position. President Elihu Thomson in review of the work of the organization paid warm tribute to the committee on organization to whom the success of the undertaking principally has been due, and especially to Dr. A. E. Kennelly, secretary of the committee who gave so generously of his time and energies to the furtherance of everything relating to the Congress. President R. Kaye Gray in his response to President Thomson expressed the opinion that probably never before had there been such a programme laid out as that which was prepared for the entertainment of the visiting delegates, and said that he could well appreciate the labor which it had incurred. Prof. M. Ascoli, head of the Italian delegation, also proffered his own thanks and those of his colleagues for the hospitable manner in which they had been entertained. With such expressions of appreciation the members of the various committees having the affairs of the Congress in charge will undoubtedly feel well repaid for their efforts.

SIR WILLIAM RAMSAY, the famous English chemist, who is now visiting this country, has been besieged by scientists from all parts of the country. Naturally, many have sought to obtain his views upon radium and its possibilities. Some of the things he has said concerning this subject are interesting and to the point. In relation to the possibilities of radium for practical purposes he is quoted as saying: "It is a far cry at present to discuss the use of radium or radium salts, for illuminating or heating purposes. I do not suppose there is one-tenth of an ounce of radium in the whole world. If you can imagine getting that amount of radium together it would supply more energy than 250 tons of dynamite. Few persons who talk about radium and its components realize the great scarcity of the raw material for yielding radium nor the exceedingly minute particles used in the experiments that have astounded the world. It is impossible to say where the future supply of raw material is to come from. I believe that in America, carnotite looks promising as a basis for it. Cleavite, a mineral found in Norway, is also looked upon as a favorable source of supply." That there is no more than one-tenth of an ounce of this substance in existence seems beyond belief at first thought. But when we remember that radium is manufactured by a concentration and crystallizing process and that it is only obtained in the form of salts which may contain but a small percentage of pure radium this does not seem so strange after all. The amount of radium salts even, as yet manufactured, is very small. He further said: "There are various theories to account for the evolution of the heat and other strange forms of radiation from helium and its allied elements. The most satisfactory one seems to be that some of the atoms in the substances are disintegrating and thereby liberating stored energy. A few physicists assume that the energy was at one time absorbed from some external source, and is now given off again. If we judge by the rate at which gas is evolved from the salts of radium, it seems probable that any given mass of it would decay and completely disappear in from 2,000 to 2,500 years. The life of three or four other radio-active metals is very much longer. My own research, which is not yet complete, encourages me to think that the 'electronic' theory of atoms has a career of usefulness before it. Our new understanding about the atom may lead to entirely unforeseen results."

RAPIDLY increasing competition between electric and steam railways has caused some apprehension among the Brotherhoods of locomotive engineers and firemen. The Brotherhoods are beginning to ask what their fate will be if the railroads are at liberty to follow up the changes in motive power by putting in men at motormen's wages in the place of high-paid engineers. They look on the movement as involving a grave problem for their organization, and conferences between the management of the lines and the engineers are now going forward. It would seem on the face of it that the roads in changing from steam to electricity have changed from a system of high-priced to low-priced labor, since the skill of the ordinary motorman cannot compare with that of the locomotive engineer. From present indications the steam roads which have adopted electric suburban service and retained steam on the longer runs will have to adopt a wage scale for each, and to the extent to which electricity is used the locomotive engineer is permanently retired.

Mr. Warren S. Stone, chief of the Brotherhood of Locomotive Engineers, had some interesting things to say recently concerning the increasing use of electricity as a motive power and concerning the possibility of its supplanting steam in long-distance railroading.

"So far as suburban traffic is concerned," said Mr. Stone, "electricity as the motive power of trains will soon be here. I should imagine it will be little more than a question of a few months before most of the suburban railroad trains will be moved by electricity."

"When people trust their lives in a railroad train, whether the motive power be steam or electricity, they are entitled to have a man in control of the power that whirls them at such great speed through the country who is a first-class man in every respect—in brains, in vigor and in responsibility of character."

This is a fact not to be lost sight of. Men upon whom the responsibility rests of operating a train, whether it be driven by steam or electricity, should be trained by long experience and should understand thoroughly the apparatus under their control. Thanks to the rigid system of "weeding out" now in vogue upon the steam roads, a man can never go beyond the capacity of fireman until he is fitted for the more responsible position. As it is with the locomotive engineer so it should be with the motorman. He should be a first-class man in his particular line, and, in order to encourage him to spend the necessary time and incur the necessary expense to become such, his pay should be equivalent to the service which he renders.

INTERNATIONAL ELECTRICAL CONGRESS.

Opening of the St. Louis Meeting of 1904.

St. Louis, September 12.—In many respects the International Electrical Congress of 1904, which began its work here today, is a remarkable gathering. It comprises many distinguished men, including a number from abroad. Great Britain and Italy responded nobly to the invitation and sent notable delegations, including such men as Ascoli, Lombardi, Prof. John Perry, Dr. Glazebrook, R. Kaye Gray, Colonel Crompton and others. Other foreign nations were not so numerously represented, but are nevertheless represented by men whose names are well known to the electrical fraternity the world over. The United States, of course, contributes the great majority of the members of the Congress, and to particularize here, in the matter of names, would be invidious. But it is in size and the magnitude and character of the work laid out for it that this Congress is especially unique. In response to invitations to join the Congress over 2,100 acceptances have been received, over 1,600 from the United States and nearly 500 from other countries. Of these, 1,700 have paid the fee and are enrolled as members of the Congress. These are notable figures. Many who are known to be coming have not yet arrived, but the number attending on this the first day is large. The actual number registered or a close approximation of the total number in attendance will be given later.

And think of the 170 papers from well-known men, promised for the Congress! Eighty-six of these were received in advance in sufficient time to be printed before the opening day. All the papers, with the discussions (there is a stenographer for each of the eight sections), will be printed in the volumes of Transactions, and furnished to the subscribing members of the Congress. An invaluable mass of material, relating to all branches of the art, will be thus collected. The Western Electrician will give its readers a general account of the proceedings, many of the papers in full or in abstract, and a report of the gist of the more important discussions.

The Congress assembled this morning about 10 o'clock in the Music Hall of the Coliseum, at Thirteenth and Olive Streets. Perhaps 500 persons were in the seats when the proceedings were begun, and more came in later. The acoustic properties of the hall were not good, and there was some trouble in hearing a few of the speakers. On the platform were Prof. Elihu Thomson; President D. R. Francis of the Louisiana Purchase Exposition; Prof. M. Ascoli, president of the Associazione Elettrotecnica Italiana; Mr. R. Kaye Gray, president of the (British) Institution of Electrical Engineers; Mr. B. J. Arnold, president of the American Institute of Electrical Engineers; Mr. J. W. Lieb, Jr., president-elect of the American Institute of Electrical Engineers; Prof. John Perry, Col. R. E. Crompton, Dr. R. T. Glazebrook, H. E. Harrison and others of the British delegation: Prof. L. Lombardi and others of the Italian deputation; H. S. Carhart, A. E. Kennelly, W. D. Weaver, C. P. Steinmetz, Carl Hering, Louis Bell, Louis Duncan, Dr. F. A. C. Perrine, Major Samuel Reber, U. S. A., and a number of other Americans and foreigners.

Prof. Elihu Thomson, president of the committee of organization for the Congress, called the assemblage to order and introduced President Francis of the St. Louis Exposition, who made a speech of welcome. Mr. Francis gave his hearers some idea of the scope of the exposition and paid a compliment to Prof. W. E. Goldsborough, chief of the Department of Electricity, whose "very intelligent efforts" had resulted in the display that was to be seen in his department.

Professor Thomson then made a statement for the committee of organization, referring to the International Electrical Congress in Chicago in 1893, and paying a warm tribute to the work of Dr. Kennelly and Mr. W. D. Weaver in preparing for the present Congress.

Major Reber moved that the president appoint a committee of three to effect a permanent organization. This was carried, and Major Reber, Professor Perry and Professor Lombardi were named as the committeemen. Professor Carhart moved that another committee of three be appointed to select honorary officers. This was likewise carried, and Professor Carhart, Mr. Weaver and Carl Hering were named on this committee. Both committees reported subsequently, and their reports were unanimously adopted. The officers of the committee on organization and of the sections were made officers of the Congress, including Elihu Thomson as president and Dr. A. E. Kennelly as general secretary. A list of foreign honorary vice-presidents and honorary vice-chairmen of sections was also read. Both lists of names are given in the more detailed account of the opening given below. The names of the officers were received with applause, particularly that of Professor Thomson.

Mr. Gray—a man of imposing presence—made the response to the welcoming speech for the Englishmen. He thought that never in the world was such a programme laid before any congress of any nation. He alluded in flattering terms to the work of Elihu Thomson in preparing for the Congress, and spoke warmly of the attachment and admiration felt by the English engineers for their American fellow-workers.

Professor Ascoli spoke for the Italians, courteously using the English language. He noted the exceptional fact that so considerable a number of Italian engineers had made the journey to the United States to attend the Congress and referred in laudatory terms to the hospitality and friendship of the Americans. Mr. Ascoli has a manner that combines dignity and gentleness, and he made an excellent impression.

Mr. Guillebot de Nerville, an official delegate from France, responded for France and the other nations not previously represented among the speakers, using the French language.

Prof. W. E. Goldsborough, chief of the Department of Electricity at the exposition, extended a welcome on behalf of the electrical men of St. Louis. "We have worked with what you have placed in our hands," he said; and he trusted the visit would be full of pleasure and profit.

In accepting the presidency of the Congress, Professor Thomson made an address that was happily brief, but clear and scholarly. He pointed out the difference between the pursuit of scientific knowledge for its own sake and for use in engineering. However, scientific research must strive always toward the ultimate value of truth, and engineering must be scientific. The speaker closed by telling his hearers that they or their successors should be prepared to accept the fact of an electrical universe. This address and most of the other speeches are given in full in the detailed account that follows.

Secretary Kennelly said that there was a branch postoffice, Western Union and Postal telegraph offices and Bell and Kinloch telephone offices in the Coliseum for the benefit of members of the Congress. The American Telephone and Telegraph Company had very courteously extended the free use of its long-distance telephone lines to members before 10 a. m. and after 6 p. m. on each day of the Congress. After some other announcements the opening ceremonies were concluded, and the Congress divided itself into eight sections for the reading and discussion of papers. These sections all held their opening meetings in various parts of the Coliseum Building.

W. E. K.

[A late estimate of the total attendance at the Congress places the figure at 700.]

Detailed Account of the Opening of the Congress.

PRESIDENT FRANCIS' WELCOMING SPEECH.

As president of the Universal Exposition, now in progress in St. Louis, I have been asked to extend to you a welcome to this city. I appreciate the honor very highly, and regret that my engagements are such that I cannot remain with you during your entire session of today, and, in fact, during all of your sessions to which I might be granted admission. The character of this International Congress is such as to commend it not only to the greatest consideration of the management of the Universal Exposition, but also to the municipality of St. Louis, our state government, and, I might say, the national government also; because our government has recognized this congress, as have the governments of many foreign countries, by appointing delegates to represent it.

This Universal Exposition, gentlemen, is a very ambitious scheme, as you know. Any assembling of the best products of the human race in any special line of human endeavor is ambitious; but when an undertaking is planned to comprise the assembling of the best products of every line of human endeavor it is almost colossal in its proportions. We who have been engaged in this movement from its inception have seen it grow in its plan and scope, from week to week, and from day to day, and we must confess that at the beginning we hardly realized the magnitude of the work. It would be presuming upon the part of the management for us to attempt to prejudice you as to the character and comprehensiveness of the exhibits that have been assembled at this Exposition. We leave it to you to pass judgment yourselves upon the Exposition when you have given as much time to the inspection of the Exposition as your engagements will permit. I think it will be a long time, in this country at least, before another universal exposition is attempted. There will, of course, be international expositions in special lines, and the line which you represent is the one in which there is likely to be another international exposition before a great many more years have rolled by. The great advances which have been made in the science to which you have given allegiance has rendered more than interesting any assembling of the different appliances and any demonstration of the different inventions and discoveries that have been made by the members of this congress or by the members of the allied organizations.

There was some argument, if I may term it such, in the organization of this Exposition as to whether electricity was entitled to recognition as a separate department. There was a claim made by the Department of Machinery that electrical appliances, when made instruments of utility, became machinery and consequently belonged in the Department of Machinery, and that there was no more occasion or necessity for a department of electricity than for a department of steam. I believe that those of you who will see the Department of Electricity which has been installed at this Exposition will admit that the action of the administration of the Exposition in determining that electricity should not only be a separate department, but should have the exclusive use of a large exhibit palace, was a wise conclusion.

It would be presuming on my part to attempt to dwell on the advances that have been made in electricity in recent years in addressing such an audience as this. I am sure, however, that you will pardon the presumption in a layman, if you may so consider it, when he expresses the opinion that the development in this line has hardly begun. The installation in the electrical department in this Exposition is, in the judgment of the management, superior to any installation that has ever been given in any exposition. (Applause.) It is the result of the very faithful and intelligent efforts of the chief of the Department of Electricity. (Great applause.) In so comprehensive an organization as a universal exposition you can readily understand that there must be a number of men who are trusted to do a great many things without consulting any higher authority.

The organization which has brought about this Exposition has been in existence about five years. This work dates back five years—dates back six years, I may say, from the inception of the movement, but the first three years of that time were devoted to promotion work, so that the organization of the company proper does not date previous to March, 1901. For three years previous to that time there were some of us in this city who were agitating the question of the celebration of a great event in the history of the United States. That took shape in the form of an exposition. After Congress had recognized this celebration by appropriating five million dollars to aid in its inauguration, a local company was formed, which company had charge of the movement from that time forward. In organizing the local company the work was divided into four great divisions—Division of Works, Division of Exhibits, Division of Publicity and Promotion or Exploitation, and the Division of Concessions and Admissions. The Division of Exhibits is under the control of a director, under whom are 15 chiefs of departments. We congratulate ourselves on the classification of these exhibits. You gentlemen, who are readers and thinkers, know how difficult it is to make a comprehensive classification, and a working classification, that will include all of the products of all of the civilized countries on the globe. One of the departments of that Division of Exhibits—one of the great departments of that classification—is electricity.

We might call electricity the new science. The discoveries that are being made in it from day to day will no doubt necessitate another classification or sub-classification before another exposition is held, whether that exposition will be universal or an international exposition of electricity.

The wisdom that has been exercised by the organizers of this congress and by those who have kept it in existence from year to year indicate a great breadth of view and a remarkable foresight in regard to the development of electricity. The different branches of this congress all demonstrate how far-reaching are the discoveries in electricity.

St. Louis is glad to be made the scene of your congress. The Exposition management feels honored that the time and place of your meeting should have been influenced by the preparations that were made by the exposition for the purpose of bringing together the best products of all the peoples of the world. Permit me on behalf of the Exposition management, to express the hope that your deliberations may come fully up to your expectations; that you may visit the Exposition exhibit of electricity; that your gathering here may be prolific not only of pleasure to yourselves, but that it may result in still further advances in the line of progress which you have pursued with such remarkable vigor and success during the last decade. I would that I could stay and listen to the remarks that I understand will be made by the members of your organization, but an engagement for an hour which is already passed, to open a congress on the grounds of the Exposition,

compels me to take my departure. I, therefore, will close by again thanking you for meeting in St. Louis, and by expressing to you the hope that you may visit the Exposition as often as your engagements will permit, that you will remain with us as long as you possibly can, and that when you return to your homes the recollection of this Exposition may induce you to come again yourselves, and to advise all of your friends to visit us. I thank you, gentlemen. (Applause.)

Professor Thomson's Review of the Work of Organization.

Elihu Thomson: We will now proceed to the work of opening the Congress. The committee on organization substantially finishes its work on this occasion. It is, perhaps, well at this time to recall a little of our past history. The four hundredth anniversary of the discovery of America was celebrated in 1893 by the establishment of a great exposition. The Chicago International Electrical Congress, the work of which is doubtless familiar to many of those present today, was the first great gathering of electrical students and workers held in the western hemisphere. A little over 100 years ago the then youthful but ambitious republic of the United States of America acquired from France, by the expenditure of $15,000,000 purchase money, the possession of an enormous territory extending from the shores of the Gulf of Mexico, west of the Mississippi River, northward and westward to the Pacific Coast. The northern limit was undefined, and was settled long after by treaty with Great Britain. The tract includes every variety of farm land, forest, semi-arid and arid land. Much of the arid land is amenable to irrigation. The agricultural and mineral wealth is beyond estimation. The Louisiana purchase must be regarded as an event not less important than any other in the history of this great nation, fitly to be celebrated after 100 years by a great exposition, showing the results of human activity and progress in the arts, sciences and engineering—and, I might add, especially in electrical science and engineering—the first in the new century just begun.

It was natural that an international electrical congress should have been deemed desirable. Accordingly, a committee of organization was called together by the Exposition authorities. The committee in undertaking the work realized that the task was not a light one, and invoked the aid of the American Institute of Electrical Engineers and the other societies which have affiliated themselves with the Congress. The work of the committee of organization is completed by this meeting, and the choice of permanent officers is now in your hands. I cannot close this short statement without a warm tribute to the work of the secretary, Dr. Kennelly, who has given time and effort without stint to every phase of the development of the Congress. (Applause.) Neither can I fail, also, to remind the Congress that the diligence, care and good judgment of the treasurer, Mr. Weaver, of the Electrical World, have been invaluable. He has been a pillar of strength at all times. I wish also to express our deep sense of the assistance and encouragement arising from the assurances of co-operation received from the various scientific and technical bodies which are represented here today.

I now have the pleasure of calling upon Mr. R. Kaye Gray, president of the Institution of Electrical Engineers of Great Britain, to respond, on behalf of the British Institution, to the address of President Francis. (Applause.)

Response from Gray of England.

Mr. R. K. Gray: We have all heard from President Francis as to the objects of this great exposition. For my part, I may perhaps state to you that we, the Institution of Electrical Engineers of Great Britain, felt very much pleased when we received the invitation to go to St. Louis and to take part in the Electrical Congress. This pleasure was made all the greater when we received from our colleagues on this side of the Atlantic, the American Institute of Electrical Engineers, a cordial invitation to come to their country, and an assurance from them that we would receive a hearty welcome, and that they would charge themselves with looking after our welfare during our sojourn in your country.

There is another pleasure which we have experienced here since our arrival, and that is that we have met our colleagues from Italy. I had the extreme pleasure in the spring of last year to visit with our Institution the North of Italy and to see the work which was being done there. I met my friend, Professor Ascoli, whom I am very glad to see is leading the Italian contingent which has also crossed the Atlantic to visit your shores and has also received the hearty welcome which you extended to us all, upon the occasion of our trip to Italy last spring.

When we arrived here and had placed in our hands the programme which you had prepared for the Congress—I think that never in this world has such a programme been laid out before, I won't say for an electrical congress, but I will go further and say that a programme such as this has never been before laid out for any congress of any nature whatever, which is at all a special one—we were still further pleased that we had arranged to visit your shores and take part in the Congress. (Applause.) Those of us who have at various times during our career had occasion to organize meetings, though of very much smaller proportions than this Congress, can very well appreciate what an enormous amount of labor has been expended by our kind friends on this side to organize such an extensive programme as is now laid before us. We have heard from President Francis, and we have heard from Prof. Elihu Thomson how much Dr. Kennelly and Mr. Weaver have done; but I think, now that we are here, and I have command of the platform, you will allow me to break through that veil of modesty which is so well known in Prof. Elihu Thomson (applause) and to give him his due meed of praise. I can see, gentlemen, by your applause, that the venture I have made has been a perfectly justifiable one. (Applause.)

I do not know that I should occupy your time any longer, because my good friend, Professor Ascoli, is going to have the pleasure of addressing you, but before taking my seat I wish to say, in the name of the Institution of Electrical Engineers of Great Britain, how warmly we feel toward you all in this country. I wish to say what great admiration we have for you. I cannot speak of St. Louis, of course, because we only arrived yesterday afternoon; but perhaps before this Congress closes some of us will have had time to appreciate the result of the work of your committee of organization. (Applause.)

Response from Ascoli of Italy.

Prof. M. Ascoli: I have the honor, which I highly appreciate, to reply in behalf of the Italian delegates to President Francis, to Professor Thomson and President Gray, who have all had such kind words to say to our delegation from Italy. It is really an exceptional fact that so considerable a number of Italian engineers should join in a visit to this country. I think it is the first time that such a large delegation of Italian engineers has visited the United States. We have already had a splendid proof of the great hospitality and of the sentiments of friendship from the Americans who have entertained us in the last few days. We had the opportunity of seeing and highly appreciating the great results of organization, which is a special characteristic of the American work. We heard from President Francis the history, I dare say, of the organization of the Exposition. We had from President Thomson an idea of the work done in the organization of this Congress, and we are sure that with such an organization the work of the Congress must have the most important results. I cannot speak in the English language as clearly as it would be necessary for me to do to express the sentiments of the Italian delegation for our American brothers on this occasion. But I hope to interpret the sentiments of my Italian colleagues to an extent sufficient to convey to you our hearty thanks for your kind welcome and our appreciation of the hard work which has been done in the organization of this Congress, and especially to Professor Thomson, Dr. Kennelly and Mr. Weaver.

Chairman Thomson: We are happy in the example set by our British and Italian colleagues, and in case we ever hold another exhibition and congress, we hope their example may be followed by other nations. We hope that our colleagues in France may be induced to send equally large or larger delegations. There are other countries, too, which might easily send delegations when they get into the spirit of it. You know, however, the traditional unwillingness of the Frenchman to leave his home and fireside and travel in foreign lands; but it so happens that we have with us one representative of the great republic of France, and I have pleasure in calling upon Mr. Guillebot de Nerville, to speak, not only on behalf of France, but on behalf of other nations which may be represented here to a greater or less degree.

M. de Nerville then addressed the meeting in French, and expressed his pleasure in being in attendance on the Congress.

Welcome from Professor Goldsborough.

Prof. W. E. Goldsborough: I cannot tell you with what pleasure I welcome you to St. Louis, on behalf of the electrical men of St. Louis. We feel that in coming here and in meeting with us you have brought to us the one gift which we have prized more than all else in connection with the exposition. It is not fair to say that the exposition management is in anywise responsible for any achievement in electrical engineering which you may find at the exposition; it is only fair for me to say that an international electrical congress which has been directing and working to a far greater extent possibly than any of us here have knowledge of, during the preceding months, has organized and placed at the exposition a demonstration of what has been accomplished in the field of electrical engineering, which is a physical embodiment of the effort of the Congress, and I say of the Congress advisedly; because the men, the brains and the muscle, the enthusiasm, which has gone into the work at the exposition, has come from you. In Machinery Hall you will find large direct-connected generating sets of very advanced type, many of them complete installations, and in the Palace of Electricity small apparatus, apparatus which bears more particularly upon the scientific and physical side of our work. On the exposition grounds there is an illumination which some have been pleased to say is a very beautiful thing, and which has been brought to its state of present perfection, as regards its conception, by Mr. Henry Rustin. In all of these things we have worked with what you have placed in our hands. There is now opening here, in this Congress, as I look at it, the work which will represent the mental concept of what has been placed on the exposition grounds in its physical aspect.

During the months that have gone by it has largely been the knowledge of the fact that you would be with us to enjoy the electrical features of the exposition which has inspired us to put forth our best effort, to make preparation for your coming. I want to say, on behalf of the exposition management, that President Francis, Mr. Skiff, the director of exhibits, and Mr. J. E. Smith, chairman of the electricity committee, have given me such support as I doubt any man might fairly have expected to receive from his superior officers; and anything which you do not feel that you can take to yourselves, I hope you will credit to them, as between you lies what credit there is for what has been done.

Naturally, the American engineers have appreciated more than words can express the effort that has been made by our foreign friends to meet with us and make our meeting here a truly international one in the broadest possible sense. We know of the measure of fatigue they have had to withstand, and how much they have been inconvenienced by having to focus their time on a very distant city without reference to their own convenience, inasmuch as this Congress was organized and had to be organized without special reference to the desire of individuals. The fact that they are here in such large number is greatly appreciated, and I think tells the story better than it can be told in any other way of the fine co-operative spirit which has animated electrical workers since its inception. We have probably a better nomenclature, we probably have more uniform standards, and have our work systematized for making it of accurate record and for passing it between men of different tongues than has any other division of human endeavor. It is a matter upon which we must congratulate ourselves, and I am quite sure as the result of your work here that we will go forward during the next decade much better equipped than the electrical fraternity has ever before been for the task before us. I thank you very much for the opportunity of extending to you a welcome on the part of the electrical men of St. Louis, and trust your visit may be one of pleasure and profit. (Applause.)

Organization of the Congress.

On recommendation of the committee, headed by Major Reber, these officers of the Congress were elected:

President—Elihu Thomson.
Secretary—Dr. A. E. Kennelly.
Treasurer—W. D. Weaver.

Vice-presidents—Bion J. Arnold, Prof. H. S. Carhart, Prof. W. E. Goldsborough, C. F. Scott, Prof. S. W. Stratton.

Section A. General Theory.—Chairman, Prof. Edward L. Nichols; secretary, Prof. Howard T. Barnes.

Section B. General Applications.—Chairman, Prof. Charles Proteus Steinmetz; secretary, Prof. Samuel Sheldon.

Section C. Electrochemistry.—Chairman, Prof. Henry S. Carhart; secretary, Carl Hering.

Section D. Power Transmission.—Chairman, Charles F. Scott; secretary, Dr. Louis Bell.

Section E. Electric Light and Distribution.—Chairman, John W. Lieb, Jr.; secretary, Gano S. Dunn.

Section F. Transportation.—Chairman, Dr. Louis Duncan; secretary, A. H. Armstrong.

Section G. Communication.—Chairman, Francis W. Jones; secretary, Bancroft Gherardi.

Section H. Electrotherapeutics.—Chairman, Dr. William J. Morton; secretary, William J. Jenks.

On the recommendation of Professor Carhart's committee the following-named gentlemen from abroad were elected as vice-presidents of the Congress: Professor Ascoli, Colonel Crompton, Dr. Glazebrook, Gonzalez Gray, Lombardi, Perry, Poincare. For the honorary chairmen and vice-chairmen of the sections these were chosen:

Section:	Honorary Chairmen.	Vice-chairmen.
Section A	Arrhenius	Lash-Miller
Section B	Grassi, Zipernowsky	Duddell and Weber
Section C	Ostwald	Dennery
Section D	Janet, Maffezzini	Jona
Section E	Otamendi	Newbery and Arizpe
Section F	Ferstel, Sandick	Latour
Section G	Hesketh, Harrison	Ferrie and Shields
Section H	Bergonie	de Nerville

President Elihu Thomson's Opening Address.

President Thomson: I thank the gentlemen of the Congress for this endorsement of what has gone before. I cannot but feel that in electing the same officers as the permanent officers of the Congress, without objection, without even a suggestion on the part of anyone of a change in these officers who have served on the committee of organization, that the work of the committee has received your endorsement. We are encouraged by that result. The duties before us will not probably be so arduous as those which are in the past. It is usual on occasions of this kind for the president-elect to make an address. I have a few thoughts to present, and without trying your patience too much I will take this occasion to give them to you.

The main object of the Congress will have been fulfilled if there is brought out in its papers and discussions the best thought and work in the electrical field. We have no need to dwell here upon the great growth which has taken place and is now going on in electrical science and engineering. True it is that equally rapid advancement may be

found in many fields, but electricity is unique in its almost universal character. Not only has it already made great revolutions in methods of lighting, in power systems, in transportation, in communication of intelligence and in many other fields of engineering, but our conceptions of the nature and workings of the forces in the universe, even the nature of matter itself, are and will be profoundly affected. It is too early even to suggest that electricity will be the study of the alchemist of the future.

Research in pure science seldom takes account of engineering and industrial possibilities. It is well that it is so; but from the present standpoint the electric arc of Davy, the voltaic couple, the magneto machine of Faraday, the electric waves of Hertz, as examples merely show how the results of inquiry undertaken for its own sake may become the bases of enormous industrial development. It is fitting, therefore, that in a body of this kind science and its applications should be united. There is, however, a difference between the work of the pure science investigator and that of the engineer. I regard invention as creative engineering. The difference alluded to is sometimes lost sight of. It touches the matter of responsibility for results. It matters not very much whether the results reached by the former are negative or positive, whether they indicate success or failure to attain expected or unexpected results. Not so with the engineer. If he is to maintain his standing his results must be positive, his work must succeed commercially, industrially and financially. Naturally the engineer receives or should receive emoluments in accordance with the responsibility incurred. As a result the pursuit of science for its own sake may suffer when the scientific investigator takes up engineering. Sometimes it is engineering that suffers. (Laughter.) It is a sign of the times that the value of research is becoming so well recognized as an aid to engineering that our large industrial organizations willingly support research work. Naturally preference is given to such new work as promises immediate benefit to the industry. The principle is gradually becoming to be recognized, however, that constant additions to knowledge of nature are in themselves valuable and likely at any time to open up new channels of industry. The little streams lead to the rivers and few rivers are without commercial possibilities.

The ethical value of the study of science and its applications is inestimable. By it and through it only will fallacious systems of thought and inequitable precedent finally lose their influence and disappear from the work. Figuratively, the honest "cold light of science" is a fact. The firefly exemplifies the actual, physical cold light of the future.

The future of science, and particularly of electrical science, is boundless. The chemist must possibly accept an electrical atom, the physicist an electrical inertia. Since the ether is only known to possess electromagnetic properties, whatever that may mean, matter and all immersed therein may be electrical. Prepare, then, to accept an electrical universe. "Who shall bring us to see that which may be after us." (Applause.)

Chamber of Delegates.

On Monday afternoon the Chamber of Delegates, composed of official representatives from various countries, held a meeting and effected a preliminary organization. At that time the revised list of foreign official and semi-official representataives, present or on the way, was as follows:

Argentine Republic—Dr. Jorge Newbery.

Australian Colonies—John Hesketh, Esq.

Denmark and Sweden—Prof. Svante August Arrhenius.

Dominion of Canada—O. Higman, Esq.

France—Poincare, Guillebot de Nerville, Ferrie, Dennery.

Germany—Litzrodt (to the Congress).

Great Britain—Col. R. E. Crompton, Dr. R. T. Glazebrook, Prof. John Perry.

Hungary—Bela, Vater.

India—J. C. Shields, Esq.

Italy—Prof. Moise Ascoli, Prof. L. Lombardi, A. Maffezzini.

Spain—Miguel Otamendi, Antonio Gonzales.

Switzerland—Prof. Ferdinand Weber.

The chamber organized by the election of Elihu Thomson as president and Dr. A. E. Kennelly as secretary.

Proceedings in the Sections.

After the adjournment of the opening session of the International Electrical Congress the different sections met in their respective rooms, organized, and immediately began with the reading of the various papers. The first day's sessions were somewhat shortened by the time taken in opening the general congress. Nevertheless a feeling of general activity prevailed and lively discussions were brought forth by a number of papers. In several instances, where advance copies of the papers had been issued to the members of the Congress, the actual reading of the paper was dispensed with, and discussion on the subject immediately taken up, which resulted in a considerable saving of time.

Section A.—General Theory.

The regular officers of this section, Prof. E. L. Nichols (chairman) and Prof. H. T. Barnes (secretary) were present.

Dr. A. E. Kennelly's paper on "Alternating-current Theory of Transmission Speed Over Submarine Cables" and Professor Barnes' paper on the "Mechanical Equivalent of Heat Measured by Electrical Means" were read in full and brought forth considerable discussion. The paper on "Theory of Ionization by Collision" by Prof. J. S. Townsend and "Spectra of Gases at High Temperatures" by Prof. J. Trowbridge were read in title only and discussed by various members.

One of the most interesting section meetings of the whole Congress was that of Section A on Tuesday. Profs. E. L. Nichols and Howard T. Barnes were again in their places as chairman and secretary, respectively. The general subject was units —electric and magnetic. All the papers bore on this subject, and after the reading of the papers there was a joint discussion between representatives of the Institution of Electrical Engineers of Great Britain and the American Institute of Electrical Engineers. Much interest was manifested.

The first feature was the reading of a paper on "Systems of Electric Units" by Prof. M. Ascoli, representing the Italian electrical engineers. This was read in English by the author, who illustrated his remarks by mathematical demonstrations on the blackboard. Then followed the paper of Prof. H. S. Carhart and Prof. G. W. Patterson on the "Absolute Value of Electromotive Force of Clark and Weston Cells." Professor Carhart abstracted the paper, showing the method followed at the University of Michigan in making these interesting investigations, and Professor Patterson followed with a brief mathematical demonstration of the reasoning employed in determining the values.

Dr. Frank A. Wolff of the National Bureau of Standards at Washington then read a part of his interesting paper on "The So-called International Electric Units." He reviewed the whole subject and showed how much remains to be done in determining a definite and universal system of electrical units. Strictly speaking, no two countries have defined the electrical units in the same way. This, the speaker thought, may in part be traced to the insufficiency of the Chicago (1893) definitions. However, the variations introduced in the definitions by some of the governments are without justification and in violation of the principles laid down at the Chicago Congress. To enable measurements the world over to be expressed in terms of the same unit is a result of much greater importance than absolute measurements, with their limited accuracy. In the definition of the concrete standard it is only necessary to assume for it a value in accordance with the best absolute measurements. This once done, with a sufficient approximation, the definition of the concrete standard need not be modified. Dr. Wolff favored the primary definition of the volt rather than the primary definition of the ampere.

In standard cells to determine the electromotive force the Weston cell has marked advantages over the Clark cell, Dr. Wolff said. Magnetic units should be defined in terms of the fundamental international electrical units—the ohm, volt and ampere. For years an error of one part in 2,000 will probably be the nearest approach to absolute accuracy that can be obtained in the standard cell.

Dr. R. T. Glazebrook, F. R. S., of the National Physical Laboratory of England, opened the discussion. The proposals before the section, he said, were somewhat vague in character. He and his official colleagues from Great Britain were only authorized to adhere personally to any decision arrived at by the Chamber of Delegates and could not bind His Majesty's government. So far as his government was concerned, any action taken by the Congress must be officially ratified to become binding upon it. He explained the Board of Trade definitions of the ohm, the volt and the ampere. These definitions are based on the c. g. s. system as fundamental. But it was necessary, legally, to have concrete standards. Therefore certain wire coils of platinum-silver, measured by the speaker, a certain ampere-balance and a certain multicellular voltmeter of a special type constructed under the supervision of Lord Kelvin, were in existence. These three instruments are the standards recognized by law in England.

Speaking of standard cells, Dr. Glazebrook said that for practical purposes the Weston cell is superior to the Clark cell. But it is a serious matter to change a legal unit. It would be necessary to have very exact specifications of the Weston cell. In his own laboratory the speaker had arrived at the same results as had Professor Carhart. The chief sinner in the cells is the mercurous sulphate. But he had succeeded in obtaining practically pure mercurous sulphate by three distinct methods. What is the electromotive force of the Weston cell? It is not exactly known. He did not favor making the actual change from the Clark to the Weston cell now. But in the future such a change should be made. Dr. Glazebrook quoted the recent report of a committee of the British Association, of which Lord Rayleigh was chairman and he secretary, to this effect: "The committee is not prepared at present to displace the Clark cell, and prefers to wait for the conclusion of the experiments at the National Physical Laboratory, and with the new balance, before coming to a decision as to the value to be assigned to the electromotive force of the saturated cadmium cell."

As to whether the volt or the ampere should be primarily defined, the speaker recognized a question of great difficulty. For fundamental definitions it is best to go back to simple facts. He doubted if it were wise to replace the ampere by the volt in fundamental definition at present. The practical advantages following the change are not so great as to make it necessary. Dr. Glazebrook closed his talk by expressing high appreciation of the Carhart-Patterson and Wolff papers.

Dr. A. G. Webster of Clark University, Worcester, Mass., and president of the American Physical Society, was next on his feet. These proposed standards, he said, differ by less than one part in 1,000. Very few engineering measurements are so accurate. Three definitions of material quantities are better as standards than three instruments. We cannot expect any appreciable betterment of the meter. But electrical units are quite different. All of them are derived units. British conservatism is best for the present. The only laws that are fixed are those of Nature. Let us depend on these and on ideal definitions.

Professor Carhart said that it was the province of the Congress not to make laws but to make recommendations. It is useful to discuss these questions, as greater uniformity should result. He believed the difficulties in the use of the Weston normal cell had been removed. The measurement of the absolute electromotive force of this cell is in progress. As to fundamental volt or ampere, he thought the volt should be first. The practical method of measuring current is by a potentiometer and a standard resistance.

H. E. Harrison of the British delegation said that little practical difficulty had arisen from the use of c. g. s units in England. If these units had been named, the names would have come into use, but practical men got along very well without them. Not one practical electrical man in a hundred in England could tell what a gauss was or a maxwell was if he were asked. The speaker advocated names for the magnetic units.

Dr. A. E. Kennelly of Harvard noted that in this country the Clark cell is legalized as 1.434 volts. However, a close approximation is 1.433 volts at standard temperature. Roughly, we are out 1 part in 1,000, or one-tenth of one per cent. It is a matter of importance that there should be such a discrepancy between our best knowledge and our practical work. One part in 1,000 is not negligible in voltmeters, because one-tenth of a volt has an appreciable effect on the life of an incandescent lamp, on which contracts are based. One proposal is to substitute the Weston or cadmium cell for the Clark cell, and thus wipe out the discrepancy. If this cannot be done, the next best thing is to change the value of 1.434 to 1.433 in the law. In power measurements the existing error becomes one-fifth of one per cent. Whether the volt standard should take the place of the ampere standard is a serious question. Personally, the speaker favored two concrete standards, but opinions differ, and the nations should arrive at a modus vivendi. As to general units, better let well enough alone. Rational units are preferable to irrational units, of course, but it is now impracticable to make a sweeping change. It is too late for general use of the c. g. s. basis. The present system is good enough for practical purposes. But it is an artificial system and terribly hampers electrical study. It is difficult to carry on long processes of reasoning in the practical system. Dr. Kennelly made a plea for names for the units of the c. g. s. system, so that all investigators could work in that system and talk in it. The same argument applies to the magnetic units.

Prof. John Perry, F. R. S., like Dr. Glazebrook, one of the official delegates from Great Britain, made a short but characteristic speech. He was in favor of basing everything on the c. g. s. system, but there was such a thing as being too logical; a number of people in the United States are too logical. The volt, the ampere, the ohm and the henry are exceedingly convenient. But do not let us multiply them; they are for convenience only. Are names necessary for the c. g. s. units? Would anybody remember them? The speaker expressed himself as in perfect agreement with Dr. Glazebrook and Professor Webster.

Dr. Wolff hoped the Congress would take some action to be referred to the various governments. Practical standards are what are needed.

Professor Carhart failed to see any essential difference between the laws of the United States and Great Britain relating to electrical standards. The definitions are practically the same.

As an interesting contribution to the discussion Dr. Glazebrook presented a note on the electromotive force of a Clark cell by A. P. Trotter of London. Mr. Trotter says: "A determination of the electromotive force of the Clark cell (Wolff's large pattern), in terms of the ampere and ohm, has been made recently at the Board of Trade Electrical Standards Laboratory. The ampere, as measured by the standard ampere balance of the Board of Trade, was passed with suitable precautions through a manganin coil having a resistance of 1.43436 ohms at 15° C., and the difference of potential between the ends of this coil was compared with that of the Clark cell upon a low-resistance potentiometer. After necessary correction, the electromotive force of the Clark cell was found to be 1.4329 volts at 15° C

The temperature of the Clark cell was read by a thermometer in an oil bath in which the cell was placed, estimating to 0.01° C. The cell had been kept for several months in a constant-temperature room and had not varied in temperature by more than 0.05° C. for 48 hours before the comparisons."

Clayton H. Sharp of New York, speaking of the variation between the true and legal value of the Clark cell, said that no companies maintained their voltage to within one-tenth of one per cent., but there were companies that maintained their voltmeters within that limit. What is a volt? The law says the standard is the Clark cell, which has 1.434 volts, but the speaker did not like to accept this and promulgate it in his testing work, for he knew it wasn't so. He thought it would be a distinct advance in electrical engineering if the silver voltameter were abolished. Set up the standard ohm, which is not attacked, and a standard cell, preferably a Weston cell.

Professor Patterson said he would vote for the standard cell rather than the silver voltameter.

W. Duddell of the British delegation said that secondary standards, absolutely reproducible, are needed. Third, or tertiary, standards, that can be carried about, are next below in the scale. These need not, and indeed, cannot, be so accurate as the secondary standards. The cell may well be the tertiary standard, as it is convenient. The speaker favored the c. g. s. system for magnetic units, but did not favor names for them or Dr. Kennelly's proposed prefixes for absolute units.

The hour for adjournment passed unnoticed in this interesting discussion, and after Professor Nichols had twice called attention to the fact, the section adjourned until Thursday morning.

Section B.—General Applications.

Prof. C. P. Steinmetz promptly opened the session, the first paper being that of Mr. W. M. Mordey on "Eddies and Hysteresis in Iron." In the absence of the author the paper was read by the secretary, Dr. Samuel Sheldon. Mr. Steinmetz made a few general remarks on the conclusion drawn and announced the next paper on "Magnetic Viscosity" by Mr. Jouaust, which was read by Mr. Slichter. The discussion on these two papers was opened by Prof. H. J. Ryan of Cornell, who pointed out the importance of wave-form on hysteresis. Mr. A. H. Ford, Dr. C. H. Sharp and others followed in the discussion, after which Dr. Sharp presented his paper on "The Equipment of a Commercial Testing Laboratory." Mr. B. A. Behrend's paper on "The Testing of Alternating-current Generators" followed and was discussed by Messrs. Waters, Rushmore and others. The last paper presented was that of Mr. Nodon on "Rectifiers," upon which Mr. Steinmetz and Mr. Duddell made some comments, after which adjournment took place.

Section C.—Electrochemistry.

Prof. H. S. Carhart presided, with Carl Hering as secretary. In the absence of the author, Prof. T. W. Richards of Harvard, Prof. Patterson read the paper on "Relation of the Theory of Compressible Atoms to Chemistry," which was discussed by Messrs. Carhart, Patterson and others, after which adjournment till 9:30 a. m. Tuesday followed.

On Tuesday J. Sigfried Edstrom read his paper on "Electrical Extraction of Nitrogen from the Air." Several other papers were read, to which reference will be made later.

Section D.—Electric-power Transmission.

As chairman of this section Charles F. Scott addressed the members, reviewing briefly the development of electric-power transmission during the last 10 years, and commenting on its present status and its future possibilities. The paper by E. Bignami on "Electrical Transmission Plants in Switzerland" was also read. A spirited discussion and many comments followed Mr. Scott's address and the paper.

Chairman Scott opened Tuesday's session, which was well attended. The nature of all the papers presented was along the line of high-tension work. Prof. H. B. Smith read his paper on "High-voltage Transformers," in which he gave a description of a 500,000-volt transformer built for experimental purposes at Worcester Polytechnic Institute. J. S. Peck read a paper on "The High-tension Transformer in Long-distance Transmission," emphasizing the tendency of higher voltages and larger units which now prevailed. Dr. F. A. C. Perrine gave a very complete resume of "American Practice in High-tension Line Construction and Operation," which appealed very much to the foreign delegates and gave them a clear picture of the status in this country. F. G. Baum read a paper on "Long-distance Transmission and Control," in which he described the Bay Counties system and the methods which had been employed to obtain simplicity and greater reliability. The system includes about 400 miles of transmission lines and many stations can be operated from more than one line. The speaker considered the disturbing influence of large currents a greater objection than those of high voltage, and added that he would rather operate a 50,000-volt line than one at 20,000, owing to the smaller current in the higher-voltage line. A general discussion followed the papers, after which adjournment until Thursday took place.

Section E.—Electric Light and Distribution.

The chairman of this section was J. W. Lieb, Jr., and the secretary Gano S. Dunn. On Monday a paper by Arthur Wright (read by Mr. Dick) on "Recent Improvements in Electrolytic Meters" was presented. W. C. L. Eglin read his paper on "Rotary Converters and Motor Generators," and George N. Eastman of Chicago presented his on "Protection and Control of Large High-tension Alternating-current Distribution Systems." Robert Hammond of London, Mr. Dick, L. A. Ferguson of Chicago and others took part in the discussion.

Tuesday's session saw the reading of four papers—Philip Torchio on "Distributing Systems," Dr. G. Stern on "The Superiority of the Alternating Current for Distribution in Large Cities," Alex Dow on "The Continuous-current Distributing Systems of American Cities," and L. A. Ferguson on "Underground Discussion." Colonel Crompton of London, R. Hammond of London, Mr. Tait, Arthur Williams of New York, Mr. Eglin and others took part in the discussion.

Section F.—Electric Transportation.

Dr. Louis Duncan of Boston was chairman of this section and A. H. Armstrong secretary. On the opening day two papers were read—one by Philip Dawson on "Electrification of British Railways" and the other by J. B. Entz on "The Storage Battery in Electric-railway Service." The discussion was led by Frank J. Sprague and H. Ward Leonard.

Section B (General Applications) and Section F (Electric Transportation) held a joint meeting on Tuesday morning, the general topic for discussion being that of "Alternating-current Traction." A fair attendance marked the session, which was presided over jointly by Prof. C. P. Steinmetz and Dr. L. Duncan.

The first paper presented was that of B. J. Arnold on "Early Work in Alternating-current Electric Railways." The author briefly reviewed the work that had been done during the early years and then gave a detailed description of the single-phase system devised by himself. The system, which involves the use of compressed air, is a very ingenious one, as readers of the Western Electrician are aware, and was described very clearly with the use of drawings by the author.

C. P. Steinmetz followed with a paper on "Alternating-current Motors," giving a detailed classification of the various types of motors and an outline of the different characteristics of the various types. Max Deri's paper on "Single-phase Motors" was abstracted by Mr. Slichter. Following this Mr. Latour read a paper on "Commutation of Direct and Alternating-current Machines," and Mr. Steinmetz abstracted Mr. Bragstadt's "Theory and Operation of Repulsion Motors." In commenting on this paper Mr. Steinmetz remarked that the author, after having used complex quantities in his deductions and calculations had finally gone back to the graphic system, quite the reverse of most of the modern writers.

The paper by Ernst Danielson on the "Theory of the Compensated Railway Motor," was read by title only, owing to its mathematical nature; likewise the paper by Prof. Niethammer, entitled "Alternating versus Direct-current Traction."

The last paper of the morning was that on "Single-phase Railway Transmission and Distribution," read and commented upon by the author, P. M. Lincoln. He pointed out very carefully the various points to be considered and gave a summary of the vital points of the system.

A general discussion immediately followed the reading of the papers. H. S. Stott commented on Mr. Lincoln's paper, favoring a three-phase system instead of a single-phase, as it compared more favorably in the matter of reducing strains like a triple-expansion engine compared to a single-cylinder type. He also remarked that the three-phase system could be operated on two transformers in case of a breakdown of one of the transformers, making the service more reliable thereby.

Mr. Lamme pointed out the difficulty which many engineers encountered in a clear understanding of the different types of alternating-current motors, and that a single-phase commutator-type of motor can have a larger air-gap than an induction motor operating with the same power factor. The induction motor has a low-starting torque at low-power factor and a comparatively large current due to the closed secondary, but in the commutator type the value of current represents torque regardless of power factor, since both wattless and energy components of current act to produce torque.

C. P. Steinmetz made a few general remarks as to the relative advantages of single and polyphase systems for railway work. Except as outlined in Mr. Arnold's paper, he said, the single-phase induction motor is entirely out of the question for such service. The single-phase commuter motor gives a far better torque efficiency than the induction motor; in fact, it approaches the direct-current series motor in that characteristic. He did not consider the single-cylinder steam engine inferior to the multicylinder, as suggested by H. S. Stott. Regarding systems of distribution, the speaker considered polyphase to be in more general use in this country than abroad. The polyphase system has a decided advantage in stationary motor work. On the other hand, the single-phase system is more simple and reliable and not as complicated in the switching devices, and had it not been for the motors it is doubtful whether the system would have advanced to its present state. For alternating-current railway work the single-phase system is most desirable. Two-phase systems can be cut up so as to feed in two directions, but in all cases reliability is the first consideration. While single-phase generators cannot be built as small and efficient as polyphase generators of the same capacity, the simplicity of the former will greatly overbalance such an advantage.

A. H. Armstrong laid special emphasis upon the fact that the commercial aspect and present existing systems must be taken into consideration.

Mr. Stott thought that a table with three legs would stand better than one with two, to which Mr. Steinmetz added that this was not a question of statics but of dynamics, and that a bicycle could go faster than a tricycle.

H. Ward Leonard briefly outlined his system of alternating-current traction in which a constant-speed alternating-current motor operated a variable-voltage direct-current generator, all mounted on a locomotive truck. Direct-current motors supplied with power from the variable-voltage generator furnished the motive power. The speaker thought that the Arnold system loses simplicity and that the reciprocating parts in it are a disadvantage, both of which objections were overcome in his system. Furthermore, the insulation of high-voltage parts can be more safely effected, which adds greatly to the element of safety.

Mr. Waters thought that the question of graphic versus vector methods depends to a great extent upon the designer.

Mr. Steinmetz remarked that the existence of so large a number of polyphase plants has somewhat retarded the progress of single-phase railway work. No company is willing to discard an existing system unless absolutely necessary. The electrification of steam roads, which had been talked about extensively five and 10 years ago, has made very slow progress. Instead of that the paralleling of steam roads by electric systems has been the most important feature, since in the latter case the electric road is apt to reach people more directly and give more frequent service. The direct-current series-wound motor has been brought to almost the highest state of perfection, and the next and most desired step is a motor which will operate on both direct and alternating current.

Mr. Lamme remarked that cases were on record where a three-phase system operated on single-phase by changing from three to two-phase on the Scott system and then feeding in two directions from the station. The speaker stated that they had operated a motor on both high and low-voltage alternating current by using a 500-volt alternating current in a portion of the city, with special taps on the transformers and a set of switches to throw from low to high voltage. The trolley voltage on alternating-current systems is still an unsettled quantity, but 2,200 to 2,400 volts seems to meet with general favor.

After a few general remarks by various members the meeting was adjourned.

Section G.—Electric Communication.

The regular officers of the section officiated, F. W. Jones (chairman) and B. Gherardi (secretary). Two papers were taken up, one by J. Hollos on "Simultaneous Telegraphy and Telephony," and the second by Mr. Saitaro Oi on "Telegraphy and Telephony in Japan." Considerable discussion followed, especially on the first paper, in which Chairman Jones, Major Reber, Mr. Gherardi and others took part.

A good day's work was done in this section on Tuesday, no less than nine papers being read. Names of authors and titles are: John Hesketh on "A New Danger to Lead-covered Aerial Telephone Cables," J. C. Barclay on "Modern High-speed Printing-telegraph Systems," P. B. Delany on "Rapid Telegraphy," F. J. Dommerque on "The Telephone Problem in Large Cities," Dr. A. E. Kennelly on "High-frequency Telephone-circuit Tests," K. B. Miller on "Automatic vs. Manual Exchange," Dr. L. M. Potts on "Printing Telegraphy," and Major Samuel Reber, U. S. A., on "Military Use of the Telegraph, Telephone and Cable," and Mr. Lori on "Harmonic High-speed Telegraphy." Major Reber, Lieutenant-commander Jayne, U. S. N., John Hesketh, John S. Stone, F. W. Jones, F. J. Dommerque, B. Gherardi and others took part in the discussion.

[A further and more complete report of the proceedings of the Congress will appear in the Western Electrician next week. On other pages of this issue appear, either in full or in abstract, a few of the many important papers presented before different sections. Other papers presented before the various sections of the Congress will appear in future issues.]

Hydro-electric Plants of the World.

A. Cambell Swinton of London stated in a paper he read recently on "Hydraulic Electricity" at a meeting of an engineering association in England that "The hydraulic electricity works of different countries showed the following total horsepower: United States, 527,467; Canada, 228,225; France, 161,343; Germany, 81,087; Italy, 210,000; Great Britain, 11,906. The amount of waterpower actually used in electrical production throughout the world at the present time would exceed 2,000,000 horsepower—about double the steampower devoted in Britain and Ireland to the same purpose."

Rates for Electricity Supply.[1]

By Etienne de Fodor.

If we take a retrospective glance in the history of current tariffs we will find that at the beginning the endeavors were to shape such tariffs as simple as possible. However, with the lapse of time, it became necessary to sacrifice such simplicity and establish rates in various grades as circumstances and local conditions demanded. It may seem astonishing to assert that at present there exists nearly as many rates as there are central stations; yet in fact this is true and can be confirmed.

In most cases—at least the larger—electrical central stations were erected in opposition to existing gas companies, which had acquired through many years a vast amount of experience in the art of lighting and power distribution. So long as they relied upon the old flame burner the gas companies at that time had nothing to bring in opposition to the brilliant and steady light of the electric arc, and it seemed at the time that the electric light would entirely supersede gas. It was evident that the moment competition arose between the existing gas companies and the new undertakings the latter would be forced to adapt themselves to the local conditions prevailing. The desire to win over this or that consumer from the gas companies rendered it necessary for the electric companies to make changes from any contemplated high-standard rate, and one can therefore say that in the history of every electrical-current tariff there was a period in which the tariff could be designated as a war tariff.

This peculiarity of tariffs was specially prominent in current charges on account of its division in two parts, namely, one for light and one for power. It is known that from the beginning in the delivery of electrical energy an attempt was made to conform to such usages and conditions as existed at the time with respect to gas. The eight and 16-candlepower units that we still retain are a heritage from the gas companies. In the creation of separate tariffs for light and power by the first electrical central stations the practice of gas companies was followed, which method of charging, it may be mentioned, had just been introduced by the latter concerns with considerable misgivings. When toward the end of 1879 Thomas A. Edison announced to the world that he had solved the problem of electric-light subdivision, and owing to growing competition from cheap petroleum, gas companies began to exert themselves and concentrated their attention to the utilization of gas for power purposes. It was at this period, just before the day of electrical central stations, that the two-rate gas-tariff system came into operation. It was thus upon the basis of this two-rate system that the gas companies conducted their opposition against the electric light, while on the other hand the electric companies quickly took up and employed the same means to fight the gas companies.

While at present there exists a tendency on the part of the gas companies to give up the old two-rate system and come back to a single-unit price or tariff, we find that in the most cases the tendency of electrical managers is on the contrary and most unfortunately toward granting the broadest concessions for power current, notwithstanding the wide gap already existing between lighting and power prices. Nevertheless the lowering of rates for power current seems apparently to have been attended with gratifying results. In Berlin, for instance, from 1902 to 1903 there was a diminution in the number of gas motors amounting to 87, aggregating 312 horsepower. In Munich during the same year the decrease in the consumption of power gas amounted to 18.68 per cent. under the preceding year, while the decrease in the number of gas motors amounted to 34, representing 157 horsepower. In Berne during the same year the decrease in motor gas amounted to 35.6 per cent.

The setback of the gas motor has not been due to the fact that electric-motor service is somewhat cheaper than other forms of power. Good coal-gas motors of small dimensions require about 575 litres of gas per horsepower-hour, while larger engines consume only 500 litres. Taking therefore the Berlin unit price of coal gas at 12 pfennigs per cubic meter we can obtain a horsepower-hour from gas engines at 6.9 pfennigs; if the electric motor were to compete with the gas motor upon the basis of equivalent cost it would be necessary for the Berlin central station to decrease its rate per kilowatt-hour to 8.4 pfennigs, the present price for motoric current being 16 pfennigs, which approaches the lowest allowable limit, and this extremely low price is just about double what is necessary to compete against the gas-motor rate.

If there is an increasing demand for electric motors notwithstanding the fact that this form of energy costs double, and in many cases much more than double the cost of other forms of energy, it will be found that the reason lies principally in the specific advantages the electric motor possesses, such as simplicity of service, noiselessness, cleanliness, the small space required, etc. Where the daily cost of energy is considered the main factor the electric motor will be kept out by the gas engine, and this latter in turn by generator-gas or the benzine motor. On the other hand, where space and the admirable flexibility of the system are the principal considerations, and the daily cost of energy is but a secondary factor, the electric motor will always hold its position, even when the cost is considerably higher than it now is in general.

If we desire therefore to standardize our tariffs for current we must above all stop at opposition tariffs against gas. If the electric light and motor cannot maintain their position through the many advantages they both possess, they surely cannot prevail in competition with gas companies. For the present, at least, it is extremely difficult to compete against the gas motor or Auer-Welsbach mantle in cheapness. Our stronghold is in the many specific advantages that the electrical form of energy possesses. These advantages therefore make it wholly unnecessary to jeopardize the incomes of electric-light and power companies through indulging in extravagant decreases in the price for power current.

It cannot be disputed that at the beginning it was necessary for electrical central stations to offer certain inducements in the form of cheap or reduced rates for power current in order to effect a popular introduction of the electric motor and make its advantages known. It was also the fashion at the time to patronize the development of home and small industries, and central stations in granting a cheap power current rate assisted in a certain sense in the solution of a problem in social economy. It was also thought that cheap motor current would be the means of introducing electricity among the poorer classes, where in the form of light it would never have had a chance.

There is a certain number of central stations which, although having a separate tariff for light and power, allow no discount upon power current, because they are of the opinion that with the low-unit rate at which they sell the latter they have reached the extreme limit. Such central stations have thus carried out, in a certain sense, the idea of a unit rate for energy—when only for power—yet within the limits of this unit rate the consumer is allowed to take whatever he requires and is neither restricted to the amount nor to the time of consumption. That formerly gas companies with their double tariff did not restrict customers to use power gas only in certain hours of the day or night, is easily explained by the fact that gas companies generally have a constant production at all hours of the day, while the delivery of gas is effected through the splendid storage system they possess. This, however, is by no means the case with electric companies, and when they fixed a threefold cheaper rate for power current than for light, while at the same time putting no restrictions or conditions as to the time when such power should be taken, they failed to recognize the logical situation.

The fact that power users have obtained such very low rates and with no conditions imposed upon them as regards time of service has encouraged them to go further and to demand the same rates for light as they have for power. The argument that they bring forward is that the light they use and need is likewise necessary in their work, and thus it is also for "industrial" purposes—which statement it must be admitted sounds logical.

If it is possible for central stations to deliver power current at a low rate during all hours of the day without any restriction, why should not this current also be used for lighting purposes? The consumer will and can never understand why he should pay more for the one and same kind of energy when it is used in the form of light and taken at the same time when he takes his power.

A precedent to such demands has already been set by gas companies, who permit customers consuming "industrial" gas to use a certain limited number of lights taken from the same meter which supplied the gas for industrial purposes. Such favors were not only given to customers for power gas, but also to those who used gas for heating purposes. For example, customers using gas for cooking were allowed a burner in the kitchen and one in the hall; and those using gas for heating the bathroom stove were allowed one burner for the room. Gas companies can easily grant such favors, for the price they ask for industrial gas is high, but electrical central stations are thereby forced to accommodate themselves to this custom also in order to compete with gas effectually, and they, too, have permitted their power customers to connect a limited number of lamps on their power circuits. Various central stations have tried to induce power consumers using the current for a few hours only in the day to concentrate their service during the daylight hours and abstain from using current during the evening, period of highest consumption. This plan has in many cases been attended with good results, but the reverse in other cases simply because power consumers flatly declare they cannot accept a proposition in which their time of service is restricted, as the time of their employes is from morning until evening and that they must pay them for this time and are thus compelled to operate in the evening. In such cases it was found that many customers whose time of power service was of short duration generally consumed power only in the evening hours. The preparation of the work for the motor was during the day as long as there was light, and then given over to motors in the evening to finish. It is evident that the more such a class of customers increases the more burdensome they become to central stations.

Central stations could, however, obviate such unfavorable cases as have just been mentioned by introducing a "double-tariff meter" whereby the current taken during the period of greatest consumption, say from four until eight o'clock in the evening, is charged at a maximum unit rate, while that taken during the other period of the day is charged at a much lower rate. Such a double-tariff system, however, can only be effectual when there is a great difference between the maximum and cheaper rate. If this maximum price for the evening hours is set at a high figure there is no doubt that power consumers will be alarmed, and perhaps feel inclined to restrict or diminish their power consumption in the evening as much as possible. If, on the other hand, this maximum motor-current price is only 20 pfennigs, as up to the present, power consumers see no necessity of putting a special restriction on themselves as to the time of consumption; and considering the short time they require power a difference of a few pfennigs per kilowatt-hour is of little account to them. Thus in order to obtain the desired results with a double-tariff system it is necessary to establish the basic price for power current during the evening hours at as high a figure as possible; in other words, power current must be raised in price. Such an increase in price will thus tend to lead to the ideal of all tariffs—to a unit basic force, abolishing thereby the difference that exists between light and power current.

The advantages to be derived from such a unit price are considerable. It dispenses with the necessity of separate circuits, separate meters and meter rents, different bills for light and power; the investments decrease while the administration becomes simplified. A double-tariff meter is just as expensive and more complicated than two separate meters, while there remains the double billing and intricate management; the meter rent must accordingly be raised on account of the higher price of double-tariff meters. Should it be desired to introduce a double tariff simply for power current in order to ward off short-time consumers from the heavy-load period, it will be logical and necessary to establish also a double tariff for light, because the time and duration in which light is employed is also an important factor. This would still involve more complications, and instead of two readings of the meter and two bills there would be required four. Therefore, if it is considered desirable to introduce a double tariff there remains but one thing to do, and that it to establish a unit rate for light and power, with only this difference, that the unit rate be divided into two classes or steps, according to the time in which the energy is consumed. It is natural that the upper portion of such a double-tariff unit should be pretty high in comparison with the other or lower portion. The consequence of such a tariff system would naturally be to raise the original very low price for power current—at least in the evening hours—and finally also raise the motor price. Such increases in motor-current rates have already been introduced in a limited manner in some of the latest current tariffs. For example, in Freiburg, Bohemia, current for elevators or lifts, is charged on a double-tariff basis of 60 and 20 pfennigs, while current for light is reckoned according to a unit rate. In Bonn, Germany, a double-tariff system has been introduced for electric motors only, and also on a basis of 60 and 20 pfennigs, while for lighting purposes the double tariff is not used. The Oberlausitz central station charges for power current at 20 pfennigs. Should, however, consumers use less current than an equivalent of 500 hours yearly, the rates go up then to 23, 25, 30 and to 35 pfennigs, according to the number of hours used in a year.

If, therefore, we wish to encourage a slow and just increase in the price of power current, we must ask ourselves, what effect such a measure will have on the development of motor service. We know from experience that there is nothing to fear from a retrogression in this respect. It is also evident that all intermittent power customers who have a small yearly consumption will hardly change over to some other form of energy, even when the price for power current is considerably raised or even doubled. Neither will there be a decrease in such a case in the number of new applications of customers of this kind. The advantages of the electric motor are well known, and they can scarcely be dispensed with nowadays, even if the cost of service is increased. One of the most formidable competitors, the generator-gas motor with its cheap service, has not only made no advance against the electric motor, but has shown that it is not even a competitor of the ordinary gas motor. We find some very instructive matter in this connection in the 1903 annual report of one of the largest gas companies in Germany, the German Continental Gas Company, where it is stated "that up to the present the generator-gas motor with its economy in fuel has effected no decrease in the consumption of coal gas for motors, but just the contrary, as there has been a steady increase in the latter motors, which proves conclusively that simple economy in fuel consumption in a motor is not the main factor. Generator gas plants are expensive, they take up more space than a coal-gas motor, while their service is more complicated; such facts play in many cases an important part when considering the pros and cons. Then again, in an intermittent service, the coal-gas motor is always ready for action, and there is no fuel consumption when at rest, which is an important advantage. We can thus calmly rest assured that the generator-gas motor will offer no serious competition, even if in the future, especially for motors of large dimensions, it should be improved considerably. The many special advantages that exist

1. Abstract of a paper presented before Section E of the International Electrical Congress of St. Louis, Sept. 12, 1904.

in the coal-gas motor service are such that they will always assert and vindicate themselves." . . . By substituting the words electric motor instead of coal-gas motor in the above citation we do not alter the bearing of the facts stated.

The Relation of the Hypothesis of Compressible Atoms to Electrochemistry.[1]

By Prof. T. W. Richards.

Theoretical electrochemistry may be divided into two closely related sections—that which treats of the phenomena at the electrode, and that which treats of the phenomena in the unchanged electrolyte. The former of these sections is the more important practically, and is likewise a more certain domain theoretically.

In the first place, then, one may ask: How would a compressible atom behave on leaving an electrode and going into solution as an ion? It would then be attacked by an entirely new set of affinities, being in its new position surrounded by molecules of the solvent instead of by atoms similar to itself, and those new affinities exerting new intensity of pressure would be expected to change its volume. Moreover, the solvent, being itself in part exposed to new internal pressures, would also change in volume. As a matter of fact, a marked change of volume is always observed when a positive and negative element go into solution in the ionized condition. For example, a liter of a normal solution of potassic chloride occupies 43 milliliters less space than the solid potassium, liquid chlorine and water from which it may be made; the change of volume in the case of common salt is 31 milliliters, and that in the case of lithic chloride 17 milliliters. Potassic bromide in the same way gives a contraction of 33 milliliters. Among these similar compounds, and in many other cases, it usually appears that the greater the electrical potential afforded by the double ionization the greater the change of volume; also, the greater the compressibility of the elements concerned the greater the change in volume. It is worth while also to call attention to the fact that these changes of volume on ionization seem to be approximately parallel with the changes of volume on forming the corresponding hydroxides; just as the heats of ionization are approximately parallel with the heats of formation of the hydroxides. This parallelism may indicate that the effective agency causing ionization or galvanic solution of a metal is the attraction of the metal for the oxygen or the hydrogen of water—most probably the oxygen.

Although these regularities are fairly prominent on comparing the properties of similar elements in a natural group, exceptions are not hard to find on comparing very dissimilar substances. Reason for these irregularities may partly be found in the extremely complex mathematical relations which must obtain if the atom is really compressible; but probably, at least, a part of the exceptions may be traced to the expected simultaneous contraction of the solvent already predicted. That the solvent really often contracts is manifest from the fact that in some cases (notably the hydroxides of lithium, sodium and barium and the sulphates of zinc, cobalt, nickel and magnesium) the solution occupies less space than the water alone from which it is made. In this connection it is worth while to call attention to the well-known fact that during the formation of 18 grams of water from its ions in the neutralization of a strong acid by a strong base, an increase of volume of 20 milliliters occurs—an increase greater than the volume of the water formed.

Although by no means all possible cases can now be studied because of lack of data, there is good reason to believe that in all cases both the solvent and the dissolved substances change in volume under the readjustment of internal pressures of ionization; and the resultant effect is so complicated that it is impossible, at present, except in the most exaggerated cases, to determine the mode of the distribution of the change.

Nevertheless, since changes of volume actually occur on ionization, and since in the more marked cases this volume-change seems to correspond roughly to the known compressibilities of the substances and to the free-energy change during the reaction, the theory of compressible atoms is supported. At least, even supposing that the explanation herein given is rejected, the theory is here able to call attention to an interesting series of facts concerning volume-change, which must receive an explanation before a complete interpretation of the nature of a dissolved electrolyte is obtained.

Another less direct relation of the theory of compressible atoms to electrochemistry is to be found in the effect of change of volume of reacting systems upon their specific heats. Thomsen pointed out long ago that a contraction in a reaction between aqueous solutions is usually accompanied by a loss of heat capacity of the reacting system; and it is possible to cite many other cases in which this is true. Probably, however, the cause of this loss is not so much the decrease in volume as the irregular stress caused by the simultaneous presence of very different affinities. In terms of the hypothesis of compressible atoms, atomic distortion seems to cause a diminution of heat capacity. As a kinetic conception this interpretation is plausible.

The relation of this change of heat capacity to electrochemistry is very important. Recent study has made it appear highly probable that a change in heat capacity during a reaction is the chief, if not the only reason why the total-energy change (or the heat of the reaction) is not equal to the electrical work which the reaction performs in a galvanic cell. In colloquial language, the heat energy which is displaced, or forced out, by a diminution of heat capacity, does not seem to be able to perform work. If this be true, change of heat capacity is responsible for the "bound energy" of a galvanic cell, and, therefore, according to Helmholtz's equation, for its change of potential with the temperature. If, further, the preceding conclusion based upon the theory of compressible atoms be also accepted, the fundamental cause of this temperature coefficient of the electromotive force is referred back to atomic compression and distortion which diminish the possibility of heat vibration in the compressible atom.

One essential condition of ionization has not yet been dwelt upon; namely, the relation of ionization to the quantity dimension of electricity. Recent investigation has shown that Faraday's law is not merely an approximation, but is rather one of the most exact of the laws of nature. If the atomic theory be accepted, one must therefore admit that each similar atom, on ionizing into a liquid, receives or releases exactly the same charge, which is a precise, simple multiple of a given unit. What now does this unit of change signify? In other words, what are the essential attributes of electrical quantity, and what explanation for this exact and fundamental law can be found in the theory of compressible atoms?

To the electrochemist who has nothing to do with electrical capacity, the quantity-dimension of electricity is important merely as a number. He recognizes it only because it is proportional to equivalent weight of deposited metal, or to equivalent volume of evolved gas. Still more simply, it may be said to represent to him nothing but the number of atomic contacts which are made or broken in a given reaction. Therefore, the electrochemist, attempting to discover the relation of the compressible atom to galvanic deposition, naturally first seeks to imagine what would happen to a compressible atom on making or breaking a firmly united atomic contact with another atom.

Evidently, for each union with other atoms, a given atom would give and suffer a shock of impact or combination. The exact effect of this shock upon the atom itself cannot be determined; but if the atom is compressible throughout, many forms of vibration or temporary rhythmical distortion might be possible because of this shock. One of the most probable forms is perhaps a vortex motion; and it will be seen that this form lends itself best to further interpretation. If the atom were perfectly elastic, such a vortex would continue to exist indefinitely, when once formed.

Let us imagine, then, that each collision of atomic combination starts or transfers a vortex or some other form of self-perpetuating shock. Then the deposition of a given number of chemical equivalents will result in the transfer of a given number of shocks, or a given quantity of electricity, and Faraday's law is explained. In short, in order to conceive logically of this law, one need not ascribe weight or mass to the electron—a permanent vortex will represent the needed unit as well as a ponderable particle. But only a compressible atom could hold or carry such an infinitesimal vortex, hence this hypothesis is dependent upon the hypothesis of compressible atoms.

This easy explanation of Faraday's law without a material conception of electricity leads one to inquire whether or not other relations of electricity might not likewise be satisfied by a vortical conception of the unit of electrical quantity. A complete study of the details of this possible explanation would be out of place, but a few of the electrical properties of substance may be mentioned in this connection. For example, the electrical conductivity of solids is in many cases what it would be expected to be if their atoms were compressible. Atomic distortion would be expected to interfere with the ready transference of the vortices. The simpler the crystalline form, the less distorted would be the individual atoms, and the more easily would the vortices be received and transmitted from one atom to another. On the other hand, with irregular atoms, permanently distorted by chemical affinity, the uneven structure would receive and transmit the vortices less easily, and the potential energy of the mutual repulsion would be converted into heat. As a matter of fact, the two best electrical conductors among metals, silver and copper, crystallize in the regular system, and the poorest solid conductors among pure metals, bismuth, antimony and arsenic, are of less symmetrical crystalline structure. The non-metals which are all poor conductors, are still more noticeably complex in symmetry; and such non-conducting substances as bromine and iodine must be very much distorted in atomic shape, if their atoms are compressible, because these atoms must be much compressed on one side, by their firm union, to form the diatomic molecules, and only slightly compressed on the other sides, by their feeble cohesion, indicated by great volatility. The relatively slight conductivity of alloys and compounds points in the same direction; for heterogeneity of atomic structure would imply irregular internal pressure, great atomic distortion, and hence poor conductivity. The considerable effect on conductivity of even slight impurity in a metal and the extremely low conductivity of substances like glass and cellulose are well known, and accord with this interpretation.

Again, it is easy to see how increased thermal energy, which, if atoms are compressible, must be supposed to exist as a simpler oscillation of a portion of the atomic centers, would interfere with the reception and transmission of this new vortex motion, and hence to see why the conductivity of solids should decrease on raising the temperature. Moreover, one would expect the slightly distorted atoms, easily receiving the electrical vortex, should usually likewise transmit more rapidly the simpler oscillations of heat energy, which is a fact.

In applying the vortex idea to the statical and magnetic manifestations of electricity, one must imagine the vortex to cause stress in the surrounding wave-bearing medium, giving rise to the repulsion of similar vortices. Such a stress must be imagined whatever conception one forms of the electron, and is at least as easily conceivable from a vortex as from a small particle of matter.

The explanation of the brilliant experiments of J. J. Thomson and his pupils on the basis of the vortical electron is possible, if one admits, as Thomson is quite willing to do, the existence of electrical inertia independent of gravitational effect. In this case, the cathode ray is to be considered as a collection of disembodied vortices, which may only be driven through the wave-bearing medium under the stress of great difference of potential. Another alternative must be adopted if one doubts the somewhat complicated evidence concerning the relative masses of the cathode corpuscle and the atom, and believes the two to be identical. In this case it is necessary to imagine that a single atom can receive many vortices under the peculiar circumstances attending the cathode discharge; i. e., that it is polyatomic.

Other possible relations of the hypothesis of compressible atoms to electrochemisty and to the new and surprising facts of radio-activity might be pointed out, but these examples will serve the present purpose. The object of this paper has been to show that the hypothesis is a suggestive one, because it views well-known phenomena from a new standpoint, and therefore may excite the imagination into devising new methods of experimental attack. The discovery of the probable relation of the change of heat capacity on the temperature coefficient of a galvanic cell is among the new relations to which this hypothesis has already led.

The long-continued illusion of phlogiston, supported by eminent minds not much over a century ago, is enough to show the danger of a one-sided scientific consciousness, and the familiar conception of inflexible atoms may also to a less degree lead the literal mind into an intellectual rut. Of course, no claim is made that the hypothesis of compressible atoms represents truly the actual fact; indeed, atoms, in any shape, are an imaginary conception which may have no counterpart in reality. Even if the thinker progresses no farther than to admit that, provided atoms exist, they may be elastic and compressible, he has broadened the train of his thought and enlarged the realm of his imagination.

It has been claimed by a few that any hypothesis is harmful; but some of the most brilliant of scientific workers have used them as a continual inspiration. Faraday, one of the greatest of pioneers, dreamed thousands of such scientific day-dreams. To him, these were nothing but a benefit; for, although led on, by visions, he knew well the difference between substance and shadow. He never confounded hypothesis with fact; and when new facts overthrew a favorite imagination, he would discard the latter gladly, rejoicing that it had led him to the discovery of new truth.

1. Abstract of a paper presented before Section C of the International Electrical Congress of St. Louis, on September 12, 1904. Mr. Richards is Professor of Electrochemistry at Harvard University.

Society for the Promotion of Engineering Education.

At the final session of the Society for the Promotion of Engineering Education, which was held recently in the lecture room of the Palace of Education on the grounds of the St. Louis Exposition, the following-named gentlemen were elected to membership in the society: Thomas Gray, Rose Polytechnic Institute, Terre Haute, Ind.; C. A. Waldo, Purdue University, Lafayette, Ind.; A. N. Talbot, University of Illinois, Urbana, Ill.; J. C. Nagle, Agricultural and Mechanical College of Texas, College Station, Texas; W. G. Raymond, University of Iowa, Iowa City, Iowa; L. E. Reber, Pennsylvania State College, State College, Pa., and R. S. Woodward, Columbia University, New York, N. Y. The election of officers resulted as follows: President, T. W. McNair, president of the Michigan College of Mines, Houghton, Mich.; vice-presidents, Ellwood Mead, University of California, Berkeley, Cal., and C. R. Jones, University of West Virginia, Morgantown, W. Va.; secretary, M. S. Jones, University of Colorado, Boulder, Colo.; treasurer, F. P. Spalding, University of Missouri, Columbia, Mo.

A forest fire that destroyed many poles of the Puget Sound Power Company's power-transmission lines took place recently near Electron, Wash. The transmission lines were not injured, but the power was off about one hour, street cars stopping in the city.

Simultaneous Telegraphy and Telephony.[1]

By Joseph Hollos.

The question of simultaneous telegraphy and telephony is not of recent date. While, however, in some places good results have been obtained, in others the advantages reached by this combined using of telephonic circuits are hardly worth mentioning, and in view of the difficulties experienced in the service it was thought preferable to abandon the scheme.

If we look closer at the question we can at once observe that wherever the telegraph and telephone services are under the supervision of one and the same interested person the results obtained are excellent. Where, however, the two systems are in different hands the result is unsatisfactory. Thus, in America, where the financial interest of the telephone companies is involved, because of the desire to increase income by leasing lines for simultaneous telegraphy, and where, for this reason, these two operations are under the control of one technical staff, the result is excellent. The results are also fair in the European services, if the same technical officer supervises both telegraphy and telephony, and one service is co-ordinated with the other. The result is, on the contrary, very poor in all cases if the telegraph and the telephone services are in different hands.

This is evident if we consider how greatly the one system interferes with the other—that is, that careless handling of the one interferes at once with the proper functioning of the other, the two systems thus being brought into mutual opposition.

For this reason the service must be arranged in such a manner that the two systems cannot interfere with each other, and in as far as troubles are unavoidable, they must be reduced to a minimum. If they should exceed, certain arrangements must be provided to hold out the less important service without delay.

In this direction the Hungarian telegraph and telephone service can show good results by comparison with similar installations, and, therefore, it will not be without interest to outline the principles which were followed in the formation of the system.

Above all, the simultaneous installation must be the simplest possible, because only thus and with the fewest possible instruments may undisturbed working be obtained. For this reason the method of simultaneous working, founded on the Wheatstone bridge principle, was made the basis of procedure.

The telephone circuit is closed through two inductive branches. At their point of intersection the battery branch is led off to the group of telegraph apparatus, while the telephone apparatus is placed in the so-called galvanometer branch.

It is thus evident that the connecting-in of the telephone apparatus—namely, the leading of the telephone circuit through the switchboard—requires some care, because if there is a ground in the switchboard connections the telegraph working is disturbed. Even if one telephone circuit is directly connected to another, and there be simultaneous working on the latter, the two telegraph simultaneous systems are brought into contact, which again causes marked disturbance. This may also be caused by the operators ringing simultaneously on several circuits from the same common source of ringing current.

Even if only one of the circuits fed from the common ringing source is connected for simultaneous telegraphy, such working will still be slow, because in ringing on the simultaneous conductor we ring also on five or six other conductors. However well insulated these circuits may be individually the insulation of the simultaneous telegraph circuit will be so far reduced by the connection that it will hardly be possible to maintain continuous telegraph working.

It is true that we can remove all these difficulties at one stroke by connecting the incoming telephone circuit, before leading it to the switchboard, to a repeating coil, and working then only on the other half of the repeating coil. But by this plan the difficulty is only transferred to the other side—the telephone side. Above all, we have a loss of energy in the repeating coil to which are added losses inevitably occurring in the signaling apparatus, and it may happen that with such an arrangement the telephone subscriber does not get as much as 50 per cent. of the incoming speaking energy into his receiver. We must strive, therefore, that along with the undisturbed working of the telegraph, the telephone working be kept at the same relative level that would exist in the absence of simultaneous working. Moreover, the repeating coil not only weakens the speaking current but also the calling current, and we must, therefore, take precautions in this direction.

Under these conditions it is inadvisable to connect the circuit first to the repeating coil. As long as the circuit is on the calling apparatus there is no danger of disturbing the simultaneous working. The disturbance arises only at the moment of connecting. For this reason it would be sufficient to place the repeating coil in the connecting cord; but in the same path there is also the clearing-out signal, and a great loss of energy might thus be incurred. This we may, however, remedy if the repeating coil is constructed in such a manner as to serve at the same time as the clearing-out signal.

The clearing-out signal is, as a rule, connected in the bridge between the two branches of the circuit, and its duty is by its great self-induction to prevent the wasting of any considerable part of the speaking current. How far it is able to satisfy this demand might be readily ascertained by inserting a receiver in the shunt path. In spite of thus increasing the impedance of the bridge we still obtain intelligible speaking even with a clearing-out signal of 2,000 ohms resistance, if the latter is entirely imbedded in iron. These currents do not so rigidly follow the rules which apply to strong currents, and therefore inferences drawn from such rules do not apply in this case, as may be shown by a simple experiment. With such a clearing-out indicator 30 per cent. of the energy is lost on the average, and 70 per cent. only is available, as I have been able to ascertain myself.

With a well-constructed repeating coil, if arranged as a clearing-out signal, the loss is not greater. Consequently if we insert such a repeating coil into the connecting cord, simultaneous working without affecting the telephone is secured.

The repeating coil transformed into a clearing-out drop naturally possesses a closed iron circuit. In European practice this plan is avoided and an open-circuit repeating coil is generally preferred. The question whether the repeating coil has an open or closed magnetic circuit does not affect the high frequency involved, and for weak currents this is of much less importance than the other losses that arise in an open-circuit repeating coil.

For relatively strong signaling currents the closed iron circuit is of decided advantage, because with open-circuit repeating coils it is only exceptionally possible to ring through with alternating current, while it is always certain when there is a closed iron circuit.

From the point of view of simultaneous working it only remains to separate the ringing currents.

This may be accomplished if alternators are used by branching the ringing current at each operator's position on a separate repeating coil. Where batteries are used, which are today exceptional, each operator's position must be given its separate battery. This is a matter for the technical department.

As for the operating department it is only desirable that the telephone and telegraph operators should be able to communicate with each other quickly, so that they can co-operate in case of troubles.

In the simultaneous working apparatus itself the branching coil is of the highest importance. It is most important that the inductance on the two sides should be equal. This is more important than the exact equality of their ohmic resistance. This, however, determines not only the resistance of the coil but also the size of copper wire to be used.

From the point of view of choking, it is desirable to use long coils; such coils, however, by reason of the phenomena of dispersion, prevent the complete neutralization of the telegraph currents, and, therefore, it is necessary to select short coils. With such an arrangement the operation of the telegraph apparatus is not perceptible on well-balanced telephone circuits.

In the Hungarian telephone system the results hitherto obtained with simultaneous telegraphy and telephony in the manner above described have been excellent.

1. A paper presented at Section G of the International Electrical Congress of St. Louis, September 12, 1904.

Denver Also Out for N. E. L. A. Convention.

As mentioned in the Western Electrician last week, the next convention of the National Electric Light Association is practically sure to be held west of the Missouri River, and the chances of Colorado Springs then seemed to be the best. Denver, however, the recognized convention city of the West, will not stand passively by but will make a fight for her rights.

The executive committee of the National Electric Light Association is understood to have adopted this resolution:

Resolved, That it is the sense of this meeting that the next annual convention be held May, 1905, and that the place of meeting be west of the Missouri River, preferably Colorado Springs, Colo., and further, that the officers of the association be and are hereby authorized to select the city, time and place of holding the convention upon receipt of satisfactory assurance as to hotel, railroad and other accommodations.

Though Colorado Springs is suggested by the executive committee, it will be seen that the matter still rests with the officers of the association. It seems therefore at present as though one or the other of the above-mentioned places will be selected, or perhaps, as has been suggested, the two places conjointly—Denver for the convention proper and Colorado Springs for the entertainment features.

In reference to this matter Mr. Henry L. Doherty says: "Denver wants the next convention of the National Electric Light Association and wants it badly. We think our work entitles us to this convention if it is to be held west of the Missouri River."

Artificial Loads for the Dissipation of Electric Power.[1]

By F. H. Davies.

Of all central-station auxiliary apparatus that is not generally included in the main contract, the artificial load is, perhaps, the most important. In the days of small sets and more or less haphazard methods it was not given much thought. Some electricity works boasted sets of large and expensive resistance frames, which, constructed of steel tape or large slabs of some resistance material, were capable of dealing with 50 kilowatts or so, and the rest had recourse to the homely tub fitted with two lead plates and filled with a saline solution of some sort. The resistance frame for dynamo testing has had its day, but the tub in series-parallel arrangements still exists in a surprisingly large number of electricity works. With the comparatively large sets in use at the present day an artificial load is an obvious necessity, and it is safe to say that due regard to reliability and freedom from risk necessitate the trial running of a set at something approaching full load for at least a few minutes after a repair of anything but a trifling nature has been performed on it. More especially is this the case in alternating works, owing to synchronizing difficulties. In direct-current stations it is often customary, say, after a bearing has been remetaled, to put the machine on load, at the same time watching carefully for any signs of heating, and being ready to change over sharply if necessary. Here this practice is fairly safe, as changing-over operations, even with large sets, may be accomplished in a very short time, but in alternating work this is not always the case, and the precious moments spent in synchronizing have to be taken into account.

The attitude of the larger electricity supply concerns may be taken as indicating that the necessity of a preliminary full-power run is appreciated, for practically all arrange for a test upon artificial load after any repair of a serious nature, but the obsolete manner in which this is often carried out is surprising, and hardly creditable to those concerned. Quite recently one of the largest London high-tension electricity works afforded an exhibition to the passer-by of an alternator of some 500 kilowatts being run on a weird and wonderful arrangement of tubs placed in the station yard. High-tension cables strung about anyhow; no one to guard the apparatus, and no precautions for safety taken beyond a few half-obliterated notices reading "Danger, 2,000 volts." This is not economical, it is not convenient, and it is certainly not safe. It is, perhaps, an extreme case, but very similar ones must be known to many.

Tubs, as an artificial load, even for the smallest sets, are not convenient, and for large powers, in a short time of regular use, absorb enough money in the shape of wages for the men that dance attendance upon them to fit up a proper and permanent arrangement, and this in addition to the extreme inconvenience experienced in their use for dissipating considerable amounts of power. In all alternating and in every direct-current works of any size it will be found to pay to install a properly designed and permanent water load, and the apparatus being simple in the extreme, this may generally be done at very little expense.

Before starting out to design a suitable arrangement, there are one or two points that must be considered and appreciated. Primarily, the passage of either alternating or direct current through water produces heat, and this lowers its resistance very considerably as boiling point is approached. It therefore follows that for convenient working the water must be continually renewed in order to maintain its temperature and conductivity at some fixed and suitable point. Then the nature of the water must be taken into consideration, for although the specific resistance of supply companies' water may be much the same all the world over, that of rivers and canals may be very different, the same stream even varying considerably, according to the period of the year and the amount of impurities or refuse contained in it. This is especially the case with sluggish canal water. In the winter, when it is comparatively pure, its resistance is fairly high, but the advent of hot weather and putrescent matter lowers it greatly, sometimes to an almost incredible amount. The writer may cite a case in his own experience where the matter of one of the London canals varied so largely in conductivity at different periods of the year that while in winter a 2,000-volt alternator would be tested with the electrodes about three or four yards apart, in summer it was necessary to increase this distance fourfold to obtain an equal dissipation of power with similar electrodes.

The accompanying curve (Fig. 1) shows the results of a test made to determine the nature of the above-mentioned use of conductivity with heat. The water was taken from the mains of the New River Company, and the test, lasting 2½ hours, with no fresh water added to keep down the temperature, was with direct current at 500 volts. It will be seen that up to a certain temperature the rise in current and heat is proportionate; after this, however, the former gains rapidly on the latter. The results, as far as the actual figures go, are, of course, of no definite value, as these will vary considerably according to the volume of water in the tank, and, to a certain extent, with the size of the electrodes em-

1. From the Electrical Engineer of London.

ployed. They, however, demonstrate the fact that the rises do not take place in equal proportion for any length of time, and the ratio will very probably be similar for every class of water within reasonable limits. If desired, an increase in conductivity may be obtained by the addition of chemicals, such as sulphuric acid, salt and common soda. Of these, the two latter are preferable, being cheaper and having less corroding action on the electrodes; but it is desirable, if possible, to do without them, as, unless the addition is made very carefully after the water has attained its maximum heat, there is a likelihood of its being overdone, and the arrangement rendered temporarily useless by the resistance having become too low.

The design of a permanent water resistance, as far as dimensions go, must, of course, be dependent upon the size of plant to be tested; but in any case it is better to err on the large side, as the greater the volume of liquid the more satisfactory will be the results. If a water rheostat is overloaded, the resultant violent boiling gives rise to vapor troubles and an unsteady current, owing to the level of the water immediately surrounding the electrodes being constantly varied by the ebullition. A very simple arrangement, suitable for dealing with up to 1,000 kilowatts at 500 volts direct current, is shown in

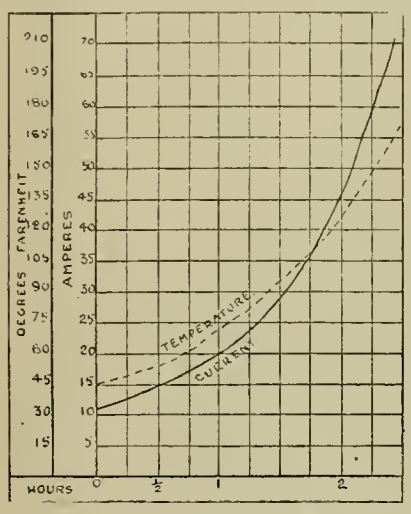


FIG 1. ARTIFICIAL LOADS.—CURVE OF TEST.

Fig. 2. Both tanks are of iron, and the inner one, which is suspended from some suitable bracket by wires, is bottomless. The immersion of this latter is regulated by aid of a small winch—preferably one of the ratchet type—and by this means the amount of current can be regulated to a nicety. It is fitted with two bars of wood, on to which the suspending wires are fixed, being broken in their length by a series of insulators. These beams have an additional function—viz., that of preventing a short-circuit should the wires break. In working with tubs or other rough apparatus it is common practice to suspend the electrodes by the cables themselves, the idea being partly that if the wire breaks, thus causing the two opposite poles to come into contact, the current will be automatically cut off; but such a system practically debars the use of winches, unless of special and elaborate design. It is, on the whole, better practice to use a strong steel rope, making sure that it is always fit for its work.

Referring to Fig. 2, the positive pole of the machine is connected to the inner tank by a flexible cable, and the negative to the outer, which is grounded, the apparatus thereby being made to all intents and purposes safe. An efficient supply of cooling water is arranged for by the two pipes at the ends of the outer tank. The outlet should be at the top, to allow the hottest water to flow off and the inlet at the bottom, thus causing the cold water to intermingle with the entire contents of the tank. If the supply is drawn, say, through the station circulating water mains from some adjacent stream, the hot overflow is probably of no value, and may be allowed to run to waste; but if, on the other hand, it is taken from the supply mains or other comparatively pure source, and not treated with chemicals in the tank, it may with advantage be passed into the hot well, and an appreciable economy thus effected.

For testing high-voltage alternating-current machinery of the same output, the arrangement shown in Fig. 2 would be too large, but it may be adapted by substituting rod electrodes, the outer tank being grounded and simply used as a container, and not as one of the poles. Single-phase work will necessitate two three-fourths-inch or one-inch iron rods placed about three feet apart for 2,000 volts, and three-phase, of course, calls for three, placed equidistantly at an angle of 120 degrees. Two-phase testing requires two separate tanks with two poles in each, the phases being treated separately as two independent single-phase circuits. One large tank such as the above may be used with only two inner electrodes and the tank as a common third, but in this case, if accurate readings are required, say, for the purpose of an efficiency test, it must be divided between the two rods by a metallic plate electrically connected to the tank all around, as otherwise considerable current that obviously cannot be metered will pass between the two inners, falsifying the results to a large degree. When using rods as electrodes, it will be found advantageous, in the interests of circulation of the water, to place earthenware drain pipes around them, with their upper ends slightly below the surface of the water. The violent boiling that takes place within the pipes, owing to the restricted volume of water, causes a very rapid circulation upward and over their tops, and this, of course, tends to the desired effect of keeping the whole of the contents of tank at approximately even temperature.

There can be no doubt that for the testing of machinery and for general station work, the water load is the best and handiest medium. Other types are, however, found in use, some of which may be recommended for purposes apart from machine testing. The carbon rheostat as a power absorber is an old friend—indeed, one of the first, and although it is not much used at the present time, it has done yeoman service in the past. The best form is the well-known one that is made up of a series of carbon plates placed in a frame fitted with a screw for tightening up or slacking back, the contact between the plates being thus increased or diminished, and the resistance of the whole varied in proportion. In this apparatus the resistance is due, not so much to that of the carbon itself, as to the more or less bad contact between the plates; and as these cannot be fitted or screwed up so as to touch equally all over their surface, the current is often forced to take a diagonal path through the plates from one point of contact to another, and by this means the resistance of the whole is considerably increased over the theoretical amount that

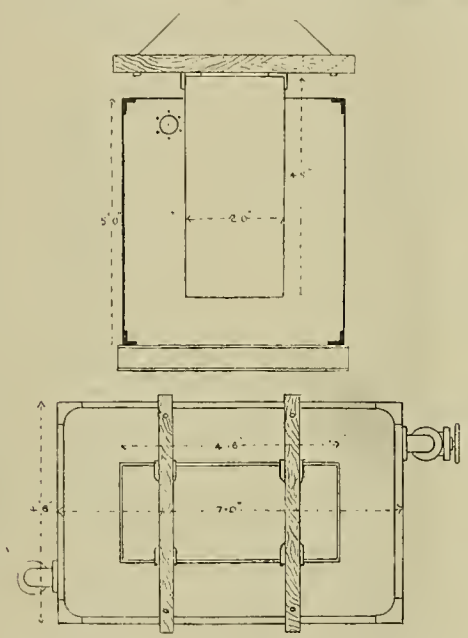


FIG. 2. ARTIFICIAL LOADS.—TANKS FOR WATER RHEOSTAT.

might be calculated for the particular length and diameter of the rheostat. Cooling is the chief difficulty presented by such apparatus, and for this reason it is only suitable for very small powers.

A very cheap and handy form of artificial load may be made up of galvanized-iron netting wound into a spiral by the aid of non-inflammable insulating distance pieces, or folded backward and forward over an iron frame built up on insulators. The resistance of this netting is approximately 0.0036 of an ohm per yard of No. 18 gauge, one-inch mesh, one yard wide, and the safe current capacity of such a piece would be about 100 amperes. Different makes of netting would doubtless vary in these figures, and before building up such a rheostat careful resistance measurements of a sample would be necessary.

For testing small machines, such as exciters, a very handy artificial load may be made in this way. As a dissipator of heat, iron netting is naturally very effective, especially the kind composed of a right-angled mesh, in which case only one set of wires will carry current, while the others at right angles will serve to carry off much of the heat generated. Expanded metal also makes a very effective resistance, and in many ways is preferable to netting, being, for instance, stronger and requiring less support. It is, of course, dearer than the former, but to a certain extent makes up for this by requiring less in the way of holding up and clamping together. If intended for a permanency, its use is to be recommended over netting, but as a temporary expedient the latter is preferable, owing to its extremely low cost.

A correspondent—apparently a Mr. Berry—of the English journal in which this article appears adds this: "There is nothing particularly original in the method of placing one iron tank inside another, in order to build up an artificial load suitable for dynamo testing, as many engineering works and central stations are using at the present time similar arrangements for the above purposes. Neither is it always advisable to earth the outer tank, especially in an engineering works where large foundation plates are used for bolting down machines which are about to be tested, because by so doing you practically reduce the insulation resistance of the machine down to one-half, which may cause trouble. I should like to ask the writer how long he proposes to run a machine under test, because he mentions the fact that he does not like the use of canal water for the above purposes, owing to its changing its specific resistance considerably during the period from winter to summer. Surely he would not run a machine for six months in order to test its efficiency or general behavior of same. Usually from 10 to 12 hours run will satisfy any reasonable engineer, during which time he will find that the physical properties or the conductivity of the canal water have not altered much, if any, certainly not enough to interfere with the test. With regard to the use of chemicals, such as sulphuric acid, salts and common soda, I beg to say that these should never be used upon any account where a very steady constant load test is required. If the tank is suitably designed, with ample electrode surface (both anode and cathode), together with some convenient arrangement for varying the distance between these electrodes, also with a large supply of cold water (either canal, river, town or even condensed water) for circulating through the tank, then, with a reasonable small tank, there is not the slightest reason why any size of machine up to at least 1,000 kilowatts could not be run under full load without the use of any chemicals whatever. Some years ago I, for the first time, made it known to the engineering community (by giving analysis and specific resistances of various waters) that it was quite unnecessary to use chemicals of any kind for any waters when testing. Again, 2½ years ago, a discussion took place between myself and another well-known engineering gentleman upon the question of testing tanks, chemicals, various waters—in fact, on similar lines to this, when I gave a few particulars and dimensions of tank I had been in the habit of using."

The Storage Battery as Applied to Electric Railways.[1]

By W. E. Winship.

Within the last few years there has been a decided change in the attitude generally taken as to the advantages and advisability of storage-battery installations. This is partly due to a better knowledge of the life which may reasonably be expected, and, to a minor extent, to improvements in construction and plates.

Storage batteries have shown their utility and economy especially in railway work, where current fluctuations are usually extreme.

Where the system, supplied from a single station, is large, and relatively small cars are operated, the instantaneous fluctuations will be a small percentage of the total load, and there would be no economy gained in removing them. The load in this case will very nearly follow the service supplied; i. e., be steady and proportional to the number of cars, and the only effectual use of a storage-battery plant, outside the large element of reliability of operation secured by it, would be in regulating the load factor on the generating units in service. There would probably be, even in this case, a considerable economy resulting in operating the generating units and boilers at their most efficient load. This fact and their importance as a reliability factor might determine their installation under the above conditions.

When large cars are operated, perhaps even in trains, and high accelerations are demanded, as in interurban work, the conditions are entirely different. The fluctuations are then enormous, frequently much in excess of 100 per cent. over the average load, and we very often find stations operating on a 50-per cent. load factor in order that the maximum demand may be within the overload capacity of the generators.

As is well known, the efficiency of a steam engine is greatly reduced, and that of a generator, also, to a smaller extent, when the average is much less than their rated load. With steam turbines this is true to a somewhat less degree, but there is still a great variation of steam consumption. The net efficiency of the engine-generator combination is the product of the efficiencies of the two, and suffers, therefore, more greatly than either singly. By using a storage battery, either with or without a booster, to absorb these fluctuations, it becomes possible to raise the load factor by shutting down one or more engines and boilers, with a consequent decrease in coal consumption, reducing also such items as labor, oil, waste and repairs, thereby effecting a great economy. It is possible, then, to operate with less apparatus, and usually some saving may be made in initial power-house outlay, since an equivalent battery plant would cost somewhat less than the engines, boilers and generators it displaces.

As with all machines and contrivances, the efficiency of a storage-battery plant is not perfect. On certain classes of work (viz., short cycles of charge and discharge) it is remarkably high. If the fluctuations are within the hour-rate of discharge of the battery, and are of short duration, it is very nearly 90 per cent. Tests published by Highfield, covering

1. A paper read before the Franklin Institute of Philadelphia.

a year's actual operation of a battery plant on such work, showed a net watt-hour efficiency of 84 per cent.

On complete charge and discharge cycles, it is decidedly less, 87 per cent. with the ordinary stationary types of batteries being about as high as can be obtained, while under practical operating conditions it is less than this, running from 70 per cent. to 80 per cent., according to the class of work the battery is called on to do. In spite of this fairly low efficiency the use of such a "peak" battery may result in a very considerable saving. Most especially is this true when the source of supply is a waterpower of limited capacity, and, as already pointed out, as an emergency it is invaluable.

The capacity of a storage battery is given in ampere-hours, and varies with the rate of discharge. Taking the capacity as 100 per cent. at the eight-hour rate, the capacities at the five, three and one-hour rates are 87½ per cent., 75 per cent. and 50 per cent., respectively. The capacity of a storage battery is arbitrary to a certain extent; that is, a battery could be discharged for a longer time than would correspond to these figures. If, however, the discharge is continued beyond these values, the voltage drops too rapidly for good efficiency. It should be noticed that by saying the capacity at the one-hour rate is 50 per cent. of that at the eight-hour rate, we do not imply that twice as many ampere-hours must he put in as are taken out, for this is not the case. The ampere-hour efficiency of storage batteries is very good, being 95 per cent. to 98 per cent.

To take care of the fluctuations on a power or sub-station, there are several ways of operating storage batteries. Necessarily, the voltage of a battery rises on charge and falls on discharge. If the generators have a falling characteristic, that is, the voltage drops with increasing load, and the maximum permissible amount of this drop is considerable, say five per cent. to 10 per cent., then a battery may be simply "floated" across the bus bars, and will charge when the external load is light and discharge when it is heavy. The extent of the load equalization under these circumstances will depend on the sharpness of decrease in voltage, and the duration and magnitude of the fluctuations with reference to the size of the battery. Roughly, it may be stated that with a five per cent. to seven per cent. variation of voltage above and below the normal and with current variations equal to the one-hour rating of the battery, lasting for several seconds, the generator load variation will be constant to within five per cent. It is possible to adjust the combination of battery and generators for different load factors in either of two ways—first, by cutting in or out a certain number of cells or by raising or lowering the average voltage of the station.

In many instances, however, it is essential that the voltage may be maintained fairly uniform. Under these circumstances, in order to have the battery charge and discharge, the difference in voltage between the battery and the system must be made up automatically in some way. It is usual to employ a differential booster for this purpose. A brief description of such boosters may not be out of place. There are two booster systems which have come into general use in America, both of which are usually motor-driven.

In the one form the booster-generator field consists of a shunt winding, to which is opposed a series winding, a portion of this latter carrying the generator load, while through the remainder is passed the external load. The shunt winding is so determined that with no external load the voltage of the booster-generator will be equal to the maximum difference of voltage between the battery and generators. The series winding is so determined that with both generator and external load equal to the average, the resultant field and consequently the booster voltage is zero. One of the objections to this arrangement is that the resultant field is small in comparison with either component, and in consequence there is a serious amount of energy dissipated in the field magnets. The field energy has practically the same value independent of the battery load, so that the amount of this loss is of considerable magnitude. The self-induction of these abnormally heavy windings is very great and the pole legs of the field magnets necessarily long to accommodate them; these two facts condition a relatively slow response of the booster to variations of the load.

In the second form, the booster-field regulation is obtained through the use of a small auxiliary generator, whose field carries the generator load. This machine is so determined that with the generator load at its normal value the voltage is equal to that of the system. The booster-field circuit includes the armature of this auxiliary machine and is connected across the generator bus bars. The result is that, with the average current in the auxiliary machine field, the voltage impressed on the booster field, and consequently the booster voltage, is zero. If the generator load increases by a small amount, the voltage of the auxiliary machine increases by a corresponding amount, and there is a resultant voltage impressed on the booster field, thus causing the booster to assist the battery to discharge. This machine may be so calculated that the generator load may be kept constant to within any predetermined limit. It has the advantage that there is no energy in the booster field when it is not required, and also that the regulation is dependent on the load which is to be regulated.

The length of the booster-field magnetic circuit is normal, and the field windings are composed of a relatively small number of turns (for a booster on railway work usually wound for 50 volts maximum); as a result, the response of the booster is almost instantaneous.

The determination of the size of a battery installation will depend on two elements, the maximum discharge rate which it is required to deliver, and the required storage capacity. When a battery is simply to act as a load equalizer, independently of its storage capacity pure and simple, then it is obvious that the battery should be chosen on the score of cost as small as is consistent with efficiency and life. For this purpose that type of battery which is calculated to withstand a maximum discharge rate with the least amount of deterioration and least drop in voltage should be chosen. These properties attach to plates having a great surface exposed to the electrolyte in the cells.

The combination of equalization of both instantaneous fluctuations and peaks of the average load is especially useful with waterpowers of limited capacity, as it is possible then to obtain the maximum output capacity of the plant. Another very prominent advantage, especially in operating on comparatively low heads, is that the difficulties of governing are largely obviated. This is of extreme importance in alternating-current installations.

An example of such an installation, at Easton, Pa., may be quoted. The power plant consists of two two-phase alternators, driven by waterwheels, located in a station about 1½ miles distant from the main power house. In this latter are steam-driven auxiliaries. A mixed railway and light service is furnished. Before the installation of this battery an 800-horsepower steam unit was in constant use to reinforce two alternating-current motor-generator sets, driven from the waterpower, in order to care for the instantaneous peaks of the railway load. Since the installation of the battery, the waterpower carries both the railway and lighting load. During the day the battery equalizes the railway load, receiving also a slight net charge; when the lighting load comes on, the battery furnishes a net discharge to cover the difference between the waterpower capacity and the total load on the plant. From 12 to 4 a. m., when the load is extremely light, the battery is recharged. They are able then to carry their load under normal conditions without the use of steam, excepting for certain auxiliary service, and are able to shut down an 800-horsepower unit, and, in addition to this advantage, by the removal of the railway-load fluctuations, their lighting service is extremely satisfactory.

The preceding has reference to installations in central or sub-stations. Under certain conditions it is advantageous to install batteries at points distant from generating stations. Such installations are of two types—"floating," or fed from a boosted feeder, and are termed line batteries. In electric-railway work such batteries would be located at some distance from the generating station to maintain the line voltage.

In the case of a battery at the end of a boosted feeder, it is usual to transmit the average current, allowing the battery to absorb or give up the difference between the instantaneous and average currents. Such an installation may have a very fair efficiency, and will show a decided advantage over a high-tension transmission and sub-station scheme if the frequency of the car service does not justify the first cost and attendance required by the latter. The instances where these conditions hold are extremely numerous in interurban work. In many cases, however, a battery simply placed across the line will serve every purpose of the above, and will show several advantages over it.

It is obvious that the voltage at different points could be maintained by copper, but the amount of copper would often be excessive. It is of great importance to maintain the voltage on the line at as high a value as is possible, for several reasons. It is the characteristic of series motors, such as are used in railway work, to take a definite current on definite grades outside of periods of acceleration and independent of the speed of a car. The speed will vary very approximately as the applied voltage; it is obvious, then, that to maintain a given schedule less cars will be required with high than with low voltage. Again, with cars on a grade or accelerating, the periods of taking excessive currents are of shorter duration with the higher voltage. The heating of the motors will depend largely on the time that these heavy currents are demanded, and as a result the motors will deteriorate and burn out very rapidly if the line voltage is too low. This item of motor repairs is a very serious one in electric-railway operation. Again, the loss in transmission with low voltage is excessive. Taking into account the schedule speed and the transmission losses, the energy consumption will be approximately inversely as the squares of the applied voltages.

If the amount of copper is sufficient to furnish the average demands of the cars with a relatively small drop, when the cars are accelerating or mounting grades distant from the power house, especially when the service is supplied by only a few cars, the drop becomes excessive, and is felt all over the line. If a battery be installed at a point about three-fourths of the distance from the power house (which point would be modified somewhat by the location of grades), whose voltage is equal to the voltage which would exist at this point if all the cars were taking the average current, then it would charge on light loads and discharge when the load becomes heavy. This results in a very considerable equalization of load on the power house and in the maintenance of the voltage at the battery location at approximately a constant value, varying only five per cent. to seven per cent. above and below the average. The battery will then neither experience a net charge nor discharge. Such batteries have been installed by putting in the number of cells corresponding to the average voltage before the erection of the battery. It is easily seen that the two values, voltage at this point with the cars taking the average current, and the average voltage may be quite different, as the battery will modify the latter quite considerably.

An objection sometimes brought against such an installation is that it has no flexibility. It is, of course, absolutely determined by the feeder scheme and the service on the line. If the latter is increased, the battery will experience a net discharge But this may he taken care of as follows: A certain number of cells may be cut out of service, corresponding to the increased drop; or if the schedule varies with the time of day, the battry may be installed so that it receives a net charge during the lighter service and furnishes a net discharge when the greater number of cars are run, or the voltage of the power house may be correspondingly varied. Sometimes the conditions would be met by a combination of these methods.

A small installation at Berlin, N. H., will illustrate what may be accomplished in this way. The road runs from Gorham to Berlin Mills, and is approximately 8½ miles long. The power house is 0.75 mile distant from the Gorham end of the line; from Gorham to Berlin there are numerous three to five-per cent. grades, with one short, heavy grade of about 12 per cent. near Berlin; toward Berlin Mills there are several eight per cent. grades. The track is 60-pound rail; bonding in poor condition. The line consits of one No. 00 trolley, with a 400,000 circular-mil feeder to within one mile of the end; from Gorham to the power house there is a 400,000-circular-mil copper return. A battery was installed in the car barn 6.5 miles distant from Gorham, consisting of 230 cells, having a capacity of 280 amperes for one hour. Ordinarily two 16-ton cars are operated under 40-minute headway. If extra cars are run for a short time, no change is made in the battery. If, however, it is desired to operate a 20-minute schedule over eight or nine hours, 30 of these cells are cut out and the battery furnishes a net discharge of about 40 amperes. Before the battery was installed it was impossible to operate more than the two regular cars. They are now able to operate four cars for eight to 10 hours, and at times six cars are run.

What promises to be an exceedingly useful application of floating batteries on interurban roads operating sub-stations at not too infrequent intervals is the installation of batteries in such sub-stations ordinarily to accomplish load equalization; in case of a breakdown of the sub-station of short duration, the battery would be placed directly across the line and allowed to discharge. If the breakdown is of long duration, a certain number of cells could be cut out and the battery "floated" between the two stations on either side to maintain the line voltage indefinitely at a value sufficient for continuous operation.

Some Views on Municipal Ownership.

An idea of the views held by a daily newspaper as regards the subject of municipal ownership of public utilities may be gained from the following item, taken from the editorial page of the New York Times of September 8th:

"To an inquiry made at a recent convention of electricians as to the best way of bringing the public to realize the fallacy of municipal ownership the most notable answer was made by a speaker who said that this end was to be obtained, 'first, by giving the best service possible and charging only enough to net a reasonable return, and, second, by showing failures on the part of municipalities that have installed their own plants.' In the account of this discussion that is before us, only the speaker just quoted made any reference to good service and small charges as effective means of fighting the public-ownership idea. The other speakers were content with reliance upon the careful exploitation of every failure of a municipal experiment along these lines, and the favorite suggestion was that the absurdities and inaccuracies of the bookkeeping by which the experimenters occasionally figure out success should be pressed upon the attention of all communities where an inclination to trouble the private corporations had revealed itself or was suspected. Much can so be done, no doubt, for the public-ownership people are most deplorable accountants. The chief difference, however, between their reports and those of a good many private corporations dealing with public utilities is that the former are false through ignorance and the latter deceptive through intention. But really admirable was the advice of the man who thought of good service and low charges. There lies safety, beyond a question, and the safety that comes, too, not from winning a fight, but from having no fighting to do. The public is too distrustful of itself, and especially of its politicians, ever to attempt business on its own account except as an escape from unendurable extortion and as the smaller of two evils."

The international space-telegraph conference will take place in Berlin on October 6th.

Defective Telephone Service in Paris.

It is a matter of general knowledge that the telephone service in France, and particularly in Paris, is uncommonly poor, but it may not be so well known that an association of telephone subscribers has been formed in the French capital to conduct an organized agitation against the many defects of the existing telephone service, which is provided by the telegraph administration of the government. This association was established in May last and has as its president Marquis de Montebello, who is assisted by a council numbering among its members well-known business men in Paris. The objects of the association are to effect an improvement in the Paris telephone service, which has long given cause for much complaint, to modify the drastic rules and regulations by which the Paris telephone subscriber is governed, to increase the development of the service and to reduce the rates. With the object of obtaining the maximum amount of publicity for the grievances of the Paris telephone subscriber, and for the opinions and investigations of the association, an official monthly journal has been started, the first number of which has appeared, and from which, through the intermediary of the London Electrical Review, the following information is obtained:

In his editorial article, Mr. de Montebello points out that the association cannot be suspected of being the advance guard of any financial combination, of being moved by political ambitions or of being irresponsible agitators anxious for notoriety. The simple object of the association is to give organized effect to the demand of all telephone subscribers who with a better and cheaper service. The telephone question, he says, is more complicated than it seems at first glance, and to understand it thoroughly it must be regarded under three main aspects—regulations, organization, and financial management. The regulations, he says, are arbitrary and vexatious, and have hitherto been borne by the subscribers with sheep-like docility. It is insufferable, for example, that the administration should have the power, while charging the full subscription, arbitrarily to cut off a subscriber's service or to bring the subscriber into court on account of a few lively remarks to a telephone operator, as if an outrage had been offered to a high dignitary of the state. As to the organization of the telephone department, Mr. de Montebello says that departmental methods reign to such an extent that it is not astonishing that there should exist the inefficiency which generally results from bureaucratic management. Not much, he says, can be done here, but nevertheless, he promises that the association will do its best to disturb the inertia of the department and to turn the searchlight of publicity on routine methods, in the hope of obtaining much-needed reform and progress. As to financial management, the main trouble is that all the revenue from the telephone department is promptly absorbed by the Treasury, and that all credits for the improvement of the system and of the staff are pitilessly refused. This, at any rate, is said to be the explanation of the under-secretary of state in charge of the telephone service, but it appears that, in future, if the under-secretary is insistent in his demand for money for the amelioration of the telephone service, he will have the active support of the Association of Telephone Subscribers. As to the line of action which the association should pursue, various courses have been suggested, ranging from an alliance with the administration to a declaration of open war against the administration. Mr. de Montebello's opinion is, that the association should remain independent, giving the fullest publicity to the difficulties and abuses connected with the telephone service, and demanding the necessary reforms without prejudice, but with vigor, not employing extreme measures until more temperate methods fail. A legal advisory board has been established, which will thoroughly investigate the legal asnect of the regulations affecting telephone subscribers and their relations with the telephone employes, and technical committees are to be appointed to study the working and development of the telephone in France and in other countries. Local committees will be established among the subscribers to bind them into a powerful organization. Mr. de Montebello concludes with an eloquent appeal to French telephone subscribers in general to support the association and give it the strength which numbers lend.

A short note in this curious telephone journal registers the successes which have already been achieved by the association in its campaign against the telegraph administration. One was the abrogation by the administration of the clause in the telephone regulations under which the administration formerly exercised the right to cut off telephone subscribers who offended the telephone employes. It seems that about 200 subscribers each year had their services arbitrarily discontinued by the administration under this rule. Another important result of the agitation has been a demand made in Parliament by the under-secretary for the necessary credits to add 237 operators to the Paris telephone staff. This request for additional operators is declared to be solely due to the intervention of the Association of Telephone Subscribers.

An interesting account is given of the official visit of a number of members of the council of the association to the main telephone exchange in Paris. The visitors were received by the chief engineer of the Paris division of the Telegraph Administration and by the manager of the exchange. Asked what were the principal causes of the slow and defective service of which Paris telephone subscribers complain, the officials gave the following reasons:

1. The insufficient number of lines (presumably trunk lines).
2. The insufficiency of staff.
3. The impatience of the subscribers.
4. The nervousness of the operators.

Asked whether the number of subscribers served by each operator was not excessive, the official reply was that the number of subscribers had no bearing; the number of calls was the point to be considered. According to the official statistics, the number of calls per operator's position in 14 hours was 1,000, or an average of 70 an hour. During the busy times of day, however, the rate of calling is twice this figure, and operators frequently have to deal with calls at the rate of 150 an hour.

These figures seemed to astonish the visitors, and they immediately asked for the explanation of the interminable waits of which they all had frequent experience.

The answer to this was simple and truly official. "The subscribers do not know how to use the telephone."

The explanation of this retort on the visitors was that a subscriber, once having called by pressing his button, must wait until the operator answers. If he presses the button again, or hangs up the receiver, he runs the risk of not being answered at all. The officials also alleged that, besides making mistakes in calling, 60 per cent. of the subscribers neglected to give the disconnection signal (!), which prevented the operators from giving new connections with rapidity.

The comment of the visitors on this explanation of the subscribers' defects showed that the official view was hardly convincing. It is worth quoting:

"To sum up, then, and this is quite in accord with all the principles of the administration, if we do not get a good service, if we often have to wait 20 long minutes for an answer from the exchange, it is all our fault."

The officials were not quite willing to go as far as that, but they certainly were of opinion that the responsibility for the bad service was largely shared by the subscribers. The real cure for the trouble, said the officials, rather inconsequently, it may appear, was more money—more money for lines, for stations, for switchboards, and for increase of staff. The visitors pointed out that the staff seemed already sufficiently numerous. The official reply was that there were 1,800 operators on the Paris staff. Of these, about 325 are always on sick leave, and about 70 are engaged in other than telephone work, leaving an active staff of 1,400, which is considered insufficient. The exact number of subscribers in the Paris system is not stated, but it appears to be in the neighborhood of 35,000.

A discussion on the financial aspect of the telephone service followed, but on these questions the officials guardedly refrained from giving any opinions. The chief engineer, however, threw a sidelight on the difficulties under which the Paris telephone system labors, by pointing out that it was only in December, 1903, that a credit of 3,000,000 francs was voted for new telephone-exchange apparatus which had been demanded three years previously.

The visitors were shown over the exchange, and the method of working was explained in detail by the officials. The impressions which the visitors received as a result of their inspection were as follows:

The work of the operators they considered trying and fatiguing, principally because the exchange is very badly equipped. With more modern and better designed apparatus, the operators would give a better service with less effort. In any case, an increase of staff seemed absolutely necessary; at least 120 operators should be added to the staff of the main exchange. The visitors consider increase of staff necessary, in order to provide substitutes for absent operators, and, in order to lighten the work of the operators in charge of the toll lines, these have to keep records in addition to the regular work of operating, which complicates the work and slows down the service.

The other side of the story, or, rather, a contribution to the same side from a more intimate point of view, is contained in a letter to the president of the association from a group of telephone operators. This communication is couched, as might be expected, in somewhat hysterical terms. The operators complain that they have too many subscribers to serve, and that the subscribers are not as polite as they might be. The volume of work increases steadily, and, at the same time, the work becomes more difficult to do, on account of defective apparatus. The complaining operators, however, have the sense to see that definite figures are more convincing than general complaints, and they give figures of some interest. Each operator, they say, serves at present from 100 to 120 subscribers, whereas it is materially impossible to serve effectively more than 75. Incoming trunk operators each serve 15 lines, whereas the maximum that they can handle satisfactorily is 10. Exact statistics, say the operators, show that an answering operator has been known to deal with 252 calls in two morning hours—104 calls from nine to 10 and 148 from 10 to 11. An incoming trunk operator has been known to handle 325 calls in two hours—147 from nine to 10, and 179 from 10 to 11. These figures show, according to the opinion of the operators, that the employes are greatly overworked, and under such conditions they cannot be expected to give good service.

The operators also claim that there is great necessity for an increase of the number of trunk lines between the various exchanges. All subscribers, they say, are familiar with the fact that there is an insufficient number of these lines, as their calls are frequently met with the answer, "all lines occupied."

A further improvement imperatively demanded, say the operators, is the installation of new switchboards. The majority of those now in use are worn and defective, with plugs out of order, annunciators out of order, and jacks and cables out of order, giving rise to false tests, contacts between neighboring lines, noisy lines and bad transmission.

The American reader will be astonished at the extent to which Paris, telephonically considered, is behind the times, both as to apparatus and conception of service.

Ohio Telephone Notes.

The district meetings of the Ohio Independent Telephone Association in the various parts of the state have been marked with much interest. J. B. Hoge of Cleveland, F. L. Beam of Columbus and a number of other prominent telephone men have attended most of them and made addresses. The result is that the district organization is very complete and the association is now in position to begin to reap some of the benefits of uniform action and uniform operation and management. Should the plan of organization adopted in this state be carried to other states and to the national organization, such a general understanding will be had of the Independent movement that the companies will be able to operate almost as one large organization. While the association will pay some attention to the competition of the Bell people, its primary purpose is for the betterment of the Independent movement. Well-informed men say there is room for both companies.

The City and Suburban Telephone Company of Cincinnati will have its new exchange at Canal and Race Streets ready for operation by November 1st. This exchange will take care of business in the portion of the city where it is located.

At this time the Lima Telephone and Telegraph Company has about 2,000 subscribers and furnishes service to 200 outside of the city. It has an up-to-date plant and underground copper-circuit lines. The business has had a rapid and substantial growth since it was started in 1895. The officers of the company are: President, D. J. Cable; treasurer, W. H. Duffield; secretary and general manager, George H. Metheany.

The council at Lorain, it is stated, will probably grant the Bell company a new franchise. An ordinance to this effect has been on the table for nearly a year.

Material has been shipped to Marysville for the new circuit to be constructed by the United States Telephone Company between Columbus and Toledo.

The American Long-distance Telephone Construction Company, organized by the Barber-Brailey syndicate of Toledo, has sold its properties in 15 or 20 towns in Kansas to a syndicate of St. Louis men, who took over the bonds and half of the stock, it is reported. The other half of the stock remains in the hands of the original holders. The consideration is reported at $225,000.

The Rushcreek Telephone Company of Junction City has been incorporated with a capital stock of $5,000. W. S. Tuttle, J. M. Elder and others are interested.

W. D. Miller, Levi Harruff and others have incorporated the Beach Telephone Company of Claridon Township, Marion County, with a capital stock of $10,000. The company will build rural lines.

The capital stock of the Trotwood Home Telephone Company, Trotwood, Montgomery County, has been increased from $10,000 to $20,000. S. Blessing is the president of the company. C.

Telephone News from the Northwest.

The Red River Telephone Company is extending its lines from Moorhead, Minn., into Clay and Cass Counties.

The Edgerton (Wis.) Telephone Company has amended its articles of incorporation, increasing the capital stock from $6,000 to $13,000.

The Northwestern Telephone Exchange Company has just installed a testing panel in connection with the switchboard in Grand Forks, N. D., for locating breaks and interferences with long-distance wires.

The council of Red Wing, Minn., is again considering the matter of a franchise for connection with the Consolidated Telephone and Telegraph lines.

Active construction work has been started at Grand Forks, N. D., on the new exchange building for the Tri-state Telephone Company.

Winona, Minn., has refused a franchise to the Northwestern Telephone Exchange Company for a conduit system leading to the new building being erected. The council has consistently refused private conduits hitherto, because it is intended ultimately to have a municipal conduit system for all wires.

The Minnesota Mutual Telephone and Telegraph Company has changed its principal place of business from Minneapolis to North Branch, Minn.

The Blue Earth Valley Telephone Company has instituted night service for its exchange at Wells, Minn.

The Tri-state Telephone Company has been granted

admission to Breckenridge, Minn., for its long-distance line from the Twin Cities to Fargo and Grand Forks.

The Hastings (Neb.) Independent Telephone Company is making preparations for erecting a new telephone building to cost $10,000.

The Fremont Telephone Company has been granted a franchise at Fremont, Neb.

The Mutual Telephone Company of Des Moines, Iowa, is negotiating for toll-line connections with lines to Philadelphia and New York.

The Interior Telephone Company has completed its line from Montezuma to Ewart, Iowa. Material has been ordered for a line from Montezuma to Grinnell.

Charles A. Towne and J. S. Clarkson have organized the Rogers Telephone Company at West Union, Iowa.

The Kearney Telephone and Construction Company has been granted a franchise at Minden, Neb.

R.

Southeastern Telephone Developments.

The Southern Bell Telephone Company (long-distance) is preparing to put up lines from Elkin via Boonville and other points to Winston, N. C.

J. M. Furr and Calvin Deal are in charge of a telephone line to connect Mooresville, N. C., with outside rural sections.

The Bell Telephone Company at Charlotte, N. C., now has 1,200 subscribers, a greater number than in any city of the Carolinas except Charleston.

General Manager F. C. Toepleman of the Home Telephone Company and of the long-distance Bell telephone lines at Weldon, N. C., is preparing to rebuild the local system, installing cables, etc.

The property of the Jacksonville (Fla.) Telephone Company has been sold at auction to G. K. Gerow for $5,000, Mr. Gerow being supposed to represent the principal creditors. About $75,000 has been invested in the property, which was organized to compete with the Southern Bell Telephone Company. It is not known whether or not the exchange will be continued.

The Southern Bell Telephone Company is extending its system to the rural districts about Cordele, Ga. J. R. Hobson is superintendent of the district.

L.

Interstate Independent Telephone Association of America.

Officials of the Interstate association are at work perfecting plans for the next annual convention, which will be held in Chicago on December 13th, 14th and 15th. The special committee appointed at the last meeting to act on questions of vital importance will make a report, which, it is asserted, will tend to make the coming meeting the most important in the history of Independent telephony. In order successfully to push the work outlined the association has been incorporated and a financial plan has been devised. In the plan outlined and adopted by the committee are contemplated the opening of permanent regular headquarters, to be the office and center of the association, and to establish in the headquarters three distinct bureaus, viz., "Information and Statistics," "Promotion and Protection," "Uniformity and Standardization." Preliminary announcements and circulars outlining the plans to be discussed at the December meeting are being sent to all Independent operators, manufacturers and supply houses from the office of Secretary Coleman at Louisville, Ky.

GENERAL TELEPHONE NEWS.

H. D. Edmonds has sold his telephone exchange at McLouth, Kan., to Sellers & Son.

The Independent Telephone Company of Seattle, Wash., has connected its lines with Vashon Island and will begin the service October 1st.

At a meeting of creditors of the Anders Push Button Telephone Company of 136 Liberty Street, New York, held at the office of Peter B. Olney, referee in bankruptcy, John Brooks Leavitt was elected trustee, and six claims, aggregating $6,300, were proved.

The Missouri and Kansas Telephone Company has won another victory over the city of Wichita, Kan., the decision of the lower court that its franchise had been improperly terminated being sustained. The city was enjoined from interfering with the company in its work of extending and repairing lines.

Farmers living along the Greer-Griffith road, near Salem, Ore., will hold a meeting soon to formulate plans for the erection of a rural telephone line along the road. It is proposed to connect the line with the Pacific States Telephone and Telegraph Company at Salem. W. L. Simeral is chairman of the committee having the matter in charge.

EXTENSIONS AND IMPROVEMENTS.

Harvey Myers and others have incorporated the Booneville Telephone Company of Booneville, Miss., with a capital stock of $10,000.

The Bell Telephone Company of Canada has completed the erection of a long-distance line from Morris to Emerson in Manitoba, and offices have been opened at St. Jean, Baptiste, Dominion City and Letellier. It is also the intention to connect at Pembina with the American Telephone Company.

The Nacogdoches Southeastern Telephone Company has been incorporated at Nacogdoches, Texas, with a capital stock of $1,000.

The Scottsville and Barren River Telephone Company of Scottsville, Ky., has been incorporated. W. B. Ray, R. F. Hood and J. T. Hunt are the interested persons.

Henry Sisler of Red House, Md., and P. F. Snyder of Sunnyside have organized the Red House Telephone Company and will build a telephone system.

The Overland Telephone Company is now giving an improved service at Pulteney, N. Y., and new connections are being made between Pulteney and the surrounding villages.

The East Okaw Mutual Telephone Company of Findlay, Ill., has been incorporated to operate telephone lines. J. E. Francisco, A. M. Lesley and Curtis Spicer are the incorporators.

The Missouri and Kansas Telephone Company has ordered 40 tons of telephone wire to meet the immediate requirements of the company in the vicinity of Kansas City, Mo. An $8,000 switchboard has been ordered for Argentine and a $20,000 switchboard for the Kansas City (Kan.) office.

The Centralia Telephone Company of Centralia, Mo., has just completed rebuilding and re-equipping its plant and has now one of the most durable systems in that section. The Centralia plant was one of the first exchanges in the state. It was built by A. Bishop Chance in the early days of Independent telephony.

Indianapolis Street-railway Station.

What is probably the largest electric-railway terminal station in the West is nearing completion in Indianapolis, Ind., and is owned by the Union Traction Company. It is to be opened on October 1st. Some of the rooms in the office part of the building are already occupied.

The main entrance to the building is on Illinois Street, leading directly to a large commodious waiting room, tastefully decorated, with nine double swinging doors leading to the sheds. All the offices on the first floor are tiled and decorated with white marble. Tracks leading to the station are all laid. The cars of the Northwestern line will enter the station from Ohio Street and leave from Market Street, turning north on Capitol Avenue. The Union Traction Company has arranged to have its cars come into the station from Ohio Street, turning off of Massachusetts Avenue at Pennsylvania Street, returning by Capitol Avenue, Ohio Street and Massachusetts Avenue. The Greenfield cars will turn off of Washington Street into Illinois Street, thence to the station.

The Greenwood cars which come in on Virginia Avenue will make their way to the station over the same track as the Greenfield line. The Plainfield and Martinsville lines, which come in on Kentucky Avenue, make their way into the station from the Market Street entrance to the sheds. There will be two callers and a station master to see that passengers catch the right cars.

Three-phase Static Ground Detector.

Static ground detectors, designed to enable the central-station operator to determine at a glance whether a ground exists on a single-phase circuit, have become well recognized as a necessary part of every first-class installation. These single-phase instruments are entirely satisfactory on two-phase circuits as well. For three-phase circuits, however, although the practice has been to use two or three single-phase instruments either in separate cases or combined in the same case, this arrangement is open to the objection that the indications of the pointer are not direct, some time being required for a person not familiar with the instruments to determine which line is grounded. It is only recently that a design has been produced which enables a ground in a three-phase circuit to be indicated directly by the use of one instrument.

In the Westinghouse detector, each of three fixed vanes is connected to a line of the three-phase circuit. The central movable vane is electrically connected to the case, which is grounded. When there is no ground upon the circuit the attraction or pull upon the central vane from each of three fixed vanes is balanced and it does not deflect from a central position. Should one of the lines become grounded, and the potential of that line become the same as that of the movable vane there will be no pull in that direction, and the movable vane will be deflected from the grounded line. The instrument is reliable in its indications and has no complications in its mechanism or construction.

The three leads to the ground detector have a condenser inserted between each line and the instrument. This obviates the necessity of carrying high-tension wires to the front of the switchboard. Each of the condensers consists of a brass tube covered with insulating material, and placed within a copper sheath, the line being connected to the inner tube and the lead to the copper sheath.

This ground detector is ornamental in appearance. In shape and size it corresponds with the other Westinghouse round-pattern switchboard instruments. The interior of the case is given a dull-black finish, against which the aluminum vanes stand in distinct relief, while the angles of deflection marked upon the glass face form a pleasing geometrical design. In every way it is a high-grade instrument.

Two-thousand-kilowatt Rotary Converters for the New York Edison Company.

The New York Edison Company will, in the near future, begin operating at the Duane Street power house the first of four new 25-cycle, six-phase, 270-volt, 2,000-kilowatt rotary converters, built according to the specifications of the Edison company's engineering staff. These converters are the largest ever made by the General Electric Company and are the largest ever installed by the Edison company. The largest rotary converters hitherto installed by the New York Edison Company are of 1,000-kilowatt output.

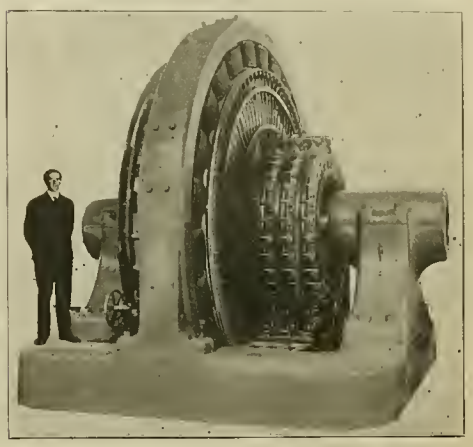


FIG. 1. TWO THOUSAND-KILOWATT CONVERTER FOR EDISON COMPANY.

Each of the new converters is of the type shown in Fig. 1, and is not essentially different, except in size and structural details, from other machines of this type. Fig. 2 shows the upper portion of one of the electromagnet rings being moved on skids into the Duane Street power station in New York city, and a six-foot man could have easily walked straight through it. The total height of the machine is nearly 17 feet, and the base measures about 13 by 17 feet, occupying about 225 square feet of floor space. The armature is 12 feet nine inches in diameter and weighs 75,000 pounds, the weight of the entire machine being 176,000 pounds, or 88 tons.

One of these machines is now in position ready for operating; a second is well advanced and active preparations are being made to install the third.

FIG. 2. MOVING UPPER PORTION OF MAGNET RING OF 2,000-KILOWATT CONVERTER.

All these are for the Duane Street power house, the fourth being for the Twenty-sixth Street station. The shafts are so long that it is necessary to ship them apart from the armatures. The bases are made in two sections, jointed in a line parallel with the shaft, and the pillar blocks are also composed of two portions.

The static transformers used with each converter are three in number, of 800-kilowatt capacity, and there are air-blast coolers. The induction regulator at the low-tension side of the transformer, between the transformer and the rotary collector rings, is of 300-kilowatt capacity, supplying direct current of from 240 to 300 volts. The regulator is operated by a small three-phase induction motor, controlled by the station regulator from the operating board.

The machines will be used for the regular lighting circuits and are being put in in anticipation of a heavy demand during the coming winter months. The normal capacity of each converter is 40,000 16-candlepower incandescent lamps. For two hours daily operation 60,000 lamps can be supplied, and in the event of emergency the number may be increased to 80,000.

Conductivity of Steel Contact Rails.[1]

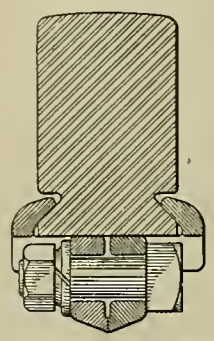
By J. A. Capp.

For certain classes of electric railways a steel conductor is preferable to the older and more commonly used overhead-trolley wire. The third rail presents a rather better appearance, because of the absence of an overhead structure; it is easily installed, cheaply maintained, presents a large area for conducting and collecting the current, and is particularly well adapted for high-speed and heavy service. With costs calculated on the basis of equal conductivity in rail and trolley wire, the third-rail construction is cheaper than the overhead trolley. But the average interurban road will use a trolley wire of considerably less conductivity than would be obtained with the smallest size steel rail (about 60 pounds per yard) that would ordinarily be used, and here the first cost of trolley construction would generally be less than that of the third rail. While no third rail installation has yet been in operation long enough to give figures of value, it would appear that the cost of the maintenance of the third-rail construction should be less than that of the overhead trolley. This consideration, together with that of sightliness and adaptability (particularly in the case of terminals, yards and very heavy or high-speed service), will frequently offset the higher cost of the third construction and make it the preferable means of conducting the current from the generator to the car motor. For the first third-rail installations, old track rails were used when obtainable, and these old rails were supplemented with new rails of standard T-section and composition. With the coming of the very heavy high-speed service during the last few years, the resistance of these old and new standard T-rails was found to be so high that they would not carry the high currents necessary without too great a drop in the line potential. The rails would, therefore, have to be supplemented with additional copper feeders, but as this would be an expensive way to overcome the trouble, rails of higher specific electric conductivity were sought.

Because of the lack of specific data on the relation between conductivity and composition of mild steels, specifications for conductor rails have usually been based on the fact that the conductivity of a metal is generally more or less directly in proportion to its purity. In most cases the purity of the iron specified for such rails has been so high that not only was it difficult to obtain, but the iron was also correspondingly costly. One of the factors governing the choice between a third rail and a trolley wire is the relative price of steel and copper, allowance being made for the difference in conductivity. Hence, a balance must be struck between high conductivity (which is equivalent to saying a high degree of purity or freedom from the usual metalloids associated with iron) and the cost of producing the steel of the composition necessary for the conductivity required. With the object of drafting a rational specification for such third-rail steels, a series of tests was started some time ago in the testing laboratory of the General Electric Company on steels of as wide a range of composition as could be obtained from the steel makers, the results of these tests forming the basis of this paper. When entering the market with an order for rails of special composition, difficulty was encountered in interesting rail makers, and the reason became apparent. The mills which make the standard T-rails, or standard rails of other sections (such as the girder and grooved rails), have generally been designed with the object of making such rails only, and practice throughout has been standardized to the greatest possible extent, both in the manipulation of the steel and in its manufacture in the furnace or converter. Hence, an order, even of considerable extent, for rails of special composition, has so upset the routine work that it was considered a nuisance to be endured, rather than a desirable business to be sought for. Obviously, then, recourse must be had to mills where such special compositions can be handled economically.

The T-section of rail was the outcome of designs intended to present the greatest life and strength of the section, with the least weight of the metal, conditions necessarily to be met in a running rail. But the conditions for the third or conductor rail are different; here there must be provided sufficient surface for the collection of the current, and cross-section ample to carry the current without an undue drop in the line potential. The strength of the section is of little moment, and any section which is easily installed in an insulator is satisfactory. This permits the use of sections rectangular, or nearly so, which may be rolled easily in any mill equipped for the rolling of merchant-bar shapes of reasonably heavy weight without any change in equipment or practice beyond the provision of grooved rails of the necessary shape. Mills rolling merchant-bar or structural steel today are generally equipped to make steel in the open-hearth furnace, which readily lends itself to the making of steel of the special composition demanded by the electrical engineers for the third or conductor rail. Having these facts in mind, a section of a conductor rail has been designed by W. B. Potter, chief engineer of the railway department of the General Electric Company, which, when 2.5 inches wide by four inches high, will weigh about 98 pounds to the yard. This shape may be easily rolled in any merchant-bar mill heavy enough to attempt sections of this weight. A dovetail at the bottom provides an easy means of securing the rails by fishplates of special forms, and any of the common forms of bond may easily be applied. Ordered in lots of 1,000 tons or more, such a rail should cost no more than a plain rectangle of equal weight.

To provide steels of sufficient range to give some indication of the relation between conductivity and composition, we obtained from as many of the steel



CROSS-SECTION OF CONTACT RAIL DESIGNED BY POTTER.

makers as we could interest samples representing all of their common products. Some of the makers kindly provided us also with samples of special steels made in crucible charges. The samples were mainly forged or rolled bars of from one inch to 2.5 inches in diameter, and from them were turned bars of 0.75 inch in diameter, or one inch in diameter by 24 inches in length, on which resistivity was determined. The chips from the finishing cuts were collected, and these furnished the samples for analysis. Also, we cut similar bars from the heads of T-rails which were to be found in the yards tracks. The table shows the electrical resistance and the chemical composition of some of the samples of steel, wrought or refined iron. Samples Nos. 1, 2, 3, 4, 5 and 6 are standard T-rails from several well-known makers, while Nos. 9 and 10 are cut from the 100-pound T-rail used for the conductor on the Aurora, Elgin and Chicago railroad. No. 19 is a T-rail used by the Underground Electric Railways Company of London, and ordered from a steel maker in Westphalia. Samples Nos. 20, 21 and 22 are ordinary refined bar iron, while Nos. 23 and 24 are special brands of refined bar iron sold for use in stayholts and similar work. Nos. 25 and 26 are Swedish and Norway irons, respectively. The second column gives the resistance of the samples compared with Matthiessen's copper as unity, the temperature at which the measurements were made being near 20° C. in all cases. The second half of the table gives the percentages of the usual elements to be found in steel or iron, the total percentage of these elements and the sum of the percentages of phosphorus, sulphur and silicon.

Resistance and Composition of Steel.

Serial Number.	Resistance.	Percentage Composition.						
	Cu=1.	C.	Mn.	P.	S.	Si.	Total Not Fe	P.+S.+Si.
1	13.20	0.33	1.27	0.09	0.05	0.05	1.79	0.19
2	12.12	0.17	1.09	0.09	0.05	0.004	1.404	0.144
3	11.55	0.20	0.93	0.10	0.08	0.05	1.38	0.23
4	11.51	0.22	1.08	0.10	0.05	0.06	1.510	0.210
5	10.04	0.36	0.87	0.08	0.09	0.04	1.44	0.21
6	9.94	0.37	0.73	0.09	0.04	0.06	1.29	0.19
7	9.48	0.23	0.80	0.058	0.01	0.005	1.103	0.073
8	9.36	0.16	0.66	0.074	0.030	0.014	0.938	0.118
9	8.42	0.144	0.46	0.09	0.08	tr.	0.774	0.17
10	8.36	0.188	0.48	0.09	0.08	tr.	0.83	0.17
11	8.06	0.16	0.48	0.091	0.04	0.01	0.781	0.144
12	8.04	0.10	0.55	0.08	0.05	0.024	0.804	0.154
13	7.92	0.10	0.25	0.04	0.02	0.05	0.46	0.11
14	7.70	0.27	0.41	0.024	0.01	0.001	0.715	0.035
15	7.66	0.28	0.28	0.027	0.034	0.04	0.661	0.111
16	7.40	0.15	0.45	0.011	0.033	tr.	0.644	0.044
17	7.38	0.19	0.21	0.025	0.04	0.034	0.499	0.099
18	7.28	0.215	0.22	0.051	0.113	.....	0 509	0.164
19	6.40	0.05	0.19	0.54	0.059	0.03	0.383	0.143
20	7.82	0.15	0.068	0.13	0.02	0.15	0.518	0.30
21	7.48	0.15	0.064	0.036	0.02	0.13	0.400	0.186
22	7.41	0.16	0.074	0.12	0.027	0.10	0.481	0.247
23	7.11	0.08	nil	0.13	0.008	0.024	0.242	0.162
24	6.76	0.17	0.027	0.074	0.022	0.077	0.370	0.173
25	6.17	0.058	0.10	0.014	tr.	0.012	0.184	0.026
26	6.12	0.16	0.018	0.049	0.011	0.015	0.252	0.075

A study of the table shows that manganese preponderates in influencing the resistance of steels, and that for lowest resistivity this element must be present in very small quantity, much smaller than is usual in merchant or structural steels. While all the other elements must be present only in very small percentages, so great is the preponderance of the influence of manganese that they may be tolerated in quantities which the steel makers would consider reasonable, without unduly increasing the resistance. For a satisfactory third rail the lowest possible resistance (from six times to 6.5 times that of copper) is not necessary; and the great cost of making such extremely pure steel is not warranted; in fact, such extremely pure steels would probably be so soft that the frictional wear of the collecting shoe would be excessive and the life of the rail in service unduly short. Assuming, then, that a rail made from steel having a resistance not greater than eight times that of copper (13.8 microhms at 20° C.) would be desirable for conductor rails, the figures tabulated would seem to indicate that the following extreme composition would be permissible: Carbon up to 0.2 per cent., manganese up to 0.4 per cent., phosphorus up to 0.06 per cent., sulphur up to 0.06 per cent., silicon up to 0.05 per cent.

This composition, however, would be extreme, and any overstepping of bounds might result in too great a resistance; therefore, for resistance up to eight times that of copper, the specified analysis should be: Carbon not to exceed 0.15 per cent., manganese not to exceed 0.30 per cent., phosphorus not to exceed 0.06 per cent., sulphur not to exceed 0.06 per cent., silicon not to exceed 0.05 per cent.

This latter composition is one which could be made easily in any open-hearth furnace, and it should present no difficulty in rolling to a shape suitable for conductor rails. In fact, steel of this composition has been successfully rolled into sheets as thin as 0.014 inch, a size which was for a long time a standard product of a large sheet mill.

1. Abstract of a paper read before the American Institute of Mining Engineers.

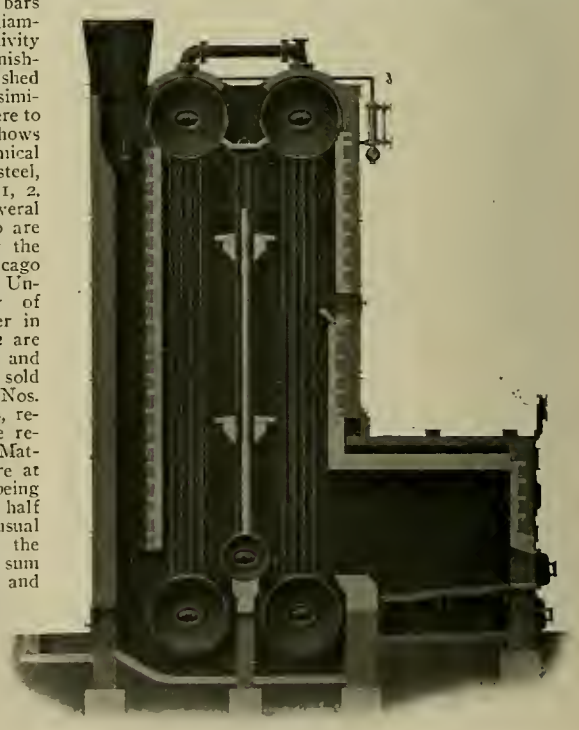
Rust Water-tube Boiler.

The accompanying illustration is a sectional view of the new Rust water-tube boiler, manufactured by the Rust Boiler Company of Pittsburg, and, as will be noted in the picture, the boiler possesses many points which are unique in the construction of this class of apparatus.

The boiler proper consists of two steam and water drums, two mud drums and an auxiliary drum, each steam and water drum being placed directly above a mud drum and connected with it by a bank of straight vertical tubes, the two mud drums being connected by a row of tubes. The auxiliary drum is placed above and between the mud drums and is connected to one of them by a row of short tubes and to a series of small headers by a bank of straight vertical tubes. These headers are placed between the steam and water drums and connected with the same by short straight tubes or nipples. Each drum is fitted with a patent pressed tube sheet.

The holes for the tubes forming the main banks are so spaced that the tubes are staggered, and the spacing of these tubes is such as to leave room enough between the tubes of the outside rows to remove the tubes of the inner rows, thus making it a simple operation to remove and replace any tube without interfering with any other tube or any of the brickwork. After a defective tube has been removed from the bank, it is passed out through doors placed in the side of the setting for that purpose.

By the introduction of the auxiliary drum and central bank of tubes, the space necessarily left between the main banks of tubes is so utilized as to secure a serviceable and convenient support for the baffle wall. The tiles forming the baffle wall are



SECTIONAL VIEW OF RUST WATER-TUBE BOILER.

placed between and supported by the rows of tubes forming the tube bank, and, owing to the consequent increased heating surface, a boiler of larger capacity results without additional floor space, fittings or cost of setting.

On one side of the setting, near the top, are placed four small doors, which furnish access to the interior of the brickwork, and through which the tubes

are passed in and out should replacements become necessary. Doors with small self-closing openings, through which to insert a hose for blowing off the top of the tube sheets, are placed near the bottom of the setting, and other doors are furnished for securing access to the interior of the setting and for blowing deposits from the exterior of tubes.

Over each steam and water drum and a little above it is placed a light steel arch, which serves as a center to support the brick arches over the drum during construction, and makes an air-tight covering for the setting.

These arches are placed sufficiently above the drums to permit all possible upward expansion of the boiler, without interfering with the brick covering. Between the two arches are placed doors, through which access is given to the headers.

Other desirable features of the setting are its ready adaptability to an underground flue connection without the use of any pipe or plate work, and its adaptability for the use of waste gases from blast furnaces, and heating or puddling furnaces. The ratio of heating surface to grate area is such as to give the best results under average conditions, but may readily be proportioned to suit the kind of fuel to be used.

An important feature of the boiler is that there are no large, flat surfaces under tension subjected to the heat of the furnace. Large flat surfaces, stayed or unstayed are among the most dangerous and otherwise objectionable features that it is possible to incorporate in the construction of a boiler. This is especially true if the flat or stayed surfaces are subjected to intense heat, or are so located that the level of the water in the boiler is likely to fall below the stayed surface, which would render possible the overheating or burning of the sheet, and a serious explosion would probably result. There is more danger of such accidents from water-tube boilers so constructed than from fire-tube or locomotive type of boilers, which latter have relatively larger water spaces and consequently less fluctuation of water level, though the frequent disastrous explosions of locomotive boilers bear almost daily testimony to the undesirability of flat stayed surfaces even in boilers of that type.

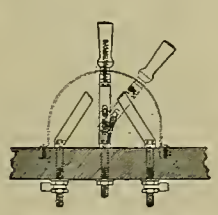
Through the development of the tube sheet there have been embodied in the construction of the Rust boiler the best features of the more successful of the old types of boilers, and many of their defects have been eliminated.

Theater Switch.

The theater switch herewith illustrated is thoroughly made, and prepared to stand the abuse which is unavoidable in the quick action always required in the manipulation of a theater switchboard. The electrician has no time to handle a switchboard gently. When he snatches it open, or slams it shut, he must be sure of results.

The detailed view shows how the blades spring

THEATER SWITCH AND MOUNTING.



DETAIL VIEW OF THEATER SWITCH.

into position, on each circuit or between them, and stay there. This is done with the greatest rapidity, because, when the blades are started, they jump the rest of the way, and stop in position. A metallic cover conceals the flash. These switches are made in one size only, 25 amperes. They may easily be attached to switchboards now in use, and will make a handsome showing, covering up the holes left by old switches.

These switches are designed and built by the F. Bissell Company, Toledo, Ohio.

After long delay and after turning the company down several times, the City Council of Kewanee, Ill., has passed an ordinance, giving the Galesburg and Kewanee Interurban Electric Railway Company a 50-year franchise within the city limits. The company will now proceed to build an extension to the boiler plant and then complete the loop around two of the principal business blocks. President Layman stated that as soon as the line within the city is completed the company will begin to construct the interurban to Galva, and that this line would be completed next year.

Wesco Supply Company's Exhibit at the Exposition.

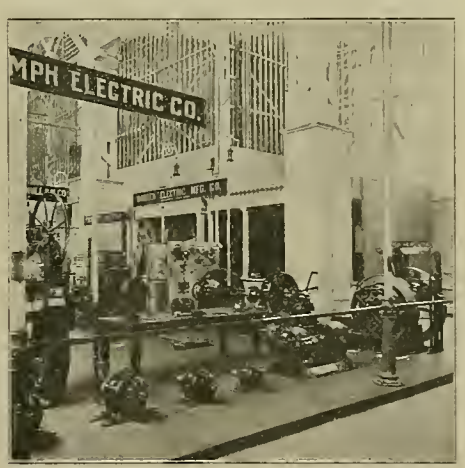
Block No. 8 in the Palace of Electricity at the Fair is occupied by the co-operative exhibit of the Wesco Supply Company of St. Louis and a number of the leading apparatus and electrical material manufacturers of the country, whose products are sold by the Wesco company.

The booth of the individual exhibit of the Wesco Supply Company occupies a space in the center of the block in which are contained a telephone switchboard with a Warner ringing apparatus, and 12 of the Wesco company's telephones installed on the same number of circuits, showing their various types and also their construction. "Wesco" ceiling, desk and wall alternating-current fans keep the booth and private office cool. The remainder of the exhibit consists of several Adams secondary generators,

EXHIBIT OF WARREN ELECTRIC AND SPECIALTY COMPANY, LOCKE INSULATOR COMPANY AND H. W. JOHNS-MANVILLE COMPANY.

shown in practical operation as a substitute for dry batteries, ringing bells, opening doors and for annunciator and telephone switchboard work. They are installed on the secondaries of an alternating-current circuit, and, their consumption being only one watt, practically cost nothing to operate.

In the matter of securing power to operate all of the working exhibits throughout the space and distribute the current required, a novel arrangement has been perfected, which no doubt will be appreciated by electrical engineers who have had similar problems to solve, due to the necessity of furnishing both alternating and direct current at different voltages for all kinds of work, and the operation of various types of apparatus. It requires 75 horsepower approximately, or 50 kilowatts of alternating 60-cycle current at 2,200 volts from a Warren alter-



HALF SECTION OF TRIUMPH ELECTRIC COMPANY'S EXHIBIT

nator, in operation in the Machinery Hall, to run all of the working exhibits, including lights, etc., of which 15 kilowatts is tapped off at the switchboard and, with the use of a Moloney transformer, is reduced to 110 volts for operating two large Reynolds flasher signs, six fans and all lamps in the Wesco booth, and also to furnish current for the alternating-current arc lamps in the Adams-Bagnall exhibit.

The Warren Electric Manufacturing Company's exhibit at the fair, in addition to the 150-kilowatt alternator in the Machinery Hall, consists of a 90-kilowatt alternator in this exhibit, direct-connected to a 35-kilowatt, direct-current Triumph generator, operating as a synchronous motor, and a 60-kilowatt machine, not running—in all a very creditable and interesting display.

The exhibit of the Triumph Electric Company occupies the whole length of the north side of Block No. 8, covering an area of 900 square feet, and was one of the first exhibits installed. It shows a full line of direct-current generators and motors, including, also, a small five-kilowatt motor-generator, consisting of a 220-volt motor and a 500-volt generator, the current obtained from the latter being used for special purposes in other exhibits in the space. In addition, the Triumph people have in their display a 100-kilowatt generator, not running, and a number of partly-wound armature cores, coils, etc., showing the materials used and the construction of their apparatus.

About 20 kilowatts of direct-current from the large

EXHIBIT OF ADAMS-BAGNALL ELECTRIC COMPANY.

generating set in the north end of the block is transmitted to the Browning Company's exhibit at the south end of the space, for the purpose of driving a motor-generating set, consisting of a 30-horsepower, 220-volt motor and a 26-kilowatt, 110-volt generator, current from the latter being used to operate a one-half-horsepower motor attached to a Blakesley dish-washing machine and a motor-driven Rumsey pump, which supplies water for a fountain in front of the entrance to the booth.

Thirty-five Adams-Bagnall arc lamps, suspended from ornamental iron poles surrounding the entire space, are lighted with current from the 110-volt generators, the iron poles being a portion of the exhibit of the Electric Equipment Company.

The Adams-Bagnall Company has an attractive exhibit, which, in addition to the 35 direct-current arc lamps for lighting the space, contains its various types of arc lamps for both alternating and direct

EXHIBIT OF MALONEY ELECTRIC COMPANY, LEONHARDT TOWER WAGON IN REAR.

current, and also its series alternating-current system regulator, all apparatus being accessible for thorough inspection.

The Moloney Electric Company shows in its space a large line of its high-grade air and oil-cooled type transformers, and has special testing racks for the purpose of showing the efficiency and low core and copper losses of its apparatus in practical operation.

An electric rock drill in the exhibit of the Gardner Electric Drill and Machinery Company, while not doing actual work, is operated for the purpose of showing its mechanism and the manner in which it can be handled. This outfit greatly interests all mining men and electrical experts.

The Warren Electric and Specialty Company's exhibit, adjoining the above, shows a complete assortment of incandescent lamps which it manufactures; also a full set of the various materials used in their construction. In contrast, this company has a collection of "Ancient History" lamps on exhibition, showing many "freaks" to interest the connoisseur. Two of the largest incandescent-lamp globes ever blown are shown here, illuminated by 50-candlepower lamps placed on the inside.

The Locke Insulator Manufacturing Company ex-

hibits a complete line of its high-tension glass and porcelain insulators, showing a variety which includes everything from the small ordinary every-day glass or porcelain pony, to the massive porcelain insulators capable of safely carrying 60,000-volt transmission lines.

The H. W. Johns-Manville Company has arranged an attractive display of Noark fuse devices, which contains everything in the line.

The Whitney Electrical Instrument Company shows several of its latest types of bond testers,

EXHIBIT OF THE PEERLESS ELECTRIC COMPANY.

Wheatstone bridges and other instruments of precision, in addition to 12 volt and ammeters, installed on the switchboard circuits.

The Globe Electric Company's exhibit consists of a line of its arc and incandescent headlights, operating off a 500-volt street-railway circuit, which shows the efficiency of the lights and the ease with which they can be handled.

Other exhibits of products handled by the Wesco company are those of the Diamond Meter Company, showing several Scheeffer wattmeters; the Marshall-Sanders Company; the Wheel Truing Brake Shoe Company, and the tower wagon of the Leonhardt Wagon Manufacturing Company.

Color-reflecting Show-window Light.

A novelty in an electrically operated show-window advertising lamp is the self-propelling, color-reflecting show light being placed on the market by H. M. Glogau & Co. of Chicago, and is shown by the accompanying picture. A beautiful brass globe studded

COLOR-REFLECTING SHOW-WINDOW LIGHT.

with various-colored "jewels" supported on chains by a fan wheel, which runs with its steel point in a jewel knob, revolves before an ingeniously constructed mirror reflector.

An incandescent bulb is placed inside the globe and shines through the vari-colored stones and openings in the metal part of the globe. The heat from the electric bulb brings the fan-wheel into rotation and the globe revolves around the light. The whole mirror screen is covered with the reflecting of the bright stones, always running from left to right and always changing colors.

The colors move as in a kaleidoscope, and the whole effect is one of great beauty.

No attention whatever need be given after the light is turned on, and the lamp is equally attractive whether used during the day or the night.

There are 15 places on the lamp to which advertisements may be attached, these revolving with the globe.

The size of lamp is 27 inches high, 10 inches broad and 13 inches deep.

CORRESPONDENCE.

Great Britain.

London, September 1.—A report has now been made by the Board of Trade with respect to the accidents which have occurred upon the electrified sections of the Northeastern railway and the Lancashire and Yorkshire railway through persons trespassing upon the track and coming in contact with the third-rail conductor. A separate report is made by an inspecting officer of the Board of Trade upon each accident, and a large part of each report necessarily details the history of the occurrence. The question of guarding the conductor rails is touched upon, but no suggestions are made as to a general policy by all electric-railway companies in this direction. As a matter of fact, a certain amount of guarding by planks is already done at level crossings and such places for the protection of the employes, and in connection with the accidents to members of the general public, the reports urge upon the companies the desirability of adopting means for making their lines less accessible in certain places. An objection is taken by the companies to having to guard by planks the whole of their tracks. Generally, the inspector seems satisfied with the steps which are to be taken by the companies at the spots where accidents have occurred, and there, for the present, the matter must rest.

In 1896 the Board of Trade issued a set of regulations for insuring a proper and sufficient supply of electrical energy and also for insuring the safety of the public in carrying out its obligations by statutory undertakers. Since 1896, however, vast strides have been made in electrical industry and a revision has now been made in these regulations. They are, of course, far too long to give here, but four sets have been prepared dealing, respectively, with companies and municipalities outside London (i. e., in the provinces) and companies and borough councils in London. An opportunity for amendments to be submitted is given, but, somewhat surprisingly, there is a general tendency to agree with the proposals of the board. The importance of the regulations will be gathered when it is stated that every electrical undertaking in the kingdom is bound by law to work under them.

Continuing the issue of reports of its sub-committees, the engineering standards committee has now issued standard specifications for tubular tramway poles and electric wires and cables.

The annual report of the electrical inspector of factories and workshops in Great Britain affords interesting reading. He prefaces his report with the statement that the increase in the use of electrical energy for motive-power purposes is very rapid and the number of factories putting in their own generating plant is greatly extending. Dealing with the comparatively few accidents that have occurred in factories, etc., through the use of electricity, he says they have been mostly due to badly designed or unprotected apparatus. The number of accidents he arranges in such a manner as to preclude useful abstract, but the general trend of the report is that greater care is now being exercised, owing to the greater supervision of the Home Office officials. The rules framed by the committee on the use of electricity in mines are also anticipated to have a beneficial effect in that direction when they come into operation. G.

New England.

Boston, September 10.—Superintendent N. C. Smith of the Newton Street Railway Company has resigned, to accept a similar position with a Connecticut railway. General Manager Brush will not appoint another superintendent, it is understood, having three assistant superintendents, who severally act as division superintendents, and will remain in that capacity.

The selectmen of the town of Wakefield, acting on behalf of citizens who are aggrieved over what they consider excessive fare charges on a portion of the Boston and Northern railway, have brought the matter before the state railroad commissioners for a ruling. The commissioners have before them, also, at the present time, the petition of the Pittsfield Street Railway Company for authority to issue $100,000 additional stock.

Harold Fish, chief operator at the Newton telephone exchange, who was among the seriously injured in the recent electric-car collision at Wakefield, is now reported out of danger.

Derailment of a loaded electric car of the Boston Elevated Street Railway Company's surface system in West Roxbury on Monday last, when the Labor Day holiday riding was at its height, badly injured seven persons and imperiled the lives of threescore others, the fact that the car struck and leveled a telegraph pole being all that saved it from a plunge over a 15-foot embankment.

August earnings of the street railways in Boston and suburbs were heavily augmented by the extra patronage they had during the big G. A. R. encampment in this city. All previous records for the number of passengers carried by the Boston company were surpassed.

The compilation of the list of heavy taxpayers in Lynn shows that the heaviest corporation tax is paid by the Lynn Gas and Electric Company, $14,958.10. The General Electric Company pays $14,050.60; the Boston and Northern Street Railway Company, $6,110.10, and the New England Telephone and Telegraph Company, $2,079.70. B.

New York.

New York, September 10.—Chief Engineer William B. Parsons has informed the rapid-transit commissioners that the subway will be ready for opening within a few days of October 1st, unless there is "something extraordinary in the way of strikes." Deputy Chief Engineer George S. Rice has reported in detail on the safety devices that have been installed in the subway. Provision is made so that two trains can never travel in contiguous blocks, for a train cannot possibly pass a danger signal until there is a clear block ahead, the current being automatically cut off from the power rail by the action of the train in front. Each signal is lighted with two lamps on independent circuits and the general lighting of the tunnel is also on an independent circuit. At each station and at every 200 feet between the stations there is a safety switch by which the whole of the power current can be cut off from all the tracks in case of need.

The negotiations between the Interborough Rapid Transit Company and the labor unions have been going on all the week with rather less than more of amiability. On Wednesday it was announced that the company had conceded a $3.50 wage and that the men on their side had agreed to a 10-hour day. The company also agreed to grant a qualified seniority to men formerly employed on the elevated system, and the men offered, somewhat reluctantly, to submit to the standard railway test as to physique. A number of minor points of difference were also reported to be adjusted, but it was obvious that although the negotiations were resulting in a way for the most part satisfactory to the majority of the men that the leaders of the unions were trying to get even still more concessions from the company. The men on Tuesday after the very definite statements of August Belmont that the $3.50 pay scale would not be granted had lost a good deal of heart, and the presence of James Farley and his 500 or more "strike breakers" depressed the unionists. Late last evening, however, an agreement was signed which is expected to end the present controversy. The text of the agreement has not been given out for publication, but it embodies the provisions named above and is binding for about two years. There are, however, circumstances which render it possible that the question of the nine-hour day will be reopened in March, 1905, when a previous agreement with the unions will expire.

The work of drilling the crews on the experimental subway trains is progressing smoothly, rapidly and satisfactorily and about 500 men are already competent to handle trains. The 20 training cars now running consist of six cars each and are run on the inner or express-service pair of tracks. As far as the handling of the trains along the tunnel is concerned, the men very quickly learn their duties, but there have been delays with the switching operations at the Ninety-sixth Street station.

H. H. Vreeland, president of the New York City Railway Company, announces an improved service this week to those districts served by his company, which will be likely to be affected by the coming competition of the west branch of the subway. Transfers will be hereafter granted between the boulevard line and the down-town lines on Thirty-fourth Street. Upper West-siders can therefore now reach the heart of the city for a five-cent fare, and by judicious discrimination in the choice of alternate routes 10 minutes may be saved on the trip.

Mayor McClellan and Bridge Commissioner Best have been in conference, and the mayor positively announces that Brooklyn Rapid Transit cars will be running over the Williamsburg Bridge on November 1st. There seems to be some possibility of this latest official promise being carried out, for the announcement is definitely backed up by the Brooklyn Rapid Transit management. Influential Brooklyn residents, who claim that the Williamsburg Bridge was primarily built to satisfy their needs for improved transit facilities are still protesting through their boards of trade against the possibility of having to pay an extra three-cent fare for a trolley ride over the bridge.

The newly incorporated South Shore Traction Company is applying to the State Railroad Commission for a franchise for 60 miles of electric lines to connect the Brooklyn Rapid Traction system with various outlying towns and villages on Long Island. The proposed route runs from Central Avenue in Jamaica to Rockville Centre, Hempstead, Oyster Bay, Babylon, Amityville, Islip, Patchogue and Brookhaven, many of the residents of which places are in favor of the scheme. The nominal promoters of the plan are James Anderson Hawes and Arthur Hume, who are respectively president and secretary of the South Shore Traction Company.

A Brooklynite who has been traveling in the West complains on his return that the surface and elevated cars in Brooklyn are the worst both in appearance and cleanliness in the whole United States.

Horace G. Martin of Brooklyn is reported to have invented a new telegraphic key to be known as the "autoplex." The key works horizontally instead of vertically, and on one side the contact makes dots and on the other dashes. The dot contact makes dots continuously, so that the alphabet can be sent

with 83 movements as against 154 required with the Morse instrument.

L. K. Comstock & Co., Broadway and Fifth Avenue, have obtained the contract for wiring and fitting the Seventy-first Regiment Armory on East Thirty-fourth Street, and are proceeding with the work of wiring as far as the uncompleted condition of the building permits.

For the lighting of the recreation piers during the evenings of the last summer the city has been paying at the rate of 28 cents per lamp for lamps lit from sundown till 10:30 p. m., and 40 cents per lamp for those alight all night.

Sealed bids will be received until September 21st for the installation of an electric-lighting system in the City Hall, Manhattan. Bids for the electric equipment of public school No. 112, Fifteenth Avenue, Brooklyn, will be received until September 19th.

D. W. W.

Ohio.

Cleveland, September 10.—The dry-pipe system of sprinkler equipment was tested in the Quincy Street car barns of the Cleveland Electric Railway Company a few days ago and proved as successful in confining a fire to the car in which it originated as the wet-pipe system tested two weeks before. Manager C. H. Patton of the Cleveland inspection bureau made a number of suggestions for the improvement of the system that should be taken into consideration in permanent equipment. Because car houses are too cold for water in pipes in the winter the dry-pipe system is recommended. It takes a little longer for this to operate and might be a little drawback, but in general it is believed the sprinkler system is a success for car-house protection.

At the annual meeting of the stockholders of the Cincinnati, Dayton and Toledo Traction Company at Hamilton last Tuesday a board of directors was chosen, and the following-named officers were elected: President, George B. Cox of Cincinnati; first vice-president, W. Kelsey Schoepf of Cincinnati; second vice-president, C. C. Richardson of Cincinnati; secretary and treasurer, J. B. Foraker, Jr., of Cincinnati; assistant secretary and treasurer, F. R. Williams of Cincinnati; general manager, F. J. J. Sloat of Hamilton; auditor, N. J. Boyce of Cincinnati.

The Richwood and Magnetic Springs Electric Railway Company has been incorporated with a capital stock of $50,000 to build a line between the two points mentioned. Christopher McGee, Jr., and W. M. Galbreath of Pittsburg and John B. Taggart, Edward S. Mendenhall and John Miller of Delaware County are the incorporators. They are also building a large hotel at Magnetic Springs.

No meeting of persons interested in the Appleyard roads was held at Springfield on Monday last as was planned some time ago for the purpose of voting on a consolidation as the Ohio Union Traction Company.

The Sandusky, Norwalk and Mansfield Railway Company will begin laying rail sfor the new road within a short time.

Reports are current that a New York house has agreed to finance the Bellefontaine and Sidney line.

The Appleyard syndicate has changed the plans of the Urbana, Bellefontaine and Northern so that it will pass through Lima instead of Kenton.

A new franchise has been granted the Cincinnati and Columbus Traction Company by the Village Council of Milford, good for 25 years.

At the annual meeting of the stockholders of the American Railways Company in Springfield Wednesday it was decided to build a new power house for the local lines at a cost of $100,000. The officers chosen are as follows: President, Oscar T. Martin of Springfield; vice-president, H. J. Crawley of Philadelphia; secretary and treasurer, C. L. Tingley of Philadelphia.

The Findlay-Marion Railway and Light Company of Marion has been incorporated with a capital stock of $25,000 by Samuel S. Thorn, W. H. Davidson, Edward N. Krauss and others.

Councilman Walker has presented a new franchise plan to the City Council of Cleveland, which provides for seven tickets for a quarter and universal transfers.

The Oakwood Street Car Company of Dayton proposes to pay for one week of the expenses of its conductors and motormen who desire to visit the fair at St. Louis.

The completion of the Urbana, Bellefontaine and Northern to Lima and the change of the Ohio River and Western to an electric road will make it possible for the Appleyard roads to make a through service from Wheeling, W. Va., to Lima. Wheeling will be reached through friendly relations with electric roads, which connect with Bellaire, where the Ohio River and Western has its terminus.

The limited service of the Western Ohio, between Lima and Dayton, is proving a wonderful success. The cars are running very close to schedule time and the daily receipts continue to increase.

With the opening of its through service from Cincinnati to Detroit over the Hocking Valley and Michigan Central, the Big Four steam road has put on 10 trains, passing through Dayton, Springfield, Urbana and Bellefontaine and has cut the rates half in two between these points in competition with two of the Appleyard lines, the Dayton, Springfield and Urbana and the Urbana, Bellefontaine and Northern, thus opening up a war for the recovery of the local passenger business, that it has lost to the trolley lines.

The Springfield, Charleston, Washington and Chillicothe Railway Company of Springfield has been incorporated with a capital stock of $50,000, to build a line between the points indicated by the name. The incorporators are Frank Patterson, Amaziah Winger, Edward H. Ackerson, John Snyder and Levi M. Goode.

Cars have been put in operation on the Fort Wayne and Lima traction line.

The council of East Liverpool is advertising for bids for a 25-year franchise for a street-car system, bids to be accompanied by a check for $25,000 to guarantee that the road will be completed within 18 months.

A franchise has been granted to the Wheeling Traction Company to operate a line between Steubenville and Mingo Junction.

The Scioto Valley Traction Company, it is said, will inaugurate an express business on its lines in response to a demand from the business men of Lancaster.

Incorporation papers have been issued to the Newark Heat and Light Company of Newark, the capital stock being $10,000. George M. Heisey, E. W. Heisey and others are interested.

Work is still in progress toward a settlement of the affairs of the Miami and Erie Canal Transportation Company, but so far they have been rather quiet.

O. M. C.

Michigan.

Detroit, September 10.—Arrangements are being made for the removal of the Matheson Motor Car Company of Holyoke, Mass., to Detroit. It is expected that contracts will be let for the construction of factory buildings this week.

At a joint meeting of the executive committee of the Detroit Municipal League and the Democratic and Republican primary reform committees one of the questions agreed upon as necessary to be submitted to candidates for aldermen is, "On what terms, if any, would you favor granting further franchise privileges to the Detroit United Railway?"

The Bay City council failed to pass the franchise for the Detroit, Pontiac, Lapeer and Northern electric road, which is seeking to enter that city. It is understood that the new line resents the treatment by the council and threatens to cut out Bay City entirely by running to West Bay City, thence to Saginaw.

The temporary injunction restraining the city of Pontiac from awarding the street-lighting contract to anyone but Jules G. Hoffman has been sustained by the Circuit Court. This action was brought about by the council's reconsideration of the contract, which was awarded to Mr. Hoffman and then given to the Pontiac Standard Lighting Company. The city will now probably carry the matter to the Supreme Court. In the meantime there will be no light.

Union City is looking into the matter of a municipal electric-lighting and waterworks plant and has secured an option upon a fine waterpower site three miles out of town. It proposes, with the sanction of the taxpayers, to purchase it, thus saving several thousand dollars a year in fuel now used in running the steam plant.

The Edison Illuminating Company of Detroit is now making use of the conduit service of the defunct People's Telephone Company, notwithstanding Corporation Counsel Tarsney some time ago advised the council that the city could order the conduits taken out of the streets. Several of the aldermen think that the city has a right to take possession by reason of the telephone company having forfeited its franchise.

The Detroit, Toledo and Monroe electric railway has the contract for carrying 1,200 carloads of brick from Toledo to Monroe for the new Catholic convent and school at that city. There was sharp competition for this contract, the electric road securing the business, as it was able to deliver the brick upon the ground where the building is being erected. The officers of this company say that the passenger receipts are steadily increasing and the road is now an assured success, although they are not yet able to operate their cars through from Detroit to Toledo; transfer has to be made just outside of the city of Detroit.

A severe electrical storm on Wednesday of this week played havoc with electric lights and telephones in Ypsilanti. The iron trolley poles had become charged in some way and persons who tried to mail letters in the boxes were in some instances severely shocked. The current which furnishes power for the store and residence lights in the city was short-circuited somewhere between the power house and the city, and as a result the streets were in darkness.

The Detroit, Toledo and Monroe Short Line electric road has finally accepted the permission given it by the Woodmere council to use the old Irvin & Pepper franchise, and has started the work of grading preparatory to laying tracks to connect with the Detroit United railway on Fort Street. The Pere Marquette railroad will not allow the new road to cross its tracks at grade and tracks will be laid up to each side of the steam road and transfer made until permission is received from the railway commissioner for a grade crossing.

C. G. W.

Southeastern States.

Charlotte, N. C., September 10.—The city of Elberton, Ga., has let the contract to Colonel T. M. Swift to erect a 15-foot dam across Beaver Dam Creek at the electric plant, for generating power for electric light. The old dam was washed away.

The Macon (Ga.) Fair Association has about decided to contract with the Macon Railway Company to supply lights for the coming state fair in lieu of putting in a private plant.

The big dam of the Atlanta (Ga.) Water and Electric Power Company on the Chattahoochee River at Bull Sluice has been completed and pole lines for transmitting power completed up to the city limits of Atlanta. F. W. Hadley, recently elected superintendent of the plant, has arrived to take charge.

The High Point (N. C.) Interurban Traction Company has applied for a franchise in High Point. W. A. Heller of Danville, Pa., is interested. It is proposed also to build lines connecting Greensboro, 16 miles distant, and Winston-Salem, 25 miles distant. Mr. Heller, who is an experienced electric-railway manager, has about 20 lines now in operation.

The Catawba Power Company has decided to move its headquarters to Charlotte, N. C., where the company has large contracts in operation.

The O. L. Barringer Company is now operating an electric-charging plant for automobiles at Charlotte, N. C.

Notice has been served on the officials of the Bluegrass Consolidated Traction Company that a motion for the appointing of a receiver would be made in court on September 21st, says a dispatch from Lexington, Ky. The company, whose capital is several millions, has outstanding claims that amount to only about $50,000.

The town of Clinton, S. C., has voted $25,000 bonds to be used in installing waterworks and electric lights.

The Elizabeth City (N. C.) Electric Car Company has a corps of surveyors on the proposed route from Elizabeth City to Weeksville and other points.

The Atlantic De Forest Wireless Telegraph Company is seeking a space-telegraph franchise in Norfolk, Va.

L.

Northwestern States.

Minneapolis, September 10.—The new electric-light plant just installed for South Stillwater, Minn., has been tested and found to be in good condition.

The plans for the new electric-light plant at the Mocket pumping station, Lincoln, Neb., have been prepared and bids will be called for at once.

The contract for enlarging the storage batteries in the City Hall at Minneapolis, for additional elevators, has been let to the Electric Storage Battery Company of Philadelphia for $2,984.

Seventy-five per cent of the right-of-way for the trolley line from Omaha to Beatrice and Lincoln, Neb., has been secured, and the work of grading is progressing rapidly.

The Twin City Rapid Transit Company has submitted a plan to the St. Paul council for the prevention of the corroding of water mains, caused by the action of electrolysis. It is estimated that the plan will require 27,600 feet of copper wire, at a cost of $23,936, in addition to the cost of conduits, should they be required. The council has submitted the plan to its expert, D. C. Jackson of Madison, Wis.

The Kenosha (Wis.) Electric Railway Company has begun work on large extensions to its system.

R.

Rocky Mountain States.

Salt Lake City, September 8.—The Willamette Valley Electric Railroad Company of Eugene, Ore., contemplates the construction of an electric road from that city to Coos Bay, Ore. The company will ask the people along the proposed route to subscribe $300,000 in stock, which the company will guarantee to take up at par in 1910. Congressman John F. Wilson of Arizona is the chief promoter of the project. The road, which will traverse a rich agricultural and lumbering district, will be constructed at an estimated cost of $5,000,000.

A franchise for the construction of an electric railroad at Willard, Utah, has been granted by the City Council to the B. Mahler Company. The same company plans the construction of electric roads in other parts of the state.

J. C. T. McKesson and C. L. Laune are promoting a project for the building of an electric road at Sheridan, Wyo. The aid of the Commercial Club has been enlisted in the enterprise.

A recent decision of the district judge at Boise, Ida., holds that the Rocky Mountain Bell Telephone Company is not entitled to transact business in the state on account of having failed to comply with the law requiring the filing of articles of incorporation. The case will be appealed to the State Supreme Court.

Colonel Spofford of Grangeville, Idaho, who has gone East to negotiate for funds for the construction of an electric railway, reports that eastern capitalists are taking great interest in the matter and will send a party out to investigate at once.

E. E. Rodgers, president of the Black Pearl Company at Boise, Idaho, has given an order to th

Boise-Payette Power Company for power to operate the mill to be installed at the mine. Electrical equipment will be ordered at once. G.

Pacific Slope.

San Francisco, September 8.—J. W. Hartzell of Vallejo, Cal., has been granted a franchise for an electric road through Vacaville. The line will follow the public roads, and all the necessary franchises have been secured.

Reports received from the Mt. Whitney Power House No. 2 indicate that the plant is ready for operation. The switchboard is completed and the pipe line has been given a thorough test. Two Stanley 36,000-volt main-line oil switches with automatic release and switchboard control are in place. The system will be fitted with reverse-current relays and other modern appliances.

The plant of the Bay Counties Power Company, near Megalia, Butte County, Cal., will soon be enlarged by the addition of a 5,000-horsepower machine. The pipe line, just finished by the Schaw-Batcher Company, is 6,000 feet in length and has a fall of 1,600 feet, giving a pressure of 680 pounds to the square inch at the nozzle.

E. G. Kruger of Silver City, Wash., has asked for a franchise from the county commissioners for an electric railway over the county road between Galena and Mineral City, Wash.

The Preston-Parton Milling Company of Athena and Waitsburg, Wash., has obtained the right to erect and maintain an electric railway between Athena and Weston. The company has purchased the electric plant at Weston and will furnish lights for both towns.

The Santa Maria Light and Power Company will soon enlarge its plant at Santa Maria, Cal.

John M. Gardiner, superintendent of the Santa Cruz and Capitola railway at Santa Cruz, Cal., has been a recent visitor in San Francisco.

W. L. Bechtel, superintendent of the Nevada Power, Water and Lighting Company of Reno, Nev., has been in San Francisco recently.

A. G. Wishon, manager of the Huntington Electric Railway and Lighting Company of Fresno, Cal., has been in San Francisco the past week on business.

E. G. Kreuger is reported to have secured the backing of outside capital to the extent of $50,000 for the construction of an electric road from Index to Mineral City, Wash., where valuable mineral properties will be opened up.

The Humboldt Milling Company of Fortuna, Cal., has sold its electric-lighting plant in that city to L. M. Hancock of San Francisco.

John B. Weddell, civil engineer of Olympia, Wash., and E. W. Haycox have asked the City Council of Montesano, Wash., for a franchise for an electric railway through Montesano. A. S. Caton of Olympia is also associated with these parties.

The Pacific Coast Coal Company will install electric conveyors at its new coal bunkers at Portland, Ore., to run the coal from the holds of ships at the wharf or from the cars at the company's switch.

A. B. Cousin of Portland, Ore., manager of the Galice Consolidated Mines Company, has been in Portland recently, arranging for the running of a telephone line from Merlin to Galice, Ore. A.

PERSONAL.

Manager of Sales L. P. Sawyer of the Buckeye Electric Company visited Chicago last week, remaining merely for a day.

Lieutenant S. S. Robinson has been detached from the United States navy space-telegraph board and ordered to the Bureau of Equipment.

Irvin Kent, a well-known electrician of Beloit, Kan., died a few days ago at the German Hospital in Kansas City, Mo., where he went for medical treatment.

R. C. Routledge, formerly of the firm of Thomas F. Smith & Co., New York, which recently went out of business, will take charge of the contract department of the H. W. Johns-Manville Company of New York.

The first victim of the subway traffic in New York city is Division Superintendent Frederick Roeber, who was knocked down and very seriously injured by a northbound train at the Twenty-third Street station last week.

Edwin S. Cramp, vice-president of the Cramp Shipbuilding Company, who was recently selected as a member of the international jury of award at the St. Louis Exposition, has been elected president of group No. 62, comprising steam boilers and their accessories.

S. B. Livermore, formerly superintendent of the Winona (Minn.) Railway and Light Company, has been appointed superintendent of the LaCrosse (Wis.) City Railway Company, to succeed Peter Valier, who resigned to accept a position with the LaCrosse and Southeastern Railway Company.

Frederick E. Clary, superintendent of the Western Union Telegraph Company at Richmond, Va., has been appointed superintendent of the same interests at Hartford, Conn., dating from September 1st, that point being selected as the headquarters of a new district just created. Lewis J. Maxwell, assistant superintendent of the Western Union at Jacksonville, Fla., has been promoted to be superintendent, and assigned to the post at Richmond, Va., made vacant by the transfer of Mr. Clary to Hartford.

Frank A. Leach, Jr., has been appointed manager of the Oakland (Cal.) Gas, Light and Heat Company. Mr. Leach has been acting as assistant to John A. Britton for the last six years, and upon the appointment of the latter to the position of general manager of the California Gas and Electric Corporation, was appointed to fill the vacancy.

N. Coe Stewart, Jr., of Cleveland, Ohio, has been chosen to build an electric railway from La Paz, Bolivia, to a point up in the mountains. Mr. Stewart is a well-trained electrical engineer and for some time has represented an eastern electrical house in Peru. He went from college into the plant of the Brush Electric Company in Cleveland, and while there also studied electrical engineering. He is well equipped for the work he has undertaken.

In a paper read before the National Electric Light Association last May by Mr. Walter I. Barnes upon "A Three-wire 500-volt Lighting System" the statement was made that the use of the 220-volt lamp in an installation in St. Louis in 1899 was made under the engineering advice of Mr. Bion J. Arnold. Mr. Barnes wishes this statement corrected, as he has since been advised that the recommendations covering the 220-volt lamp were made by Mr. H. H. Humphrey of St. Louis.

Edward E. Goudey, who recently resigned from the general management of the Goudey-McLean Company to take a partnership interest in the engineering firm of B. F. Bell & Co., is one of the incorporators of the Bell Engineering and Construction Company of New York. The latter concern is a New York corporation, organized to succeed B. F. Bell & Co., and carries on a consulting and contracting engineering business. Mr. Goudey, who is well known in electrical circles, is treasurer of the new company.

ELECTRIC LIGHTING.

The Roswell Electric Light Company of Santa Fe, N. M., has been incorporated with a capital of $50,000.

The Rockford Electric Company, with a capital of $50,000, has been incorporated at Rockford, Tenn., by J. Burger, J. A. Goddard and others.

E. R. Vincent of Indianapolis has been engaged by the city of Danville, Ky., as the engineer to pass on bids for an electric-light plant in Danville.

The city of Paducah, Ky., is now considering means by which the electric-light plant will be considerably enlarged so as to give better service.

The East Chattanooga (Tenn.) Water, Power and Light Company has been incorporated with a capital of $25,000 to erect a light and waterworks plant.

The issue of bonds for the municipal ownership of a lighting and sewerage system was carried at the special election recently held in the village of Kiel, Wis.

O. K. Cole of Cincinnati, Ohio, has purchased the controlling stock in the electric-lighting plant at Clinton, Iowa, and will assume immediate charge. He is making extensive improvements.

The citizens of Sumner, Iowa, have voted favorably on the question of establishing an electric-light plant and granting the City Council the right to grant a franchise to private parties for the same.

The Gulf Electric Company of Mobile, Ala., has been incorporated with an authorized capital stock of $20,000. C. W. Chase is president, Sidney Lowenstein, vice-president, and R. W. Jones, secretary.

J. A. Powers and W. H. Mansfield of Troy, N. Y., have purchased the real-estate, waterpower and electric-lighting business of the Keeville Electric Company in that state. The company will continue to do the lighting at Keesville, Port Kent and vicinity.

Nearly $10,000 has been subscribed, it is said, for building an electric-light plant and system of waterworks in Harrison, Ark. Efforts are being made to secure the required capital for furthering the project.

Bonds to the amount of $325,000 have been issued by the city of St. Joseph, Mo., $250,000 of which is to be spent in the construction of a sewerage system and the balance in the construction of an electric-lighting plant.

The power house of the Dixon Light and Power Company of Dixon, Tenn, was burned recently and everything in the plant was destroyed. The officers of the Dixon company are T. E. Stone, J. B. Swafford, W. C. Bailey and J. T. Dean.

The Purvis (Miss.) Light and Power Company has been organized to operate a light plant, telephone system, construct waterworks, manufacture ice, etc. W. H. Magee is president; J. W. Woodward, vice-president, and C. V. Hathorne, secretary.

The mayor of Baltimore has approved the report of C. E. Phelps, chief engineer of the city electrical commission, on the feasibility of establishing a municipal electric plant for furnishing light, heat and power. The report estimates the cost of the plant, including all machinery and distributing equipment, at $150,000. The mayor, it is said, will encourage the project.

The electric-light plant at Clarks, Neb., owned by Chamberlain & Brown, has been greatly damaged by fire.

The Moscow (Idaho) Electric Light Company has submitted a proposition to the City Council to run the city waterworks pumps by electrical power. Included in the same proposition is also the furnishing of arc lights to the city for five years at the rate of $8 per lamp per month.

The Graves County Water and Light Company of Mayfield, Ky., with a capital stock of $125,000, will be dissolved, when it is expected to introduce the new company just organized under the title of the Mayfield Water and Light Company, with a capital of $62,500.

The stockholders of the United Gas and Electric Company have authorized the issuance of $1,500,000 of bonds, $750,000 worth to be sold, the proceeds to be used for the extension and improvements of the plants of the company in New Albany and Jeffersonville, Ind.

The Alton Gas and Electric Company has been organized at Alton, Ill., with the following-named directors: F. E. Allen and L. C. Haynes of East St. Louis, W. P. Kennett of St. Louis, O. S. Stowell, H. E. Weeks, George Kuhn and J. F. Porter of Alton. The company has a capital of $500,000 and was organized to take over the electric and gas-lighting and hot-water-heating plants of Alton. These were formerly owned by the Alton Traction Company. When the latter company was consolidated with the St. Louis and Granite City Street Railway Company, a new corporation was formed, known as the Alton, Granite and St. Louis Traction Company. This company took over the street-railway lines of Alton and Granite City, and is building an interurban road between the two cities.

ELECTRIC RAILWAYS.

The Alton and Southern Railway Company of Alton, Ill., with a capital of $100,000, has been incorporated to operate an electric railway. The incorporators are P. B. Warren, W. J. Lawlor and C. F. Matthew.

The City Council of Sioux Falls, S. D., at a regular meeting recently by a vote of eight to two passed the ordinance granting to a syndicate of Des Moines (Iowa) capitalists a franchise for the construction and operation of an electric street-railway system in Sioux Falls.

It is stated that the Great Northern railway branch lines in the province of British Columbia will all be operated by electric power in the near future. The Canadian Pacific Railway Company is also taking steps to operate its line from Vancouver to Steveston by electricity.

The first car to run in Peterboro, Ont., over the old track which has been reconstructed by the new Peterboro Radial Electric Railway Company, took place a few days ago. The trial was a success and everything will soon be in readiness for continuous operation of the new street railway.

Affiliated lines of the New York and Philadelphia electric-railway line report the following gross receipts for August: Camden and Trenton, $15,689.18, an increase of 71 per cent. over August last year; Trenton and New Brunswick, $12,705.35, an increase of 101 per cent. over August, 1903.

The first installment of the new machinery of the Sterling, Dixon and Eastern electric railway has arrived at Sterling, Ill. The shipment includes a dynamo manufactured by the General Electric Company, which will develop 1,000 horsepower. The new machine will be installed in the power house as soon as possible.

The Fairmont and Morgantown Traction Company of Fairmont, W. Va., has been chartered to build an electric railway between the towns mentioned in the name. This is a rich coal country, and a traction line should prosper. C. L. Barnes, T. T. Holt and other wealthy citizens of Fairmont are among the incorporators.

The charter of the Nashivlle (Tenn.) and Lewisburg Interurban Railroad Company has been filed. The company is capitalized at $1,375,000 and the incorporators are C. W. Silver, A. G. Rutherford, W. T. Turley, T. F. Allison, H. T. Campbell, W. C. Smith and Charles Sykes. The proposed road will be 55 miles long.

The Rockford and Freeport Electric Railway Company has been absorbed by the Rockford and Interurban Railway Company of Rockford, Ill., which has taken charge of the line. Next spring the construction of a new line to the southwest through Ogle County to touch Byron and Oregon and possibly on to Dixon will be commenced.

Work on the Englewood extension of the South Side Elevated railroad system, Chicago has been begun. Starting from the main line between Prairie and Calumet Avenues, the branch will curve southward across Fifty-ninth Street for 125 feet, and then run westward on a private right-of-way. Work is to be pushed at once also on the third track for express service from Forty-third Street downtown, the eastward extension to the Illinois Central right-

of-way south of Fortieth Street, and the connection with the elevated loop in the stockyards.

An official of the Chicago City Railway Company says a small gain was shown during August as compared with last year, but the stockyards strike and unusually cool weather of the month curtailed surface-line street-car travel materially. The company is deriving a great deal of benefit from the improvements made during the last year.

At a recent meeting of business men at the Commercial Club in San Francisco it was decided to push the project of an electric railroad up Mount Hamilton to the Lick Observatory. All present were in favor of the road. A large sum of money was raised at the meeting to begin the work of surveys and looking into rights-of-way for the road.

Six masked robbers recently visited the Lehigh Valley Traction Company's car barn, in Souderton, Pa., and after beating and gagging four employes blew open a safe and escaped with between $700 and $800, the Labor Day receipts of the company. The men were all armed, and when the employes of the company attempted to resist they were assaulted.

Mayor John P. Overton has vetoed the ordinance recently passed by the City Council of Santa Rosa, Cal., granting the Petaluma and Santa Rosa electric road a right-of-way to enter that city by way of Main Street and Sebastopol Avenue. The company already has a franchise by way of Fourth Street. Rails are now laid almost to the city limits from Sebastopol and wires are strung most of the way.

The president and directors of the St. Louis Transit Company have called a meeting of stockholders for October 19th to pass upon a proposition to cancel the issue of $20,000,000 improvement and refunding bonds, authorized last May, and to issue in lieu thereof bonds not exceeding $12,500,000. Another feature which it is believed will be considered is that in all probability the Transit company will be able to wipe out its deficits this year by its net earnings.

The Mexican Railway, known as "The Queen's Own," the oldest railroad of the republic, proposes, if consent be given by the London office, to adopt electricity along the entire line from the City of Mexico to Vera Cruz. The system recommended is the trolley system, and it is estimated the company would save approximately $500,000 annually on coal. The railway was commenced in 1857 and completed in 1873, and its operation has never resulted in the loss of life among passengers.

The expenditure of hundreds of thousands of dollars in improvements by the Twin City Rapid Transit Company, much of it within the limits of Minneapolis, waits upon the action of the St. Paul City Council, it is said. These improvements consist of the two talked-of new interurban routes and the building of the new shops. The company will not extend its lines in St. Paul, nor begin work on its shops, because of the fact that such improvements bring it under the five per cent. gross-earnings tax. Council members in St. Paul fear to take any action to repeal the gross-earnings proposition because of the criticism they believe would come from some sources based on the allegation that such action was for corporate interests and not for the people. Thus the extensive improvements for which plans have already been prepared and are ready for bids are being held back by what the street-railway people consider excessive taxation.

About 35,000 shares of the stock of the Philadelphia Rapid Transit Company belonging to the estate of William L. Elkins have been sold to a syndicate of Philadelphia and New York traction interests composed of men who were close friends of Mr. Elkins, among them being John B. Parsons, president of the Rapid Transit; P. A. B. Widener, George D. Widener, J. J. Sullivan, William H. Shelmerdine, Michael Murphy, John M. Mack, George A. Huhn and Clarence Wolf of Philadelphia, and Thomas F. Ryan, August Belmont, James H. Hyde and John D. Crimmins of New York. The sale marks the end of the Widener-Elkins traction syndicate, organized 30 years ago. The transfer is one of the steps in the harmony plan that will eventually develop into a community-of-interest scheme to be participated in by the lines of Greater New York, Philadelphia and the roads in New Jersey controlled by the Public Service Corporation. Previously about 15,000 shares of the stock were sold to the same interests. The capital of the company is $35,000,000. Much of the money being called on the stock is going into the construction of the Market Street subway and elevated line and other improvements.

SOCIETIES AND SCHOOLS.

The executive committee of the American Railway Mechanical and Electrical Association suggests that, in view of the fact that during the last year a movement has been on foot among the superintendents of the way departments to form an association of their own, steps be taken at the next meeting of the association to induce the superintendents to combine with the American Railway Mechanical and Electrical Association, instead of forming a separate organization. Notice is therefore being sent to the members of proposed changes in the constitution and by-laws which will be necessary to do this, in order that the matter may be brought to a vote at the next meeting.

PUBLICATIONS.

A number of circulars from the Sterling Electrical Manufacturing Company of Warren, Ohio, are calculated to impress the patrons of the company and others interested in lamps with the advantages of the Sterling Special lamps, which are said to possess unequaled light-distributing qualities.

A flashy little "flasher circular" is being sent out by the Reynolds Electric Flasher Manufacturing Company of Chicago. It is unique and attractive. The Reynolds electric flasher is an automatic switch intended for flashing electric signs, flags and electrical displays of all kinds.

A complete catalogue of coal-handling machinery has been issued by C. W. Hunt & Co. of New York, including apparatus for power stations, boiler rooms, coaling stations, gas companies, coal yards, shipping docks, etc. The catalogue is profusely illustrated, giving a short description of each type of apparatus. It is worthy of careful inspection.

MISCELLANEOUS.

The Canadian General Electric Company's works at Peterboro, Ont., were damaged recently by fire to the extent of $20,000 or $25,000.

James Farley is threatened, it is said, with opposition in his business as strike breaker because of the settlement of the New York elevated-railway troubles without a strike. Men engaged by him in anticipation of a long fight object to being dismissed with three days pay and threaten to form a strike-breakers' union.

The United States Board of Appraisers has been called upon to decide a customs controversy on radium. A protest has been made against the payment of a 25 per cent. ad valorem duty on the ground that radium is not a chemical compound, but as a crude mineral should be admitted free. The consignment over which the protest was made is valued at $1,000 and weighs only a few grains, so that, even if the importers win their case, no great reduction in the price of radium is expected.

TRADE NEWS.

The receiver of the Denver Gas and Electric Company has been discharged.

The Boise (Idaho) Electrical Supply Company has succeeded to the business of the Simpson Electric Company.

The Cascade Fixture and Electric Company of Seattle, Wash., has purchased the electrical supply stock of A. L. Kasan from the receiver.

The town of Gen, Idaho, was recently damaged by fire to the amount of $125,000. The telephone, telegraph, electric-light lines and the lines of the Washington Water Power Company were destroyed.

The Lindsay Light Company of Chicago will shortly open a new store at 54 the Bowery, New York city. The store will be equipped with a full line of incandescent lamps and up-to-date accessories.

The Universal Electric Equipment Company of Montgomery, Ala., has been incorporated with a capital of $100,000 by J. E. Thompson of Charles, W. Va., and Daniel Rogan and others of Birmingham, Ala.

It is reported from Milwaukee that the Browning Manufacturing Company of that city has been sold to the Northwestern Manufacturing Company, which was recently incorporated with a capitalization of $60,000 by John F. Harper, William Stark Smith and William P. Harper. The new company will continue the manufacture of motors, dynamos and small machinery. William Stark Smith was associated with Howard L. Browning in the old company.

The Surgeons' Electric Company with headquarters at Newburg, N. Y., has been incorporated with a capital of $50,000 to manufacture surgical appliances. The directors on record are H. H. Childs and Russell Sturges of New York, and M. B. Zeigler of Newark, N. J.

Sealed proposals in triplicate will be received until October 6, 1904, for the construction and installation of generators, motor-generators and switchboard as per drawings and specifications in the office at West Point, N. Y. Forms and specifications furnished upon application. Address Quartermaster, U. S. M. A.

W. W. Smythe, Jr., western manager of the Fibre Conduit Company, Orangeburg, N. Y., states that he has secured the order for all underground conduit and distributing-pole bends necessary to the construction of the new Independent telephone system at Sioux City, Iowa. Approximately 100,000 feet of conduit will be required for this installation.

The Elgin Brass and Electrical Manufacturing Company, a new industry, is about to open a factory in Elgin, Ill., where it will at first give its attention to the making of electric and gas combination fixtures. The directors of the company are E. W. Lawson, Fred Zeigler, H. A. Daggett and M. J. Anderson of Elgin and W. R. Switzer of St. Charles.

Judge Blanchard of the Supreme Court has appointed Theodore C. Wallace receiver for the Swan Electric Manufacturing Company, formerly of 55 William Street, New York city, on the application of William J. Wilson, who obtained a judgment against the company for $15,190 on March 17. The assets consist of some patents and a few outstanding accounts.

The Electrical Manufacturers' Export Company has been organized in New York with an initial capital of $10,000. The directorate includes the names of O. C. Durland of New York city, Marshall D. Barr of Pittsfield, Mass., and F. S. Hunting of Fort Wayne, Ind. The company proposes to make Mexican trade a specialty, and to increase its capital as required.

S. Pearson & Son, who are building the Pennsylvania railroad tunnels under the East River and Long Island City, have awarded the contract for two complete compressed-air power plants to the Ingersoll-Sergeant Drill Company of New York city. It is the largest order of its kind in the history of the business. The same company will also supply two compressed-air power plants to be used in building the Pennsylvania railroad tunnel under the Hudson River.

BUSINESS.

The F. Bissell Company of Toledo, Ohio, district manager of the Northern Electrical Manufacturing Company of Madison, Wis., for Ohio, Indiana and Michigan, is sending out a serviceable paper-clip souvenir to its friends in the trade.

The Northern Electrical Manufacturing Company of Madison, Wis., has been awarded the contract for the entire motor equipment of the new shops of the Southern Railway Company at Spencer, N. C., designed by Mr. S. D. Cushing, signal and electrical engineer of the Southern Railway Company. About 450 horsepower of motors will be required, and a combination of group and individual drive will be used.

Among the contracts recently secured by the Gould Storage Battery Company of New York are the following: City and Suburban Railway Company, Portland, Ore., 280 cells, O-515, and regulating booster; Edison Electrical Illuminating Company, Topeka, Kan., 280 cells, S-617, and regulating booster; Leominster, Shirley and Ayer Street Railway Company, Shirley, Mass., 224 cells, O-511; corporation of the town of Port Arthur, Port Arthur, Canada, 240 cells, O-507 and also a number of isolated plants.

Dodge & Day, engineers, Philadelphia, have been commissioned by Alexander Bros. to take charge of the electrical installations in the property recently acquired by them at No. 406 North Third Street, Philadelphia, Pa. A generator will be required, several motors, switchboard, line-shafting, wiring, etc. Other commissions of this firm are the purchase and installation of a night set for the new plant of the Jeanesville Iron Works Company, Hazleton, Pa., and the running of a transmission line to Jeanesville (a distance of two miles) to furnish illumination for the town and residences.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued (United States Patent Office) September 6, 1904.

769,195. Brush Holder for Electric Generators. Leon R. Smith, Pendleton, Ind., assignor to the Motsinger Device Manufacturing Company, Pendleton, Ind. Application filed April 13, 1904.

Insulating bushing provided with a pair of adjacent parallel axial perforations and a connecting slot carries a pair of tubular brush holders formed by a single piece of metal and inserted in the perforations.

769,203. Electric Signal. William T. Wheeler, St. Louis, Mo. Application filed November 7, 1903.

An electric lamp is carried in a casing and is operated by a circuit containing a translating device. A push button for the casing is movable relatively to the lamp and controls the circuit. A second circuit includes the lamp and is controlled by the push button, with means independent of the push button for controlling the second circuit.

769,214. Block-switch and Signal System for Electric Railroads. Thomas F. Gaynor, Brooklyn, N. Y., assignor to the Gaynor Train Control Company. Application filed August 19, 1902.

In an electric railroad a resistance is connected between the feed conductor and contact conductor through branch connections. An actuating lever connects a signal, electric switch and resistance mechanism, and is adapted to actuate the switch, the signal and the resistance mechanism synchronously.

769,228. Electric-circuit Closer. John K. Norstrom and Henry M. Graif, Chicago, Ill., assignors to the Automatic Telephone Company, Chicago, Ill. Application filed May 20, 1903.

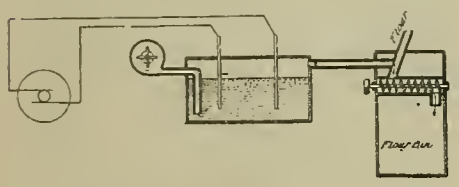
A pivoted primary actuating member having a tooth and a lever pivoted in a support has its end projecting substantially radially into the path of movement of the tooth. A pair of contact springs are supplied, one of which is operatively associated with the lever to be moved into contact with its fellow spring by movement of the lever in one direction only.

769,236. Electrode Holder for Electric Headlights. Mark A. Ross, Chicago, Ill., assignor to the Pyle National Electric Headlight Company, Chicago, Ill. Application filed October 15, 1903.

An electrode holder for electric arc lamps comprises an upright bar having a concave upper end portion presenting an electrode-clamping jaw, a lever in pivotal relation to the bar having an upper short concave arm presenting an electrode-clamping jaw, and a long arm. A spring is confined between the bar and long arm of the lever, and a raising and lowering support is provided for the electrode between the clamping jaws and spring.

769,250. Electric Furnace. Michael R. Conley, New York, N. Y., assignor to the Electric Furnace Company, New York, N. Y. Application filed October 1, 1902. Renewed January 27, 1904.

A receptacle formed of resisting material adapted to grow incandescent on the passage of an electric current through it bears integral extensions on opposed portions. A series of connections connect with the extensions in different planes to the end that the electrical distribution through the furnace may be controlled.



NO. 769,522.—PROCESS OF TREATING FLOUR.

769,273. Inclosed Electric Arc Lamp. Henry C. F. M. Petitdidier and Theodore M. Schmitt, Paris, France, assignors to themselves and Victor Reclus, Paris, France. Application filed November 10, 1903.

The arc lamp comprises a carbon holder, an electromagnet in series in the main circuit, a movable core for the magnet and supporting the carbon holder, feed mechanism for one of the carbons and an electromagnet arranged in parallel with the main circuit for actuating the feed mechanism and controlled by the series electromagnet.

769,279. Apparatus for Signaling to Trains. Joseph Seel, Manchester, England. Application filed March 19, 1904.

Apparatus for electrically signaling to trains contains a transmitting instrument comprising a spring adapted to be positively tensioned to a greater or less extent, according to the signal desired to be sent. A shaft is adapted when free to be forwardly rotated by this spring. An electromagnet has an armature which, when attracted by the electromagnet, frees the shaft.

769,303. Means for Supporting Electrical Lamps. William B. Churcher, Cincinnati, Ohio, assignor of one-half to Albert F. Maish, Cincinnati, Ohio. Application filed December 26, 1899.

Combined with an incandescent lamp is a socket and a permanent magnet attached thereto, the electrical coil as a part of the magnet being connected in series with the lamp. The magnet is constructed as specified to attract independently of the electric circuit.

769,304. Telephone. William B. Churcher, Cincinnati, Ohio, assignor of one-half to Albert F. Maish, Cincinnati, Ohio. Application filed April 26, 1900.

A transmitter shell having a circular edge flange carries a plate or shell at one side carrying the switch and its buttons and having a rabbeted and curved edge overlapping the flange and secured to it. A plate or shell on the opposite side carries the bell and has likewise a rabbeted and curved edge secured to the flange.

769,306. Telephone or Telegraph System. Frederick E. Denzer and William W. Black, Everett, Wash. Application filed September 3, 1902.

A circuit-breaker is placed in the selective circuits, together with a selective mechanism and means for controlling the mechanism by the opening and the closing of the selective circuit. A switch in the communicating circuit is controlled by the selective mechanism.

769,364. Pyrometer. Henry M. Tory and Howard T. Barnes, Montreal, Canada. Application filed April 2, 1904.

An instrument for measuring temperature comprises a pyrometer containing a coil and loop. A calibrated contact and a second contact adapted to be brought into electrical connection with the first cooperate with a normally open main electric circuit having its terminals connected to the contacts and forming two paths, which respectively include the coil and loop of the pyrometer.

769,403. Secondary or Storage Battery. Carroll Potter, Philadelphia, Pa. Application filed December 21, 1903.

Combined with a connecting strap and depending plate-lugs, are bridge pieces interposed between and attached to the lugs to relieve the strain at the joints of the lugs with the straps.

769,466. Means for Controlling and Regulating Electric Motors. Gustaf Rennerfelt, New York, N. Y. Application filed November 9, 1903.

Apparatus for regulating electric motors comprises a motor and controller therefor, with means for automatically operating the controller so as to obtain an increase in speed of the motor, and means for stopping the operating means when the rate of speed increase exceeds a predetermined limit.

769,469. Electric-signaling System. Paul H. Schmitt, Chicago, Ill. Application filed November 30, 1903.

Signaling with this device is done by rotative circuit-breaking and circuit-closing disks, which are insulated from each other. A movable contact arm is adapted to coact with either of the disks, an electromagnet is applied to move the arm and a locking device is adapted to positively hold the contact arm in position to coact with one or the other of the disks.

769,413. Weighing Machine. Charles J. Simeon, Thomas St. Julian B. Parnall and William E. Hipkins, Birmingham, England. Application filed April 22, 1904.

Trip levers which operated the valves of the weighing machine to admit the grain or pulverized material to be weighed to the hopper are actuated in part by electromagnets.

769,462. Self-adjusting Trolley for Electric Railways. Charles C. Benson, Newburyport, Mass. Application filed November 19, 1902.

In a self-adjusting trolley a hanger bracket is carried by the trolley pole and provided with a pendent member having a pair of offstanding vertically aligned supporting ears. A swivel pin fitted to the support ears of the bracket, and an upright swiveled bearing fork carrying the trolley wheel and having at its base a journal collar swiveled upon the pin between the supporting ears of the bracket are essential parts of the device.

769,473. Electrical Signal Transmitter. Arthur C. Ferguson, Brooklyn, N. Y. Application filed January 30, 1904.

Combined with a diaphragm and an electrical device having a traveling contact member connected in closed circuit with the diaphragm, is a series of signal-selecting devices, one of which is adapted to be actuated by a circuit established by the contact member in accordance with the extent of the travel.

769,522. Process of Treating Flour. John M. Williams, Guthrie, Okla. Application filed October 23, 1903.

Whitening and purifying flour is accomplished by decomposing an oxygen-bearing liquid by electrolysis and then immediately forcing the gaseous product through the flour. (See cut.)

769,540. Audible Indicator for Electric-light or Electric-motor Circuits. Joseph P. Gillette, New London, Conn. Application filed December 22, 1903.

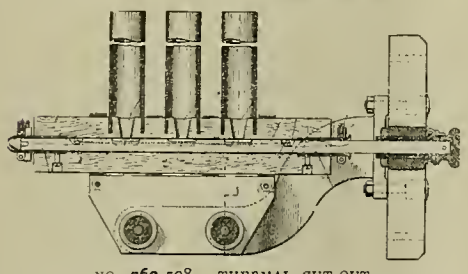
In an audible indicator for connection in series in electric-light or electric-motor circuits are a shell having two oppositely arranged lateral openings located near its base, a cover for the shell, a magnet located in the shell, a vibrator coacting with the magnet to produce an audible signal, and electric connections leading into and out of the shell through the lateral openings.

769,565. Compressed-air Supply for Electric Vehicles. Roland Le Baron Owen and Robert O. Le Baron, Pontiac, Mich. Application filed September 30, 1903.

A lever connected with the controller of the car throws the compressor pumps into or out of action.

769,572. Time-limit Device for Electric Switches. Samuel B. Stewart, Jr., Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed May 31, 1902.

In combination with a switch are means for closing the switch, an independent means for holding the switch closed and for maintaining the switch in its closed position for a definite predetermined length of time after the closing means have become inoperative.



NO. 769,598.—THERMAL CUT-OUT.

769,598. Thermal Cut-out. William L. R. Emmet, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed December 4, 1899.

The fuse comprises a wire, a grooved support in which the wire rests and against which it bears throughout the major part of its length, and one or more enlargements of the groove leaving a free air-space all around the wire at a point or points desired to first give way, the wire being in contact with the grooved walls at all other points. (See cut.)

769,599. Brush Holder. William L. R. Emmet, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed December 22, 1900.

The device consists of a holder provided with a guide for the brush, a spring, and a device for carrying the spring, which device is removably mounted on the holder independent of the guide and provided with means for adjusting the spring independently of the holder.

769,619. Starting Rheostat. Frederick Mackintosh, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed July 26, 1901.

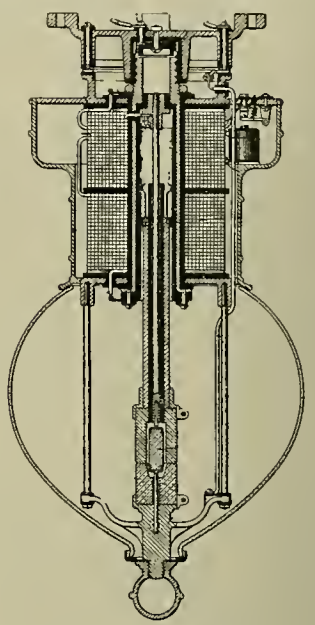
Embodied in the invention are a work-circuit, a motor-operated rheostat, a clutch between the motor and the movable contact of the rheostat, means operated by the work-circuit for storing energy, and means for restoring the rheostat to the "off" position after a determinate amount of energy has been stored.

769,637. Electric Lamp. Edwin W. Rice, Jr., Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed July 8, 1899.

Associated in the lamp with a pyro-electrolyte adapted to form part of an electric circuit, are means for establishing a voltaic arc in proximity to the electrolyte. A circuit-breaker depends for its operation upon the condition of the electrolyte for breaking the arc-circuit at a point other than the arc when the pyro-electrolyte shall have become conducting. A magnet coil prevents the formation of an arc while current is flowing through the pyro-electrolyte. (See cut.)

769,638. Regulation of Electric Circuits. Howard R. Sargent, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed November 28, 1900.

Two translating devices are connected by a switch having four stationary contacts, one connected with one translating device, two connected with the other translating device, and one common to both translating devices. A movable switch member carries segments to connect the contacts so that both translating devices will be in series, or one translating device cut out, or both in parallel.



NO. 769,637.—ARC LAMP.

769,639. Cleat for Electric Conductors. Howard R. Sargent, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed March 26, 1902.

The cleat is composed of similar halves, each comprising a high portion, a low portion, and an intermediate curved portion.

769,652. High-potential Energy Detector. John D. Hilliard, Jr., Glens Falls, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed March 13, 1903.

A voltage-detector comprises a metallic contact connected to a metal plate, a second plate insulated from the first plate and in inductive relation therewith, and a readily observable spark gap between the plates.

769,658. Telephone Receiver. Ray H. Manson, Chicago, Ill., assignor to the Kellogg Switchboard and Supply Company, Chicago, Ill. Application filed August 3, 1903.

A receiver having a shallow insulating shell is fitted with a permanent magnet and co-operating parts carried within the shell. Binding posts for the receiver extend through independent openings in the rear wall of the shell. Receiver-cord tips, and means for connecting the receiver-cord tips with the binding posts so that they shall be inclosed practically their full length by the shell are the other essential features.

769,685. Electric-railway Switch. Schuyler C. Gurley, Indianapolis, Ind. Application filed September 8, 1903.

The armature of an electromagnet is adapted to move the switch point.

EXPIRING PATENTS.

Following is a list of electrical patents (issued by the United States Patent Office) that expired on September 13, 1904:

369,754. Dynamo-electric Machine or Motor. E. Thompson, Lynn, Mass.
369,769. Galvanic Battery. H. J. Brewer, New York, N. Y.
369,793. Manufacture of Insulated Electrical Conductors. J. T. Jaques, Boston, Mass.
369,801. Electric Valve Controller. William H. Markland, Brooklyn, N. Y.
369,808. Electrical Call Bell. J. G. Noyes, New York, N. Y.
369,810. Electrical Annunciator Call System. F. J. Patten, Fort Sidney, Neb.
369,813. Underground Conduit for Electric Wires. G. Rader, New York, N. Y.
369,880. Railway Telegraph. L. J. Phelps, New York, N. Y.
369,889. Electrical Cut-out. N. F. Stoddard, Detroit, Mich.
369,917. Governor for Electromagnetic Brake Circuits. G. F. Card, Covington, Ky.
369,929. Electric Railway Signal. J. Hamilton Farrar, Chicago, Ill.
369,954. Automatic Reverse Movement for Spacing Mechanism for Electrical and Mechanical Typewriters. J. F. McLaughlin, Philadelphia, Pa.
369,989. Electric Bell. H. P. F. Jensen, B. W. Webb and J. Jensen, London, County of Middlesex, England.
370,000. Regulation of Electric Motors. S. S. Wheeler, New York, N. Y.
370,007. Electric Heat-regulating Apparatus. W. A. Connelly, Boston, Mass.

WESTERN ELECTRICIAN

EVERY SATURDAY

Vol. XXXV. CHICAGO, SEPTEMBER 24, 1904 No. 13

The International Electrical Congress at St. Louis.

As may be judged by the reports presented in the Western Electrician of last week and this week, the International Electrical Congress held in St. Louis last week was an important affair. It will probably be the last assemblage of its kind to be held for a number of years and is quite sure to have been the very last with an official Chamber of Delegates. An international commission, with two delegates from each country interested in electrical standard-unit legislation, is recommended as the future body to consider the vexed question of electrical units, in order to obtain practical uniformity in all countries. Heretofore, electrical congresses have been held at international expositions, and chambers of delegates appointed by governments have formed parts of such congresses. But, "the old order changeth," and a more exact, scientific and authoritative method of fixing electrical standards is outlined and recommended by the Chamber of Delegates at St. Louis. This recommendation was the chief work of the International Electrical Congress of 1904, so far as official action is concerned.

But it is a question whether the chief value of the Congress does not exist, after all, in its contribution to the literature of electricity and applied electricity. Some 160 papers were read before the eight sections into which the gathering was divided. A large proportion of these papers were of much value, and many well-known names are included in the list of authors. In nearly all of the sections there were instructive discussions, although it was imperative that some of the papers be read by title. Nearly 100 of the papers were printed in advance, and the fact was again demonstrated that authors who desire appreciation of their work by an adequate discussion should furnish their papers well in advance of the meeting at which they are to be read, so that they may be printed. For discussion, the advantage of advance printed copies is very great. Dr. Kennelly, the secretary, hopes to have the printed volumes of Transactions out before New Years. A set will be furnished to each member of the Congress and will contain the proceedings in full. In its issues of last week and this week the Western Electrician lays before its readers a complete survey of the work of the Congress, with several good papers. Other papers will be published in abstract in future issues.

In membership the International Electrical Congress of 1904 made a fine record, with over 2,100 names on its list, of whom about 400 were foreigners. But in actual attendance at the sessions in St. Louis the accomplishment was good but in no way remarkable. The estimate of attendance is 700—probably about the same as at the Chicago Congress of 1893, if the general opening meeting be accepted as the test in each case. In total attendance at sectional meetings, however, St. Louis exceeded Chicago. The group picture on this page shows members of the St. Louis Congress on the steps of Festival Hall at the World's Fair on Electricity Day, September 14, 1904. Those curious in such matters can compare it with the corresponding Chicago picture of '93, republished in the Western Electrician in its issue of September 10th last on page 197. The number of foreign engineers in attendance at St. Louis was in excess of 100.

In the group picture on this page many well-known faces will be recognized. The front row, reading from the left, consists of Jorge Newbery of Buenos Aires, S. W. Stratton of Washington, D. C., Prof. John Perry of London, J. W. Lieb, Jr., of New York, Col. R. E. B. Crompton of London, Dr. R. T. Glazebrook of London, R. K. Gray of London, B. J. Arnold of Chicago, Elihu Thomson of Lynn, Mass., C. P. Steinmetz of Schenectady, N. Y., and Prof. L. Lombardi of Naples. A separate group of the government delegates is illustrated on page 237 of this issue.

On Saturday night, September 17th, the members of the "circular-tour" party left for Pittsburg under the general pilotage of Charles F. Scott. They went to the Hotel Schenley, and on Monday were taken to the offices and works of the Westinghouse Electric and Manufacturing Company at East Pittsburg. After visiting the works the members of the party were the guests of the Westinghouse company at luncheon. The plan, after leaving Pittsburg on Monday, September 19th, was to arrive in Washington the next day, in time to assist at the dedication of the offices and laboratories of the United States Bureau of Standards. Visits to the White House and to Philadelphia were also scheduled.

MEMBERS OF INTERNATIONAL ELECTRICAL CONGRESS ON STEPS OF FESTIVAL HALL, ST. LOUIS EXPOSITION, SEPTEMBER 14, 1904

INTERNATIONAL ELECTRICAL CONGRESS

HELD IN ST. LOUIS, SEPTEMBER 12-17, 1904.

Beginning on Monday, September 12th, the International Electrical Congress of 1904 was held in St. Louis. The opening session of the general congress was held in the Music Hall of the Coliseum on that day, and was reported fully in the Western Electrician of last week. After organization the Congress divided into eight sections, each devoted to a branch of the science or the art of electricity, and meetings of these sections were held on Monday, Tuesday, Thursday and Friday in smaller rooms or in partitioned-off places—some, it must be confessed, poorly adapted for the purpose—in the Coliseum. On Wednesday there were no sessions of the Congress proper, but the members attended a joint meeting of the American Institute of Electrical Engineers (annual convention) and the Institution of Electrical Engineers of Great Britain, which was held in Festival Hall, World's Fair grounds. The Chamber of Delegates held meetings during the week in a parlor of the Jefferson Hotel. On Saturday the concluding session of the Congress was held in the Hall of Congresses on the World's Fair grounds. At this session the report of the Chamber of Delegates was presented, and final adjournment was taken. As this was the most important session of the Congress, it will be considered first.

Report of the Chamber of Delegates.

President Elihu Thomson presided at the final session of the Congress, which was called to order on Saturday, September 17th, at 11 a. m. A distinguished visitor was Henri Poincaré of Paris, perhaps the first mathematical physicist of the day, who was appointed as one of the government delegates from France, but who did not arrive in time to participate in the deliberations of the Chamber of Delegates. In a few remarks prefacing the reading of the report of the chamber, Professor Thomson said there was no vote to be taken upon it, nor was it to be acted upon in any way. It was merely presented as the result of the work of the Chamber of Delegates. Following is the report in full:

ANNOUNCEMENT CONCERNING THE ACTIONS OF THE CHAMBER OF DELEGATES.

The following are the reports of the sub-committees of the Chamber on international electromagnetic units and on international standardization of electrical apparatus and machinery, which have been unanimously adopted by the Chamber:

Committee on International Electromagnetic Units.—The sub-committee appointed September 13, 1904, begs leave to suggest that the Chamber of Delegates should adopt the following report:

It appears from papers laid before the International Electrical Congress and from the discussion that there are considerable discrepancies between the laws relating to electric units, or their interpretations, in the various countries represented, which, in the opinion of the chamber, require consideration with a view to securing practical uniformity.

Other questions bearing on nomenclature and the determination of units and standards have also been raised, on which, in the opinion of the chamber, it is desirable to have international agreement.

The Chamber of Delegates considers that these and similar questions could best be dealt with by an international commission representing the governments concerned. Such a commission might in the first instance be appointed by those countries in which legislation on electric units has been adopted, and consist of (say) two members from each country.

Provision should be made for securing the adhesion of other countries prepared to adopt the conclusions of the commission.

The Chamber of Delegates approves such a plan and requests its members to bring this report before their respective governments.

It is hoped that if the recommendation of the Chamber of Delegates be adopted by the governments represented, the commission may eventually become a permanent one.

It is recommended that the delegates report the resolution of the chamber as to electrical units to their respective governments, and that they be invited to communicate with Dr. S. W. Stratton (Bureau of Standards, Washington, D. C.) and Dr. R. T. Glazebrook (National Physical Laboratory, Bushy House, Richmond, Surrey, England) as to the results of their report, or as to other questions arising out of the resolution.

Committee on International Standardization of Electrical Apparatus and Machinery.—The committee of the Chamber of Delegates on the standardization of machinery begs to report as follows:

That steps should be taken to secure the cooperation of the technical societies of the world by the appointment of a representative commission to consider the question of the standardization of the nomenclature and ratings of electrical apparatus and machinery.

FOREIGN AND AMERICAN ELECTRICAL DELEGATES AT THE TOMB OF LINCOLN, SPRINGFIELD, ILL., SEPTEMBER 11, 1904

If the above recommendation meets the approval of the Chamber of Delegates, it is suggested by your committee that much of the work could be accomplished by correspondence in the first instance, and by the appointment of a general secretary to preserve the records and crystallize the points of disagreement, if any, which may arise between the methods in vogue in the different countries interested.

It is hoped that if the recommendation of the Chamber of Delegates be adopted, the commission may eventually become a permanent one.

It is recommended that the delegates report the resolution of the chamber as to international standardization to their respective technical societies, with the request that the societies take such action as may seem best to give effect to the resolution, and that the delegates be requested to communicate the result of such action to Col. R. E. B. Crompton, Thriplands, Kensington Court, London, England, and to the president of the American Institute of Electrical Engineers, New York city.

CONCLUDING SPEECHES AND ADJOURNMENT.

After Secretary Kennelly had made some announcements, among other things stating that 160 papers in all had been read, and that it was the intention to distribute the printed Transactions before the close of the year, the closing exercises were begun.

President Thomson introduced Professor Poincaré, who was received with great enthusiasm and who addressed the Congress in French. The speaker expressed his cordial adhesion to the proposal of the chamber favoring the establishment of an International Commission on Electrical Units.

President Thomson: I should like to call on Mr. Gray for a few remarks.

Mr. R. K. Gray, president of the Institution of Electrical Engineers of Great Britain: I don't know, sir, that I can say very much on the subject except to mention that we are very happy to know the result of the deliberation of the Chamber of Delegates, because, talking from the point of view of a man dealing with electrical matters, I also feel that Professor Poncairé has expressed the feelings of an institution such as ours. I could not for one moment criticise the action of the Chamber of Delegates, except that criticism be one of the most favorable kind. I have no doubt, gentlemen, that all you who deal with electrical matters will find that they acted in the wisest and most correct manner in the decision they have arrived at, and when there is constituted a central bureau to which recourse can be had, that a stability will be given to the matter of units, and that, also, certain international standards can be arrived at; but if I might express my personal feeling, I hope when the latter question is dealt with that, while the units ought to be absolutely correct—as correct as human agency can make them—yet it would be very much to be regretted if any standard should be created which would have the effect of retarding the progress of our great industry.

I thank you, Mr. President, for your kindness in calling upon me to speak, and I also thank you very much for the kindness shown to my colleagues of the Institution of Electrical Engineers at your Congress. (Applause.)

President Thomson: I know that gentlemen on the floor—particularly certain gentlemen— have been called upon frequently during the week to state their feelings and attitude, and if Professor Ascoli is here I will simply ask him to tell us—(The secretary announced the absence of Professor Ascoli.) In the absence of Professor Ascoli, the head of the delegation of Italy, I ask Professor Lombardi to say a few words in regard to the proceedings of the Congress from his point of view.

Professor Lombardi: Mr. President, I was not prepared to speak here, but I take with very great pleasure this occasion to express my perfect accord with the conclusions of the Chamber of Delegates. I think the question of the units could not be decided better, because a permanent committee, appointed by the different governments, would be the most suitable body, studying and deliberating.

I think some difficulties will arise, perhaps, in regard to the question of standardizing dynamo machines, etc., because of the very different conditions existing in the different countries, but I could not usefully enter into a discussion of the matter now. I think it will be the duty of the commission which will be appointed in the future to discuss the very important problem and to propose, after having given it their very best deliberations.

Having had the honor to come for the second time to America, I have enjoyed very much the cordial reception of our American colleagues, and therefore I take occasion to express my best thanks—not only mine, but also those of our president, and our colleagues of Italy. (Applause.)

President Thomson: I had hoped we might persuade Mr. Litzrodt, a representative here present from Germany, to say a few words, but he prefers to give place to Professor Arrhenius.

Professor Arrhenius (of Sweden): I feel that it is the time now to express thanks for the brilliant way in which this Congress has been conducted. It will surely leave on our memories unforgettable traces during our whole lives. We all feel the deepest sentiments of admiration for the extraordinary development of the culture and of the industry of this new great power, the American nation. There has never been in history an example of such a rapid development as this lying before our eyes. It has been to us all a very great pleasure and benefit to see our colleagues here, and to make their acquaintance; to find old friends whom we have met before, and to form new bonds of friendship with many others. (Applause.) I hope that we all feel the extraordinary good to be derived from these gatherings, and I hope we will meet again, either on this

side or on the other side of the great water that separates the continents.

Especially I might express our thanks to the officers and to the president of the local committee and to the American Institute of Electrical Engineers for their great hospitality and their extraordinary benevolence tendered to us during these days, and it will stand out most prominent and unforgettable in our whole lives. I know some of us will remain here for some time still, but most of us must depart from here in a few short hours, and for us all I might express our sentiment of deepest gratitude and admiration for the leading men of this Congress, and say that their work will bear fruits in the future.

As you have already heard from the lips of our illustrious chairman, the Chamber of Delegates has accomplished work which we hope will lay the foundation stones for development to the benefit of all nations, and I will express our pleasure that this work has been done on the free American soil.

We express our best wishes for this grand nation, which has shown us all these brilliant features during this past week, and we hope that this nation may go forward under the banner of harmony and liberty as it has done hitherto, to benefit not only itself, but all nations in the whole world. (Applause.)

President Thomson: As a representative of the co-operating societies which have met with us, I should like to call on Prof. A. G. Webster of Clark University, if he does not object. I know he has received no notice of this invitation. I should say that Professor Webster is president of the American Physical Society, and, of course, physics is the nearest kin to electricity. In fact, there are symptoms that electricity will swallow up physics.

Professor Webster: This is quite unexpected to me, and I may say quite unnecessary. I have been attending during the last week merely as an extremely interested participant in these meetings, although I have no official connection with the Congress or with the Chamber of Delegates; yet, if it is of any advantage to them I may say that their proceedings have my hearty approval. The more they leave things as they are the better we shall be satisfied with them. That is my point of view, and I may say the same thing of physics. I don't share, sir, your fear, or hope, that physics is about to be swallowed up in electricity, though I think it extremely probable that everything of which the physical world is made is made of electricity.

I would like to call your attention to the fact that the electricity is in very small pieces, indeed—I may say, ultra-homeopathic pieces of electricity. I may say, therefore, that we are perfectly willing to be made of electricity, and to know whatever it is that makes us go slowly—and the Lord be praised for anything in this country to bring about that result—and whatever there is that forms a resistance to acceleration is made of electricity.

I don't think I can add anything to what has been said. I regret very much that I came in too late to hear Professor Poincaré, for I have been looking for him for the last week. I am perfectly sure I agree with whatever he said.

Gentlemen, at the various dinners we have attended this week we have heard the greatest variety, or similarity, I would rather say, of fraternal sentiments. I am sure I should like to associate myself with you all. I love England; my people came from England 260 years ago. I love Germany; I spent four of the happiest years of my life in Germany as a student. I love France, where I consider Paris to be the center of the earth. I love Italy, because it is the most beautiful country where I have ever been. I love Japan, and I should like very much to go there, for I am sure it is more beautiful than Italy (laughter and applause); and I wish only to say in closing that if there is anything that is going to bring the world together, as it has always done and always will do, it is the pursuit of science, and I should like to quote a remark made by a distinguished gentleman from the state of Massachusetts, which is my home. Edward Atkinson, in an address on the application of science to the arts of war, said that every application of science and of all the sciences—I am sure electricity is the greatest, because it does everything but make the power, and I hope some time it may do that—of all applications of science to the arts of war, every one tends to make war more nearly impossible, and he concluded with the statement that it was only required that scientists should invent a gun which should pick off generals at headquarters with the same accuracy that the Boer sharpshooters picked off the British captains and lieutenants, to make war forever impossible. Gentlemen, I commend that to you and to all scientists as the most worthy of occupations—the abolishment of war through the development of science.

President Thomson: I felt sure that in calling in Professor Webster he would show a capacity for emergency work, which is always the sign of true genius, and I am gratified to have the expression from him which may be taken as representative of the views of most of us present.

J. W. Lieb, Jr.: I arise on behalf of the official delegates and members of the International Electrical Congress, to propose a vote of thanks to the St. Louis reception committee for its hospitable entertainment while we have been in St. Louis. (Applause.)

B. J. Arnold: I take pleasure in seconding that motion most heartily. St. Louis has treated us royally, and I have no doubt we shall take pleasure in passing the motion by acclamation.

President Thompson: This motion admits of no discussion. I should like to have you pass that by acclamation. (Motion put to a vote and unanimously carried.)

It is my pleasure to state that the unity and harmony which has pervaded our meetings has been a source of great satisfaction to us who have had to do with the organization and control of the Congress while it has been here in St. Louis. We are grateful for the evidence of self-abnegation exhibited by the members of the Congress, and the officers in control of the sections, where there was so much temptation to draw them away; so many things to see. And we know, also, that many of them, besides, have so little time that there is only a fraction of a day left before they return to the East, and many of them much further than the shore of the Atlantic Ocean.

We feel that the work accomplished at this Congress will render it a memorable one, not only on account of the importance of the subjects under discussion, but for the move that has been taken in regard to the international commission. I have no doubt whatever that this commission will soon be a fact, and will then be able to take up questions which are not, or which many of us have thought are not, proper to be discussed during exhibitions. It is a question, too, as to when there will be another exhibition.

It is particularly gratifying to me, as executive officer of the Congress, to find that so much has been done by everyone connected with the Congress to render my duties as pleasant and agreeable as possible, and I thank every member of the Congress for the evidences of good will and assistance whenever it might be required.

We have come to the point of parting from those who have visited us from abroad. I don't know that their enjoyment can have been greater than ours. We regard it as great a privilege to have had them with us—a privilege inestimable—to have had them with us and to have had the fellowship and assistance which have come to us, and without which this Congress could not certainly have accomplished anything like the valuable results which will, we hope, go from it. These gentlemen have enlivened our discussions and entered heartily into every move which was made for the benefit of the Congress at large. To the foreign delegates who have been present in the Chamber of Delegates I particularly wish to say a word. I have found that the unanimity of action, the absence of any disagreement whatever, has been remarkable. As soon as a measure was known to be a proper thing, all votes were unanimous from every country; not a dissenting vote. And this bodes well for the future of the work of the Chamber of Delegates.

We must part. Many of the acquaintances are new acquaintances—visitors from abroad; others are old friends. Some I have had the pleasure of meeting at the Chicago Congress, but I will say this, that, though we part in body, we will be together in spirit. We cannot forget this admirable occasion on which we have been able not only to enjoy having them with us, but we hope they will carry pleasant memories from us, as we part. (Applause.)

There is nothing more that will need to come before the Congress I believe, and I can now declare the International Electrical Congress of 1904 adjourned.

1 Ryan of the United States.
2 Maffezzini of Italy.
3 Wolff of the United States (assistant to the secretary, but not a delegate).
4 Gati of Hungary.
5 Dennery of France.
6 Higman of Canada.
7 Kennelly of the United States (secretary).
8 Otamendi of Spain.
9 Hesketh of Australia.
10 Ferrié of France.
11 Crompton of Great Britain.
12 Newbery of the Argentine Republic.
13 Lombardi of Italy.
14 Solari of Italy.
15 Stratton of the United States.
16 Carhart of the United States.
17 Perry of Great Britain.
18 Shields of India.
19 Litzrodt of Germany (delegate to the Congress at large).
20 Arrhenius of Sweden.
21 Glazebrook of Great Britain.
22 Thomson of the United States (president).
23 Ascoli of Italy.
24 De Nerville of France.
25 Gonzalez of Spain.

THE CHAMBER OF DELEGATES OF THE INTERNATIONAL ELECTRICAL CONGRESS AT ST. LOUIS, SEPTEMBER 16, 1904.

List of Government Delegates.

Omitting delegates appointed but not present, the Chamber of Delegates was made up as follows:

Argentine Republic—Dr. Jorge Newbery.
Australian Colonies—John Hesketh, Esq.
Canada—Ormond Higman, Esq.
Denmark and Sweden—Prof. Svante Arrhenius.
France—M. Guillebot de Nerville, M. Ferrie, M. Dennery.
Germany—Kaiserlich Postrath Litzrodt (to the Congress at large).
Great Britain—Col. R. E. B. Crompton, Dr. R. T. Glazebrook, F. R. S.; Prof. John Perry, F. R. S.

[*Continued on page 241.*]

A Secret Telephone System.

Public telephone service, as well as the systems of intercommunication from one department to another in use in the banking houses, stock exchanges, brokers' offices, and other important places of business in large cities, would be improved by privacy of telephonic conversations. Moreover, in smaller towns and villages the annoyance caused by outsiders listening to the conversations of subscribers has been considerable.

A system devised by Richard M. Beard of New York is especially designed to meet the demands of persons requiring absolutely private telephonic communication and is equally adapted to fill all the other requirements of telephone traffic.

The disposition of the local circuits and apparatus in the central exchanges is as follows: The individual visual signal for indicating the subscriber's call is tapped directly onto one side of the subscriber's line and makes connection with the other side of the line through the jack springs when no plug is in the answering or any of the multiple jacks. The answering jack and multiple jacks are so connected together through their contacts that when a plug is in any of the jacks the line is open to every jack occurring after it in the multiple. On the keyboard the keys for each pair of cords are arranged in a separate group, consisting of one two-way listening key and two signaling keys, so that when all of the keys are in the normal position the cords are connected together, but when either of the signaling buttons is pressed the cord to which it corresponds is disconnected from the other cord and the listening key and the generator contact springs are placed in circuit with it. When the lever of the listening key is thrown the one way or the other from the normal position the cords are disconnected from each other and the operator's telephone is connected with the one cord or the other, according to the position of the lever, and all the other apparatus and circuits are arranged in the manner usually employed in central exchanges.

In installations having more than one central exchange the exchanges are connected by trunk lines, as in common practice.

Fig. 1 shows two different subscribers' lines terminating in the spring jacks and line signals at the central exchange. In the diamgram (C' S') and (C''S'') are, respectively two subscribers' lines, (1) is the line signal, (2) is the answering jack for subscriber's line (C'S'), while (3) (3^a) and (3^b) are the multiple jacks, (3^b) being the last in the multiple. The line signal is (1^a), (2^a) is the answering jack for subscriber's line (C''S''), and (3^c) is the last multiple jack. There may be no multiple jacks, or there may be any number of them, according to the number of operators' positions, which are omitted from the drawings, as indicated by the dotted lines (y) and (y').

In Fig. 2, (4^c) is the two-way listening key, while (5) and (5^a) are, respectively, the signaling keys for the plugs (6) and (6^a). For the sake of clearness the cords are omitted from the drawing, and the pair of wires from each signaling key is represented as leading directly to the ring and tip contacts of the respective plugs. Clearing-out signal (7) is provided for the pair of plugs (6) and (6^a). The two wires, of which (GG'') and (G'G''') are respective sections, are common wires which multiple to every signaling key on the keyboard and are the two sides of a generator circuit which supplies the current for signaling.

In Fig. 3, (4) (4^a) and (4^b) are three listening keys, and (8) is the operator's telephone. The wire (o) is connected to one side of the key (4) and is connected to the next key (4^a) through the contacts (20) and (21), which are normally closed, and is again connected to the key (4^b) through the contacts (20^b) and (21^b), which are normally closed, while the wire (o') is connected to the side of the key (4) opposite to the side to which the wire (o) is connected. It is also connected to the next key (4^a) through the contacts (20^a) and (21^a), which are normally closed, and is again connected to the key (4^b) through the contacts (20^c) and (21^c), which are normally closed, and so on. The method of connecting the operator's telephone wires to the listening keys is to connect them to each succeeding key through a normally closed pair of contacts on the preceding key in the multiple. The key (4^c) in Fig. 2 may be considered as the fourth key in the multiple of three listening keys (shown in Fig. 3); for if the key (4^c) in Fig. 2 were placed so that (o) and (o') in Fig. 2 coincided with (o) and (o') in Fig. 3 the key (4^c) would be connected as the fourth key in the multiple. (Shown in Fig. 3.)

Now let it be assumed that a subscriber desires to call and talk with another subscriber to which he has no direct line, but with whom he can get a connection through the central exchange in which the line (C'S') terminates.

When the operator inserts the plug (6) in the answering jack of the subscriber calling, he throws the listening key (4^c) into the position to listen on

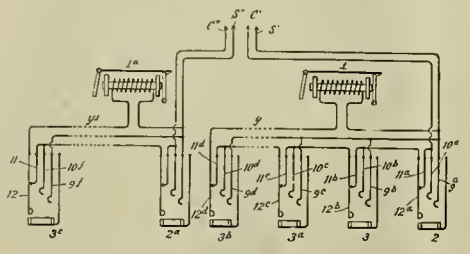


FIG. 1. A SECRET TELEPHONE SYSTEM.

plug (6), in which position the wedge (17) is forced in between the springs (15) and (15^a) far enough to cause them to break contact with the springs (16) and (16^a) and to make contact, respectively, with the springs (18) and (18^a). The springs (18) and (18^a) are tapped, respectively, to the wires (o) and (o'), the two sides of the circuit to the operator's telephone set, and the operator is then in talking circuit with the party calling.

As soon as the operator learns what subscriber the party calling wants to be connected with he inserts the other plug (6^a) in the jack installed at his position, the number of which corresponds to the number of the desired subscriber. If the line terminates in an answering jack and drop located at his position, he inserts the plug (6^a) in the answering jack; otherwise the operator inserts the

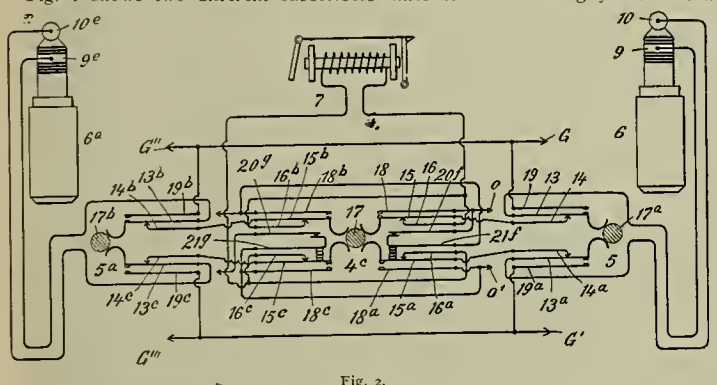


Fig. 2.

A SECRET TELEPHONE SYSTEM.

plug (6^a) in the multiple jack installed at his position to connect the desired subscriber. To signal him, the operator throws the signaling key (5^a) into the position to signal on plug (6^a), in which position the wedge (17^b) is forced in between the springs (13^b) and (13^c) far enough to cause them to break contact with springs (14^b) and (14^c) and to make contact with springs (19^b) and (19^c), which are tapped, respectively, to (G G'') and (G'G'''), the two sides of the circuit to the signaling generator, and then restores the key to the normal position.

If the multiple jack (3^c) (shown in Fig. 1) is the jack installed at the position which corresponds to the number of the desired subscriber and is the jack in which the plug (6^a) (shown in Fig. 2) is inserted, the circuit may be traced in Fig. 1. To the spring (9^f), in contact with the ring of the plug, a wire is connected which is tapped to (S''), one side of the line (C''S''), and to the spring (10^f) in contact with the tip of the plug a wire is connected, which is tapped to (C''), the other side of the desired subscriber's line (C''S''). The plug in the jack (3^c) also operates to cut the drop (1^a) out of circuit with the line (C''S'') by separating the contacts (11) and (12).

Returning again to Fig. 2, after signaling on plug (6^a) the operator may listen on the same plug. When the key (4^c) is in position to listen on plug (6^a) the wedge (17) is forced in between the springs (15^b) and (15^c) far enough to cause them to break contact with the springs (16^b) and (16^c) and to make contact with springs (18^b) and (18^c), thus placing the operator's telephone wires (o) and (o') in circuit, respectively, with (9^e) and (10^e), the ring and tip contacts of plug (6^a).

If the operator has occasion to signal back to the subscriber calling on the plug (6), he may do so by operating the signaling key (5) in the same manner the signaling key (5^a) was operated.

It will be seen that when either signaling key is in position to signal on the plug to which it corresponds, the circuit to the other plug and keys is broken, and when the listening key is in position for the operator to listen on one of the plugs the circuit to the other plug is open, so the operator can listen on but one plug at a time, and when listening on either plug the connection between the two subscribers is broken. All keys in the group connected with a busy pair of cords must remain in normal position until the two subscribers connected finish talking. When the two subscribers finish, each gives a signal which operates the clearing-out-signal drop (7), and the two plugs may then be removed from the jacks.

St. Louis-Chicago Wireless Transmission.

On September 14th, Electricity Day at the World's Fair, St. Louis, the formal opening of the De Forest long-distance wireless communication between the World's Fair grounds, St. Louis, and Chicago, was inaugurated. This is the longest overland distance yet covered and is rendered more remarkable from the fact that the Chicago station is on the North Shore, completely screened by the many miles of steel-framed structures in this city, lying between it and St. Louis. The Chicago station was originally erected by the Marconi company for working with Milwaukee.

W. J. Hammer and Prof. J. C. Kelsey, two of the jurors of award in the Department of Electricity, World's Fair, went to Chicago to witness the receipt of messages. Many members of the International Electrical Congress, then in session, were present at the World's Fair station on Art Hill. Among those present were F. B. Herzog, Prof. A. S. Langsdorf, Carl Hering and other jurors of the Department of Electricity. The jury had control of the demonstration for two hours, and sent a number of test and code messages to their fellows in Chicago. The preliminary message read: "Regards to Hammer and Kelsey by wireless."

Inasmuch as the Chicago station is not yet equipped with powerful transmitting apparatus, long-distance telephone communication was maintained between the two stations throughout the afternoon. The co-operation of this first message was instantly

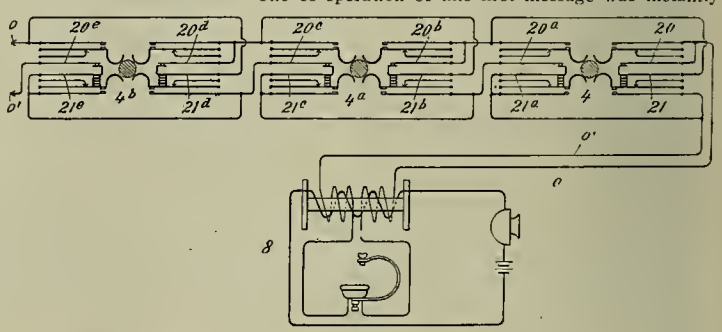


Fig. 3.

received by Dr. Herzog of the jury at St. Louis. The following sealed message was then opened and at once transmitted to Chicago: "The names of Faraday, Hertz, Branly, Popoff, Lodge, Muirhead, Marconi, De Forest, Edison, Tesla, Braun, Fessenden, Slaby, Arco, Rochefort and Shoemaker are among those names indissolubly connected with the principles and the application of wireless telegraphy." This message was sent twice, the second time with the word "indissolubly" omitted, and was received both times in Chicago exactly as transmitted. Several other code messages were sent and the jurors at Chicago listened to the signals themselves, which they state came in remarkably strong. Prof. Kelsey stated that if the station had been at Minneapolis, instead of Chicago, signals could have still been read.

At the conclusion of the jury's test, Prof. W. E. Goldsborough, at its request, made the following formal announcement, dated September 14th: "I have the honor to announce the jurors report every message sent from St. Louis has been received in Chicago with perfect accuracy. I heartily congratulate Dr. De Forest and his co-workers."

SENDING BLANK
AMERICAN DE FOREST WIRELESS TELEGRAPH COMPANY
AEROGRAM
ABRAHAM WHITE, President. LEE DE FOREST, Ph. D., V.-P. and Scientific Director.

FAC-SIMILE OF HEAD OF "WIRELESS" SENDING BLANK.

The De Forest company now advertises in the daily papers a regular service at regular Western Union rates. A facsimile, considerably reduced, of the company's sending blank, is reproduced herewith. This is the first time in history that such service in competition with land lines over any dis-

tance whatever has been offered the public by space telegraphy. It is especially appropriate that a formal opening of this importance should have occurred on Electricity Day before the presence of the International Electrical Congress.

While in Chicago during the formal opening, Mr. De Forest expressed his satisfaction at the success of the test and stated that a permanent long-distance station would be constructed on the South Side in Chicago, the present one being only for temporary use. It is the announced plan of the company soon to open up a New York-St. Louis service. A station in New York, it is said, is practically ready for service, and there are already relay stations at Cleveland, Buffalo and Port Huron, Mich.

Illumination in Honor of Knights Templars in San Francisco.

San Francisco has acquired the reputation of being the best illuminated city in the world on special occasions, and the display made during the week commencing September 5th, on the occasion of the

KNIGHTS TEMPLARS ILLUMINATION IN SAN FRANCISCO.—CITY HALL AT NIGHT.

twenty-ninth triennial conclave of the Knights Templars eclipsed by far all previous efforts in this line. To the visitors arriving in San Francisco at night time, during that week, the city must have seemed to be aflame, as the brilliant illumination cast such a fiery glow upon the sky. The Ferry Building, at the foot of Market Street, was lighted as never before, its tall spire rising from the bay like an obelisk, being outlined with green lights, while just under the huge clock glowed a Maltese cross, 24 feet square, done in the appropriate colors of the Knights.

Just beyond the Ferry Building, at the commencement of Market Street, the main artery of the city, the first of the street decorations appeared. Here, upon an arch crowning a colonnade of beautiful white pillars of Corinthian architecture, a fiery "Welcome" glowed. From this point to Tenth Street, a distance of two miles, was one continuous display of colonnades, columns, arches, buildings, stores and emblems, all alight with glowing incandescent bulbs. At intervals of every 60 feet a string of lamps was looped gracefully across the street at an even height and the effect was that of a huge arbor of light stretching forth apparently to the infinite.

At the juncture of Market, Kearney, Geary and Third Streets, the illumination reached its climax. From stout cables stretching from tall buildings on each side of Market Street, was suspended a huge bell-shaped mass with a rim almost 50 feet in diameter. The top of this design resembled a blazing drum, so closely were the lights placed, and upon its lower side it bore the sign of the order, a huge passion cross and crown and the motto "In Hoc Signo Vinces," all done in colored lights. From this drum, long strings of lights swept down to the rim, marking the outlines of the bell. The rim of the bell was constructed of structural steel and was held in shape by a spider work of iron rods. From it, at regular intervals, were suspended other emblems of the order all done in colors and richly illuminated.

Leaving the grand court of honor, the canopy of lights continued to the grand colonnade that extended between Fifth and Sixth Streets. The approaches to both sides of the colonnade were made between Corinthian columns twined with strings of frosted lights, while in the center of the colonnade was a three-column triumphal arch, from which was suspended the cross of the most eminent grand master, beautifully embossed with lights. From here the arbor of lights continued to Tenth Street. The City Hall, which has in past illuminations been such a feature, was more gorgeously decorated than ever, the main building being outlined in lights, while the dome was ablaze. At the Mechanics' Pavilion near by was one of the greatest indoor illuminations ever attempted, the lighting and decorating of which cost $40,000. At the corner of Post, Montgomery and Market Streets, the Masonic Temple was ablaze with light, showing to great advantage its Gothic beauty, and upon its walls hung all the emblems of the Templars. The building of the San Francisco Examiner was the most beautifully decorated of all the private buildings. Suspended from its walls were graceful festoons of light, while above the grand entrance was a huge horse and rider, representing a knight upon his charger, done in colored lights. At Union Square, the original plans for illumination were not fully carried out, but the display made was very creditable and effective. The square was surrounded by white masts with clusters of lights upon them, while connecting the masts were strings of lights and Japanese lanterns with incandescent lamps inside.

The construction work of this illumination was done by Hetty Bros. and was more substantial than the work of previous occasions. Porcelain weatherproof sockets were used throughout, as well as the best grade of weather-proof wire. Each festoon of lamps was fused separately, making a serious short-circuit impossible. The current was supplied by the San Francisco Gas and Electric Company's station in the Potrero, and was transmitted to Market Street at a pressure of 2,200 volts. At the colonnade two large transformers on poles reduced the current to the proper voltage. In a little side street near the court of honor eight large transformers were installed in a temporary house on the sidewalk and fed the lights in the great bell and immediate vicinity. The bell at Third and Market Streets contained over 8,000 lights and weighed nearly 10 tons. At the main colonnade, 7,500 lights were used. The lowest bid for the plant was $53,000, and the cost of the current for one week, $25,000. The decorations will be left as they are, with but few exceptions, until the latter part of the month, when the Odd Fellows will hold an encampment. San Francisco is peculiarly adapted to out-of-door illuminations, the favorable weather at this season of the year rendering temporary construction work possible, where in other cities its successful operation would be problematic. Then, too, there is an abundance of power available, and if necessity demanded it, the current of the Standard Company's Blue Lakes line could be utilized.

KNIGHTS TEMPLARS ILLUMINATION IN SAN FRANCISCO.—THE COLONNADES.

Street-railway Convention in St. Louis Next Month.

The twenty-third annual meeting of the American Street Railway Association will be held on October 12th and 13th, on the second floor of the Transportation Building, exposition grounds, St. Louis, Mo., and headquarters will be at the Southern Hotel. Papers will be presented on the following subjects: "Steam Turbines," "Reciprocating Engines," "Gas Engines," "Transfers," Their Uses and Abuses," "Signals."

The week of October 10th will be Street Railway Week, the Mechanical Association holding its meet-

KNIGHTS TEMPLARS ILLUMINATION IN SAN FRANCISCO.—THE BELL AT THIRD AND MARKET STREETS.

ings on October 10th and 11th, and the Accountants' Association, October 14th and 15th. Wednesday, October 12th, has been designated as Street Railway Day by the fair officials, and it is expected to have addresses by President D. R. Francis, Mayor Rolla Wells and Professor Goldsborough. The manufacturers' committee has prepared a fine programme of entertainment. It will have one of the finest bands in the country, which will give a concert at the hall before the opening of each session, and numerous concerts during the week. On the evening of the 13th the annual banquet of the association will be held.

Arrangements have been made by the Wabash railroad to run a special train from Chicago, leaving Dearborn station, Sunday night, October 9th, at 11:30 p. m. This train is due at the Wabash World's Fair station, located at main entrance to World's Fair grounds, at 7:45 Monday morning, October 10th, and at Union station 8:04 a. m. Delegates who may not be able to take the special train on Sunday night can leave Chicago daily during the week at 8:45 a. m., 11:03 a. m., 9:17 p. m. and 11:30 p. m.

WESTERN ELECTRICIAN

EVERY SATURDAY.

PUBLICATION OFFICES:
510 Marquette Building, • CHICAGO.
TELEPHONE, MAIN 1746.

Eastern Office, 193 Times Building, New York.
Telephone, 3806J Cortlandt.

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted. This paper is entered at the Chicago postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the **old address** as well as the new should be given.

CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—**the only general electrical paper published in the West**—thoroughly covers a territory *exclusively its own.* THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be furnished on application.

REMITTANCES.—All checks, drafts and other remittances should be made payable to the order of the publishers, the **Electrician Publishing Company,** and addressed to the offices of publication, Suite 510, Marquette Building (204 Dearborn Street), Chicago, Illinois, U. S. A.

CONTENTS OF THIS NUMBER.

International Electrical Congress Held in St. Louis September 12-17, 1904. Illustrated 235, 236, 237, 241, 242, 243, 244, 245, 246, 247, 248, 249
Portrait Group 235
Chamber of Delegates. Illustrated 236, 237, 241
Application of Electricity to Steam Railroads. (Wednesday's meeting, including President Arnold's annual address and speeches by Steinmetz, Lamme and others) 241, 242, 243, 244
Section A—General Theory 244, 245
Section B—General Applications 245
Section C—Electrochemistry 245
Section D—Electric Power Transmission 245
Section E—Electric Light and Distribution 245, 246, 247
Section F—Electric Transportation 247
Section G—Electric Communication 247, 248
Section H—Electrotherapeutics 248
Social Features of the Congress 248
Members in Attendance 248, 249
Congress Notes 249
A Secret Telephone Service. Illustrated 238
St. Louis-Chicago Wireless Transmission. Illustrated 238, 239
Illumination in Honor of Knights Templars at San Francisco. Illustrated 239
Street-railway Convention in St. Louis Next Month 239
Editorial 240
Electricity Day at the World's Fair 249
Meeting of the Illinois State Electric Association 249
Direct versus Alternating-current Distribution for Large Cities. (Papers by Stern and Dow before Section E of the International Electrical Congress. With discussion) 250, 251, 252
Chicago Street-railway Situation 252
Loaded Telephone Lines in Practice. By H. V. Hayes. Illustrated. (International Electrical Congress, Section G) 252, 253
Ohio Telephone Notes 253
Southeastern Telephone Developments 254
Michigan Telephone Matters 254
Extensions and Improvements 254
Standardization of Dynamo-electric Machinery and Apparatus. By Col. R. E. B. Crompton. With discussion. (International Electrical Congress) 254, 255
Toggle Bolt for Electrical Fixtures. Illustrated 255
Mid-year Meeting of the Northwestern Electrical Association 255
Production of Manganese Ores, Barytes and Lithium in the United States 255

DEPARTMENTS.

Correspondence 256, 257
Great Britain 256
New York 256
Ohio 256
Dominion of Canada 256, 257
Southeastern States 257
Michigan 257
Northwestern States 257
Pacific Slope 257
Personal 257
Electric Lighting 257, 258
Electric Railways 258
Power Transmission 258
Societies and Schools 258
Publications 258
Miscellaneous 258
Trade News 258, 259
Business 259
Illustrated Electrical Patent Record 259, 260

DATES AHEAD.

Illinois State Electrical Association (annual meeting), Decatur, Ill., October 5th and 6th.

Michigan Electric Association (annual meeting), October 11th.

American Street Railway Association (annual meeting), World's Fair grounds, St. Louis, October 12th and 13th.

Kansas Gas, Water and Electric Light Association (annual meeting), Leavenworth, Kan., October 18th and 19th.

Interstate Independent Telephone Association of America (annual convention), Chicago, December 13th, 14th and 15th.

VISITORS to the Louisiana Purchase Exposition at St. Louis who are interested in electricity or electrical literature are cordially invited to call at the booth of the Western Electrician, which is in Block 1 (Section 13) of the Palace of Electricity, just west of the main northern entrance to the building. Here will be found copies of the current issue of the paper, bound volumes of the Western Electrician from the first number, a careful selection of electrical books exhibited by the Electrician Publishing Company, and other objects of electrical interest. Chairs are provided for weary sight-seers, and an attendant will extend a hearty welcome to all readers or friends of the paper.

IN SPITE of the many discussions which have arisen as to the relative merits of alternating and direct current for distribution work in large cities, engineers and central-station men are still far from being a unit on the question. Advocates of direct-current distribution still maintain, as they always have, that a direct-current network is the only logical plan to adopt in the thickly populated districts of large cities; while those who uphold alternating current for this purpose seek to prove by a detailed analysis of the subject that their scheme is not only the best, but so far superior to the other as to warrant even the reconstruction of existing direct-current systems. Looked at from an impartial viewpoint, there are many and good arguments to be presented on both sides, and in the two papers on this general subject presented at the St. Louis International Electrical Congress, one by Dr. Gotthold Stern of Vienna and the other by Mr. Alex Dow of Detroit, we find both sides of the question upheld with vigor.

Brief abstracts of these two papers appear on other pages of this issue and should be of more than passing interest. Like most friends of the alternating-current system, Dr. Stern advances the argument of the abolition of sub-stations and sub-station apparatus necessary with direct-current systems, their places being taken in the alternating-current systems by the less expensive transformer, which requires no attendance. Another point in favor of the alternating-current system is the fact the polyphase motor possesses a smaller number of parts subject to wear and is cheaper to manufacture than the direct-current type, the author stating that "there is hardly a service which cannot be undertaken with polyphase motors more rationally and economically than with direct-current motors." Dr. Stern further believes, that, while alternating and direct current are generally considered to be of equal value for incandescent-lamp service, the former may be used at lower voltage than the latter, the common tendency of central stations employing direct current being to raise the voltage in order to utilize their network to the best advantage. Incandescent lamps of high voltage, say, 200 or 220 volts, consume more current, relatively, with the same life and the same efficiency than do the lower voltage lamps.

Mr. Dow, in the presentation of his views on the matter—which are the views of the typical large-city central-station manager in the United States—maintains that with the present enormous outlay of money in existing direct-current systems it would be suicidal to attempt a conversion, even if alternating current were the more satisfactory, which assumption he does not accept. Alternating-current construction, he says, would cost but little less; arc lamps would cost more. Moreover, the requirements of good regulation with an alternating-current distribution system of considerable area would make some sub-stations, at least, not only desirable, but necessary; perhaps not as many as with direct current, but still numerous enough to form a considerable item of cost.

THE INTERNATIONAL ELECTRICAL CONGRESS of 1904 will be remembered, no doubt, as the last having a Chamber of Delegates representing governments interested in legislation respecting electrical units. It took no action affecting units, but it recommended the formation of an international commission, to be quite independent of congresses and expositions, to which the whole subject shall be referred. This action is undoubtedly wise, and while the Chamber of Delegates of 1904 did nothing in the way of re-defining existing units or creating new ones, it did much in the direction of clearing the way for an effective adjustment of the whole subject in the future by an authoritative body. This conservative course antagonized no one. The English delegates were especially pleased, for they desire conservative action. The Americans, who favored the adoption of the Weston normal cadmium cell rather than the Clark standard cell as the unit for measurement of electromotive force, lose little by delay, as the Englishmen appear to admit the superiority of the Weston cell, but, with the deliberation characteristic of their nation, desire to make haste slowly. Germany was not, unfortunately, officially and specifically represented in the Chamber of Delegates. Mr. Litzredt of the Imperial Postoffice attended the sessions of the Chamber, but was officially a delegate only to the Congress at large. France and Italy accepted the postponement with no displeasure, as did the other nations represented. Austria, Belgium and Switzerland were not represented by delegates sitting in the Chamber. The action taken met the unanimous approval of the government delegates present. It is to be hoped that the various electrical manufacturing nations, Germany included, will act upon the recommendation, appointing commissioners within a reasonable time and agreeing upon a time and place of meeting.

It will be noticed that the report of the Chamber of Delegates is in two parts—one devoted to international electromagnetic units and the other to the international standardization of electrical apparatus and machinery. The former is the portion of the report to which reference has been made already. The part relating to machine standardization is quite distinct. It is recommended that the various electrotechnical societies appoint a commission—entirely separate, of course, from the government commission mentioned above—to consider the question of the standardization of the nomenclature and ratings of electrical apparatus and machinery. This is a good suggestion, and one which should be followed. The "representative commission" will have a difficult task ahead of it, but possibly much of the work can be accomplished by correspondence, as is suggested. To secure a standard rating of electrical apparatus and machinery in all the countries of the world that are interested is a great task, but certainly nothing will be accomplished if nothing is attempted.

A great mass of material was presented to the sectional meetings of the Congress—about 160 papers—and there was much informing discussion. On Wednesday, September 14th—Electricity Day at the St. Louis Exposition—there was a joint meeting of the American Institute of Electrical Engineers and the Institution of Electrical Engineers of Great Britain. This was actually, although not technically, a session of the Congress, and the discussion on the application of electricity, and particularly alternating current, to railroads, was important. This discussion, with President Arnold's address on the same subject, is given in this issue of the Western Electrician. Another interesting feature was the joint discussion of Tuesday, September 13th, in Section A, on electric and magnetic units, between representatives of the British and American societies. This was reported quite fully in this journal last week.

Mention cannot be made here of all the important papers. It may be said, however, that special attention was attracted to the papers of Arrhenius on the sun's radiation as affecting the earth's magnetism, Barnes on the mechanical equivalent of heat measured by electrical means, J. J. Thomson on the corpuscular theory, Kennelly on high-frequency telephone-circuit tests, E. L. Nichols on standards of light, Pender on moving charges, Crompton on standardization of machinery, Ryan on insulation, Kennelly on the Edison storage battery, Baum on long-distance transmission, Buck on aluminum conductors, De Fodor on rates of charging for current, Roderbourg on train lighting, Torchio on distributing systems, Jona on insulating materials, Steinmetz on the electric arc, Steinmetz on the theory of the single-phase motor, Arnold on electric traction, Sprague's history of the electric railway, Hayes on loaded telephone lines, Stone on wireless telegraphy, Barclay on high-speed telegraphs, and Hollos on simultaneous telegraphy and telephony. This is a brief, almost arbitrarily selected list, and yet it assumes quite formidable proportions. Some of the papers mentioned have been printed already in the Western Electrician. Others are given this week, while still others will appear in subsequent issues.

Many pleasing social features marked the Congress, which was attended by about 700 electrical men, a considerable proportion of whom were foreigners. All in all, the gathering may be fairly judged to have been a distinct success.

INTERNATIONAL ELECTRICAL CONGRESS.

[*Continued from page 237.*]

Hungary—Joseph Vater, Bela Gati.
Italy—Prof. Moise Ascoli, Prof. L. Lombardi, Ing. A. Maffezzini, Marquis Luigi Solari.
India—J. C. Shields, Esq.
Mexico—Señor Rafael P. Arizpe.
Spain—Miguel Otamenti, C. E.; Antonio Gonzalez, C. E.
United States—Prof. H. S. Carhart, Dr. A. E. Kennelly, Prof. H. J. Ryan, Prof. S. W. Stratton and Prof. Elihu Thomson

Application of Electricity to Steam Railroads (Wednesday's Meeting).

In the Western Electrician of last week an account of the opening of the Congress on Monday, September 12th, and brief reports of the section meetings of Monday and Tuesday, were given. This brings the proceedings down to Wednesday. On that day no meeting of the Congress proper was held, but instead there was a joint meeting of the American Institute of Electrical Engineers and the (British) Institution of Electrical Engineers, to which members of the Congress were invited. At this meeting, held in Festival Hall, World's Fair grounds, President Bion J. Arnold delivered his annual address, and there was a discussion of the application of electricity, particularly the alternating current, to steam railroads. President R. K. Gray of the British Institution and President Arnold of the American Institute presided jointly. In opening the meeting Mr. Arnold referred to a similar joint meeting held in Paris in 1900 and hoped that there would be others in the future. President Arnold's annual address, which was followed by a discussion —not of the address, but on the same general subject—was as follows:

Application of Electricity to Steam Railways

(Presidential Address of Bion J. Arnold to A. I. E. E.).

Eleven years ago this summer it was our privilege to meet under the auspices of a great exposition located upon the shores of Lake Michigan, organized not only to commemorate the four-hundredth anniversary of the discovery of this country, but also to direct attention to the advancement made in the various fields of the world's activities, and especially in those arts in which we, as workers, were most interested.

Today we meet under the auspices of another great exposition, brought into being to commemorate the one-hundredth anniversary of the peaceful acquirement by the government of the United States of a large portion of the territory now contained within its borders, to have our attention directed to the development of the various industries of this and other countries that have taken place during the intervening years.

For a few years preceding the former exposition engineers and others engaged in electrical pursuits had had their energies absorbed in attempting to show the owners of street railways that operation by electricity was cheaper and better than by means of the horse or the cable. We, at that time, had seen the horse practically disappear from street-railway service and the cable supplanted in some instances.

The more ambitious engineers were then advocating the use of electricity on elevated railways, and making figures to prove to the owners of such railways that electricity was cheaper in operation and more desirable for such conditions than steam locomotives, then universally used for such work.

At that exposition was placed in operation an elevated electric road, known as the Columbian Intramural Railway, which (although the Central London Underground, a road of light equipment, was started some time before and the Liverpool Overhead road soon after) was the first practical commercial application on a large scale of electricity for the propulsion of heavy railway trains. The success of these roads gave the electric-railway industry an impetus which has since resulted in the abandonment of steam and the adoption of electricity on every elevated railway now in operation and practically all of the underground roads, thus effectually proving the soundness of the theories of those engineers who pinned their faith to the correctness of the conclusions which their figures showed, and who staked their reputations upon the future to prove them true.

The interval between the expositions has also been one of great activity and development in the field of interurban railways, which has brought into being the extensive use of the alternating-current, rotary-converter sub-station system of operating direct-current roads, resulting in the interlinking of thousands of cities with one another and with intervening points, thus not only affording a new field for the investment of capital, but bringing to most of the inhabitants of the territory through which these roads pass greater facilities for the prosecution of business and the widening of their social life.

With the introduction of the suburban railway came an increased volume of passenger travel, induced by the increased facilities, which may well be noted by the managers of great steam-railway properties as an example of what may be expected in increased revenue when frequent and pleasant service is available to the public.

The energies of those engaged in electrical industries have thus far been absorbed in fields which now seem to have been naturally theirs, and their success has been such that they now aspire to enter the field occupied by the steam locomotive as a legitimate field of conquest.

The question now is whether this field is one in which the advantages of electricity will be sufficient to overcome the obstacles which seem almost unsurmountable, and enable it to win, as it has in the cases cited. Those who have given the subject little thought, or who are unable to analyze it carefully, on account of the lack of the technical knowledge necessary to appreciate the difficulties to be overcome, are most apt to predict the early supremacy of the electrically driven train over the steam locomotives. That the fields referred to have been apparently formidable yet quickly overcome is not necessarily proof, or even good evidence, that the legitimate field of the steam locomotive can be entered and successfully achieved.

Those most familiar with the subject are now prepared to admit that our great steam-railway terminals, where many switching locomotives are shunting back and forth continuously, and those portions of the steam roads entering our great cities, where suburban trains are numerous, frequent, and comparatively light, can be more economically operated by electricity than by steam. This is evident to most of those engaged in the work, for the reason that it simply means duplicating, on a large scale, the systems which have proven successful in our street railways, operating, as they do, numerous units running at frequent intervals.

Proof that this field is recognized as a legitimate one for electricity is furnished in the examples of steam-railway terminals that are now being equipped electrically, such as the lines of the New York Central and Pennsylvania Railroad Companies in the vicinity of New York, involving an expenditure of about $70,000,000, where not only suburban service will be operated electrically, but where, in the case of the New York Central, the main-line trains will be brought into the city from points 30 to 40 miles distant.

While these are great examples of electrical operation on steam railroads, and heroic instances of faith on the part of the railway managers in the ability of electricity to meet successfully the conditions of steam-railroad work, where the trains are sufficiently frequent, they are by no means conclusive evidence that electrically propelled trains can be made successfully to meet the conditions of trunk-line passenger and freight service, the field now so successfully held by the steam locomotive.

The best conditions for electrical success are a great number of units moving at a practically uniform schedule, at equal intervals, within a limited distance. The legitimate field of the steam locomotive is now one in which there are few but heavy units moving at uneven speeds over long distances at unequal intervals and at high maximum speeds.

The amount of energy transmitted to any great distance and used by electric cars that have been put in use until recently has been small when compared with the amount of energy that it takes to propel a steam-railroad train of 500 to 600 tons weight at the speeds ordinarily made by such trains.

It may be taken as axiomatic that, when investment is taken into consideration, power cannot be produced in a steam central station, under conditions that exist today, and transmitted any great distance to a single electrically propelled train, requiring from 1,000 to 2,000 horsepower to keep it in motion, as cheaply as a steam locomotive, coupled directly in front of the train, will produce the power necessary for its propulsion. Therefore, there must be other reasons than the expected economy in power production to warrant the adoption of electricity on a trunk-line railway, unless it can be shown that the trains are frequent enough to make the saving in the cost of producing power greater than the increased fixed charges made necessary by the increased investment due to the adoption of electricity.

There are undoubtedly in existence today conditions where waterpower in abundance is available along the right-of-way of existing roads, in which the substitution of electricity for steam could be made a paying one, with apparatus now available, even on roads having a comparatively infrequent service, but these are special cases and only tend to prove the correctness of the position, for in these special cases the cost of power would be but little over half the present cost of producing it by means of a central steam-driven station.

The ideal conditions for any trunk-line railroad having a traffic heavy enough to warrant the investment in a sufficient number of tracks properly to handle this traffic in such a manner as to get the most efficient service out of its rolling stock, would be to have four or more tracks between terminal points, upon which, in pairs, could be run the different classes of service at uniform rates of speed. Thus, if six tracks were used, the through-line passenger and express service would be run on one pair of tracks; the local passenger, local express and local freight service upon another pair of tracks, while the through-freight service would be run upon a third pair of tracks, and all the trains upon any pair of tracks would run at the same average speed and stop practically at the same places.

If these conditions could prevail and the traffic were sufficient to warrant this investment in tracks, such a service could be operated more economically and more satisfactorily electrically than by steam.

The difficulty is that few roads in existence have sufficient traffic to warrant such an investment in permanent way, and the result is that all of their traffic must be handled over one or two tracks, thus necessitating trains of all weight and all speeds running upon the same rails. This results in a tendency to bunch the cars into as few trains as practicable, in order not only to reduce the cost of train service to a minimum, but to give the fast-running trains greater headway to allow them to safely make their time. Such an arrangement of trains necessitates the concentration of large amounts of power in single units, which is leading away from the ideal conditions for the application of electricity to the propulsion of trains, and it is this element, combined with the fact that the traffic on most roads is not great enough to warrant the investment necessary in electrical machinery to produce and transmit the power to the distances necessary to keep a few heavy trains in motion, that makes the trunk-line railway problem so difficult, as it is more economical to propel these heavy trains by steam-driven locomotives, which are practically portable power houses.

It being admitted that electricity becomes most economical when a sufficient number of trains are available, and that the steam locomotive is most economical when the trains have become few and heavy, the problem then resolves itself into one of the density of traffic, and the question then is: Where is the dividing line?

It was my intention to attempt such an analysis of this subject as to be able to formulate some general law which could be readily applied to any given case, and thus enable one to decide when electrical operation would be more economical than steam in any concrete case. After carefully analyzing the subject, I have become convinced that no general law or formula can be laid down which will apply to all cases, for the reason that the elements entering into different cases vary so greatly that any formula would contain too many variables, dependent upon local conditions, to admit of a general application. I shall, therefore, only attempt to point out a way in which the dividing line between steam and electricity can be determined after the elements of each case are known.

It will readily be seen that with steam-locomotive operation the fixed charges, cost of fuel and engine labor increase almost directly proportional as the train-miles increase, for in this case an additional locomotive means simply a given amount of increased investment, a given amount of increased fuel and labor, and thus total investment is least when the number of locomotives is small.

On the other hand, with electricity it is necessary to invest at once a large amount of capital in the power houses and transmission systems, which amount must be great enough to provide for handling the maximum number of trains required upon the line, and unless this number of trains is great enough so that the economy effected in the different method of producing and applying the power is sufficient to offset the increased fixed charges, due to the additional invested capital, it will not pay to equip and operate electrically.

Any problem, therefore, must be analyzed for the relative cost in operation. In case this does not show a saving the advisability of equipping electrically will depend entirely upon the probable increased traffic to be derived from the adoption and operation of electrically propelled trains.

That electricity will be generally used on our main railway terminals and ultimately on our main through lines for passenger and freight service I am convinced, but I do not anticipate that it will always be adopted on the grounds of economy in operation: neither do I anticipate that it will come rapidly or through the voluntary acts of the owners of steam railroads except in special instances.

At first the terminals will be equipped for special reasons, due either to voluntary act on the part of the terminal companies to effect economy in operation or to public pressure brought to bear upon the owners through an increased demand on the part of the public for better service on the grounds that the use of the steam locomotive is objectionable in our great cities.

Those roads which run through populous countries will either build new roads or acquire for their own protection those electric railroads already built and operating in competition with them, and utilize them as feeders to their through-line steam trains. Thus the steam-railroad companies will gradually become interested in electric railways and eventually become practically the real owners of them. With these roads operating as feeders to the main-line system and with the terminals thus equipped and the public educated to the advantages of riding in electrically equipped cars the next step will logically be the electrical equipment of the trunk lines between the cities already having electrical terminals.

Thus some favorably located trunk line having a sufficient density of population will feel warranted in equipping electrically, and when this is once done the other roads running between the same competing points must sooner or later follow in order to hold their passenger traffic. This may result in temporarily relegating some roads to freight service so long as they operate exclusively by steam, but with the increased demand on the part of the public for better and cleaner service will come a corresponding

increase in passenger revenue to the roads equipped for handling it until one road after another finds it advantageous to furnish an electric passenger service.

With the terminals and main lines equipped electrically and the desire on the part of the public for more prompt and effective freight service resembling that which is given by the steam roads in England and on the Continent, due to the great density of population, there will be developed a great high-class freight service conducted in light, swiftly moving electric trains which can be quickly divided and distributed over the surface tracks of our smaller cities or through underground systems similar to that which is now being built in Chicago. Such a system would soon prove indispensable to the public and a source of great profit to the roads as it is now getting to be to many suburban railways.

This class of freight service would soon prove so large a part of the freight traffic of a road that the operation of the through-freight traffic by steam locomotives, though at present cheaper, would in time, as the cost of coal increases, grow less, until those roads operating an electric-passenger service would ultimately use electricity exclusively.

It has not seemed advisable to me in an address of this character to attempt to furnish detailed figures to support my theories, for the subject is of such general interest that many able men are presenting papers upon it at the International Electrical Congress now in session here, in which papers will be found information of much value to those interested, and from which I believe the correctness of some of my assumptions can be proved.

The principal problem before the electric-railway engineer today is how to make the most effective use of the high-pressure transmission and high-tension working conductor and maintain safety of operation. Experiments conducted during the last year by engineers in this country and abroad have made this problem simpler than it seemed before, and today we seem reasonably certain of the solution.

Until recently the cost of electrically equipping a trunk line under the standard direct-current, rotary-converter system has been such as to practically prohibit its adoption, but recent developments in the single-phase alternating-current motor field have made it possible to eliminate a large part of the investment heretofore necessary, and the prospects for the application of electricity to long-distance running are better than ever before.

When it is recalled that the rotary converter, which was the means of reducing the cost of long-distance roads, was introduced in 1898, and that within six years from the time of its adoption through the development of the single-phase, it has been practically rendered obsolete for heavy railroad work, it will be seen that the dividing line between the steam locomotive and the electrically propelled train has moved several points in favor of the latter, due to the reduction which can now be made in first cost and the saving in operating expenses.

With the single-phase motor and the steam turbine a reality and the transmission problem almost solved, and with the rapid development of the internal-combustive engines now taking place, are we, as engineers, not warranted in believing that we can so combine them into a system which will ultimately supplant the steam locomotive in trunk-line, passenger and freight service?

I do not anticipate that all roads will soon adopt electricity, for the steam locomotive will hold its field in this country for many years to come, but I do expect, judging somewhat from "positive knowledge," a remarkable development soon to begin in the electrical equipment of favorably located steam roads.

From Richmond, where the first commercial electric road was built, to the present is but 17 years, yet within that time the horse has been relegated to the past as a serious factor in transportation, the cable has served its usefulness and awaits its end, the suburban railway has been developed and is now rapidly encroaching upon the field of the steam railway. With the terminals of the two greatest roads in the United States now being equipped electrically and with an investment of something more than $4,000,000,000 in electrical industries made within a quarter of a century, we have reason to feel satisfied with the past. With several of the leading roads in this country, of England, of Sweden, of Switzerland, of Italy and Australia equipping branch lines and seriously considering changing large portions of their present systems from steam to electricity, we, as personal factors in this great industrial advancement, have every reason to be hopeful for the future.

President Gray: I do not think that anyone could even have wished to criticize in any way the address which has been so ably given by our president, because if any man, either on this side or on the other side of the Atlantic is pre-eminent in connection with the subject he has treated I think it is President Arnold. His name is exceedingly well known to us on the other side, and I think I am not giving away any secret in telling you that the evidence of his work which he has been tendering to us has received a very warm reception there and the evidence is considered to be the best that can be obtained in relation to the matters with which it deals. I therefore wish, in the name of the Institution of Electrical Engineers of Great Britain, to tender to my colleague, President Arnold, our very sincere thanks for his exceedingly able address; and with your permission I will ask the senior past president of the Institution of Electrical Engineers of Great Britain to second the motion—Colonel Crompton.

Colonel Crompton: It is with the most heartfelt pleasure that I rise to second the motion of President Gray, that the thanks of the American Institute of Electrical Engineers as well as our own institution of England be given to President Arnold for his address, which I personally feel is worthy of this great occasion—the meeting of the two institutions. (This motion was carried with much applause.)

President Arnold: I assure you, gentlemen, that your expression of approval is very much appreciated indeed. We have for our discussion this morning a subject similar to that which I have treated in my address; in fact, the address was written as a sort of introduction to the discussion on different methods and systems of using the alternating current in electric-railway motors. This subject has received the attention of engineers interested in electric railways for the last three or four years. I have the pleasure of introducing Dr. C. P. Steinmetz, past-president of the American Institute of Electrical Engineers.

Steinmetz on Alternating-current Railway Motors. (Abstract.)

The problem which we have before us—the problem of the direct application of alternating currents to electric railways—is not a new one, but it has become of primary importance and interest in the last few years. The early pioneers in electric railroading, 10 or 15 years ago, started the development of the alternating-current railway motor, and prominently among them I may mention Mr. Eickemeyer and Mr. Vandepoele, who built alternating motors for railway purposes and started the investigation into this field. However, very little progress has been made in this field for many years for a number of reasons, one being that in those early days the frequencies which were customary were 125 to 130 cycles, far higher than we are familiar with now, and the difficulties of the problem were thereby increased so formidably that advance was necessarily very slow. In addition, the very rapid development of the direct-current railway motor fully occupied the attention of all electrical engineers, and therefore the less urgent field of the alternating-current motor was necessarily somewhat sidetracked. Furthermore, the alternating-current polyphase induction motor came into the foreground, showed its superiority over other types of motors for stationary work and impressed the engineers to such an extent that for a long time it overshadowed the work done by the early investigators on the variable-speed alternating-current motor—that is on motors with series characteristic. Attempts then were made to introduce this very successful polyphase induction motor to electric-railway work, attempts which have not been successful to any great extent. In the meantime in the United States the rotary converter was developed and became a standard piece of apparatus familiar to everybody—standard as much as the direct-current generator and the alternating-current generator, and experience with such rotary converters showed that, for electric-railway work, for the violently refluctuating loads on the railway system, the rotary converter is superior even to the direct-current generator. Now, however, in the last year or two, with the still further development of the electric railroad, we have approached and in many instances reached the limits of applicability of this rotary converter.

Personally I do not believe that the alternating-current motor will make very serious inroads in the field now occupied by the direct-current railway motor. I do not believe that the direct-current railway system will be changed to any extent into the alternating-current railway system; but what I expect of the alternating-current railway motor is that it will find a field of its own, that it will develop a field; just as when the alternating-current method of distribution arrived in this country it did not displace the direct-current method of distribution or occupy the centers of our large cities, but it found a field of its own, a field which has gradually developed to be possibly superior in importance to the field occupied by the direct current.

Hence, to conclude these remarks, what I expect of the alternating-current railway motor is that it will find and develop a field of its own, that field which the direct-current railway motor cannot reach—interurban service, long-distance service, secondary railway service.

The polyphase induction motor is essentially a constant-speed motor, with shunt-motor characteristics, that is, it can efficiently operate over a certain range of speed only, cannot exceed the synchronous speed, and when operating below this speed it operates less efficiently; that is, it merely wastes that part of the power which it could give at higher speed when operating at lower speed. The direct-current series motor gives a characteristic like all similar motors, that is to say, that the torque developed by the motor decreases with increase of speed and inversely with increasing load the speed of the motor will decrease. The maximum torque of such a motor is in starting. All commutator motors, alternating and direct, more or less differ from each other in the rate at which the torque varies with the speed.

The alternating-current commutator motor has characteristics very closely similar to the direct-current railway motor, except that possibly the variation of torque with the speed is less. That means, with the same decrease of speed, the torque does not increase at the same rate as with the direct-current motor; but if we assume again the same free-running torque, and the torque of acceleration six times the free-running torque, the direct-current series motor will carry the acceleration torque up to half speed; the alternating-current motor not quite as high. You get under way, then, slightly slower, or to get the same average acceleration you have to start with a higher maximum acceleration. Now, this is an advantage in some cases in so far as you run for a long period of time over wide range of speed on the "motor curve;" that is, without controlling devices; that is, in the most efficient manner possible; and thereby recover or gain a considerable part of that power which the alternating-current motor inherently loses by its slightly lower efficiency, due to the alternating character of the magnetic field, and losses or magnetic hysteresis in the motor field of the alternating-current motor which do not exist in the direct-current motor. It is undoubtedly true that alternating-current motors can be designed to give identically the same characteristics as the direct-current series motor. However, at present the motor as it is before us reaches the "motor curve" at the same lower speed, therefore with the same maximum acceleration gives a lower average acceleration up to full speed, or with the same average acceleration requires slightly higher maximum acceleration.

In rapid-transit service we can well get along with a lesser torque of acceleration, but we must have the same surplus torque as on city-service work, rather a greater surplus torque, because, while in city service, where the distances are relatively short, we can count on maintaining fairly constant voltage in the supply system, we cannot to the same extent count on this interurban and suburban service where we are far away across the country. Hence, there the motor must have a greater surplus power, a greater surplus torque than in the city, so as to get a sufficient margin to start the train or the car under the most severe conditions on an upgrade or an overload, even if the voltage in the system is low, as it should not be, but very commonly is. Now, the motor which is most sensitive to voltage variation is the polyphase induction motor. The maximum torque which this motor can give necessarily cannot much exceed the acceleration torque without very viciously spoiling the characteristics of the motor; but the maximum torque varies with the square of that voltage and hence rapidly decreases if the voltage of the system is low. In the motors with series characteristics, however, like the single-phase commutator motor and the direct-current series motor, the maximum-voltage torque does not depend on the voltage; rather, while it may so depend—the theoretical maximum torque which you would get from the motor when standing still—the voltage is so far in excess of the torque of self-destruction in most cases that you cannot reach it, and do not reach it, and the effect of variation in the supply of voltage is a variation in the motor speed; that is, if the voltage is low in your system, the direct-current motor and the alternating-current motor will run at slower speeds, but still be able to give you the same torque. The polyphase induction motor will run at the same speed, though it will not be able to give you the same torque, and at a certain load will fall down and not start. That means that in designing a system of transmission and distribution for alternating-current commutator motors or direct-current motors we are able to design the system for the average drop of voltage in the same, while in designing it for induction-motor service we have to take into consideration the maximum drop of voltage in the system, which is very much greater than the average.

For interurban and suburban service we require an excess overload in torque, but do not require an acceleration up to the high speed. The alternating-current commutator motor appears to be pre-eminently satisfactory in this work and is suited to it, and there is where I believe it will come in.

In trunk-line passenger service the rate of acceleration at present as given by the steam locomotive is very much less than every-day practice in electric-railroad service, though here we do not need this excess acceleration torque sustained up to high speeds. Here again, then, we find a field where we may apply the alternating-current commutator motors and possibly the polyphase induction motors. If the question of voltage supply did not come in here and if, furthermore, the limit in speed of the induction motor was not so objectionable in passenger trunk service, where, more than anywhere else, we desire to get the full benefit of our track by running at the highest safe speeds wherever the track is level, the induction motor would be favorable.

In trunk-line freight service the same considerations come in, except there the speeds are relatively low, the train-weights enormous, and it is more than anywhere essential to have a very large surplus torque available to get under way or to hold the train on an up-grade. You must, therefore, in this class of service, just as in suburban and interurban service, have a motor running efficiently at light load, but being able to give very high torque, although it does not need to carry this torque up to high speeds. On the contrary, it is not desirable in freight service that the motor should sustain a high torque up to high speeds, because that would mean the consumption of very large power.

The steam locomotive is a unit of very high efficiency, but a very large unit. Therefore, for effi-

cient operation it requires the massing of traffic in heavy trains, and therefore results in less frequent trains, but large trains, and has practically rearranged and reorganized the whole system of locomotion by collecting it into a small number of very large units. That is not the most efficient manner of operating electrically propelled vehicles. Furthermore, you have to consider that every city and almost every village has a direct-current railway system. Now, the places where the electric-railway motor and electric propulsion have gained and are gaining on the steam locomotive is in the point of frequency of headway and terminal stations. The electric railway picks up its passengers anywhere in the city and deposits them anywhere in the city, and it does not require them to consult time tables; on the other hand, the steam locomotive requires you to go to a depot and consult a time table. As soon as the electric railroad gives up this advantage which I have just mentioned I believe one of the main advantages of the electric railroad over the steam railroad will be lost, and in electrifying the steam railroad this is the thing which has to be kept in view. This means that whatever type of motor may be adopted in interurban or suburban service, or long-distance service, it must be able to carry the passengers through the cities over existing railways.

The existing railways are direct-current railways, and I believe will remain so. That means that the long-distance motors, at least the suburban and interurban motor, must be able to run over the direct-current system. Hence, there must be a direct-current motor, or a type of alternating-current motor equally applicable and capable of operation on the 500-volt direct-current system.

The enormous investment in electric-railway systems existing at present has all gone in on the large systems, on 25-cycle polyphase. That means that we shall have to continue to operate at 25 cycles. It may be preferable, possibly, to run at lower frequencies, or it may be preferable to run at higher frequencies in this instance or that instance, but regardless of whether it is preferable or not, if it can be done on 25 cycles, it will have to be done on 25 cycles, and if it has to be done on other frequencies it will be a very severe handicap to the new system. I am glad to say that there is no doubt that 25 cycles is the frequency best suited to the alternating-current single-phase railway motor.

Prof. John Perry's Remarks.

Everything seems to depend, to a very great extent, as to what is to occur in connection with the electrification of steam railroads in the next 10 years on the success of the single-phase alternating-current motor. I had heard a great deal about it before leaving the other side, and it is one of the things that I promised myself to learn something about during my visit here. I have not yet been able to do much in the way of getting accurate knowledge on the subject. I have been on a tramcar at Schenectady, the motor of which, I was informed, was driven by direct current and the car ran well; and then I would get on another car, and I was told that the motor was driven by alternating current and it seemed to run just as well, so that I was not able to acquire any knowledge. I had no means of experimenting or ascertaining what the efficiency of the various arrangements were. Some 10 or 12 years ago I was tremendously interested in the single-phase alternating-current motor, perhaps for a selfish interest, as I had invented a system of traction which required the use of that system. I suppose we are all tremendously interested in this thing and are all anxious to learn what we can about the alternating-current motor. I can only say that I should like to hear the discussion of this subject proceed further before I shall feel able to take any part in it.

B. G. Lamme's Address. (Abstract.)

The company which I represent took up this [polyphase railway] question in an active way about 1895, and built two motors of 75 horsepower for traction work. These motors were equipped with collector rings and rheostatic control, and tests were made in regard to performance, both rheostatic control and with the now well-known tandem control, in which the secondary-wound motor is connected to the primary of the other for half-speed conditions. Even under this condition it was found that the motor would not compare favorably with the direct-current motor, or with the direct-current motor and the rotary-converter system, and this work was abandoned. It was recognized that the motor did not possess the proper series characteristics which the development had shown as so necessary for railway work.

In 1892 the question of the use of the commutator type of motor for railway work was taken up. Two motors were designed and built, of nominally 10 horsepower. These were built for 2,000 alternations per minute, 16⅔ cycles per second. They were put on a car and were operated for a while, but the system was not a success. In the first place the voltage used was rather low, 400 volts, as compared with 550 in the direct-current motor. As it was considered that 550 volts in the direct-current motor was as high as we were allowed to go; we thought that 400 volts alternating would be the limit. The motors were put on a track with iron rails, practically no bonding. The track drops were excessive and the voltage fluctuations very great. The generator used was entirely too small for this work, and it was not adapted to handle the inductive loads which were found with alternating motors. We ran a series of tests and finally decided that the motor could not compete with the direct-current system, as it was not laid out for suburban work, but for city work. It was also considered at the time that such a type of motor would probably furnish the solution of the heavy-railroad problem, but there was no such heavy-railroad problem at that time, so that the work was dropped for a while; but in 1897 the question of the use of the commutator type of motor was again taken up on a somewhat larger scale. Motors of 50 horsepower were built for variable-speed work and given a long series of tests. Then after a lot of experience had been obtained the work was gradually carried to the larger sizes.

In 1900 and 1901, when the question of the polyphase traction in Europe was so extensively advertised, it became evident that people were looking around for an alternating-current system. At that time it was decided that it would be well to go into the large motors of the commutator type, and two motors of 100 horsepower were designed and built. The frequency adopted was 2,000 alternations per minute, or 16⅔ cycles per second. That was primarily adopted on account of some steam-engine conditions. It was recognized that an even frequency of 16 or 18 would have been practically as good.

In the earlier work, with the 10-horsepower motors at the low frequency, it was recognized that it would be absurd to put such a system on the market, as even 25 cycles had not been adopted at the time. The frequencies in common use were 50 or 60 and a drop to 16 cycles was considered primitive. In the later work, as 25 cycles had come into general use, and 15 or 20 cycles had been talked about and proposed by certain companies, it was considered that frequencies like that would be the most suitable for railway work and should be adopted. The motors were built for this frequency. The results were so satisfactory with these large motors that a contract was taken for a rather large road and the apparatus prepared. Knowing that news of this would soon be abroad it was decided that the matter should be brought before the American Institute of Electrical Engineers, and a paper was presented on September 26th, two years ago, which I believe was the first announcement of the application of the single-phase alternating current to railway motors. There was considerable discussion—but mostly criticism—at that time; and it was considered that the weak point of the whole thing was the commutation. I believe at the present time that is not considered as a serious point.

Previous to building the 100-horsepower motors we had made a long series of tests. We had run 40-horsepower motors at practically a full load on a 60-cycle system for nine months, day and night, and had gotten some experience with the commutator. At the end of the nine months the commutator was in practically as good condition as in the beginning, showing that the commutator on such machines could be made to have a long life. The nine months of operation under the condition of steady service probably equaled two or three years of traction service; however, we were satisfied several years ago that there was no difficulty on that point. The conditions on the 60-cycle machines were much worse than on the lower frequency, but the commutator stood up so well that we decided definitely that that part of the trouble was out of the way.

The reasons which led to the adoption of the single-phase motor was stated in that paper; the principal reasons being that but one trolley wire would be required and that the motors had the series characteristics. It was considered that no motor, except a motor of the commutator type, would give suitable characteristics for this service, and it was stated that there were several types of motors having commutators which had the proper characteristics. They all may be classed as series motors, but some of these motors are combined with transformers and may be considered as transformer-series motors, or, as they are called by another name, repulsion motors, and others are pure series motors. The pure series motor is one which can operate on direct current as well as alternating current. The repulsion motor can be modified to do so, but as ordinarily arranged is not as well adapted as the other type. This is one of the reasons which led us toward the adoption of the pure series—the fact that the motor was primarily a direct-current motor of a first-class design. It was recognized in the first undertaking of this system that the motor would probably be required to operate on direct current at times. As the theory and experience indicated that such motors would probably be wound for 200 or 250 volts, it was recognized that the motors would probably be operated in series for direct current, and either in series or in parallel for alternating current, depending on the arrangement. The arrangement for the operation of direct current was considered rather complicated, due to the fact that it is necessary to switch from one system to the other in passing from the alternating to the direct current. We did not consider that the electrical public would consent to such a combination, but since that time we have found that it does not object to the increased complication.

In the heavy-railroad problem it has been considered that the direct-current motor is not entirely suitable, as usually but two speeds can be obtained, and four speeds can be obtained with four motors by increasing the commutation. With the alternating-current motor of the commutator type for locomotive work any speed can be obtained, because any voltage can be applied to the terminals of the motor. As soon as the alternating current is fed to the motors we at once have a method of transformation. As on locomotives for large current the difficulty of handling the current is considered a very prominent one, it was considered that some form of potential control would probably be the best one, and as the system is a compromise and adaptation to existing conditions, it was decided, as far as possible, to avoid complication in the application of the system, so that the first equipments advocated used potential control entirely, and many of the later equipments also used the same. One form of potential control permissible is what is called the induction regulator. This regulator varies the voltage without opening the circuit. The relation of the primary and secondary windings with respect to each other is varied. This gives a means of varying the voltage to the motors and varying the speed of very heavy motors with practically no tendency to sparking. The only time the circuit is opened is at the end of the operation cutting it off. Therefore it was considered as a solution of the general-railway problem.

The single-phase motor is the one thing presented at the present time as the solution of the problem. It has all the advantages of the direct-current motor in the variable speeds; it has the advantage of the alternating-current system in the use of any voltage desired, and the variable voltage applied to the motor, and thus adjustable speed, and it also has the advantage of control that can be obtained without sparking.

In the adaptation of the alternating-current motor to direct-current service it is found that two motors can primarily be connected in series for 500 volts; also in operating on alternating current the motors can be connected in series, if desired, or in parallel.

In the Baltimore-Annapolis project, a description of which was given in the American Institute paper read two years ago, we had balancing transformers connected across the two motors in series. The balancing transformer was across the outside terminals and a tap from the middle of the transformer was connected between the two motors. In this way equal voltage was supplied to the two motors in series and the danger of a runaway was thus avoided. It is not yet determined how important this is, but I believe that something like this would be found advisable for the operation of motors in series, especially where we have high-power motors on medium-weight cars for high-speed service.

In the application of the motor to alternating and direct current we have found some special conditions which affect the arrangement of control. Take, for instance, a large road being installed between Cincinnati and Indianapolis, where it is intended to run on direct current at the terminals and alternating current on the rest of the line. The speed on the alternating-current part of the line is so great, the normal speed, that it would be prohibited in the towns; and it was found to get the speed down to the desired rate in the city service on the direct-current portion of the road it is necessary to connect the four motors permanently in series, and any series parallel arrangement can be used. Pure rheostatic control is necessary in the city. On the suburban part, as series parallel could not be used, a switch was used in order to throw the current from direct to alternating, simply throwing the four motors in parallel, and taps are used on the lower transformers to get the number of voltages on the alternating. In that way we get the effect of series-parallel control, and even better by having more than two steps. On a long line it is possibly not of advantage to have so many steps, but as a rule the more steps you get the easier it is on the controlling apparatus and the more running speed you have.

I will say something of the application of the system to locomotives. On the steam roads, where the systems are not tied up, it is probable that in time the railroads will adopt their own voltages, possibly their own frequency. This may not be 25 cycles, but may be somewhat lower. I believe this may be a controlling factor in the change from direct to alternating current in city service. If the large railroads, with their large power plants, adopt alternating-current motors throughout, then the towns lying along the roads will in time probably adopt the same power system. The large cities will probably adopt the same system. At the present time the railroads, as far as they have gone, have adopted direct current because the cities through which they pass or the terminals they are in are using direct current. When the railroads take the big end of the project, then the cities will probably adopt what the railroads are using. That is when the direct current will be superseded by the alternating in the cities.

Dr. C. V. Drysdale's Speech. (Abstract.)

At this late hour in the discussion I do not propose to take up your time very much, especially as I am afraid that very few of us over in England have had much experience on this important subject. I should like, in the first place, to take this opportunity of congratulating you on this side of the water on having carried this important problem to such an extremely successful issue as has been recently shown in Balston and in other places. I think this subject has been worked on in several places, yet to America belongs the honor of having constructed the first line of any considerable length working on the single-phase system. We must still further admire the way in which it has been done when we remember that the result has been achieved by getting over the great difficulties that stood in the way of

the series motor, and that in so doing it has been found practicable to use the same motive plants on direct and alternating-current lines.

There is one thing that does not seem always to be kept in view in traction matters in the starting of the cars, and that is the very simple matter that in the starting of the car you do not require power—you require force; if you wish to get anything into motion, what you require in the first instance is purely force, and until the body moves it does not require power at all. One of the great disadvantages which the steam engine has over any electrical system up to the present time is the fact that when you first turn the steam into the locomotive you get the pressure on the back of the cylinder and get the starting force without taking any power from the steam. If it were not for the other disadvantages of the locomotive there is no question that one point would give it a strong pull over anything we have electrical, because if we turn to the ordinary direct-current motor we find that we have to use half, or with one motor, the whole, of the full-load power merely to secure a starting torque. This has several objections. Not only is this uneconomical and wasteful of power, but it throws a sudden strain on the general plant, and furthermore has to be wasted in resistances, and these resistances sometimes attain a considerable magnitude. With alternating-current motors these matters are worse, as we have in addition low-power factors and consequently difficulties in regulation.

The time is too short to refer to many other systems, but I will mention one—that known as the Ward Leonard system—which at first sight appears to be an unworkable one. In the Ward Leonard system, as I understand it, the system is to use a single-phase motor coupled to a direct-current generator, which runs direct current on the locomotive or cars; and, of course, the indirectness of the method seems to put it at fault, but on the Continent that method has been developed with considerable hope of success; in fact, with considerable practical success, and it has this great advantage that by the use of this arrangement you can start, get your starting effort, with very small power taken from your station. In the other system—it is too well known for me to describe it here—you have your single-phase motor continuously running, and you can do the whole of the regulation of your speed, etc., by merely regulating the excitation of the generator. The result is that it is possible to get the full starting effort with only something like one-third or one-quarter of the full-load current on the motors. That is so important a matter, especially in view of the huge strains liable to be thrown on the plant in the large schemes which we are hoping to see realized in the future that I think we should give that method the consideration which it deserves, although it at first sight appears to be roundabout. In addition to that we have the magnificent system invented by your president, Mr. Arnold, and I hope we shall hear more of that in the future.

A Question of Priority.

President Arnold: I will correct one statement by Mr. Lamme which rather puts me on the defensive. I understood him to state that his announcement of the single-phase motor made in September, 1902, was the first announcement. I beg to state that in the month of June preceding I read a paper on a single-phase motor, which was built at that time and which I have since put in operation.

Mr. Arnold [a few minutes later]: It occurs to me that I may not have put my explanation in regard to Mr. Lamme's statement in just the way it should be put. I think what he meant was that his announcement was the first of a purely single-phase commutator-motor system. I think with this correction he will accept my statement. I think my work was first, but he got in with his announcement in September regarding the single-phase commutator motor.

Lieut. Sprague's Juvenile Analogy.

Frank J. Sprague: The alternating-current motor is like a somewhat brilliant boy, who, being exposed to various diseases, has contracted a number of them. He has had a moderate experience in mumps, the measles, and a touch of typhoid fever, and the various doctors—and there are some most able ones here and elsewhere—have administered, sometimes in homeopathic, but oftentimes in allopathic doses, large measures of quinine. Whether, as the child grows—and we are all hopeful of that child—and he is subjected to the various climatic conditions of commercial introduction and use, those undercurrents of disease common to all fevers will recur, or whether the child will outlive them and become strong and robust is a matter which must be left to your own belief.

Our worthy president is very hopeful, and so am I, that electricity will be used on trunk lines; but the reasons which will dictate the adoption of electricity on trunk lines—what are they? Will it be because economical service cannot be gotten by steam? No. Will it be because there cannot be obtained today an efficient service by steam? Again no. Will it be because of esthetic reasons? Distinctly not. The adoption of electricity on any trunk-line service will be determined by the hard and fast rule of financial necessity. It will not be because we engineers urge it. It will be because the men who raise the money and run the road and have to divide dividends find that is the only way to do it, and the reasons which will apply to one road are not those which will apply to another. It is my belief that some of the largest expenditures, and those most fruitful of return to those who own the steam railroads of the country today, will be in the purchase and control of the competing electric railways which, having in the past acquired franchises of undoubted value, have built up a business which they can hold and which will increase, and many a steam railway will be better off financially and bring bigger returns if it gathers in these franchises and systems and takes to its lines an advantage it will be difficult to duplicate in the future. I think I will not discuss the alternating and direct-current motor. I know there are one or two gentlemen back of me who feared that I would make some break on the subject, so I will close my remarks.

Elihu Thomson Gives Historical Data.

Many of you will recall, no doubt, that at one time the electrical profession might have been said to have been divided into two camps—the alternating-current camp and the direct-current camp. Those who have visited the power stations on the circular tour have noticed that the direct-current men have called in the alternating-current to help them out, and combine, therefore, the virtues of the alternating current with the virtues of the direct current.

I was connected in the early days, and am still connected, with an organization which had not many prejudices of one kind and another. In 1886 we put out our original alternating-current apparatus, and finding that the necessity might perhaps arise for motors on the system, it was at that time I undertook to get a motor for that system, a self-starting alternating-current motor, and the first motor of the repulsion type was made in 1886 and finished in the fall of that year. It was a little affair and was found not to operate very well on the higher cycles, but by connecting a machine which I was using for electric welding, giving 30 cycles, I found it operated very well and satisfied me as to the general features of the machine. The Paris Exposition of 1889 had a couple of examples of machines on a little different basis. It was a machine which was started as a series alternating-current motor, and as soon as it reached a certain speed the commutator was short-circuited and it became an induction motor.

I am a strong believer in the field being open for such work. I believe that not only will the direct-current motor maintain its place, but that certain lines of service which the direct-current motor cannot easily take will be taken by the alternating-current motor for railway service, without question, and the exhibition of a system which you will be able to see, of a system which adapts itself to the use of both currents, is certainly a very instructive one.

Section A.—General Theory.

In last week's issue of the Western Electrician the sessions of Section A of the Congress on Monday and Tuesday, September 12th and 13th, were reported, the former briefly and the latter with considerable fullness. On Wednesday there was no session, and brief accounts of the proceedings of Thursday and Friday are given herewith.

This section was graced on Thursday by the presence of that distinguished scientist, Dr. S. A. Arrhenius of Stockholm, who, as honorary chairman, presided. The paper of Prof. C. D. Child of Colgate University on "The Electric Arc" was the first presented. It related to the ionic theory of the arc and was discussed by Prof. Howard T. Barnes of McGill University, Montreal, the secretary of the section, and Mr. P. H. Thomas of New York city. The next paper was that of Dr. E. B. Rosa and Mr. F. W. Grover on "Absolute Measurement of Inductance." Dr. Rosa presented this paper with the aid of chart tables, and Dr. Drysdale of England opened the discussion.

In the absence of its well-known author, Prof. E. Rutherford of McGill University, who is perhaps equally well known, read the paper of J. J. Thomson, professor of experimental physics at Cambridge University, England, on "The Relation Between Mass and Weight for Radium." The following are the concluding paragraphs of this scholarly contribution:

"These results show that, at any rate to an approximation of one in some thousands, the ratio of mass to weight for radium has its normal value. Hence we conclude that if the view of the structure of the atom given at the beginning of the paper is true, either the ratio of mass to weight must remain constant, even when the mass, owing to the great velocity of the particles, is variable or, what seems a priori more probable, that the number of corpuscles which possess a velocity approaching that of the β rays is an exceedingly small fraction of the whole number of corpuscles.

"It should, however, be remembered that the effect of velocity on the mass of a corpuscle is influenced by the pressure of other corpuscles in its neighborhood. Thus, for example, if we have a number of corpuscles placed at equal intervals along the circumference of a circle, the corpuscles all rotating arund the center of the circle, the effect of velocity on the mass of each corpuscle will be less than the effect on the mass of an isolated corpuscle.

"If the corpuscles followed one another so closely around the circle that the electrical field was the same as that of a uniformly electrified ring, the mass of the corpuscles would be entirely unaffected by their velocity; for this to be the case, however, the distance between the neighboring corpuscles would have to be comparable with the diameter of a corpuscle."

Six papers that were printed and ready for distribution were read by title, as follows: "Radioactivity of Mineral Oils and Natural Gases," by Prof. J. C. McLennan of Toronto University; "The Electrical Conductivity of Gases," by Prof. Percival Lewis of the University of California; "Magnetic Effect of Moving Charges," by Dr. Harold Pender; "Electrostriction," by Prof. L. T. More of the University of Cincinnati; "Magnetostriction," by Prof. H. Nagaoka of the Imperial University of Tokio, Japan, and "Natural Radioactivity of the Atmosphere and the Earth," by J. Elster and H. Geitel.

On Friday Section A met in joint session with the American Physical Society. Prof. A. G. Webster of Worcester, Mass., president of that society, occupied the chair. The first paper on "The Earth's Magnetism" was read by the author, Dr. L. A. Bauer. Several interesting points were brought forth, among them the fact the earth was apparently losing its magnetic energy at the rate of 1.6 per cent. in 46 years; but that changes in direction and intensity might cause some effect in the measurement of the magnetic moment. The author also stated that during the last 50 years very little progress in the accuracy in the measurement of the earth's magnetism had been made. It is also evident that the distribution of magnetism over the terrestrial globe is somewhat related to the distribution of heat, since places of high temperature show a field of lower magnetic intensity than those of lower temperature. Dr. Glazebrook congratulated the author on his paper and said that he had great hopes for the early construction of magnetic laboratories in England. He also thinks that the work on the antarctic expeditions will be of service in this field. Professor Steinmetz thought that the only way to obtain results in the measurement of terrestrial magnetism would be to remove the laboratories to such a place as could be made entirely safe from the disturbances caused by electric machinery and iron masses in the vicinity, and property should be acquired at an early date and in such a way as to guarantee magnetic isolation.

A great burst of applause greeted the distinguished author of the next paper, Dr. S. A. Arrhenius of Stockholm, honorary chairman of Section A, whose subject was "The Electric Charge of the Sun." Few men occupy a position such as Dr. Arrhenius does in the scientific world, and his paper was followed with the greatest interest. Dr. Arrhenius stated that the force of radiation is able to drive particles against the force of gravitation, and the exact size of an electron, or charged ion, which will just balance by radiation the force of gravity can be calculated. If the particles be large, then gravitation will hold it; if smaller, radiation will drive it away. These electrons, then, are driven away from the sun, and some of course will come within the path of the earth. There is a great difference of time between the outburst of a sunspot and the magnetic storm on the earth. Calculations made to show the time taken by the electrons to reach the earth show this to be about 45.9 hours. This agrees quite closely with the observed time of 45.5 hours between the outburst of a sunspot and the resulting terrestrial disturbance. The electrons leaving the sun are negatively charged and they are driven over a wide zone. The sun drains about one-tenth of the distance between the sun and the nearest star, Alpha Centauri. During years when sunspots are frequent the discharge of these electrons becomes somewhat larger than normal, but the average discharge is about one-tenth of the possible maximum. Dr. Arrhenius worked out the path of these electrons and showed that they followed a hyperbolic law. These electrons have their orbits, by which they are again returned to the sun; otherwise there would be a loss of electrons at the sun.

Dr. Bauer remarked that he regretted very much that the study of cosmical physics is not taken up to a very great extent in this country. He believed that we had radiations from the sun which do not reach us except in the arctic regions. Professor Rutherford complimented Dr. Arrhenius, and thought that his deductions were based upon theoretical assumptions which seemed logical, and that we get the effects of the sun's outer zone only. Prolonged applause followed the conclusion of Dr. Arrhenius' paper.

The next paper was that by Dr. Rutherford on "Radium." The author described the different forms of radium and what happened after the alpha, beta and gamma rays had been emitted. He also described methods of testing for the isolation of the various rays and showed by curves the constancy of the beta ray, while the alpha kept on increasing in intensity. The probable limit of activity is about 40 years, but measurements have not gone on long enough to determine this definitely.

Professor Webster then read his paper on "Recent Developments in Electrical Theory," which was of a mathematical nature and was not discussed. The final adjournment then followed.

Section B.—General Applications.

Monday's session of Section B and Tuesday's joint session of Sections B and F were briefly reported in the Western Electrician last week. On Thursday the first paper "Plunger Electromagnets," by Prof. S. P. Thompson of London, who was not present, was abstracted by Mr. Steinmetz in the absence of the author. No advance copies had been issued and discussion was therefore omitted. Prof. E. B. Rosa then presented a very interesting paper on "Wave-shape and Meter Indications." This paper was dis-

cussed in general by Dr. Drysdale, Professor Adams, Mr. Pratt and others. Mr. Rushmore asked if other loads than full load had been considered, to which Professor Rosa answered that full load only had been used so as not to introduce two variables. The most exact methods of measurement for determining the effect of wave-form were found necessary, as with the ordinary commercial methods no satisfactory results could be obtained.

Prof. H. J. Ryan of Cornell University then read his paper on "Some Elements in the Design of High-pressure Insulation," which dealt with the strains present; the permeability of insulation; the various insulating materials and the methods of testing. Comments were made by Professor Adams and E. K. Scott of London. The latter remarked that a movement in the direction of dispensing with many insulating parts, such as fibers, etc., was in progress and that the value of the work done by Professor Ryan should be fully recognized.

Charles Day's paper on "Electric Motors in Machine-shop Service" was next taken up. Mr. Day presented a clear outline of the requirements of a shop, the different systems of motor-driving, and gave a general commentary of the features of different systems and makes of apparatus. In his conclusions he stated that motor drive forms a distinctly different problem from that of standard motors and generators and must be carefully considered for each separate shop. No discussion followed and the sectional meeting adjourned until Friday morning.

Following the adjournment of section B, a joint meeting of Sections B and E was held. The subject was the discussion of Col. R. E. Crompton's paper on "Standardization of Dynamo-electric Machinery and Apparatus," read at Festival Hall on Wednesday. An abstract of this discussion follows an abstract of Colonel Crompton's paper, given elsewhere.

Friday's meeting of Section B was called to order by Professor Steinmetz. The chairman abstracted and commented upon a paper by F. J. Eichberg on "Single-phase Railway Motors," and Mr. Slichter gave abstracts of Mr. Blondel's paper on "Reaction in Alternators." Mr. Steinmetz resigned the chair to Mr. Rushmore, being called to Section A. Prof. C. A. Adams then read a paper on "Leakage Reactance of Induction Motors." He pointed out that the object was to determine how far fundamental principles could be applied to determine or calculate the leakage of alternating-current machines, applying the problem particularly to motors, and proceeded to describe various methods of making leakage tests.

Mr. Rushmore next read his paper on the "Regulation of Alternators," in which he gave a description of the methods commonly used for determining the regulation and a summary of many tests on machines of different types. A large number of curves of the tests and a complete reference of work previously done on the subject accompanied the paper. Professor Adams complimented Mr. Rushmore very highly on his paper and stated that the paper would be extremely valuable for reference.

Mr. Heyland's paper on "Compounded Self-exciting Alternators" was next taken up. Mr. Heyland's motors are well known in the electrical world, and in his paper the author described some of the details, not to modify the previous system but to introduce simplifications in the construction. Mr. Karapetoff, Professor Adams, Dr. Drysdale and Edmond Roth made some general comments on the paper.

The last paper was that by H. M. Hobart on "Design of Induction Motors," which, in the absence of the author, was abstracted by Professor Ryan. The object of Mr. Hobart's valuable paper was to work out designs fr a polyphase squirrel-cage-type induction motors, and it furnishes many formulæ and data as well as a large number of tables, giving sizes, ratings, etc., necessary for the design of alternating-current motors.

Professor Ryan moved that a vote of thanks be extended to the chairman and temporary chairman of Section B for the efficient performance of their duties, which was duly passed, and final adjournment took place.

Section C.—Electrochemistry.

Section C met at 10 a. m. on Thursday, Professor Carhart presiding. Six papers were read and a general discussion followed. The papers by Dr. A. E. Kennelly and S. E. Whiting on "Edison Storage Batteries," George A. Hulett and Professor Carhart on "Standard Cells," P. L. T. Héroult on "Electrometallurgy of Iron and Steel," and Prof. J. W. Richards on "Electrolytic Conduction" were read and commented upon by the authors. Dr. Richard Lorenz's paper on "Electrolysis of Fused Salts" and Prof. W. Ostwald's on "Electrolysis and Catalysis" were read by proxy.

Dr. Kennelly in his paper pointed out the general properties of the Edison cell and the fact that no attempts had been made to use it for general work, owing to its low efficiency, which is not much above 50 per cent. The programme of papers in Section C was concluded on Thursday.

A joint meeting of the American Electrochemical Society, the Faraday Society of England and the Bunsen Society of Germany was held in the room of Section C on Friday, Prof. H. S. Carhart presiding. On behalf of the American Electrochemical Society Professor Carhart extended a welcome and greeting to the Bunsen and Faraday societies, to which Dr. Hans Goldschmidt replied on behalf of the society he represented.

Four papers were read before the joint meeting and a general discussion took place. Dr. W. D. Bancroft read two papers, one on the "Electrolytic Separation of Nickel and Cobalt," and the other on the "Aluminum Rectifier." In connection with the second paper he pointed out that his observations had shown an efficiency of about 30 per cent. for this rectifier, which made it very undesirable for commercial work.

Dr. H. E. Patten's paper on "An Analytical Study of Aluminum as Deposited from Ethyl Bromide" was discussed at length by Dr. Bancroft, and W. Mc. Johnson's paper on "Industrial Electrochemistry" gave a complete resume of the applications and adaptations of electrochemistry in commercial life.

Adjournment then took place. Boston is to be the place of the next meeting of the American Electrochemical Society.

Section D.—Electric Power Transmission.

In Section D on Thursday Mr. Charles F. Scott, the chairman, and Dr. Louis Bell, the secretary, each presided part of the time, and each participated in the work of other sections, Mr. Scott in that of the joint meeting of Sections B and E, and Dr. Bell in Section E. The first paper was that of H. W. Fisher of Pittsburg on "Sparking Distances," and then followed the instructive paper of H. W. Buck of Niagara Falls on "The Use of Aluminum as an Electrical Conductor." The author reviewed the possibilities of aluminum in electrical work. He said the metal was not useful for interior wiring. Owing to its sag and the difficulty of soldering it, it is not adapted for telephone construction. In this class of work it is usual to place a number of wires close together, on poles, and here the sag of the aluminum is a disadvantage. However, aluminum wires carry the voice well. Aluminum is good for bus-bar work in stations and is suitable for railway feeders. However, it is most prominently useful for overhead high-voltage circuits. For this purpose it has distinct advantages. Mr. Buck described experiments undertaken by him at Niagara Falls to determine the wind pressure on wires. This determination is especially important for aluminum wires, owing to their greater area than copper for like conductivity. The speaker established the formula $P = 0.0025\ v^2$, where P is the wind pressure per square foot of area and v is the actual—not indicated—velocity of the wind. Sixty-five miles an hour may be taken as the maximum wind velocity to be encountered, tornadoes excepted. Tornadoes have a higher velocity, but it is commercially impracticable or perhaps impossible to build lines strong enough to withstand such storms, which are of course rare. The weight of aluminum wire is 47 per cent. that of copper wire of same resistance. When aluminum becomes low in price, Mr. Buck declared, it will probably become the principal metal for the conduction of electric current.

Three other papers were read before adjournment—F. O. Blackwell's on "Conductors for Long Spans," V. G. Converse's on "High-tension Insulators" and M. H. Gerry's on "Construction and Insulation of High-tension Transmission Lines." These papers were discussed together by Dr. F. A. C. Perrine of Pittsfield, Mass., Dr. Louis Bell of Boston, John S. Peck of Pittsburg, F. Carini of Italy, Thomas J. Creaghead of Cincinnati and others. The details of insulators and of polehead work were dwelt upon. Some very large insulators for high-tension work were mentioned. One is 36 inches in diameter and weighs 50 pounds. Dr. Bell referred to it as a "bathtub."

Insulator pins especially, and high-tension pole-line construction generally, formed the principal topic of discussion at the meeting of Section D on Friday. The paper of J. F. Kelly and A. C. Bunker on "Some Difficulties of High-tension Transmission and Methods of Mitigating Them" was read by Mr. Bunker. The writers advocated iron pins. Others, notably P. N. Nunn of the Telluride (Colo.) plant, defended the wooden pin. Mr. Nunn said his 40,000-volt plant has been in operation seven years. Wooden pins are used and none was ever burned except when an insulator broke or became coated with alkali dust. He said the insulator is the weakest point in the transmission plant. Others who spoke were C. W. Hutton of Sacramento, Cal., N. J. Neall of Pittsburg and Dr. Louis Bell of Boston. Methods of treating wooden pins were discussed at some length.

In introducing P. N. Nunn, who described the interesting plant of the Telluride Power Company, Chairman Charles F. Scott spoke highly of Mr. Nunn's work. The Telluride company has six power stations and nearly 1,000 miles of transmission lines in Colorado, Utah and Montana. Mr. Nunn gave a brief record of its work since 1890, when it began operations as a single-phase synchronous system, becoming the most extensive plant of the kind in existence. It was a commercial success, but disturbances due to starting motors were trying, and in 1896 the Tesla induction system was substituted. Pressures of from 30,000 to 60,000 volts are used. The present plant was described. Leakage losses are not serious except during storms, and not even then unless insulators are broken. Only one transformer has required repair other than change of oil. Long periods of uneventfully perfect operation have proved the success of power transmission. The pioneer days have passed and the new station is modern in every respect.

Mr. Bunker asked how large a wire, mechanically, could be used on the wooden pins, and Mr. Nunn said he wouldn't hesitate to use a No. 000 or No. 0000 copper wire.

Dr. F. A. C. Perrine thought it would perhaps be well to have the pole line all wood or all iron. The method of treating wooden poles and cross-arms is very important. Paraffin as an insulator is extremely unreliable in the air; it will absorb moisture almost as readily as a sponge. A 24-hour exposure of a paraffin-filled cable, with the end cut off, in the air of New York or Chicago would destroy the insulating value for a distance of 10 feet from the end. It is practically impossible thoroughly to impregnate a piece of hard wood with dead oil of coal tar or like substance. Sealing of the surface must be relied on. The best surface protection is from seven to 15 coats of varnish, but this will not last more than two or three years. It is doubtful, however, whether this method would be practicable on poles and cross-arms. A thick coating of asphaltum one-sixteenth of an inch has been used, but its use is attended with practical difficulties, although still worth considering. The impregnation of soft woods with dead oil of coal tar is practicable.

Mr. Nunn said that pins could be treated successfully with paraffin, but the process must be carried out with care and exactness. Mr. Humphrey asked if the tops of the poles were treated. Mr. Nunn answered that the poles were dried with special care and then treated with bitumen.

Mr. Nunn, at Mr. Scott's request, described the system of training young men established by the Telluride company. The young men employed by the company are given special opportunities to acquire knowledge and experience. In the new plant at Olmsted buildings have been erected for use in the development of this idea. The establishment is not a school but a place for research work. It is proposed to give the young men an opportunity to do some post-graduate work during the transition period which young college fellows must undergo ere they become engineers of affairs and experience.

Chairman Scott added a word about the human side of power transmission. There is an evolution in men as well as in pins and insulators. More men must be developed for the work. The colleges are doing it. Many professors were at the Congress getting in touch with practical work. In turn they would influence their students.

The reading of two somewhat similar papers in abstract and a brief discussion closed the work of the section. These papers were L. M. Hancock's on "The Bay Counties Transmission System" and R. F. Hayward's on "Operation of Power Plants in Parallel." John S. Peck read the abstract of the first and Mr. Scott that of the second. In the discussion he said that too narrow a view of the function of the lightning arrester must not be taken. On a transmission system the lightning arrester is a safety valve to relieve the stresses set up by a variety of things—not by lightning alone. Charles S. Ruffner, electrician of the Telluride company at Provo, Utah, described briefly the method to be adopted in meeting an interesting problem of regulation. By means of a three-phase induction regulator, adjusted by hand, the voltages of the transmission system and local system at Salt Lake are to be brought into proper relation. The only effect of the regulator is to affect the ratio of transformation.

R. D. Mershon's paper on "Power Transmission" was read by title. A vote of thanks to the president and secretary of the section was carried with enthusiasm, and after a few closing remarks by Mr. Scott the section took final adjournment. In common with some of the other sections the gathering had to contend with poor accommodations, but it triumphed over all difficulties and did good work.

Section E.—Electric Light and Distribution.

Etienne de Fodor's excellent paper on "Rates for Electricity Supply" was given in abstract in the Western Electrician of last week. It was presented in Section D on Monday, and an abstract of the discussion on it is given herewith.

Paul Doty, St. Paul, Minn.: I did not intend to take part in this discussion, although as manager of a joint gas and electric-light and power property, I am deeply interested in the subject of rates. The subject has been so thoroughly discussed at the various gas and electric-light association meetings in this country that it seems little more can be said that is new upon the subject. I will not attempt to go into a detailed discussion of the subject, but want to say that Mr. de Fodor's paper is particularly valuable to the gas man. There is much information in the paper that bears on the point for which a struggle has been made for years, and that is the "unit" system. We know there are many systems advocated in America, and one which is quite prominent is based on the fact that the rates for electricity should be founded chiefly on the theory that the electrical business is an investment business, and that there is a direct ratio between the investment and the cost of current. The cost of current is relatively small. If the price charged for electric current for lighting is 15 cents per kilowatt-hour, the cost for current may be only 10 per cent. of that amount. The public looks on the price as in the nature of a

"hold-up." We want to discourage that as much as possible, and sell the current at as low a rate as possible to bring about increased net earnings, in which we are interested. It has been my good fortune, as manager of the Detroit Gas Company, to raise the percentage of gas used for industrial purposes, gas for heating and cooking, as well as for power, to nearly 70 per cent. of the total output of the Detroit City Gas Company.

F. E. Gripper: This question is a large question, and I should like to throw out the suggestion as to whether the writer of the paper has not taken hold of the thing at the wrong end. My idea is that it is a possible thing to get down to the single unit, but I throw out the suggestion that the right way to do it is to decrease the price that you charge for the power supply, so that the amount of energy supplied for power would increase to such an extent that you can ignore the amount used for lighting. The amount used for lighting will be so small, compared with the total output, that you can adopt a unit and throw the lighting in at the same price as the current for power.

Arthur Williams, New York city: It occurs to me to suggest, Mr. Chairman, that there is a question as to the accuracy of the statement that as the power business increases the average use of the horsepower decreases. I do not know where that has been shown in practice, but theoretically it would seem to me to be that almost the contrary would be true; at least would be true if the original use of power in a given class would remain practically constant, without regard to the wideness of the range which the use of power takes. I personally look upon any high unit rate for electricity as meaning a high peak, and any low rate as meaning a broad peak or the absence of a peak. I think the experience of electric-light as well as gas companies has been in keeping with the suggestion of the author of the paper, that, as the rate is lowered the financial conditions of the supplying company are improved. I think anything which tends to restrict the use of power is unfortunate. The largest cost in the manufacture of electricity is labor. It is true that in some communities the use of power has been confined to the daylight hours, but that has made it necessary to upset the conditions of labor. I think it much better to advocate the advantages of electric power than to establish artificial barriers to its use. Where we eliminate the use of power from the darker hours of the day we eliminate also the use of light. I think that we all recognize that the difference between the power rates and the lighting rates is not largely due to the difference in the load factor. The motive behind the user of power is to use the power just as long as he can get work out of his plant; whereas, on the other hand, the use of light is only occasioned by the conditions of the weather, the season of the year, or local conditions prevailing in the premises of the user, which controls the use of light. There is also an amount of competition in the power service which we have always had to a very much larger extent than in the illuminating service of the supplying companies. I think the average use of power in this country, knowing little of what the conditions are abroad, are three hours per day per unit of use. Mr. de Fodor gives two rates—60 pfennigs for the first hour, 300 hours a year, which I take to mean one hour a day, and five pfennigs for any increase over 300 hours per year, or one hour a day. If you take three hours, if that be the average in Germany, you have an average cost in our money of five to eight cents per kilowatt-hour, which is not far from the average price received by the companies here under the same conditions of use.

Col. R. E. B. Crompton, London: I want to support what Mr. Gripper said just now. In England our position is very peculiar, for we have had the competition of gas at a low price the whole of our lives as electric men, and I think we have come down to the conclusion that we must fix, and have practically fixed, a low unit price, and give back discounts to consumers who use the current for long hours. It is a simple way, has been in force for many years, and in our case it has worked well. We find this—that in England the companies which supply current at the lowest prices are the ones which pay the biggest dividends.

J. W. Lieb, Jr., New York city: I think it is but just to state in a word the rather peculiar conditions of the American electricity supply industry. We are not forced to recognize to the same extent as our English friends the gas industry, particularly the competition with gas motors. Instead of the gas motor as a power element being decidedly on the rapid increase here, and which the electric-supply companies have to recognize as an element of very active competition, the contrary more nearly represents the case; in many of our large cities, where the electricity-supply companies operate on a large scale, the number of gas motors in use is perhaps on the decrease rather than on the increase, which is perhaps somewhat different from the case of our friends on the Continent.

Mr. Williams: May I ask Mr. Crompton what the rates are for light and power?

Colonel Crompton: It differs in different parts of the country. In London, about 10 cents; 10 cents is the average rate, with a discount on that, and half of that amount for power.

Robert Hammond, London: Furthering answering the question of Mr. Williams, I may say that in one district in London we charge for lighting, 14 cents for the equivalent of the first hour's use, and all beyond that at two cents. We thereby get the principle laid down in this paper, of having a time rate, a base rate or time rate, in which everyone can participate according to their hours of use. It is 14 cents for the first hour and two cents per unit for all beyond. With regard to power, it is stated by Mr. de Fodor that the power peak coincides with the lighting peak. We find that is not so in actual use. We know that the sun goes down at a certain hour, and the people turn on their lights, but we find in the use of motors that the peak is not so decided. We recognize that in the district of London, and instead of charging 14 cents for the first hour of lighting, we charge eight cents for the first hour and two cents for all beyond. I worked that out as a question of average. Mr. Williams says that the average use for power here in this country is three hours. We find that the average for power use in London is much more than three hours. Our load factor is 10 to 12 per cent. load factor on lighting, which is equivalent to 2½ to 2¾ hours per night, and we find the average of power is much higher. On the 14-cent basis the average price for two hours of use comes down to eight cents for lighting; three hours, six cents; four hours, five cents; and for power, with eight cents for the first hour and two cents beyond the first hour, the average for six hours is three cents.

There is one more remark I will make on this paper. I find the author advances the idea that the power should be charged at the lower rate and the lighting should be so much more. I think he overlooks the fact that the cost of production of electrical energy does not consist in coal alone. There is no gentleman who can speak more strongly on this point than the gentleman in the chair (Mr. Lieb), and I believe he will agree with me that the heaviest cost in the production of electrical energy is interest and the wear and tear on the plant, which is very often double the cost of actual out-of-pocket daily expenses. Therefore, it seems fitting that the correct charge must be one which loads up on each consumer his share of the capitalistic part of the undertaking, and then the actual running charges will be only light ones.

L. A. Ferguson, Chicago: I wish to indorse what Mr. Hammond has to say regarding the justification of the difference in price for power and for lighting customers. Our American practice shows that the peaks of lighting customers are coincident, whereas the peaks of power customers are not coincident. Therefore, the average load factor of power customers is better than the average load factor of lighting customers. It will be seen, therefore, that we are perfectly justified in making a lower rate to power customers than to lighting customers, because the cost of supplying energy to customers is dependent upon the load factor of the system. The better the load factor of the system, the lower will be the cost of production.

J. R. Dick, Brighton, England: Mr. de Fodor seems to be under the impression that by obtaining simplicity of tariff you are thereby securing the best development of the electrical supply business. I am not of that opinion. For instance, take the case of a man who is manufacturing two or three articles, if he were content to lump all at an average price, he would be in the dark as to which article he makes a profit on. Commercial analytical methods are for the purpose of determining cost and fixing prices in proportion to cost, and in this way we would be able to secure a far more profitable business. For simplicity, a man might say that he would keep no books, but put the receipts in one pocket and the outgo in the other, and be quite satisfied at the end of the year if he had something in his pockets. That, however, is not a wise nor a practical method of keeping track of these matters.

With regard to the details of the paper, Mr. de Fodor points out that small electric motors need not fear competition with gas, but I will impress upon you the way in which this matter has been tackled in various cities in England. We give a low rate, two cents per kilowatt-hour for power, on the condition that the consumer consents to have his supply cut off during the hours of peak load, during each month in the year, the hours varying from month to month. This obtains in the case of a vast number of people who require power and obtain it at low rates. It does not disorganize their working methods to utilize power in the winter months up to four o'clock only. They can arrange their manufacturing processes so that this does not become a nuisance. In connection with the general argument, to make the same price for light as that for power, so that one flat basic unit is employed, seems unapproachable.

Mr. Williams: There are so many representatives of foreign companies, including gas companies, present, that I ask the gentlemen if any gas companies in Europe have rates which compare with our electric-light rates for light—a high unit price for the first few hours and a low rate for the others?

Mr. Hammond: We deliver it off the machine, but the gas people store their gas; their rate is always a flat rate.

"The Prussian System of Electric Train Lighting," by Carl Roderbourg, was the first paper of Tuesday. It was read by Professor Sever. Colonel Crompton and Prof. G. F. Sever of New York city discussed it. Then came the paper of R. Jona of Italy on "Insulating Materials in High-tension Cables," read by the author and commented upon by Mr. Lieb, Colonel Crompton and Mr. Hammond. Distribution systems took up the discussion of the remainder of the session. Torchio of New York, Dow of Detroit and Dr. Stern of Vienna contributed papers. Abstracts of the Dow and Stern papers and of the discussion is presented elsewhere in this issue.

The section was called to order by Chairman Lieb at 9:30 a. m. on Thursday. The paper by Professor Feldmann and Josef Herzog on "Conducting Networks" was read by title. Dr. Kennelly, in the discussion, said that this problem had long received the attention of physicists and mathematicians, and he believed the paper a very interesting contribution. He emphasized the fact that the actual current distribution in a closed network should be regarded as a combination of two partial distributions—one with load and equal potentials and the other with no load and unequal potentials. Colonel Crompton of London, Mr. Lieb of New York and Mr. Junkersfeld of Chicago concurred in the view that it was largely a matter of anticipating the growth of business and in laying a network of mains of a very few standard sizes, rather than any extended calculation of current distribution, especially as the latter would, in a growing business, be varying. Such a network of standard-size mains is then reinforced by additional feeders and feeding points as the load becomes more dense. Likewise, when the amount of feeder conductor becomes too great in any one locality, a sub-station is established, which then performs much the same function in reinforcing feeders that the feeders do in reinforcing mains.

Dr. Steinmetz read an extremely interesting paper on the luminous arc. This paper was one of the best presented at the Congress. Primarily, it was an analytical discussion of phenomena of electric arcs with various materials. Andre Blondel's paper was abstracted by Dr. Louis Bell. This paper was an exhaustive treatise, dealing particularly with impregnated arc-light carbons and included numerous tests, the most important of which gave the following result:

	Watts.	Mean Spherical Candlepower.
Ordinary open arc	495	700
American enclosed arc	768	320
Steinmetz arc	385	400
Bremer nine amp	495	4,814
Blondel nine amp	500	4,800

The discussion indicated that the tests were not made with the same carbons used by Dr. Steinmetz at present, and therefore were not conclusive, at least in this particular. Mr. Lieb stated that the Blondel carbons were really double concentric and in general effect on the street a three-ampere Blondel arc was apparently better than the five-ampere ordinary enclosed arc. Prof. J. P. Jackson recited some experiences and comparisons made between magnetite and other street arc lamps. He found the effective illumination on the street as measured by illuminameters such that type could be read at distances 20 per cent. farther than any other street lamp. This was borne out by such photometric tests as could be made.

Prof. E. L. Nichols deplored the absence of satisfactory methods of exact comparison. Ordinary photometry, he said, must, with the many new illuminants now appearing, soon give way to spectrophotometry, a science still but very little known; in fact, exact methods of comparing the new illuminants, he declared non-existent. Dr. Clayton Sharp gave some details of photometric tests very favorable to Blondel arcs, especially as to efficiency. Section E at this point joined Section B, and the report of the joint meeting will be found in the account of that section.

After the joint meeting Professor Lombardi of Italy read a very interesting paper on "Stroboscopic Observations of the Arc." He illustrated the paper with a large number of photographs, showing the arc between electrodes of various materials, and differently treated carbons, at different periods during a complete cycle. Dr. Steinmetz commented briefly on the paper, and stated that the rectifying action of the arc formed an interesting study. Professor Nichols read his paper by title, "Standards of Light," after which the section adjourned for the day.

The first paper of Friday was by Gerhard Goettling on "Storage Batteries" and was read by the author. It was discussed by Mr. Lieb, Colonel Crompton, Mr. Hammond, Mr. Junkersfeld and Mr. Goettling. Chairman Lieb, in introducing the discussion, called attention to the extreme importance of storage batteries in large American alternating-current generating and transmission systems to sub-stations for conversion to direct current, in order to maintain continuous service. He also stated that while formerly most batteries were sold under maintenance guarantees, today most companies preferred to maintain their own batteries. Colonel Crompton contrasted the English practice of discharging storage batteries on general lighting service through boosters, instead of through end-cell switches as in America. The discharge through a booster he found always under perfect control, while with the end-cell switches it was always a jump from one cell to the next. In England they preferred to have

storage-battery manufacturers maintain the entire battery, including tanks as well as plates. Mr. Hammond emphasized the excellent results by discharging through a booster, which he considered an almost ideal arrangement. To Colonel Crompton he gave credit for the development and manufacture of this excellent booster arrangement. The proportion of battery capacity to total load is less in England than with the large American companies. His experience indicated better general results from maintenance by manufacturer than by owner, the former acting as "policeman" to keep the latter on right track for best results. Mr. Junkersfeld stated that American railway batteries were of necessity nearly always discharged through boosters. On lighting and general power systems in America the batteries were, however, discharged through end-cell switches because it was desired to avoid the additional link (rotating machinery) which a booster would introduce between battery and service. It is desired to secure the greatest possible security for continuous service, and batteries are allowed to "float" and discharge directly to the distributing bus bars through end-cell switches. He stated also that with the very sharp "peaks" on the annual December load curves it pays many American companies to install a considerable amount of battery capacity to carry these December short-hour "peaks" rather than install additional complete generating equipment. Most of the larger companies are thus able to carry from 20 to 40 per cent. of their annual maximum demand on storage batteries. Mr. Goettling, in answer to inquiries, stated that with the extra depth of tanks for sediment space much better results from positive plates were secured, probably due to a more uniform current density in the cell. The "box" negative plates he considered thus far as very satisfactory indeed.

H. N. Potter's paper on "Nernst Lamps" was read by P. H. Thomas. Mr. Hammond referred to an experimental street installation in a certain London district which was replaced by arc lamps, due to the very uncertain life of Nernst glowers and the resultant objectionable interruptions to street-lighting service. For interior lighting he believed the Nernst lamps to have a field, even though limited. Mr. Wilkinson and Mr. Webb both recited more favorable experience in England with Nernst lamps. The slowness in coming to full candlepower was deplored for interior work. Mr. Terven called attention to the extreme care necessary when installing glowers, to allow for expansion, which, he said, accounts for the erratic life. If, after proper installation, the lamp survives the first 15 hours it will probably burn 1,200 hours. The lamp can be made to reach full candlepower more quickly on starting if this is generally desirable. Arthur Williams said that in outlying New York districts the single-glower lamps had been a disappointment, but that the three and six-glower lamps were very satisfactory and were being installed in competition with all the cheaper illuminants, including oil. Dr. Jorge Newbery of Argentina said that Nernst lamps were being installed extensively in Buenos Ayres for interior and exterior use in competition with other illuminants. These lamps were of German manufacture.

The paper on "Steam Turbines," by W. L. R. Emmet of Schenectady was read by the author; the paper of Rateau of Paris on the same subject was abstracted by Mr. Lieb, and the paper by Francis Hodgkinson of Pittsburg on the same subject was abstracted by Mr. Townley.

Rateau's paper was an exhaustive analytical and mathematical discussion of steam turbines, which he divided into two general classes, namely, fall-of-velocity and fall-of-pressure systems. In theoretical possibilities he strongly favored the fall-of-velocity types. Mr. Hodgkinson's paper gave results from several tests on different size turbines. Under full-load conditions, with 150 pounds steam-gauge pressure 150° Fahr. superheat and 28 inches vacuum most of the tests gave 13 and 14 pounds per brake horsepower. The sizes of units varied from 400 to 1,000 kilowatts, normal rating. Each additional inch of vacuum above 25 inches improved the economy from three to four per cent. Mr. Emmet, in answer to Professor Rateau's disparagement of the fall-of-pressure turbines, said that turbine development was not safely guided by mathematical deductions exclusively. Exact knowledge of turbine working was still so meager that it is a matter of best design with known and practicable materials, then careful and complete testing, to secure exact experimental data, which data can then be subjected to careful mathematical analysis, and deductions used for the next experiment. The results of numerous tests were contrary to Professor Rateau's conclusions.

The long paper on "American Meter Practice," by G. Ross Green, was abstracted by Mr. Eglin. This was followed by another meter paper by C. D. Haskins. Neither paper was discussed, owing to the lateness of the hour. This concluded the programme of the section.

Section F.—Electric Transportation.

Section F held but a short session on Thursday morning. Dr. Louis Duncan of Boston presided. Three papers were read by title—Rasch on "The Booster Machine in Traction Service," Frank J. Sprague's "History of the Electric Railway," and L. B. Stillwell on the "Wilkesbarre and Hazleton Railway." It was decided to inspect the model of the Behr monorail system in the British exhibit in Electricity Building in the afternoon and then listen to the reading of F. B. Behr's paper on "The Monorail" at the Westinghouse Auditorium in Machinery Building at 5:30 p. m. Adjournment was taken accordingly.

On Friday this section held a joint session with Section G to discuss electrolysis of underground conductors.

Section G.—Electric Communication.

F. W. Jones and B. Gherardi, both of New York, were respectively chairman and secretary of this section. John Hesketh of Brisbane, Australia, was honorary chairman. After the general meeting on Monday the time was so short that only three papers could be presented: "Simultaneous Telegraphy and Telephony," by Joseph Hollos (printed in the Western Electrician last week); "Telegraphy and Telephony in Japan," by Saitaro Oi, and "System for Producing Continuous Electrical Oscillations," by V. Poulsen. Printed copies of the first two papers were available. On Tuesday a greater number of papers was presented and of such a character as to invite an animated discussion. The first papers pertained to telegraphy, as follows: "Modern High-speed Printing Systems," by J. C. Barclay; "Rapid Telegraphy," by Prof. Ferdinando Lori; "Printing Telegraphy," by Dr. Louis M. Potts; "Rapid Telegraphy," by Patrick B. Delany.

The subject of these four papers is well indicated by their titles. The last two papers only were read. The discussion, in which the authors of the papers and Mr. Hesketh took a prominent part, brought out different opinions as to the preference of systems and as to the speed obtainable in sending. But in this case, as in general, no fixed solution could be advanced, as the time given the members to familiarize themselves with the papers was too short. The paper "Military Use of the Telegraph, Telephone and Cable," by Major Samuel Reber, formed a stepping stone from telegraphy to telephony.

The paper on "High-frequency Telephone-circuit Tests," by Dr. A. E. Kennelly, would have been the one to open the telephonic series, but owing to the fact that Dr. Kennelly had to attend other sections on the same morning he presented his paper at the beginning of the meeting, giving only the salient features on account of his limited time. The paper on account of its mathematical character could not be digested quick enough to afford an opportunity for discussion.

Mr. John Hasketh did not read his paper on a "New Danger to Lead-covered Aerial Cables," but presented to the audience samples of lead sheets, showing perforations made by Australian bugs. He also had on hand a collection of the various bugs that made different-sized holes. The exhibition was very interesting and caused others in a discussion to recall their experience in America with cables destroyed by rats, etc.

F. J. Dommerque of Chicago gave an abbreviation of his paper on "The Telephone Problem in Large Cities." Mr. Hesketh and Lieton H. Reber participated in the discussion, which brought out the question of mistakes that may be attributed to the subscribers in a division system where they would have to press buttons to select a particular division at the exchange. The experience in St. Louis showed that such mistakes occurred but not to any great extent. It was pointed out furthermore in the discussion that the selection of a system for large cities depended on local conditions and would have to be left to the engineer familiar with such conditions.

The papers on the programme for Thursday's session pertained, with one exception, to wireless telegraphy.

Two papers, one on the "Present State of Wireless Telegraphy," by Dr. J. A. Fleming, F. R. S., London, and the other one on "Wireless Telegraphy," by Reginald A. Fessenden of Old Point Comfort, Va., were only read by title on account of absence of the authors. The first paper actually read was on "Wireless Telegraphy of the Italian Government," by Marquis Luigi Solari. The author read from the manuscript, and as no printed advance copies were available the paper could not be discussed easily. The second paper was on the "Theory of Wireless Telegraphy," by John Stone Stone of Boston. The paper was also read from the manuscript, but the circumstance that the author presented the equations and curves on large sheets made it somewhat easier for the audience to follow him. Dr. De Forest and Mr. Delany took part in the discussion, in which it was said that Mr. Stone's paper formed undoubtedly a step in advance by giving the engineer a comparatively simple illustration of the underlying theory and assisting him to grasp the physical process. Dr. De Forest mentioned, however, that his experiments did not substantiate the theory as announced by Mr. Stone.

Dr. De Forest's paper on "Electrolytic Receivers in Wireless Telegraphy" attracted the audience on account of the possibility of observing his experiments in actual working on the fair grounds. In the discussion it was shown that the doctors still disagree as to the phenomena in the receiver.

The last paper on the programme of Thursday was on "Loaded Telephone Lines in Practice," by Hammond V. Hayes, a Bell engineer of Boston, and was read by the secretary in the absence of the author. As the subject was of such great importance to the telephone world at large the paper was submitted to a general discussion. Dr. Kennelly was invited to open the discussion, which he did in analyzing the curves that gave the results of tests between loaded and unloaded lines. The curve of unloaded line shows that vocal transmission in cables is carried on in high G and that the actual cable behaves as if it were operated at one frequency, namely, 825 cycles per second. The secretary (B. Gherardi) related his actual experience in the experiments with loaded lines in which he participated in and around Greater New York. He showed diagrammatically the lines used between the Courtlandt Street office, Newark and Elizabeth; also on Long Island from Prospect office in Brooklyn to Jamaica and Far Rockaway, in which lines the cables served to bring in long lines. This experience proved that loaded cable lines are particularly valuable in bringing long lines into cities. The cable line itself, however, must not be too short, else the loading may actually deteriorate transmission. The secretary also illustrated the actual form in which the load coils were put into service. Seven layers of seven coils are placed into a cylindrical pot, which is closed by a flanged cover. The pot is set upon the manhole floor and the cable from the pot is spliced to the cable to be loaded at a point about midway between the opposite manhole walls.

Friday was set apart for a joint meeting between Section G and Section F so as to give both sections an opportunity to hear the paper on "Electrolysis of Underground Conductors," by Prof. G. F. Sever of New York. The author did not read his parer in full there were no advance copies available. The results of inquiries in relation to electrolysis observations from street-railway companies and municipalities had been tabulated by the author, who communicated the most interesting data to the audience. The information mostly desired, namely, as to remedies that would be effective, was rather meager. In the discussion the representatives of Australia and Sweden took a prominent part. Mr. Hesketh pointed out that it would be a difficult matter exactly to place the responsibility and that mutual co-operation between the parties concerned was absolutely necessary. He declared the system of fixing an allowable drop of potential without reference to length of line as wrong He also pronounced the measuring of potential between rails and pipes as insufficient. The German proposition of measuring between rails and adjacent earth seemed more proper to him.

Secretary Gherardi gave some data from his experience. He said that they experienced in Brooklyn as much as 700 amperes coming back on the cable sheaths, but by means of mutual agreements they had the trouble reduced so as to be inappreciable. The gentleman from Sweden related some of the rules and regulations in existence in continental European cities, principally in Hamburg and Berlin. He stated that in Europe railway systems are more heavily bonded and better insulated as to the return current than in this country. In some cases return cables of the same capacity as the feeders are used, which has the additional advantage of interchangeability of returns and feeders in case of accident.

P. B. Delany and the chairman discussed the subject with respect to telegraph cables and cited an instance where cable sheath and rails were connected so as to let the cable sheath carry its portion of the return current, which so far has not exceeded the carrying capacity of the sheath.

The discussion seemed to develop as the best remedy in the present situation a heavily bonded track and substantial returns.

After this paper Section G took up again its own work. The paper on the "Theory of Telephone-exchange Development," by G. de la Touanne of Paris, was read by title. As advance copies had been at hand, a short discussion ensued, in which Messrs. Hesketh, Gherardi, Reber and Dommerque participated. In the subdivision of annual expenses the item of depreciation seemed to be superfluous as long as maintenance and sinking fund were provided for. The rate of working per operator was severely questioned and the opinion was strongly expressed that the author's minimum rate of 200 connections per operator-hour was really too high and should be considered as the maximum limit.

K. B. Miller of Chicago gave a short account of his paper on "The Automatic vs. the Manual Telephone Exchange," and he was asked to lead the discussion, in which also Messrs. Gherardi and Dommerque participated. The author emphasized that the automatic was still at the beginning of development, while the manual exchange had reached a high degree of perfection and that no new developments in that direction could be expected in the near future. Mr. Dommerque thought that trouble will occur at the subscribers' station from complication of apparatus; also that at the exchange maintenance will cost heavily in future when the apparatus grows older. He believed that in very large cities like New York and Chicago satisfactory service requires functions that need brains and could not be performed automatically. In very small places an operator is required for toll service who could handle the local business also, therefore an automatic exchange for small places was too costly. In medium-sized cities the automatic would become too costly to operate when the present apparatus was improved upon and adapted to modern requirements. The speaker

thought that the solution of the problem would be a combination of manual and automatic apparatus.

Mr. Gherardi called attention to the fact that the manual apparatus was crude and badly built at the beginning, and in order to improve service and keep step with the times it had to be better constructed until at the present time the workmanship in manual exchanges is of the highest grade, which is not found in automatic exchanges. The change in the automatic to high-grade workmanship would increase the cost of the automatic apparatus greatly.

Prof. J. C. Kelsey's paper on "Features of the Dunbar Two-strand Common-battery System" was read by title only, in the absence of the author. It was, however, discussed by Messrs. Miller, McBerty, Hesketh and Dommerque. It was pointed out by Mr. Dommerque that the two-wire principle had been worked out for trunk and other services. He also mentioned that Mr. Dunbar had originated the two-wire idea, but that Mr. Miller was entitled to a great deal of credit for his co-operation in the development.

Mr. McBerty questioned the preference of a two-wire over a three-wire system and believed also that an advantage in cost could not be found in a two-wire system. Mr. Miller gave his opinion that a three-wire system must be more flxible, as there was a third element available in the third conductor. Mr. Hesketh asked about the adaptability of the two-wire system to tone tests, reverting and qualified busy tests, automatic ringing and automatic-trunk signaling.

The last paper was read by L. W. Stanton of Cleveland on "Modern Telephone Engineering." The late hour and the absence of advance copies were the reasons for not entering upon a discussion.

Section H.—Electrotherapeutics.

In this section Dr. William J. Morton and Mr. William J. Jenks, both of New York, were chairman and secretary, respectively. The first day's work consisted of the address of welcome by the chairman and the reading, in abstract, of several papers by foreign authors who could not be present.

On the second day the first paper presented was by Dr. T. P. Hall of Chicago on the subject: "Principles of Electrotherapeutics." Next followed a paper by Prof. S. Schatzky on the "Effect of Constant Current on Vitality of Microbes." Due to the absence of the author, Dr. Hall kindly volunteered to read the paper.

Following this the chairman read a paper upon "Electrical Purification of Drinking Water," written by John W. Langley.

Dr. Emil H. Grubbe of Chicago read the next paper, "Roentgen-rays and Radioactive Substances as Therapeutic Agents." The author gave a history of his researches in the field of radioactivity and announced the discovery of a new fluorescent substance which he has used in connection with X-rays in the treatment of malignant diseases. This paper was discussed by the chairman, who has done much research work in this same line.

Next followed a paper by Prof. Dr. M. Benedikt on the "Radiodiagnostics of Diseases of the Head and Brain." The author, although not explicit in his technique, nevertheless made it very clear that he has been able to diagnose, by means of the skiagraph, such conditions as epilepsy and eclampsia —two conditions which up to this time were not thought diagnosable by X-ray methods. The paper was discussed by Drs. Grubbe and Morton.

A paper on "Static Electricity in Chronic Nephritis," by Dr. C. S. Neiswanger, was read, in the absence of the author, by the secretary. Drs. Grubbe, Morton and Massey took part in the discussion. "Some Observations upon the Treatment of Lupus Vulgaris by Phototherapy, Radiotherapy and Otherwise," by Dr. Charles R. Dickson followed and was discussed by Drs. Snow, Baer, Skinner, Grubbe and Morton. Dr. Clarence E. Skinner read his paper entitled, "A Large Fibrosarcoma Treated by Roentgen Radiation." He reported a symptomatic cure in a bad case of sarcoma under X-ray treatment. The chairman read an abstract of Dr. G. O'Farrill's paper on "Improvements in High-frequency Generators."

On Wednesday a joint meeting with the American Electrotherapeutic Association was held at Congress Hall on the World's Fair grounds and a paper on "Diagnosis of Calculi by Roentgen Rays" was presented by Dr. R. H. Baggs. The paper was discussed by Dr. M. Kassabian, who differed from the author practically in every detail of technique. Dr. W. J. Herdman's paper on "Du Puyten's Contraction" was read by title. A member read Dr. J. H. Kellogg's paper on "Electrotherapeutics." Next followed Dr. William B. Snow with a paper on "Therapeutic Uses of Static Electricity." This paper encouraged the use of pure static currents. The discussion was by Drs. Skinner, Massey, Morton and Grubbe. Owing to the fact that the papers of Dr. Jacques Loeb and Dr. G. G. Burdick had gone astray in transit, they were not read before the society, but will appear in the Transactions. The chairman next read, in abstract, the paper of Dr. J. A. Riviere on "Physicotherapy of Neurasthenia."

On Thursday Dr. Carl Beck of New York read a paper on and gave a demonstration of a radiograph diaphram apparatus of his own invention. This instrument, due to its simplicity and cheapness, attracted considerable attention. The paper was discussed by Drs. Grubbe, Snow, Morton and Mr. Friedlander. After this followed a paper on "Fluorescence of the Human Organism," by Dr. William J. Morton of New York. Dr. Morton exhibited many specimens of fluorescent substances and also a compressor instrument used in radiographing deep soft parts. This instrument is extremely simple, consisting only of a brass ring seven inches in diameter and about one-quarter inch in thickness. The inner circle of the ring consists of a plate of aluminum from one-sixteenth to one-eighth inch in thickness. By means of straps this plate is firmly fastened to the patient and radiographing table. Dr. Grubbe led the discussion.

The last paper presented was by Dr. G. B. Massey of Philadelphia on "Cataphoric Diffusion of Metallic Ions in Destructive Sterilization of Cancer and Tuberculous Deposits." The doctor exhibited the instruments used by himself and assistants. Lantern slides also were shown of "before and after" cases. This paper was discussed by Dr. Granger of New Orleans, who also exhibited photos of cases treated by this method. Drs. Dickson and Morton concluded the discussion.

Social Features of the Congress.

During the week of the International Electrical Congress there was a succession of dinners, receptions and other social features in honor of the visitors. Nearly all the foreign delegates and many of the Americans arrived on Sunday, September 11th, and on the evening of that day there was an informal reception in the parlors of the Jefferson Hotel, which was the headquarters of the "circular-tour" party. On Monday, the opening day of the Congress, there was an automobile ride for the ladies in the forenoon. This feature was tendered by the St. Louis reception committee. On the evening of that day there was a reception at the New York State Building at the World's Fair, also tendered by the reception committee.

The Italians took a hand in the entertaining on Tuesday, giving a reception from 5 to 7 p. m. at the Italian pavilion on the Fair grounds, to which members of the Congress were invited. The music for the afternoon was furnished by 10 mandolin and guitar players, whose rendition of popular Italian airs was much enjoyed. Mrs. Ascoli assisted her husband, Professor Ascoli, in receiving. About 500 guests called and were made welcome by Mr. Pavia of Italy, president of the Royal Italian Commission, and Commissioners Branci and V. Zeggio.

On Tuesday afternoon, too, a special display of moving pictures was given for members of the Congress in the Westinghouse Auditorium in Machinery Building.

One of the most brilliant social events of the Congress was the formal dinner of Tuesday night, given by Mr. Bion J. Arnold, president of the American Institute of Electrical Engineers, in honor of the president, delegates and officers of the Institution of Electrical Engineers of Great Britain. The dinner was given in the Jefferson Hotel and was attended by about 60 gentlemen, including all of the foreign official delegates. Mr. Arnold presided, with Mr. R. Kaye Gray, president of the British Institution, on his right. Speeches were made by Mr. Gray, Dr. R. T. Glazebrook of England, Prof. John Perry of England, Mr. Robert Hammond of England, Prof. M. Ascoli, president of the Associazione Elettrotecnica Italiana, Prof. L. Lombardi of Italy, Antonio Gonzalez of Spain, Prof. Elihu Thomson of the United States, Prof. Samuel Sheldon of Brooklyn and others. The whole affair passed off delightfully and will long be remembered.

Wednesday was Electricity Day at the World's Fair, and all the events took place on the fair grounds. After the forenoon session in Festival Hall the members of the Congress were entertained at luncheon in Electricity Building by the exhibitors in that building. In the evening there was an elaborate reception in Electricity Building from 8 to 11 p. m. The building was brilliantly illuminated and tastefully decorated. Mr. F. H. Gale introduced the guests to President and Mrs. Francis and others, who helped to receive. Refreshments were served, and all working exhibits in the building were in operation for the benefit of the electrical visitors, only invited guests being admitted to the building. Prof. W. E. Goldsborough, chief of the department, was indefatigable in planning for the comfort and entertainment of all.

On Thursday night Prof. Elihu Thomson, president of the Congress, gave a dinner at the Jefferson Hotel for the delegates from governments and from affiliated societies and for the officers of the Congress. Dr. Kennelly acted as toastmaster, and there was a response from some representative of each foreign nation sending a delegation.

Dr. F. A. C. Perrine gave an interesting illustrated lecture on "Power Transmission" at the Westinghouse Auditorium on Thursday night.

A luncheon was given on Friday at the Jefferson Hotel by members of the jury of electrical awards at the World's Fair to Prof. W. E. Goldsborough, chief of electricity at the World's Fair. Covers were laid for 60 guests, and Oscar T. Crosby of Washington, D. C., acted as toastmaster. Prof. Elihu Thomson and Dr. A. E. Kennelly were special guests.

Commissioner-General and Mrs. Watson gave a reception in honor of the president and members of the International Electrical Congress at the British Royal pavilion from 4 to 6 p. m. on Friday. Tea was served by East India servants, whose oriental dress added a touch of color to the brilliant scene.

The principal banquet of the week was given on Friday evening at the German National Pavilion on the fair grounds. The St. Louis reception committee arranged for the affair, and entertained the foreign and society delegates and officers of the Congress as its guests. There was an attendance of several hundred, and a witty St. Louis lawyer acted as toastmaster. Responses were made by Mr. R. K. Gray, Mr. B. J. Arnold, Professor Ascoli, Mr. Robert Hammond and others.

Mr. R. K. Gray, president of the British Institution of Electrical Engineers, gave a luncheon on the World's Fair grounds to a large number of electrical guests on Saturday.

Members in Attendance.

It is impossible to give the names of all who attended the Congress. Following are some of the names secured:

Elihu Thomson.
B. J. Arnold.
W. D. Weaver.
A. E. Kennelly.
Prof. H. S. Carhart.
C. F. Scott.
Prof. W. E. Goldsborough.
Prof. H. T. Barnes.
C. P. Steinmetz.
A. H. Armstrong.
Prof. E. L. Nichols.
Dr. Louis Bell.
John W. Lieb, Jr.
W. J. Jenks.
Dr. W. J. Morton.
Prof. Samuel Sheldon.
Carl Hering.
Gano S. Dunn.
Francis W. Jones.
Dr. Louis Duncan.
Bancroft Gherardi.
Antonio Gonzalez.
J. C. Shields.
Prof. M. Ascoli.
Miguel Otamendl.
Guillebot de Nerville.
Prof. John Perry.
Ormond Higman.
Jorge Newbery.
Jos. Vater.
John Hesketh.
Capt. G. Ferrie.
A. Dennery.
Col. R. E. B. Crompton.
Dr. R. T. Glazebrook.
Dr. S. W. Stratton.
A. Maffezzini.
Prof. L. Lombardi.
E. Jona.
G. Goetlling.
Arthur Williams.
W. Duddell.
R. Kaye Gray.
H. E. Harrison.
Louis A. Ferguson.
T. F. Grover.
G. N. Eastman.
Marius Latour.
Maj. Samuel Reber, U. S. A.
F. A. C. Perrine.
W. D. Bancroft.
Dr. W. Litzrodt.
C. R. Dickson
Lieut. Com. J. L. Jayne.
W. C. L. Eglin.
Dr. G. J. von Swaay.
William Goltz.
W. H. Bradt.
R. B. Owens.
F. J. Sprague.
Prof. A. S. Langsdorf.
Gerard Swope.
W. A. Layman.
H. H. Humphrey.
W. V. N. Powelson.
B. Pantaleoni.
George Rosenthal.
W. A. Kreidler.
W. E. Keily.
F. L. Perry.
Franz Welz.
C. D. Chateney.
E. G. Cowdery.
Fred V. Edgell.
F. Frolich.
W. Worth Bean.
J. R. Cravath.
R. H. Rice.
K. Sosnowski.
G. Magnus.
Gaston Roux.
E. R. Weeks.
Svante Arrhenius.
Cecil P. Poole.
H. C. Parker.
Chas. A. LaFever.
C. B. Graham.
Townsend Wolcott.
Chas. M. Knight.
G. Faccioli.
E. F. Roeber.
Patrick Delany.
Emmanuel Freund.
A. Maxwell.
W. Scarlett.
E. H. Mullin.
A. S. McAllister.
R. J. McNitt.
Capt. R. F. Willis.
E. G. Bernard.
Chas. Day.
F. G. Bolles.
Geo. C. Leber.
E. W. Hawkins.
F. Carini.
Darwin Bates.
C. F. Burgess.
C. L. Williams.
Leonard E. Hurtz.
Robert P. Mitchell.
Solomon Davis.
C. B. Bolton.
S. B. Way.
Guido Robb.
L. G. Rosenstock.
W. G. Bain.
G. Stramezzi.
L. Galimberti.
H. E. Patten.
W. H. Scott.
Godfrey Pope.
E. L. Ogle.
John T. Connolly.
A. C. F. Webb.
Silvio Magrini.
Edward Roth.
N. Castellini.
Prof. F. C. Caldwell.
Arthur Simon.
G. C. Sbadd.
H. Ho.
P. N. Nunn.
W. E. McCay.
Homer E. Niesz.
F. J. Sprague.
A. H. Kalbfleisch.
Henry Crew.
C. Marshall.
William I. Bradley.
F. J. Dommerque.
W. I. Crompton.
R. B. Perring.
C. J. Hopkins.
Eugene H. Abadie.
J. T. Morris.
H. W. Wyckoff.
R. F. Schuchardt.
G. W. Patterson.
F. H. Nalder.
John C. Ostermann.
W. A. Barnes.
W. H. Martin.
F. B. Behr.
S. O. Ochs.
L. C. Marburg.
Edward R. Taylor.
E. Kilburn Scott.
W. B. Marr.
George Bullock.
J. A. Moyer.
C. D. Child.
Theo. Feilden.
R. S. Erskine.
Dr. A. R. Tarkington.
O. S. Bragstadt.
F. B. Crocker.
Robert Rankin.
S. S. Sadtler.
N. J. Neall.
W. L. Waters.
A. L. Staderman.
Dr. C. E. Skinner.
C. H. Sharp.
H. B. Smith.
E. M. Tingley.
Chas. H. Roth.
J. M. Thuringer.
F. E. Barker.
Dr. L. M. Potts.
C. W. Hutton.
Amadee Granger.
F. C. Toepleman.
M. H. Gerry, Jr.
F. W. Grover.
Prof. G. F. Sever.
John C. Hays.
M. L. Holman.
Frederick Bedell.
Francesco Giudice.
W. S. Andrews.
George Wilkinson.
W. C. Yeatman.
K. E. Guthe.
Edvardo Ambrosana.
Arthur Frantzen.
W. A. Layman.
Andrew Pinkerton.
C. E. Reid.
J. H. Finney.
J. F. Burns.
E. H. Seaman.
Frank P. Foster.
J. L. Foy.
James Edgar.
Edgar L. Larkin.
R. E. Heine.
Hermann Spoehr.
B. F. Eicholtz.
C. A. Hobein.
R. E. Hayward.
E. B. Woodson.
V. R. Lansingh.
John S. Peck.
N. A. Eckart.
Peter Junkersfeld.
Prof. A. G. Webster.
H. Leisse.
William T. Wheeler.
B. F. Ever.
A. L. Swanson.
George T. Street.
B. G. Lamme.
Paul H. Patton.
N. D. Hoffman.
W. T. Humphreys.
P. H. Thomas.
C. H. Smith.
C. O. Sares.
T. E. Crossman.
Carlo Barzano.
A. S. Crane.
H. H. Seabrook.
C. E. Skinner.
M. M. Fowler.
H. C. Whiting.
F. E. Greenman.
C. A. Gaines.
L. G. VanNess.
L. Stenhouse.
D. M. Kintner.
F. C. Kidman.
O. C. Maey.
H. W. Fisher.
F. Boldenweck.
J. P. Jackson.
F. Loti.
Dr. F. H. Munroe.
T. J. Crosehead.
David B. Rushmore.
Prof. Guido Grassi.
Richard Fleming.
Antonio Pesenti.
P. M. Lincoln.
Dr. Emil G. Beck.

Benjamin Longbottom.
Stucchi Alderlo.
Rietti Emilio.
William J. Engelen.
Philip Torchio.
Emil H. Liebert.
A. Pancaldi.
Warren E. Weinsheimer.
Frank F. Loomis.
A. F. T. Atchison.
G. C. Giorgetti.
A. B. Martin.
A. Odozio.
J. M. Morehead.
H. G. Osburn.
Stucky Grancarlo.
Dr. E. H. Grubbe.
Wm. E. Dickinson.
Fullo Sorazni.
Frank Foster.
Harry Alexander.
S. A. Bouslog.
I. S. Edstrom.
F. H. Cole.
G. M. Sanburn.
F. W. Sloan.
William Hand.
Calvert Townley.
C. V. Drysdale.
A. Zelewsky.
M. I. E. Tilney.
D. H. Cohen.
George Balfour.
F. Danioni.
W. J. Hammer.
F. E. Drake.
E. McCleary.
E. F. Kern.
G. M. Gest.
J. R. Wiley.
W. A. Caldwell.
P. S. Sheardown.
A. L. Pierce.
Henry Pikler.
L. G. E. Morse.
J. C. Kelsey.
M. Jennison.
C. I. Fechheimer.
I. C. Hatzel.
W. Summerscales.
C. F. Beames.
Dr. A. F. Endstrom.
I. W. Richards.
Kemoster B. Miller.
G. G. Ponti.
M. Hayashi.
W. H. Hale.
H. H. Willard.
E. O. Schweitzer.
O. W. Brown.
J. A. Foster.
S. von Prusinowski.
W. M. Riges.
A. Carrelli.
R. W. Hemphell, Jr.
Robert Abel.
L. Hammerstrand.
C. A. Adams.
H. B. Foote.
H. W. Leonard.
C. E. Waddell.
E. F. Schenk.
W. C. L. Eglin.
S. C. Sbaffner.
T. Proctor Hall.
Arthur W. Smith.
W. I. Slichter.
A. A. Kind.
W. P. Carstarphen.
John R. Hewett.
H. H. Roberts.
W. McA. Johnson.
W. S. Gradolph.
Clayton W. Pike.
J. H. Perkins.
R. N. Davidson.
J. J. Green.
Thos. Hesketh.
R. A. Porter.
A. C. Bunker.
B. D. Horton.
E. Ruehel.
H. R. Snyder.
Robt. T. Lozier.
H. Almert.
Robert Ferris.
W. Lewis Brosius.
H. W. Buck.
Dr. W. B. Snow.
P. H. W. Smith.
G. B. Massay.
E. S. Camp.
C. W. Rice.
David M. Donnar.
E. S. Marlow.
E. B. Rosa.
C. E. Scribner.
W. A. Blanck.
G. H. Condict.
W. W. Donaldson.
E. M. Hewlett.
Morris Hale.
E. H. Anger.
Robert Hammond.
Geo. A. Damon.
V. S. Converse.
H. A. Calderwood.
F. B. Sharpe.
I. L. Marr.
H. B. Cobo.
V. Karapetoff.
W. E. Phelos.
C. H. Moritz.
S. B. Pike.
C. J. Axtell.
R. Miehling.
I. H. Hudgson.
R. R. Ramsey.
A. White.
W. K. Dunlap.
Dr. L. Kablenberg.
O. M. Stewart.
J. M. S. Waring.
A. C. Farrand.
Timothy O'Hearn.
C. E. Diehl.
Dr. Russell H. Boggs.
Schuyler Skaats Wheeler.
H. Randall Allensworth.
G. H. Higgins, M. D.
A. J. O'Reilly.
H. J. Ryan.
Geo. H. Holderman.
Lee DeForest.
C. Gordon Cox.
T. B. Lambert.
Gianfranco Tesi.

Electrical Congress Notes.

The Royal Society of England sent as fraternal delegates Dr. R. T. Glazebrook and Prof. John Perry.

The Northwestern Electrical Association was represented by T. F. Grover, president, and William Goltz.

Prof. J. A. Bergonie and Marius Latour were named as the delegates of the Société Internationale des Electriciens of France.

English was the official language of the Congress, but French was used by delegates from France in the opening and closing exercises.

The Italians contributed appreciably to the success of the Congress. Ascoli, Jona, Lombardi, Carini and others contributed papers and took part in the discussions.

Arrhenius of Sweden, although a great scientist, is an unassuming, modest man. It was with difficulty that he was persuaded to occupy a seat in the front row of delegates at the taking of the photograph on Friday. This is the picture reproduced on page 237.

There were many college professors at the Congress. In introducing the guests at the reception at the Palace of Electricity on Wednesday evening Mr. Gale became so facile in introducing "Professor Soandso" to President Francis that occasionally he found himself saying "Professor Francis, allow me to introduce President Soandso." The introduction went as well one way as the other.

The St. Louis reception committee, which did so much for the social success of the week, was made up as follows: W. V. N. Powelson, chairman; W. A. Baehr, John I. Beggs, Murray Carleton, E. G. Cowdery, S. M. Dodd, G. F. Durant, W. E. Goldsborough, H. H. Humphrey, S. M. Kennard, A. S. Langsdorf, W. A. Layman, Robert McCulloch, W. F. Noelker, G. Pantaleoni, H. L. Reber, G. D. Rosenthal, Roger Scudder, J. E. Smith, E. J. Spencer, Gerard Swope and J. S. Walsh.

"The St. Louis Exposition is certainly very grand," said Mr. Gaston Roux, director of the Bureau of Electrical Installations, Paris, "but I consider the extensive grounds somewhat a disadvantage. Too much time is lost in going from one place to another, and in some cases nothing is gained by thus separating the various buildings. We are doing considerable work in long-distance power transmission in France now," continued Mr. Roux, "and have been trying a new type of insulator. This insulator is made of glass, of three parts, cemented, and is used on a 50,000-volt line. The glass is made by a special process, the parts being oil-tempered, and a non-hygroscopic surface is produced thereby. The insulating qualities of glass are higher than those of porcelain, and the chances of imperfection not so great as with glazed porcelain. We expect to operate a line about 300 miles in length."

"The St. Louis street-railway system is far more extensive than any of those we have in England," said Dr. R. T. Glazebrook of the British Institution of Electrical Engineers. "Our cities are much older, and do not have the streets crossing at right angles to such an extent as you have here. This is a decided advantage in the layout of a street-railway system. It is certainly remarkable with what ease one may reach any part of the city. We do not use as long a car in England, but employ a large number of double-deck cars, which enjoy great popularity."

Mr. F. Froelich, representative of the German Society of Engineers of Berlin, said that he and his fellow-countrymen are somewhat disappointed about the character of the electrical and mechanical exhibits at the World's Fair. While the exhibits are very interesting and attractive, they felt that among many of the manufacturers the real live interest had not been displayed, and consequently the character of the exhibits had suffered somewhat. As far as the general exhibits are concerned, he thought that Japan, Germany and Italy had shown greater care and preparations than many other countries, even than the American exhibitors in some respects.

Electricity Day at the World's Fair.

An elaborate programme prepared by Professor Goldsborough and the exhibitors in the Palace of Electricity was carried out on Electricity Day at the Fair, September 14th. During the forenoon the exhibitors were at their posts to welcome visitors and demonstrate the use of the many interesting electrical machines and appliances. The large building was decorated with bunting and banners and at night was brilliantly illuminated. There were also special decorative lighting features about the grounds.

At the close of the forenoon session of the American Institute and British Institution of Electrical Engineers in Festival Hall the electrical men were escorted to the Palace of Electricity, where they were entertained at luncheon by the exhibitors in the main entrance hall. A band in the court of the building furnished music. Following the luncheon the Electricity Day parade took place over the main avenues of the Exposition grounds. After this the delegates and visitors to the Congress took part in the formal opening of space-telegraph communication between the Exposition grounds and Chicago. This event was of more than ordinary interest. An account of it appears elsewhere in this issue.

The reception came in the evening, when the Palace of Electricity was handsomely illuminated and the different booths were also specially lighted. All moving exhibits were in operation. There was a series of electrical displays about the building. The most interesting was a high-tension discharge demonstration at 500,000 and 1,000,000 volts, arranged on the north side of the building by professors and students of Purdue University.

The reception in the Palace of Electricity was in honor of the president and members of the International Electrical Congress. All the machinery in the building was in motion for the benefit of the guests, who took advantage of the opportunity to inspect the exhibits. The gentlemen who were on the reception committee were Messrs. H. W. Pope, E. Dixon, E. Solari, O. Zwingenburger, P. Letheul, W. A. Layman and J. S. Lamlin. In the receiving line were Prof. and Mrs. W. E. Goldsborough, Prof. Elihu Thomson, President Francis, Mr. and Mrs. F. J. V. Skiff, R. Kaye Gray of England, Professor and Mrs. Ascoli and Mr. and Mrs. F. H. Gale. Many guests were present, among them many local society people and the majority of the visiting electricians.

An idea of the number of people visiting the exhibits during the day may be gained from the announcement of Mr. H. W. Pope, who states that 16,084 persons visited the exhibit of the American Telephone and Telegraph Company in Electricity Building on Electricity Day.

A movement is on foot, it is said, to purchase and control 20 different trolley roads in various sections of Massachusetts and Northern Connecticut. This will also include the construction of a large number of amusement parks in connection with the electrical enterprises. The United Gas Improvement Company, whose corporation is considered to be in control of the Connecticut Railway and Lighting Company's network of roads in that state, is said to be largely interested in the negotiations. The purchase of lines and the construction and improvement of parks will involve an expenditure of some $7,000,000.

World's Fair Visitors of Last Week.

Among those registered last week at the booth of the Western Electrician in Electricity Building at the St. Louis Exposition were the following: J. George Kaelber, Rochester, N. Y.; Dr. Wilhelm Hosaens, Rothan, Bohemia, Austria; Dir. Torcf Takoubck, Komorau, Bohemia, Austria; F. Eiscuman, Kirolsbau, Bohemia, Austria; C. M. Cariapa, Mercara, S. India; E. F. Kirkpatrick, Chicago, Ill.; C. H. Morton, Morton Grinding Company, Worcester, Mass.; H. R. Allenworth, Columbus, Ohio; James F. Burns, Schenectady, N. Y.; Joseph B. Starshall, Lemont, Ill.; O. C. Brown, Bucklin, Mo.; K. Nemoto, Tokio, Japan; J. W. Ricke, Grand Rapids, Mich.; A. S. Dixee, St. Louis, Mo.; B. E. Salisbury, Solvay, N. Y.; J. W. Brooks, Syracuse, N. Y.; H. W. Wilson, Bokcheld, I. T.; J. R. Conner, Huntsville, Ala.; Edward R. Taylor, Penn Yan, N. Y.; Ben J. Dalter, Louisville, Ky.; C. Mercadal, New Orleans, La.; Alberto Pecchi, Florence, Italy; T. K. Manemilon, New York; George Johnson, New York; Walter Erdman, St. Louis; W. Q. Chase, Bellingham, Wash.; J. Mahler, Fremont, Ohio; Lewis Monter, Fair Grove, Mich.; Arthur Q. Einstein, Electrical Appliance Company, Chicago; H. P. Jennings, Chicago, Ill.; W. S. Sisson, D. & W. Fuse Company, Providence, R. I.; James B. Olson, India Rubber G. P. I. Company, New York; F. M. Pierce, Electrical Supply Co., Chicago; Carleton H. Burrows, Bloomington, Ill.; Curtis McCain, Bloomington, Ill.; Mr. and Mrs. A. E. Saman, Cincinnati, Ohio; John Thomas, Jersey City, N. J.; W. R. Gunnison, St. Louis; Samuel David, Laclede, Ill.; G. R. Hurst, Beloit, Wis.; Frank M. Welch, Martinsville, Ind.; Herman Andrea, Milwaukee; J. F. Wiley, Standard Underground Cable Co., Chicago; J. D. E. Duncon, New York, N. Y.; Stanley L. Pierce, Philadelphia, Pa.; D. W. McMillen, Chester, Ill.; J. E. Ansmus, Paris, Texas; Harold Rossi, Mexico City; Charles F. Scott, Pittsburg, Pa.; Ralph W. Pope, secretary A. I. E. E., New York, N. Y.; A. T. Beck, Charleston, W. Va.; C. L. Slomeger, Morton, Ill.; J. C. Hughton, Farmdale, Ill.; Mr. and Miss R. Maldonado Leon, Gr. Mexico; John Cessna, Albia, Iowa; Mr. and Mrs. H. B. Merritt, Philadelphia, Pa.; Nat F. Prentice, Minneapolis, Minn.; H. C. Kendall, Joliet, Ill.; Mr. and Mrs. Nelson Howard, South Dakota; Mrs. Edward Johnson, Lamesboro, Minn.; W. C. Keeman, chief draftsman of United States Navy Yard, New Orleans, La.; Leon C. Weiss, mechanical engineer, New Orleans, La.; W. A. Weaver, Williamsport, Pa.; S. R. Weber, St. Louis; H. N. Rus, St. Louis; Carl Smith, Muncie, Ind.; J. L. H. Trey, St. Louis; J. D. Hall, city electrician, Peoria, Ill.; R. P. Lowther, Grandin, Mo.; W. T. Pittman, Franklin, Texas; Henry Marty, St. Louis; D. E. Godwin, Fort Worth, Texas; Mr. Smith, Fort Worth, Texas; J. H. Goehst, Chicago Edison Company, Chicago; R. Feld, Chicago; J. Yossen, St. Louis; J. B. McMullin, E. A. Company, Chicago; W. J. Tenny, Hamlin, N. Y.; E. J. Pietzcker, Chicago; Ira F. Nestor, Morgantown, W. Va.; Roy I. Wallace, Kendallville, Ind.; Earl Pierce, Kendallville, Ind.; A. M. Obrecht, St. Louis; George Anderson, St. Louis; C. W. Harris, Merkel, Texas; J. W. Perkins, Melrose, Mass.; Beverley Tucker, Toronto, Ont., S. P. S., Toronto; W. D. Dougherty, Pittsburg, Pa.; Mrs. W. A. Kreidler, Chicago; Mrs. F. L. Perry, Chicago; Frank L. Perry, Chicago; W. A. Kreidler, Chicago; G. M. Smith, Beloit, Wis.; Belden B. Ran, Beloit, Wis.; Mr. and Mrs. J. C. Welch, Baltimore, Md.; G. S. Thompson, Benhow, Va.; William Higginbothom, Frankfort, W. Va.; H. Bowen Daily, Tazewell, Va.; R. E. Heine, Chicago; J. F. Strickland, Dallas, Texas; Roy B. Graham, Stockton, Kan.; Norman Laird, Columbia, Mo.; F. W. Downs, Washburn, Wis.; Alfred Eckstrom, Sparta, Mich.; J. W. Lacy, Brookfield, Mo.; W. O. Floreth, St. Louis; F. S. Palmer, electrical engineer for the Consolidated Engineering, Light and Power Company, New York; R. F. Schuchardt, Chicago; Francis Raymond, G. I. Company, Chicago; George Carson, Iowa City, Iowa; Jean Miller, Meta, Mo.; Mr. and Mrs. C. A. Nichols, Chicago; J. H. Scott, Kirksville, Mo.; E. Boynton, Peoria, Ill.

Meeting of the Illinois State Electric Association.

The coming annual meeting of the Illinois State Electric Association will be held at Decatur, Ill., on October 5th and 6th, with headquarters at the office of the Decatur Railway and Light Company. The business sessions will be held in the Elks' clubrooms in the same building. The programme, it is announced, will be very good. On the evening of the 5th seats will be reserved at the opera house for the association. The session on October 6th will be concluded at 1 p. m. At 2 p. m. the guests will take special electric cars, visit the new power house at Riverton and go from there to Springfield. The Hotel St. Nicholas will be the headquarters. From present indication, Secretary Chubbuck of La Salle announces that this will be a very successful meeting.

The Grand Trunk railway will substitute electricity for steam in the Sarnia tunnel, and will install a plant for that purpose to cost $500,000. The third-rail system will be used.

Direct versus Alternating-current Distribution for Large Cities.

The question of the best method of distribution to be used in large cities has never yet been settled to the satisfaction of all concerned; the relative advantages of alternating and direct current for this purpose will probably be discussed for a good long time to come.

Two papers read on September 13th before Section E of the International Electrical Congress are of much interest in this connection, since they represent the views of men who are experts in this branch of electric work, one for direct current and the other for alternating current, and also since they represent German and American practice.

The papers referred to are those of Dr. Gotthold Stern upon "The Superiority of Alternating Current for the Supply of Current to Large Cities," and Mr. Alex Dow upon "The Direct-current Distributing Systems of American Cities."

Dr. Stern is managing director of the Internationale Electricitäts Gesellschaft of Vienna and Mr. Dow is manager of the Edison Illuminating Company of Detroit. Space will only allow of abstracts of these papers to be given.

The Superiority of Alternating Current for the Supply of Current to Large Cities.

BY DR. GOTTHOLD STERN.

My proposition divides itself naturally into two parts: First, in which form of current the unit (kilowatt-hour) can be supplied by the producer at the lowest price, and second, in which form of current the unit is of most value to the consumer.

The production of direct current by steam-driven dynamos, in large cities, requires only short treatment in view of our experience to date. The necessity of subdividing the service between several smaller central stations built on expensive real estate and the difficulty of supplying them with coal and water in the midst of streets crowded with traffic, has led all modern electrical engineers to abandon this oldest method of current supply, even such as, until recent years, wished to have nothing whatever to do with alternating current.

It will be contended that smaller units could be apportioned more readily to the variable load created by the varying demand on an electric-light station; but on drawing the load curves of a characteristic summer and winter's day and circumscribing them by a broken-line diagram indicating the units in operation, it is evident at once that even in the largest stations a sufficient relation between engines in operation and the load on the station can be secured by six to eight units, including the reserve; this number is still further diminished in the case of direct current if the load is equalized to a certain extent by batteries.

We must not forget, however, that alternating-current working has also its inconvenience; the separate exciter in the case of the alternating-current generator is a certain complication, and the paralleling of alternators undoubtedly requires somewhat more practice than paralleling of direct-current dynamos.

Finally, we must not leave out of consideration the advantages inherent in the direct current in connection with the possibility of its storage in storage batteries. If this possibility were coupled with smaller losses and if storage batteries had greater durability, there would be established a preference which for many purposes would outweigh many other disadvantages. Unfortunately, however, both conditions have not been fulfilled. The real purpose of a storage battery should consist in changing the variable load on the central-station machinery to a more uniform load, i. e., to almost integrate the daily load curve. We should then reach a steady loading of the engines and boilers and they would operate continually at highest efficiency. The increased safety attained by the application of storage batteries is certainly very valuable as the batteries can take up at once the supply of current should an accident occur to the machinery.

But with what losses and costs is coupled the operation of storage batteries! It appears from statistics of the "Association of Central Stations" in Germany that in cities with a population of over 200,000, in which storage batteries are used, the losses occurring in the batteries amount on the average to 33.5 per cent. The first cost of the storage batteries for each kilowatt-hour supplied through them amounts to 98 pfennigs (24.5 cents), and as interest and depreciation at the longest life of the cells—10 years—must be reckoned as at least 15 per cent. per annum, they increase enormously the cost of the current passing through them. If the cost of production of the kilowatt-hour at the dynamo terminals be 10 pfennigs (2.5 cents), it is increased by the losses in the storage batteries to 13.35 pfennigs (3.337 cents); and on account of interest and depreciation on the invested capital by 14.7 pfennigs (3.675 cents) additional, a total of 28.05 pfennigs (7.01 cents). Of course, the increase of price applies only to that part of the output which has passed through the storage batteries. In the cities above referred to this amounts on the average to 12 per cent. of the total energy produced, so that the storage batteries cause an actual increase of 21.6 per cent. in the price of the total production of current.

And notwithstanding this, it cannot be denied that storage batteries present a considerable advantage on account of the increased safety and better equalization of the service. This advantage cannot be realized, however, until such time as a good storage battery may be available—a time unfortunately not yet at hand.

The comparison will not be complete if the losses in the transformers are not considered also. The capacity of the transformers in well-planned alternating-current stations is less than the number of connected lamps; their efficiency is up to 99 per cent. at full load, and even at half load, and, in good construction, not under 97 per cent. Of course, the iron loss of the transformers is continuous while the transformer is in circuit.

In the case of a large city, with a diameter of about five kilometers (3.1 miles), if it is desired to limit oneself to a single station—and it is desirable to do this for many reasons—it becomes necessary to use high tension, to avoid the expenditure of unheard-of sums for copper conductors, and the enormous loss of energy in the cable network. If some measure of importance is attached to uniformity in the pressure furnished to the consumer, the demonstration of this statement by actual figures need hardly be required at this time.

Direct current can hardly be seriously considered for high-tension: First, because it is almost impossible to maintain high-tension, direct-current dynamos in operating condition; secondly, because high-tension direct current can be transmitted by cables only with great difficulty, and thirdly, because the pressure of direct current can only be converted by rotating machinery.

Alternators, on the contrary, can be safely built for almost any desired high tension, the leading away of the current not presenting any difficulties, because the high-tension windings can be applied in the simplest manner to the parts of the machine at rest, and, therefore, not subject to displacement and the resulting strains.

Operating at the same pressure, conductors for alternating current are superior to those for direct current as regards safety and durability, for in the case of direct current in addition to the electromotive force, which constantly tries to effect an equalization between the conductors of different potential, thereby tending to break down the insulation, there is added thereto the electrolytic effect which exerts a destructive action, not only on the conductors, but under certain conditions, on neighboring metal parts also. This is particularly the case with underground cables, and probably no manufacturer has yet given a guarantee for an underground cable for direct current over 1,000 volts.

Alternating-current high-tension cables are, of course, subject to many dangers not present with direct-current cables; there are breakdowns caused by oscillations in pressure which arise with certain relations of self-induction and capacity, favored by the appearance of harmonic waves. Since these phenomena have become better known, it is not so difficult to provide protection against the consequences, and disturbances from these causes are avoided by the application of devices protecting against excessive tension and spark-gaps. High-tension alternating-current cables are always so constructed that the several conductors are inclosed under the same sheath and iron armor. This is necessary to avoid inductive effects.

It is, of course, also practicable, in the case of alternating current, to transform from high tension to the distributing voltage by rotary converters, and many large stations convert the high-tension alternating current into direct current of the pressure to be delivered to the customers. The opponents of alternating current give as a ground for this conversion that the alternating current cannot perform equally as good service as the direct current, the correctness of which assertion we shall test later on.

Transformers require no constant attendance; they occupy less space and their efficiency is higher. It is not difficult to construct transformers having 99 per cent. efficiency. Rotary converters with over 99 per cent. efficiency have probably not been constructed, and at partial loads the difference in favor of transformers increases, especially if the comparison is made between smaller types.

All of these circumstances lead to the fact that it is possible with transformers to increase notably the number of sub-stations without sacrifice in economy of cost of installation or of operating. In such cases the sub-stations supply only a small area of the city, and the influence this has upon the cost of the secondary network is clearly apparent.

In the case of rotary-converter installations, in order to secure larger units and a smaller operating force, and because it is difficult to obtain suitable real estate for sub-stations, it is desirable to limit the sub-stations to the smallest possible number; the primary circuits are in consequence somewhat shorter, but the increased cost of the secondary network is many times this saving.

It is desirable then to select as high a secondary pressure as possible, delivering to the consumer by a three-wire system of 2x200 volts, or even 2x 250 volts, not forgetting, however, that by so doing the mistake which it is desired to avoid becomes emphasized—the delivery to the consumer of a less valuable kind of current.

We have now touched upon the second question which I advanced: Which kind of current is of more value to the consumer? In connection with the house wiring there appears at once a great difference. The same conditions which appear to make the direct-current conductors in the street inferior as regards durability and safety hold in a still higher degree in favor of the alternating current in residences. The insulation of direct-current house wiring at the same pressure must be better on account of the more severe requirements imposed by the electrolytic effects; they are on this account dearer for the same safety, or at the same installation cost, are less safe. Furthermore, the distributing pressure in the case of direct current must be higher on account of the greater distance between the sub-stations, causing an additional difficulty in this direction. Finally, it appears, that on account of the secondary network with widely ramified branches, every lack of insulation at every point either in the street cables or in any house installation, causes an undesirable disturbance in the installation of every consumer connected to the same sub-station.

The most desirable from the standpoint of the consumer is, therefore, an alternating-current service with house-to-house transformers at low secondary pressure. I believe I am not saying too much when I maintain that the consumer will also prefer the alternating-current meter to the direct-current in the long run. Without the commutator or brush contacts common to most direct-current meters, it is a simpler instrument and subject to fewer troubles. The clock meters of the American type are constructed for both systems, and the electrolytic meter has been abandoned for many years.

The consumer in a large city uses electricity primarily for lighting and usually with incandescent lamps; arc lamps and motors occupy a second place, and, finally, we may consider several special applications for medical purposes, etc., which, however, would not determine a preference in the selection of the type of current. After careful reflection I have not put motors in the first place in the consideration of central-station service, as is generally the case. Although the question as to which form of current is best adapted for motor service should not alone determine the choice of the system, it is, nevertheless, a factor which must be considered. Until several years ago the majority of electrical engineers recognized only the direct-current motor; since the discoveries of Ferraris and Tesla in connection with the concatenation of alternating-current circuits, all this has gradually changed, and today the polyphase motor is no doubt superior to all others. In large cities it is largely a question of application to industries of a character in which the motor will receive but little attention—small factories, private establishments, bakeries, butcher shops, etc., services which require that the motor should operate as soon as the switch is thrown. The commutator is an obstruction for such service: it is often neglected and then gives rise to disturbances; even the rheostat which must be switched in is too complicated.

The polyphase motor is of a type which of all electrical machines, has the least mechanical workmanship, possesses the fewest number of parts subject to wear, requires least repairs, and approaches most nearly the ordinary machine construction. As regards efficiency, it is the equal of the best direct-current type, and produced in quantities its cost of production is less than direct-current motors. Even the constructions with contact rings are characterized by their simplicity as compared with direct-current motors, and possess all of the characteristics through which the shunt direct-current motor secured its extensive introduction for steadiness of running, regulation of speed and large starting torque.

One of the most important applications of the electric motor in large cities is the driving of elevators. In the continental cities of Europe this part of the service is not very lucrative for the central station, as the average use is very small and is contemporaneous with the lighting maximum; however, the elevator service is the best means of securing the introduction of electric lighting in a house. In this service also, the polyphase motor has surpassed the direct-current motor; it has, like it, a steady speed; it can be arranged for equally large starting torque; it is reversible with equal ease, and much less sensitive as to its windings, which in the case of shunt direct-current motors, particularly for 2x 200-volt systems in which the motors are wound for 400 volts, are easily burned out by careless switching, and in other respects is subject to greater repairs than the polyphase motor.

As regards the utilization of the electric current for incandescent lamps, the two kinds of current have for a long time been considered as of equivalent value. This is really the case at the same pressure; but the fact is becoming more recognized that the filament incandescent lamps are more advantageous at low than high pressures. But the direct-current stations have a tendency, in order to utilize their net works to best advantage, to raise the pressure, while in the case of alternating current, especially with house-to-house transformers, the service pressure can be chosen almost as low as may be desired. The 200-volt incandescent lamp, according to exhaustive tests, consumes 20 per cent. more current with the same life or at the same efficiency; it has 20 per cent. shorter life than the 100-volt lamp, while the cost is 15 per cent. greater. Two-hundred-volt lamps of less than 10 candlepower or less than 2½ watts per candlepower, cannot be produced as yet. Extensive tests have shown that in order to

operate filament incandescent lamps most economically, it is necessary to go below 100 volts and down to 50 and 25 volts. The newer types of incandescent lamps, like the Auer osmium lamps, with their wonderful efficiency, cannot be advantageously manufactured above 35 volts.

The alternating-current arc lamp was for a long time considered of less value than the direct-current arc lamp. As a matter of fact, with the same consumption of energy at the lamp terminals, the useful developed light is about 20 per cent. greater for direct current than for alternating current. This relation changes at once, however, if account is taken of the fact that about 20 per cent of the energy necessary for a lamp is expended without utilization as a steadying resistance, and this loss can be reduced to a minimum in the case of alternating current by economy coils and inductive resistances. With the alternating current there is secured at the same time the independence of each lamp, while with direct current only two or three lamps can be simultaneously operated on 110 volts and four or five lamps on 220 volts. Enclosed arc lamps of the Jandus type which require higher pressures do not give the light output which is the advantage of the direct-current lamp and they require still greater steadying resistances.

The production of current is too costly as yet for it to receive wide application for heating purposes. The type of current is indifferent for most heating appliances, but in the case of electric furnaces, where the electrolytic effects might come into play, the direct current is excluded, as also in the case of intense heat from large currents at low tension, in the generation of which special transformers afford the best means.

On the other hand, the direct current meets with better success in soldering with the arc and for large projectors for demonstration. No one would think of supplying a city with direct current on this account, if alternating current were more advantageous in most other respects. For such purposes in isolated cases motor-generator sets can be used which generate the direct current at once of the desired pressure. This is the case for electrolytic purposes, for which, even with direct current, motor-dynamos are often necessary for conversion in order to avoid too large resistances and the excessive losses due to the reduction of pressure often necessary.

Until we have available lighter storage batteries the electric automobile will have but little hope for a wide application. Charging stations for automobiles, if supplied from an alternating-current distribution, must be equipped with motor-generator sets; but this complication brings with it an advantage, in that the charging pressure can be easily adjusted to the number and state of charge of the cells on charge without additional losses.

On the other hand, there are a large number of special applications which can be enumerated which require in the case of direct-current distribution a conversion into alternating current; for instance, for physicians and dentists who generally require alternating and direct current for instruments which need both kinds of current, for lectures, for watchmakers, for demagnetizing watches, etc.

The Direct-current Distributing Systems of American Cities.

BY ALEX DOW.

In its essentials the system of distribution which I describe is that which has been employed by the Edison companies of the United States for 20 years past. The independent steam-power district stations of the original Edison plan have in many cases been replaced by sub-stations receiving and transforming power transmitted from a single generating station.

In speaking of large cities I have in mind cities of a population of 250,000 or upwards. It is to be noted, however, that what I may call the Edison system of distribution is to be found in many cities of a much smaller population. Generally speaking, that system will be found in any American city which has a well-defined business district. It was in the business and shopping districts as distinguished from the residence and manufacturing districts of our cities that the Edison system had its early development. In these districts only could—at least in the early days of electric lighting—such loads be obtained as would justify the installation of underground mains. In later years, with the increasing use of electric light and power, the Edison distribution system has been extended to residence districts and in some cities throughout the entire settled area, these extensions being with underground or overhead mains as the demand for service, or as municipal regulations, might dictate.

For reference I append a table showing for the eight cities which I mention herein, the population, the municipal area and the area served by Edison distribution.

	Population, Census 1900.	Estimated Population 1903-04.	Area, Sq. Miles.	Area Served By Edison Distribution, Sq. Miles.
Boston	560,892	600,939	43	3.6
Buffalo	352,387	425,000	51	5
Chicago	1,698,575	2,231,000	190	12
Cleveland	381,768	426,000	33	1.5
Detroit	285,704	317,000	29	3.2
New York (Manhattan)	1,850,093	.....	22	15.5
Philadelphia	1,293,697	1,700,000	129.5	3
St. Louis	575,238	612,279	62.5	7.5

NOTE.—The built-up areas outside of the central business district of each city (except Manhattan) have electric supply by alternating currents. The direct-current distribution of Manhattan Island covers all the built-up territory of the island. Each city named has within its municipal area much land not yet built on.

The companies using the Edison system do not abjure the alternating current. They use it not only in transmission, but for general distribution in areas where the density of business is not sufficient to warrant the construction of an Edison network. They supply alternating current to motors, both polyphase and single-phase in these outlying areas. In fact, the so-called Edison companies are among the largest distributors of alternating current for general use.

In the older steam-driven generating stations each engine carries two dynamos connected one on each side of the neutral wire of the three-wire system. These dynamos are shunt-wound and can be regulated by hand for any voltage between the standard pressure of the network and the maximum pressure required to supply the longest feeder. In stations constructed within the last six or seven years the pairs of dynamos are usually only sufficient to provide for the balancing of the system and single dynamos, of the voltage proper for connection across the outer wires, furnish the greater part of the output. Substations are in some instances purely storage-battery stations, in which case the battery is charged from the network by motor-driven boosters during the hours of light load or else through a direct-current tie line from the nearest generating station.

The apparatus for transforming alternating current to direct has thus far in the majority of cases been the rotary converter, but there is a large minority preferring and using motor generators. As a rule, those companies whose alternating-current transmission is at 25 cycles use rotary converters for transformation and those other companies whose alternating-current transmission is at 60 cycles prefer motor generators. There are, however, some notable exceptions; as (for instance) the Cleveland Electric Illuminating Company, which uses 60-cycle rotary converters, as also do several Pacific Coast companies; and the Buffalo General Electric Company, which uses motor generators to convert the 25-cycle Niagara supply.

Obviously the multiplication of sub-stations means the reduction of the investment in feeders. The network of mains will be the same whether it is served from one station or from several, but the cost of feeders will be much reduced if the service is from several sub-stations instead of from one. In general it pays to increase the number of sub-stations so long as the reduction in cost of feeders will pay for the land and buildings.

Pressure wires led back from feeding points are used to indicate in the station or sub-stations the pressure maintained on the system. The regulation is performed by a switchboard attendant. Neither automatic regulating devices nor the compound winding of generators have been approved by the Edison companies. The switch gear is so arranged that separate groups of feeders may be connected to separate generators or banks of generators. The longer or heavier loaded feeders are thus connected to and served by a generator which is operated at a higher pressure than that required by the shorter or less lightly loaded feeders.

The network itself may be either overhead or underground, but in all cities of the first class the mains in the central districts have been underground from the beginning. In small cities and in the less densely populated districts of the large cities overhead mains are customary. The Edison tube is still in use as a distributing main. It is likely to continue in use for many years to come. As manufactured during the last 10 years it has proved to be a reliable and convenient form of conductor. The only radical difference between the older and newer form of Edison three-wire tube is that in the new tube more space is left for insulating compound around the coppers. Tubes of 2-inch internal diameter containing three 200,000-circular-mil (0.157 sq. in.) coppers, and tubes of 2½ inches internal diameter containing three coppers either of 350,000 circular mils (0.275 sq. in.) or of 500,000 circular mils (0.392 sq. in.) are the sizes in most common use. The connections between sections of the underground network are fusible links of sheet copper of such dimensions that they will fuse at twice the "overload rating" of the mains they are intended to protect.

From the commercial point of view the adoption of direct-current distribution was warranted in the beginning by the fact that the capitalist who desired to invest his funds in an electric-lighting enterprise could obtain an operative direct-current system complete in all its details from the generating plant to the last translating device without engaging in any experiment, and with a positive certainty as to the operative efficiency and a reasonable certainty as to the extent of the repair bill. The capitalist who invested in direct-current central-station apparatus in the early days of the industry usually made money. The capitalist who invested in alternating-current apparatus almost invariably lost money. It is necessary in recalling the causes which led to the commercial success of the Edison companies to recognize the effect of the establishment among them almost from the beginning of a uniform system of accounts and reports and of arrangements for the confidential distribution and exchange of practical information. The system of accounts, although far from complete, served for the making of intelligent comparisons.

The reasons for the persistence of the use of direct current are not merely commercial, but are technical. The immediate and obvious commercial reason is that the existing investment in direct-current apparatus is so great that only some tremendous advantage to be gained by a change—an advantage very much greater than the most extreme advocates of alternating current have yet suggested—could possibly warrant the wiping out of our present equipment. That equipment includes not only our central-station machinery but the immense investment of our customers in motors and the investment made both by our customers and ourselves in arc lamps. How great these investments are must be obvious even to our most recent visitor. It is well, perhaps, to give some idea of the investment in direct-current motors which, scattered around in customers' premises, are not so apparent to a chance visitor. On the Island of Manhattan, for instance, there are connected to direct-current distributing circuits approximately 15,000 motors, having a capacity of 85,072 horsepower. In the direct-current area of Chicago the connection is over 9,000 motors, having a capacity of 43,230 horsepower. In the comparatively small city of Detroit the connection is 872 motors of 4,541 horsepower. You will note that the average horsepower is small. You will please also understand that this connection does not include fan motors, dental motors and similar little machines. It includes only motors of one-half horsepower and upwards. The expense of substituting alternating-current machines for these direct-current machines would have to be borne by the electric-light company. The customers would not stand it.

To sum up the case in favor of the distribution of alternating current in our urban districts: The advantages to be obtained are a reduction in the first cost of engines and boilers; a reduction in the cost of sub-station apparatus because of the substitution of transformers for converting machinery; and a longer life for the glowers of Nernst lamps. The disadvantages are inferior regulation of voltage or (as an alternative) greater cost of mains and feeders; inferior arc lighting and greater cost of arc lamps; special contrivances required for charging small storage batteries; and the requirement that to each large storage battery be added converting machinery capable of carrying the maximum discharge of the battery. These advantages and disadvantages seem to be permanent consequences of the difference between the two currents. Temporary disadvantages of the alternating current are the greater cost of constant-speed motors and the lack of satisfactory motors for elevator work. I am perhaps optimistic in terming these motor disabilities "temporary." My conclusion is, after in many specific cases comparing these advantages and disadvantages, that the direct current is at least equal, and likely to remain equal, to the alternating current in its suitability for general distribution, and over and above its inherent equality it has the immense advantage of prior occupation of the territory.

Discussion.

Col. R. E. Cromoton: I have come from England with other English engineers to learn by discussion with you gentlemen here matters covering the whole question of electric supply, and I am particularly anxious not to appear didactic or positive, because certain of our conclusions that we have arrived at in England vary from yours. We want to say why we have come to certain conclusions in England which differ from conclusions you have arrived at here and I take it that these two very excellent papers which have been read represent the point of view from which the subject is looked at by American engineers. I therefore wish to make it clear at once that it is not the point of view from which we put it to English engineers. English engineers have had a problem to solve which differs materially from the American problem. You have not had the gas competition that we have had—you have not had cheap gas installed in every dwelling all over the towns we have had to supply with electrical energy. Further than that, your towns are so built that the industrial parts of the town are mixed up with the residential part—I speak under correction—that until quite recently the motor load throughout the United States has been of greater importance than we have been able to make the motor load in England, at all events. There are exceptions in some of our towns, Manchester and Glasgow, and certain parts of London, where the motor load has begun to be of great importance.

Now we come to the great variety of systems and results. In England we started with three-wire, 200 or 220-volt systems, distributed into 110 volts. Practically we have doubled it everywhere. The largest cities in England, London with its six millions, and four other cities with over 800,000, have practically adopted, after very careful consideration, what you have called this double-voltage system. It was not adopted without a struggle. The struggle was on the side of the consumer, who was told, and probably with reason, that he was at some disadvantage, and he probably was, at the commencement.

I may tell you that the people who mainly started the consumer in the contention that 100 volts was better for him than 200 volts were the lamp manufacturers. They said they could not make the double-voltage lamps to give the high efficiency of the single-voltage lamps. But we forced them to do it, and they do it now, and there has been case

after case, arbitration after arbitration, which showed practically that for lamps of 16 candles and upward there is no practical difference. There may be a difference, but it was so small as to be negligible. As a result, the majority of our consumers have their supply at over 200 volts in London and 250 volts in Glasgow.

I think I am correct in saying that all the large distributing systems, all the large central stations in England, that have gone over, have gone over with economical advantage, and with the result that the cost of the kilowatt-hour, the Board of Trade unit as we call it, has been steadily diminished, and now that we have the full advantage of this double voltage in the distribution systems, we find that we have got greatly reduced cost. You have great advantages here and we have great advantages in England. We are greatly indebted to Mr. Hammond in this matter. Mr. Hammond for 13 years has been analyzing the accounts of the large power companies in England, and publishing them.

Robert Hammond: Col. Crompton has made a kindly reference to the analytical work which for the past 15 years I have carried on. We have the very great advantage in England of holding powers under government which makes it a condition that the actual cost of operations of the concerns under certain headings, prescribed by them, must be duly filled out at the Board of Trade, which reports must be handed out to any one interested in them, or rather copies of the reports, upon the presentation of a quarter, or, as we call it, a shilling. With the necessary number of shillings I have gone and I have demanded the accounts of every single electrical concern in the country.

We do seriously think that the companies throughout the length and breadth of the United States will have to tackle this question of doubling their voltage. We grasped the problem which lay before us in England by supplying so many million lamps—giving them away—and we had to face it, because we felt that if we did not face it, we should have to put in so much capital in extra distributing mains, and the interest and depreciation on this would far outweigh any small difference in efficiency. We read in these papers of loss of current. Take a system with which I am connected in London. We started, not with a clean field—we have not had the opportunities of starting with clean fields—but we started with a little system and gradually built it up to a bigger system. But when you start with a clean sheet, what do you do? You go on in a bold manner; you do not begin in a peddling way, but the result was that we spent $600,000 in the generating plant, everything outside of the distributing system, and $600,000 in the distributing system. Had I not been using straightaway the 480 volts pressure, I should have had to recommend these gentlemen, much against my desire, to spend instead of $600,000, $2,400,000 in mains, but by the application of 480 volts, and the supplying of lamps at 240 volts, I was able to keep down the distributing system over a large area to the sum of $600,000. The result of the first year's work was, the supply of electricity beginning at nothing and running up to a matter of 60,000 lamps at the end of the year, that we were delivering to the consumers at an all-around cost, excluding the interest upon the capital, but an all-around operating cost of generating and distribution, of 2 cents (1.03 pence) per unit. We can see, by having these costs to compare with one place and the other, that this use of the higher voltage plant is not the wasteful use that some would make it.

Chicago Street-railway Situation.

There are persistent rumors afloat that a syndicate of Chicago Union Traction Company interests is forming for the purpose of securing the majority of stock in the Chicago City Railway Company and merging the two systems. It is even asserted that the merger will probably be effected before the City Council assembles to consider the ordinance pending for the Chicago City company. Such action would further complicate franchise-extension negotiations. However, the members of the council committee on local transportation say that the present ordinance represents their views covering both companies and no radical changes will be entertained by them even if considering the two systems, and the terms embodied in the tentative ordinance for the South Side company will be demanded for a universal system. It is stated that an offer of $200 a share is made by New York interests in control of the Union Traction for the Chicago City stock, on condition that a majority of the stock be tendered.

Immediate municipal ownership advocates are hard at work in an effort to prevent the passage of the tentative ordinance by the council. Should they secure the required number of signatures demanding a referendum, and, to add to the troubled traction situation, should the two street-railway systems be merged, it is hard to tell what the next move in the complicated situation will be.

Judge Lanning, in the United States Circuit Court at Trenton, N. J., made an order authorizing Receiver James Smith, Jr., to lease the Atlantic Coast Electric Railroad Company to the Seacoast Electric Railroad Line. The latter company's line connects at Belmar, N. J., with the Atlantic Coast Line.

Loaded Telephone Lines in Practice.

By Dr. Hammond Vinton Hayes.

The mathematical discussion of the theory of loaded telephone lines has been fully given in the writings of Prof. M. I. Pupin and Dr. G. A. Campbell. In the present paper it is intended to state briefly the results which have been obtained by the use of loading coils on many of the telephone circuits of the Bell companies.

In every problem affecting the transmission of telephone waves over a line, there are two factors to be considered—the attenuation and the distortion of the waves. The loss of energy of the waves upon the line must be kept at a minimum and the several component waves of the telephone or voice waves must be transmitted without unequal relative impairment.

Distortion.

The introduction of lumped inductance in the form of loading coils upon a telephone line tends to increase the distortion by the possible unequal reflection of the component waves of different periodicities, and by the possible unequal attenuation of the several waves in passing through the coils.

Reflection Losses.

The mathematical work of both Pupin and Campbell showed conclusively that if several loading coils lay within a wave-length on any particular loaded circuit, and the coils themselves were theoretically perfect, the circuit was distortionless. The spacing of the coils upon a circuit in practice, therefore, depends simply upon a determination of the highest periodicity that should be retained in the telephone waves in order to maintain the character of the voice waves unimpaired. It has been found convenient in studying the spacing of loading coils to consider the number of coils which would be passed by a wave front on each particular circuit in the unit of time, or a second. As the velocity of all waves upon a given circuit is the same, and as the wave-length for any periodicity can be readily determined from the velocity, this convention makes it possible to readily determine the number of coils lying within any particular wave-length.

A large number of long telephone circuits have been equipped with loading coils, the spacing of the coils upon the several circuits being such as to produce a range of the number of coils per second between 13,000 and 7,000. A comparison of the transmission over these several circuits has shown that the quality of transmission is not appreciably impaired even with the lower number of coils per second. This seems to indicate the lack of importance of the overtones of very high periodicity in the successful transmission of speech.

It can be said, therefore, with considerable certainty that the distortion due to reflection losses in a loaded telephone circuit can be neglected, provided the coils are so spaced upon the line as to give at least 7,000 coils per second, and that this spacing of the coils is substantially uniform throughout the line.

Distortion in Coil.

To entirely eliminate distortion in a loading coil, it is necessary to have it so designed that the effective resistance of the coil to all the essential periodicities of the telephone waves shall be the same. Such a coil is theoretical, and cannot be obtained in practice. A loading coil is primarily one so designed as to provide a required amount of inductance, and must, of necessity, consist of several turns of wire. Moreover, to prevent attenuation, it is imperative that the resistance of the coil be kept as low as possible. To make the resistance of the coil low, the wire employed should be of copper of large size, and the number of turns of wire in the coil should be kept small. A reduction in the turns can, other thing being equal, be most easily obtained by the use of iron for the core of the coil. If the coil is made entirely of copper, the effective resistance of the coil with the frequencies within the range of telephone periodicities will differ from the resistance by an amount corresponding to the losses due to eddy currents in the copper. If iron forms a portion of the coil, there will be, in addition to the eddy-current losses in the copper, eddy-current losses in the core, as well as hysteresis losses in the iron, which will augment the difference between the resistance and the effective resistance. As it is impossible to eliminate the eddy current and hysteresis losses entirely, the effective resistance of a loading coil will vary with different periodicities, and thereby tend to produce distortional losses in the transmitted telephone waves. The difference between the resistance and the effective resistance, at telephonic periodicities, can be made much smaller in a coil composed entirely of copper than in one having an iron core.

Practical and commercial reasons demand an iron-cored loading coil, provided that such a coil can be so designed that its use in a telephone circuit will not be productive of appreciable distortion. To determine whether in practice, there was appreciably more distortion introduced by loading coils having iron cores, as compared with those made entirely of copper, the two circuits first loaded were equipped, one with iron-cored coils, and the other with copper-inductance coils. The circuits were each about 1,000 miles in length. The coils used on these two circuits were spaced alike, and had the same inductance and approximately the same resistance. The effective resistance of the coil having an iron core was about 15.5 ohms at a periodicity of 2,000 per second and that of the copper coil 11.8 ohms at the same periodicity. These circuits thus loaded were compared with each other with the greatest care and no difference was apparent either in the character or quality of the telephone transmission. These tests are again confirmatory of the fact that the suppression or reduction of the waves of the highest periodicities of the voice waves does not appreciably affect the quality or intelligibility of transmitted speech. This experiment was considered as demonstrating conclusively the possibility of the commercial use of loading coils having cores of iron.

1. A paper presented before Section G of the International Electrical Congress of St. Louis, September 16, 1904.

Loading Coil.

A discussion of the theoretical dimensions of loading coils for different classes of circuits may be found in Dr. Campbell's paper, to which reference is above made. In practice the size and cost of the coil are factors requiring serious consideration. For aerial circuits, where the size of the line wire is large, and consequently the resistance of the circuit small, it is of the utmost importance that the effective time-constant, $\frac{L^1}{R^1}$, of the coil should be made as large as is consistent with reasonable cost. Except so far as the cost is affected, the size of the aerial loading coil is of no special moment, as the coils can be mounted singly upon the poles. The time-constant of a coil can be increased by enlarging its size, but such increase in size increases its cost. The best commercial loading coil is, therefore, the smallest coil that will give the required inductance and the largest effective time-constant.

Following the theoretical considerations as deduced by Dr. Campbell, the resistance of the coils which

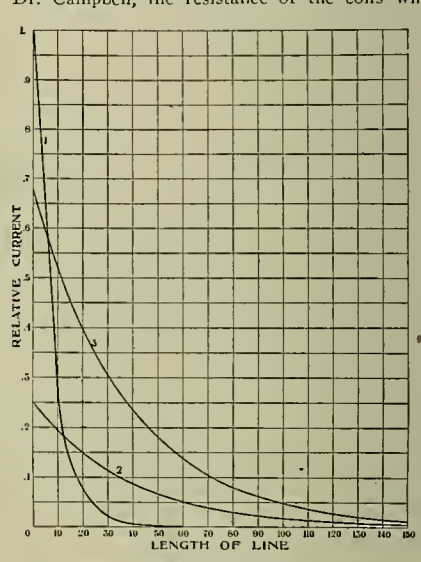


FIG. 1. LOADED TELEPHONE LINES.—RESULTS OF TESTS OF HEAVILY LOADED LINES.

have been used on aerial circuits has been made 2.4 ohms. The design of the core, the permeability of the iron, the subdivision of the iron and the copper have been made such that a loading coil has been produced having an inductance of 0.25 of a henry, a time-constant of 0.048 second, at a periodicity of 1,000 periods per second, and a bulk of approximately 314 cubic inches. This coil is toroidal in shape, 10 inches in diameter and four inches high. It has an effective resistance of 15.5 ohms at 2,000 periods per second.

Coils designed to be used on cable circuits in which the size of wire employed is much smaller do not require to be made of as low resistance as the coil above described; consequently their size and time-constant may be made much smaller. Large numbers of cable-loading coils have been placed in service, their design varying with the character of the circuit upon which they are to be used.

Reflection.

In the terminal apparatus at present used in telephony, or where there is a condition of non-uniformity in the character of the line, the telephone waves suffer a reflection, which, in many cases, is effective in materially increasing the attenuation. This reflection is particularly pronounced at the point where an unloaded section of line is connected to a loaded section. The amount of reflection is greater the greater the divergence from homogeneity. Thus a section having large inductance per mile, when connected with a non-loaded section, exerts a larger reflective action than one having a small inductance per mile.

In practice, the effect of reflection is of very considerable importance, particularly when the loaded section is not relatively long. Theoretically, these reflection losses may be eliminated by the use of a perfect transformer introduced at every point of non-uniformity in the line. Even could such a perfect transformer be made, its introduction on commercial circuits is open to practical objections, and, as a substitute, its equivalent, in the shape of a series of coils of varying inductance, has been em-

ployed. This arrangement of coils of varied inductance is known as a "terminal taper." The arrangement of the several coils constituting the taper is such that a coil having an inductance somewhat less than that of the coils used on the loaded section is placed nearest the loaded line, a coil of inductance somewhat less than the first taper coil is placed next in order, and a coil of small inductance is placed nearest the non-loaded section, or the terminal apparatus. The spacing of the coils in the taper corresponds with that of the coils of the line of which it is to form the terminal.

Results Obtained on Commercial Circuits.

The following figures illustrate the results which have been obtained on several typical commercial circuits. In what follows, all comparisons are made on the basis of relative attenuation between similar circuits loaded and unloaded, without reference in any way to distortion or quality of the transmitted speech. The curves shown in these figures are the results of actual tests, made on commercial-loaded circuits, using standard terminal apparatus at the transmitting and receiving stations.

Loaded Cable.

In Fig. 1 are shown the results obtained in tests of a heavily-loaded standard telephone cable. In this cable the wires are 0.03589 of an inch in diameter, having a resistance of about 96 ohms per mile of circuit. The mutual capacity between the two wires of the circuit is 0.068 of a microfarad per mile. The inductance added to the circuit by the loading coils amounted to about 0.6 of a henry per mile. In this figure the abscissæ represent lengths of cable and the ordinates the relative strengths of current. Curve 1 is that representing the attenuation of current on an unloaded circuit as the length of cable is increased.

It will be seen that the attenuation increases very rapidly as the length of cable is increased. Curve 2 represents the attenuation on a similar circuit but loaded as above described, the terminal telephone apparatus being placed directly at the ends of the loaded cable, thereby obtaining the full effects of reflection. It will be noticed that the initial current on the loaded circuit is about one-quarter of what it is on the unloaded circuit. Moreover, the transmission on shorter lengths of the loaded circuit under these conditions is much poorer than the transmission over similar lengths of the same cable circuit unloaded. But the rate of attenuation per unit of distance is much less on the loaded than on the unloaded circuit; so that for the longer lengths of circuit the transmission is superior on the loaded circuit to that on the same lengths of unloaded circuit. Curve 2 shows the attenuation when no terminal tapers are employed and the reflection is a maximum. If terminal tapers are employed at the two ends of the loaded circuit and the telephone transmitting and receiving apparatus is connected directly to the tapers, the attenuation on the loaded circuit is represented by Curve 3. Here again it is seen that the initial current is considerably less than that on the unloaded circuit and that the transmission on short lengths of circuit is better on the unloaded than on the loaded conductors, but the introduction of the tapers on the loaded circuit has more than doubled the initial current and has shortened by about one-half the length of circuit which showed the unloaded circuit superior. A comparison of Curves 2 and 3 shows how great a factor the reflection losses are between the terminal apparatus and a loaded circuit and the importance of the taper in reducing these losses. In practice it has been found that reflection losses can be still further reduced and under special conditions almost, if not entirely, eliminated.

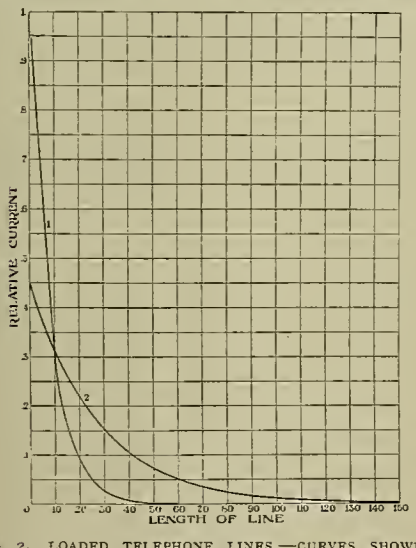


FIG. 2. LOADED TELEPHONE LINES.—CURVES SHOWING ATTENUATION OF CURRENT IN UNLOADED CIRCUIT.

In the case above described a large amount of inductance has been added to the circuit. The results which have been obtained upon cables where less inductance has been added are shown in Fig. 2. In this case the cable is substantially similar to that previously described. Upon it loading coils are placed so as to bring the inductance of the circuits up to approximately 0.17 of a henry per mile. In other words, the inductance is less than one-third of that in the case just described.

In Fig. 2, Curve 1 is similar to that in Fig. 1 and represents the attenuation of the telephone current in an unloaded circuit in the cable. Curve 2 represents the attenuation in the lightly loaded circuit when no tapers are employed and the telephone transmitting and receiving apparatus are placed at the terminals of the loaded cable. It is to be noted that the reflection losses are much less in the case of the lightly loaded cable than is the case in that having the heavier loading. In fact, for shorter lengths of cable the lighter loading is more effective in transmitting the telephone wave than the heavier. For longer lengths, however, the heavier loading gives better results. With proper apparatus at the terminals of the loaded cable to reduce reflection losses, much less attenuation would result than is indicated by Curve 2.

Loaded Aerial Circuits.

In Fig. 3 are shown the results which have been obtained on open-wire circuits composed of copper wire weighing 435 pounds to the mile. On these circuits loading coils were so placed as to make an inductance of about one-tenth of a henry to the mile. Curve 1 shows the attenuation with various lengths of line upon a similar unloaded circuit, and Curve 2 shows the attenuation on the loaded circuit when the telephone transmitting and receiving apparatus are placed directly at the ends of the line without tapers. Curve 3 shows the attenuation under similar conditions when tapers are employed. The results resemble those obtained with loaded and unloaded cable. There is a large reflection loss which is considerably reduced when tapers are employed. Even with tapers the loaded line for shorter distances is inferior to the unloaded. The point particularly to be noticed is the relative slope of the curves in the two cases indicating that the benefits to be obtained from loading open-wire circuits are less than with cable circuits.

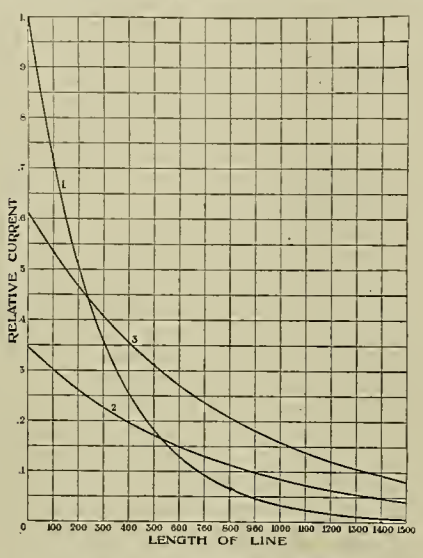


FIG. 3. LOADED TELEPHONE LINES.—RESULTS ON OPEN-WIRE CIRCUITS, CONDUCTORS 435 POUNDS PER MILE.

Fig. 4 illustrates the results which have been obtained from loading open-wire circuits using a conductor weighing 176 pounds to the mile and having an added inductance equal to about 0.1 of a henry to the mile. As before, Curve 1 represents the attenuation on a similar unloaded circuit; Curve 2, the loaded circuit without tapers, and Curve 3, the loaded circuit with tapers.

General Considerations.

The above curves show the results which have been obtained by the use of coils of considerable inductance added to open-wire and cable-telephone circuits and may be considered as typical of the results obtained on similar circuits of different capacity or composed of wires of different size. As before stated, the curves illustrate simply the relative volumes of transmission under the various conditions described.

In the case of cables there is a distinct improvement in the quality of the transmission produced by the introduction of the loading coils, the voice of the speaker being received more distinctly. The high insulation which can be maintained at all times on cable circuits renders it possible to introduce loading coils upon the circuits without danger of materially augmenting leakage losses. The marked diminution in attenuation, the improvement in quality of transmission and the ease with which inductance coils can be placed on cable circuits without introducing other injurious factors, such as leakage or cross-talk with other circuits, renders the use of loaded cable circuits especially attractive.

The reduction of attenuation that can be obtained by the introduction of loading coils on air-line circuits, even under theoretically perfect conditions, is less than can be obtained on cable circuits. This difference in the effectiveness of loading between the two classes of circuits, as far as attenuation is concerned, can be explained by the fact that on a cable circuit the capacity is large and the inductance of the circuit itself is practically negligible, due to the proximity of the two wires of the pair. On aerial circuits, on the other hand, the distance between the outgoing and return wire is such as to make the capacity of the circuit much less, and its inductance much greater. This larger self-induction of the open-wire circuit operates to decrease the attenuation, and, as it were, to rob the loading coils of part of their usefulness. Again, the insulation of an aerial circuit cannot be maintained as high as that of a cable circuit, so that the added inductance due to the introduction of loading coils upon the line tends to increase the losses due to leakage.

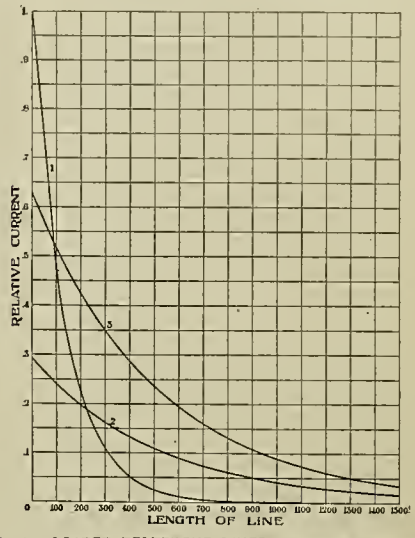


FIG. 4. LOADED TELEPHONE LINES.—RESULTS ON OPEN-WIRE CIRCUITS, CONDUCTORS 176 POUNDS PER MILE.

Moreover, there is not the same improvement in the quality of transmission on a loaded aerial circuit as compared with a similar circuit unloaded, as is found between loaded and unloaded cables. Initially, open-wire circuits are practically free from distortion, whereas the distortion on cable circuits of long length is considerable. The addition, therefore, of loading coils to aerial circuits cannot be expected to effect any improvement in the quality of transmission, whereas in the case of cables the introduction of the additional inductance renders the circuits practically distortionless and effects a marked improvement in the clearness of the transmitted speech.

In presenting this brief summary of the operation of loaded telephone circuits, it is desired to make acknowledgment to Mr. H. S. Warren and Mr. E. H. Colpitts for the solution of the many problems involved in the design of suitable coils for use in carrying out this invention, and to Mr. W. L. Richards and Mr. A. N. Mansfield for the careful tests upon which the curves above shown are based.

Ohio Telephone Notes.

Telephone-equipment companies in Cleveland and other cities have been asked for estimates for stringing wire along the Erie railroad from Cleveland to New York. For some time the Erie people have been figuring on telephone equipment and their plans are far enough along to consider estimates for the wire work. It is said that plans for the switchboard and other equipment have also been completed, but as yet no estimates have been requested. The length of the road from Cleveland to New York is about 659 miles, but the wire will be strung on telegraph poles, thus doing away with the pole expense. It is planned to have a complete system, with lines running into each way station, so that an agent may call up his chief or any other person connected with the road and converse with him directly about business matters. The service will be complete in every detail. The Erie now has a telephone service between Cleveland and the division offices in Galion, but telegraph wires are used for the transmission of messages and the convenience is not what it would be with a private line.

The United States Telephone Company has begun work on new toll lines at Columbus and Medina and will soon begin the construction of a line between Ravenna and Alliance.

There is some probability that the line of the Phœnix Telephone Company from East Liverpool to Steubenville and Columbiana will be reopened within a short time. Should this be done the Phœnix may install an exchange in Steubenville.

Some comment has been caused by the offer of the Cuyahoga Telephone Company to furnish all the telephones in the waterworks department at a rate $60 a year less than the regular figures.

In order to make some improvements on the system, the Jackson County Home Telephone Company of Jackson, will issue $50,000 bonds as of date September 1st. A deed of trust has been filed to the Provident Savings Bank and Trust Company of Cincinnati, to secure the bonds. The lines will probably be extended and the exchange improved.

C.

Southeastern Telephone Developments.

The Enterprise Telephone Company, capitalized at $15,000, has filed papers of incorporation with the secretary of state at Montgomery, Ala.

The South Carolina Railroad Commission will shortly take up several complaints about telephone rates at issue between exchanges in the state, as the recent legislation has placed the matter in the control of the commission. It is said that the law is deficient in several points, especially in the matter of a raise in rates, which is left largely with the commission.

The Georgia Telephone Company of Atlanta has asked permission to install a local and a long-distance system in the city of Athens, Ga. The company has already secured franchises at Union Point and Madison, and with the Independent exchange at Covington, it expects to reach Atlanta in this manner.

The Southern Bell Telephone Company has secured new quarters at Salisbury, N. C., and a new switchboard is being installed.

The Batesburg (S. C.) Telephone Company has been formally organized with William Westmoreland of Samaria, president, and Dr. J. A. Watson, secretary and treasurer.

The Bell Telephone Company has fitted up a new exchange at McColl, S. C., and made other improvements.

The Southern Bell Telephone Company is preparing to enter Eatonton, Ga., and to put in connections with Atlanta. L.

Michigan Telephone Matters.

Articles of association have been filed by the Grand Ledge Telephone Company, capitalized at $10,000.

The Northville Telephone Company has held its annual meeting, which resulted in the re-election of the old officers and directors. Reports showed the company to be in a prosperous condition with 186 telephones in operation and 25 miles of lines, exclusive of the village service.

Monroe is to have an Independent telephone exchange. The Stoddard Telephone Construction Company has begun work on an exchange in the Goldberg Block and it is expected that it will be in operation by October 1st. This company has of late been building many farmers' lines and all of these will center in the Monroe exchange, connection to be made with the Home Telephone Company of Toledo. This will make it possible to reach that city otherwise than by the Bell lines, which have a monopoly of this business. The new line also holds a franchise for a local exchange, and it is expected that one will be put in before long. When this is done keen competition between the two companies is expected. W.

EXTENSIONS AND IMPROVEMENTS.

Mr. M. C. Myrtle of the Overland Telephone Company is superintending the construction of a new telephone line in Middlesex, N. Y.

Charles N. King and associates of Jersey City, N. J., have incorporated the Dixon Home Telephone Company with a capital of $125,000.

W. A. Strickland, who operates the local telephone exchange at Turner, Kan., has made application for a telephone franchise in Argentine, Kan.

The Tri-state Telephone Company of Memphis, Tenn., has been chartered with a capital of $10,000. C. D. Greer, J. T. Warren, F. N. Fisher and others are interested.

The Findlay (Ill.) Mutual Telephone Company has been incorporated to construct telephone lines. The incorporators are S. D. Dole, W. B. Wallace and J. W. Coventry.

The Chesapeake and Potomac Telephone Company is about to repair its building damaged in the recent Baltimore fire, having let the contract to John McGregor of Washington, D. C.

H. G. Whitsett, Henry W. Bishop and associates, have organized a company to construct a telephone system in Eustis, Fla. Mr. Bishop recently secured a franchise for the construction of the system.

The Pacific States Telephone and Telegraph Company will erect a new building on Bush and Belden Streets, San Francisco, to cost about $100,000. New machinery is to be purchased and a switchboard installed.

C. E. Hinchcliffe, manager of the Consolidated Telephone and Telegraph and Electric Company, states that work will commence in the very near future on a telephone line to connect Phœnix, Ariz., with Los Angeles, Cal.

D. S. Murray, manager of the Rocky Mountain Bell Telephone Company, intends to recommend to his company that a line be constructed to reach the Roosevelt and Big Creek sections of the Thunder Mountain district, Idaho.

The New York Telephone Company has now 144,495 instruments connected in Manhattan and in the Bronx. This is an increase of more than 23,000 since September, 1903. Ten yers ago the total number of instruments in use was 11,835. The company has just opened a new contract office at 23 East Fifty-ninth Street, for the especial use of its contract department.

Standardization of Dynamo-electric Machinery and Apparatus.[1]

By Col. R. E. B. Crompton.

The standardizing of materials and machinery used by engineers has already made considerable progress in America. In England a strong and representative committee was appointed by the council of the civil engineers about three years ago, at the suggestion of Sir John Wolfe Barry, originally to standardize rolled iron and steel sections; but this led to the formation of other committees to deal with the standardizing of all classes of machinery and parts used by engineers wherever such standardizing seemed to be necessary or advantageous to manufacturers and users.

The committee appointed to deal with electrical questions, after a few preliminary sittings, decided to divide the subject as follows, and appointed subcommittees to deal with them:

1. Cables and conduits.
2. Telegraphs and telephones.
3. Electrical generators, including the prime movers that drive them, motors and transformers.
4. Materials used in tramway construction.
5. The determination of certain physical constants, particularly those relating to temperatures and methods of determining the same.

These sub-committees, which really became the working committees dealing with electrical questions, have now been at work for two years. That which dealt with cables has completed and issued a very complete report and recommendations. That dealing with tramway material has reported on part of the material they use. The third, dealing with the more complex subject of dynamo-electric machinery, of which I had the honor to be elected as chairman, has had many sittings, and has recently issued an interim report.

One or two important subjects have not yet been finally reported on. These relate to transformers, standard test conditions and to the allowable variations from the adopted standards. During the early stages of our work we were helped by the labors of the committees which sat previously in America and Germany to deal with the same subject, and we feel that it might assist those who are interested in the matter if some description of our work was laid before this Congress in the hopes that any discussion that follows on this paper may be of service to all of us engaged in this interesting subject.

I think we must all agree that electrical standardization must bear a different meaning to standardization of the far older and more crystallized types of machinery used by mechanical engineers. It is highly undesirable that any types, patterns or sizes should be standardized if these are likely in any way to hinder the future development of design, but all who have looked into the matter know how much useful electrical standardizing can be carried out in such matters as the settling on correct nomenclature and definitions of certain terms hitherto used in a somewhat loose way in text books or in trade lists, in settling standard test conditions, and in determining a satisfactory method of measuring the rise of temperatures in the parts of electrical machinery that are affected by temperature rise. In addition to these we all feel that some attempt must be made to standardize sizes in order, if possible, to reduce the number of patterns that now must be kept by manufacturers and many of which are felt by them to be wholly unnecessary, and which are only demanded because some manufacturers have produced them for special purposes.

It appears desirable that in place of these many patterns a standard list of a sufficient number of sizes to fill the ordinary requirements of users should be laid down, that these sizes should be so marked and their output under various working conditions should be so clearly defined that any purchaser of a standard machine should always be able by referring to his table of standard conditions to determine with accuracy exactly what the manufacturer guarantees when he attaches the standard mark to each standard machine.

It may be convenient at this stage to explain the procedure by which our committee has obtained the views of manufacturers, consulting engineers and users on all the debatable points which they have met with. The committee itself, being very representative, was able to draw up a list of the questions which appeared likely to arise and to circulate these in the form of a circular, which in our case we marked "C. L. 36," and on which we invited remarks and criticism. This circular was sent out to the whole trade and to most of the consulting engineers and to a selected number of the principal users. After the replies were received and tabulated they were discussed in the committee, which was then in a position to see that certain points were practically accepted by everyone. The same circular was then reissued marked "C. L. 36A," calling attention to other points remaining unsettled. By the successive issues of this amended circular considerable progress was made without the necessity and loss of time which would have followed if we had held conferences to decide on all these minor points, but when all that was possible had been done by correspondence it became necessary to hold a conference to decide on the matters which remained unsettled. At this conference everyone who held strong views on these questions was invited to speak, and the matters were voted upon and final decisions were thus arrived at.

The first question we attacked was the very serious difficulty which has arisen in England, owing to the multiplicity of electrical pressures or voltages used. The first electrical pressure measured at the consumers' terminals which can in any way be called a standard pressure was that adopted throughout London and other large towns, of 100 volts. This was adopted because, at that time, the electrical energy generally used for lighting 100-volt lamps was on the whole the most trustworthy and suitable to the users' requirements. These 100-volt lamps were, as a rule, supplied from three-wire systems, supplied with 200 volts across the outers, and in a few cases from five-wire systems having 400 volts across the outers. As the lamp manufacture improved other towns successively adopted 105, 110, 115 up to 130 volts at the consumers' terminals, but as soon as trustworthy lamps in excess of 200 volts were produced many towns doubled their pressure, supplying their customers for a time from the original outer conductors and eventually resumed the three-wire pressure at the outers at double the original, that is to say, from 400 up to 500 volts. This great range of pressures in use made it extremely difficult to draw up a list of standard plant, which would serve the majority of these pressures. We, therefore, finally decided to fix on standard pressures which, with a 10-per cent. variation on either side of them would fit most of the existing voltages. We therefore fixed on 110, which, with the above margin, will fit pressures from 99 to 122; 220 will fit pressures of 198 to 244; 440 will fit pressures of 396 to 488; 500 will fit pressures of 450 to 550. It would, of course, have been more symmetrical if we had been able to give 550 as our highest low-pressure standard, but unfortunately up to the present our Board of Trade, which is the ultimate controlling authority, has not sanctioned a higher maximum than 500 volts, so we are obliged to depart from symmetry at this point. As a matter of fact, these voltages appear to be very suitable and to fit very well with existing practice both in England, America and Germany, 110 volts being almost universal as the standard pressure for ship lighting.

The two sets of standard high pressures, namely, those at the terminals of the generators and at the primary terminals of the transformers, were fixed by a committee presided over by Mr. C. L. Sparks. It was found convenient to settle on the even figures of 2,000, 3,000, 6,000 and 10,000 volts at the primary terminals of the transformers, whereas those at the terminals of the generators were necessarily 10 per cent. higher. The standard pressures at the secondary terminals of the transformers were fixed so as to allow of a five-per cent. drop in the low-pressure distribution system in order to fit into the standard pressures laid down as above at the consumers' terminals.

We next had to deal with the vexed question of frequencies. Originally two frequencies, one of 50 cycles and another of 25 cycles were proposed. Some engineers went so far as to demand a third in the interests of turbine generators and rotary transformers, but after much correspondence at a conference at which the views of all who held strong opinions on this matter were considered and voted on a strong majority was of the opinion that 50 cycles should be fixed as the chief standard frequency, with 25 cycles as a subsidary frequency for such power schemes or other uses where the lower frequency was specially desirable.

This work took many months, but as at the same time Dr. Glazebrook was carrying on the work of his committee, which had been appointed to investigate the question of the safe limit of temperature at which electrical machinery can be worked for lengthened periods, no time was lost thereby.

The points to be investigated by Dr. Glazebrook's committee were the following:

1. The maximum temperature to which the insulating materials used in the manufacture of electrical apparatus can be exposed for lengthened periods of time without electrical or mechanical deterioration.
2. The relation between the mean temperature of any coil obtained by the measurement of rise of its electrical resistance and the maximum temperature at the hottest part of the same coil, obtained by inserting thermo-junctions at these points.
3. The permissible rise in temperature and the best and most certain methods of measuring the same deduced from this experimental work.

A long series of experiments, lasting many months, was carried out by this committee, principally at the National Physical Laboratory, but other check determinations were carried out at the works of those of the electrical firms who wished to aid the labors of the committee. Moreover, in some cases it was desirable to repeat the temperature measurements on coils made at the National Physical Laboratory on the same coils when eventually mounted in position on the generators, motors or transformers for which they were intended.

Although the labors of Dr. Glazebrook's committee are not yet complete, sufficient work has been done to show that although both in America, Germany and England up to the present a maximum temperature of 50° C. should not be exceeded in the hottest part of the coils, and in a few cases when the work is intermittent of 75° C.; yet that when more accurate methods of determining the temperatures of the hot-

1. Abstract of a paper presented before the International Electrical Congress at St. Louis, September 14, 1904. Col. Crompton is an English electrical man of prominence and was an official delegate to the St. Louis Congress from Great Britain. His military record is well known.

test parts of the coils have been laid down considerably higher temperatures may be allowed by our English committee when it issues its final test conditions, for many of the materials which are today used by the manufacturers for the insulation of coils and other portions of electrical machinery were actually subjected for periods up to nine months to a steady temperature of 150° C. without either electrical or mechanical deterioration. It has also been shown that the maximum temperature reached by the hottest part of the coils that are nowadays used can never reach a point more than 25° in excess of the average temperature of the coil obtained by percentage rise in the electrical resistance of the copper of the coil itself. It appears, therefore, that these materials may be exposed for great lengths of time to a temperature which when measured by rise in electrical resistance may be as high as 125° C., which corresponds to somewhat less than 150° C. at the hottest part of the coil.

Our committee found that manufacturers and users both attach great importance to clear standard definitions of what is meant by continuous and intermittent running. As regards the former, as it was generally admitted that the coils and hottest parts of generators and motors of modern type up to 100 kilowatts usually attain their maximum temperature within the limits of a six-hour full-load run, it was decided that a six-hour run should stand for the definition of continuous working; but as regards intermittent running, more especially in regard to crane and lift motors which work for short periods and stand so that their coils may cool down during the much longer periods between each run, it was found very difficult to settle on a simple and clearly understood definition of intermittency. Many firms and users considered that the only definition of intermittent running would be that the intermittency should be defined by the customer, who should lay down a load factor on which the machine could be worked; but after much discussion this idea was abandoned as impracticable and a simpler, although admittedly imperfect, definition of intermittency was settled by the test run being reduced from the six hours of continuous running to one hour's running at full load.

The difficult questions arising out of the pressure rise in alternators were very sharply debated by Mr. Sparks' sub-committee and the definitions were only arrived at after much correspondence and many meetings. In their present form, however, they appear worthy of consideration as a satisfactory solution of this important question.

Finally, I come to the most important advantage that standardizing offers to manufacturers and users —that is, the issue of standard lists of sizes. We first issued a list of standard motors. We cut down the number of sizes from one-quarter-horse up to 100-horse to 15 for direct current to 11 for single-phase alternators and to 17 for two and three-phase alternating motors. We were also able to issue a list of direct-current generators from six to 100 kilowatts comprising only 10 sizes, and of these we found that in the case of the direct-current generators all but the largest size could utilize the frames of nine of the standard-motor frames.

For larger generators, above 100 kilowatts, we found the matter to be more difficult. Most of these larger generators are direct-coupled to prime movers, and we have been compelled to await the labors of our sub-committee on prime movers before we can issue our final list for large sizes. Luckily, in this case, the fact that the speed in revolutions per minute for alternators is fixed for us by the standard frequency and by the number of poles has enabled us to issue a preliminary list of nine standard sizes and speeds for direct and alternating generators ranging from 100 up to 1,000 kilowatts, which appears to be convenient, and for the reason above given the speeds of these cannot be varied.

Of the work which remains to be done that on transformers is nearly complete but awaits the labors of Dr. Glazebrook's final recommendations on temperatures. That of standard test conditions is not so advanced, but will be recommended in October, when we have Dr. Glazebrook's results before us. The permissible variations from standard require extreme care.

I have mentioned the one case where, in order to fit existing electrical pressure, 10 per cent. variation must be allowed to enable these pressures to be served by our standard sizes. Manufacturers have informed us that this can be done, but it is evidently desirable in the future that the number of large centers of distribution that use pressures away from the standard pressures now laid down must gradually be reduced so that the large 10-per cent. limit may be no longer necessary. This 10-per cent. limit imposes on manufacturers of standard motors and generators a corresponding margin in the size of their standard patterns, and this margin cannot be reduced until the call for the plant to suit pressures 10 per cent. away from the standards is greatly diminished.

The other classes of permissible variations to be standardized are those due to the necessary errors of instruments and observers in carrying out the standard tests.

In addition to these it would be advisable to standardize permissible variations due to small errors in manufacture or variations in the quality of the material. It would be probably advisable to fix two limits of variation from standard up to the first of which the goods would be accepted and beyond which and up to a second limit the manufacturer would be penalized. In addition to these, as in some cases to the permissible errors, must be added those due to instruments and observers' probable errors; it may be advisable for simplicity sake to lay down a maximum scale including all such errors and variations for each class of measurement and which must in no case be exceeded.

Finally, I wish to call attention to the constitution of this committee. Out of 19 members only seven represent manufacturing interests, two-thirds of the committee being composed of consulting engineers or users.

Discussion.

J. W. Lieb, Jr., of New York city remarked that the one point difficult to decide would be the standards of frequency. In this country 25 cycles had been adopted for rotary work and 60 cycles where no conversion was required, but in England and on the Continent 25 and 50 cycles seemed to be more prevalent. The British engineers recommended 50 cycles instead of 60, and this point should be carefully considered. Colonel Crompton, who spoke as an English designer, asked that any points for discussion be taken up one at a time. Mr. Steinmetz remarked that any recommendations or decisions of the committee on standardization must meet the approval of the consulting engineer, as well as the manufacturing and operating company. Engineers and manufacturers in this country would be quite willing to adopt 50 cycles for the higher frequency, but nearly all of the existing plants and systems operate now at 60 cycles, and the demand would be for the same frequency.

Colonel Crompton remarked that the German engineers had adopted 50 cycles as their standard, and that there were a few points in favor of that frequency. Rotaries can be operated at 50 cycles, even when internal-combustion engines, which do not give as uniform a rotative speed as steam engines, are used. There had been a strong movement in England to adopt a frequency of 40 cycles, but owing to the fact that electric lighting would be unsatisfactory at that periodicity it was dropped. The two frequencies as recommended by the English Institution, bear a ratio of 1 to 2 to each other, which is more desirable than the American practice.

Charles F. Scott of Pittsburg stated that when he visited England a few years ago he found a comparatively large number of frequencies in use. In this country, where electrical industries are controlled by a few large companies, whose engineers are mostly American, there is less liability to such a great variety. Standardization, if attempted, should be such as to not impose any limitations which would tend to impede progress, and he thought that the British Board of Trade had exerted a somewhat detrimental influence. The reports on standardization in this country have been made more valuable through the assistance of the manufacturing companies, and the standards are and should be such that will be readily accepted. While it is desirable to have a common frequency, it is by no means fundamental.

Dr. R. T. Glazebrook of England said that the Board of Trade had no detrimental influence, such as Mr. Scott thought, since its proceedings were now in perfect harmony with the engineers' desires.

Professor Ascoli of Rome said, when called on, that the Italian Society had not taken up the question of standardization and that he was therefore unable to make any statements.

Colonel Crompton closed the discussion by saying that he thought the sense of the American engineers to be in line with the English, except as to the point of frequency. Standardization ought to be taken up in all countries, and the reports revised from time to time, to keep apace with progress.

Toggle Bolt for Electrical Fixtures.

A new toggle bolt that will commend itself especially for electric-fixture and telephone work where a neat and finished-appearing piece of work is necessary is the patent trunnion-nut toggle bolt manufactured by Thomas Wrigley & Co. of Chicago, shown in the accompanying illustration. This new toggle bolt is asserted to be different from any

TOGGLE BOLT FOR ELECTRICAL FIXTURES.

now on the market in that it has a pivoted trunnion nut in the keyhead through which the bolt is screwed, as shown in the illustration. The bolt may be screwed through as far as desired, a cap nut being put on the end, which is all that remains visible, thus leaving no end projecting through the nut, as in the ordinary toggle bolt. The key-head turns upon the pivot to a position parallel to the bolt and can thus be passed through a half-inch hole in plastered walls, hollow tiling, etc., a slight movement only being necessary to turn the head at right angles to the bolt when once in position, holding the bolt firmly in place when the cap nut is set tight. The cap nut can be furnished in different finishes, nickel, brass, etc., so as to harmonize with the fixture.

Mid-year Meeting of the Northwestern Electrical Association.

The members of the Northwestern Electrical Association who were in St. Louis last week to attend the mid-year meeting of the organization, and incidentally to take in the International Electrical Congress and see the Exposition, met at the Forest Park University Hotel on September 13th. The session was short and there was but little business transacted; the reading of papers was also dispensed with, a those present unanimously preferred to give up their time to attending the meetings of the Congress and seeing the attractions at the Fair. Upon the recommendation of President Grover, the members voted to favor the admittance to membership of street and interurban railway companies of the Northwest, and the applications of such companies will be received at the next regular meeting of the association to be held in January.

President T. F. Grover, in a short address, spoke in part as follows:

When you visit the Louisiana Purchase Exposition you will behold the marked advance that has been made in the arts and sciences since the World's Fair at Chicago. In place of the great Machinery Hall in 1893, strewn with engines, belts and generators, we have engines and steam turbines up to 5,000 horsepower, direct connected to generators of the same capacities and occupying less than one-half the floor space. Comparing the 2,000-horsepower Corliss engine belted to two 1,000-horsepower, two-phase generators in 1893, occupying a floor space of 4,700 square feet, we may see today a turbine-driven alternator with 7,500 horsepower capacity, occupying less than one-fifth the floor space. I only mention these as a few of the many advances since 1893. Capital and the brain of genius must have worked hand in hand to have accomplished these results, and the world has attained a higher degree of civilization by reason thereof.

The officers of the association have deemed it advisable to omit the presentation of papers at this meeting on account of the meeting of the Electrical Congress at this time, feeling confident that the members would prefer to attend the meetings of the Congress and the Exposition. I wish to recommend at this time that the street and interurban-railway companies of the Northwest be admitted to membership in this association. Many of the lighting plants are interested in street-railway systems, or furnish power for same. There is no street-railway association in the Northwest at present, and should it be necessary to form an independent street-railway association, many of our members would hesitate in attending both. I trust the members will thoroughly discuss this subject and act at this meeting in order that suitable papers can be secured for our January meeting, and that the street-railway and power companies may present their applications for membership at that time.

Production of Manganese Ores, Barytes and Lithium in United States.

The domestic production of manganese ores during 1903 was only 2,825 long tons, valued at $25,335, or $8.97 a ton. As spiegeleisen and ferromanganese, both of which are manufactured from manganese ores and manganiferous ores, are used in the production of steel, the limited supply of native ore must be largely augmented by that imported from foreign countries. The quantity of manganese ore brought in during the year 1903 was 146,056 long tons, valued at $1,278,108, or $8.75 a ton.

The production of crude barytes in the United States in 1903 amounted to 50,397 short tons in quantity, valued at $152,150 at the mine. This is a decrease of 11,271 tons in quantity and of $51,004 in value as compared with the production of 1902, which was 61,668 short tons, valued at $203,154. The average value of a ton in 1903 was $3.02, which is 27 cents less than the average value of a ton ($3.29) in 1902.

The quantity of lithium minerals produced in the United States in 1903 amounted to 1,155 short tons, valued at $23,425. This is a decrease of 905 tons in quantity and of $2,325 in value as compared with the production (1,245 short tons) and value ($25,750) in 1902. The demand for lithium minerals increased considerably, however, toward the close of 1903.

S. W. Divine and associates who are interested in the proposed Cleveland and Ducktown (Tenn.) interurban railway will apply for a cahrter of incorporation. It is understood that the company will incorporate under the name "Tennessee-Alabama Interurban Railway." Rapid progress is being made, it is said, in reference to the preliminary arrangements and recently a great deal of the right-of-way has been purchased for the proposed railroad. The location of the proposed tunnel through Missionary Ridge has been decided upon, practically, and everything is in readiness for steps to be taken looking to incorporation.

CORRESPONDENCE.

Great Britain.

London, September 7.—The utilization of water-power in Great Britain for the generation of electrical energy has never been developed to any great extent, for obvious reasons, but it would not be unfair to state that such small possibilities as do exist have not been taken sufficient advantage of. There are signs, however, that great activity in this direction will shortly be evident. Of course, the strong prejudice against the use of overhead wires in this country, even in rural districts, has retarded what little progress is possible here, but now that this prejudice is being broken down, better things can be hoped for.

The huge waterpower scheme which has for its object the supply of electric power to a number of quarries and railways in North Wales, has had its details well developed. The waterpower will be derived from Llyn Llydald, which has a total length of 1¾ miles and a breadth of from a quarter to half a mile, the area being 5,750,000 square feet. By means of a dam the level of the water of the lake will be raised and sufficient storage for 90 days obtained. The total fall will be 1,150 feet, and the total horsepower available on a basis of a nine-hour working day will be 8,200 horsepower. The first installation will consists of two steel pipe lines and four 1,000-kilowatt sets, each consisting of a double tangential waterwheel coupled to a three-phase alternator giving 11,000 volts at 40 periods. The company owning the concession also possesses another source of water supply of equal volume. The distribution will be by means of three-phase currents, copper overhead wires 0.324 inch in diameter being employed, carried on insulators triangularly carried on wooden poles.

Mr. Campbell Swinton in a paper before the British Association at Cambridge treats of the subject of the use of waterpower in Great Britain and puts the total amount of power now produced by this means at only 11,906 horsepower. Practically all this, however, is used for manufacturing purposes and no public supply is at present given by this means. Another instance mentioned in the paper, however, of a public-supply undertaking of this character, relates to Scotland, where generation and distribution to sub-stations will take place at 40,000 volts. The total cost of the initial portion of this scheme is put at $1,000,000. A feature of the scheme is that the overhead bare wires, where they run along or cross over public streets, are to be enclosed in a wire cage, to meet the Board of Trade regulations.

An interesting experiment is now being tried in connection with space telegraphy. The Daily Telegraph, a London newspaper, has arranged, in conjunction with the Marconi Wireless Telegraph Company, to have weather reports transmitted from a number of ocean liners. It is said that these have been received from as far out as 900 miles.

The electrification of the District railway is now being pushed forward with such rapidity that one section of the line was shut down last week in order to facilitate the progress of the work.

The old question of the somewhat inefficient fenders used on electric tramways has again cropped up through a fatal accident at Liverpool. A boy was run over and drawn underneath the car, which had to be raised by jacks in order to release him.

G.

New York.

New York City, September 17.—President Alexander Orr of the Rapid Transit Commission is sanguine that the subway will be opened for passenger service early in October. He reports also that he finds the material and mechanical equipment of the tunnel in entirely first-class order.

An ingenious statistician has been computing that the aggregate money advantage to the estimated number of 10,000 daily users of the subway, on the modest basis of 50 cents per hour, will represent an annual saving of $12,450,000. In fact, by utilizing the time that will be saved by taking a subway train, a passenger will very nearly travel free.

The Interborough Rapid Transit Company has organized an elaborate plan to handle freight on the subway and elevated lines. This is a blow to the Metropolitan Express Company, which has hitherto had a monopoly of this kind of traffic on the Third Avenue company's surface lines.

After many months of bitter wrangling it has been definitely decided that the Manhattan Bridge shall be constructed with suspended cables, and not on the eyebar method. Bids for the construction will shortly be advertised. Bridge Commissioner Best is also bearing in mind, even at this early date, the probable traffic needs of the new bridge, and is planning so to organize the track connections that ultimately the interborough passenger traffic over the Brooklyn, the Williamsburg and the Manhattan bridges will in reality constitute one system.

The New York Times last Sunday published an interesting map showing all the electric-traction lines in operation or under construction in New York state, and demonstrating that there are only a few gaps in a through system of trolleys from New York city to Buffalo. The capital invested in these lines exceeds $210,000,000 and the total of passengers carried is approximately 3,000,000. These lines use 13,700 cars and employ 60,000 men.

The Pittsburg Dispatch prints a story to the effect that the Brooklyn Rapid Transit Company has recently been victimized by passengers paying their fares by dropping trading stamps into the ticket boxes. The ticket choppers are, however, declared to be not so stupid as that! There is, though, a Brooklyn printer, now under arrest, who has been printing advertisement slips closely resembling the Brooklyn Rapid Transit surface-car transfers.

The capital of the National Battery Company of New York has been increased from $500,000 to $1,000,000.

The Electrical Carriage Call Company of 328 West Forty-eighth Street is putting in some lamps for the New York City Dock Department at a cost of $182.50.

H. H. Kurtz and two others are the directors of the International Telegraph and Construction Company of New York city. The concern was chartered on September 16th with a capital of $100,000.

The Queens Borough Gas and Electric Company is erecting a sub-station on Ocean Avenue, Rockaway Beach, near the power house of the Long Island railroad. On the latter building Westinghouse, Church, Kerr & Co. are making great progress. The site was formerly a swamp, but has been filled in and the foundations are now complete. The building is estimated to cost $50,000, and will be of brick, on a space 70 by 80 feet. Provision is made for an extension 100 feet in length.

A serious collision occurred on Friday morning on the Brooklyn Rapid Transit Company's line on the elevated structure on Thirty-eighth Street. There is a sharp bend at this point, and, apparently, the motorman of the rear train did not see the flag in time to stop his cars.

D. W. W.

Ohio.

Cleveland, September 17.—The organization of the Springfield, Washington Courthouse and Chillicothe Traction Company, incorporated a few weeks ago, has been completed by the election of directors and the following officers: President, H. L. Rockfield; vice-president, Frank Patterson, New York; second vice-president, Lee M. Good; treasurer, Capt. A. M. Winger. Surveys have already been made and the new road will almost parallel the Detroit Southern from Springfield to Washington C. H., and the Cincinnati, Hamilton and Dayton from that place to Chillicothe. Contracts for equipment have already been let, it is stated, and work on the roadbed will be commenced at once. The plans include extensions to McArthur and Athens, with branches to Gallipolis and Pomeroy.

Thomas M. Campbell, formerly superintendent of the Youngstown Gas Company, has been appointed electrician at the Ohio penitentiary, with Herman Reasoner of Mansfield as assistant in charge of the work at night. Two electrocutions are scheduled for the latter part of this month.

The Wilmington-Hillsboro Traction Company of Dayton has been incorporated with a capital stock of $10,000 to build and operate an electric line between Dayton, Hillsboro and Wilmington. The incorporators are Edwin G. Orr, Edward A. Fay, F. E. James, W. D. Riddell and A. J. Miller.

The Lake Shore Electric Railway Company has dispensed with the use of the power plant at Sandusky and all the current for the entire line is now furnished from the two plants at Fremont and Beach Park. Formerly the company operated four power plants. The same amount of power is furnished by the two plants that was formerly generated by four. Eleven rotary transformers are in use and the entire line thus supplied by the two plants is 160 miles in length.

The Osborn Engineering Company of Cleveland has begun a survey of the Canton and Youngstown road, which will be 50 miles long. Two routes will be surveyed from Randolph to Youngstown and the best one selected. Cleveland capital is back of the plan. John E. Monnett of Canton is the president of the company.

A few days ago the new freight depot of the Interurban Railway and Terminal Company at Cincinnati was opened for business. The building has a frontage of 50 feet on Sycamore Street and extends back 240 feet. The Cincinnati, Dayton and Toledo Traction Company will use a portion of the new building. Its first freight cars ran into the city a few days ago. The Scrugham lines will operate a night freight service. This building adjoins the passenger depot and is convenient in this way for handling business. The Toledo line has arranged platforms for farmers to load and unload goods all along the line, as have other roads that will use this depot.

It is stated that when the present leases on Scenic Park expire, the Cleveland Electric Railway Company will have nothing more to do with parks. The park is sublet to others. The management says that a railroad company has no business with parks. Private individuals may run them at a profit, where a railroad company would lose thousands of dollars.

The Toledo Interurban Railway Company has been incorporated as the Ohio end of the Toledo and Ann Arbor Electric Railway Company, which is now building a line from the Ohio line to Ann Arbor, Mich. The Ohio company has a capital stock of $100,000 and Clem V. Wagner, Edgar Daykin, W. M. Long, George W. Acker and P. S. Willis are the incorporators. It is the intention of this company to build a loop around Ottawa Park in order to give other interurbans an entrance to the city.

President Horace E. Andrews of the Cleveland Electric was in the East again this week to witness the test of the General Electric Company's single-phase system on the Oriskany division of the Utica and Mohawk Valley line. The trolley arranged by the company will carry a single-phase alternating current of 2,200 volts and the car used was equipped with both direct and alternating motors. Mr. Andrews wishes to satisfy himself as to the advantages of the new system, which may be adopted on the Utica and Mohawk Valley.

The Columbiana county commissioners have agreed to grant the East Liverpool Traction Company a franchise to build a road out past Empire, if it will widen the pike and make improvements where necessary, as well as use space at one side of the wagon drive.

Considerable rumor has been going the rounds the last few days regarding the proposed reorganization of the Miami and Erie Canal Transportation Company. It is understood that a new lot of stockholders have been brought into the controversy whose names did not appear among the record stockholders. The re-organization committee has prepared a plan of taking up the old bonds and issuing new ones that will give the company $200,000 in cash. Then the stockholders are to be assessed $3 a share, which would produce $90,000. With the sale of $60,000 more of bonds, which the present bondholders are expected to take under the arrangement, $350,000 in money will be realized. It will require this amount to pay the floating debt, interest on bonds and expenses in completing the property to Dayton. The claim of the Cleveland Construction Company has been taken up, but others have become plaintiffs in order to keep the Cleveland suit alive until the matter is straightened out.

No bids were received on the Springfield-Xenia road, that was to be sold at receiver's sale Saturday. It is said the appraisement is considered too high and the court will be asked to have it reappraised. The Bushnell interests will then take hold of the matter, it is thought. Many of the stockholders are Cleveland and Cincinnati men.

O. M. C.

Dominion of Canada.

Ottawa, Ont., September 16.—An interesting illustration of the practical uses of wireless telegraphy has been afforded by the British warship Ariadne. When off the harbor of North Sydney, Nova Scotia, recently, a wireless message was sent from the Ariadne to H. M. S. Indefatigable, then in the harbor, asking that 1,000 loaves of bread be ordered for the former ship. When the Ariadne arrived, the bread was ready.

A. F. Legatt of Ottawa has purchased the electric-light franchise and plant in the town of North Bay, Ont. The gas and electric business will be combined. The electric plant has been established in the town for 10 years and has an exclusive franchise. The gas supplied is acetylene and the amalgamation of the gas company and the electric business in North Bay is the first instance on record of the combination of electricity and acetylene.

There are signs of renewed activity in the mica mining business in the near vicinity of Ottawa. For the last two years the mica market has been overstocked. On this account the mines in the Ottawa valley were obliged to close down with thousands of dollars' worth of stock on hand. A large mine near Ottawa has been purchased by the Westinghouse company of Pittsburg, Pa. The company will at once begin work upon this mine with a force of men from Ottawa.

A prominent Canadian banker asserts that Canadians are pioneers in making a success of the development of electric energy by hydraulic power. He points out that a review of the large enterprises which Canadian capitalists have undertaken in foreign countries, shows that both Great Britain and the United States have been distanced in this matter. The first big Canadian enterprise in a foreign country was the Sao Paulo Tramway, Light and Power Company, with a capital of $7,000,000. The group of Canadian capitalists, who ventured to underwrite the bonds, were given stock at the rate of 100 per cent. as a bonus, and now this stock is not only paying eight per cent. and selling around par value, but there is already a probability of another increase in dividend. This enterprise was followed by the Mexican Light and Power Company, capitalized at $12,000,000, and the Rio de Janeiro Light and Power Company, with a capital of $50,000,000. A curious feature in connection with these big enterprises is that while English and American capitalists refused to embark in them at the outset, Canadians have experienced little difficulty in making them yield as much as 10 times what the stock cost when once such enterprises had proved successful.

The Shawinigan Water and Power Company of Shawinigan Falls, Que., announces that it will be in a position to deliver 10,000 additional horsepower into Montreal on December 1st. This large undertaking, which entails the erection of another transmission line all the way from Shawinigan to Montreal, upwards of 80 miles, will also require the installation, both at Shawinigan Falls and at the Maisonneuve station in Montreal, of particularly

large and improved machinery. At Shawinigan a new large penstock pipe is being erected from bulkhead to power house, which will have a capacity of 11,000 horsepower. The waterwheel, which is being installed by the J. P. Morris Company of Philadelphia, Pa., will have a capacity of 10,500 horsepower. The generators which are being installed by the Westinghouse company will have a capacity of 6,600 kilowatts, and the transformers a capacity of 4,400 kilowatts. By existing contracts, the Montreal Light, Heat and Power Company takes all the electric power brought into Montreal by the Shawinigan company. W.

Southeastern States.

Charlotte, N. C., September 17.—The town of Lexington, N. C., will receive bids during the remainder of September, for the erection of an electric-light plant for the town, embracing two 85-horsepower engines and two 60-kilowatt alternating-current generators for 50-light series service.

The town of Dublin, Ga., will hold an election on October 10th, on the question of issuing $45,000 bonds for lights and other improvements.

The survey for a three-mile loop for the Greenville Traction Company of Greenville, S. C., has been completed and the work will be started shortly.

The town of Whiteville, Columbus County, N. C., will soon install electric lights.

The Highland Park Manufacturing Company of Charlotte, N. C., a large cotton-mill company, contemplates the building of an electric-railway system in the suburban town where the plant is located.

At a meeting in Philadelphia of the parties interested in the new electric line, 20 miles long, starting at High Point, N. C., the plans of the experts were approved. There is a movement taking shape to get the company, the High Point Interurban Company, to extend the line to Yadkin County, and it is said that the people along the way will give $100,000 toward the project.

The Catawba Power Company of Charlotte, N. C., has so far contracted for 3,600 incandescent lights in the city.

A bond election was held in LaGrange, Ga., recently and $25,000 was voted for an electric-light plant.

The town of Laurens, S. C., has voted $40,000 bonds for an electric-light and sewer plant.

The Great Falls and Old Dominion electric line from Washington, D. C., to Great Falls, has been graded half way, and a part of the construction work is now completed. Six bridges have already been built on the completed part of the route. The length of the line will be about 14 miles. L.

Michigan.

Detroit, September 17.—Ypsilanti has a project on foot for the establishment of a new automobile factory. The company was recently organized in Detroit and has valuable patents as well as orders. The new company is capitalized at $400,000, and will use the old Follett Fence Building.

John H. Chase and William L. Haag, who were given a franchise to carry on a central-heating business in Lansing last March, now ask the council to extend the terms of the franchise to 30 years, and also to permit a maximum charge of 60 cents per 1,000 pounds of condensation.

The Wolverine Mines of Bay City, controlled by the Pere Marquette Railroad Company, are being equipped with electric haulage systems, and the mines generally overhauled at an expense of $40,000. This will do away with the mules, and the output of both mines will be increased 30 per cent.

The Bay City street-car employes have just passed through a bitterly fought strike. The employes gained some few concessions, but nothing like the change in the running arrangement made by Manager Morris. The new plan will give car service until midnight, allow the men ample time for dinner, and 10 hours' work each day. It is understood that the citizens are well pleased with the change, and it will insure the city up-to-date street-car service.

Five Milwaukee aldermen, who have been visiting several of the large cities in which municipal lighting plants are operated, are visiting Detroit this week and spent some time at the power house at the foot of Bates Street. While pleased with the Detroit plant, the visitors were voluble in their praise of a plant in Connellsville, Pa., where turbine engines furnish the motive power for the lighting system. The party will next visit Grand Rapids.

The Municipal Electric Lighting Commission of Detroit has made an inspection of the system and accepted a recommendation from the executive committee for improvements amounting to $111,500. The committee recommended the purchase of two boilers with piping, and at least one more engine and generator. The instructions of the executive committee are also to include in their estimate an additional $12,000 to cover the purchase of land east of the lighting-commission property, to be used as coal-storage grounds. Two hundred extra lights will be placed at various points throughout the city, and many lights put up on top of poles will be equipped with mast arms. It is the purpose of the commission to place the plant upon a comprehensive basis, so as to provide for the taking in of smaller municipalities into the city and sufficient to cover all the needs for 10 years. This may be done by issuing the remaining $150,000 of the issue of $800,000 bonds, authorized by the Legislature.

The Detroit United Railway has at last produced from its own shops a drop fender which has been found satisfactory by Commissioner Maybury. It is so devised that it may be lowered at the will of the motorman, riding about six inches from the pavement. It can be dropped instantly flush with the pavement, where, on both sides, it fits snugly into the groove of the rail, so that it will be an impossibility, with the fender down, for a car to run over a person. The new device also has a latticework guard that prevents the victim coming into violent contact with the front end of the car. C. G. W.

Northwestern States.

Minneapolis, Sept. 17.—Bids are being received at Wayne, Neb., by L. W. Roe, for the installation of a power plant and equipment for the city electric-light plant.

The Southern Wisconsin Interurban Railway Company, which is to build a line from Janesville to Madison, has been granted a franchise for a line through Edgerton.

The election on the installing of a municipal electric-light plant at Spring Valley, Wis., resulted against the proposition.

The Tri-City Railway Company of Davenport, Ia., will build a line from Sears to Milan.

The Washburn (Wis.) Street Railway Company has asked for a 50-year franchise at that place. The city is considering the purchase of the light, water and other public plants, with a view toward municipal ownership.

The Central Construction Company of Oshkosh, Wis., has closed the contract for a pole line and wiring for the Stevens Point Power Company. The cost will be about $14,000.

U. P. Hord of Aurora, Ill., has secured franchises for an electric railway from Mankato, Minn., to St. Peter. He proposes to continue the line from the latter place through to Minneapolis, and work on a preliminary survey will be started at once.

The Mankato (Minn.) Railway, Light and Power Company has asked the county commissioners for a franchise for a trolley line from Mankato east to St. Clair.

The Central Construction Company of Oshkosh, Wis., has completed the installation of a municipal lighting plant at Kilbourn City, Wis.

S. C. Lee and others of Des Moines, Ia., have been granted a franchise for a street car line in Sioux Falls, S. D. Work will begin at once. R.

Pacific Slope.

San Francisco, September 15.—President B. Von Homeyer of the Humboldt County Water and Power Company is perfecting details for the electric plant to be erected at Eureka, Cal. A site for the plant has been secured near the Eureka foundry and work will be commenced soon on a building and a 5,000-barrel oil tank. Arrangements to lay a pipe line from the plant to the wharf have been made. A wagon road is to be constructed in the Mad River section.

The trustees of Vacaville, Cal., have awarded to J. W. Hartzel of Vallejo a franchise for an electric railway through Vacaville. Part of the system is now running to tide water at Vallejo, and the new franchise is a link in the general plan of development in Northern California. The line will follow the public roads to Vallejo and will not be delayed by questions of right-of-way. The franchise is now complete for the entire route.

Mrs. V. J. Bell is reported to have purchased the roadbed and rails of the Auburn Electric Railway Company, with the intention of putting a new road into operation, and continuing the same to Newcastle.

The Nevada County Traction Company has accepted the proposition of the city of Grass Valley, Cal., and the electric road will be continued out Mill Street to the corporation line. Within a few weeks the work of constructing the road will commence. C. C. Skewes is superintendent of the traction company.

The Chilliwack Light and Power Company of Chilliwack, B. C., will soon proceed with the construction of its extensive plant. The estimated cost is $100,000.

The Portland and Suburban Street Railway Company of Portland, Ore., which is a consolidation of the Portland Railway Company and the City and Suburban Company, will improve the equipment of the company. Many new cars will be built and the light rails will be replaced with 60-pound steel, set in cement.

The electric-lighting business of the Redondo Improvement Company at Redondo, Cal., has been absorbed by the Edison company.

It is reported that C. H. Crippen and C. T. Moscher contemplate building an electric railway between Arlington and Snohomish, Wash.

The Westinghouse Electric and Manufacturing Company is preparing plans and specifications and estimates for the complete electrical equipment and construction of the Portland Southern line, and also for a trolley line to run from Portland, Ore., to the base of Mt. Hood, the power to be generated on Sandy River near that mountain.

The Diamond Match Company will soon award contracts for the construction of a modern street railway at Chico, Cal. The road will be constructed and operated under the supervision of C. W. Waller of San Francisco.

The Shasta Power Company of Redding, Cal., has awarded to the National Electric Company the contract to furnish all the electrical machinery required for the power plant. A.

PERSONAL.

Clare F. Beames, formerly in the engineering department of the Chicago office of the General Electric Company, but now chief engineer of the Mexican Gas and Electric Company, Mexico, was in Chicago recently.

Charles F. Scott, past president of the American Institute of Electrical Engineers and formerly chief electrician of the Westinghouse Electric and Manufacturing Company, bears now the title of consulting engineer for the same company.

W. A. Blanck, formerly with the Arnold Electric Power Station Company of Chicago, is now connected with the Chicago and Milwaukee Electric Railroad Company in the capacity of electrical engineer, with headquarters in Highwood, Ill.

H. C. Walter, a graduate of the Worcester Polytechnic Institute in the class of 1900, and also associate member of the American Institute of Electrical Engineers, has been appointed instructor in electrical engineering at the Institute and will have immediate charge of the work in electrical engineering design. C. D. Knight, a graduate of the Institute and one of the prize men of the class of 1903, has been appointed instructor in electrical engineering, and will devote most of his time to work of instruction in the electrical engineering laboratories. F. J. Adams, a graduate of the Institute, associate member of the American Institute of Electrical Engineers, and one of the prize men of the class of 1904, has been appointed graduate assistant in electrical engineering, with duties in connection with the electrical engineering laboratories.

Mr. Guido Pantaleoni, who has been for so many years manager of the St. Louis office of the Westinghouse Electric and Manufacturing Company, has been relieved of these duties in order that he may act as the personal representative of Mr. Westinghouse during the St. Louis Exposition in the reception and entertainment of distinguished visitors. He has been appointed general southwestern manager of the company, in which capacity his duties will be with the large financial interests of the Southwest. Mr. William Clegg, Jr., who has for the last five years been the active man in the St. Louis territory as Mr. Pantaleoni's associate, has been advanced to be special agent for the handling of the specially important contracts in this field. This mark of the high regard in which Mr. Clegg is held by the company is due to his excellent record, and to the desire to leave him free from the executive duties coming upon a district-office manager, so that his marked ability as a salesman may have a wider scope. Mr. D. E. Webster comes from the Denver office to be acting manager of the St. Louis office. During his 11 years with the Westinghouse company, Mr. Webster has held a number of important positions, including that of chief of the Testing Department at East Pittsburg, so that he brings to his new office fine ability as an engineer as well as commercial experience.

ELECTRIC LIGHTING.

The Clarks Electric Light Company of Clarks, Neb., has been incorporated with a capital stock of $8,000.

The North Shore Electric Company of Evanston, Ill., is extending its wires from Lake Bluff to Libertyville.

The town of Utica, Miss., has voted $19,000 bonds for the construction of a waterworks and electric-light plant.

The Roswell (New Mexico) Electric Light and Power Company has been incorporated with a capital stock of $50,000.

The city of Helena, Ga., is receiving bids for the construction of an electric-light system and the contract will be let soon.

The Sealy Cotton Company of Sealy, Tex., will increase its capital stock and install an electric-light plant of 750 lights capacity.

E. M. and J. K. Jones have sold their electric-light plant at Aberdeen, Miss., to the city. It will be operated as a municipal plant.

The Enid Electric and Gas Company of Enid, Okla., with a capital of $200,000, has been incorporated by J. C. Moore, C. E. Rentchler and associates.

R. L. Patram and John Moor have been appointed by the council of Manchester, Va., as a committee to look into the advisability of the city installing an electric-light plant.

The Edison Electric Illuminating Company of New York reports gross earnings for the year ended June 30, 1904, amounting to $3,125,517, an increase of $457,708 over the preceding year. The expenses amounted to $2,055,758, and after figuring income from other sources the total net income was $1,208,-

046. From this amount dividends amounting to $974,405 were paid.

A bond issue of $25,000 has been approved by the voters of Clinton, S. C., for the construction of an electric-light plant and system of waterworks.

Th city of Greenwood, Miss., has purchased the plant of the Greenwood Light and Water Company for a consideration of $123,000. The city will operate the plant under the management of A. J. Dabney.

Application has been made by the Cascade Electric Company to the Common Council of Cascade, Mich., for a modification of the franchise granted it last year to construct lines in that city for the sale of electric current.

The ordinance providing for the issuing of $150,000 bonds for the purpose of beginning work on a municipal lighting plant in Milwaukee, Wis., is ready to go before the council. A majority report of the committee which recently paid visits to cities owning their lighting plants has been presented to the council, and the erection of such a plant in Milwaukee is recommended. The report was signed also by City Engineer C. J. Poetsch. It is stated that a plant big enough for Milwaukee's need can be erected for $500,000.

ELECTRIC RAILWAYS.

On account of the inauguration of a trolley line between Charleston and Mattoon, Ill., a distance of 11 miles, parallel to the Big Four railway, the latter has posted notices offering four rides for one dollar, good in either direction, and for one or more persons on the same ticket. The railway fare heretofore has been 32 cents one way, as against 20 cents on the trolley.

Two big electric-railway projects, backed mainly by Pittsburg capitalists, are to be launched in the near future. One will be known as the Pittsburg and Allegheny Valley railway, with a capital-stock and bond issue amounting to $1,100,000, and the other line will be called the Meyersdale and Salisbury railway, and will have a capital of $1,500,000. O. W. Kennedy, formerly manager of the H. C. Frick Coal Company, is to be president of both lines.

The directors of the Louisville Traction Company, operating the property of the Louisville Railway Company, Louisville, Ky., have declared a semi-annual dividend of 1¼ per cent. on $11,000,000 common stock. The statement for the six months ended July 31st shows net earnings of $201,035.41. Deducting dividend of $62,500 on preferred stock, leaves $138,535.41 for common stock. The company charges a straight five-cent fare, with transfers.

During the last three or four years the various elevated-railway companies of Chicago have had a normal gain, from month to month, ranging between four and eight per cent. over the corresponding period of the preceding year. These years, however, chiefly the spring and fall months, have been on the top wave of prosperity, so far as industrial activity is concerned. The present year, however, is reported as showing a slight reaction in the amount of traffic which is due, it is said, to the fact that there are fewer men employed at the various industries.

According to the daily papers a car for wedding parties may be the next move that the Aurora, Elgin and Chicago electric railway may place on its rails. The records at Geneva, Ill., show that there have been 1,600 marriage licenses issued in Kane County in the last two years and the number is on the increase. Hundreds of Chicago people go into the Fox River valley to get married and to enjoy the picturesque scenery along the route. The electric lines are being used to a great extent in making short wedding trips. A large number of contracting parties are taken to Rockford, where there are now three interurban lines. In that town there is an average of one Wisconsin wedding a day, the couples coming across the border on the Janesville and Beloit line. Aurora is soon to have an additional electric line, so that the number of marriage licenses of the Kane County seat may be still increased.

The Westinghouse Electric and Manufacturing Company has just completed contracts with the Indianapolis and Cincinnati Traction Company for the introduction of the Westinghouse single-phase system. The Indianapolis and Cincinnati Traction Company intends to extend the road through Connersville and Hamilton on its way to Cincinnati. Under the single-phase system an average speed of 42 miles an hour will be maintained, and it is the purpose of the railway company to adopt a regular schedule of high speed. The equipment of the road will be modern throughout. On each of the handsome and massive cars the company is having built will be mounted two Westinghouse single-phase motors of 75-horsepower each. This will insure power enough to haul the cars at high speed. The consulting engineers, it is said, estimate that the adoption of this new system will result in a saving of $500,000 on the line from Indianapolis to Connersville.

POWER TRANSMISSION.

Thomas H. McCann and T. E. Brown of New York, engineers connected with the Highland Power Company of Boise, Idaho, have settled on plans for the restoration of the plant. The power house will be built on the north side of the river. The machinery will be removed from the wrecked structure.

The Connor Mining and Electric Company of Salt Lake, Utah, is preparing for the installation of an electric power plant of 700 horsepower in Soldier Bridge canyon, near Stockton, Utah. W. B. McSherry is general manager of the company.

It is reported at Buffalo that the New York Central railroad has signed a contract with the Ontario Power Company to take the whole of its output for a term of years. Details have not as yet been made public, but the approximate energy is 40,000 horsepower and the term is probably 25 years.

The Utica (N. Y.) Gas and Electric Company has under consideration plans for the construction of a large storage reservoir on the West Canada creek near Hinckley. Extensive water rights are owned by the company and the steps toward building the dam may not be taken for some time.

SOCIETIES AND SCHOOLS.

Arrangements for an international electrical exhibition to be held in December at Madison Square Garden, New York, are progressing satisfactorily. The show will be under the management of the Electrical Contractors' Association of New York City, and Mr. J. R. Strong is chairman of the executive committee.

The annual convention of the Old Time Telegraphers was brought to a close on September 20th, after an interesting meeting in Atlanta, Ga. J. C. Barclay of New York, assistant general manager of the Western Union company, was elected president, and J. E. Pettit of Chicago was chosen secretary-treasurer of the Military Telegraph Corps.

The twenty-second annual meeting of the Street Railway Association of the State of New York was held in Utica, September 13th and 14th. Great enthusiasm was shown and the attendance and quality of papers read made the meeting a memorable one. E. G. Connette of Syracuse is president of the association. The courtesies of the local telephone and trolley lines were extended to the delegates.

A few months ago the Central Trades Association of Königsberg, Prussia, instituted a free course of instruction for those who are employed at the electrical works in that city (minors excepted). The lectures, which are held two evenings a week, from 7:30 until 9:30, are delivered by some expert engineer who has had long practical experience. At the end of each course, which lasts about 12 weeks, examinations are held. Those who succeed in passing these examinations are awarded certificates which set forth the fact that they have performed their work in a satisfactory manner. It is thought that this idea of giving free instruction to the employes of electrical works will be introduced in other places.

PUBLICATIONS.

Once more a "krow" comes from the Woolley Foundry and Machine Works of Anderson, Ind., this time in the form of a small folder illustrating the Burger Gas Engine, which is one of the company's main "spurs" to back up its "krow."

A storage-battery plant installed in the power house of the Easton Power Company of Easton, Pa., is made the subject of a bulletin issued by the Gould Storage Battery Company of New York city. The battery is used in connection with the water-power plant of the company and is said to be very efficient in taking care of load fluctuations. Four interior views of the battery installation are shown in the bulletin.

"A Little Light on the Subject" of the proposed Supply and Machinery Dealers' Association, the organization of which is now being agitated, gives the opinions of some of the leading manufacturers on the subject. C. B. Carter of Knoxville, Tenn., has been corresponding with a large number of representative firms in regard to the matter and the little pamphlet with the above title contains some of the answers he has received, selected to show the different phases of the situation.

Some new advertising literature which is being distributed by the Automatic Electric Company of Chicago consists of two small booklets, one entitled "What They Say About the Automatic in Grand Rapids," and the other, "What Portland, Maine, Thinks About the Automatic Telephone." These booklets contain, besides pictures of the interior of the respective exchanges, numerous letters from prominent business firms in the two cities testifying to the merits of the automatic system. The company has also issued a reprint of the annual report of the Citizens' Telephone Company of Grand Rapids, Mich.

Bulletins Nos. 2 and 6, issued by the De Laval Steam Turbine Company of Trenton, N. J., do credit to the company's publishing department. Number 2 describes direct-current turbine units of from seven to 300 horsepower. The bulletin contains a detailed description of this class of apparatus, including many clear illustrations of the parts and of the machines as a whole. All units are self-contained and free from vibration. Bulletin No. 6 is devoted to the De Laval turbine blower. In these units both the Sirocco and Sturtevant blowers are used. One unit illustrated has a capacity of 23,000 cubic feet of air per minute, 21 inches water pressure, the turbine itself being of 150 horsepower.

MISCELLANEOUS.

The Pinar Del Rio Railway and Improvement Company has been incorporated at Wilmington, Del., to build and operate lines of railway, telephone and telegraph in any part of the United States and friendly countries. The incorporators are Leonard L. Bishop, West Hampton, N. Y.; Joseph Bailey, Patchogue, N. Y.; Fred D. Gilman, Chicago, and Louis G. Cone, Havana, Cuba.

The application for patents during the last fiscal year broke all records, according to the annual report of the commissioner of patents made public recently. There were 50,321 applications for mechanical patents and 2,554 applications for trademarks. There were 31,979 patents and 2,213 trademarks granted. The total receipts of the office were $1,663,880, and expenditures, $1,460,124.

A public demonstration of Dr. Hans Goldschmidt's Thermit welding system was given by the Cleveland Electric Railway Company one day last week. W. H. Cole, chief engineer of the Thermit company, was present to answer all questions. The Cleveland road has been experimenting for some time with the new system of welding, as well as with the electric welding machine. It seems that the officials are quite well pleased with the new method and its use may become still more extensive.

Numerous experiments have recently been made by large manufacturing concerns to better the lot of their employes. The Weston Electrical Instrument Company of Newark, N. J., has a plan for improving the condition of its men without incorporating any semblance of charity. An employes' club has been formed, which is self-governing, with the responsibility directly upon the workers composing it. It is from this club the unique features of the business concern have their start. For example, there is a dining room where a table d'hote is served for 20 cents. Service is composed of employe volunteers, who are compensated by being permitted to eat at the expense of the club, and to whom the company allows enough extra time at noon to insure their having the full 40-minute recess. Each one of these serves a month at a time. Then there is a luncheon counter where members may buy what they choose and wait on themselves.

There is an interesting hydro-electric power installation at Iyo, Japan, which develops 260 kilowatts of power. The water is obtained from Wakigafuchi Rapids in the Ishite River, where a mean flow of about 50 cubic feet per second is obtained. At present there are in the power house one waterwheel, an electric generator and a switchboard. The waterwheel develops 380 horsepower at 600 revolutions per minute, a suction pipe 15 feet long being used. Regulation of speed is accomplished by Voith's governor to within three per cent. The turbine is connected directly through a leather coupling to a three-phase generator of the revolving-field type, developing 260 kilowatts at 3,500 volts, the frequency being 60 periods per second when running at 600 revolutions per minute. The exciter is wound for 110 volts, and is placed on the same shaft with the generator. The three-phase transmission line consists of No. 3 B. W. G. wires, fixed to petticoat insulators. Telephone wires are also strung on the poles. Both the primary and secondary wires enter the transformer chamber by way of a vertical pipe 20 feet above the roof of tower. In the chamber are two 10-kilowatt transformers.

TRADE NEWS.

The Mills Electric Company of Peoria, Ill., recently incorporated by L. A. Mills, W. H. Taylor and Winslow Evans, will manufacture electrical fixtures.

The High Commissioner for South Africa has rendered a decision to the effect that the following articles falling under item 63 of the tariff of the Transvaal, providing for machinery and parts, are dutiable at the rate of 2½ per cent ad valorem: Accumulators, batteries, dynamos, electric cable, electric pumps, and electric motors.

At Trenton, N. J., last week a charter of incorporation was granted to the Oliver Electric Company, with offices in Jersey City, and a canital of $1,000,000. The incorporators are Eben F. Oliver, Edwin R. Lampson, Edwin Lampson and Rutherford Trowbridge.

Sealed proposals will be received at the office of James Knox Taylor, supervising architect, Washington, D. C., until 3 o'clock p. m., October 17, 1904, for the construction of the United States government buildings, Lewis and Clark Centennial Exposition, Portland, Ore., in accordance with the drawings and specifications, copies of which may be had at the architect's office or the office of the superintendent of the United States postoffice and courthouse at Portland. Sealed proposals will also be received at the office of the supervising architect until 3 o'clock p. m., on October 18, 1904, for the construction (including heating apparatus, electric wiring and con-

duits), of the postoffice at Nashua, N. H., in accordance with drawings and specifications, to be had at the architect's office, or at the office of the postmaster at Nashua, N. H.

C. O. Baker, president of Baker & Co., platinum refiners and manufacturers of Newark, N. J., and New York city, returned recently from an extended European trip. He reports that the prices of crude platinum have been very materially effected by the drafting of the laborers from the Ural Mines, owing to the Russo-Japanese War, and, notwithstanding recent advances, a further rise in prices seems almost assured.

BUSINESS.

The electric-light wires in the cars of the New York subway will run through the Sprague Electric Company's flexible metallic conduit. Flexible metallic conduit is a tube formed by a succession of steel convolutions which give not only great flexibility to the tube, but, also, by its metal composition, a thorough protection to the insulated wires which it carries. Injury from rodents or mechanical causes is thus prevented and even a short-circuit will produce no serious damage, so that safety to the passengers is insured and they have nothing to fear from defective wiring.

A recent shipment made by the American Electric Telephone Company of Chicago consisted of a 500-line bell express board built up in two sections of three positions each. This switchboard is provided with very complete arrangement for rendering toll service, and the trunking circuits are so arranged as to operate in conjunction with a specially equipped toll-line switchboard. The magneto switchboard is arranged for an ultimate of 1,200 lines, and each position of the switchboard may be equipped with 200 lines. The local trunking service between the operators is accomplished over the usual lamp transfer system. The company also reports a brisk demand for small-exchange switchboards.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued (United States Patent Office) September 13, 1904

769,698. Electric Switch. James C. Keller and Otto F. Kadow, Cleveland, Ohio. Application filed June 10, 1903.

A railway-switch tongue is fitted with a lever engaging the tongue. An electromagnet has a core consisting of two members, one member arranged to serve as a weight to hold the lever and tongue in their normal positions. Means are further provided for lifting the weight and thereby moving the lever and switch tongue out of their normal positions, the means comprising the other member of the core.

769,701. Two-wire Multiple Telephone System. Jacob W. Lattig, West Bethlehem, and Charles L. Goodrum, Philadelphia, Pa., assignors to the Eastern Telephone Manufacturing Company, Westchester, Pa. Application filed June 6, 1903.

The telephone-exchange system embodies a signal magnet comprising a divided winding, a continuous core for both divisions of the winding, an armature at one end of the core and an extension of the core from the point of division between the coils to the armature. Suitable connections and sources of current are supplied for signaling, arranged so that a portion of the winding only will be effective, but in developing self-inductance in the circuit the entire winding will be effective.

769,702. Telephone Transmitter. Jacob W. Lattig, West Bethlehem, and Charles L. Goodrum, Philadelphia, Pa., assignors to the Eastern Telephone Manufacturing Company, Westchester, Pa. Application filed June 6, 1903.

In a telephone transmitter are a movable electrode, a fixed electrode, an intermediate partition supported upon and between them, and a body of granular conducting material between each electrode and the partition. (See cut on next page.)

769,738. Lightning Arrester. Willis H. Geist and John E. Geist, Gallatin, Mo. Application filed April 26, 1904.

An insulator is arranged for attachment to a support and comprises a plate having enlargements at its ends. Wires engage with the enlargements and have their ends bent into hooked form toward each other, the hooks being spaced from each other at their bills. The wires are arranged for connection with the ground and line wires, respectively, of a telephone.

769,739. Electric-lighting Device. Otto Gergacsevics, Vienna, Austria-Hungary. Application filed November 30, 1903

Electric apparatus for igniting gas jets consists of a burner pipe, a pilot-flame pipe, means for causing a simultaneous current of gas through both pipes, normally closed electric contacts near the outlet of the pilot-flame pipe, and means for causing a rapid make-and-break action of the contacts without cutting off the gas. By this means a succession of sparks may be produced, by which, upon the ignition of the pilot and burner flames, the current in the pilot-flame pipe is automatically cut off.

769,749. Water-purifying Apparatus. Frederick G. Kuné, New York, N. Y. Application filed November 5, 1903.

In a water purifier are combined a pair of imperforate conduits, the outlet of one of the conduits being connected with the inlet of the other; a drain cock is situated at the junction of the conduits. Electrodes are placed in the conduits, but insulated therefrom, and electrical connections connect the electrodes and conduits with a source of electrical energy.

769,750. Water Purifier. Frederick G. Kuné, New York, N. Y. Application filed December 19, 1903.

Essentially, the water purifier consists of an electrode and casing with a threaded plug engaging the casing. A packing between the plug and casing, an insulating plug provided with a shoulder and passing through the first plug, a packing between the shoulder and plug, an insulating washer surrounding the end of the insulating plug and bearing against the end of the first plug, and a nut engaging the projecting end of the electrodes and bearing against the washer are the other features.

769,751. Motor for Portable Tools. Peter La Court, Clinton, Mass. Application filed October 23, 1901.

An electric motor for portable tools has its armature rotatably mounted at one end of a handle with its shaft crosswise. The pole pieces of the motor extend perpendicularly to the shaft into the handle. The handle is fastened to and incloses the extensions of the pole pieces.

769,760. Telephone-exchange Switchboard Apparatus. Frank R. McBerty, Evanston, Ill., assignor to the Western Electric Company, Chicago, Ill. Application filed January 13, 1902.

The line lamp and the supervisory lamp and their local circuits are connected with the battery. The local circuit of the lamp includes resistance. The jack has a test piece and the tip of the plug has a connection to the same side of battery with which lamp is connected. A shunt is placed about the lamp, whereby in case the tip of the plug touches the test piece of the jack, there will be no increase of the current from battery through the lamp.

769,812. System of Multiple Electric-motor Control. William Baxter, Jr., Jersey City, N. J. Application filed August 29, 1903.

In a motor-controlling system are combined a master switch, a controller consisting of electromagnetic switches, independently connected, and arranged to act in succession with progressively increasing energizing currents, conductors connecting the magnets of the controller in proper relation and terminating in one wire for each direction of rotation of the motors, and conductors connecting the controller-circuit terminals with the master switch.

769,813. System of Signaling on Railways. François Bongrand, Cusset, France. Application filed August 7, 1900.

Apparatus for railway signaling embodies an electromagnet and its keeper placed upon a contact board, the keeper being provided with contact parts contacting with like parts placed upon the board. Connections are made to an electric motor, a drum being mounted upon the shaft. A cable on the drum operates the signal.

769,815. Dynamo. Martin C. Burt, Chicago, Ill. Application filed November 14, 1903.

Combined with an armature having a hollow interior is a series of plates, one of the plates having a hollow portion and a fan arranged within the hollow portion for effecting a circulation of air.

769,824. Electric Fire Alarm. William B. Hopkinson, Muscatine, Iowa, assignor of one-half to Amos Coe Hopkinson, Muscatine, Iowa. Application filed April 15, 1904.

A circuit-closing member is movable to a closing position under the impulse of an explosive charge. Yieldable contact plates are adapted to receive and lock the member in closed position to continuously sound the alarm.

769,842. Electric Arc Lamp. Frederik Sindingchristensen, New York, N. Y. Application filed September 29, 1903.

An electric arc lamp embodies in its construction a solenoidal magnet, a pair of armatures situated and movable within the cavity of the solenoid, and a pair of carbons carried by the armatures and angularly disposed as regards each other.

769,854. Trolley Wheel. William T. Wilkinson, Medford, Mass. Application filed December 18, 1903.

Removable check pieces on the inner periphery of the wheel are the new feature.

769,862. Guard for Third Rails. John H. Guest, Brooklyn, N. Y. Application filed December 12, 1903.

Insulating guard strips or plates covering the upper surface of the third rail are supported by springs adapted to press them down in a vertical direction.

769,863. Telephone Attachment. William S. Haddock, Uniontown, Pa. Application filed August 20, 1903.

A device comprising a plate attached to the receiver extends over and closes the transmitter when hung thereon.

769,916. Telemotor for Steering Ships, or Other Uses. Mathias Pfatischer, Philadelphia, Pa., assignor to the Electro Dynamic Company of Philadelphia, Pa. Application filed December 21, 1900.

A prime motor is adapted to produce rotation in either direction and an electric generator is driven by the motor. Electric motors are connected to the generator for synchronous operation, together with means on one of the motors for adjusting the apparatus, and means on another of the motors and positively connected with the prime motor for stopping the latter.

769,920. Dynamo Mounting for Railway Car Trucks. Willard F. Richards, Buffalo, N. Y., assignor to Charles M. Gould, New York, N. Y. Application filed November 2, 1903.

A dynamo is movably supported with drive connections between the dynamo and the car axle. Means are provided acting to normally hold the dynamo stationary and which positively hold the dynamo from movement away from the cax axle, but permit a movement of the dynamo toward the car axle.

769,961. Circuit-protecting Device. Edwin W. Rice, Jr., Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed February 18, 1903.

In a lightning arrester are combined a rod of resistance material and a number of metallic rings secured to the rod and separated from each other.

769,962. Safety Device for Railways. Pickens A. Sawyer, Memphis, Tenn. Application filed April 27, 1903.

An electromagnet is provided for setting each signal and a separate electromagnet for releasing each signal.

769,973. Means for Protection Against Reversal of Energy. Leonard Wilson, Pittsfield, Mass., assignor to the Stanley Electric Manufacturing Company, Pittsfield, Mass. Application filed November 2, 1903.

A polyphase generator has a potential transformer connected to one phase, a series transformer connected to another phase, and a core adapted to be saturated by a fraction of the full-load current of the generator. An electroresponsive device is connected to the secondaries of the transformers.

769,975. Storage Battery. James P. Wood, Buffalo, N. Y. Application filed March 14, 1904.

A series of spaced positive plates and a series of spaced negative plates are separately suspended in alternation within the cell, each plate of the two series being held in central rigid suspension.

769,983. Block-signal System. Fred B. Corey, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed February 10, 1904.

A source of alternating current is connected to the rails at one end of a block, and a similar device connected to the rails at the other end of the block so that the current for the device flows through all the rails of the block.

769,984. Electrical Measuring Instrument. Thomas Duncan, Chicago, Ill. Application filed June 26, 1901.

769,985. Electrical Measuring Instrument. Thomas Duncan, Chicago, Ill. Application filed June 26, 1901.

These two patents embody specifications covering a new instrument for indicating the lag or lead in an alternating-current circuit.

769,986. Electric Meter. Thomas Duncan, Chicago, Ill. Application filed July 18, 1901.

A supplemental pressure winding of the meter modifies the normal torque of the meter, the main and supplemental pressure windings being in the form of commutated armature windings mounted upon a common shaft.

769,987. Electric Meter. Thomas Duncan, Chicago, Ill. Application filed July 19, 1901.

Combined with a storage battery is switching mechanism for connecting the storage battery in circuit with the translating means supplied thereby. A meter in circuit with the battery may be caused to rotate continuously in one direction while the battery is discharging and being charged.

769,988. Electric Meter. Thomas Duncan, Chicago, Ill. Application filed July 18, 1901.

A form of wattmeter is described for measuring separately the charge and discharge of a storage battery.

769,989. Electrical Measuring Instrument. Thomas Duncan, Chicago, Ill. Application filed August 26, 1901.

In combination with a storage battery is a switch for changing the connection of the storage battery from the translating means to the charging machine through a meter and vice versa.

769,991. System of Electrical Distribution. William L. R. Emmet, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed February 9, 1900.

A relatively movable contact co-operates with a fixed set, with means for causing the movable contact to move intermittently over the set. Means are provided for locking the movable contact in various positions.

769,995. Cut-out or Fuse for Electric Circuits. Otto Feuerlein, Charlottenburg, Germany, assignor to the Siemens & Halske Electric Company of America, Chicago, Ill. Application filed September 9, 1899.

A fuse bent in the form of a loop is carried by a casing carrying terminals to which the fuse is connected. A filling of cement incloses the terminals and portions of the fuse.

769,996. Electric Arc Lamp. Richard Fleming, Lynn, Mass., assignor to the General Electric Company, Schenectady, N. Y. Application filed February 20, 1903.

A movable electrode is controlled by a clutch which grips the electrode firmly whenever the former is brought into contact with a stop.

770,007. Time-limit Circuit-breaker. Edward M. Hewlett, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed February 11, 1899.

A controlling coil for the circuit-breaker is inoperative under a normal current carried by the circuit-breaker, but operative under predetermined abnormal current.

770,014. Electromedical Appliance. Samuel H. Linn, Rochester, N. Y. Application filed April 14, 1904.

In an electromedical appliance is a sheet of insulating material having an opening, a voltaic element consisting of a sheet of suitable material having a projection thereon for extending through the opening in the sheet of insulating material and means for supporting the element and the sheet of insulating material upon the body of the wearer with the projection extending toward the tissues to be treated through the openings in the sheet.

770,017. Automatic Regulator. Walter S. Moody, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed January 9, 1903.

A movable voltage-changing member cooperates with a continuously rotating member, while a pair of flexible shafts are each connected at one end to the voltage-changing member. Each electrode carries at the other end a disk and means for moving one or the other of these disks into engagement with the continuously rotating member accordingly as the voltage changer is to be operated to raise or lower the voltage.

770,028. Brake for Electric Motors. Leonard A. Tirrill, Lynn, Mass., assignor to the General

Electric Company, Schenectady, N. Y. Application filed February 16, 1904.

An electric brake is connected to the driven member of the motor with means for short-circuiting the armature of the motor through the winding of the brake, the brake being so proportioned relative to the motor that the current in the short-circuit produces a braking effect on the motor and on the driven member approximately proportional to their inertia.

770,033. Electrolytic Meter. Howard I. Wood, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed February 14, 1903.

A body of liquid contains a tubular floating body partially submerged. A receptacle is supported from and beneath the float carrying an electrode. An electrical contact for the electrode passes upward through the float. (See cut.)

770,034. Fuse. Gilbert Wright, Pittsfield, Mass., assignor to the Stanley Electric Manufacturing Company, Pittsfield, Mass. Application filed September 28, 1903.

Details are described.

770,040. Motor-control System. Charles E. Barry, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed April 18, 1903.

A motor controller is built of separately actuated contacts and means are provided for operating the contacts. Relays control the contact-operating means automatically and successively, the relays being adjusted to respond to certain successive increments of counter electromotive force in the motor circuit as the motor increases in speed.

provided with a commutator; brushes which connect the commutator electrically with the source; field coils, and other brushes which connect the field coils with the commutator. (See cut.)

770,098. Dynamo Regulator. George S. Neeley, St. Louis, Mo. Application filed January 19, 1904.

A dynamo regulator comprises an alternating generator and its exciter, a pair of arc-forming contacts adapted to be placed in series with the exciter field winding, and a solenoid in circuit with the alternating generator and adapted to automatically regulate the resistance of the exciter field winding. (See cut.)

770,099. Voltage Regulator for Dynamos. George S. Neeley, St. Louis, Mo. Application filed April 1, 1904.

Two solenoids are magnetically separated, the cores for the solenoids being connected by a stem. A spring is arranged to oppose the force exerted by one of the cores. A pair of arc-forming platinum contacts are provided, one of which is connected to the stem, a glass-tube holder being also connected to the stem. A glass inclosure is carried by the holder and incloses the contacts.

770,109. Vapor Electric Apparatus. Max von Recklinghausen, New York, N. Y., assignor to the Cooper Hewitt Electric Company, New York, N. Y. Application filed October 17, 1903.

In a gas or vapor electric apparatus having a volatilizable, negataive electrode and two or more volatilizable positive electrodes are an auxiliary positive electrode, and separate condensing chambers for the positive electrodes, the chambers having capacities proportionate to the vaporization at the several electrodes.

770,113. Trolley Harp. Edward D. Rockwell, Bristol, Conn., assignor to the Liberty Bell Company,

a receptacle for the electrode, separated from the walls of the container, and a condensing chamber located above the negative electrode and so disposed as to discharge its condensations into the receptacle. (See cut.)

770,198. Method of Replenishing Electrode Waste in Gas or Vapor Electric Devices. Percy H. Thomas, Pittsburg, Pa., assignor to the Cooper Hewitt Electric Company, New York, N. Y. Original application filed May 2, 1903. Divided and this application filed June 22, 1903.

Condensations within the tube are partly restored to the negative electrode. The excess is expelled and restored to the positive electrode by a negative electrode flame.

770,222. Manufacture of Electric Incandescent Lamps. Francis M. F. Cazin, Hoboken, N. J. Original application filed December 16, 1903. Divided and this application filed March 16, 1904.

The process of making joints between vitreous parts, consists in heating the parts adjacent to the joint and in simultaneously applying to the joint preheated glass.

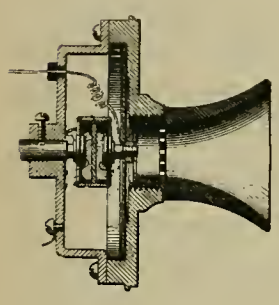
770,223. Incandescent-lamp Bulb. Francis M. F. Cazin, Hoboken, N. J. Application filed March 17, 1904.

A bulb is composed of an integral outer and inner envelop, the inner envelop having a seat. A base provided with a shoulder is adapted to fit the seat of the inner envelop.

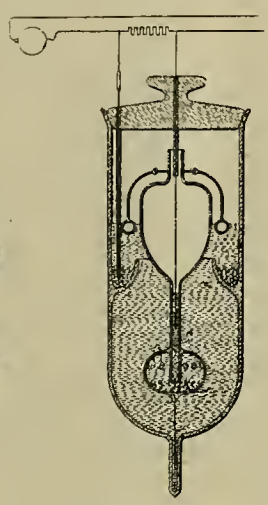
770,228. Receiver for Space Signaling. Lee De Forest, New York, N. Y. Application filed December 24, 1902.

A wave-sensitive member comprises two poles of like material. A rod of different material extends between the poles, and a yielding support for the rod is adapted to maintain it in contact with the poles.

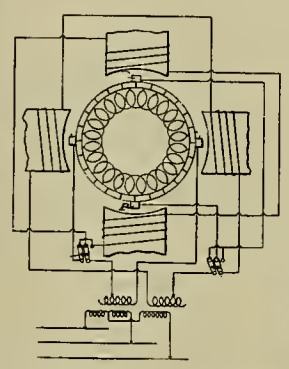
770,229. Wireless Signaling Apparatus. Lee De Forest, New York, N. Y., assignor to the Greater New York Security Company, New York, N. Y.



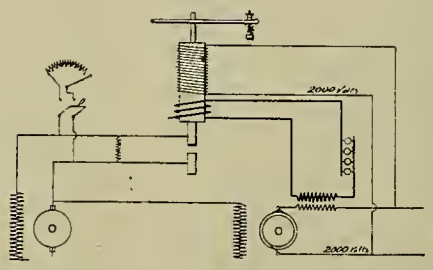
NO. 769,702.—TELEPHONE TRANSMITTER.



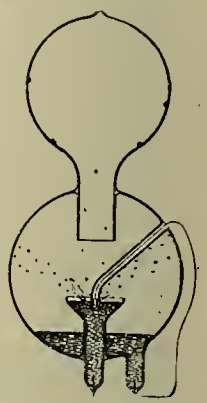
NO. 770,033.—ELECTRIC METER.



NO. 770,092.—ALTERNATING-CURRENT APPARATUS.



NO. 770,098.—DYNAMO REGULATOR.



NO. 770,197.—MERCURY-VAPOR LAMP.

770,041. Electric Railway. Asa F. Batchelder, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed March 29, 1901.

A box or housing is adapted to be mounted along the line of an electric railway, the box being slotted on three sides for the passage of a car collector. A separate contact device is yieldingly supported within the box and permanently connected electrically with the feeder, the contact being adapted to move bodily both vertically and in the direction of travel of the car collector.

770,054. Electrical Connector. Philip H. Fielding, New York, N. Y. Application filed July 31, 1903.

One part of the connectors consists of a central web of insulating material provided on opposite sides with contact terminals offset from its face, while the other is provided with two tongues straddling the web, and having contact terminals corresponding with those of the other member.

770,073. Method of Controlling Electric Motors. Charles W. Kennedy, Rutledge, and Francis A. Pocock, Landsdowne, Pa.; Sarah H. Kennedy, administratrix of said Charles W. Kennedy, deceased; said Francis A. Pocock and said administratrix assignors of three-eighths to Edward W. Patton, Philadelphia, Pa. Application filed April 16, 1902.

A method of controlling two or more motors having armatures provided with two sets of windings, consists in starting the motors as series machines, increasing their speed by first varying the relative connections of the individual field magnets and of the various sets of armature windings and then changing the connections of the motors so that they operate as shunt machines.

770,078. Magnetic Curtain for Covering Leaks in Ships. Ludwig Krüger, Sonderburg, Germany. Application filed January 29, 1904.

A flexible curtain for covering holes in the side of a ship is composed of a sheet of rubber reinforced by iron bars secured upon cloth and covered by a canvas, the edges of the rubber cloth being provided with pieces of magnetized steel. The outer piece is concave and the inner piece is convex snugly fitting in the cavity of the outer piece, both being united by screws, rivets or the like, and clamping between them the rubber cloth.

770,091. Alternating-current Machinery. Addams S. McAllister, Ithaca, N. Y. Application filed February 15, 1904.

In a machine of this sort is a coil-carrying rotor provided with a commutator. Brushes are in contact with the commutator and connected with a suitable source of current supply.

770,092. Alternating-current Machinery. Addams S. McAllister, Ithaca, N. Y. Application filed March 23, 1904.

An alternating-current machine capable of use either as a motor or a generator, comprises a coil-carrying rotor

Bristol, Conn. Application filed January 13, 1904.

Details or described.

770,140. Electrode for Batteries. Albert C. Wood and James A. McMullan, Philadelphia, Pa. Application filed April 22, 1902.

An electrode for a secondary battery comprises several series of parallel strips of lead tape, the strips in one series extending in a direction at right angles to the strips in the next adjacent series. An integral cast-metal supporting-frame in which the series of strips are arranged is provided, the strips having a width equal to the thickness of the frame, and the ends of the strips of each series being fused to the frame.

770,148. Electroplating Machine. James Bailey, Walsall, England. Application filed February 14, 1903.

A non-conducting framework is suspended above the tank and a continuous chain conveyor serves as a cathode and is arranged in parallel lengths and supported by the framework. Anodes are supported by the framework between the lengths of the conveyor.

770,157. Telephone Desk Standard. Charles L. Boyce, Detroit, Mich., assignor to the Western Electric Company, Chicago, Ill. Application filed August 9, 1902.

Combined with a hollow telephone-desk standard is a frame plate fitted into it from the top, a transmitter support and switch mechanism, and the connection terminals, all mounted upon the frame plate, whereby the working parts may be removed as a unit from the hollow standard.

770,166. Electrical Switch. Harry W. Cox, Nottingham, England. Application filed July 15, 1903.

Specifications for the switch embody a contact arm, pole pieces to be connected by the arm, an axle upon which the arm can turn, a bracket carrying the axle, a handle and cam levers fixed upon the axle, a catch pin carried by the contact arm, a spring on the catch pin, holes in the bracket for the catch pin, stops for limiting the motion of the contact arm and a spring or springs between the contact arm and handle.

770,184. Attachment for Telegraph Sounders. John F. Mickey, Baltimore, Md., assignor of one-half to Joseph J. Noppenberger, Baltimore, Md. Application filed May 2, 1904.

An attachment for telegraph sounders comprise a base plate and magnets mounted thereon, plates supported by the base, armature-supporting standards carried by one of the plates, an armature, and means for varying the distance between the plates.

770,197. Gas or Vapor Electric Device. Percy H. Thomas, Pittsburg, Pa., assignor to the Cooper Hewitt Electric Company, New York, N. Y. Application filed May 2, 1903.

Embodied in the apparatus are a container, a negative electrode consisting of vaporizable conducting material,

Original application filed May 14, 1902. Divided and this application filed March 14, 1903.

In a receiving apparatus for space signaling are a periodic and an aperiodic antenna, and a wave-responsive device having one end connected with one antenna and its other end connected with the other antenna.

770,230. Electrical Indicator. William J. Forrest, Jr., Kenosha, Wis. Application filed November 30, 1903.

A ratchet wheel device for operating an indicator is controlled in turn by an electromagnet.

770,232. Gas or Vapor Electric Lamp. Peter C. Hewitt, New York, N. Y., assignor to the Cooper Hewitt Electric Company, New York, N. Y. Application filed February 12, 1902.

A method of starting a gas or vapor electric apparatus consists in creating by means located within the apparatus a radio-active effect, and applying to the terminals of the apparatus a condition of electrical potential.

770,233. Gas or Vapor Electric Apparatus. Peter C Hewitt, New York, N. Y., assignor to the Cooper Hewitt Electric Company, New York, N. Y. Original application filed February 12, 1902. Divided and this application filed June 10, 1903.

Combined with a composite conductor, consisting of a solid and a gaseous portion, is an electrode, and a source of negative rays located in the vicinity of one terminal of the gaseous portion in such position as to project the rays into the region where the gaseous portion of the conductor contacts with the electrode.

EXPIRING PATENTS.

Following is a list of electrical patents (issued by the United States Patent Office) that expired on September 30, 1904:

370,052. Signal and Pyrotechnic Electric Light. A. C. Ferguson, Saratoga, N. Y.
370,123. Electric Meter. Thomas A. Edison, Menlo Park, N. J.
370,124. Manufacture of Filaments for Incandescing Electric Lights. Thomas A. Edison, Menlo Park, N. J.
370,125 to 370,132, inclusive. Electrical Transmission of Power. Thomas A. Edison, Menlo Park, N. J.
370,134. Secondary Battery. O. C. Flick, Brooklyn, N. Y.
370,193. Adjustable Support for Automatic Switch for Telephones. S. J. Jermain, Toledo, Ohio.
370,230. Auditory Transmitter for Telephones. M. H. Allison, Xenia, O.
370,243. Electric Attachment for Locomotives. N. F. Chase, Montrose, N. Y.
370,282. Electric Welding and Tempering Metals. E. E. Rics, Baltimore, Md.
370,285. Vehicle Hub. B. Schad, Batavia, N. Y.
370,293. Telephone System. F. C. Watkins, Philadelphia, Pa.
370,357. Printing Telegraph. R. J. Sheehy, New York, N. Y.

WESTERN ELECTRICIAN

EVERY SATURDAY

Vol. XXXV. CHICAGO, OCTOBER 1, 1904 No. 14

Rack Railway to the Gornergrat, Switzerland.

By Franz Koester.

The Gornergrat railway in the Alps, in the southernmost part of Switzerland, is a particularly interesting rack railway, electrically operated, water-power being used to generate the current. It starts opposite the Visp-Zermat station, which is 5,272 feet above the level of the sea, and runs through the valley, crossing the bridge over the river and up the east slope of the mountain until it comes to the Riffle Mountain, 7,277 feet above the sea level. From this station the road is run in the form of a reverse curve (Fig. 1) in order to avoid a grade greater than 20 per cent., and comes to a plateau which is comparatively level. From here it runs along a ledge cut out of the steep, rocky side of the Riffle, the elevation being 8,478 feet above sea level. Passing the Riffle station the road runs in a southerly direction along the footway, turning sharply to the east at Rothenboden and running up to Gornergrat, which is 9,805 feet above the sea level. Thirty per cent. of the entire length of the road is made up of curves.

Between stations the distance varies from 1½ to two miles, thus affording favorable conditions for operating. Allowing five minutes for stops at each station, the trip is made in one hour and 40 minutes. Each train may carry 110 passengers, and thus it will be seen that the capacity of the road is large as compared with other mountain railroads. The entire length of the road is 5.6 miles.

The construction of the road was attended with a great many difficulties, due to the high altitude and the temperature changes. Great difficulty was experienced in getting workmen who were able to stand these conditions, and the constant change in force was a severe handicap.

There are five tunnels on the line varying in length from 131.2 feet to 662.4 feet, and two bridges, one 78.7 feet long and another which is 272.5 feet in length. The maximum grade, as previously mentioned, is 20 per cent.; the least radius used for the curves is 262 feet, and the gauge is 3.28 feet. The roadbed is 11.7 feet wide, and on fills the sides have a slope of two to three. The roadbed is built partly on fills and in cuts, and in some places the fill is made on the slope of the mountain, the downward side being strengthened by stone or concrete slopes.

The tunnels are 12.3 feet wide and 14.7 feet above the top of the rail. The top of the tunnel is in the form of an arch, the walls up to the spring line being vertical. They are of masonry and concrete construction and have niches for workmen provided at intervals of 165 feet. The cars are 11.8 feet wide and 12.5 feet high, thus allowing ample clearance.

The most difficult part of the construction was encountered between Zermat and the Riffle Mountain, as it was on this portion of the road that it was necessary to build the two bridges. The bridge over the Visp River is constructed of lattice steel trusses resting on masonry abutments. The second bridge spans the valley of the Findelen, and may be seen, by close inspection, in the lower left-hand corner of Fig. 1. This bridge is divided into three spans of 91.8 feet each, which rest on two abutments and two piers. The piers are 157.4 and 189.2 feet high, and the grade on the bridge is 12.4 per cent. The piers and the abutments are built of masonry and the bridge is built of steel trusses.

There are also four tunnels on this portion of the road, these being 147, 196, 82, and 662.4 feet long, respectively. The first three tunnels are cut through rock and did not require any lining, while the longest, the Under Alp tunnel, was cut through the loose mountain soil and had to be lined throughout. The tunnel construction had to be carried on entirely from one end and all sand and mortar transported to the work on mules, the sand alone costing 35 cents a cubic foot delivered at the lower end of the tunnel. Wooden falsework was employed throughout in the construction of this tunnel, the grade being 20 per cent. In the first 4.8 kilometers 1,260,000 cubic yards of side fill were required, this being largely made up of dry masonry.

Line rails are of the ordinary tee cross-section and weigh 20.6 kilograms per meter. The ties are of iron, of trough cross-section, 1.8 meters long, and weigh 21.24 kilograms; they are placed on 90-centimeter centers. The rail joints are suspended and the rails fastened to the ties by clamping plates and screws. The rails are not elevated on curves on account of the low speed, 4.5 miles an hour. The gauge is widened, however, the increase amounting to 14 millimeters. The racks are double, 38 millimeters apart, fastened by bolts to an iron support, which is bolted to the tie. The racks are constructed of steel and are 110 millimeters high and 1.8 meters long, they are 20 millimeters thick and the teeth on the two racks are alternated. The adjoining sections of the rack rails are connected together by means of bolts and flat iron plates. The rack and specially built switches are of the Abt system.

FIG. 1. RACK RAILWAY TO THE GORNERGRAT, SWITZERLAND.—MOUNTAIN VIEW SHOWING LOCATION OF LINE.

The road is ballasted with trap rock one foot thick, the trough form of the ties preventing its movement.

Water for the generating plant is taken from the Findelen Creek, which is fed by the Findelen Glacier, and thus the supply in the summer, when the traffic is heavy, is greater than during the period of light traffic in the winter time. The flow available in winter is 3,500 liters a second and in summer 15,000 liters a second.

For utilizing this water a dam has been built across the stream and the water passes through a gravel filter and a regulating sluice gate into the head water canal. A special overflow sluice gate is also provided in the canal. One-third of the length of this canal is in an open trench and the remainder is in a closed conduit, easily accessible. The canal ends in a collecting basin, in which is provided a settling chamber, the water flowing from the settling chamber into the portion of the reservoir which connects with the penstock.

The penstock is connected to the reservoir at a point 9.8 feet below the water level to prevent the entrance of air and the disturbance of the water. The penstock leading to the power plant is 656 feet long, 2.95 feet in diameter and has a slope of 67 per cent. The diameter of the penstock was so chosen that the speed of the water in it does not exceed 3.28 feet per second. The pipe is made up of rolled steel plates riveted in sections 14.6 feet long, the sections being joined by wrought-iron flanges. The line is divided into three zones. In the upper one the plates are six millimeters thick, in the second the plates are eight millimeters thick, and in the third section 12 millimeters in thickness on account of the increased pressure.

Figs. 2 and 3 show, respectively, a plan and transverse section of the power plant, which is located on the second kilometer of the road, 80 meters below the track, and on the left side of the river. The station has an ultimate capacity of four turbine sets, three of which are at present installed, the units being 250 horsepower each. The penstock is led to a trench behind the power plant and is connected to the turbines by means of pipes. The foundation of the power plant is of concrete and the portion above the ground is built of masonry, the roof being of wood. Two of the turbines are sufficient to furnish the required power, the third being held in reserve. They are of the Girard high-pressure inward-flow type, mounted on horizontal shafts and revolve at a speed of 400 revolutions a minute. Each turbine is equipped with a delicate spring pendulum governor of the Schadt system. The necessity of delicate regulation is very great, as occasions may arise when two loaded trains may start at the same time, thus increasing the demand on the plant from zero to 50 horsepower. To prevent damage to the penstock, due to sudden heavy demands on the plant, the penstock is equipped with an air cushion, the air being furnished by a compressor, which is driven by a separate small turbine.

When the water supply to the turbine is cut off by means of the regulator a valve in the air chamber opens and the water is admitted. When the water is again allowed to flow to the turbine this relief valve is closed, a dash-pot arrangement admitting air to the chamber. In order to insure the satisfactory operation of a regulating apparatus of this kind it is necessary that the entering water be free from any suspended matter. This is accomplished by specially constructed filters, through which the water passes. The filters are capable of being removed and cleaned in a period of a few minutes. During cleaning, the water for the regulating apparatus is obtained directly from the penstock. According to the contract under which the turbines were furnished a maximum speed variation of from two to three per cent. is required, with a 25 per cent. change in load and a variation of from three to four per cent. change in the speed, with a 50 per cent. change in load. Tests on the turbines have shown a maximum speed variation of one per cent. from no load to full load and a maximum variation of two per cent. from no load to a load of 240 horsepower suddenly applied. The results of these tests show very clearly the efficiency of the regulating apparatus.

Three-phase generators are direct connected to the turbines on the same shaft by means of flexible insulated couplings. The generators furnish current at 3,400 volts and 40 cycles per second and run at a speed of 400 revolutions per minute. They are of the revolving-field type, manufactured by Brown, Boveri & Co., and have 12 poles. The armature conductors are placed in insulating tubes and are imbedded in the iron core, the tubes being tested for their insulating qualities by a pressure of 20,000 volts. The generators are excited by two direct-current generators direct connected to two small turbines by means of insulated flexible couplings. These machines are placed on the opposite side of the building from the main units, one on either side of the switchboard.

The switchboard is placed in the switching room at one side of the building and contains all the measuring instruments and switches for controlling the high and low-tension lines and, also for controlling the parallel operation of the generators. Triple-conductor cables lead the high-tension current from the switchboard to three sets of transformers. Each set is made up of six 30-kilowatt single-phase transformers connected in three groups of two each. Two of the groups are connected in parallel and the third two are star-connected, the secondary side furnishing current at 550 volts.

Transformer sets are located at the second, the

fifth and the eighth kilometer of the line. The cables to the transformer stations do not follow the railway but take the most direct route to the station, the conductors up to the second station being 5½ millimeters in diameter, and four millimeters in diameter to the third station. Two feed wires eight millimeters in diameter lead from transformer stations to the lines.

Trolley wires consist of two wires eight millimeters in diameter and are supported by a span wire between poles on either side of the roadway. The poles are spaced 80 feet apart. The track rails act as the return conductor and are bonded with Chicago rail bonds. A telephone circuit which runs the entire length of the line is also carried on the pole line.

Electric locomotives operate the line, weighing 10½ tons and equipped with two 90-horsepower motors operating at 800 revolutions a minute and taking current at 500 volts. Fig. 4 is a diagram

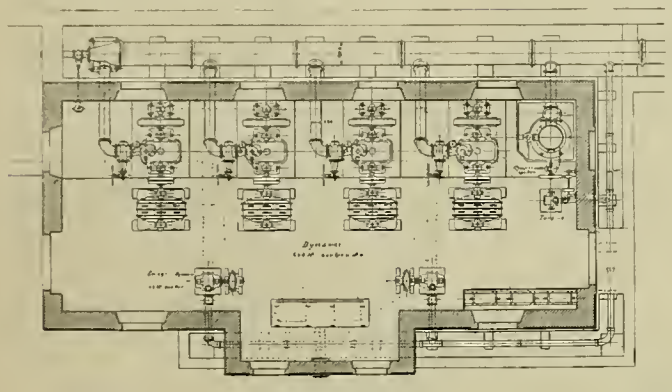


Fig. 2. Plan of Power Plant.

GORNERGRAT RACK RAILWAY IN SWITZERLAND.

of the car-motor wiring and Fig. 5 shows the construction of the locomotive. Each motor operates one pinion for engagement with the rack, being geared to the rack pinion by a ratio of 12 to one. The speed is seven kilometers an hour. The maximum bearing pressure of the teeth is six tons. The locomotive is equipped with two hand brakes, one operating on the left side of both pinions and the other on the right side of both pinions. It is also equipped with an electric emergency brake, which operates when the current is cut off or when the speed limit is exceeded. All of these brakes may be controlled either from the locomotive or from the car. The motors are of the three-phase asynchronous type, provided with collecting rings and arranged for rheostatic control. They can start with full load without an excessive current consumption and also at a load above their normal rating. The motors have six poles and a periodicity of 60 cycles at 800 revolutions per minute.

Controller and measuring instruments are located in the cab. The trolley pole carries two rolling contacts, this type being chosen in order to avoid interruption of the current at switches and crossings. On the descending trip the motors act as

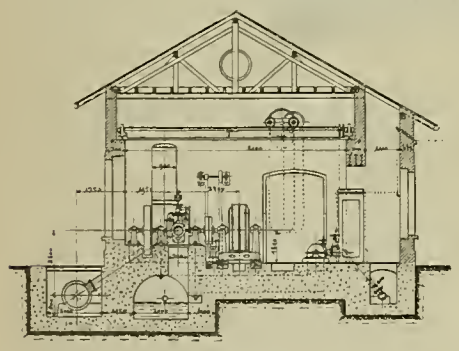


FIG. 3. CROSS-SECTION OF POWER PLANT OF GORNERGRAT RAILWAY.

generators, when their speed is above synchronism, and return current to the line, thus decreasing the demand upon the power plant.

Where more than one car is descending the mountain at the same time, a case might arise where the demand for current upon the generators at the power plant would become so small that their speed would in consequence become excessive. For preventing this condition, the generators are equipped with automatic controlling rheostats, which are thrown into circuit when the speed exceeds a predetermined limit, and which absorb the excess current. In addition to this method, the motors on the descending cars may be reversed and rheostatically controlled from the car, current being consumed and the speed of the car lessened. A recent test, using the above method of control, was made on this road. A fully loaded car was allowed to descend the mountain with all brakes released, the motor being reversed and rheostatically controlled, the speed of the car at no time exceeding seven meters per hour. The results of this test have shown conclusively that it is not only theoretically possible, but also entirely practicable, to return current to the line from the motors on the descending car.

Both closed and open passenger cars are used, the former having a seating capacity for 60 passengers; they are divided into six compartments. One end of the car is supported by the locomotive, the other end resting on a four-wheel truck, this being done in order to distribute the load, so that a portion of it is carried by the locomotive. In consequence, the bearing between the rack and pinion is increased and a greater tractive effort obtained. The open cars have a seating capacity for 50 passengers each and are divided into five compartments; they are mounted on a single four-wheel truck, and are equipped with hand brakes and are so arranged that the electric brakes on the locomotive may be controlled from these cars. It is customary to place these cars in the front of the train on the ascending trip and at the rear of the train when descending, thus rendering it unnecessary to couple them. They are, however, provided with couplings which are used when switching the cars from one track to another. The rolling stock is lighted by means of

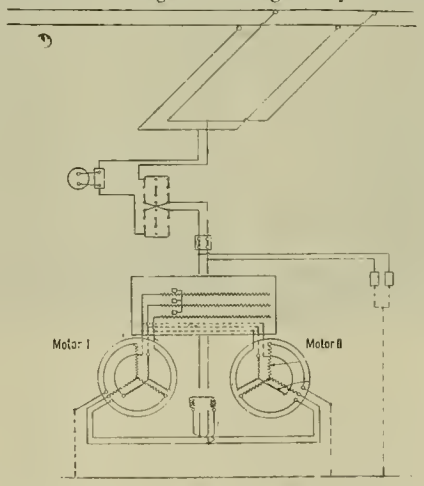


FIG. 4 DIAGRAM OF CAR-MOTOR WINDING, GORNERGRAT RAILWAY.

incandescent lamps, connected three in series, and small transformers are provided at the stations along the line, which reduce the tension of the line current to a voltage suitable for lighting the station by incandescent lamps. The tests which have been made on this installation have shown it to be thoroughly safe and free from dangerous features, and the results obtained from the low cost of operation have been entirely satisfactory. The entire electrical equipment of the power plant, the road and rolling stock was furnished by Brown, Boveri & Co. of Baden, Switzerland.

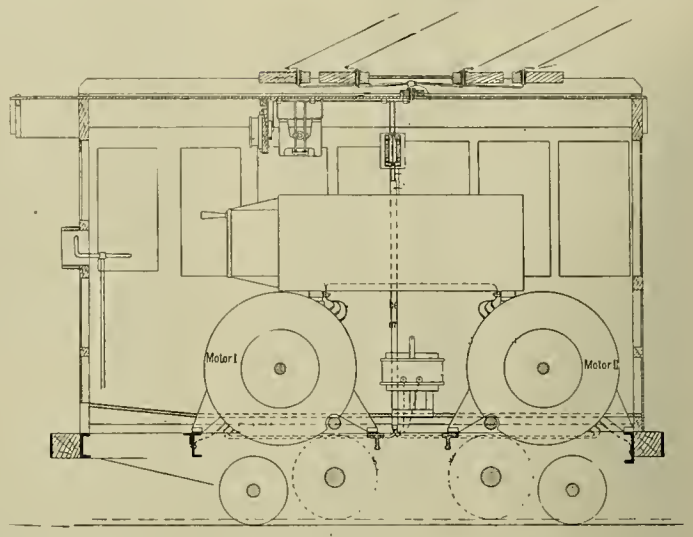


Fig. 5. Construction of Locomotive.

Large Power Plant on the Conchos River.

After many long delays the project of establishing a large electric power plant on the Conchos River in the state of Chihuahua, Mexico, is in a fair way of being consummated. Bernard J. Mahony, an attorney of Chicago, has just obtained a concession from the Mexican government for the enterprise. A concession for the establishment of this plant was obtained from the state government of Chihuahua by R. M. Burke, former United States Consul at Chihuahua, several years ago. Mr. Mahony recently visited the City of Mexico on business connected with the enterprise. It is stated that the syndicate will expend not less than $1,000,000 gold in installing the power plant and constructing the transmission lines. It is proposed to transmit the electrical energy to the cities of Chihuahua and Parral and to various mining districts of the state. Those interested have organized the Conchos River Power Company to carry out their plans. John F. Kelly, New York city, is president of the company. Large storage reservoirs will be built for the purpose of storing water necessary to afford the waterpower for operating the generating plant.

Tour of Society of Chemical Industry.

The Society of Chemical Industry held its annual meeting in New York, as was stated in the Western Electrician of September 17th. From there the party went to St. Louis to attend the meetings of the chemical section of the International Congress.

En route to St. Louis the visitors stopped at Pittsburg on September 17th to inspect the works of the Nernst Lamp Company. Here they were met by a reception committee composed of H. F. J. Porter, second vice-president; Superintendents Williams, Miller and Carleton, and Messrs. Zimmerman and Otto Foel of the engineering department, Gulentz of the inspection department and Sorber and Haas of the sales department. After an address on the late developments on the Nernst lamps by Mr. Zimmerman the party was conducted through the works and evidenced great interest in the mechanical engineering features of the lamp. Sir William Ramsay of London, England, showed particular interest in the American development. A considerable portion of the party were of French, German and Scandinavian nationalities, and seemed thoroughly to enjoy the efforts that had been made by the management for their proper entertainment and instruction.

The delegation spent about a week in St. Louis and then started on the return trip. The party, numbering about 200, arrived in Chicago September 23d. It consisted of 110 foreign members, the remainder being members of American branches of the society which joined the others at different points en route, and also 25 ladies. Many distinguished chemists and manufacturers were among those who filled the parlors of the Auditorium Annex, among them being Sir William Ramsay, Dr. Ludwig Monde, the Right Hon. Lord Allerton, Sir W. H. Bailey, Prof. J. Dewar, Sir David Gamble, Sir James Kitson, Sir Henry Roscoe, Ernest Solvay, W. M. Sowerby and F. Spence. A large local committee superintended the entertainment of the visitors during their stay in Chicago, which was from the 23d to the 25th, inclusive.

On Friday forenoon the members assembled at headquarters and parties left for various points of interest about the city, including the Board of Trade and larger banking establishments. At a little after noon all left by train for the Union Stock Yards, where luncheon was served by the courtesy of Swift & Co. After inspecting the various packing plants the party returned to the hotel, where a banquet was given in the evening.

Saturday's sightseeing including a trip down the Drainage Canal and inspections of the Fisk Street station of the Commonwealth Electric Company and the plant of the International Harvester Company. The ladies on this day assembled, and, in company with members of the ladies' reception committee, visited Hull House, where luncheon was served. Park drives were also a feature of the day. In the evening all listened to a concert in the Auditorium Theater by Sousa's Band.

On Sunday Rev. Dr. Gunsaulus spoke in the Auditorium Theater; after the services the members spent the time resting or driving.

Detroit was the next city visited after Chicago, the party returning to New York via Niagara Falls.

A fund is being raised at Baxter Springs, Kan., for the purpose of buying a right-of-way for the electric railway from Galena, Kan., to Baxter Springs.

Conclusion of "Circular Tour" of Visiting Electrical Engineers.

On Sunday evening, September 18th, the party of foreign electrical engineers, escorted by the American Institute of Electrical Engineers on the "circular tour" in the United States and Canada, reached Pittsburg on its return from the International Electrical Congress at St. Louis in order that they might spend the following day in viewing the various features of the Iron City. Among those composing the local reception committee were Charles F. Scott, chairman; F. H. Taylor, L. A. Osborne, E. E. Keller, H. F. J. Porter, P. M. Lincoln, B. G. Lamme, P. A. Lange, S. P. Grace, H. W. Fisher, S. S. Wales and J. W. Marsh. So much of interest to men of the electrical profession is to be found in Pittsburg that the local committee used its best endeavors to plan ways and means whereby these notable men could see in one day what would ordinarily require a week's time. Accordingly a programme was arranged whereby the visiting delegates were divided into six groups, and under the guidance of members of the local branch of the Institute they were taken on chartered trolley cars to the various industrial establishments. By means of this grouping the visitors were given the best opportunity of inspecting the various plants and their products. Among the important works which were visited may be mentioned the following: At East Pittsburg, the works of the Westinghouse Machine Company and the Westinghouse Electric and Manufacturing Company; at Wilmerding, the works of the Westinghouse Air Brake Company; at Swissvale, the works of the Union Switch and Signal Company; in Pittsburg, the works of the Nernst Lamp Company and the R. D. Nuttall Company; at Bessemer, the Edgar Thomson Steel Works; at Homestead, the Carnegie Steel Works.

BANQUET FOR FOREIGN AND AMERICAN ELECTRICAL VISITORS IN WESTINGHOUSE WORKS, SEPTEMBER 19, 1904.

At the Nernst Lamp Company's works the visitors were first ushered into the business offices of the company, which had been arranged into a temporary display room for the various mineral exhibits such as the company has in the Mining Building at St. Louis. After registration the guests were taken into the exhibition rooms of the company, where expert engineers explained the recent interesting developments which have been made on the lamp, and the comparative practical value of the illuminant was also explained. The party was then conducted through the factory, where it inspected the various departments. Among the notable men present were Dr. Schuyler S. Wheeler and Gano S. Dunn of Ampere, N. J., and George Wilkinson, C. C. Hawkins, F. M. Long, D. K. Morris, Robert B. Perring and A. P. Pyne of England and others. All the visiting members spoke very highly of their appreciation of the efforts of the Nernst Lamp Company to entertain them during their brief visit to the works.

The ladies accompanying the party were met in the morning by a reception committee consisting of Mrs. F. H. Taylor, Mrs. Charles F. Scott, Mrs. L. A. Osborne, Mrs. J. C. Schreuder, Mrs. James Todd, Mrs. Lincoln, Mrs. George C. Smith and Mrs. Capean. Following this reception a drive was taken through the boulevards and parks in the city, after which the party returned to the Hotel Schenley for luncheon. During the afternoon the ladies were escorted to special cars by the Pittsburg Railways Company, which took them through the industrial section of Pittsburg to the works of the Westinghouse companies at East Pittsburg. The following-named ladies accompanied the delegation: Mrs. Ascoli, Miss Hammond, Miss A. M. Perry, Miss Stower, Miss J. D. Cormack, Mrs. Mullin, Mrs. John W. Lieb, Mrs. Philip Torchio, Mrs. H. W. Leonard, Mrs. Calvin W. Rice, Mrs. John T. Conolly, Mrs. W. G. T. Pope, Mrs. D. Bates, Mrs. Thomas Hesketh, Mrs. R. L. Erskine, Mrs. S. S. Wheeler, Mrs. F. J. Sprague and Mrs. R. F. Willis. Those who chanced to be at the steel plants at the time for luncheon were entertained in the dining-rooms at those works, while those who were at the Westinghouse plants took their luncheons with the officials in charge of the different concerns. Mr. T. G. Wagner of the Carnegie Steel Company acted as special escort through the works at Homestead, Duquesne and Bessemer on behalf of President A. C. Dinkey, who was absent from the city.

The rendezvous for all the groups was the works of the Westinghouse Electric and Manufacturing Company at East Pittsburg. Here a section of one of the largest aisles in the new east machine shop had been cleared for the occasion and served admirably as a reception room and banquet hall. A huge table arranged in the form of the figure 8, with covers laid for 400, greeted the visitors as they collected in this section of the electrical works after their day of sightseeing. The banquet hall was decorated in the colors of the various nations represented. Bremer lamps, which are manufactured by the Westinghouse Electric and Manufacturing Company, were used in illuminating the hall, while Cooper Hewitt lamps were provided in order that photographs might be taken of the guests seated at the banquet table. It is interesting to note that but 15 seconds were required to expose the photograph from which the illustration shown herewith was made. Masses of potted plants and palms brightened the main room, and up in a lofty gallery was stationed an orchestra, which added much to the entertainment, rendering national airs of our own and other countries.

At nine o'clock Mr. George Westinghouse, the head of the many great concerns bearing his name, arose and briefly expressed his great pleasure, as well as that of his many lieutenants surrounding him, in having this opportunity of meeting and greeting the electrical engineers of our own and foreign lands. President R. Kaye Gray of the British Institution of Electrical Engineers responded and spoke in behalf of his associates and warmly eulogized the host of the evening. Following him Prof. Moise Ascoli of Rome spoke for the Italian Society, while Mr. B. J. Arnold of Chicago spoke fitting words in behalf of the American Institute of our own country. Mr. Arnold referred in particular to two prominent features in the work of Mr. Westinghouse—first, the pioneer work which he had done in the commercial introduction of alternating current into America, and second, the prominence which he had given to the development of young men, particularly young engineers, in connection with his various companies. These words of fellowship were followed by the singing of well-known songs, after which the guests moved out of the large hall toward the railroad station near by, where awaiting them was the special train on which they were to travel to Washington, D. C.

In Washington the party was met on Tuesday morning by Philander Betts of the local reception committee. Breakfast at the New Willard was the first item on the programme; then the party went in special cars to the Bureau of Standards, where a half hour was spent in inspecting the new buildings and equipment. It was intended to hold the dedicatory ceremony at this time, but the buildings were not ready. An inspection of the Capitol and Library of Congress was the next event. Superintendent Green personally conducted the party through the Library, after which there was an informal luncheon in the Library cafe. In the afternoon the party was divided into groups, according to the trips they desired to take. Some went to Mount Vernon, others visited the navy yard, still others went to the Washington Monument and other places of interest in that neighborhood, but there was a far greater number in the group which went to the White House, Treasury, Corcoran Art Gallery, and the State, War and Navy Building. The engineers took dinner at the New Willard in the evening and left on their special train at eight o'clock for Philadelphia, escorted by J. B. McCall, W. H. Johnson and H. F. Sanville of the Quaker City committee.

Philadelphia was reached at a late hour and nearly all of Wednesday was devoted to that city. Plants of the Philadelphia Rapid Transit Company and Philadelphia Electric Company, the Baldwin locomotive works, the mint and places of historic interest were visited. There was an elaborate luncheon at the Bellevue-Stratford at 1:30 p. m., preceded by an informal reception. Mayor Weaver sat at the head table, with Thomas Dolan, Bion J. Arnold of Chicago, president of the American Institute of Electrical Engineers; John W. Lieb of New York, who has been elected to succeed Mr. Arnold; John M. Mack, Colonel A. Louden Snowden, Presidents Gray and Ascoli, William F. Harrity, John B. Parsons, president of the Philadelphia Rapid Transit Company, and Randal Morgan. Mayor Weaver made a brief speech of welcome to the delegates. President Arnold expressed the thanks of the delegates for the hospitality of Philadelphia and of the local committee of the Institute.

After visiting Washington and Philadelphia most of the party, together with a number of American electricians, accepted the invitation of Mr. Thomas Alva Edison to visit the laboratories at West Orange, N. J., where, on Thursday morning, September 22d, the inventor was assisted in the reception by Mrs. John R. Schemerhorn, Mrs. Walter S. Mallory and his niece, Miss Edith Edison.

Returning to New York on the afternoon of Thursday, the English party gave a dinner at the Waldorf-Astoria to the members of the New York reception committee of the American Institute and a number of friends that had been made during the visitors' trip. The dinner was highly enjoyable and free from formality, but occasion was taken during the evening by the Britishers to make a graceful acknowledgment of the many courtesies that had been extended to them throughout their tour. Mr. Robert Kaye Gray, president of the British Institution of Electrical Engineers, was the chairman of the dinner. In an appropriate speech he presented to Mr. R. W. Pope, secretary of the American Institute, a solid silver casket, beautifully engraved with floral designs, and bearing the inscription: "R. W. Pope, from his friends of the British Institution of Electrical Engineers, New York, September, 1904." A silver tea service was also presented to Mrs. Mullin, wife of Mr. E. H. Mullin, of the General Electric Company, who, with her husband, accompanied the party all through their wanderings, and who was especially active in looking after the lady members of the English party. Mrs. Mullin was loudly cheered on receiving the parting souvenir, and responded in a little speech. A gold cigarette case was also presented to Mr. T. C. Martin of New York.

While the above dinner was proceeding, the visiting members of the Associazione Elettrotecnica Italiana were holding a similar dinner at the Café Martin, in honor of Mr. J. W. Lieb, Jr., of New York, chairman of the general reception committee. Mr. Lieb was the recipient of a handsome silver bowl from the Italian visitors. He spent some years in Italy, speaks Italian fluently, and was the guide, philosopher and friend of the Italians, who showed their gratitude in this manner.

On Friday afternoon the party was finally broken up by the sailing away of about 40 of the visitors for Liverpool, on board the White Star liner Arabic. Many of the party, however, remained in America for a few days longer to make private visits.

Trimming Arc Lamps by Automobile.

The accompanying picture, reproduced by the courtesy of the New York Edison Company, illustrates a new method of lamp cleaning introduced a few days ago for the purpose of trimming the arc lamps on the Williamsburg Bridge, New York city. The ladder, which is of the ordinary extension type, is so modified at its lower extremities as to fit into the stake sockets of an ordinary electric truck. The truck in this case is rated at two and a half tons' capacity and is driven by two General Electric motors from a 44-cell, 15-plate storage battery, supplied by

TRIMMING ARC LAMPS BY AUTOMOBILE.

the Electric Storage Battery Company of Philadelphia, and capable of running 25 miles without recharging.

The platform, when extended to its full height, is 19 feet above the roadway, and it collapses to 14 feet. By means of this conveyance all the lamps on the bridge, which number 128, can be attended to in half a day, which means a saving of 50 per cent. in time and labor.

Marconi Again in This Country.

William Marconi arrived in this country recently to make important changes in the space-telegraph station at Cape Breton, and when these are completed, which will be about the middle of October, he expects to return to England and make similar changes in the Poldhu station. He will return again to America in December, and with both stations in electric accord he believes he will then demonstrate that the distance of 3,500 miles is no bar to a successful operation of his instruments. "Though thus far the experiments have been imperfect, they have mainly failed because of lack of power," said Mr. Marconi. "I purpose to increase that of the Cape Breton station, and I have new appliances for a more perfect radiation for the electric waves. I believe that I can overcome the long distance with more power. The Cunard steamships now get their bulletins readily and accurately when 1,500 miles from shore. With sufficient power the remaining distance across the sea can be overcome, I believe. Recent experiments in Italy developed curious phenomena which distance only cannot explain."

Thawing Ice on a Third Rail by Electricity.

Results of experiments conducted by William Grunow, Jr., W. T. Oviatt and R. B. Davis of the Connecticut Railway and Lighting Company at Bridgeport last winter to determine the amount of current required to heat a third rail for the removal of sleet have been published and show that with the air at 15° F., the temperature of the rail was raised 19 degrees in 15 minutes; and with the air 21° F. the temperature of the rail was raised 19 degrees in 12 minutes. The energy consumption during these 15 minutes was equivalent to 90 kilowatts if the heating had been applied to a one-mile length of the same section of rail. A 70-pound T-rail 30 feet long was used and was heated by means of a steel wire carried under the head of the rail and insulated from it by porcelain bushings. Wood protections were employed to shield the rail from wind and to maintain its temperature.

INDEPENDENT TELEPHONE ASSOCIATION OF THE UNITED STATES.

The annual convention of the Independent Telephone Association of the United States—the eighth in the history of the organization—was held in the Inside Inn, World's Fair grounds, St. Louis, on September 21st, 22d and 23d. The convention was called to order by President Hugh Dougherty, who immediately introduced Prof. W. E. Goldsborough, chief of the Department of Electricity, who represented President Francis. Among other things Professor Goldsborough said: This week we welcome you, and for your instruction and entertainment we have many interesting telephone features on exhibition in the electrical building. The telephone has been preeminently a valuable assistant in the work of building and operating the World's Fair. We have had stations and instruments all over the grounds ever since the Fair opened and have thereby kept in the closest touch with every part of the vast Exposition grounds. Without the advantage of the telephone it would have been difficult to have built or to have managed this great exposition. It would have been well-nigh impossible, in fact.

Professor Goldsborough was followed by the president, who delivered his annual address, an abstract of which follows:

President Dougherty's Address.

The operator must concede a reasonable profit to the manufacturer, and the user of the telephone must do likewise to the operator, and the manufacturer must be fair to the patrons, through his treatment of the operator, by giving apparatus of the best class at reasonable prices. So each owes a duty to the other, and selfishness should not be the dominating spirit in our deliberations, or after them, in the practical operation of our business.

Many have been the victories of the Independent telephone user since the first convention, eight years ago. While my heart is filled with joy over these successes, in our litigation with the Bell Telephone Company on account of the Berliner patents and other inventions and the very pleasant associations with the advisory board, and especially the committee on litigation, composed of Judge J. M. Thomas, Hon. S. P. Sheerin, Hon. H. D. Critchfield, Hon. E. B. Fisher and myself, yet my heart is sad to know of the serious illness of my predecessor, as president of this association, and who was one of the committee. He was never idle when the interests of Independent telephony were in danger, cheerfully giving up his time, his money, and even pledging his credit to a large degree, that the Independent users of telephones might be protected against the Bell telphone's efforts to destroy their rights in the United States court. No more faithful servant of you people ever lived, always untiring, ever wise, and therefore successful in every effort he made in protecting your rights.

After years of experience, the Independent telephone people of this country, like all other benefactors, will lose their hold on the minds and affections of the people when they become a mere business proposition, and must meet the public expecting to be treated the same as all other competitors for business. However, there should continue to be a fealty between Independent operators that should hold them together and cause each to have the sympathy and aid of the other. This does not, however, always prevail, even at this early stage.

In some instances, it has been observed that one Independent company would try to drag down another Independent company, out of jealousy, by criticisms to the public and praise to the assessor; the one to take away business, the other to increase the expense account. This has been noticeable in my own state, and I understand that it prevails to some degree in other states.

We have reached a point, as Independent telephone operators, where a better understanding must exist between the operators. We must become more of one mind, and, therefore, we must become as one institution. Our apparatus and construction should be better balanced, and we must take better care of the public.

Professor Kelsey on Telephone Engineering.

The presidential address was followed by a paper by Prof. J. C. Kelsey of Lafayette, Ind., on "What Telephone Engineering Needs." This paper was a short one, and showed how the breaking of the monopoly had fostered telephone engineering.

Hoge on the Value of Organization.

Mr. James B. Hoge of the United States Telephone Company of Cleveland, Ohio, read a paper on the value of organization, which was discussed by C. J. Simmons of the Atlanta Telephone and Telegraph Company of Atlanta, Ga., Thomas Finucane of the Rochester Telephone Company of Rochester, N. Y., Col. H. C. Young, Columbia, Pa., Senator C. W. Kline, Hazelton, Pa., and E. B. Fisher, of the Citizens' Telephone Company, Grand Rapids, Mich.

An abstract of Mr. Hoge's paper follows:

During the last 10 years the Independents have installed more than 2,500,000 telephones connected with their various systems throughout the United States. During the same time their competitors had many times doubled the number they had when the Independents were allowed to enter the field, so we find the telephone growth today is greater than that of any of the other public-serving corporations. The result has been that the Independent telephone companies have extended their systems from county seat to county seat, and from center to center, until today they are touching elbows with each other on practically every boundary line. Until the last three years they had but very limited long-distance service. Today their long-distance service is equal in many cases to that of their competitor and promises in a very short time to be in every way equal if not superior to that service. The Independent movement is made up largely of the most substantial and most active business interests in the country. The leaders of the Independent movement have gone into the business from various other vocations, and the result has been that they have carried their former ideas as to bookkeeping, operating rules and regulations, from the banking, manufacturing, mercantile, transportation, gas and electric-light business, into the telephone business. It is important and necessary to standardize rules and regulations, forms of accounting, advertising methods, equipment, and various other essentials. It is no more necessary to consolidate these local exchange properties, in order to carry it out successfully, than it would be to consolidate all the steam railroads, or electric railroads in the United States in order to operate them successfully on a uniform basis.

During the last five or six months I have been in correspondence with the various officers of a number of state associations, and find that in nearly every case they agree that the time is ripe for better organization. What we need today is uniformity of organization. There is no other business parallel to that of the Independent telephone companies. The advantage of a strong organization would carry weight with the various legislative bodies, national and state, much greater than where taken up in a haphazard sort of way, without proper organization.

During the last eight months we have reorganized our Ohio association by dividing the state into nine districts. The state association has a president and nine vice-presidents, secretary, assistant secretary and treasurer, and an executive committee of four members, besides the president, he being an ex-officio member. There is one vice-president from each district, and this vice-president is president of his district. Each district has an executive committee, consisting of one representative from each county in the district. Hereafter our state-association meeting will be a delegate body. Each district will elect one delegate to the state convention for each 1,000 telephones or fraction thereof they have represented by their district associations. A mile of long-distance toll line is counted as one telephone. In this way district meetings will be held quarterly and semi-annually, so as to bring people with common interests together frequently to discuss subjects of special importance to the district.

We believe this plan is feasible and practicable for all the states in the Union to adopt. We believe it

J. B HOGE, NEW PRESIDENT OF THE NATIONAL INDEPENDENT TELEPHONE ASSOCIATION.

feasible and practicable to carry it a step farther, making an organization of the various state organizations, so that the various districts would elect one delegate annually to a general convention, and the state associations at their annual meetings would elect a sufficient number at large, so as to give the state one representative for each 10,000 telephones or 10,000 miles of toll line they have represented in their state associations. In that way the state delegations would be able to exchange ideas and to conduct their business on a uniform basis. Statistics can be accumulated and published that will be of special value to the Independent companies. By working the entire plan out on a basis of this kind, the securities of the various companies will be strengthened, the equipment of the companies will be improved upon from time to time, the disposition of two companies to parallel lines or to compete with each other in any way will be a minimum, and the matter of adverse legislation, national or state,

can be protected. This sort of an organization would be able to get the best results from their various business and political leaders.

Report on Organization.

Mr. Hoge moved, after the discussion (seconded by F. B. Lee), that a committee of seven be appointed by the chair to bring in a report on organization, benefits and ways and means. The motion was carried and the president appointed the following committee; J. B. Hoge, Cleveland, Ohio (chairman); C. W. Kline, Hazelton, Pa.; H. Linton Reber, St. Louis, Mo.; J. B. Earle, Waco, Texas; E. B. Fisher, Grand Rapids, Mich.; Ed. L. Barber, Kansas City, Mo., and Cyrus Huling, Columbus, Ohio. On Thursday this committee submitted the following report, which was unanimously adopted:

The undersigned committee appointed to consider and report the question of the organization of this association, begs leave to report that we believe the National association should be a representative body, primarily selected by the state organizations of Independent state associations, upon the basis of the number of Independent telephones owned and operated in each state, and by such other duly accredited delegates, from local companies and representation from states having no state organization and such representation from the manufacturers as may be deemed desirable. We recommend that each state shall elect delegates on a basis of one for each 10,000 telephones or majority fraction thereof and for the purposes of representation one mile of toll-line circuit be considered equal to one telephone. States not organized to elect delegates on the above basis by companies, and each local company to elect one delegate, who shall have the privilege of the floor and on all questions cast the vote of the number of telephones owned and operated by such local company. Each manufacturer of telephone supplies and such other persons as may be accepted by the advisory board, on the payment of prescribed annual fee, shall be entitled to one full membership.

We further recommend that a per capita tax, not to exceed one cent per telephone and one cent per mile of toll-line circuit, be assessed on each telephone in the Independent association for the purpose of defraying the expenses of this association.

We further recommend that a committee be appointed by this convention for the purpose of fully working out the details based on this report and for the further purpose of suggesting amendments to the present by-laws and constitution in the spirit of this report.

Other Proceedings of Thursday.

The convention was called to order on Thursday by President Dougherty. By special request of F. S. Dickson, president of the Cuyahoga Telephone Company of Cleveland, Ohio, his paper was advanced on the programme and was the first paper read at the day's session. Following Mr. Dickson, Edward E. Clement of Washington, D. C., read a paper on the patent situation, prefacing it by reading a number of letters received from various prominent Independents. Following this the committee report already given was read. The president announced the appointment of the following nominating committee, to present the names of officers for the following year: E. B. Fisher, Max Reber and George W. Beers.

Samuel G. McMeen of Chicago, Ill., then read a paper on "Planning a Telephone System."

Name of Organization Changed.

A member moved that the name of the association be changed to National Independent Telephone Association, and the motion was carried. The committee on resolutions was ordered to prepare a plan of reorganizing, and to submit a new or amended constitution at the meeting on Friday.

New Constitution Adopted.

In the absence of President Dougherty and Secretary Jones at Friday's session the positions were filled, respectively, by Cyrus Huling and Frank L. Beam, both of Columbus, Ohio.

The first business before the convention was the reading and subsequent acceptance of a new constitution. Among the salient features of the new constitution was the provision for the appointment by the president of a committee composed of five members, which shall be known as the committee on litigation and legislation, which shall have charge of all legislation affecting the interests of the association and inquire into all litigation that might affect the interests of the association or its members.

Any state, district or local organization representing a majority in interest in such district of Independent telephone exchanges or telephone toll lines in the United States, with not less than 500 units (each unit to consist of either one operating telephone or one mile of long-distance toll line) and having subscribed to the constitution shall be eligible to membership in the association upon an affirmative two-thirds vote of the members present at any regular or called meeting of the association; provided, however, that the application may be made in the interim between meetings to the executive committee, which may pass upon such applications. It is further provided that the units represented by any such organization shall not be represented by any other organization in which they may have membership; that after the state organization is completed in any state (or territory) representing a majority of the Independent telephones or toll lines in such state (or territory), district or local organizations in such states shall not be eligible for separate membership in the association, except upon the recommendation of the state organization, or when after direct application to the association it is found that the reason for such direct application is valid and reasonable. The executive committee shall have the right to create the office of assistant to the secretary or treasurer and employ one or more persons to fill these offices who shall give their entire time to the interests of the association. The committee shall also appoint an auditing committee of three, whose duty it shall be to audit all bills of the association before payment is made and shall fix salaries of all officers and employes, the salaries to cover actual time spent in the interests of the association.

Any member or officer becoming in any way connected with other telephone interests than those identified with the Independent companies shall be regarded by the executive committee as having tendered their resignation to the association. Anyone becoming a member of or accepting an office in the association does so with the above understanding; and the executive committee shall, in case of resignation of officers, appoint their successors until the next regular or special meeting of the association, when the vacancies shall be filled.

The constitution may be amended at any annual meeting of the association by an affirmative vote of a majority of the members present, or at any special meeting of which due notice by mail shall have been given at least 30 days previously to every member of the association, when such notice shall specify among other things the sections of the constitution proposed to be amended and the amendments offered thereto.

The committee on resolutions reported a resolution of regret at Judge Thomas' absence on account of illness.

Election of Officers.

The convention proceeded to election of officers and the nominating committee placed in nomination the following-named gentlemen, who were unanimously elected:

President, J. B. Hoge, Cleveland, Ohio; first vice-president, Breckenridge Jones, St. Louis, Mo.; second vice-president, William Flinn, Pittsburg, Pa.; treasurer, Hugh Dongherty, Bluffton, Ind.; secretary, A. L. Tetu, Louisville, Ky.

Friday's Entertainment.

Mr. Stroud of the Controller Company provided the delegates with Mr. Lewis' private car, Mabel, and after a trip over the St. Louis Transit Company's tracks entertained them at luncheon at the Mercantile Club, after which the delegates returned to an inspection of the Woman's Magazine Building as the guests of Mr. Lewis. From this point the party returned to the Fair grounds and inspected the exhibit of the Wesco Supply Company of St. Louis. A visit to the Philippine exhibit was made at the invitation of the Wesco company, where Dr. Hunt, in charge of the Igorrotes, had previously provided several unique features in the way of savage dances for the benefit of the delegates

The several exhibitors in Electricity Building having issued invitations to the convention members, Friday evening was devoted to an inspection of apparatus on display. The Kellogg company at its exhibit distributed a handsome combination purse of leather to each member of the convention. It is assumed that several of the delegates will have the purse, at least, as a souvenir when they arrive at their several homes. Those who forgot the combination from various causes may also find what was originally placed therein.

Taken altogether the convention was largely attended and more real enthusiasm was displayed than at any recent gathering of the association.

DELEGATES AND VISITORS TO ST. LOUIS TELEPHONE CONVENTION.

Convention Notes.

George Conover's "hot-air protector" did good service as an advertisement.

President Frederic Greer of the Harvard Electric Company of Chicago mingled with the boys.

Western Manager Frank Donohoe of the American Electrical Works appeared on Wednesday. Mr.

[*Continued on page 270.*]

WESTERN ELECTRICIAN

EVERY SATURDAY.

PUBLICATION OFFICES:
510 Marquette Building, · CHICAGO.
TELEPHONE, MAIN 1746.

Eastern Office, 193 Times Building, New York.
Telephone, 3806J Cortlandt.

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted. This paper is entered at the Chicago postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the **old address** as well as the new should be given.

CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—**the only general electrical paper published in the West**—thoroughly covers a territory *exclusively its own.* THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be furnished on application.

REMITTANCES.—All checks, drafts and other remittances should be made payable to the order of the publishers, the **Electrician Publishing Company,** and addressed to the offices of publication, Suite 510, Marquette Building (204 Dearborn Street), Chicago, Illinois, U. S. A.

CONTENTS OF THIS NUMBER.

Rack Railway to the Gornergrat, Switzerland. By Franz Koester. Illustrated 261, 262
Large Power Plant on the Conchos River 262
Tour of Society of Chemical Industry 262
Conclusion of "Circular Tour" of Visiting Electrical Engineers. Illustrated 263
Trimming Arc Lamps by Automobile. Illustrated 264
Marconi Again in This Country 264
Thawing Ice on a Third Rail by Electricity 264
Independent Telephone Association of the United States. (Annual convention in St. Louis, September 21-23, 1904.) Illustrated 264, 265, 270
Editorial 266
Fall Trade Outlook 267
Burlington Road Tests New Motor Car 267
Foreign Trade Possibilities 268
Relative Manufacturing Growth of the United States and European Countries 268
Trade in Japan 268
Regulations Concerning Agents in Japan, Persia and Siam 268
Alcohol Motors and Pumps in Cuba 268
Electrical Opportunities in Italy 268
American Business in South Africa 268
Foreign Trade Notes 268
Dust and Waterproof Floor Outlet Box 268
Colorado Electric Light, Power and Railway Association. (Annual convention in Colorado Springs, September 21-23, 1904.) 269
New Power House for Marion Light and Heating Company 269
Death of Dr. Finsen. Portrait 269
International Association of Municipal Electricians. (Annual convention in St. Louis, September 13 and 14, 1904) 269
Telephone versus Electric-light Circuits. By H. M. Rounce. (Communication) 269
World's Fair Visitors of Last Week 270
Book Table.—"Business Short Cuts" 270
The Present Status of the Edison Storage Battery. By A. E. Kennelly and S. E. Whiting. Illustrated. (International Electrical Congress) 271, 272
National Electrical Contractors' Association. (Annual convention in St. Louis, September 14-17, 1904) 272
Tesla Patents Upheld in Stanley Instrument Case 272, 273
Fuse Exhibit at St. Louis. Illustrated 273
The Telephone Patent Situation. By E. E. Clement. (Independent Telephone Association) 273, 274
Bell Telephone Output 274
New Companies 274
Telephone News from the Northwest 274
Ohio Telephone Notes 274
Southeastern Telephone Developments 274
General Telephone News 274
Modern High-speed Printing Telegraph Systems. By J. C. Barclay. (International Electrical Congress) 275, 276

DEPARTMENTS.

Correspondence 276, 277, 278
Great Britain 276
New York 276
New England 276, 277
Southeastern States 277
West Virginia and Kentucky 277
Indiana 277
Texas and Mexico 277
Ohio 277, 278
Northwestern States 278
Rocky Mountain States 278
Pacific Slope 278
Personal 278
Electric Lighting 278
Electric Railways 278
Publications 278, 279
Space Telegraphy 279
Telegraph 279
Miscellaneous 279
Trade News 279
Business 279
Illustrated Electrical Patent Record 279, 280

DATES AHEAD.

Illinois State Electric Association (annual meeting), Decatur, Ill., October 5th and 6th.
Michigan Electric Association (annual meeting), October 11th.
American Street Railway Association (annual meeting), World's Fair grounds, St. Louis, October 12th and 13th.

VISITORS to the Louisiana Purchase Exposition at St. Louis who are interested in electricity or electrical literature are cordially invited to call at the booth of the Western Electrician, which is in Block 1 (Section 13) of the Palace of Electricity, just west of the main northern entrance to the building. Here will be found copies of the current issue of the paper, bound volumes of the Western Electrician from the first number, a careful selection of electrical books exhibited by the Electrician Publishing Company, and other objects of electrical interest. Chairs are provided for weary sight-seers, and an attendant will extend a hearty welcome to all readers or friends of the paper.

DR. FINSEN'S death will be sincerely regretted in all countries where unselfish work for the good of mankind is prized. His researches into the therapeutic value of light in the treatment of skin diseases have resulted in a distinct alleviation of the ills of humanity. The light of the electric arc is used, and there seems not to be the slightest question that in this class of disease, and particularly in lupus, the results are highly beneficial. Dr. Finsen went forward with his work while himself afflicted with an incurable malady. He gave his discovery freely to his fellow men. He reached the end of his earthly career while still a young man. But his memory will be treasured by all who admire true greatness and nobility of character.

CHEERFULNESS and confidence in relation to the business outlook are shown by the interviews with electrical men printed in this issue. There is not such a great swing and boom to business as has been witnessed in a few preceding years, but the subsidence was not unexpected and was rather a gradual settling to a lower level of steady volume than a slump. The present political campaign has some effect in retarding industrial extensions, but not so much as in previous presidential years, for in truth the political maneuvering so far has not aroused great excitement in anybody. Business has improved noticeably within the last three or four weeks over the conditions of the summer months, and in the electrical trade may be described as "steady," with good prospects. As is said by Mr. Seymour Bell, British commercial agent in the United States, "The general business of the United States is absolutely sound." The comments on the situation printed on the opposite page will be found to be encouraging and interesting.

AMONG a multiplicity of other conventions, electrical men in this state should not forget the annual meeting of the Illinois State Electric Association, which will be held at Decatur on October 5th and 6th. The programme of arrangements, which is attractive, was given in the Western Electrician last week. Members of state associations have an opportunity at the conventions to get together for heart-to-heart talks in a manner not practicable at the meetings of the national organizations. They all work under the same laws and have, in general, the same problems to face. Consequently their meetings have a peculiar value and should not be neglected. Colorado has just held a good electrical convention; Iowa had one in the spring of exceptional value; Ohio central-station men met in August, but their meeting, so far as attendance of plant managers is concerned, was not up to their previous record. Illinois electrical men owe it to themselves to make their association of constantly increasing usefulness.

ONE OF the more interesting papers read at the International Electrical Congress was that of Dr. A. E. Kennelly and Mr. S. E. Whiting on "The Present Status of the Edison Storage Battery," which is presented in abstract in this issue. Dr. Kennelly, one of the authors, is particularly well qualified to discuss the Edison accumulator, for he was intimately associated with Mr. Edison for many years and wrote the first account of the battery for the American Institute of Electrical Engineers several years ago. Readers of the Western Electrician will remember that this initial paper was deemed of such importance at the time that it was telegraphed entire from New York, where it was delivered, to the Western Electrician.

In the present paper the authors give a description of the cell, which, as is now quite well known, has steel grids, with oxide of nickel as the active material of the positive plate and iron as the active material of the negative plate. It is of the oxygen-lift type; that is, the oxygen is driven electrolytically from the negative to the positive plate in charging. The chemical action in the cell has not been completely investigated as yet. The authors give an interesting working theory, however, to which the reader is referred. The mean electromotive force of discharge is 1.3 volts. With 100 per cent. ampere-hour efficiency the watt-hour efficiency is 65 per cent.

In practical service the great durability of the cell is marked. No electrical depreciation is discernible in three years' experience. The cells stand careless treatment remarkably well. The authors conclude that the battery is especially adapted for use on automobiles, by reason of its large output at heavy discharge rates, its low depreciation in capacity and its durability.

IT IS rather surprising to find a newspaper of the prominence of the Chicago Daily Tribune using the term "electrical engineer" when it means "motorman" or "electrical engineman" or "electrical engine-driver"—in other words, one who operates the motors of an electric car or a train of electric cars. The expression occurs in an editorial headed "Electricity versus Steam," and the following sentences show the sense in which it is employed:

Warren S. Stone, chief of the Brotherhood of Locomotive Engineers, naturally is interested in the possible substitution of electricity for steam in long-distance railroading. One cannot tell in advance whether the status of the electrical engineer would be the same as that of the steam engineer. It is evident that the man who is in charge of a fast, heavy electric train must be as well equipped in some respects as the locomotive engineer.

Now the term "electrical engineer" has a specific meaning as applied to the man who practices the profession of engineering in its electrical branches. It is nowadays as well fixed as "military engineer," "civil engineer," "mechanical engineer," "mining engineer," or any other of the series. An electrical engineer is a person quite distinct from the motorman. The former plans the railway and the electrical apparatus used on it. The latter is hired to run a part of the machinery after the road is built. One is a professional man; the other is not. It is true that colloquially the word "engineer" is frequently applied to the locomotive-engine driver. But "engineman" is better. However, the term "electrical engineer" is never used for "motorman," and the Tribune should have known better.

NO LONGER the Independent Telephone Association of the United States of America, but now the National Independent Telephone Association, the national organization of the Independent telephone men enters on a new era of its somewhat checkered career. The change was made at the convention held in St. Louis last week, where a new constitution was adopted and general reorganization effected. The association had its beginning in Detroit in 1897 and grew out of the feeling of the Independent telephone men—manufacturers and operators—that a strong national association would do much to advance their interests. James E. Keelyn of Chicago had a great deal to do with the initial organization, and from the start Judge James M. Thomas, for several years president of the association, was conspicuous in its affairs. The association undoubtedly was of much value to the Independent cause, in defending Independent companies attacked for infringing Bell patents. This was particularly true in the Berliner and Carty cases. The organization also held several enthusiastic and largely attended conventions—notably those at Chicago, Cleveland and Buffalo—whose moral effect in strengthening the position of the competing telephone companies was good.

But for the last few years the prestige of the association has declined, owing partly to dissatisfaction with methods of administration and partly to changes in the telephone industry itself. Now there has been an entire reorganization, and the society, with a new name and a new constitution, starts out with a clean sheet to be of assistance to the Independent telephone industry. The new name is a better one than the old one; the constitution seems drawn up on a rational basis, and the new president, Mr. Hoge, is a capable, successful telephone operator of national prominence. Altogether the National Independent Telephone Association seems to be beginning its career with the earmarks of success. We hope that its development will in every way justify the expectation that the reorganized association will be of real helpfulness to the telephone business, both technically and commercially. There is certainly a field for such a national organization.

FALL TRADE OUTLOOK.

Although business in the electrical field generally has slackened during the summer of 1904 as compared with the corresponding season in the last few years, electrical business men declare that the outlook for the coming fall and winter is encouraging. As the result of a canvass of the various branches of the electrical industry it may be said that the prospects for considerable activity in fall and winter business are good.

The presidential campaign, the labor situation, the war in the Far East are conditions which combine to make the present a period of exceptional interest to business. Many representative men in the electrical industry are free to admit that they anticipated more or less reaction this fall from the exceptional prosperity of the last few years. To ascertain the real condition under these circumstances the Western Electrician has made inquiry of a number of men in various parts of the country identified with the industries, and the responses, presented herewith, will be of interest.

Personal interviews with electrical men of Chicago—engineers, contractors, manufacturers, supply men, etc.—furnish authority for the statement that the last month has shown a decided improvement in business conditions. Especially among the smaller concerns, with but few exceptions, is the prediction of a lively fall and winter trade made. The larger industries, some of whom prefer not to be quoted, state that while the outlook three months ago was somewhat apprehensive, the indications at present and during the last month are for increased activity.

B. E. Sunny, western manager of the General Electric Company, Chicago, a recognized authority, says: "The outlook for business for the fall is satisfactory, based on the amount of business secured during that period of the year during the last 10 years. It probably will not be as large as 1901 or 1902, but it promises to be as good as last year. Perhaps 75 per cent. of the railway and lighting properties were rebuilt from 1900 to 1903, which gave the electric manufacturing companies a large volume of business, which will not come again for some time. Our hope for a large business in the immediate future is in the development of new enterprises. There is a reasonable prospect that such enterprises will receive more financial encouragement during the next 12 months than at any time during the last 18 months."

Other expressions of opinion are as follows:

J. W. Marsh, vice-president and general manager of the Standard Underground Cable Company, Pittsburg: I am pleased to say that we have found business in our lines fairly active, considering that this is a "presidential year," and while we do not look for any material improvement in business conditions until after the election, we nevertheless believe that the last two months of the year will prove very satisfactory to all who are concerned in the electrical trades in particular.

N. C. Cotabish, sales manager of the National Carbon Company, Cleveland: We look for brisk trade this fall. In our estimation the outlook is very satisfactory. June and July were very dull; August showed quite an improvement. Commencing with September 1st, we have found business has been very brisk, and, from present indications, we believe fall business has a better outlook than the early part of the year.

A. O. Kuehmsted, vice-president of the Gregory Electric Company, Chicago: We are at present extremely busy, and have been so for the last two months. We are looking for a very good season this fall and think that the dull business complained of by many during the spring was only a temporary illness, likely to occur once in so often.

Thomas Duncan, vice-president and general manager of the Duncan Electric Manufacturing Company, Lafayette, Ind.: We are pleased to report that the presidential campaign and war in the Far East are in no wise interfering with the business of this company. Our sales show a steady increase and at the present time our output is more than double that of 12 months ago. Our orders are two weeks behind, due to the demand of our product increasing quicker than we were able to turn it out, but additional machinery now being installed will materially assist us in catching up. The present is, without doubt, the busiest season in the history of this company, and everything points toward it being a representation of what we expect to enjoy throughout the entire winter.

Frank G. Jones, president of the American Electric Fuse Company, Chicago: The spring and summer of 1904 have witnessed but a very slight falling off in the volume of our business as compared to the same periods a year ago. I can ascribe this only to the fact that the protector business is less liable to sudden changes in volume than are any other branches of the telephone and electrical trade. We have equipped a larger number of telephone exchanges with protective apparatus during the year 1904 than ever before in our history. The most noticeable thing in the present tendency is conservativeness on the part of buyers. We find that the present need is well taken care of by the purchaser, but that he is not buying far in advance of his immediate requirements. We have not noted any tendency toward lower prices on any of the material which we purchase, but we do notice a decided improvement in the time required to fill orders. Material which a year ago could not be secured under three months can now be obtained in less than the same number of weeks. In the telephone business we notice a very marked improvement in the standard of the buyer. Quality in apparatus is being considered of more importance than cheaper prices. There has been a decided broadening in the telephone field, although not so much in the way of new installations as there was a year ago. Taken altogether, we regard the year 1904 as a satisfactory year, and from indications received from contact with our customers, we believe that 1905 will surpass any previous year in the history of the telephone business in the volume of sales and the quality of apparatus sold.

Charles Blizard, sales manager of the Electric Storage Battery Company of Philadelphia, Pa., says that the business of the company is satisfactory and the prospects excellent.

F. L. Middleton, sales manager of the International Telephone Manufacturing Company, Chicago: Judging from our own business, the last month has shown a decided improvement in trade in the electrical field, and the indications are that this will continue throughout the fall. We can see no reason why a political campaign, such as the present one, should affect business, yet it is apparent that many buyers have been holding off until after election. We have enjoyed a good business, and were it not for the fact that this is presidential year our second year in business no doubt would show a still greater increase over the first year. Prospects generally are very good for the coming year.

W. W. Low, president Electric Appliance Company, Chicago: The outlook for fall and winter trade may be summed up into one word—good. I have been extremely busy and will not enter into details.

Forcé Bain of Chicago expressed his views from the point of the patent attorney. If there were a depression in business, said he, I believe the patent lawyers would be the first to feel it. There would be less patent litigation, fewer applications for patents, and capital would not be investing so freely in new enterprises and industries. Mr. Bain said that the first quarter of this year was the dullest of any like period in his experience and the prospects then were rather gloomy for the fall and winter. The summer, however, has been about normal, and since the usual quiet spell in July and August there has been a decided improvement. Events of the last 60 days indicate a lively fall trade, which will probably not be affected by the campaign.

A. A. Serva, assistant sales manager of the Fort Wayne Electric Works, Fort Wayne, Ind.: The fall trade will no doubt be excellent. Especially in supplies and light machinery has the Fort Wayne company been doing a large business. The demand for heavy machinery, such as generators, is not so great, but there is an unusual demand for second-hand apparatus. The supply business of our company—meaning by that are lamps, meters, transformers, etc.—will probably be 25 per cent. greater this year than last. There have been indications of some hesitancy in placing orders for large generators and motors, due no doubt to the presidential campaign, but in this line there has been an improvement within the last four weeks. We look to the future with entire confidence.

John J. Gibson, Westinghouse Electric and Manufacturing Company, Chicago: As to the outlook for the fall trade in the electric business, we think the prospects are very good. Using an average of the four prosperous years just passed as a basis of comparison the fall trade of the present year in the electric business is very promising. Judging from the volume of orders for small apparatus, instruments and supplies, it is plain that central stations are preparing for a fall load as heavy as ever heretofore experienced. Many stations contemplate extensions involving comparatively large machinery, and there is very little hesitancy as to such undertakings involving expense for new construction, save in those states whose general welfare depends on crop conditions, and the sentiment in them is optimistic. In industrial lines recovery to conditions equal to last year's business is not so rapid, but is expected to come very soon. In railway work there are more new projects than ever before, which state of affairs is due in a great degree to improvements and developments in that line, primarily to the introduction by the Westinghouse Electric and Manufacturing Company of the single-phase railway system. It is indicative of good general business conditions at this time that money is not lacking to back new electric-railway projects.

W. H. Beattys, Jr., sales agent of the Cutler-Hammer Manufacturing Company, Chicago: In spite of the general slowness in the electrical trade the Cutler-Hammer Manufacturing Company has enjoyed a prosperous season, partially due to the large amount of special apparatus for which demand is rapidly increasing from year to year. Owing to the recent Iroquois disaster the theater business has been exceptionally brisk, as theaters all over the country have been refitting to conform to new fire laws, etc. The machine-tool business is steadily increasing, as manufacturers learn the advantages of machine-tool drive over the antiquated belted methods. The modern office building is also creating a market for a line of electrical apparatus peculiar to itself and used in connection with the various appliances found in buildings of this type. From the building activity manifested the trade indications seem to be very promising and we should have a very successful year. One of the chief causes of the general let-up in business seems to have been the strife between capital and labor, which at the present time seems likely to be settled, partially at least, by the former adopting the "open-shop" basis. This, together with general prospects, the writer believes, serves to indicate that the coming year will be more promising than the past one has been relative to business in general.

A. W. Buchanan, secretary and general manager of the American Conduit Company, Chicago: In response to your request that we give you our opinion as to the business outlook in the electrical field with special reference to the possible effect of labor troubles, the coming presidential election and the war in the East upon same, will say that if we are to judge from our own business, we cannot see that these influences are being felt in the business world near so deeply as might be expected. It is true there has seemed to be some holding off of construction work, yet we believe to a much less extent than has been usual in the past, when such depressing influences as above mentioned have swept over the country. Our own business is actually gaining ground in spite of whatever might otherwise be expected. Will also say that our traveling men report that their intercourse with telephone and electrical interests satisfies them that a large amount of construction work is planned for the next year, and we feel that the outlook for the coming season is very bright.

A Boston newspaper dispatch reports that an official of the General Electric Company says that business is looking up, and that his company is receiving inquiries for more electrical materials and supplies than for some time. Encouraging advices from all sections of the country are coming in, and from present indications there should be a busy fall and winter. When asked as to the extent the development of the Curtis turbine engine had figured in the business of the year the official said: "The big demand for Curtis turbines has kept a large part of our force permanently employed, and although I have no very definite information on the subject, I think it would be safe to state that the gross business on turbines this year will aggregate well over $10,000,000, based on the orders already in hand. Our total gross sales last year amounted to about $41,000,000, and this would be about one-quarter of the entire business."

Burlington Road Tests New Motor Car.

The Chicago, Burlington and Quincy Railroad Company has just completed a new gasoline-electric motor car at its shops in Aurora. The car, which is operated by electricity generated by a gasoline engine on the car, was tested last week between Aurora and Chicago. A speed of 30 miles an hour was attained, but the vibration of the machinery was excessive, and some changes will be necessary. The car is designed for suburban service and branch lines. The electric motors have a capacity of 225 horsepower, but the engine which drives the dynamo on the car, although of an improved type, did not work satisfactorily.

The Pittsburg, McKeesport and Connellsville (Pa.) Trolley Company has bought the Pittsburg, McKeesport and Greensburg line for about $2,000,000.

FOREIGN TRADE POSSIBILITIES.

Relative Manufacturing Growth of the United States and European Countries.

The rapid growth in the exportation of manufactures from the United States and the increase in the share which they form of the total exports has led the Department of Commerce and Labor through its Bureau of Statistics to a comparison of the growth of the manufacturing industry in the United States with that of other countries engaged in supplying the world's international markets with manufactured products. Four countries—the United Kingdom, Germany, France and the United States—are the world's chief purveyors of the manufactures which enter into international commerce. The value of manufactures entering the international markets of the world amounts to about $4,000,000,000 annually, and of this sum about $3,000,000,000 in value is supplied by the United Kingdom, Germany, France and the United States. It is interesting and important, therefore, to study both the share which these four countries are at present supplying of the manufactures entering the world's international markets, and especially to determine the relative growth in their production of manufactures.

Studies of production of manufactures as a whole are extremely difficult because no country other than the United States makes any measurement by census or otherwise of the value of its manufactures as a whole. Estimates have been made by Mulhall and other statisticians of the value of the manufactures produced in the principal countries of the world at various dates.

These figures are in all cases estimates, except those of the census of 1900. If approximately accurate, the comparison of conditions in the United States and the European countries at the two periods named would indicate that the increase in the production of manufactures in the United States is much greater than that of the European countries in question. During the period 1888 to 1903 the growth of production of manufactures in the United States is estimated at $5,932,000,000, and in the three European countries combined, $3,863,000,000, and the percentage of increase for the United States 85 per cent., and for the three European countries combined 42 per cent.

Trade of Japan.

Complaints of dullness in trade, owing to uncertainty regarding war prospects, were very general last fall and during the early winter, but the actual beginning of hostilities in February was the signal for renewed activity along many lines, and the total commerce for the first six months of 1904 amounted to $159,410,086.44, a gain of $14,010,229.52, or 9½ per cent. over that of the corresponding period in 1903. While it is true that the importation of war material has contributed considerably to this result and to that extent the showing does not represent a natural permanent growth of the commerce of the country, still there was a marked increase independent of war purchases. In exports, which the existence of war could not affect unless adversely, the gain over last year was nine per cent. The exports of electrical machinery from the United States to Japan during the last few months have been the largest on record.

The Japanese government is going to increase its taxes and tariff in order to meet the expenses of the war now being waged. A bill to this effect has gone through the Japanese Parliament and has met the approval of the Mikado. Up to 50 years ago Japan carried on a policy of practical exclusion, limiting its foreign trade to China, Korea, the Netherlands and Portugal. Treaties entered into with Great Britain, the United States, France, Russia and the Netherlands in 1858 brought Japan within the circle of the world's trade. In accordance with these treaties Japan opened to foreign trade in 1859 the ports of Yokohama, Nagasaki and Hakodate, erecting custom houses for the regulation of traffic and the collection of duties. Eight years later, in 1867, Kobe was opened to foreign trade, and a year later Osaka and Niigata.

Regulations Concerning Agents in Japan, Persia and Siam.

In Japan commercial agents are exempt from all taxation as business agents. Their samples are admitted free of duty if all the prescribed customs formalities are observed and a deposit made as guaranty for the re-exportation of the samples within the time fixed by the customs regulation.

In Persia, also, the traveling agent is free from all taxes. He must, however, be in possession of a passport which has been properly visaed by the representative of the Persian government who resides in the country in which the agent has his permanent residence. Thus, an American agent is required to produce a passport which has been visaed by the Persian representative at Washington. Samples without market values are admitted free of duty. All those which possess a commercial value, as shown by the appearance and general character of the goods, are subject to duty.

Commercial agents traveling in Siam are free from all taxes and other fees. It is, however, considered advisable to carry a passport. Samples are admitted free of duty under observance of certain formalities. It seems that all kinds of samples, irrespective of size and quality, are entered free. On their re-exportation certain customs regulations must also be observed.

Alcohol Motors and Pumps in Cuba.

Mantanzas, a city of about 40,000 inhabitants, has water connection in 1,500 out of 4,000 houses, which use about 100,000 gallons a day. The waterworks, operated by an American company incorporated in the state of Delaware, are located a few miles distant from the city, where there are springs giving excellent water in sufficient quantity to supply a city of 100,000 people. An alcohol motor pump, used recently for the first time, is of German manufacture, and costs, complete with installation, $6,000. This motor pump is a 45-horsepower machine and is operated at a fuel cost of about 40 cents an hour, or $4 a day of 10 hours, pumping 1,000,000 gallons of water. As alcohol here is very cheap (10 cents a gallon) the running expenses of these motors are at the minimum. The Germans are selling in Cuba many such motors for electric lighting and water plants at very low prices. One firm has a contract to put in an alcohol motor pump at Vento for use in connection with the Habana water supply, which is expected to develop 180 horsepower, to cost, with installation, about $25,000, and to pump 1,000,000 gallons an hour at a fuel cost of $1.60. The same firm has installed an electric-plant alcohol motor of 45 horsepower, which supplies 138 lights (Hersh lamps) at a fuel cost of five cents an hour. H. G. Squiers, minister at Habana, calls the attention of those who are interested in our Cuban trade to the fact that at the breakfast which followed the installation there was not one article on the table of American origin except the flour in the bread.

Electrical Opportunities in Italy.

The Adriatic Railroad Company is planning to build an electric road from Chiasso to Como and Chiavenna.

The City Council of Venice has decided to purchase a number of electric launches for use on the canals of that city.

The authorities of the province of Rome propose to build an electric railroad between the city of Rome and Civita Castellana.

The general inspector of the Adriatic railroad, whose office is in Rome, has received permission to purchase 150 electric-accumulating batteries.

The Italian ministry of posts and telegraphs has received authority from the Parliament to establish telephonic connections between Brescia and Bergamo, Lecco and Bergamo, Cremona and Piacenza, Genoa, Pisa and Leghorn, Naples, Foggia and Barletta, Naples, Reggio, Calabria, and Messina.

American Business in South Africa.

With the prospect of the Transvaal again taking the lead in gold production, a steady and permanent return to South African prosperity is anticipated Mr. Wilshere, controller of customs of Cape Colony, reports that South Africa imported during 1903 more goods than in 1898 (the year before the war); so that the present anticipated improvement will start from a relatively satisfactory point. South Africa imports from the United States for 1902 were $22,149,195, and increased in 1903 to $31,056,515. Imports from Great Britain only advanced from $146,238,895 to $155,282,575, while reduced imports from British possessions made the total receipts of British origin in 1903 about $1,000,000 less than in 1902.

Foreign Trade Notes.

The exports of electrical machinery from Germany increased during the first three months of 1904, amounting to $3,776, against $2,913 in 1902. The countries to which Germany's general export has most decidedly insreased are Russia, Austria-Hungary, France, Switzerland, Spain, Holland and India.

The British consul-general at Rio de Janeiro, Brazil, recently reported that the erection of small electric power plants in the southwestern part of the state of Minas Geras would perhaps be a profitable venture. In this agricultural district there are, in addition to the great fazendas, a great many small towns, having from 1,000 to 10,000 inhabitants. The electric energy, for the production of which water-power exists in sufficient quantity, could be used for lighting purposes, for ice and butter fabrication, for operating small machines and for other purposes.

Consul Robert Wood of Venice, Italy, says that a company has been steadily working for several years to "harness" the waterpower of the River Celina for the purpose of furnishing cheaper electric light in Venice, for which there is great need. There is, however, no immediate prospect of the city being so illuminated, owing to the existence of a contract for lighting by gas. The opportunity, therefore, is given to American manufacturers to introduce the many electrical appliances for which there will soon be an increased demand, but, as has been so repeatedly noted in past reports, the Venetian merchant pays little attention to catalogues, even though printed in Italian, and the only successful way to compete in this market is through commercial travelers.

In a variety of electric fittings, and also lamps for incandescent gas lighting of streets and parks, the Germans are offering satisfactory goods to Edinburgh, Scotland, at much below American or English prices, and are, therefore, getting an extensive trade, it is said. Among 34 bids, a Cologne firm received a recent order from the city for 10,000 incandescent lamps.

According to Indian Engineering, the Ceylon government is seriously considering the proposition of substituting on all fit roads light automobiles for the old stagecoaches which still exist on important routes for mail and passenger traffic. The required speed is 30 miles an hour, and each vehicle must carry six passengers, 300 pounds of letters and 26 pounds of baggage.

Road locomotives have been and are still wanted in South Africa because of increasing mining industries. It is found that much of the water utilizable produces damage by incrustation, hence motors using other than steam power are gaining preference. It is asserted that there is a future in South Africa for oil and gasoline engines in which beauty is sacrificed for solidity.

The foreign commerce of the United States in the fiscal year 1904 is the largest in its history; the exports of manufactures are larger than in any preceding year, and the exports of domestic products exceed those of any other country. The total exports during the year ending June 30, 1904, are $1,460,829,539, against $1,420,141,679 in the fiscal year 1903, an increase of $40,687,860; the imports for the year are $990,745,084, against $1,025,719,237 in 1903, a decrease of $34,974,153; and the excess of exports over imports is $470,084,455, against $394,422,442 in 1903, an increase of $75,662,013 in the excess of exports over imports.

There are now in the United Kingdom 20,076 motor cars and 22,916 motor cycles. The trade in these vehicles is certain to grow in leaps and bounds during the next few years. Consul J. G. Stephens at Plymouth, England, states that the English roads are perfect, and while the money market is doubtless tight, there is, nevertheless, an immense amount of wealth in reserve among the people, and they will not hesitate to spend it for wants and luxuries, even though they at present hesitate to trust it in commercial enterprises. Several of the large American manufactures have established agencies in London, and I am informed, says Mr. Stephens, by the principals that business is good. Nevertheless, the United States is not securing as much of this trade as it might and should. Germany has its representatives traveling all through the kingdom, and English firms are pushing their business with systematic and untiring enterprise. American firms would do well to stimulate their London representatives to greater activity in the provinces.

Dust and Water-proof Floor Outlet Box

Floor outlet boxes have hitherto been the weakest points of a wiring installation, being exposed to water and dirt when floors are swept or scrubbed, and from the nature of their location, subjected to hard usage. The General Incandescent Arc Light Company of New York is placing on the market an outlet box which has many points of superiority.

The lower body of this outlet box is drawn from one-eighth inch cold rolled steel of the best grade, in one piece. The collar is also made of the same material in one piece. The threaded portion is arranged to give an adjustment of one inch, so that the depth of the box may be lengthened from four inches to five inches, and remain perfectly level after once being set in position. The top plate is made of heavy brass. It is fastened to the iron collar, a rubber gasket being placed between, which insures a watertight connection.

The floor outlet box is especially adaptable in construction work for bringing wires to floor outlets for connecting to electric lights, electric fans, push buttons or telephones located on tables, desks, counters, or show cases. It has the following special features which will be appreciated by all engineers and construction men:

It is strong and substantial and will not sink in the floor when subjected to heavy weight.

It is thoroughly dust and water proof.

It is adjustable with respect to floor level, saving wiremen's time. Adjustment can be made after floor is laid.

It is accessible after being installed, the parts being held together by standard machine screws and is not liable to injury for the reason that the flexible cord comes from the side of the outlet nozzle, where it cannot be stepped on and the insulation crushed or injured.

When it is desired not to use unsightly cords from nozzle at floor level, one-half inch plain iron conduit, or conduit encased in polished brass tubing, can be screwed into the one-half inch gas-pipe thread in the floor-plate and extended to the under side of desk, table, counter or show case.

Colorado Electric Light, Power and Railway Association.

The second annual meeting of the Colorado Electric Light, Power and Railway Association was held in Colorado Springs on September 21st, 22d and 23d. The various sessions of the convention were held in the sun parlors of the Antlers Hotel, which is a large hotel, favorably situated for convention purposes. The only exception was in the reading of the paper by P. J. Brown on "The Curtis Steam Turbine," which was delivered in the Science Building of Colorado College, because of the facilities furnished for exhibiting cuts, diagrams, etc., by the use of an electric stereopticon. Although this meeting was only the second annual one, the attendance was very good and the interest manifested was great.

The delegates and their guests attended in a body the performance of "The Tenderfoot" Wednesday evening. On Thursday afternoon special cars were utilized in carrying them to the main power station at Austin Bluffs of the Colorado Springs Electric Company, sub-station "A," which is the distribution station of the company on Cucharras Street in the central portion of the city. This special trip also included a visit to the Lignite coal-mining district. A special trip was made to the Pikes Peak Hydro-electric Company's plant in Manitou, which is now in the process of construction and which will operate under a head of 2,200 feet, and from this plant the delegates were taken to the power station and car barns of the Colorado Springs and Interurban Railway Company.

Papers were read at the convention under the following-named titles: "Notes on Induction Integrating Wattmeters and Their Uses," by A. A. Serva, Fort Wayne, Ind.: "The Curtis Steam Turbine," by P. J. Brown, Schenectady, N. Y.; "Commercial Testing of Transformers," by C. W. Humphrey; "Modern Large Gas Engines, with Particular Regard to Their Suitability to Central Stations," by H. L. Woolfenden; "Electric Track Switches for Street-railway Work," by W. G. Matthews; "A Description of the Power Plants in Colorado Springs," by E. P. Dillon; "Lightning Arresters," by J. E. V. Titus, Keokuk, Iowa.

The election of officers for the ensuing year resulted in the following-named gentlemen being chosen: President, J. A. Beeler, general manager of the Denver City Tramway Company; vice-president, C. E. Doolittle, manager of the Roaring Fork Electric Light and Power Company of Aspen; secretary-treasurer, George B. Tripp, general manager of the Colorado Springs Electric Company; Executive committee, J. A. Beeler of Denver, C. E. Doolittle of Aspen, George B. Tripp of Colorado Springs, William Mayher of Greeley, and J. F. Vail of Pueblo; finance committee, C. W. Humphrey of Denver, F. C. Webber of Leadville, and J. E. Lundstrom of Colorado Springs; membership committee, John J. Cooper of Denver, Charles Chamberlain of Colorado Springs, and C. H. Peters of Durango.

The place of the next meeting was left to the executive committee.

The following-named companies were represented at the convention:

La Junta Electric Company, La Junta, Colo.; Pueblo and Suburban Traction and Lighting Company, Pueblo, Colo.; The Greeley Power and Light Company, Greeley, Colo.; The Colorado Springs Electric Company, Colorado Springs, Colo.; The Roaring Fork Electric Light and Power Company, Aspen, Colo.; The Denver Gas and Electric Company, Denver, Colo.; The Durango Light and Power Company, Durango, Colo.; Colorado Springs and Interurban Railway Company, Colorado Springs, Colo.; Larimer Light and Power Company, Fort Collins, Colo.; Las Animas Light, Power and Manufacturing Company, Trinidad, Colo.; The Arkansas Valley Electric Company, Florence, Colo.; Gilpin County Light, Heat and Power Company, Central City, Colo.; Boulder Electric Light and Power Company, Boulder, Colo.; Las Animas Electric Company, Las Animas, Colo.; Lamar Electric Company, Lamar, Colo.; Denver City Tramway Company, Denver, Colo.; Tucson Gas, Electric Light and Power Company, Tucson, Ariz.; Albuquerque Gas, Electric Light and Power Company, Albuquerque, N. M.; Sheridan Electric Light and Power Company, Sheridan, Wyo.; United States Light and Traction Company, Denver, Colo.; Continental Oil Company, Denver, Colo.; Wesco Supply Company, St. Louis, Mo.; General Electric Co., Denver, Colo.; Mountain Electric Company, Denver, Colo.; Nernst Lamp Company, Denver, Colo.; Central Electric Company, Colorado Springs, Colo.; Western Electric Company, Denver, Colo.; Gilbert Wilkes & Co., Denver, Colo.; New York Insulated Wire Company, Hendrie & Bolthoff Manufacturing and Supply Company, Bryan-Marsh Company, Fort Wayne Electric Works, Manitou Electric Company.

These companies were represented by a total of 54 delegates, 29 of which were active and 25 associate.

New Power House for Marion Light and Heating Company.

The Marion Light and Heating Company of Marion, Ind., is building a new power house on the bank of the Mississinewa River, adjoining the Big Four tracks, from which a switch track will run to the plant over a trestle from which coal may be dumped.

The company will install two 500-kilowatt Curtis steam turbines, supplied by Edgmoor boilers, and a 600-horsepower Russell tandem compound engine from one of the old plants, there being two old plants now in operation. The company is a consolidation of the Marion Light and Heat Company, formerly operating a plant in the Glass Block, and the Mead Electric Company. The company has operated a central-station hot-water heating system for the last three years and will extend the heating mains to the new plant. Double the present capacity of the heating system will be installed, the contract for this work being in the hands of Evans, Almirall & Co. of Chicago.

Death of Dr. Finsen.

Dr. Niels R. Finsen, the noted Danish scientist and discoverer of the famous Finsen rays, died last week. He at last became a victim to the ravages of the disease with which he has been afflicted for years. His death recalls the incidents and many trials of his life, which led up to the discovery which interested the whole world.

Niels R. Finsen was the son of a well-known Icelandic functionary. He was born in 1860, on one of the Faroe Islands. His early education took place in Iceland, and from there he went to Copenhagen to pursue and finish his studies. He entered the University of Copenhagen for the purpose of studying medicine. What decided him to do this was the fact that he was never a well man himself, and, realizing what good health means to mankind, he wished to fit himself so he could be of assistance to his afflicted countrymen. He finished his education in medicine in this university at the head of his class and received his doctor's degree in 1890. It was in a small attic room of the old Chirurgical Academy building where his first investigations, touching the effect of light on the human organism, were carried on. This was while he was still a student in the university.

NIELS R. FINSEN.

Sophus Bang, a fellow student, now considered one of Europe's first anatomists, shared Finsen's enthusiasm as regards a complete reform in medical therapeutics. They thought of and discussed all kinds of schemes for the betterment of mankind. Then ill health came to both. Bang went to Switzerland, where he gradually regained his strength. Not so with Finsen. His pet scheme was his very life, and he remained at home to fight, single-handed, his battle against the disease that ever since has held him in its relentless grasp, and to which he finally succumbed. His ill health, which left him a badly shattered constitution, did not deter him from pursuing the studies he had begun of his own accord. He was considered little short of "queer" when he began discussing the influence of sunlight upon the human organism. True, it was admitted by the medical world that light influenced all animal life, but Finsen was alone in declaring that the sun's rays held the key to a new method of treating certain diseases. He pursued his investigations and experiments, not deterred from the undertaking by any remarks from friends or associates. Gradually it became clear to the skeptically inclined that there was much of common sense in what Finsen claimed for his discovery. He began writing articles for medical magazines, and his article, "The Influence of Light on the Skin," published in Hospitaltidende for July, 1893, aroused general attention.

Finsen arranged an oblong box, covering one half with red colored glass, the other half with blue. Into this box he put a number of little animals and noticed that they were plainly ill at ease under the blue glass and would crawl away under the red glass, where they would rest comfortably. He followed the idea conveyed to him, and his further experiments convinced him that it was the blue, violet and ultra-violet rays that were death to bacteria. Then, to prove his theory to himself, he experimented on a case of lupus. As the sun of the northern countries is too uncertain, he took his patient to an electric-light station, where he could get light every day. By a crude contrivance, consisting of a rock-crystal lens and water, he personally superintended the application of his famous rays on the face of the lupus patient. Day by day he watched the results. Little by little the treatment gained the mastery, the destroying germs were killed and the patient was freed from the disease.

The cure of this case startled the world. In 1896 the Danish government subsidized the Finsen Light Institute at Copenhagen, Denmark, and Dr. Finsen's work bore its fruit. The dread lupus or skin consumption was conquered. Beginning, as he did, with only a shed for an institute and one lamp, treating only a few patients daily, the Finsen Light Institute of Copenhagen has grown to be an immense institution, where upward of 350 patients are treated each day. Soon other countries took up the treatment, establishing Finsen lamps and institutes in such cities as London and Manchester, England; Paris, France; Vienna, Austria; Berlin, Germany; St. Petersburg, Russia, and Chicago, U. S. A.

After establishing his institute Finsen bent his whole energy to the perfection of a lamp by which electric light could be utilized to produce a greater number of violet and ultra-violet rays, and at last he perfected what is now known as the high-power Finsen lamp. It has been recently asserted that rays from these lamps may be made to penetrate the human thorax, and, this being true, it is hoped that in time this form of treatment will be utilized in the treatment of pulmonary tuberculosis.

In December, 1903, the Norwegian Parliament awarded Dr. Finsen the annual Nobel prize of $40,000 for the most notable discovery in medical science. It is said of Finsen that he unselfishly gave his life for the betterment of his fellow men.

International Association of Municipal Electricians.

The ninth annual convention of the International Association of Municipal Electricians, which was held in the Grand View Fraternal Hotel, St. Louis, on September 13th and 14th, was opened by President A. C. Farrand of Atlantic City, N. J., who delivered his address to the members. Following the usual routine business the reading and discussion of papers was taken up.

The first paper was on the "Limitation of the Telephone for Fire-alarm Purposes," by Adam Bosch of Newark, N. J. Mr. Bosch favored the use of the telephone only as an auxiliary to the fire-alarm telegraph and pointed out the disadvantages of the former compared with the latter system. The paper was freely discussed, principally by Messrs. Yeakel of Baltimore and Murphy of Cleveland. William Thompson of Richmond, Va., then read a paper on "The Inspection of Theaters from an Electrical Standpoint." From the paper and the discussion which followed it was apparent that theater inspections have become more rigid in the last year and that the electrical equipment of theatrical companies has been improved since the Iroquois fire in Chicago.

A. S. Hatch of Detroit, Mich., read an interesting paper on "Street Lighting," in which he brought out what he considers the best methods in street lighting. He showed drawings of various apparatus used in Detroit and gave some valuable advice concerning public lighting. Among others who discussed Mr. Hatch's paper were Messrs. Bosch, Murphy, Williams, Foster and Storer. An interesting and instructive feature of the convention was the question box, which produced many important questions of interest to municipal electricians, all of which were freely discussed. Following the question box was a paper by W. M. Petty of Rutherford, N. J., on "Methods of Testing."

The next meeting of the association will be held in Erie, Pa. Following is the result of the election of officers: President, W. M. Petty of Rutherford, N. J.; vice-presidents, J. B. Yeakel of Baltimore; G. H. Holderman of Indianapolis; C. E. Diehl of Harrisburg, Pa., and Charles Greenland of New Brunswick, N. J.; secretary, F. P. Foster of Corning, N. Y.; treasurer, G. F. McDonald of Ottawa, Canada; executive committee, J. Murphy, William Crane, M. J. Donohue, A. S. Hatch, C. L. Williams, A. C. Farrand, W. H. Thompson, F. C. Mason, John S. Craig; finance committee, W. H. Bradt, James Grant, T. C. O'Hearn, J. D. Hall.

COMMUNICATION.

Telephone versus Electric-light Circuits.

To the Editor of the Western Electrician:

What class of wire is used in underground installations for electric-light plants and what should be its insulation resistance? The electric-light company here is installing some ordinary rubber-covered and braided wire in its ducts without any other protection. The wire had been in use nearly three years in aerial work and had suffered to that extent that there is considerable leakage in places. They are operating a three-wire system, 220 volts positive to negative, and 110 to the neutral. Their negative leaked to the ground in an alley in which we had some cable and made way with the cable in four days. We are bonded to the street-railway return and do not suffer from them at all. In such a case who is responsible for the damage done? We claim they must keep their system free from such leaks, at least on the negative side. A ground on the positive side would not damage us any.

We should very much like to see some one qualified to speak discuss the subject in all its bearings, as it is important to all telephone companies.

H. M. ROUNCE,
Manager La Crosse Telephone Company.
La Crosse, Wis., September 13, 1904.

Telephone Convention Notes.

[*Continued from page 265.*]

Donohoe is never absent from telephone functions and is always welcome.

Consulting Engineer Samuel G. McMeen read a most able and conservative paper at the convention.

General Manager F. W. Pardee and F. R. Parker took care of Frank B. Cook's interests and did it well.

Attorney Edward E. Clement of McGill Building, Washington, D. C., made a hit with his convention paper.

General Contractor G. M. Gest was well represented at the gathering by Cincinnati Representative W. T. Jackson.

W. H. Trimm and J. C. Hubacher allowed no one to forget the Monarch Telephone Manufacturing Company of Chicago.

A. B. Conover represented as usual John A. Roebling's Sons Company, and "wire rope and wire" was the burden of his song.

Of course Carl Seyler, the popular representative of Hubbard & Co., Pittsburg, Pa., as usual put in an appearance. Mr. Seyler was warmly welcomed.

General Manager W. E. Doolittle of the Sterling Electric Company of Lafayette, Ind., was present. Mr. Doolittle as usual received the "glad hand" from everyone.

No convention could be complete without J. J. Nate of the Stromberg-Carlson Telephone Manufacturing Company, and this gathering was one of the successful ones.

"In fine feather" A. J. Rousseau of the Automatic Electric Company appeared early Wednesday morning. Rousseau's smile is worth considerable money to his employers.

Clyde L. Matthews of W. N. Matthews & Bro. was indefatigable as a convention representative at the Inside Inn, talking "corkscrew Stombaugh anchors" everywhere.

Of course the Controller Company of America was represented by the only "Stroud." Mr. Stroud is promising a number of new specialties in the line of coin controllers.

R. Schweitzer of the Crawfordsville Wire and Nail Company of Crawfordsville, Ind., made a good impression upon the members of the convention in forwarding the interests of his company.

The Controller Company of America of St. Louis advertised itself thoroughly by signs all over the Convention Hall in the Inside Inn, inviting delegates to its exhibit in the Electricity Building.

The Swedish American Telephone Company was looked after by A. V. Overshiner, Vice-president and Superintendent Tidolf Lidberg and J. A. Russell. The company made no attempt at an exhibit.

Ernest L. Clark of the Valentine-Clark Company appeared early Wednesday morning, accompanied by his son, Lyle H. Clark, or, as Mr. Clark aptly put it, by the "future partner" of the Valentine-Clark Company, Chicago.

President Nicholas of the Nicholas Lightning Arrester Company, 229 West Eleventh Street, Columbus, Ohio, presented his new lightning arrester, claimed to be "the simplest in form and the most durable and longest lived of arresters."

The American Conduit Company filled a want with its memorandum book, distributed so freely throughout the telephone convention and the World's Fair. A. L. Waterbury and C. M. Ripley were the representatives of the company at the convention.

Treasurer and Manager Thomas W. Finucane of Rochester and Chicago, accompanied by Chicago Manager C. W. Stiger and Mr. Cracraft of the Stromberg-Carlson Company's Chicago office, were decidedly "in evidence," arriving with the crowd on the opening day of the convention.

Secretary Franz J. Dommerque of the Kellogg Switchboard and Supply Company was accompanied by Mrs. Dommerque. Secretary Dommerque, however, was able to spend only Wednesday at the convention, leaving St. Louis for Chicago the same evening after dinner at the Tyrolean Alps.

President Frank G. Jones of the American Electric Fuse Company covered himself with glory by his demonstration of executive ability as secretary of the association. When it came to forwarding the interests of the company Mr. Jones was aided efficiently by James A. Kenny and F. W. McMeal.

Manager C. E. Stinson of the Toledo (Ohio) Home Telephone Company was one of the most enthusiastic visitors to the World's Fair and the telephone convention. Mr. Stinson this time made himself doubly welcome by bringing Mrs. Stinson. Thursday evening Mr and Mrs. Stinson entertained friends at a dinner party in the Tyrolean Alps.

President James S. Cuming of the Central Telephone and Electric Company of St. Louis was indefatigable in his efforts to fulfill his part as "chief St. Louis entertainer." Mr. Cuming is to be congratulated on his convention arrangements at the Inside Inn and also for his hospitable provision of an automobile "free" to carry visitors on a tour of inspection to the Electricity Building, and incidentally to see the very handsome exhibit of the Central Telephone and Electric Company. C. H. Wallace, J. A. Becker and J. P. Poertner were his willing co-operators in the good work.

Secretary G. Hallett Johnson of the Western Telephone Manufacturing Company of Chicago appeared early Wednesday morning at the convention. Mr. Johnson this time was accompanied by Mrs. Johnson, who found great enjoyment in this her first telephone convention, to say nothing of the pleasure derived from her visit to the Fair.

The Dean Electric Company of Elyria, Ohio, was represented by its "prime movers," Secretary and General Manager Arthur E. Barker and Chief Electrical Engineer W. W. Dean. These gentlemen made an exhibit of some special apparatus in their room at the Inside Inn. The Dean Electric Company is reported as doing exceedingly well in the market.

The North Electric Company of Cleveland, Ohio, was represented by President North, Arthur B. Kratz and Advertising Manager Sapp. In addition to the active business members of the party Mr. North brought with him his son, and Mr. Kratz was accomplished by his wife. Incidentally, it should be mentioned that Mr. Kratz has only recently joined the benedicts.

President Joseph Belden of the Belden Manufacturing Company, magnet wire manufacturers, turned up at the Inn Wednesday. The Belden company is prospering under Mr. Belden's management and its success is largely due, it is said, to its careful handling of every special order for magnet wire, the smallest orders receiving as prompt and as careful attention as the larger ones.

The Kellogg Switchboard and Supply Company, Chicago, was represented most energetically by F. V. L. Turner of the sales department. Milo G. Kellogg of the Kellogg company, Chicago, dropped into the Inside Inn on Wednesday morning and mingled with his friends, the Independent telephone people. Other Kellogg representatives were J. C. Lewis, H. N. Fares and W. R. Hind.

President E. P. Baird of the Baird Manufacturing Company of Chicago was "all there," and this time in person to exhibit not only his latest improved type of telephone pay-station equipment for measured service, etc., but to present a new specialty in the form of a novel transmitter arm with a new type of joint. This joint, Mr. Baird stated, had been moved by machinery 72,000 times to test its wearing quality, with the most satisfactory results.

President P. C. Burns and General Manager Ihmsen of the American Electric Telephone Company made quite an extensive exhibit at the Inside Inn during the telephone convention of their latest-improved telephonic accessories. A special exhibit was made of a new extension desk bracket that has just been worked out by President P. C. Burns. This device is worthy of investigation, as it has several new features of value. Messrs. Burns and Ihmsen as usual came early and stayed late and were aided in their work by S. J. Bear.

The Automatic Electric Company of Chicago was as usual most skilfully advertised by its well-known representatives, J. F. Crook of the sales department and Electrical Engineer H. S. Durant. These gentlemen were clever enough to placard the wall behind the president's desk with one of the most prominent signs in the Convention Hall, and one that must have done the Automatic company a world of good in impressing upon the members the present great strength of "automaticity" among the Independents. Other representatives of the Automatic company were James Strasburg, H. D. Critchfield and G. L. Fisher.

The Ewing-Merkle Electric Company of St. Louis had secured a parlor adjoining the Convention Hall where its representatives, Assistant Manager of Sales C. F. Philo, Telephone Department Manager L. G. LeBourveau and L. G. Kalloch "did the hospitable" and extended invitations to visitors to inspect their company's very handsome exhibit in the Electricity Building. President Brown of the company was likewise in attendance at the booth at the Fair at various periods to extend his well-known hospitality to the company's out-of-town friends. The Ewing-Merkle company has quickly earned for itself a well-deserved and what promises to be a lasting reputation for conservative yet thoroughgoing and business-like treatment of customers.

Members and Visitors.

Following is a list of those in attendance at the convention:

Arnheim, A. V., Swedish-American Tel. Co.....Chicago, Ill.
Baird, Edw. P., Baird Mfg. Co.....Chicago, Ill.
Baldwin, John F., Jr., Irontown Independent Telephone Company.....Irontown, Mo.
Barber, E. L.....Kansas City, Mo.
Barker, A. E., Dean Elec. Co.....Elyria, O.
Beam, Frank L., Columbus Citizens Tel. Co....Columbus, O.
Bell, J. H., Hoosier Telephone Company.....Salem, Ind.
Blasingam, L. F.....Hawkinsville, Ga.
Bowman, W. P., John A. Roebling's Sons Co...Cleveland, O.
Caldwell, W. A., Standard Underground Cable Co. .....St. Louis, Mo.
Clement, Edward E.....Washington, D. C.
Crook, J. F., Automatic Elec. Co.....Chicago, Ill.
Conover, A. B., John A. Roebling's Sons Co....Chicago, Ill.
Cracraft, J. P., Stromberg-Carlson Tel. Mfg. Co. .....Rochester, N. Y.
Crumb, W. H., W. H. Crumb & Co.....Chicago, Ill.
Dalrymple, H. T., Morrow County Tel. Co...Mt. Gilead, O.
Dougherty, Hugh, United Tel. Co.....Bluffton, Ind.
Donohoe, F. E., Amer. Elec. Works.....Chicago, Ill.
Earle, J. B., Texas Telephone Co.....Waco, Tex.
Ecoff, John C., Wesco Supply Co.....St. Louis, Mo.
Fisher, E. B.....Grand Rapids, Mich.
Fisher, C. L., Automatic Elec. Co.....Chicago, Ill.
French, O. F., Cuyahoga Telephone Co.....Cleveland, O.
Greer, Frederic, Harvard Elec. Co.....Chicago, Ill.
Hoge, James B., U. S. Tel. Co.....Cleveland, O.
Hopkins, Wm. A., Jr.....Columbus, O.
Huling, Cyrus.....Columbus, O.
Ihmsen, J. G., American Elec. Tel. Co.....Chicago, Ill.
Judson, C. H.....Council Bluffs, Ia.
Kelsey, J. C., Purdue University.....Lafayette, Ind.
Kleine, C. W., Interstate Tel. Co. of New Jersey, Consolidated Tel. Companies of Pennsylvania. .....Hazelton, Pa.
Kneisel, Arthur, Tel. Hygienic Co.....St. Louis, Mo.
Kratz, A. B., and wife, North Elec. Co.....Cleveland, O.
Land, E.....Grand Rapids, Mich.
Lee, F. B., Pittsburg and Allegheny Telephone Company .....Pittsburg, Pa.
Lidberg, F., Swedish-American Tel. Co.....Chicago, Ill.
Marshall, L. W., Electrical Review.....Chicago, Ill.
McMeal, H. M., Telephony.....Chicago, Ill.
McQuillan, G. T., Lexington Improvement Company .....Lexington, Miss.
McVey, C. Y., Federal Tel. Co.....Cleveland, O.
Metzell, Wm. E., Measured Service Co.....Chicago, Ill.
Mock, Ed. J., Telephony.....Chicago, Ill.
Montrove, Wm., Commercial Elec. Supply Co..St. Louis, Mo.
Nicholas, C.....Columbus, O.
Nymann, M. R., Amer. Tel Instrument Co....Chicago, Ill.
Bear, S. J.....Topeka, Kan.
Perry, Frank L., Western Electrician.....Chicago, Ill.
Reber, Maxime.....St. Louis, Mo.
Ripley, C. M., American Conduit Co.....St. Louis, Mo.
Rotau, Edward, Texas Telephone Co.....Waco, Tex.
Rousseau, A. J., Automatic Elec. Co.....Chicago, Ill.
Russell, J. A., Swedish-American Telephone Co.....Chicago
Schock, C. A., Grayson County Tel. Co.....Sherman, Tex.
Schulter, Albert.....Wheaton, Ill.
Schweitzer, A., Crawfordsville Wire and Nail Company.....Crawfordsville, Ind.
Seyler, Carl, Hubbard & Co.....Pittsburg, Pa.
Snider, C. C., Home Tel. Co.....Kansas City
Stanton, L. W.....Cleveland, O.
Stegerk, C. W.....Chicago, Ill.
Stroud, H. D., Controller Company.....Chicago, Ill.
Torlle, C. H., The Suttle Elec. Co.....Cleveland, O.
Turner, F. V. L., Kellog Switchboard and Supply Co..Chicago.
Waterbury, A. L., American Conduit Co.....Chicago, Ill.
Waite, E. R., Finance.....Cleveland, O.
Watts, N. E.....Stannton, Va.
Wenich, P. J., United Tel. Co.....Monroe, Wis.
Whitney, A. A., Marion County Telephone Company .....Mt. Gilead, O.
Wiley, J. R., Standard Underground Cable Co...Chicago, Ill.
Young, H. E.....Columbia, Pa.
Zapp, Dwight E.....Mt. Vernon, O.

World's Fair Visitors of Last Week.

Among those registered last week at the booth of the Western Electrician in Electricity Building at the St. Louis Exposition were the following-named: George I. Herrick, C. E., Wheaton, Ill.; Frank Gardiner, Dallas, Texas; L. O. Poulson, Dayton, Iowa; H. E. McDaniel, Stamford, Texas; Walter McDaniel, Stamford, Texas; D. O. Wallace, Stamford, Texas; T. Rudolf, M. D., New Orleans, La.; V. Strong, Amsterdam, N. Y.; Etta Stecher, St. Louis; James S. Reane, Steubenville, Ohio; A. F. Manchester, Providence, R. I.; Eustace Larey, Liverpool; Anselm B. Smith, Denver, Colo.; Henry S. Carhart, Ann Arbor, Mich.; J. S. Alexander, New York city; George F. Nolde, Richmond, Va.; Samuel M. Hinckley, St. Louis; L. Wipperman, Buffalo, N. Y.; J. H. Stubbs, Conway, Ark.; Pearl Stubbs, Conway, Ark.; Charles Hamlet, Atkins, Ark.; George R. Williams, Fort Worth, Texas; J. C. Bann, Knoxville, Tenn.; R. P. King, Cincinnati, Ohio; J. J. Brown, Toronto, Ont.; J. H. Smith, Toronto, Ont.; S. H. Allen, Oxford, Ohio; James Burrows, Missouri and Kansas Telephone Company, St. Joseph, Mo.; Buford Adams, Missouri and Kansas Telephone Company, St. Joseph, Mo.; Charles C. Clark, Myersville, Md.; F. M. Badders, Topeka, Kan.; Harry D. Chopin, Chicago; E. W. Cougdon, Chicago; R. E. Noble, Chicago; W. N. Foster, Conroe, Texas; H. F. Connell, Chicago; G. Brookmann, Madrid; I. T. Alvord, Ogden, Utah; A. O. Summer, Moravia, Iowa; Ned M. Conley, Moravia, Iowa; J. M. Lenz, Chicago; B. G. Miller, Boonville, Mo.; W. H. Freeman and wife, New York city; Miss M. L. Jones, New York city; Jabez Pethericlle, Tavistock, England; James McGonnis, Chicago; J. H. Baxtan, Ash Grove, Mo.; A. E. Taylor, St. Louis; L. M. Berry, Wabash, Ind.; E. B. Mason, Athens, Ohio; Ernest L. Vantrees, Butler, Mo.; Edward H. Vantrees, Butler, Mo.; Edward H. Armstrong, Butler, Mo.; C. A. Davis, Windleer, Pa.; A. E. Venneberg, Havensville, Kan.; Arthur C. Fox, Houghton, Mich.; O. Lanash, St. Louis; W. S. Smith, St. Louis; Deane Wyant, Bethel, Kan.; H. M. Beeck, Waukesha, Wis.; T. A. Berhalter, Chicago; Mr. and Mrs. W. H. Bomb, New York city; J. H. Browning, Jr., New York city; Frank S. Welton, Philadelphia Electric Company, Philadelphia, Pa.; John Z. Miller, Erie, Pa.; Richard A. Bradley, Kansas City, Mo.

BOOK TABLE.

BUSINESS SHORT CUTS. Compiled by the Board of Experts of the Book-keeper and Business Man's Magazine. Detroit: The Book-keeper Publishing Company. 1904. Pp. (5 by 7 inches) 157, with illustrations. Price, $1.

Considerable valuable information of a kind to be appreciated by office men and accountants is presented in this conveniently arranged hand-book. Improved methods are briefly described and explained. Their employment is calculated to lessen the labors and increase the abilities of the class to whom the book is dedicated by the compilers.

James M. Martindale will construct a street-railway system in Guthrie, Okla. It will be an electric road, and Mr. Martindale will put in 25 per cent. of the capital.

The Present Status of the Edison Storage Battery.[1]

By A. E. Kennelly and S. E. Whiting.

Type E is the cell now manufactured and placed on the market in three sizes, which differ only in the number of assembled plates. The full capacity of the cell is found to be about 140 ampere-hours, which makes the total output at 30 amperes, 173 watt-hours, and at 120 amperes, 145 watt-hours; or the specific output 13.7 watt-hours per pound (30.2 watt-hours per kilo) and 11.5 watt-hours per pound (25.4 watt-hours per kilo) at the two rates, respectively.

The containing cell, as also the grids and pockets, are made of thin sheet steel plated by a special process. The jar completely encloses the element and the lid is soldered permanently in place. There are four openings in the steel top. Two of these are insulated by rubber bushings, through which the terminal posts project. The third opening is a filler hole with gas-tight hinge-stopper. The fourth opening is a gas vent provided with a valve and gauze screen, to prevent escape of entrained liquid.

The insulation between the walls of the can and the enclosed element is all of hard rubber. On the bottom is a four-barred grating, 0.4 inch deep. On the ends are ladder-like frames, giving about 0.11 inch clearance and grooved to hold the edges of the plates. On the sides are solid sheets 0.014 inch thick. It has been found necessary to subject all the rubber insulation to a special chemical treatment to prevent a foaming action of the alkaline electrolyte.

Between the plates are threaded four-cornered rods of rubber about 0.1 inch thick and spaced 0.57 inch apart. The distance between opposed plate surfaces is about 0.04 inch. Plates of like polarity are bolted to a horizontal bar at the top, provided with spacing washers and joined to the vertical terminal post.

For use in vehicles the cells are grouped in wooden trays containing three, four or six cells each. Connections between cells are ingeniously made by taper lugs, and each jar is insulated from its neighbors and from the base by spacing blocks and a rubber pad, respectively.

The grid itself and the pockets containing the active materials are identical for both positive and negative electrodes. The grid is 9.25 inches high—excluding the lug—4.75 inches wide and 0.015 inch thick. It contains 24 rectangular holes, each 2.95 inches high and 0.5 inch wide. Into these holes are fitted pockets. These are made up of strips of 0.003-inch steel, having flanged edges that telescope together to form the pocket or container of the active material. These pockets have each about 5,000 perforations.

The active material of the positive plate is an oxide of nickel in finely divided form commingled with a conducting substance, such as flake graphite, in order to improve the conductivity of the mass. The active material of the negative plate is finely divided iron similarly commingled with a conducting substance. The electrolyte is a 20 per cent. aqueous solution of potassium hydrate.

In assembling, the pockets are filled with active material, closed and inserted in the holes of the grid. The plate is then subjected to a pressure of 150 tons, for the purpose, first, of flanging the pockets over the holes in the grid, in order to lock them firmly in position, and, second, of corrugating the surface of the pocket in such a manner as to provide adequate elastic movement of the envelope, in view of the contraction and expansion of the contents.

The weight of the active material in its initial condition, and including the conducting material, is about 3.2 grammes per pocket for the nickel and 4.6 grammes for the iron plate. This represents a total quantity of 922 grammes positive active material, and 662 grammes of negative active material in an E-18 cell. The weight of electrolyte per cell is 3.1 pounds (1.40 kilos) at a normal density of 1.190, which represents about 25 per cent. of the total weight of the cell.

The Edison cell is of the oxygen-lift type. That is to say, the process of charging consists in driving oxygen electrolytically from the negative to the positive plate. During discharge the oxygen leaves the positive plate and enters the negative plate. The chemical actions in the cell have not, as yet, been completely investigated. The following conditions may, however, be accepted provisionally as forming a working theory:

Condition.	Positive plate.	Electrolyte.	Negative plate.
Charged.....	NiO_2 NiO_2	KOH H_2O KOH	Fe
Discharging.....	NiO_2 K + H_2O NiO_2 K	HO	— Fe HO
"	$+Ni_2O_3KOH$ KOH	H_2O	FeO—
Discharged.....	Ni_2O_3	KOH H_2O KOH	FeO

The cycle represented in the above table shows that during discharge the electrolyte divides into potassium cations and hydroxyl anions, the former being directed toward the positive plate and the latter toward the negative plate. On arriving at these plates the ions give up their respective charges. At the positive plate, the potassium robs the nickel oxide of a portion of its oxygen and, in combination with the water present, forms new molecules of potassium hydrate, the original electrolyte. At the negative plate the hydroxyl ions deliver oxygen to the ion and form water. Thus the electrolyte tends to become concentrated in the pores of the positive plate and attenuated in the pores of the negative plate. Diffusion ultimately destroys this difference of concentration and leaves the electrolyte in its original condition, since at any instant the total quantity of water and of potassium hydroxide (including the pores of both plates), remains the same.

It would appear from the form of electromotive-force curve (Fig. 1) during complete discharge, that after the cell has become almost entirely discharged other stages of oxidization develop, and further investigation may show that the outline of the chemical cycle above presented is very incomplete. Whatever

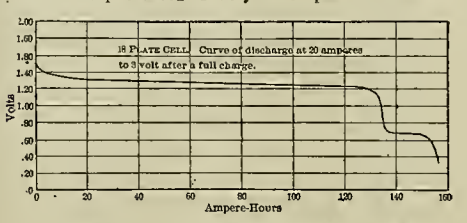


FIG. 1. EDISON BATTERY DISCHARGE CURVE OF ELECTROMOTIVE FORCE.

the complete cycle may be, it is, in all probability, however, of the type indicated.

Various observations, both of the authors and other observers, show that the discharge curve of electromotive force of the type-E cell possesses the following peculiarities:

(1) An initial period of rapid descent occupying about 10 per cent. of the delivery period.

(2) A nearly steady gradient of gradual descent continuing until within about 10 per cent. of the end of the whole delivery period.

(3) A final period of rapid descent occupying the last 10 per cent. of the delivery period (assumed as stopping at a potential difference of 0.75 volt).

A fair sample of this curve is represented by the heavy line in Fig. 1. The initial electromotive force is influenced by the previous history of the cell, more particularly by the time which has elapsed since the close of the preceding charge. The range of initial electromotive force is between 1.35 and 1.65 volts. It would seem that this electromotive force depends upon the amount of gases remaining after the charge, occluded in the pores of the cell.

The electromotive force at and near the end of the discharge is also somewhat variable, depending in some measure upon the rate and nature of the discharge. It clearly accompanies the exhaustion of the active materials.

It has been observed both by the authors and by other experimenters that the internal resistance of an Edison type-E cell is substantially constant during the main working portion of the discharge corresponding to (bc) in Fig. 2. Thus, in the E-18 cell, the internal resistance at ordinary temperatures is about 0.0022 ohm. This would correspond to 0.0278 ohm in a type-E similar cell weighing one pound, or to 0.0126 ohm in a cell weighing one kilo. The internal resistance is slightly less at the beginning of the discharge, but becomes considerably greater near the end of the discharge. Since, however, this rise in resistance occurs only during a small portion near the end of the delivery, its effect in the total discharge may be neglected for most practical purposes.

The internal resistance does not vary greatly with

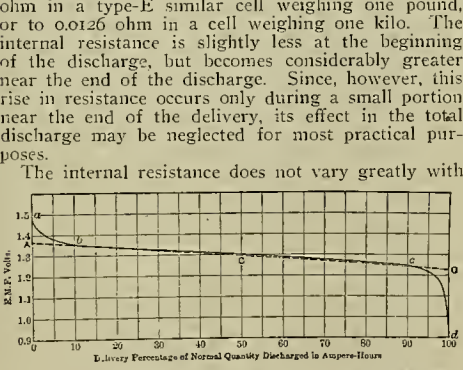


FIG. 2. ACTUAL AND EQUIVALENT ELECTROMOTIVE-FORCE CURVES OF EDISON BATTERY DURING DELIVERY.

the discharge rate within the usual working limits of 0 to 150 amperes. In other words, the drop of pressure in the cell is approximately proportional to the discharging current strength.

The maximum amount of power obtainable in the external circuit of any cell is $\frac{e^2}{4r}$ watts; where e is the actual electromotive force and r the actual internal resistance of the cell. Under these conditions the cell will work at 50 per cent. efficiency, with equal internal and external resistance.

The energy liberated in an Edison E-18 cell is 1.3 volts × 141 ampere-hours = 183.3 watt-hours = 14.48 watt-hours per pound (31.9 watt-hours per kilo), and this liberation of energy is constant to a first approximation for all rates of discharge within the working limits. The amount of this liberated energy which is delivered in the external circuit depends only on the electrical efficiency of the circuit, or on the drop of pressure in the cell. Thus, at 90 per cent. electrical efficiency, or 10 per cent. internal drop (corresponding to about 60 amperes in the E-18 cell), the externally delivered energy would be 183.3 × 0.9 = 165 watt-hours.

The charging electromotive force of an Edison cell is approximately 1.6 volts (somewhat greater at the outset) until about 60 per cent. of the charge has been stored, when it rises to about 1.75 volts, simultaneously with increased evolution of gases. This rise is, therefore, apparently connected with gaseous polarization. To the electromotive force of the cell must be added the drop in internal resistance, in order to find the potential difference at charging terminals. The mean electromotive force of the cell during charge may, therefore, be taken as roughly 1⅔ volts. The resistance of the cell during charge is approximately the same as during discharge, being greater at the outset of the charge, corresponding to the condition of resistance at the end of the discharge.

During the charge of Edison cells, bubbles of gas are liberated at both plates, oxygen at the anode or positive plate, and hydrogen at the cathode or negative plate. The collected gases form an explosive mixture.

Since the mean electromotive force of discharge is approximately 1.3 volts, and the mean electromotive force of charge approximately 1.67 volts, it follows that the superior limit of watt-hour efficiency in an Edison cell is $\frac{1.3}{1.67}$, or 78 per cent. In practice it is always less than this, due to internal drop.

The efficiency may best be examined first in relation to the voltage of charge and discharge, and, second, in relation to the electric quantity charged and discharged.

If there were no drop of pressure due to internal resistance, either in charging or in discharging, and all the electricity charged in the cell (as expressed in coulombs or ampere-hours) were discharged, the ampere-hour efficiency of the cell being thus 100 per cent., the watt-hour efficiency would be 78 per cent. or thereabouts. This figure can, in fact, be approached by employing very low rates of charging and discharging; i. e., by taking many hours to each process. On the other hand, the more rapid the

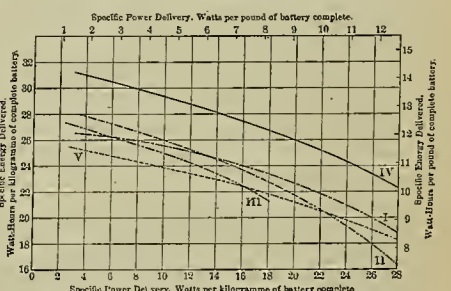


FIG. 3. CURVES SHOWING USEFUL ENERGY DELIVERED IN DISCHARGE TO 0.75 VOLT BY EDISON BATTERY.

charge and discharge, the greater the IR drop in the cell, and the less the efficiency, even on the assumption of 100 per cent. ampere-hour efficiency. Thus, at 60-ampere charging and discharging rates, the potential difference in charge would average about 1.8 volts in the E-18 cell and the potential difference in discharge would average about 1.17 volts to the 0.75-volt limit, representing a watt-hour efficiency of 65 per cent., with 100 per cent. ampere-hour efficiency.

The Edison cell would manifestly possess an ampere-hour efficiency of 100 per cent. if no gases or irreversible substances were generated in its cycle of chemical action. Thus, if a certain number of grammes of iron were reduced and a certain number of grammes of nickel were oxidized by one ampere-hour of charging current, and no other action took place, then, on discharge, the reconversion of these masses of active material would develop the complete ampere-hour of electricity. On the other hand, every gramme of hydrogen (or the equivalent mass of oxygen) liberated and discharged from the negative plate during charge absorbs 26.8 ampere-hours of electricity, which is not returned to the circuit during discharge. The ampere-hour efficiency of the Edison cell is, therefore, determined by the amount of gas escaping during the charge. This in turn depends upon the rate of charge, or charging-current strength, since the greater this strength the greater the drop in internal resistance, and the sooner the plates are brought to that difference of potential at which the water is rapidly decomposed.

The essential results of various tests are represented in Fig. 3. This chart gives the output of the Edison cell (per unit mass) at varying power rates of discharge. Curves I., II. and III. represent the laboratory tests obtained for type D by the Laboratoire Central d'Electricité, Mr. Hibbert and M. Hospitalier, respectively. Curve V. represents the corresponding values for the E-18 cell on normal-rated capacity and delivery. Curve IV. represents, on the other hand, the corresponding values for the E-18 cell, when operated under laboratory conditions of maximum capacity and delivery. In practice, the output may be expected to fall between these two curves, IV. and V.

Although the authors' tests of the type-E cell have been confined to the E-18 12½-pound cell, factory tests of the larger sizes of this latest show about 12

1. Abstract of a paper presented before Section C of the International Electrical Congress of St. Louis, September 15, 1904. Dr. Kennelly is professor and Mr. Whiting instructor of electrical engineering at Harvard University.

per cent. greater maximum output per unit mass than corresponds to Curve V. This may be accounted for by the lesser proportion of dead weight (solution, jar and connections) than is presented in the E-18 cell.

Much experience has been attained in actual service from the Edison battery on automobiles. This experience has led to the elimination of some of the minor practical difficulties that any new battery always encounters. The successive improvements in the battery have, in fact, been due to the perception of defects discovered in actual vehicle practice.

It would seem that the Edison cell is so durable that no electrical depreciation is discernible in the cells during the three years' total experience of the practical construction of the battery. No mechanical corrosion of the plates or pockets has been discernible during that time, and no depreciation seems to have yet occurred in the active material, judging from the capacity tests of cells, which are stated to be as great at the present time as they were when the cells were first constructed. The authors have recently confirmed this observation in the case of type-D cells that have run nearly 3,000 miles in an automobile of the Edison company in Boston. The capacity of these cells was found to be equal to that of new cells of the same type. Two of these cells were opened for examination and the sediment in them collected and dried. The dry sediment weighed 3.9 and 7.1 grammes, respectively, probably less than one-third of one per cent. of the active material in the grids. In fact, a new cell, freshly set up will show about this quantity of material washed by the solution from the external surface of the plates. No signs of depreciation or corrosion appeared on any of the plates or connections.

According to observations at the factory, Edison cells lose 15 per cent. of the ampere-hour charge in eight weeks of idleness. Another test showed 11 per cent. of loss by standing one week. Hibbert's tests on type D showed nine per cent. loss in 48 hours and 27 per cent. in 26 days. Hospitalier's tests on type D showed less than 10 per cent. loss after 24 days. A test of the authors on four type E-18 cells gave, after 26 days' idleness, 100 ampere-hours per cell. This represents a loss of nine per cent. of the normal rated capacity of the cells, or 28.6 per cent. of the maximum rated capacity. At a corresponding charge, the delivery within 24 hours would have been about 140 ampere-hours.

All of the tests show that the cells are remarkably immune from deleterious effects due to careless treatment. Cells have been allowed to dry out, have been permanently short-circuited, or even charged in the wrong direction. These cells have shown a full restoration of their capacity after a prolonged restoring normal charge.

CONCLUSIONS.

The Edison nickel-steel alkaline storage cell, in its large output at heavy discharge rates, its low depreciation in capacity and its durability under severe and adverse treatment, approaches the capabilities of a piece of mechanical apparatus more nearly than is ordinarily credited to electrolytic structures. For this reason it is specially adapted to automobile service, where the treatment is abnormally arduous and severe.

The authors desire to express their indebtedness to Mr. Edison for the cells which he placed at their disposal for test, as well as facilities for becoming acquainted with the facts concerning their manufacture. Also to his assistant, Mr. R. A. Fliess of the Edison Storage Battery Company, who very kindly placed an invaluable collection of experimental data at our disposition. We are also indebted to Mr. C. L. Edgar, president of the Edison Electric Illuminating Company of Boston, for the use of his battery in tests and information concerning the same from his assistants.

The National Electrical Contractors' Association.

The fourth annual convention of the National Electrical Contractors' Association was opened on the afternoon of September 14th in the Century Building, St. Louis, after a meeting of the board of directors in the forenoon. The convention lasted three days. The meetings of the first two days were held behind closed doors. On the third day many important subjects were discussed. G. W. Sanborn of Indianapolis spoke on the developments bearing on the Underwriters' rulings. W. S. Sisson of the D. and W. Fuse Company of Providence discussed various points in fuse construction. Other speakers were W. W. Low, Chicago; C. E. Flanck, Pittsburg; C. E. Lee, Pittsburg; H. B. Coho, Erie, Pa., and Alexander Henderson, New York city. An important discussion arose on the subject of state licensing for electrical contractors, in which Messrs. Gray, Eidlitz, Galloway and Kneider spoke in favor of the plan.

The board of directors elected the following-named officers: President, M. E. McCleary of Detroit, Mich.; vice-presidents, W. J. Gray of Minneapolis, Minn.; Walter C. McIntire of Philadelphia, and J. P. Coughlin of Worcester, Mass.; secretary, W. H. Morton of Utica, N. Y.; treasurer, John R. Galloway of Washington, D. C.

The new board of directors is made up as follows: New York, James R. Strong of New York city and M. L. Barnes of Troy; Pennsylvania, E. R. Keller of Philadelphia; Michigan, F. J. Miner of Detroit; Minnesota, E. A. Richardson of Minneapolis; Maryland, H. K. McKay of Baltimore; Missouri, F. E. Adams of St. Louis; Indiana, G. M. Sanborn of Indianapolis; Washington, D. C., E. C. Graham; Ohio, E. M. Lawton of Cincinnati; Illinois, Arthur Frantzen of Chicago; Connecticut, H. E. Page of Hartford; Massachusetts, Seth B. Witherbee of Boston; Wisconsin, George C. Rohn of Milwaukee; Iowa, Edward Kunkel of Des Moines; Arkansas, T. B. Martin, Jr., of Little Rock.

Tesla Patents Upheld in Stanley Instrument Case.

An opinion was handed down September 9th by the Circuit Court of Appeals for the first circuit in the case of the Westinghouse Electric and Manufacturing Company, complainant and appellant, against the Stanley Instrument Company, defendant and appellee, known as the "Stanley instrument case," the case having been appealed from the United States Circuit Court for the District of Massachusetts. The Court of Appeals reversed the decree of the lower court, which was in favor of the defendant. The opening and closing paragraphs of the opinion of the court, written by Judge Putnam, are of interest, and are here given:

There is so much judicial literature bearing on this case that only a brief preliminary statement is required. The bill alleges an infringement of the two claims of letters patent for an invention, No. 511,559, issued to Nikola Tesla on December 26, 1893, on an application filed on December 8, 1888, and of the first claim of No. 511,560, issued to Tesla on the same December 26th, on an application filed on the same December 8th. No. 511,559 is captioned "Electrical Transmission of Power," and opens with the statement that Tesla had invented "certain new and useful improvements in electrical transmission of power." No. 511,560 is captioned "Systems of Electrical Power Transmission," and opens with the claim that Tesla had invented "certain new and useful imorovements in systems of electrical power transmission." The claims of No. 511,559 are as follows:

"1. The method of operating motors having independent energizing circuits, as herein set forth which consists in passing alternating currents through both of the said circuits and retarding the phases of the current in one circuit to a greater or less extent than in the other.

"2. The method of operating motors having independent energizing circuits, as herein set forth, which consists in directing an alternating current from a single source through both circuits of the motor and varying or modifying the relative resistance or self-induction of the motor circuits and thereby producing in the currents differences of phase, as set forth."

The claim of 511,560 in issue is as follows:

"1. The combination with a source of alternating currents, and a circuit from the same, of a motor having independent energizing circuits connected with the said circuit, and means for rendering the magnetic effects due to said energizing circuits of different phase and an armature within the influence of said energizing circuits."

The bill was dismissed by the Circuit Court by an opinion passed down on March 11, 1903, 129 Fed. Rep., 140. The only reason for dismissal given was that the complainant had failed to establish by sufficient proofs a conception of the invention by Tesla prior to April 22, 1888, the date of a certain publication in Italy known as the Ferraris publication. The opinion refers to one of the Circuit Court of Appeals for the second circuit, Westinghouse Company vs. Catskill company, 121 Fed. Rep., 831, passed down on February 25, 1903, wherein it was held that the proofs were insufficient to establish invention by Tesla prior to April 22d, as rendering unnecessary an extended statement by himself. Thereupon, the complainant appealed to us.

The patents in suit relate to the conversion of alternating currents of electricity into a continuous current. The latest condition of the prior art is shown by patents issued to Tesla under date of May 1, 1888, referred to over and over again in the judicial literature on this topic. These describe a system "of electrical power transmission in which the motor contains two or more independent energizing circuits through which were caused to pass alternating currents," "conveyed directly from the generators to the corresponding motor coils by independent lines or circuits." The improvement of the patents in suit dispenses with one of the lines, or circuits.

* * * * * * *

It is not necessary for us to discuss whether what Tesla applied his inventive ability to was a "great engineering problem," as described by plaintiff; but it was a problem practically unsolved in the then state of the art, and of such a character that its solution was certainly a useful one. Therefore, the invention, according to settled rules, is to be protected to its fullest extent unless something of a positive character, either in the patent itself or elsewhere, prevents. It is true that Tesla's specification indicates strongly that he probably had not in mind the application of his invention to any motors except his own. Possibly he valued no other two-phased alternating-current motors, or he conceived that there were no others; so that naturally the practical application which he had in mind was limited accordingly. Nevertheless, he is entitled to the advantage of the well-settled rule by virtue of which an inventor who has patented his invention, is entitled to all the uses to which it may be applied, of the class to which he himself practically applied it. Therefore, we do not perceive how, on any rule relating to the fundamental nature of inventive conceptions, or to the construction and effect to be given to the specifications and claims in patents for invention, it can be held that the respondent can escape, for any reason we are now discussing, the charge of infringement.

Our observations so far have been more particularly with reference to the phraseology of the only claim of patent No. 511,560 in issue. The claims of patent No. 511,559, so far as the topic we are discussing is concerned, are as broad as the single claim of patent No. 511,560. It is true they contain the words "as herein set forth," which are not found in the other patent; but these words connect directly with the words "independent energizing circuits," and they do not necessarily relate, either grammatically or by any reasonable demands of the rules of construction, to any particular description of motors. Therefore, within the rules stated in Reece Button-Hole Company vs. Globe Button-Hole Company, ubi supra, by virtue of which all expressions in specifications or claims are to be held to sustain the actual invention so far as they can reasonably be so construed, this one does not stand in the way of our giving, so far as the topic we are discussing is concerned, as broad a construction to patent No. 511,559 as to the claim of patent No. 511,560 in issue.

The difficulty which presses itself upon us on the question of infringement, grows out of the fact that the amount of power used by the respondent is approximately what is described by it as negligible; that is very minute. Nevertheless, it is power developed, as set out by Blathy's claims, by "a metallic rotating body," and transmitted to a "suitable counting apparatus, operated" by the same rotating body. If the device stopped with "a metallic rotating body," and some method other than a counting machine operated by it was used for determining the number of its revolutions, we might not be able to charge the respondent with infringing. We might then well apply the proposition of the respondent that a mere meter is in a different art from a motor; but, as it does not stop there, we must look further.

The Tesla invention in issue, as already explained by us, derives its right to recognition from the fact that it was applied to the production of power. In that respect, it falls within the limited class referred to or described by us in Davey Company vs. Isaac Prouty & Co., 107 Fed. Rep. 505, 509, 510, 511. The adaptation of the tortional spring which laid the basis of Western Electric Company vs. Larue, 130 U. S. 601, was a marked instance of this class of cases. The ingenuity of Tesla was displayed in the conception of an adaptation to a particular use; and any adaptation which did not involve that conception could hardly infringe. Therefore, as it may well be that, if the counting mechanism was of a kind not operated by the "metallic rotating body" we should not be compelled to find infringement, we hesitate in view of the minute amount of energy exerted. But Blathy did not merely reproduce the academic experiments which must have preceded Tesla. While Tesla uses the word power, he makes no maximum nor minimum; and it is entirely conceivable that, for certain fine work, or work of a peculiar character, the minimum may be of the utmost value. Therefore, we are unable to make any distinction on this account.

Probably we ought to refer to what is spoken of by the parties as Baily and Deprez. We apprehend that Deprez is disclosed by what is known as "Deprez French Patent of 1879," and that Baily is represented by the article in the Philosophical Magazine of October, 1870. These are each relied on by the respondent. Baily was seeking simply a revolving disk, and not looking beyond that. He did not attempt to transmit that electrical power which, as we have shown, was the soul of Tesla's invention, and which we have also shown is involved in the infringing device, although, perhaps, to a minimum. It is apparent, also, that Baily did not concern himself about alternating currents as such; and it is not at all clear that he proposed to make use of them at all. Deprez, on the other hand, made commutators necessary elements in his device, which essentially distinguishes him from both the complainant and respondent, and lays him out of the case without the necessity of further discussion.

Possibly, relating to some other infringers than those at bar, we might be compelled to determine more positively than we have the construction of some of the claims which are put in issue here, pertaining to the two patents in suits. For the present case, however, any further investigation or discussion relating to them would be purely academic and of no practical importance. The infringement by the respondent relates entirely to the method by derivation, or self-induction, which for present purposes, are the same; and, so far as that is concerned, it can make no possible difference as to practical results whether the injunction and accounting relate to all the claims in issue or only to one or two of them. Therefore, in view of the construction which we are now inclined to give the claims, as already stated, we hold that the relief granted should relate to all.

We wish to call attention to the fact that, at various points, the respondent has referred to the affidavits filed in connection with the motion to the

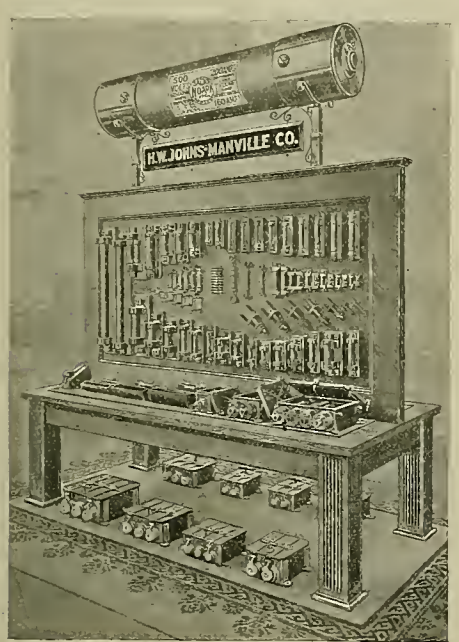
Circuit Court to reopen the case, as though they were adverse to the complainant, and, especially, as though contradicting, in one important particular, the testimony of Mr. Page. On the other hand, at some points, the complainant has undertaken to strengthen its case by reference to the same affidavits. We reject all these, and open the record only so far as it is properly before us. To do otherwise would be to enter on a field which has not been explored by the parties according to proper rules of procedure.

The decree of the Circuit Court is reversed; the case is remanded to that court, with instructions to enter a decree in favor of the complainant for an injunction and an accounting, and to take such further proceedings as may be required not inconsistent with this opinion; and the appellant recovers the costs of this appeal.

Fuse Exhibit at St. Louis

An inspection of the exhibition of Sachs "Noark" enclosed fuses and fuse devices, made by the H. W. Johns-Manville Company in the Palace of Electricity at the St. Louis Exposition impresses the observer at once that the enclosed fuse as an electrical accessory has obtained an important position in the electrical field.

While the exhibit is not large, it shows to excellent advantage the various enclosed fuse devices of different types and styles manufactured by this concern. It is mounted on a large display board, rising from the center of a handsome oak table, as shown in the accompanying illustration. Over all is suspended an enormous enclosed fuse, duplicating the actual device in every particular, and attracts the eye of even the casual visitor, as it can be seen long before the exhibit is reached. Mounted on both



FUSE EXHIBIT AT ST. LOUIS.

sides of the display board are the different styles of fuse blocks equipped with their respective fuses; one side of the board being covered with 220-volt devices, while the other presents the higher potential appliances. The display of blocks and fuses is very comprehensive, including every standard block and fuse manufactured by the company.

Placed upon the table on each side of the the display board and also on the floor underneath the table is a complete line of fuse and service boxes, with the now well-known lobster-claw fuse-clamping arrangement; and also a line of car-equipment fuse boxes, subway boxes, etc. A feature which is by no means the least attractive, both to the layman and others, is the actual demonstration which is given from time to time of the operation of open and enclosed fuses. The exhibit includes a testing box containing an open fuse block and a Sachs "Noark" enclosed fuse block. The open fuse is first blown with the usual terrific explosion, while the enclosed fuse—in that quiet manner which has won for it the approval of discerning engineers—opens the circuit.

Much credit for the attractive appearance of this display is due to the efforts of Mr. G. D. Pogue of the electrical department of the St. Louis branch of the H. W. Johns-Manville Company, who has charge of the exhibit.

The Worcester and Blackstone Valley street railway has been sold to the New York, New Haven and Hartford Railroad Company. The officers of the company resigned and new officers were chosen. M. J. Whittal and Alfred Thomas of Worcester, Mass., were the principal owners of the road, which is operated between Worcester and Whitinsville, a distance of nearly 17 miles. This makes the third street railway entering Worcester to be bought by the New Haven road.

The Telephone Patent Situation.[1]

By Edward E. Clement.

We are met here for one purpose which all present, I believe, hope earnestly may be accomplished. I refer to the formation of a strong, representative and truly national association, which shall not only serve to unite and harmonize the operations of the various state organizations but shall furnish an offensive and defensive alliance in the best and fullest sense. The necessity for such a body is strongly apparent, and its effect, not only in strengthening the market for telephone securities and insuring protection from patent persecution in the courts, but in adding to the facility and ease of transaction of business, cannot be overestimated.

With regard to patents, it is far too soon to consider the field as open. On the contrary, in this case, as in every other, eternal vigilance is the price of liberty. The old association has done excellent work in defending the suits brought under the Berliner and other patents, but its future work, if properly carried out, will be even more important. Day by day more patents are being issued, month by month the Bell interests and the Independents alike are acquiring new leases of monopoly on the application of principles which in the near future will become essential to the operation of high-grade systems. The Patent Office is issuing an average of over 30 patents a month, and whereas a few years ago two examiners could handle the class of telephony, it now takes four, with the assistance of a fifth, and they are overworked. Few people have any adequate conception of what the patent situation has meant in work and money expended. I will give you a few figures to illustrate.

There have been issued 4,298 telephone patents, of which 3,798 are in the class of telephony proper and 500 are scattered. I do not include in this number all the patents for electric lighting, power generation and distribution which have a bearing on telephone systems as installed, but I should say there are probably 500 more of these. The modern telephone plant is not essentially telephonic. It comprises really a power generating and distributing system, with auxiliary telegraph system, whereby the supply of power is controlled. The only things telephonic about it are the transmitters and receivers at subscribers' stations and the central office.

Of the 3,798 strictly telephonic patents, that is, those so exhibited and classified, 327 are for receivers, 683 are for transmitters (of which 216 relate to the granular type), 469 relate to exchange systems and 715 to switchboards, of which 465 cover multiple boards exclusively and the rest single or transfer boards. About 75 of the system patents also relate to multiple boards, and nearly 300 cover circuits which are applicable thereto. Ninety-five apply to exclusively transfer systems, so the preponderance of choice in the favor of the multiple board is thoroughly apparent. Of intercommunicating or house systems, there are 57 patented, and of party-line systems, 577! Of the latter, 200 employ step-by-step selective mechanisms, and I believe there are two things every man who has an idle hour tries his hand at. These are car couplings and step-by-step telephone selectors—both classes absolutely overworked.

There are 160 patents for transmitter arms and receiver supports, and 211 switch hooks. Last, but by no means least in importance at the present time, there are 125 patents for automatic exchange systems and apparatus. The actual number of automatic patents is small, but I assure you they must be measured by weight to be appreciated. No living man knows all the details of all the apparatus in those 125 patents, and no man ever will, not even the inventors themselves. Some of the devices are fearfully and wonderfully made, and some are distinctly abortions.

In these patents, I estimate, there are altogether 48,038 claims, each, of course, standing as a distinct patent for what it covers.

The patents have cost:

Government fees	$150,430
Attorney fees and expenses	200,000
Interferences	300,000
Total	$650,430

This is what the patents themselves cost. It does not touch the value of the inventions, nor the amount at which they have been capitalized, which has, of course, run into many millions. Nor does it touch the cost of litigation, past and present. For all this the people at large have to pay sooner or later. The manufacturer or operator is only a middleman, who collects on the one hand and distributes on the other. Out of the total number given, about 1,800 or 2,000 are owned or controlled by the Western Electric Company and the American Telephone and Telegraph Company (Bell).

Assuming that 20 per cent. of the patents in the class of telephony have expired, and that 30 per cent. are invalid or worthless, there remain 24,000 in force, many of which probably need serious consideration. A respectable percentage of these 24,000 belong to Independent companies or individuals, but I wish to point out that, without more than a friendly understanding (which binds nobody), this is no guarantee that suits will not be brought on them. If the Independent companies, both operating and manufacturing, stand together, the Bell interests can never again do them serious damage by patent suits; and the growth of public sentiment in favor of Independent investments will be sure though slow; but if any amount of litigation develops among the Independents themselves, it will be the very worst thing that could happen, and must have a very depressing effect. The weakness of a house divided against itself is proverbial, and so surely as the larger Independent companies are gathering the elements of monopoly into their hands, so surely will division come. I know that men do not spend money in development and patents out of charity, nor do I mean to depreciate the full protection of every man's property; but surely there must be some division line between those things that are essential and those that are not.

There are many patents on transmitters—683 in all—and the transmitter is a common necessity. Of the 216 granular instruments patented, probably 100 belong to Independent owners, and more are coming as fast as patent attorneys can hatch up new excuses for them. There are 327 magneto-receiver patents, of which probably 75 are modern and in Independent hands. Suits on such patents as these, where they cover only differences in details, should be discouraged. Of course, no one can be absolutely deprived of his right to go into court, but a strong restraining hand would tend to avoid scandals. My suggestion upon this point would be that a national arbitration board be appointed, and that it be made absolutely obligatory upon all members of the association or its component state associations, as well as upon those non-members with whom they deal as purchasers, that they submit all disputes or questions of infringement to this board before going into court. They need not disclose their proofs necessarily; but if a charge of infringement be made, the board should have an opportunity of passing upon the prima facies, so that if, upon the face of things, the complainant had not a righteous cause he would go on with the official stigma attached to him, stamped "disapproved." This board, of course, would have to be made up of disinterested men of sufficient standing and technical knowledge to give their decisions weight. I believe such an arrangement would tend to discourage litigations over trifles, and, in my belief, large causes of dispute are few and far between.

The manufacturers have shown a meritorious desire to avoid infringement of any patents, and some of them have spent large sums in securing competent advice to this end. This is money exceedingly well spent. Another method of achieving the same result would be to form a pool to hold all non-essential patents, with a scale of reciprocal royalties, so that anyone in the pool could be free of the patents held for a reasonable sum per annum, which would be divided among the members in proportion to the pro-rata royalties paid on claims they put in. This, however, is for the manufacturers to settle, although the operators are the parties most interested.

With regard to important suits of the past, or likely to be brought, especially by the Bell, in the future, the broadest patents are all expired, and the most threatening ones are out of business, temporarily or permanently. The Firman multiple-board patent, the Haskins and Wilson busy-test patent, the Seeley answering-jack patent, and the Bell common-battery patent are all gone forever, while Berliner is on the shelf along with the narrow subject matter to which he was restricted and which no one wants to use.

The Scribner patent 330,061 (expired) was sustained against the switchboard put in use at Mobile, Ala., but resulted in no other damage to the interests of the Independent telephone business. The Carty patent for the arrangement of bridging bells in party-line work was sustained in the Millheim case, but was reversed in the Anthracite case, and is now awaiting final decision by the Court of Appeals.

The suits brought by the Western Electric Company against the Citizens' Telephone Company of Grand Rapids, Ind., on the Eldred patent, 303,714 (106 F. R., 215) and the Watson patent, 266,806 (89 F. R., 670) and against the Western Telephone Construction Company on patents, 215,833 to Rosevelt (79 F. R.) and 270,522 to Watson (81 F. R., 572) and against the Williams-Abbott Electric Company on the Gray patent 309,617 (108 F. R., 952), all resulted in defeat for the patents sued on and established the right of the public to use the various switching and switchboard devices alleged to have been covered by them.

More recently Judge Wing decided against the Western Electric Company on suits brought by it against one of the Independent manufacturing companies for the alleged infringement of four of its patents (357,358, 477,616, 488,033 and 552,729), involving the construction of spring jacks and annunciators, while suits on the five common-battery patents to Bell 346,708 (expired), Stone 507,568, Scribner 559,616, Kitsee 430,960, and Hayes 474,323, brought by the American Bell Telephone Company against certain Independent operating companies, and suits brought by the Western Electric Company on patents 575,653, 488,038, 431,531, and 11,929 (reissue), against other Independent telephone companies, have been indefinitely suspended awaiting the decision of the United

1. A paper (slightly abridged) read before the Independent Telephone Association of the United States at St. Louis, September 22, 1904. Mr. Clement is a well-known Washington patent lawyer.

States court on the alleged illegal purchase of the Kellogg Switchboard and Supply Company by the Bell interests. Numerous other patent suits have been brought and subsequently abandoned by the Bell interests, while suits on a number of patents, including 427,629, 669,708 and 667,463, in addition to those above mentioned which have been indefinitely suspended, have as yet received no action from the courts.

Another decision has been rendered in Rochester within the last few days on a Bell patent, which will be welcomed generally. I refer to the Scribner patent 559,411, covering the control of supervisory lamp in the third conductor in the cord. The patent is declared invalid, I am informed, and this opens one more door, which is of some importance.

On the whole, I can see no reason to fear successful attack along any important line from the Bell company. I do not mean by this that there will be no suits, but they will be brought for effect only, and the effect can be discounted, if not entirely destroyed, by a united and harmonious stand. With the same amount of reasonable precaution and the same investigation that an investor in any other field would feel bound to make, every assurance can be given that success will continue to crown our banners in the future, as it has in the past.

Independent telephone securities are absolutely safe, so far as patent suits now being prosecuted or to be brought in the future by the Bell people may go. All that is needed to create confidence is Union. I trust, in closing, I may be permitted to express my earnest hope, as one who has been with this movement since its birth, that its end will be more glorious than its beginning, or, in Oriental phrase, "May the end of this house be peace."

Bell Telephone Output.

The August statement of the instrument output of the American Telephone and Telegraph Company for the month and the first eight months of the year makes the following exhibit:

August—	1904.	1903.	1902.	1901.
Gross	98,272	63,565	84,279	81,144
Returned	46,540	46,136	43,034	42,997
Net	51,732	17,429	41,245	38,147
Since January 1—				
Gross	770,304	732,823	733,323	607,593
Returned	336,572	325,393	303,355	267,807
Net	433,732	407,430	429,968	339,786
Outstanding—				
August 31,	4,213,249	3,557,750	2,955,574	2,292,602

NEW COMPANIES.

The Viele Independent Telephone Company has been incorporated in Viele, Iowa.

The Spring Creek (Kan.) Mutual Telephone Company has been incorporated with a capital stock of $5,000.

The People's Mutual Telephone Company of Lagrange County, Lagrange, Ind., has been incorporated with a capital of $10,000.

The Farmers' Mutual Telephone Company of North Branch, Kan., has been incorporated with a capital stock of $4,400, and will put in a rural line.

The Chickaskia Mutual Telephone Company has been organized at Milan, Kan., and expects to build a rural line to Wellington and nearby towns.

C. W. Hobson, A. L. Collins and Hyde Macfarlan are the incorporators of the Hubbard City Telephone Company of Hubbard, Texas. The capital is $5,000.

The Manokin Telephone Company of Oriol, Md., has been incorporated with a capital of $5,000. The incorporators are A. B. Fitzgerald, R. R. Hoyt, G. W. Bozman and others.

The Hubbard City Telephone Company, with headquarters at Hubbard City, Texas, has been organized. It has a capital stock of $5,000. A. L. Collins is one of the incorporators.

The Century Telephone Construction Company of Buffalo, N. Y., has been incorporated with a capital of $500,000. The directors are B. G. Hubel, Martin Coney and Theodore S. Fassett of Buffalo.

The Washington Mutual Telephone Company has been organized and will apply for a charter to build rural lines out from Washington, Kan. John King is president, and O. G. Labaugh, secretary.

Jacksonville, Texas, is to have a telephone system to be built by the Jacksonville Telephone Company, recently incorporated, by W. H. Sorry, W. H. Sorry, Jr., and M. L. Sorry, with a capital of $15,000.

The Unionville Telephone Company of Unionville, Ind., has been incorporated by George W. Welch and W. J. Slater of Bloomington and Milford Young, B. F. Linicomb and others of Unionville.

The Nacogdoches Southeastern Telephone Company was recently organized, with headquarters at Nacogdoches, Texas, and has a capital stock of $10,000. Robert Lindsay is one of the incorporators.

The Lamonte (Mo.) Telephone Company was recently organized with W. E. Files, president; A. F. Wilmer, vice-president; J. A. Fleming, secretary, and John McCurdy, treasurer. The capital of the company is $6,600.

Telephone News from the Northwest.

The Morrill Rural Telephone Company has been incorporated with $50,000 capital to build lines radiating from Morrill, Minn.

Farmers of Stillwater and Grant townships, near Stillwater, Minn., have formed the Twin Lake Rural Telephone Company.

The Chippewa County Telephone Company seeks admission to Eau Claire, Wis.

The Monroe County Telephone Company has begun improvements to its system at Sparta, Wis., which will cost $25,000. There will be a new switchboard, and repairs to the lines.

The Northwestern Telephone Exchange Company is putting up about 10,000 feet of new cable in Stillwater, Minn.

A shortage of tall poles has delayed the completion of repairs to the telephone companies in Minneapolis and St. Paul, which have been under way since the tornado of August 20th. The work of restoring connection has been completed. A second storm on September 5th caused a great deal of damage to telephone lines also.

The Zumbro Falls (Minn.) Telephone Company has been incorporated with a capital stock of $7,000. Frank Robertson, Bert W. Disney and others are incorporators.

The Nevada (Ia.) Mutual Telephone Company has purchased a lot and expects to erect a central exchange building thereon.

Harry Kent has resigned charge of the Osakis (Minn.) Telephone Company, to go to Ohio. He is replaced by James Kirk.

It is reported that the local telephone system at Harvey, N. D., has been sold to W. B. Bascom by W. B. Leslie.

The North Dakota Central Telephone Company is building a line from Sykeston to Bowdon, N. D.

The First Ward Improvement Association of St. Paul, has declared that the Northwestern Telephone Exchange Company must remove its poles on Payne Avenue within 30 days or the poles will be cut down.

H. Fant, manager of the telephone exchange at Thief River Falls, Minn., announces that new toll lines are in working order to the new towns of Middle River, Newfolden and Sanridge.

Although the City Council of Anoka, Minn., has repeatedly refused admission to the Twin City Telephone Company, and allied lines, the company is building into the city over private property. As there is no way to prevent it, the line will probably stay.

The Northwestern Telephone Exchange Company is installing a central-energy switchboard for the Prior sub-exchange between St. Paul and Minneapolis, and making extensive improvements.

The Rogers Telephone Company of West Union, Neb., has been incorporated. The capital is $50,000. O. W. Rogers is the leading stockholder.

The Standard Telephone Company of Dubuque, Iowa, is installing a complete long-distance telephone system at Chester, Iowa.

Materials are arriving in Fond du Lac, Wis., for rebuilding the system of the Wisconsin Telephone Company.

The new Zumbro Falls (Minn.) Farmers' Telephone Company will connect with the long-distance system of the Tri-state Telephone and Telegraph Company.

The R. L. Polk Company is issuing a telephone directory of the Twin Cities, covering both companies. All subscribers are listed both by name and by street number.

The Tri-state Telephone Company has completed connection between the Twin Cities and La Crosse, Wis.

The American Telephone and Telegraph Company will soon establish toll-line headquarters for all long-distance business from the Northwest in the sub-exchange of the Bell system on the east side in Minneapolis. The building has been enlarged for the purpose. Two new circuits are to be opened between the Twin Cities and Chicago. The new station will be in use for long-distance service about the middle of November.

A new telephone company has been organized at Adams, Neb. F. B. Draper is president and W. C. Gray secretary.

The Guthrie County Mutual Telephone Association has been formed at Guthrie Center, Iowa, by the various mutual telephone companies of that vicinity. I. White of Panora is president, and Charles Wall of Panora, secretary. -R.

Ohio Telephone Notes.

Independent telephone men in Cleveland deny that the Gould interests have made any advances toward purchasing the Independent property in Ohio, although rumors to that effect were on the street a few days ago. A denial also comes from Dayton, where it is said that the Goulds were attempting to purchase the plant. The stories have perhaps come through the fact that the Postal Telegraph-cable Company and the Bell interests have been a little more friendly than usual and the consequent report that the Goulds had taken a step to unite the Western Union with the Independents, to hold an equal advantage.

An exchange will be installed at Bethesda by the Belmont Telephone Company and a complete system will be put in.

Homer Hood of Toledo has asked for a franchise for an Independent system in Geneva, and an ordinance is being prepared for that purpose. The Bell people have so far had the field.

It is now alleged that the ordinance granting the Bell Telephone Company a franchise in Lorain is illegal and that the Black River Telephone Company will have no trouble in preventing the installation of its system in the town.

Improvements aggregating $70,000 will be made in Columbus by the Central Union Telephone Company.

Having won its condemnation suit against Charles Myers and others, the Preble County Telephone Company will begin its extensions from Eaton toward Winchester.

The Ohio Valley Telephone Company has accepted the franchise granted by the City Council of Bellaire, and work on the system will be commenced at once. Both overhead and underground wires will be used.

An automatic exchange is being installed at Chagrin Falls by the Bell Telephone Company. It is possible that these switchboards will be installed at a number of small towns in the northern part of the state, as it is believed they will greatly reduce the expense of operation. As yet, however, no decision has been made as to towns having more than 200 subscribers.

Lines through Jackson, Pike, Ross, Gallia, Vinton, Lawrence and Scioto Counties are being planned by the Jackson County Home Telephone Company of Jackson.

An increase from $10,000 to $20,000 has been made in the capital stock of the Home Telephone Company of Plattsburg, Clarke County.

The line of the National Telephone Company from Martins Ferry to Pittsburg has been completed.

Business men of Elmwood have agreed to back a new company to furnish service for the villages of Millcreek Valley, owing to the fact that the City and Suburban Telephone Company of Cincinnati advanced the price of single messages from five to 10 cents. C.

Southeastern Telephone Developments.

Books of subscription have been opened for the Colleton County (S. C.) Telephone Company, which proposes to connect every part of the county with Walterboro. A local system is also being installed. Dr. T. B. Whatley is interested.

The Kernersville (N. C.) Telephone Company has been chartered with a capital of $5,000, by W. C. Linville, G. V. and M. V. Fulp of Linville and F. W. Lubert of Waterbury, Conn.

The Southern Bell Telephone Company at Marietta, Ga., is expending $15,000 in improvements. The work is under the direction of D. F. McClatchey. The City Council recently refused a franchise to another company seeking admission to the city. L.

GENERAL TELEPHONE NEWS.

William Powell Putnam of Boston has been elected to the board of directors of the American Telephone and Telegraph Company, to succeed Thomas B. Bradley, resigned.

F. T. Green has resigned as manager of the Fox River Valley Telephone Company of Appleton, Wis., and will go to Los Angeles, Cal. He will be succeeded by F. L. Von Almen.

The Pioneer Telegraph and Telephone Company is building a line from Tulsa, I. T., to Bartlesville, I. T., and from there to Coffeville, where it will make connections with eastern lines.

George M. Lathrop, night branch manager of the Cuyahoga Telephone Company, Cleveland, Ohio, and Miss Edna McGuire of Denver, Colo., were married in Cleveland last week.

William H. Hacker, interested in the telephone business at Warren, Ind., and Miss Belle Buxton, daughter of Dr. and Mrs. E. O. Buxton of Youngstown, Ohio, were married at Beaver, Pa., a few days ago.

The city of Brantford, Ont., has decided to install a civic telephone service. The estimated cost is $37,000, for which it is expected that business telephones will be given for $25 a year and residence telephones for $12. Except in the case of the joint municipal service in Port Arthur and Fort William, Ont., the Brantford service will be the pioneer municipal telephone service in Canada. As Brantford is a city of some size, the results there will be more decisive than at Port Arthur as regards the success or failure of the experiment.

The Iowa Telephone Company and the Mutual Telephone Company, both operating exchanges in Des Moines, Iowa, are said to be having an interesting fight for supremacy in that city. The Iowa company has recently moved into its new building and has made other important improvements, basing its claims for patronage upon excellent service rendered. The Mutual company, at present enlarging its switchboard in order to be able to take on more subscribers, will also occupy a new home in about six weeks. It is made up of local business men and lays claim to being the means of reducing telephone rates from $60 and $48 to $36 and $24. The Mutual is hopeful on account of the toll connections which it will soon have through an agreement of the Independents throughout the state.

Modern High-speed Printing Telegraph Systems.[1]

By J. C. Barclay.

Machine telegraphy is undoubtedly destined to play, if not a dominant, at least a highly conspicuous part in the telegraphy of the future. For the present, and probably for a long time to come, the Morse system will continue to be the standard system employed in this country. It is doubtful, indeed, if the Morse apparatus—representing, as it does, the very acme of simplicity—will ever be wholly superseded, but new and improved, as well as more economical methods of working, will, slowly, perhaps, but nevertheless, surely, limit its field of operations.

The advances made in recent years in the direction of developing and perfecting a printing-telegraph system, adapted to meet all the requirements of a modern telegraph service, have been of such a practical and progressive character as to leave no room for doubt that the successful advent of such systems into the domain of commercial telegraphy will soon be, if it is not indeed already, an accomplished fact.

Ever since the birth of telegraphy, the subject of printing-telegraph systems has more or less engaged the serious attention of electrical inventors, and, as a result of their efforts, quite a number of such systems have been devised and put into operation; but until quite recently their usefulness has, with few exceptions, been restricted to stock and market reporting or other enterprises of a more or less private and local character.

For the general telegraphic work of the country these systems are entirely too slow; they can only be successfully operated over limited distances, and their records are, as a rule, made upon a strip of paper which is regarded with anything but favor by the telegraphing public of today.

In the elements of weakness above mentioned lie the stumbling blocks to success, but of this the majority of printing-telegraph inventors appear to be entirely unconscious, judging from the way their energies are misdirected in continued efforts to develop and perfect a type of machine for which there is absolutely no demand in the great commercial departments of the telegraphic industry.

Many of the more recent inventions are based upon the principles embodied in the ordinary commercial typewriter, whose peculiar adaptability to the requirements of a telegraph printer was soon recognized, and whose advent into the art may be said to have marked the beginning of the new era of modern high-speed type-printing-telegraph systems.

It may be said of the majority of printing-telegraph contrivances based on the typewriter principle that they are "fearfully and wonderfully made," but a few comparatively simple ones are to be found that can be operated at speeds higher than those attainable by any of the ticker systems, while at the same time making their records in page form instead of upon the objectionable paper tape. The maximum speed at which they can be worked, and the distances over which they can be satisfactorily operated, are, however, so far below the requirements of the present telegraph service, that until they have become more highly developed along the lines indicated, their sphere of usefulness will be limited to enterprises outside the field of commercial telegraphy.

One principal source of weakness in connection with these moderately fast short-distance machines consists in the character of the signaling currents employed, which, as a rule, lack the necessary quality for overcoming the retarding and attenuating effects of the main line. Very short signaling impulses that differ greatly in strength with occasional changes in direction—as employed by some inventors—is not a current arrangement adapted to long-distance transmission. Nor is a combination of electrical impulses of one polarity and of uniform strength much better calculated to increase the signaling distance over lines of considerable inductive capacity, the tendency of which is to retard and absorb such impulses.

A much better plan to secure effective signaling is to incorporate into the system a method of reversing or alternating the line currents, and until inventors more fully realize the importance of some such arrangement, their chances for success in the direction of long-distance working will be highly problematical.

The superiority of the alternating-current method for printing-telegraph purposes has already been pretty well demonstrated, and this fact opens up the interesting question as to what particular extent such currents might be utilized with advantage in the working of ordinary telegraph circuits. It is well understood that the successful operation of these circuits is seriously handicapped by certain line-disturbing elements that are more likely to increase than to diminish in magnitude and intensity as the years roll by.

The leakage interference from the ubiquitous trolley lines constitutes, for instance, one of the growing evils that beset the telegraph engineer, while more or less trouble is to be apprehended from the development and extension of high-pressure transmission lines with their immense capacity for creating inductive or other disquieting influences. It is possible to exclude the former, and to modify the effects of the latter's interference by the use of condensers directly inserted in the main line, which arrangement would also wholly or partly rid the circuit of all ground currents and leakage currents from neighboring wires, as well as minimize the deleterious results arising from defective insulation, variations of resistance, capacity, etc. Such an arrangement, however, would be utterly impracticable with the ordinary battery currents, but, as the alternating signaling impulses can be easily transmitted through condensers, a combination of the character mentioned would seem to lend itself in a manner quite feasible to the practical exclusion of most of the disturbing influences to which all telegraph lines are more or less subjected.

Whether or not this principle will ever find a general application in ordinary telegraph working, it is certain that the subject is receiving considerable attention at the hands of telegraph inventors, several of whom have already succeeded in making practical applications of such a character as to suggest possibilities of the utmost importance in this new and promising field of telegraphic development.

Harking back to the subject of printing telegraphs, it may be remarked that no matter what kind of transmitting current may be employed in connection therewith, a satisfactory system at the present time calls for page printing, at a high rate of speed, over considerable distances, and some few of the latest inventions pertaining to this particular art take note of these essential requirements.

The most highly developed specimens and best-known examples of this modern class of machine are those invented by Murray, Rowland and Buckingham.

In the Murray system the messages are both transmitted and recorded mechanically through the medium of a typewriter. A perforated-paper tape is first prepared by means of a keyboard mechanism, and is then run through a Wheatstone transmitter which automatically, and at a high rate of speed, sends out the signaling currents to the distant receiving station. These currents are utilized, not to actuate the printing mechanism direct, as is the case with all other printing-telegraph systems, but to reproduce another perforated tape, the particular function of which is to mechanically control the working of a typewriter in a manner analogous to that by which a mechanical piano may be operated by a perforated band of paper. This is a highly novel and ingenious application, since the actual printing is accomplished locally, and without regard to the signaling currents coming over the line; but the use of the perforated tape at both the transmitting and receiving stations introduces an element of delay that is more or less objectionable, despite the rapidity with which the signaling currents may be flashed over the main wire.

In Rowland's printing arrangement there is no such objectionable feature, the transmitting apparatus having been designed to work directly into the line, and to operate the receiving mechanism in a manner equally direct. Direct transmission and reception is, in fact, one of the most desirable features in connection with the operation of any telegraph system, but when this is accompanied by a very large increase in the carrying capacity of the wire over which such system is worked, the latter may not unjustly be regarded as one coming well within the range of being an ideal method of working. Such, at least, are the views expressed by the advocates of Professor Rowland's "octuplex system," and these views might be readily accepted if to the other admirable features of this "telegraphic wonder of the age" the great merit of simplicity could only be added.

The system is operated on the multiplex principle, and requires that between certain corresponding parts of the rotating mechanism at each end of the line perfect synchronism be maintained. Success in this direction heretofore has only been practically accomplished over very short distances, with transmissions as numerous as those involved in the Rowland printing arrangement. It is claimed, however, that the difficulties previously encountered in the way of maintaining unison over considerable stretches of line have now been fully overcome by the use primarily of an alternating current continually flowing to line, which current not only provides for the necessary synchronizing impulses, but for the signaling impulses as well. The sending of the signals, it may be remarked, is actually accomplished not by supplying the line with current at the moment the signal is being transmitted, as in the ordinary telegraphic methods, but by cutting out certain of the alternating-current waves, the arrangement being such that one or more of these signals can be made to consist of a combination of suppressed half-waves, the signals so produced being then automatically translated into printed characters. In this way, and by grouping the waves in a manner admitting of entirely different and independent signals being sent from four Remington keyboards, each of the four transmitting operators employed can cut out four different wave combinations, and send as many different signals over the line in a single second. Forty words per minute is said to be an ordinary rate of speed for a practiced operator using this system, or, since the system can be duplexed, eight times that number, making 320 words in all that may be sent and printed over a telegraph wire in the course of a minute. This, if practicable under the regular conditions of working, would make the Rowland system the fastest of all printing systems, or, what amounts to the same thing, it would be capable of more fully utilizing the electrical conductivity, or transmitting properties of a wire than any other system of similar character.

That the Rowland machine has been very highly developed on the most modern and approved scientific principles is undoubtedly true, but it remains to be more fully demonstrated that an extremely complex system, necessitating the maintenance of the most perfect synchronism, and employing as many impulses as those required for the formation of each of the letters or characters, is one practically adapted to the working of other than circuits of moderate length.

To Mr. C. L. Buckingham belongs the credit of having invented the first really rapid, long-distance, page-printing mechanism that was ever successfully employed for the transaction of ordinary telegraph business. Many years had been spent by the inventor in an endeavor to devise and perfect a printing-telegraph machine that could be operated over practically unlimited distances, but it was not until the happy idea was conceived of utilizing the Wheatstone automatic system as a basis that success appeared in sight. Through the medium of the Wheatstone terminal and repeating apparatus, it at once became possible to transmit and receive the necessary signaling pulses over the longest telegraph lines, the pulses in this case differing from those of the Wheatstone or Morse in being quite definite in the number requisite to form the various characters, for each of which six electrical impulses alternating in direction are essential.

The distinguishing features of the invention consist of the perforating apparatus for preparing the slip for transmission, and the printer, which is placed in a local circuit arrangement at the receiving end of the line.

The operation of punching differs from that employed in the Wheatstone, in that it involves the use of a typewriting machine, by means of which anyone may manufacture the slip without the slightest knowledge on the part of the manipulator as to the particular code employed, and at a rate of speed considerably greater than that possible by the use of the Wheatstone perforator.

The slip thus prepared is then run through the Wheatstone transmitter, which automatically forwards the signals to the distant terminal station, where they are received upon a Wheatstone relay, and thence repeated into the local-circuit arrangement. In this circuit is a variety of relays and electromagnets which call into action a number of novel and ingenious contrivances of both a mechanical and electrical character. Under the control of the electrical impulses received over the line these devices perform their various functions with a regularity, precision and harmonious working of parts that is simply amazing.

One of these devices is a modified form of "sunflower" or current-distributing apparatus of very peculiar construction. It was especially designed to secure a rapid transmission or switching of certain line pulses through one or other of a series of relays connected to the sunflower. Five of these relays, known as "selectors," are employed for the purpose of actuating a corresponding number of electromagnetic "adjusters," which control the movements of the type-wheel. Short pulses do not affect the selecting relays, but when the pulses are sufficiently prolonged, the motion of the sunflower or distributor—which is normally one of rotation—becomes temporarily checked or arrested by means of an electromagnetic escapement, thereby permitting any such pulse to actuate the particular relay whose circuit is at that moment completed through contact arms on the sunflower.

At least one of the series of the six line pulses required to form a character must be prolonged, and the particular relay or number of relays that shall be affected within the time required to transmit the entire series of pulses is determined by the regular order in which such pulses are transmitted to line. If, for instance, the first pulse be a prolonged one, the first in the series of relays with its corresponding "adjuster" will respond, and no other. Similarly, if the second pulse be lengthened, the second only in the group of relays will respond thereto, and so on. One or all of the selector relays may be involved in the operation of bringing any letter or character into the required position for printing, the impression itself being invariably accomplished through the medium of the sixth pulse. This pulse, the last in the series, is always a prolonged one of a certain definite polarity, and is not only utilized for the purpose stated, but also to start the feed mechanism, as well as to operate a dogging device which holds the type-wheel firmly in position while the impression is being made. It contrives, furthermore, to actuate the synchronizer, and thereafter to reset or restore to their normal positions such of the selecting and adjusting instruments as were brought into activity by the one series of line pulses, and to thus put them in a condition of readiness for the next cycle of operations.

The type-wheel is suitably mounted upon a shaft of such construction as to permit the wheel to move axially, or circumferentially, or in both directions simultaneously. Instead of a comparatively large wheel having the entire number of characters on its periphery and rotating all the way round, the inventor employs a small wheel bearing four rings or rows of type, which only rotate through a half revolution in either direction. The regulation of the type-wheel is effected through the action of the adjuster magnets, whose armature levers are connected with certain impelling or driving devices, some of which impart a rotary, and others a longitudinal motion, or a combination of both movements to the type-wheel. The axial, or longitudinal movements of the

1. A paper presented before Section G of the International Electrical Congress of St. Louis, September 13, 1904. The author is assistant general manager of the Western Union Telegraph Company.

wheel bring any desired ring or row of type into line with the press pad, while the rotary movements shift the different type of a row or ring into the proper position for printing.

It is by such movements, either singly or in combination, that any type of the several rings may be brought to position on the completion of the requisite number of pulses.

The blanks upon which the messages are printed are the regular message forms whose edges have been pasted together, so as to give the blanks a tubular shape or appearance. When the printing of a message is about to begin a tube is placed in position beneath the type-wheel by sliding it edgewise upon a brass tube, which serves as a support, and in which there is an opening to admit of the necessary operations and impressions taking place. The blank, when printed, is quickly slipped to one side and a fresh one takes its place, after which the first blank is removed from the support by opening it on the line where its edges are joined, and so on. These latter operations are performed by hand, and they constitute about the only ones, so far as the printer is concerned, that are not entirely automatic in character.

The Buckingham system may well be regarded as the most unique and original one in existence, and it will deservedly take high rank among the list of marvelous and useful telegraph inventions of the times. It has been in practical operation over the Western Union lines between New York and Chicago, and New York and Buffalo, for the last six years, and has a maximum working capacity of about 200 messages per hour, operated as a duplex. It does not, as will be noticed, utilize the transmitting properties of a wire to the same extent as that theoretically possible with the Rowland multiplex system, but it is successfully operative over distances that would not at all be practicable with any synchronous multiplex system as yet invented.

The Buckingham system possesses the disadvantage of requiring a perforated strip for transmitting purposes, but, as in the case of the Rowland, the received record is a direct one, instead of having to be translated, as in the Murray system. If the perforated tape could be entirely abolished, and a rate of speed obtained by direct manual transmission approximately equal to that obtained in actual practice by automatic working, a grave objection to the Buckingham system would be overcome, and the author is strongly of opinion that such a change is not only desirable, but entirely feasible, and is, in point of fact, well under way.

One other defect of the Buckingham system consists in the fact that the number of characters that can be printed by means of the type-wheel is limited to 32, admitting only of the letters of the alphabet and certain punctuation marks being recorded. To print all of the characters desirable for commercial-telegraph purposes would involve some radical changes in the apparatus and greatly increase the already complicated character of the system. By substituting for the present recording arrangement a modified form of electrical typewriter of great sensibility and rapidity in action, a comparatively simple printing mechanism can be devised that will more fully meet the service requirements along the lines indicated, and at the same time increase the legibility, and improve the general appearance of the printed message. This is what the author has set out to accomplish, and his experiments so far demonstrate that a speed of at least 100 words per minute can be readily secured thereby. The particular changes necessary to bring this about involve the use of as many small printing magnets as are requisite for the desired number of mechanical operations. As this particular arrangement is the subject of patent proceedings, nothing can be said further than to intimate that the printing magnets are actuated by local currents properly directed through the medium of certain electromagnetic selecting devices, whose particular function is to distribute the different signaling impulses among the various printing and auxiliary magnets in a manner appropriate to the requirements in the case.

In looking over its past history, one cannot but be struck with the fact, and take pardonable pride in the knowledge, that the printing-telegraph art constitutes an industry, the origin, growth and development of which may be credited almost exclusively to American inventors, whose persistent efforts, in the face of many difficulties and discouragements, have at last brought about an extension of its sphere of usefulness into the commercial branch of practical telegraphy. It may be reasonably assumed as a consequence thereof, that the technical and industrial development of this particular art will be much more rapid in the future than it has been in the past; but much remains to be done in the way of simplifying and more nearly perfecting the working apparatus in order to thoroughly complete the task of those early experimenters, who, some 50 years ago, first undertook to solve the problem of devising a practical, useful, as well as economical, printing-telegraph system.

A big company is being formed with the idea of placing several hundred automobile fiacres in Paris. The promoters are two of the best known personalities in the automobile world, and they are assured of the support of a powerful group of capitalists. The new venture will be launched early in the winter it is said.

CORRESPONDENCE.

Great Britain.

London, September 17.—Dublin is just now agog with excitement, owing to certain developments in connection with the municipal electric-lighting scheme. The original station was one of the first to be erected in Great Britain, but the management was not all that could be desired. In the latter end of the '90's it was decided to reorganize the electric-lighting department and to erect a new generating station. Mr. Robert Hammond was selected as consulting engineer and he advised the adoption of a high-pressure three-phase system. After a good deal of discussion and hesitation these suggestions were adopted, and last year the new works were opened and the old ones shut down. Since the time of the adoption of Mr. Hammond's suggestions and the opening of the works, everything had gone smoothly enough. The first "development" was the appointment of Mr. Hammond as a kind of superintendent of the works, in which capacity he had sole control of the staff, fixed their salaries, etc. After some trouble with the engine builders nothing of moment happened until August, this year, when the resident electrical engineer, who had acted in that capacity before the advent of Mr. Hammond, reported to the corporation his conviction that sufficient plant was not available for the winter load and that generally he was of the opinion that the new works were in an unsatisfactory condition. This drew a report from Mr. Hammond in reply, who, in the final paragraphs, made the following offers, which have set all Dublin on the qui vive. Mr. Hammond, so strong is his belief in the scheme he has advised and so far carried out, offers to take over the works from the corporation for a period of 14 years, to supply electrical energy at the present rates, and to pay all charges for interest and sinking fund; practically form a company to run the works. As an alternative he suggests that he should be put in absolute control of the works without permanent salary, but to receive as remuneration the difference in the cost of generation below 1½d. per unit; i. e., should he be able to produce at 1¼d. per unit, he would receive ¼d. per unit on all the units generated. What attitude the corporation will take in the matter cannot be prophesied, but the opinion of the Dublin ratepayers seems to be that Mr. Hammond's offer should be scouted. These offers have yet to be dealt with by the corporation.

Another important matter concerning municipal electric supply relates to a suburb of London named Wood Green. The local authority, despite the fact that the district is purely a working-class residential one, had been advised to go in for an electric generating station of its own. Application was accordingly made to the Local Government Board for the necessary loan to carry out the works, but this has been refused on the ground that the possibility of the scheme being a financial success was not great. As a fact, one of the large electric power companies, of which so many now exist in Great Britain, has authority to supply in the district of Wood Green, and the general tendency nowadays is for small local authorities to take a supply "in bulk" from such companies and carry on the distribution themselves. Thus the question of municipal versus private trading does not arise, inasmuch as the company merely supplies the local authority wholesale and does not deal with the consumers direct. The wisdom of such a course is fully recognized by the loan-sanctioning authority, the Local Government Board, which has already refused two loans when it appeared that a supply from such a company would be more profitable than erecting a separate generating station. A few more decisions of this sort will tend to cause local authorities to pause in the reckless expenditure of the ratepayers' money that has gone on in the past without proper consideration.

The Huddersfeld corporation has just commenced the wholesale delivery of coal by means of specially designed trucks running over the corporation tramway system. In the days of the old horse tramways many provincial local authorities had powers to carry goods, minerals and animals upon their tramways, but hitherto the existence of such powers have been regarded in the light of a joke. Thanks, however, to Huddersfeld, this state of things will shortly be remedied, as, if the experiment there proves a financial success, undoubtedly many other corporations with similar powers will seek to exercise them. The car runs to the sidings of the railway company, where a load of 10 tons is put aboard, and the time taken to deliver to a given point is naturally considerably less than with the usual methods.

The British Electric Traction Company, which owns a large mileage of electric tramways all over the country, and in many cases purchases its power from the local authorities, is just at present having serious trouble over the price which should be paid for electrical energy. As a result, they have ceased running their cars in one particular district altogether. This opens up the very wide question of the extortionate demands of some local authorities upon tramway companies, and the report of the Royal Commission on London traffic is expected to contain some remarks appertaining to this matter.

The patent act of 1902, which comes into force on January 1st next provides that a search for 50 years will be made by the Patent Office to ascertain the novelty of any invention which it is proposed to patent. At present any invention which can be patented is accepted irrespective of the fact that similar patents have already been granted. G.

New York.

New York September 24.—The excavation for that part of the subway which will extend from City Hall to the Battery is now completed, except for a length of about 100 yards. On Wednesday, Mr. M. J. Degnon, president of the contracting company, was able to walk from point to point along the preliminary tunnel, which was completed early on the morning of that day.

The overhead equipment for the Brooklyn Rapid Transit trolley cars over the Williamsburg Bridge has been commenced. The equipment is being put in by the city, and will remain city property, on account of the alleged possibility of the city granting running privileges to some other company at some future date. It seems very likely the Brooklyn Rapid Transit cars will be running over the bridge by November 1st, as recently promised officially.

August Belmont, it is said, has quietly acquired the outstanding interests in the franchise of a tunnel under the East River to connect Forty-second Street, Manhattan, with Long Island City, originally granted to the Steinway interests about 10 years ago. The construction of this work was started some years ago, but an unfortunate dynamite explosion led to so many damage suits that operations were suspended. The plaintiffs have, it is said, been severally satisfied, and the soundings for the line of the tunnel were completed this week by the United Engineering Company.

The Hoboken and Manhattan Tunnel Company, after much litigation, has received a favorable decision from Vice-chancellor Stevenson of Jersey City, allowing the tunnel construction to be carried under the yards of the Lackawanna railroad in Jersey City. The proposed tunnel is to extend from Sixteenth Street, Jersey City, near the Pavonia Ferry, to Hoboken, and will be a branch of the New York and New Jersey tunnel, now under construction beneath the Hudson River.

President Vreeland of the New York City Railway Company has issued an order that hereafter the street-car motormen must obey the requests of the policemen whose duty it is to regulate the street traffic.

The death is recorded on Wednesday of Ira Nelson Stanley, inventor of the fenders now used on the cars of the Brooklyn Rapid Transit Company. Mr. Stanley was born at Attleborough, Mass., in 1820, and died at Freeport, L. I. He leaves a widow, one son and two daughters.

In addition to the 4,000 incandescent lamps to be used for lighting the new Times Building at Forty-second Street and Broadway, there will be no less than 111 motors in the building, used for a multitude of different purposes, from driving octuple presses to a dental drill.

Forty-five internal telephone stations are provided for in the plans of the new Manual Training High School, now approaching completion in Seventh Avenue, Brooklyn. D. W. W.

New England.

Boston, September 24.—The frightful accident last Wednesday on the Boston and Northern Street Railway Company's system at Melrose, about eight miles out from Boston, killed nine persons outright, including the motorman, and wounded more or less seriously 22 others, 17 of whom were taken to hospitals or physicians' offices for treatment. The car that was wrecked was en route for Reading, and struck a 50-pound box of dynamite which had dropped from an express wagon, the ensuing explosion being of terrific force. The motorman was hurled about 100 yards forward; the car was splintered, and one woman, who lives in spite of her remarkable experience, was blown into the air with the unroofing of a portion of the car, grasped the trolley wire, and dropped therefrom, burned and bruised, back upon the debris. Windows of buildings within a radius of 200 yards were broken, and fronts of nearby structures were wrecked, while many narrow escapes from serious injury to the residents were reported.

The directors of the West End Street Railway Company, which is under lease to the Boston Elevated Street Railway Company, have sold the issue of $750,000 four per cent. bonds, recently authorized, to Blodget, Merritt & Co., a Boston banking house. They will mature in 1932, and bear date of August 1, 1902, being designed to reimburse the elevated company for expenditures made from April 1, 1902, to April 1, 1904.

At the meeting of American Telephone and Telegraph Company directors on September 21st, William Lowell Putnam of Boston was elected as the successor on the board of directors of Thomas B. Bailey, who recently resigned. A quarterly dividend of 1½ per cent. was declared.

Worcester Polytechnic Institute at Worcester, Mass., opened on September 15th with an enrollment 15 per cent. larger than in any previous year. There are seven post-graduate students in electrical engineering.

Eugene Gilman Ware of Brookline, age 56, well known in financial and railway circles, and receiving cashier of the Boston Elevated Street Railway Com-

pany, died on September 21st. He held the position of cashier for the West End Street Railway Company prior to its absorption by the elevated company and had been identified with street-railway interests for a quarter of a century. He was a native of Thetford, Vt. B.

Southeastern States.

Charlotte, N. C., September 24.—The City Council of Waynesboro, Ga., has advertised for bids for the new water and electric-light plant, which, it is expected, will be completed by January 1st.

The Hendersonville (N. C.) Light and Power Company is completing a new power plant on Big Hungry Creek, and the wires are being strung to the city. The power will be used for lighting purposes.

The High Point Interurban Traction Company has been granted a franchise in Greensboro, N. C. The company is obligated to start work in six months.

Engineer George E. Ladshaw of Spartanburg, S. C., has let contracts for the hydraulic and electrical machinery for an 11-mile transmission plant on Pigeon River, the power to be carried to Waynesville, N. C., to be used for lighting the town and for other purposes. The promoter of the enterprise is B. J. Sloan of Waynesville.

The town of Broxton, Ga., has granted a franchise to A. G. Garbutt for a local lighting system, to be in operation by the end of the year 1904. The city secures the lights at $70 a year.

The town of Westminster, S. C., is considering a plan to install an electric-light system.

The city of Cairo, Ga., will vote on October 20th on the question of issuing bonds for water and electric lights, it being proposed to put in a first-class plant. L.

West Virginia and Kentucky.

Lexington, Ky., September 24.—Judge Mat Walton, representing the creditors of the Blue Grass Traction Company, has filed a motion in the Circuit Court asking that a receiver be appointed for the company. He gave notice some time ago that the action would be taken, but gave time for Senator George S. Davis to make arrangements for a settlement of the troubles, if possible. This, it seems, has not been done.

Plans have been filed by the Louisville and Southern Indiana Traction Company for the New Albany and Corydon Rapid Transit Electric Railway Company for a line that has been surveyed from New Albany to Franklin Township, Floyd County, Indiana, and thence to Corydon.

Rumors about Wheeling, W. Va., are to the effect that the Wheeling Traction Company will begin soon on an extension to Brilliant. Work has been commenced on the extension in the Ætna Standard addition. It may be that the Brilliant Line will be extended to Martins Ferry.

The City Council of Newport, Ky., is endeavoring to make an investigation of alleged damage to water pipes by electrolysis. The matter has been brought up several times in the past.

James F. Allen has received a contract for building the Monticello and Broad Oaks extension of the Fairmont and Clarksburg Traction Company of Fairmont, W. Va.

The Louisville and Southern Indiana Traction Company will build a passenger depot on Third Street, in Louisville. C.

Indiana.

Indianapolis, September 24.—The Merchants Heat and Light Company of Indianapolis is installing as an addition to its present plant two 1,200-horsepower Westinghouse turbine engines, together with two 750-kilowatt generators. A coal-conveyor system with bunker capacity of 500 tons will supply the four new Stirling boilers of 650 horsepower each, which, combined with the boilers now in use, will give a total capacity of 5,000 horsepower. The company will generate both direct and alternating current, having installed at the sub-station two 500-kilowatt rotaries arranged to convert and invert.

As a preliminary step to the building of an interurban electric railroad from Vincennes to Washington, passing through the towns of Wheatland, Montgomery, Cannelsburg and Loogootee, the Vincennes, Washington and Eastern Electric Railway Company has filed articles of incorporation with the secretary of state. The new company is capitalized at $1,000,000, in shares of $100 each. William H. Schott of Chicago is a director and the chief promoter of the line. The other directors are Austin F. Cabel, Hervey T. Trueblood, S. C. Eskridge, Frank E. Hakeman and A. J. Padgett, all of Washington.

The Indianapolis, Hartford City and Celina Traction Company, which recently filed articles of incorporation with the secretary of state at Indianapolis, expects to build an electric-railway line from Indianapolis to Celina, Ohio, by way of Alexandria and Hartford City, and asserts that construction work will begin October 1st. The road is to be run from Hartford City to Alexandria first. The company has opened offices in the Campbell Block, Hartford City, with J. P. McGeath of Hartford City, W. H. Maxwell of Boston, and C. Francis Knowlton.

The Union Electric Manufacturing Company of South Bend was recently incorporated with a capital of $5,000. The directors are Joseph Holstrom, James MacGregor, Donald MacGregor, Charles T. Wade and Edward B. Jackson.

The Huntington Light and Fuel Company has completed an enlargement of its plant, to meet the demands for the extension of electric-lighting service. The company has just received a franchise permitting it to charge a meter rate of 25 cents a thousand for natural gas instead of the stove rate in force 13 years.

Work on the new interurban line from Warsaw to Goshen, which is intended to go far toward completing the chain of electric railways from Benton Harbor to Cincinnati, will begin this week. Civil Engineer R. M. Murray is now on the ground and all the right-of-way has been secured. H. J. Heinz of Pittsburg is one of the capitalists interested and Indianapolis men are also in the company. H.

Texas and Mexico.

Austin, Texas, September 22.—M. M. Brice of the Southern Realty Development Company, with headquarters at Chicago, Ill., and George A. Hill, a street-railway promoter of Beaumont, Texas, have been investigating the situation at New Braunfels, Texas, with the object of building an electric railway from that place to Seguin.

The North Fort Worth City Council has granted the Northern Texas Traction Company a franchise to extend its lines over certain streets of that suburb.

The American Telephone and Telegraph Company is building two long-distance telephone lines from Joplin, Mo., to points in Northern Texas, where they will connect with the long-distance lines of the Southwestern Telegraph and Telephone Company. The new circuits pass through many of the principal towns of Oklahoma and Indian Territory.

The Albuquerque Electric Power Company has been organized at Albuquerque with a capital stock of $50,000. The incorporators are William L. Iliff, William B. Childers and Edward Callen.

The Indian Territory Traction Company is extending its electric line from Alderson to Hartshorne, I. T., a distance of nine miles. It is already in operation from South McAlester to Alderson, a distance of six miles.

Carlos Escobar, Nicolas Tortolers Vallejo and Oscar J. Braniff are the three bidders for the contract to furnish the city of Euliacan, Mexico, with electric light. The City Council has the bids under consideration.

It is stated that the street-railway line which runs from the City of Mexico to the Penon resort, and is now operated by animal traction is to be converted into electric traction by the Mexico City Tramways Company.

The work of constructing the new electric-light and power plant for the city of Campeche, Mexico, will soon be commenced by the Compania Campechana de Electric idad y Fuerza, which was recently organized with a capital stock of $150,000. The company has a contract to supply that city with 60 arc and 300 incandescent lamps, for which a yearly rental of $18,500 will be paid. It is also expected that about 1,500 incandescent lamps will be provided for private parties. Harry H. Hinkle is manager.

An electric power plant has been installed at the San Francisco del Oro mine, situated in the Santa Barbara district of Mexico. It is capable of developing 100 horsepower.

The Guanajuato Electric Light and Power Company, which established a large electric power plant on the Duero River, near Zamora, state of Michoacan, Mexico, several months ago, has in operation long-distance transmission lines to Guanajuato and other places, and is preparing to build other transmission lines to the towns of La Barca, state of Jalisco, and to Celaya, state of Guanajuato. The transmission line which this company is building to the city of Leon is about one-half completed. The company is now supplying about one-half of its actual capacity of 6,400 horsepower. Of this amount, between 1,700 and 1,800 horsepower are used in Guanajuato, and the remainder in the city of Irapuato and that section.

An electric-light and power plant is being installed at San Martin, Texmelucan, Mexico, by Francisco M. Conde.

An American syndicate, composed principally of Chicago capitalists, and represented in Mexico by ex-Governor William T. Thornton of New Mexico, has applied to the government of the state of Jalisco, Mexico, for a concession to establish a complete system of electric street railway in the city of Guadalajara. The syndicate, through Mr. Thornton, has offered to pay into the state treasury $400,000, Mexican money, in eight annual installments of $50,000 each for the franchise.

It is stated that the Catholic Bank of the City of Mexico will finance the building of the proposed electric railway between Guadalajara and Morelia, Mexico. J. N. Zermeno, an attorney of the City of Mexico, has been active in arranging the preliminary details for the enterprise. The plans of the Mexican syndicate, which is organized under the name of the Guadalajara and Morelia Railroad Company, contemplate the construction of the road from a point on the south side of Guadalajara to the town of Chapala, a distance of 50 kilometers. From Chapala it is proposed to run a line of steamers across the lake to the town of La Palma, to connect with the Michoacan division of the road, and thus avoid the difficulties of construction which appear in the mountain ranges on the south and west of Laka Chapala. From La Palma to Morelia the railroad will be 350 kilometers in length, and will run through a productive and thickly settled region. Electric power for the proposed road will be obtained from the Compania Industrial de Guadalajara and the Guanajuato Electric Light and Power Company.

The concessions owned by Leon Pegot and Manuel and Miguel Quenedo for utilizing the waters of the Santiago River near Tolotlan, Mexico, for the purpose of generating electric power have been consolidated, and it is stated that active steps are in progress looking to the establishment of the proposed electric plant. It is proposed to transmit the electrical energy to the cities of Guadalajara and Aguascalientes.

The Mexican government has granted a concession to Guillermo Vega for the construction of hydraulic works on the Baluarte or Rosario Rivers, in the state of Sinaloa, Mexico. Mr. Vega proposes to establish a large electric power plant, and the waters of one of these rivers will be used to operate it. Under the terms of the concession, the construction of the proposed plant must be commenced within six months from September 9, 1904, and it must be completed within seven years from that date. Mr. Vega has deposited $5,000 in the National Bank of Mexico, as a guaranty to the government that the terms of the concession will be complied with.

Luis Ugarte of Guadalajara has made application to the Mexican government for a concession to establish an electric power plant on the Lerma River, near La Piedad, state of Michoacan, Mexico. He proposes to provide electric lights and power for the town of La Piedad and for industrial concerns of that district.

The Reforma line of the Mexico City Electric Tramways Company is to be extended to the Colonia station of the National railroad of Mexico in the City of Mexico.

An electric-light plant has been established at Real del Monte, Mexico. The state government of Hidalgo bore part of the expenses of installing the new plant. H.

Ohio.

Cleveland, September 24.—Attorney T. C. Willard of Cleveland has been appointed receiver for the Cleveland and Sharon Traction Company and the Warren, Cortland and Jefferson Traction Company, both properties being owned by the same persons. President C. S. Fenton of the Cleveland and Sharon was the plaintiff against that road and Francis B. Morgan against the other one. This step was taken as a protective measure, as some action was anticipated from others. The officers state that the companies are abundantly able to take care of themselves, but they do not care to be under the necessity of fighting a suit brought by enemies. The Cleveland and Sharon has a capital stock of $2,000,000 and has issued bonds to the amount of $1,000,000 and has authority to issue that much more. It was formed for the purpose of building a line from Middlefield to Sharon, Pa. The other company was formed to build a branch line.

Blue prints showing the proposed line of the Cleveland, Caton and Dover Electric Railway Company have been sent out to interested parties by J. V. Ward of Cleveland, who represents a number of English capitalists. The main line from Cleveland to Canal Dover will be about 86 miles long and from New Baltimore to Alliance a line 10 miles long will extend. Branch lines from Mantua to Warren, 23 miles; Sparta to Bayard, 18 miles; Oneida to Carrollton, 10 miles, and Zoar to Mineral City, three miles, are also proposed. The main line will pass through Newburg, Corlett, Randall, Solon, Geauga, Aurora, Mantua, Shulerville, Revenna, Rootstown, Randolph, New Baltimore, Hartville, Middlebranch, Oval City, Canton, North Industry, Howensten, Sparta, Sandville, Zoar and to Canal Dover.

People of Doylestown and Wadsworth have asked the Northern Ohio Traction and Light Company to extend its Barbeton line to those places, but it is doubtful whether any new work will be undertaken at the present time. Should business conditions be better the coming year, such an extension might be undertaken, as the territory is good and this is the logical direction for the enterprise.

It is said that the receiver for the Springfield and Xenia Traction Company will offer the property for sale again under the first appraisement, which some traction men consider too high.

Attorney Harry Probasco of Cincinnati was refused a writ of mandamus before the Circuit Court at Canton a few days ago requiring that Judge Dissette of Cleveland should vacate a recent order prohibiting Referee Fuller from taking further testimony in the Miami and Erie Canal Transportation case. Probasco has been attempting to have Governor Herrick and a number of business men over the state brought in as witnesses and has also tried to have brokers who have handled the stock brought on the witness stand. They refused to testify until ordered to do so by the court. It is said that the plan of reorganization is progressing as rapidly as could be expected, notwithstanding the knocking Probasco is giving the company and stockholders all the time.

Reports are current that a syndicate is being

formed to purchase the Columbus, Lima and Milwaukee steam railroad between Lima and Defiance, transform it into an electric road and extend it from Lima to Columbus.

The City Council of Columbus has appropriated $3,000 for the defense of the ordinance fixing the price of electric current. Solicitor Butler recognizes the difficulty of proving that the price fixed is sufficient to pay the cost and leave a fair price for the company.

After the expiration of the present contract with the Welsbach Street Lighting Company electric lights will be used on Bond Hill, Cincinnati.

Receiver George T. Bishop of the Eastern Ohio Traction Company has reported to the courts that he has accumulated sufficient funds to pay interest on the bonds due in May and also the instalment due in July.

The Williams Electric Machine Company of Akron has been incorporated with a capital stock of $100,000 by Harry A. Williams, J. F. Townsend and others.

Marcus Aaron has received a 25-year franchise for an electric railway on Newell Street, East Liverpool.

A. S. Wright will be president of the Toledo Interurban Traction Company. He is also president of the Toledo and Ann Arbor road, of which the Toledo line will be the southern extension.

Fairfield county commissioners have granted an extension of two years to the Lancaster and Newark Traction Company to build its line. The original time expired on July 1st

The Marion-Bucyrus Railway and Light Company of Bucyrus has been incorporated with a capital stock of $250,000 to build a line between the points named. Ellis Bartholomew, G. K. Canfield, Charles B. Shelby and others are interested.

A company is being formed at Kenton to manufacture a lighting outfit invented by L. G. Wolley.

An order has been issued by the Cleveland Board of Public Service that all companies owning telephone, telegraph or street-railway lines place the company's name on all poles along the curb.

The Columbus people interested in the new express company for interurban lines has not made any overtures to the Cleveland roads yet and may not at this time, owing to the fact that a successful express business is already being done over them.

O. M. C.

Northwestern States.

Minneapolis, September 24.—The Council of Sioux Rapids, Iowa, has contracted to purchase the electric-light plant and will completely remodel it.

Hill & Johnson will put in an electric-lighting plant at Earlham, Iowa.

The heating and lighting system at Grinnell, Iowa, is to be thoroughly remodeled and considerable new machinery will be installed.

McArthur Bros. & Co. of Chicago have received the contract for constructing the light and power plant for the Manistique (Mich.) Light and Power Company. About $50,000 will be expended and 1,000 horsepower developed. The company has incorporated with a capital of $50,000.

The Shenandoah (Iowa) electric-light plant has been sold to the Artificial Ice Company of that city.

The Chicago and Northwestern Railway Company will put in a new electric-light plant at Baraboo, Wis., for furnishing light for its shops, roundhouse and offices.

The Interurban Railway Company of Des Moines, Iowa, has awarded the contract for 4,000 tons of steel rails and for 72,000 ties, the former to the Cambria Steel Works and the tie contract to the T. J. Moss Tie Company of St. Louis.

The Oshkosh (Wis.) Electric Light and Power Company is installing a steam turbine at its plant. It is a 500-kilowatt machine and will develop 700 horsepower. The cost of the improvements will be about $30,000.

A. F. Guenther, owner of the electric-light plant at Mondovi, Wis., has filed a petition in bankruptcy, placing his liabilities at $3,240 and assets at $2,750.

The Oshkosh (Wis.) and Western Electric Railway Company has filed articles of incorporation. It proposes to build a line from Oshkosh to Omro and Berlin. Joseph H. Porter heads the list of incorporators.

The City Council at Lincoln, Neb., has accepted plans for a new municipal-lighting plant to be erected at a cost of $82,000. Bids will be received until October 18th.

R.

Rocky Mountain States.

Salt Lake City, September 22. The Comstock Pumping Association, composed of 31 mining companies of Nevada, has agreed to a contract with the Truckee River Electric Company for the erection of a new power plant on the Truckee River to furnish power for the Comstock mines. The new plant will cost $200,000.

The final contracts between C. M. Clark and parties comprising the Globe Power Company have been signed in Los Angeles by which Mr. Clark conveys to the power company all water rights, rights-of-way, franchises, etc This will result in the speedy erection of the largest electric-power plant in Arizona, the capacity to be 5,000 horsepower. The construction will consist in part of a 30-foot concrete diversion dam in Salt River below the mouth of Cherry Creek. A tunnel will be constructed which will be 7,015 feet long, 10 feet high and 13 feet wide. A pipe line will cross the river and convey water to a canal about one mile above Pinal Creek, where a power house will be built.

A.

Pacific Slope.

San Francisco, September 22.—C. W. Buker, a dealer in electric supplies at San Diego, Cal., is in San Francisco this week.

M. V. McQuigg, who is interested in the electric-lighting and power business at Monterey, Cal., is in San Francisco on business.

The Pierce Electric Company of San Francisco has removed its offices from 206 to 289 Post Street.

The Lane County Electric Light Company is preparing to install lights in Springfield, Ore. Poles are now being placed.

Work has been commenced on the construction of a $50,000 auxiliary transforming station on the water front at Eureka, Cal., between X and Y Streets. The Humboldt Construction Company has secured the contract for the foundations.

The Willamette Valley Electric Railway Company has begun surveying for its line in Oregon. T. W. Archer of Eugene, Ore., will have charge of the work.

The California Electrical Works is to do the electrical work in the Union Trust Company's addition to the old building on Montgomery Street, the cost to be $5,070.

The Van Emon Company, 52 and 54 Natoma Street, is to install the large electric elevators in the new furniture store of Jos. Fredericks & Co. at 50 Ellis Street.

It is rumored that parties have secured a private right-of-way for an electric railroad from a point between Palo Alto and Mayfield to San Jose, Cal. The line will be direct to Sunnyvale and from there will curve through Cupertino to San Jose. W. F. Hanrahan is promoting the project. This is a separate proposition from the O. A. Hale line skirting the foothills further west.

The Power, Transit and Light Company will begin at once the construction of an additional electric line through Bakersfield, Cal., to the sub-station. The extra line will be connected with the pumping plants.

The trustees of Black Diamond, Cal., are looking into the legality of issuing bonds to pay for putting in a municipal electric-light plant.

The council of Milton, Ore., has advertised for bids for laying 1,700 feet of barrel flume and for a waterwheel for the electric-light plant at that place.

Application has been made to the City Council of Corvallis, Ore., by the Willamette Valley Railway Company for a franchise for its lines through the streets of Corvallis and for the privilege of maintaining poles and other appliances for supplying electric power for commercial purposes.

The H. G. Lacey Company is preparing to invest about $10,000 in the improvement and extension of the electric-light and power service in Hanford, Cal., during the next three months.

A.

PERSONAL.

Employes of the Pennsylvania and Mahoning Valley railway at Youngstown, Ohio, presented W. C. Smith, who recently resigned as general manager, a fine diamond stud.

Arthur W. Brady has been elected president of the Indiana Union and Indianapolis Northern Traction Companies, to succeed George F. McCulloch, who was elected chairman of the board of directors of each company. W. C. Sampson, assistant treasurer, was elected secretary, to succeed Mr. Brady.

Carl Wiler, one of the foremost engineers of arc lighting and power work of the Western Electric Company, Chicago, sailed on September 20th for Königsberg, Germany. Mr. Wiler expects to return on the steamship Deutschland about October 20th and will bring with him a wife from his native country. His many friends in Chicago join in hearty congratulations.

The numerous friends of Dr. F. A. C. Perrine will be interested to know that this gentleman will have opened on the date of this issue an office as consulting electrical engineer at 49 Wall Street in New York city. Dr. Perrine's reputation as an electrical engineer who has made high-tension work a specialty will without doubt redound greatly to his credit now that he has entered the field as an independent electrical engineer.

ELECTRIC LIGHTING.

The city of Danville, Ky., has granted a franchise for an electric-light plant to Frank T. Snider of St. Louis.

The Diamond Ice Company of Seattle, Wash., has applied for a franchise for the extension of its electric-lighting and steam-heating privileges.

A franchise has been granted to J. L. Sales & Co. of Dallas, Texas, by the city of Stroud, Okla., for the construction of an electric-light plant.

The Arkansas City (Kan.) Electric Light Company's plant has been destroyed by fire. The loss was $50,000, with insurance of $3,300. The plant was destroyed by fire about four years ago and rebuilt. The rebuilding of the plant will be begun again at once.

The people of Dallastown, near York, Pa., will vote at the next election whether to increase the taxation so as to have a system of electric lights for street illumination.

The Commercial Club of Lindsborg, Kan., has appointed a committee to look up a proposition for electric lights for the city. It expects to have the plant under headway within a short time.

The Waupaca Electric Light and Railway Company of Waupaca, Wis., has substituted for its open direct-current arc lamps the enclosed series alternating-current arc lamps manufactured by the G. I. Company, and the streets of Waupaca are now lighted with these lamps. The appearance is certainly much improved, and the people of the city as a general thing are well pleased with the change. The Waupaca company has a 10-year contract for street lighting and has recently purchased and is about to install a new 100-kilowatt alternator from the shops of the Fort Wayne Electrical Works, Fort Wayne, Ind.

ELECTRIC RAILWAYS.

The Great Falls and Old Dominion Electric Railway Company of Washington, D. C., will erect a new power house, car sheds and make other improvements at Rosslyn, Va.

It is stated in Colorado Springs dispatches that the Continental Gold Mining Company has been incorporated and will build an electric road from Buena Vista to its mines.

Bernard Corrigan, president of the Metropolitan Street Railway Company of Kansas City, Mo., says the Swope Park line will be built this fall, and that the Summit Street cable line will begin operating electric cars on October 1st.

The Oklahoma City, Lexington and Sulphur Springs electric railway has been granted a 99-year franchise to operate cars on the streets of Sulphur, I. T. The Commercial Club has pledged $6,000 to the road as soon as it is built.

New interests are reported to have acquired control of the Chicago and South Shore electric railway. O. D. Mallory of Batavia, Ill., has been elected president, R. L. Henry of Chicago, vice-president, and A. M. Hews of Chicago, secretary.

The New York, New Haven and Hartford railroad is dismantling its third-rail electric line between Nantasket Junction and Braintree, Mass. This dashes the hopes of tens of thousands of Boston's suburbanites, who have been expecting electric transit.

The Laporte and Michigan City Traction Company of Laporte, Ind., with a capital of $400,000, has been incorporated and the following gentlemen were elected directors: Albert D. Mallory, Robert L. Henry, Thomas W. Spence, Isadore I. Spire and Alanson M. Howes, all of Laporte.

It is reported that the contract for the construction of the Scranton, Factoryville and Tunkhannock electric railway has been let and work will commence at once. The road will be 30 miles in length and connect several good Pennsylvania towns. The contract price for the work is $950,000.

The financiers of the Missouri Central railway say that the experimental part of the line has been passed and that they will put in $60,000, and, with $40,000 Missouri capital, the line will be built. Power houses have been decided upon at Higginsville, 55 miles east of Kansas City, one at Marshall and one at Glasco.

Work on the Aurora, De Kalb and Rockford Electric Traction Company's line between Aurora and De Kalb, Ill., has been begun by William C. Ross & Co. of Chicago. Three hundred men were put to work and construction started at each end of the 29-mile section. It is expected the road will be in operation by December 1st.

The New York State Board of Railroad Commissioners has thrown out the application of the Elmira and Corning Short Line electric railroad. The company, however, has purchased the Painted Post and Corning trolley line and will extend the Painted Post line to Elmira, being able to do this without the permission of the board.

The statement of the Metropolitan Elevated Railroad Company of Chicago filed with the Railroad and Warehouse Commission for the year ended on June 30, 1904, shows but small changes compared with the previous year. The surplus for the year was equal to 3.28 per cent. on the preferred stock. The whole number of passengers carried during the year was 41,817,227, being a daily average of 114,254. The total earnings were $2,169,211 and the total operating expenses $1,020,280.

PUBLICATIONS.

The Central Electric Company of Chicago in its recent catalogue, No. 22, has even surpassed its own high-class advertising literature. The catalogue is nine by 12 inches and contains 80 pages. It is devoted to lighting fixtures, and many electroliers, combination chandeliers, pendants, brackets, etc., are

illustrated. Besides all the various hanging fixtures there are many different styles of desk reflectors, table lamps and globes and reflectors of various types. The catalogue is very complete and the illustrations are sumptuous.

What is probably the largest hanger ever issued by an electrical company is one now being sent out by the Cutler-Hammer Manufacturing Company of Milwaukee. It is 38 by 50 inches, and on it is illustrated some of the standard and also some of the special apparatus made by that concern. It is arranged by bulletin numbers and in consequence will be of great value for ready reference.

SPACE TELEGRAPHY.

George Hanscom, master electrician at the government naval station, Mare Island, has gone to the Farallone Islands to establish a space-telegraph station.

The international wireless-telegraph conference, summoned at the initiative of Germany, which was to have met October 4th, has been postponed at the request of France and Great Britain, which countries desire more time to study the questions involved.

TELEGRAPH.

President Louis De Goll of the Rowland Telegraphic Company announces that the company will immediately begin the equipment of extensive shops for the manufacture of the Rowland multiplex-telegraph machine.

The Western Union Telegraph Company reports that the net revenue for the quarter ended June 30th amounted to $1,802,791.03. The surplus on April 1st was $14,588,205.04. A 1¼-per cent. dividend, amounting to $1,217,018.75, was paid on July 15th, and the interest on the bonded debt amounted to $292,559, leaving a surplus on July 1st of $14,881,428.28.

The Union Pacific railway has arranged to supply a telegraphic news service to passengers on the overland limited twice each day. Bulletins of the most interesting events in this and foreign countries are to be sent out from Omaha at noon and at 4:30 o'clock p. m., and these dispatches will be posted in the observation cars. Two eastbound trains and two westbound trains, each 24 hours apart, will be supplied with the service at the same time.

MISCELLANEOUS.

A congress to discuss X-ray methods will meet in Berlin April 30, 1905. Professor Roentgen will be the guest of honor of the congress, which marks the tenth anniversary of the publication of his discovery.

Thomas A. Edison has, it is said, completed his experiments on a method for converting straw into a serviceable fuel, and he has also demonstrated, according to the account, that the process is commercially profitable.

A company of New York financiers, headed by J. Coleman Drayton, has about decided to build an experimental monorail road from Baltimore, Md., to Ellicott City. It is said that trains can be run at the rate of 100 miles an hour. The road is to be completed in two months.

The production of magnetic alloys from non-magnetic metals is a matter of recent successful experimentation, particularly with respect to the production of manganese steel. With the same manganese that obtained a practically non-magnetic iron alloy a magnetic copper alloy may be produced. The non-magnetic metals, copper, aluminum, and manganese, combined in certain proportions, produce an alloy having considerable magnetic properties. No combination of copper and aluminum produces a magnetic alloy; hence the presence of magnetic properties must be ascribed to the manganese. The manganese was submitted to the temperature of liquid air, but no change was found to occur, the metal remaining non-magnetic. This was found to be the case with the copper and aluminum.

Chief Engineer Wallace of the Panama Canal, who arrived in New York last week, is said to be here for the purpose of employing four or five engineers of the $10,000-a-year class. Mr. Wallace has also been commissioned to open bids for pipe lines and waterworks in Panama and Colon.

TRADE NEWS.

The capital of the Manhattan Electrical Supply Company of Jersey City, N. J., has been decreased from $1,000,000 to $750,000.

A special election will be held in LaGrange, Ga., for the issuance of $40,000 in bonds, $25,000 of which will be used for the equipment of an electric-light plant.

Norman McMillan, J. E. Wesley and Buella McMillan, all of Buffalo, have incorporated the Buffalo Lighting Company, with a capital of $30,000. They will sell electric lamps and gas burners.

The City Council of Waynesboro, Ga., has let the franchise for new electric lights in Waynesboro, an election has been called and as soon as these preliminaries are completed work will be commenced.

Contracts have been signed with a Pittsburg firm for the building and equipping of a power house at Elkhart, Wis., for an interurban line which will connect that village with Plymouth and Chilton and later with points along the lake shore.

C. S. Holloway, superintendent of public works at Honolulu, T. H., is advertising for bids for furnishing the government with a 200-kilowatt alternating-current generator with transformers, arc lamps, switchboards, arresters, waterwheel and pole and line material.

One of the features of the B. F. Sturtevant Company's new office building at Hyde Park, Mass., is the lunchroom located in the basement of the building. Arrangements were first made with a caterer to furnish lunches, but the desire for home lunches became so prevalent that the company now hires the help and furnishes lunches at cost.

The Canadian Westinghouse Company of Hamilton, Canada, has opened offices in Winnipeg, Man. The offices are located in the Union Bank Building. The representative in charge of the district covered by this office is Mr. W. E. Skinner, who was formerly associated with the Westinghouse Electric and Manufacturing Company of Pittsburg, Pa.

A test was recently made upon a Reeves simple engine manufactured by the Reeves Engine Company of Trenton, N. J., at Sibley College, Cornell University. The test shows some satisfactory results. Two series of runs were made, the one non-condensing, the other condensing. For the former the air cock on the condenser was left open, thus insuring condensation under atmospheric pressure, for the latter this was closed, and the runs were made under a vacuum as high as could be obtained. This was found to be about 23.5 inches. For each series a number of runs were made, varying from friction load to approximately 25 per cent. overload. The duration of these runs varied from one to two hours each, depending upon the constancy of the various observations. A Prony brake was use and indicator cards were taken every 10 minutes. The tests showed the minimum pounds of dry steam per indicated horsepower per hour to be 26 pounds at about 130 indicated horsepower for the condensing runs and about 28 pounds for the non-condensing runs. The dry-steam consumption per developed horsepower per hour at the best point was 27 pounds at 130 developed horsepower condensing, and about 31.9 pounds non-condensing. The relation between mechanical efficiency and developed horsepower were excellent, the highest on the non-condensing runs being 92.5 per cent. at 147.1 developed horsepower and for the condensing runs 95.8 at 154.1 developed horsepower.

For several weeks past prices in copper have been remarkably steady and a fair demand has held electrolytic wire bars at 12⅝ cents a pound. Domestic consumption is now taking a good share of the output. Copper cannot go on a permanently higher basis, however, until the demand increases greatly in the United States. The extremely heavy exports of copper are a subject of wonder, for they reveal remarkable activity abroad.

Sealed proposals will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until October 25th for the construction, including plumbing, heating and ventilating, gas piping and electric wiring and conduits, of the postoffice and courthouse at Huntington, W. Va. Drawings and specifications may be had of the supervising architect or at the office of the postmaster at Huntington. Also, in like manner, until October 26th, for the construction, including plumbing, heating apparatus, electric conduits and wiring, of the postoffice at Rock Hill, S. C.

BUSINESS.

A. P. Munning, sales manager for the Cutler-Hammer Manufacturing Company of Milwaukee, has been spending several weeks in the West in the interests of his company.

Suits have been commenced by the General Electric Company for infringement of patents relating to processes of exhausting incandescent electric lamps against George Campbell, trading under the name of the Germania Electric Lamp Company and James McLaren, trading under the name and style of Standard Incandescent Lamp Company.

The Speer Carbon Company of St. Marys, Pa., manufacturer of the Speer high-grade carbon brush, announces that this company's headquarters during the street-railway convention at St. Louis will be at the Inside Inn from October 10th to 15th, where officials of the company will be pleased to meet their friends and anyone interested in carbon brushes.

The Electric Appliance Company of Chicago and San Francisco reports that its Zenith type of lamp has passed the novelty stage and is now a full-fledged lamp of commerce. A lamp of this description was a long time coming, and now that it has come the demand for it is great. It is so adequately "the thing," the company says, that its usefulness is beyond question.

The American Conduit Company, Chicago, has been awarded a contract by the electrical commssion of Baltimore to furnish that city with 200,000 feet of bituminized fiber conduit. This contract was awarded after a series of exhaustive tests and investigations and thus forms another important link in the strong chain of evidence favorable to bituminized fiber conduit for underground construction.

The American Electric Telephone Company of Chicago has just received an order for the building of a combination long-distance and rural-line switchboard to be installed at Hopkinsville, Ky., by the Ideal Construction Company of Lima, Ohio. This order is regarded as an important one from an engineering standpoint, owing to the special requirements which it is necessary to meet. For this switchboard must be provided with means for trunking to and from both the Strowger exchange and the Globe automatic exchange. At the same time service must be given on the American company's system of selective party lines. Thus, it will be observed, that the trunking and cord-circuit arrangement must be such as to permit of interconnection between magneto bridging lines, party-line selective, Globe automatic and Strowger automatic lines.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued (United States Patent Office) September 20 1904

770,265. Railway Switch and Interlocking Apparatus. Clyde J. Coleman, New York, N. Y., assignor to the Hall Signal Company. Application filed October 2, 1902.

Pneumatic means operate the interlocking mechanism, electromagnets being used to control the air valves.

770,268. Telephone-exchange System. William M. Davis, Chicago, Ill., assignor to the Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y. Application filed December 2, 1901.

Sub-station apparatus, a source of current and a relay are each connected in an independent bridge of the telephone line, the resistance of the relay being high and the resistance of the sub-station apparatus being comparatively low.

770,269. Telephone-exchange System. William M. Davis, Chicago, Ill., assignor to the Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y. Application filed May 20, 1903.

An impedance winding is permanently serially included in one of the line limbs and a line relay has a winding permanently serially included in the other line limb. A line signal is normally controlled by the line relay, while a cord connects one line with another.

770,277. Secondary Battery. Lothar Fiedler, Stoke Newington, England. Application filed June 28, 1904.

A secondary battery is composed of superposed cells, each of which consists of a horizontally placed layer of zinc amalgam serving as one electrode and a tray made with shelving sides and composed of lead. The zinc amalgam forms an inside bottom to the lead tray and is in metallic connection therewith. An insulating support rests on the layer of zinc amalgam, an electrolyte occupies the interstices of the insulating support and a second electrode composed of lead peroxid is metallically connected with the lead tray above.

770,278. Insulation Rack. John R. Fletcher, Dayton, Ohio. Application filed May 14, 1904.

A rack for supporting a number of sets of split insulations is described.

770,296. Telephonic Relay. Isidor Kitsee, Philadelphia, Pa., assignor to the Keystone State Telephone and Telegraph Company, Philadelphia, Pa. Application filed January 8, 1903.

Electromagnetic coils are included in a transmitting-line circuit and provided with opposed cores. A polarized armature is interposed between the proximate ends of the cores. Microphonic material electrically connects the armature to the cores, and local circuits include the primary of an induction coil and a source of current connected to the cores and armature. The secondary of the induction coil is included in a receiving-line circuit. (See cut on next page.)

770,303. Electrical Conduit. James B. McGinley, Allegheny, Pa. Application filed March 19, 1903.

Conduit for electrical conductors is composed of sections of sheet metal, each section consisting of a single sheet and comprising a central web and integral circular side portions. The central web is formed with inwardly bent edges and the edges of the circular side portions meet the edges of the web upon the outer side. The central web is disposed tangentially to the circular side portions.

770,312. Compensating Terminal for Electric Furnaces. Henry N. Potter, New Rochelle, N. Y., assignor to George Westinghouse, Pittsburg, Pa. Application filed August 6, 1903.

A terminal for electric-resistance furnaces consists of a body of carbon and a metal contact, shaped to conform to the carbon body and clamped against the body by a

bolt. The contact is composed of a metal having a higher thermic expansion coefficient than that of the metal composing the bolt.

770,322. Electric Clock. Herbert Scott, Bradford, England. Application filed September 17, 1902.

770,323. Electric Clock. Herbert Scott, Bradford, England. Application filed May 4, 1903.

An oscillating device controlling the movement of the clock is propelled by electrical means.

770,342. Insulated Joint. George A. Weber and Percy Holbrook, New York, N. Y., assignors to the Weber Railway Joint Manufacturing Company, New York, N. Y. Application filed November 13, 1903.

Insulating material is placed between the rail proper and the supporting base or shoe to which it is bolted by bolts passing through insulating openings.

770,358. Cell for Storage Batteries. Pietro Figuecia, Boston, Mass., assignor of one-half to Louis M. Rossi, Boston, Mass. Application filed February 19, 1904.

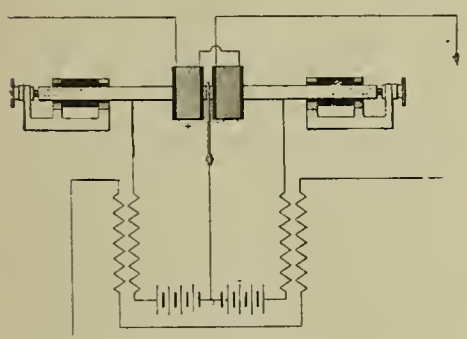
A battery cell contains one or more partitions of non-conducting material extending from side to side of the cell and down to the bottom to divide the cell into compartments. A positive and a negative electrode is placed in each compartment and a freely-removable separator is located between each pair of the electrodes.

770,368. Surgical Instrument. Albert C. Heath, St. Paul, Minn. Application filed May 9, 1904.

An otoscope comprises a casing formed of metallic extremities and an intermediate non-conducting body portion. A tube or conduit has its end contacting with the extremities of the casing, whereby the tube is brought into electric circuit with the extremities.

770,373. Electric Arc Lamp. George M. Lane, Asbury Park, N. J., assignor of three-fourths to Joseph Ackerman, James D. Carton and Benjamin Albertson, Asbury Park, N. J. Application filed November 21, 1901.

The principal features of the lamp are an armature or core of the controlling-electromagnets, the movable carbon, clutch-levers pivoted near their inner ends, vibrating levers pivoted intermediate of their ends and having their inner ends connected to each other and to the armature for movement therewith, and means connecting the outer ends of the vibrating levers with the corresponding ends of the clutch-levers.



NO. 770,296.—TELEPHONE RELAY.

770,377. Register and Alarm Mechanism for Telephone Toll Apparatus. George A. Long, Hartford, Conn., assignor to the Gray Telephone Pay Station Company, Hartford, Conn. Application filed November 8, 1902.

A bodily removable signaling and registering device is adapted to be secured to the front of the telephone adjacent to the incoming wires.

770,378. Switch-operating Mechanism for Electric Motors. James A. Mehrten and John H. Howard, Exeter, Cal. Application filed October 6, 1903.

An energized circuit includes a motor and switch and a pump having operative connection with the motor. A switch-operating mechanism controlled by a governor co-operates with a means operable continuously by the fluid issuing from the pump during all the time the pump is in operation and connected to the governor.

770,405. Starting Box for Motors. James F. Tracy, Sheridanville, Pa., assignor of one-half to William H. McFadden, Pittsburg, Pa. Application filed May 4, 1904.

Included in a starting-box for shunt-wound motors having a series of knobs or surfaces is a bar pivotally mounted in the plane of the knobs and a contact spring or plate movable along the bar. An electromagnet holds the bar in such position that the spring or plate will in its movement contact with the knobs.

770,424. Switch or Ringing Key for Telephone Switchboards. Lars M. Ericsson, Stockholm, Sweden, assignor to Aktieholaget, L. M. Ericsson & Co., Stockholm, Sweden. Application filed June 18, 1902.

In combination with a ringing key for switchboards are a lever arm, a series of fingers and springs with which the fingers contact. One of the fingers has an extension, a spring returning the lever arm to normal position.

770,431. Interrupter. Thomas B. Kinraide, Jamaica Plain, Mass. Application filed April 6, 1904.

An interrupter comprises separable contacts with means tending to maintain them closed. A striker momentarily separates them.

770,432. High-potential Induction Coil. Thomas B. Kinraide, Boston, Mass. Application filed May 25, 1904.

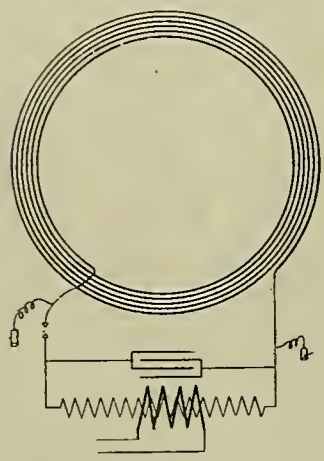
The induction coil secondary is composed of over-lapping sections successively shorter as they recede from the primary.

770,433. Thermal Inductor. Thomas B. Kinraide, Boston, Mass. Application filed May 25, 1904.

A source of high-frequency current includes in its circuit a condenser of small capacity, and a coil in series consisting of few turns of large diameter and extremely low self-inductive resistance. (See cut.)

770,456. Electromechanical Switch Mechanism. James A. Duffy and Oscar Irwin, Pittsburg, Pa., assignors of six-tenths to Charles D. Armstrong, Pittsburg, Pa. Application filed December 23, 1903.

Automatic switch-reversing mechanism contains a rocking switch having two hooked bars, latches arranged to guide the movements of the heads of the bars, a rocking lifter arranged to alternately engage the hooks of the bars, and an electromagnet connected to the lifter.



NO. 770,433.—THERMAL INDUCTOR.

770,472. Rheostat. John Nelson, Peru, Ill. Application filed July 5, 1904.

Combined with a series of coils of a given resistance connected with a series of contact members is a second series of coils of less resistance connected with a second series of contact members. A slide connected with the contact members, connections joining the free ends of appropriate coils of each series, and means for short-circuiting either series of coils, complete the apparatus.

770,489. Electric Arc Lamp. Louis Wolff, Berlin, Germany. Application filed November 25, 1903.

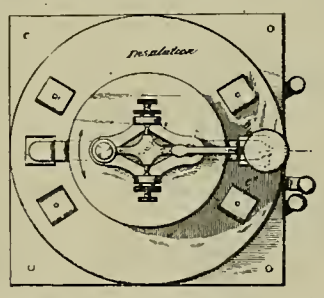
Associated with a stationary supporting frame having a vertical guide pillar is a plate slidable on the pillar, a hollow core being secured to the plate. An adjustable guide tube for a carbon is connected to the core and provided with an opening near one end thereof. A supporting catch for the carbon, pivotally connected with the guide tube, projects through its opening.

770,505. Insulating Fixture Support. Adnah McMurtrie, New York, N. Y., assignor to Thomas & Betts, New York, N. Y. Application filed February 12, 1904.

Details are described.

770,541. Contact-breaker. John B. Schug, Detroit, Mich. Application filed May 31, 1904.

Mechanical parts are described, consisting primarily of a vibratory member operating between contact points.



NO. 770,628.—INTERCHANGEABLE TELEGRAPH KEY.

770,556. Single-wire Selective Signaling and Intercommunicating Telephone. John A. Brown, Blythewood, S. C. Application filed October 28, 1903.

Telephone stations having suitable transmitters, receivers and call bells, the receivers and transmitters of each station being normally cut out of the line, are provided with means in each station for calling a predetermined station, a device for short-circuiting the receivers and transmitters in each station adapted to be operated by the calling means, and a short-circuiting device in each station for cutting into the line the receivers and transmitters of the stations in communication.

770,569. Railroad Safety Signal Device. Bruneau Etienne, Providence, R. I. Application filed January 2, 1904.

Insulated conductor rails, divided into blocks, parallel the track rails of a steam road. A contactor on the locomotive follows the rail and is in circuit with means on the locomotive for shutting off steam and applying brakes when the rail is energized.

770,579. Magneto-generator. Herman Hess, Indianapolis, Ind., assignor to John A. Kurtz, Indianapolis, Ind. Application filed November 10, 1903.

In a magneto-generator are magnets, an armature journaled between the arms of the magnets and an inclosing non-magnetic casing surrounding the armature at its ends, the casing being cut away at its middle opposite active portions of the magnet.

770,628. Interchangeable Telegraphic Key. Walter C. Dean, Quitman, Ga., assignor to James H. Mathis and Dunham B. Price, Quitman, Ga. Application filed November 30, 1903.

An interchangeable telegraphic key comprises a base having on its upper face two series of circularly arranged and insulated contact-faces, the two series being disposed on opposite sides of the center. A turntable is pivotally mounted between them to rotate in a horizontal plane and carries a telegraphic key. A spring contact-plate mounted on one side of the turntable in permanent electrical connection with the key is adapted to bear upon any one of the circular series of contacts on one side, another spring contact-plate being mounted on the opposite side of the turntable and in electrical connection with the insulated anvil-pin of the key and adapted to bear upon any one of the circular series of contacts on that side. Short-circuits connecting the two series of contact in pairs and means for opening the short-circuit of any one of the pairs are provided. (See cut.)

770,631. Motor-controlling System. Arthur C. Eastwood, Cleveland, Ohio. Application filed June 10, 1904.

Included in the system is a series motor, means for reversing the motor, and means for automatically causing the energy of the moving parts of the motor to be absorbed before the reversing means act to change the direction of rotation of the motor. (See cut.)

770,656. Interlocking System for Railroads. Benton C. Rowell, Chicago, Ill., assignor to the Rowell Potter Safety Stop Company, Portland, Maine. Application filed January 9, 1902.

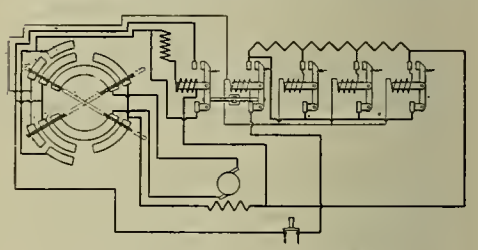
In an interlocking system, a locking slide is carried by a lever, a bolt locking the slide when the lever is reversed. An electromagnet disengages the bolt from the slide, and means for energizing that magnet under the joint control of the operator and a passing train are further provided.

770,657. Automatic Block System for Railways. Benton C. Rowell, Chicago, Ill., assignor to the Rowell Potter Safety Stop Company, Portland, Maine. Application filed March 14, 1902.

Train-circuits, each with its track instrument operated by a passing train are associated with shifting circuits for shifting the blocking appliances, and means by which one train-circuit automatically completes its shifting circuit, partially completes a second train circuit, and breaks itself; the second train circuit partially completes the first train circuit and also breaks itself.

770,660. Resistance Bar. Ralph Scott, Wilkesbarre, Pa. Application filed May 28, 1904.

A resistance-bar formed of non-metallic material and provided with spaced contacts, a slotted metallic bar arranged parallel with the resistance-bar, and a slidable contact carried by the slotted bar, are the prominent characteristics of the device.



NO. 770,631.—MOTOR-CONTROL SYSTEM.

770,665. Typewriting Machine. William W. Torrence, Montrose, Colo., assignor of one-half to Edwin S. Kassler, Denver, Colo. Application filed May 11, 1903.

Combined with a typewriter carriage are gearing and clutch mechanism, an electric motor, the clutch operating to connect the gearing to or disconnect it from the armature of the motor, and means for reversing the armature to release the gearing when the carriage shall have been returned by the motor to its normal position.

770,668. Wireless Telegraphy or Transmission Through Space. Alessandro Artom, Turin, Italy. Application filed January 3, 1903.

A method of directly producing electric waves consists in arranging discharge conductors to discharge in different directions and produce oscillatory discharges between the conductors.

770,717. Automatic Brake System. James J. Finney, Milwaukee, Wis. Application filed November 27, 1903.

Liquid under pressure from a pneumatic pump operates the brake system; an electric motor drives the pump.

EXPIRING PATENTS.

Following is a list of electrical patents (issued by the United States Patent Office) that expired on September 27, 1904:

370,421. Motor. P. M. Sharples, Westchester, Pa.
370,423. 370,424. Electric Lamps. J. J. Skinner, Boston, Mass.
370,434. System of Electrical Distribution. F. A. Wessel, Brooklyn, N. Y.
370,439. Electric Burglar Alarm. J. B. Yeakle and A. Steuart, Baltimore, Md.
370,477. Telephone. H. V. Hayes, Cambridge, Mass.
370,528. Electric Cable. F. Borel, Cortaillod, Switzerland.
370,572. Electric Arc Lamp. E. Thomson and E. Wilbur Rice, Jr., Lynn, Mass.
370,573. Regulating Device for Alternate-current Circuits. E. Thomson, Lynn, Mass.
370,575. Electric Speed Regulator for Revolving Motors F. Van Rysselberghe, Brussels, Belgium.
370,576. Repeater for Harmonic Telegraphs. F. Van Rysselberghe, Brussels, Belgium.
370,577. Phono-multiple Telegraphy. F. Van Rysselberghe, Brussels, Belgium.
370,605. Coupling for Electropneumatic-brake Systems. J. F. Carpenter, Berlin, Germany.
370,683. Apparatus for Use in Copying Telegraph Messages, and the Like. A. C. Carey, Boston, Mass.
370,691. Printing Telegraph. S. D. Field, New York, N. Y.

WESTERN ELECTRICIAN

EVERY SATURDAY

Vol. XXXV. CHICAGO, OCTOBER 8, 1904 No. 15

Street-railway Service in St. Louis.

St. Louis possesses, among other things of which its citizens are justly proud, an efficient street-car service. The cars run at frequent intervals and at good speed; overcrowding is uncommon; transfer privileges are liberal; the conductors and motormen are courteous and attentive to business; and all indications point to harmonious co-operation between the management and those who come in daily contact with the thousands who make use of the cars.

The principal street-railway company now operating in St. Louis is the St. Louis Transit Company, which was organized on March 6, 1899, to lease all the lines controlled by the United Railways Company, which corporation had received its charter the previous year. By a city ordinance of March 20, 1899, the St. Louis Transit Company is empowered to acquire, lease and operate for 40 years any of the lines acquired by the United Railways Company. This gave the Transit company almost a monopoly of the street-car business in St. Louis, the only competing company being the St. Louis and Suburban Railway Company.

At a meeting of the directors and large stockholders of the Transit and United Railways companies which was held September 27th a plan was, however, agreed upon for a reorganization of the finances of the former company. The plan has been under consideration for a year past and involves the practical elimination of the Transit company. Under it the United Railways Company will take over the management of the lines now composing the big system. Transit company stockholders will be allowed to exchange their shares for shares of the United Railways Company on the basis of five shares of the latter for two shares of United Railways common stock. Most of the latter is still in the company's treasury. No change, however, will take place in the operation of the system, and the officers of the company will continue to hold their respective positions. There was no friction in regard to the matter upon the board, and the steps were taken simply to relieve the financial situation.

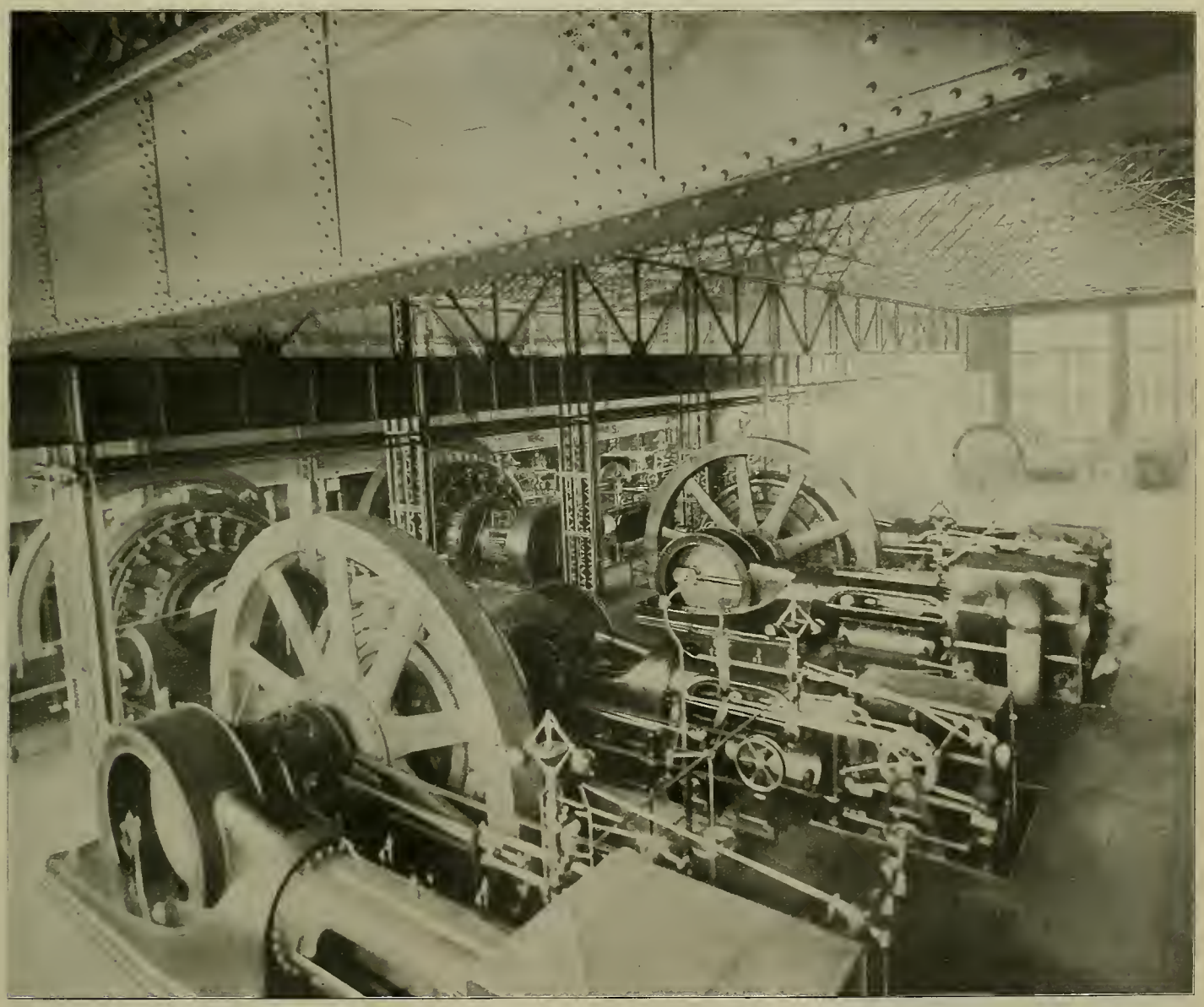


FIG. 1. STREET-RAILWAY SERVICE IN ST. LOUIS.—VIEW IN ENGINE ROOM OF CENTRAL STATION OF TRANSIT COMPANY.

Owing to a bend in the Mississippi River, the general conformation of the city, as shown by the map on the next page, is somewhat semicircular, the main business center being near the river and about midway between the northern and southern boundaries. The main trunk lines of the street-railway system traverse this central business district, numerous crosstown lines completing the network. The contour of the surface is rolling for the most part, and there are often grades of six or seven per cent. encountered.

Electric power for the Transit system is supplied from four generating plants in various parts of the city. The principal plant is known as the Central Station, and is located at Park and Vandeventer Avenues. Here are also located the offices of the company and the repair shops.

Central Station is divided into three distinct portions—the generator room (shown in Fig. 1), the south boiler plant and the north boiler plant. The total capacity of this station is 13,800 kilowatts, and the power is developed by nine units, some of which are shown in Fig. 1. In the foreground of this picture are shown the four large units, each consisting of a Westinghouse 2,250-kilowatt, direct-current generator direct-connected to a Porter-Allen cross-compound 36 and 70 by 60-inch engine running at 75 revolutions a minute. In the further left-hand corner of the room are two units of a type similar to those described, with the exception that the generator capacity of each is but 1,500 kilowatts, and the engines are 32 and 62 by 60 inches. The remaining three units consist of 600-kilowatt Westinghouse generators, direct-connected to Porter-Allen 20 and 40 by 30-inch tandem-compound non-condensing engines.

The engines of the larger sets run condensing. Two Worthington jet condensers are used, the cooling water being obtained by the use of 12 cooling towers, illustrated in Fig. 2. These cooling towers are 20 feet in diameter and 32 feet high. The fans for the towers are motor-driven, a shaft connecting the fans in each opposite pair of towers, and the shaft in turn being driven by a bipolar 500-volt motor located in a small brick house adjacent the towers. Thus there are six separate units in the cooling system, and any one or all may be operated when desired.

Coming now to the boiler installation, this consists, as before mentioned, of the south and the north plant. The former is made up of 14 Stirling boilers, arranged in two batteries—eight of 300

horsepower each and six of 375 horsepower each. The boilers are supplied with down-draft furnaces and three steel stacks seven feet six inches in diameter and 160 feet high. The pump room lies between this boiler and engine room. Feed water is obtained from six 500-foot wells, six feet in diameter, giving a total of 100,000 gallons in 24 hours.

The other boiler room of the Central Station contains 16 400-horsepower O'Brien water-tube boilers

MAP OF ST. LOUIS SHOWING STREET-RAILWAY LINES.

supplied with Green traveling-chain-grate stokers and Hoppes purifiers. One stack furnishes the draft for these boilers. This stack is 202 feet high and 14 feet inside diameter and rests upon a concrete block containing about 26,500 cubic feet of concrete. Coal for the Central Station and also for what is known as the Northern Station is switched in directly from the railroad tracks. The other two stations, however, which are known as the Cass Avenue and Geyer Avenue stations, are supplied with coal from Central Station. This coal is hauled in side-dump trolley cars carrying 25 tons each.

Perhaps the next station in importance to Central Station is the Northern Station, which is located near the river on the north side of the city. Its equipment consists of two 36 and 70 by 36-inch cross-compound Fulton-Corliss engines, direct-connected to 2,250-kilowatt General Electric railway generators running at 75 revolutions a minute, and two 28 and 56 by 60-inch engines of the same type, driving 1,200-kilowatt, three-phase, 25-cycle alternators. These alternators generate current at 6,600 volts and are the only alternators now operated in the system. They are used in connection with rotary-converter sub-stations, which will be mentioned later. The boiler plant contains 16 400-horsepower O'Brien water-

FIG. 2. WATER-COOLING TOWERS AT CENTRAL STATION OF ST. LOUIS TRANSIT COMPANY.

tube boilers equipped with Green traveling-chain-grate stokers, Surface condensers of the Wheeler pattern are used in this plant instead of jet condensers, as at Central Station; these work in conjunction with four cooling towers on the roof of the building.

Geyer Avenue Station, on the corner of Geyer and Jefferson Avenues, is of an older type. It contains several generating units, as follows: One 800-kilowatt General Electric generator, direct-connected to a 36 by 48-inch Allis engine; one 500-kilowatt Westinghouse generator, belted to a Hamilton-Corliss engine; one 1,500-kilowatt General Electric generator, direct-connected to an Allis 36 by 60-inch engine; two 400-kilowatt General Electric generators, driven by Porter-Allen engines; one 1,050-kilowatt General Electric machine, run by a 38 by 60-inch Allis engine; one 800-kilowatt General Electric driven by a 36 by 60-inch Rankin-Fritch engine, and one 600-kilowatt Western Electric booster. This makes a total generator capacity for the station of approximately 5,500 kilowatts.

Cass Avenue Station is the smallest of the four generating plants, containing three 800-kilowatt generators and one 150-kilowatt generator. The boilers for this station are 16 in number, of 200 horsepower each, provided with down-draft furnaces.

Besides the generating stations, there are two sub-stations in the system. The newer of these two sub-stations is located at 1711 Locust Street and is a model plant in every particular. The building is of brick, 155 feet long by 56 feet wide. The floor on the street level contains the room for the distribution of the incoming high-tension cables. Other space is also provided on this floor for storage purposes, for the water distillers, rheostats, etc. The second floor contains the rotary converters, switchboard and boosters. A basement and sub-basement contain each a storage battery of 294 cells of the Electric Storage Battery Company's make. The pressure of these batteries stands at 600 volts when idle. There are 77 plates per cell.

Fig. 5 is a view of the rotary-converter room on the second floor. Here are located seven 1,000-kilowatt General Electric rotaries and two 250-kilowatt boosters, the latter being at the rear of the room, as seen in the picture. Directly behind each rotary is its transformer, and back of the transformers are the oil switches. The switchboard, 125 feet long, extends along the opposite side of the room. The transformers are air-cooled, the air being circulated through the casings by electrically driven fans and then forced down into the compartment for the high-tension cables already alluded to. This compartment is airtight and is located directly beneath the transformers. The air passes through this compartment, gathering what heat it may from the cables, and then is carried through openings back into other parts of the building for heating purposes. It is calculated that when all the rotaries are running enough heat will be thrown off by the transformers to heat the building.

At present, and until matters have been adjusted with regard to the supply of current to this sub-station, but two of the rotaries are operated, and these but a few hours during the evening. Three-phase current at 6,600 volts is obtained for this short run from the Curtis turbo-generator in the exhibit of the General Electric Company at the Exposition. The three-phase, 6,600-volt cables are brought into the compartment on the first floor beneath the transformers, and are laid along concrete slab shelves. At points beneath the respective transformers the leads are tapped off and after passing through a disconnect switch, used only for safety when work is being done on the line, they are taken to the terminals of the oil switches. All high-tension work is confined to this one compartment, and the leads are all carried in concrete cells, which are made of concrete-slab work. Up in the rotary room the oil switches are contained in concrete cells. Fig. 3 shows several of these switches.

The two boosters already mentioned are supplied with exciter sets, which are controlled by automatic regulators. These regulators are placed on the switchboard, and, as the load on the bus bars varies the regulators, by a simple electromagnetic device, vary the excitation to a corresponding degree in the boosters.

Pure water for the batteries is obtained by the use of three distillers, which are run constantly. They discharge into a large tank, and 600 gallons per week are required to keep up the batteries. The distillers are located on the first floor, as are also the rheostats for field excitation. The rheostats are all operated by chains connected to hand-wheels on the switchboard on the floor above.

Another sub-station is located at the corner of Delmar and De Baliviere Avenues. This plant contains four 600-kilowatt rotary converters and one 1,000-kilowatt rotary converter of the General Electric type. The Delmar sub-station, among other things, feeds the 13-mile line to Creve Cœur Lake. This is the only suburban line operated by the Transit company and, the lake being a popular resort, the line has a good traffic. Standard double-truck cars are used on this line, similar to those used for city service. Only on extraordinary occasions is it necessary to use a booster in connection with the line.

The St. Louis Transit Company is now operating 358.6 miles of track and over 1,100 cars. Necessarily, these cars are of varying types, since the system

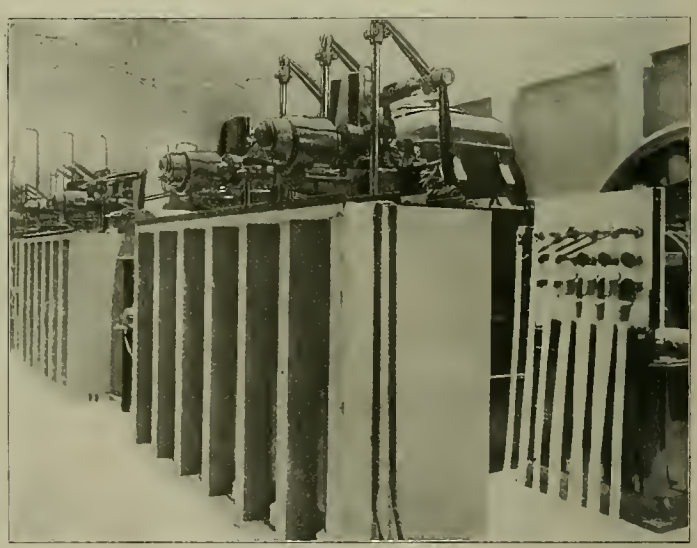


FIG. 3. OIL SWITCHES IN LOCUST STREET SUB-STATION, ST. LOUIS.

has been in operation many years. The standard form of car, which is most extensively used now, however, is the one shown in Fig. 6. This is a double-truck car having a body 33 feet long and nine feet wide. The seats run crosswise, with an aisle down the center. Forty-eight passengers may be accommodated in the seats. A small platform is provided for the motorman at the front of the car, while at the rear is a platform seven feet in length, with transverse railings, which will hold comfortably 12 or 15 standing passengers. These cars are equipped with four 40-horsepower motors each, and weigh empty 40,000 pounds. Another form of car is also used to some extent and was made by splicing together two old-time single-truck cars and forming the two into a double-truck car.

All cars are now being equipped as fast as possible with air brakes operated upon the storage system. To furnish the necessary air for this purpose compressor stations are located at convenient points about the city. There are now 15 of these compressor plants in operation, and it is expected that 20 will be required. As far as possible these have been located in car barns, where there is someone in attendance, since the compressors, though automatic in action, occasionally need looking after.

A typical air-compressor station is located at the end of the Park Avenue line. The station consists of a brick building about 20 by 30 feet containing,

Robert McCulloch, Vice President and General Manager. Richard McCulloch, Chief Engineer.

OFFICERS OF THE ST. LOUIS TRANSIT COMPANY.

besides the compressor apparatus, sand rooms, storage rooms, and the like. The compressor plant itself is in a room about 20 feet square and consists of two motor-driven air compressors, delivering the compressed air to two storage tanks at a pressure of 300 pounds to the square inch. The motors are of 30 horsepower each and run at 550 revolutions, operating the compressors by chain drive. All that is necessary to supply a car with air is to connect the car storage tank, which is located beneath the car and between the trucks, with the tank in the compressor house. An automatic arrangement is provided which starts the motors when the air pressure in the tanks falls below a predetermined point.

The distance which a car will run upon one charge of air is, of course, entirely dependent upon the number of stops. On the Olive Street line, however, a view of which is shown in Fig. 4, and which is the heaviest loaded line in the system, two or three trips may be made over the line, which is about six miles long, before recharging is necessary. This system of braking seems to be giving good satisfaction on the Transit company's lines. The cars are all supplied with hand brakes for use in cases of emergency.

The tracks of the system are well laid; the principal type of rail used is a seven-inch girder, though in the last year a considerable amount of seven and nine-inch grooved rail has been laid.

A rather unusual feature which has met the approval of the public, is the operation of what are known as "moonlight" cars, principally on the suburban line. These cars are nothing more or less than large flat cars which are fitted with awnings and side curtains of canvas to protect the occupants in case of bad weather. The covers, however, are not ordinarily used, the car remaining entirely open. These are very popular for private parties and picnic excursions during the summer. There are in all eight "moonlight" cars owned by the company.

The World's Fair has increased largely the revenues of the company during this year, the increase

FIG. 4. VIEW ON OLIVE STREET, ST. LOUIS.

being estimated at 50 per cent. or over. In 1903 the total number of passengers carried was 210,238,108. Of course, the increase does not mean clear profit, for a considerable outlay was required to take care of the greater traffic. Four hundred and fifty new cars were necessary for one thing, which is quite an item in itself. When the Fair is over these new cars will be retained and old ones thrown aside, as they are no longer needed. The effect of the World's Fair business has been to increase the day load and accentuate the evening peak. In addition to this, there has been a heavy night load, lasting till 11 or 12 o'clock.

The officers of the St. Louis Transit Company are: President, Murray Carleton; vice-president and general manager, Robert McCulloch; secretary and treasurer, James Adkins. Mr. Richard McCulloch is the chief engineer.

St. Louis and Suburban System.

A smaller system which is giving efficient service in St. Louis is that of the St. Louis and Suburban Railway Company, which was chartered in 1891. This company operates 95 miles of track, 48.5 of which is over private right-of-way. Previous to its purchase by the Suburban company the system was operated as steam and cable roads. Immediately after its purchase by the present company the system was converted from steam and cable to electric traction. Since 1891 several suburban roads have been built and added to the system. These are the St. Louis, Brentwood and Clayton railroad, the St. Louis and Meramec River railroad and the Brentwood, Kirkwood and Forest Park railway. The Suburban system has but one line reaching the heart of the city, and all other divisions run into this one line west of Vandeventer Avenue.

Within the last year all lines operating on the city streets have been reconstructed with girder rails either nine or six inches high. In the country, on the company's private right-of-way, the standard rail is a 60-pound T-rail, with the exception of 10 miles, on which the old 35-pound T-rails are used.

Power is derived from a single plant and consists of both direct and alternating current. The power plant is located at De Hodiamont, on the Wabash railroad. It contains two 800-kilowatt direct-current generators, driven by 32 by 60-inch simple Hamilton-Corliss engines, direct-connected; two 300-kilowatt direct-current generators, driven by belts, to a single Hamilton-Corliss engine running at 68 revolutions a minute; two 1,200-kilowatt, alternating-current generators, direct connected to two Allis-Chalmers compound engines, 30 and 50 by 60 inches; one 1,200-kilowatt, alternating-current generator, direct-connected to a compound Fulton Iron Works engine, running at 75 revolutions a minute, and one 800-kilowatt, direct-current generator, driven by an Allis-Chalmers simple engine. The total capacity of the plant is approximately 5,400 kilowatts.

Sub-stations for the transformation of the alternating to direct current are located at Sixteenth Street and at Brentwood. The former contains three 600-kilowatt rotary converters and the latter two, also of 600-kilowatt capacity. The direct current generated at the power house is used in the vicinity of the plant and is distributed by overhead feeders. The alternating current is transmitted at 6,600 volts, 25 cycles, to the transforming points already named, where it is changed to direct current at 500 volts.

Two types of cars are used on the system. The large cars are 46 feet eight inches long over all and nine feet two inches wide and weigh 48,000 pounds. The seating capacity is 52 passengers. Four motors are used upon this type of car. The small cars are 38 feet long by nine feet 1.5 inches wide and weigh 34,000 pounds. They seat 40 passengers.

The total number of passengers carried by this line for the year ended December 31, 1903, was 19,931,178. The total car-miles run was 5,515,536, and the percentage of transfers 12.1. The officers of the company are: President, Julius S. Walsh; vice-president, Julius S. Walsh, Jr.; secretary and treasurer, E. P. Somers.

East St. Louis Electric Railways.

Street and interurban railways in East St. Louis and the adjacent territory have made marked progress, and the system of the East St. Louis and Suburban Railway Company is large and well equipped. Besides the street railways of this system operating in the city of East St. Louis, Ill., several long interurban lines extend out into the country. One road runs from East St. Louis to Edgemont, with an extension through O'Fallan to Lebanon. Another runs northeast to Collinsville, and thence to Edwardsville, about 21 miles in all. Edgemont and Collinsville are also connected by a line. From East St. Louis a double line extends southeast to Belleville, by way of Edgemont. This is a line of heavy traffic, 14 miles long. At present the entire system of the East St. Louis and Suburban Railway Company includes 111 miles of track. Belleville is a city of about 20,000 people, while Collinsville possesses 7,000 inhabitants. Edwardsville, the northern terminus, is a rapidly growing city.

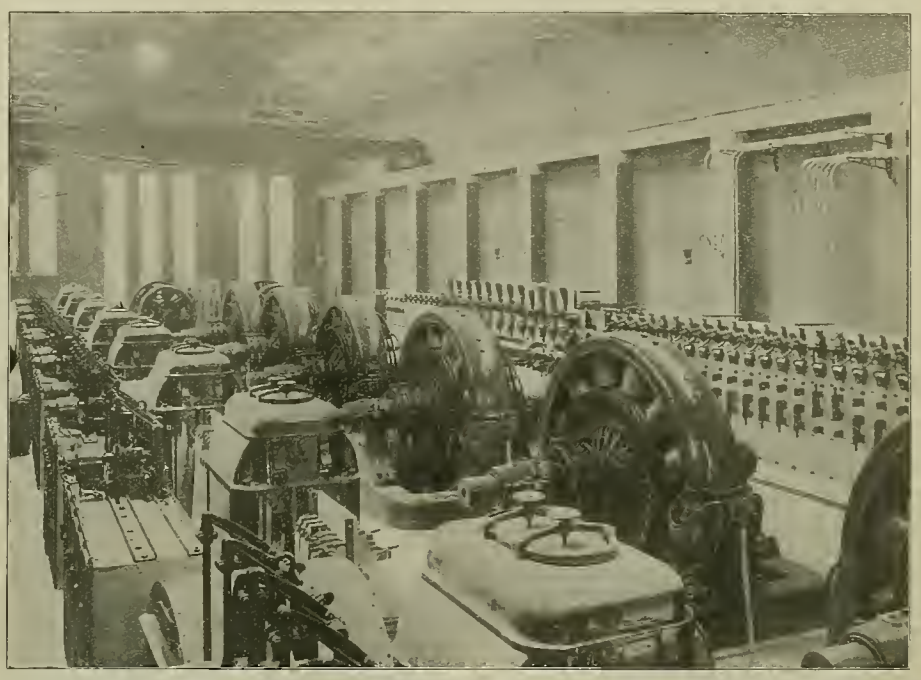


FIG. 5. VIEW IN LOCUST STREET SUB-STATION, ST. LOUIS, SHOWING ROTARIES, TRANSFORMERS AND SWITCHBOARD.

The power house is located in East St. Louis. It is a brick structure, 207 feet six inches long by

FIG. 6. STANDARD DOUBLE-TRUCK CAR OF ST. LOUIS TRANSIT COMPANY.

115 feet wide. There is no convenient source of water supply in large quantities in the neighborhood of the power plant, and as extremely cheap nut, pea and slack coal can be obtained from the mines in the vicinity of East St. Louis, and conveyed in the company's own dump cars to the station, the engines used are of the simple non-condensing type. The coal is handled in the power house entirely by a conveyor system. The boiler room contains five 1,000-horsepower batteries of Heine water-tube boilers. Owing to the grade of coal used, a very large grate surface is necessary, and to obtain this it was necessary to install the boilers in pairs, each boiler of

250 horsepower, instead of in single 500-horsepower units. The generator room contains five direct-connected units, three motor-generator sets, one synchronous converter, one motor-driven exciter and two steam-driven exciters. Direct current for the city trolley lines is furnished by a 1,600-kilowatt generator, driven by a twin Corliss engine, and also by two 425-kilowatt generators, each direct-connected to a Corliss engine. Current for the suburban lines is generated at 13,200 volts, 25 cycles, by two 750-kilowatt, three-phase alternators.

There are several sub-stations, of course. A typical one is that located at Maryville, and contains two 200-kilowatt, synchronous converters and seven 75-kilowatt, oil-cooled transformers.

A feature of interest in connection with this system is the telephone facilities that are provided. A telephone system covers all the city and suburban lines. Portable telephones may be attached to the poles every 1,600 feet. Each suburban car carries a portable telephone and a list of the poles with telephone connections, so that it is possible in a very few minutes after a breakdown or accident of any kind to communicate with headquarters.

Cars for the city service seat 36 passengers and are of the closed type. The suburban cars are each supplied with four motors. They have a seating capacity of 60 people and are 40 feet long in the bodies. Freight traffic between East St. Louis and Belleville is handled by two 50-ton electric locomotives. Each is equipped with four 160-horsepower motors and air brakes.

Chicago Street-railway Situation.

The proposition of the advocates of immediate municipal ownership contained in an ordinance presented to the City Council on Monday night, and providing for the submission to the people (as provided by the Mueller law) at the November election of the question, "Shall the city of Chicago proceed to operate street railways?" was defeated by a vote of 36 to 31. It was thoroughly understood that the passage of the ordinance meant a stop to all negotiations with the street-car companies for renewals of their franchises and an entire change of policy. It was to mean that the city must go ahead at once on the lines of immediate municipal ownership, casting all other considerations aside. Those who opposed the ordinance urged that it was unwise to commit the city to a policy of immediate ownership of the street-car lines without first knowing its rights in the case and gaining some idea of the probable cost of condemnation proceedings and the cost and plan of furnishing satisfactory service. They advocated the plan of the local transportation committee of the council and maintained that the present tentative ordinance for the Chicago City Railway Company, if passed and accepted, would be the safest and surest solution of the problem.

The merger negotiations of the two large traction systems of the city, it is stated, are nearing a satisfactory conclusion, and, it is said, a plan of consolidation has been practically agreed upon. Should such a community of interests become actual, the present tentative ordinance would be inapplicable, and therefore a different ordinance, more suited to the unified management of the street-railway systems of the city, but on the basis of the present Foreman ordinance, will probably be drawn up.

As an evidence of the work done, the municipal-ownership advocates brought their referendum petition to the City Hall on Monday in an express wagon drawn by four horses. It was said to contain 100,259 names. Mayor Harrison said that if the petition withstood scrutiny and proved sufficient his effort would be to delay action on the tentative ordinance until the spring election, when the people might vote on the question.

Death of H. C. Payne.

Henry C. Payne, postmaster-general of the United States, died in Washington on October 4th. Mr. Payne had been in poor health for two years, but his last illness was only of seven days' duration, heart disease being the cause of death. After funeral services in Washington, the body will be taken to Milwaukee for interment. Mr. Payne was perhaps best known to the country at large as a political organizer, but in his extensive business relations he was identified with electrical interests centering in Milwaukee, which was his home. He was born in Massachusetts in 1843, but removed to Milwaukee as a young man and engaged in business there. He gradually became identified with large business enterprises. One of these was the Wisconsin Telephone Company (Bell), of which he was president for many years, being elected to the position in 1885. He became interested in the street railways of Milwaukee in the old horse-car days, and under his management electricity was adopted as the motive power. His first connection with street-railway work was as vice-president of the Cream City Street Railroad Company. Later he became vice-president and general manager of the Milwaukee Street Railway Company. In 1893, while holding this position, he was elected president of the American Street Railway Association. At a subsequent date the street-railway and electric-lighting interests of Milwaukee were consolidated, largely through the efforts of Mr. Payne, and the present Milwaukee Electric Railway and Light Company grew out of a somewhat complicated situation.

Fond du Lac-Oshkosh Interurban Railway.

Wisconsin is fast becoming one of the prominent states in the development of interurban electric railways. Many of the towns and cities of the beautiful lake region are connected by interurban lines; others are being connected; and it is safe to say—to cite one striking instance of this development—that within a short time it will be possible to ride all the way from Chicago to Green Bay, Wis., a distance of nearly 250 miles, on electric railways. Among the interurban railways of this state, that of the Eastern Wisconsin Railway and Light Company, connecting Fond du Lac and Oshkosh, and traversing a prosperous community, is worthy of description. The company also controls the electric and gas lighting, electric power and street-railway business of Fond du Lac. It is a consolidation of several other companies.

The Fond du Lac Electric Company was organized in 1895 and did a commercial light and power business until 1899, when it secured a franchise for street railways, electric and gas lighting for a period of 50 years. At this time the Fond du Lac Street Railway and Light Company was formed, purchasing the Fond du Lac Electric Company. This company built the street-railway system in the city. In 1901 this company also purchased the Gas Light Company of Fond du Lac, rebuilding the entire gas plant, and making extensions. The Fond du Lac and Oshkosh Electric Railway Company was incorporated in 1902 and built the interurban railway between Fond du Lac and Oshkosh, terminating in both cities over city lines. On October 1st, a year ago, the present company was incorporated, purchasing and consolidating the property of the Fond du Lac and Oshkosh Electric Railway Company and the Fond du Lac

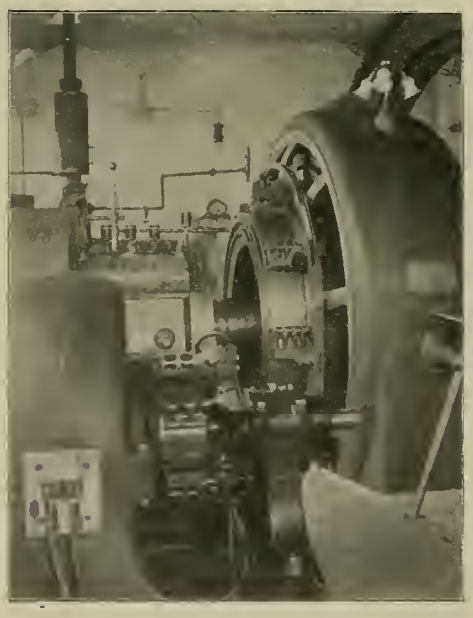


FIG. 2. GLIMPSE OF 500-KILOWATT GENERATOR FOR FOND DU LAC-OSHKOSH RAILWAY.

Street Railway and Light Company, thus coming into control of an extensive system of public utilities.

The interurban line of the company will be especially dealt with in this article. Lying along the shores of beautiful Lake Winnebago and almost within sight of the lake for the entire distance of 18 miles between Fond du Lac and Oshkosh, this road serves an estimated population of 97,000. Fond du Lac has a population of 20,000 and Oshkosh of 35,000, and the tributary population is estimated at 12,000. The line passes through the center of the business district of Fond du Lac, North Fond du Lac, Vandyne and Oshkosh, as shown by the map (Fig. 1). At Oshkosh it connects with the interurban line to Omro and with the line to Neenah and Menasha. The Appleton and Kaukauna interurban line connects at Appleton with the Neenah line, and the Green Bay-Kaukauna line, just completed, connects at Kaukauna with the Appleton line, thus giving through electric-railway service from Fond du Lac to Green Bay, nearly 70 miles.

Once outside the city limits, there are no sharp curves, the track being almost straight. Fig. 5, showing a stretch of track through the town of Friendship, is a good illustration of the entire line. The road is also remarkably level, the only grade of more than one per cent. being at the subway under the right-of-way of the Wisconsin Central and Chicago and Northwestern railroads (Fig. 4). For much of the distance between Fond du Lac and Oshkosh, the electric road, parallels, within a stone's

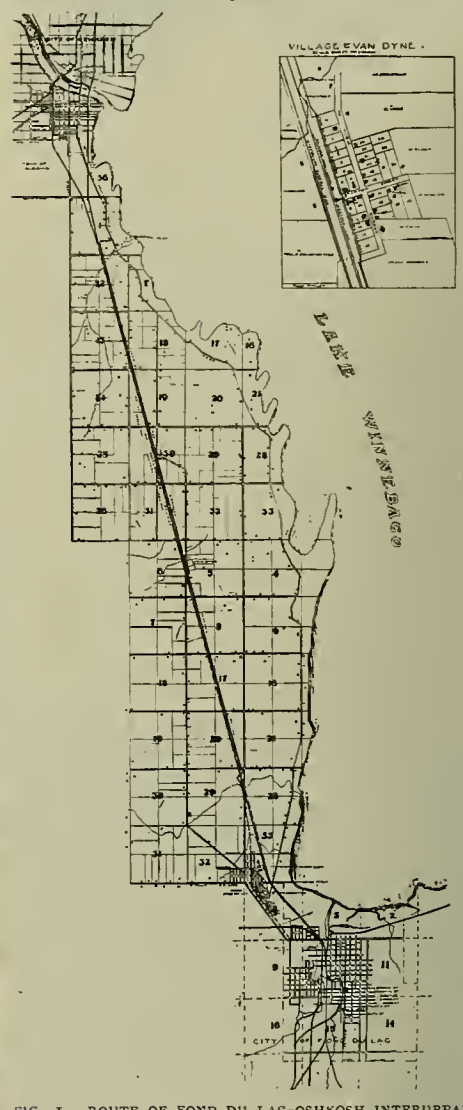


FIG. 1. ROUTE OF FOND DU LAC-OSHKOSH INTERURBAN RAILWAY.

throw, the two steam roads just mentioned, yet with this competition the management of the electric figures that it does 95 per cent. of the local passenger business. The fare is only 25 cents for the 18 miles, and cars are run between the two cities on an hourly schedule at ordinary times and half-hourly on special occasions.

The line is single track with turnouts. The roadbed is of red clay, with 12-foot base and slopes 1½ to one. It is gravel ballasted, tamped six to 12 inches below the bottom of the ties with gravel taken from the company's pit on its own dump cars. Seventy-pound T rails of 62-foot lengths are used on the interurban. The bonding is done with American 38-inch pin bonds, with ⅞-inch heads. Part of the track is double bonded. The ties are eight feet six inches long, of cedar, and are laid 24 inches apart.

To avoid crossing the tracks of the Wisconsin Central and Chicago and Northwestern steam roads at grade outside the city limits a subway was built, which passes under one track of the former road and three of the latter (Fig. 4). The subway is 1,350 feet long, with four-per cent. grades on approaches and level track through the center. The cut is in red clay, and here the roadbed has a 30-foot base with side slopes one to one. There is a clearance of 14 feet six inches between the top of the rails and the bottom of the steel work of the bridges carrying the steam-railroad tracks. The cut is drained with a 24-inch tile sewer 1,595 feet long, which has a fall of one foot in 1,000 feet and empties into a creek. The subway is double-tracked.

The overhead electric work is of the best double-

pole construction, with double hangers and two No. 000 figure-eight trolley wires, well insulated. All poles are 30 feet long and are guyed with five and six-inch Stombaugh guy anchors, with three-eighths-inch turnbuckles. The spans and guy wires are of five-sixteenths-inch galvanized strand.

The feeder system consists of three 500,000-circular-mil cables and one No. 0000 cable to the end of the city line. The first of the three 500,000-circular-mil cables feeds to a point five miles from the power plant, the second 10 miles and the third 15 miles from the plant. There are no sub-stations, a booster being inserted in the distributing system which serves this purpose.

A very convenient arrangement which affords communication with the dispatcher or office from frequent points along the interurban line is a telephone system which connects with the company's private city system. The wires are run on the side poles and the telephones, which are of the iron-box type, made by Couch & Seeley, are placed in telephone booths built at the meeting points along the line.

Four large cars are operated on the interurban line. They were built by the St. Louis Car Company and are 46 feet five inches long and eight feet eight inches wide. They are full-vestibuled and finished in mahogany. One of the cars is shown in Fig. 7 standing at a street corner in the business portion of Fond du Lac. The passenger compartment contains 15 high-back plush seats of the "walk-over" type. The trimmings and parcel rack are of brass throughout and there is a push button at each seat. In the smoking section the seats are of rattan, arranged longitudinally. This section also contains a toilet room, heating apparatus and other modern conveniences. The cars are heated by the Peter Smith hot-water system. Equipped with extra heavy trucks, each car has four Westinghouse 50-horsepower motors with K-14 controllers, Westinghouse circuit-breakers, Christensen air brakes, air whistles, fenders, headlights, registers, etc. The total weight of the car is 51,000 pounds. The bottom frame is of the Robertson patent-beam construction. The principal feature in the construction of the car is the height above the rail, which was made as small as possible. The platform is 10 inches below the floor of the car, and there is only one step between the platform and the ground.

The other rolling stock of the company includes two double-truck enclosed cars mounted on maximum-traction trucks, equipped with two 50-horsepower Westinghouse motors and K-11 controllers, and seven single-truck enclosed cars, fitted with two 30-horsepower slow-speed motors and K-10 controllers. There are also two 10-bench open cars, two 10-bench trailers, two eight-bench trailers, one double-truck flat car for hauling material, one combination sand and salt car and one McGuire snow-sweeper. The last is equipped with three 30-horsepower slow-speed motors.

The management believes that there is profit in the park business, and to encourage this branch of its business will begin work extending its line one mile south of the present terminus in Fond du Lac to Eldridge Park, shown in Fig. 6, a beautiful natural park containing 35 acres of ground, with Fond du Lac River in the center. The company also owns 15 acres adjoining the park, which will be used for athletic grounds, golf links, etc.

At present the city lines, which consist of 4.5 miles of track, extend to Lake Park, shown in Fig. 3, which lies at the foot of Lake Winnebago. This park is owned and has been improved by the city of Fond du Lac. It has all the attractions of a modern summer park and is a delightful, refreshing spot, well patronized by the citizens. Among the attractions is the electric illumination at night furnished from the current of the Eastern Wisconsin Railway and Light Company. Along the shore in Fig. 3 can be seen three of the electric arches spanning the lake shore drive and which are illuminated by the company. A powerful searchlight has also been set up by the employes of the street-railway company which furnishes much amusement at night when its rays are sent out over the water, revealing the otherwise invisible pleasure boats which dot the lake on a summer evening.

Lake Winnebago is the largest and one of the most picturesque of inland lakes of Wisconsin. It is 35 miles long and about half as wide. During the summer there are numerous regattas and yacht races at Oshkosh, which tend to increase business on the interurban line.

Before long the company intends to construct a line over its own right-of-way into the city of Oshkosh, terminating an air line at the corner of Main and High Streets in the business portion. The company now enters over the tracks of the Winnebago Traction Company and holds a 35-year franchise for interurban privileges.

The Eastern Wisconsin Railway and Light Company does all the lighting, both electric and gas, in the city of Fond du Lac and North Fond du Lac. It also furnishes current for power and gas for fuel. The incandescent lighting is furnished by single-phase alternating current, 133 cycles, 2,080 volts primary and 104-108 volts secondary. The streets are lighted with 126 series inclosed 6.8-ampere Adams-Bagnall arc lamps under a 10-year contract. The lamps are burned on the moonlight all-night schedule at $84 a year per lamp. The commercial circuits also carry 92 service arcs. Besides there are 56 multiple alternating-current arc lamps, an equivalent of 15,000 16-candlepower incandescent lamps and 54 Nernst lamps. The transformers are all placed on poles. Where secondary feeders are possible the three-wire system is used, thus doing away with small transformers as far as possible. The company now furnishes power to many of the factories throughout the city and has connected about 75 power motors with a capacity of approximately 300 horsepower. The power circuit is 500 volts. All incandescent lighting and power work is done by meter, there being at present installed about 1,000 electric meters.

The power house, shown in Fig. 9 during the construction of the steel smoke stack, is situated on West Rees Street just west of the office building and car barns. It is a brick building, having an engine and generator room and a boiler room. The former is 29 by 109 feet with a wing 46 by 62 feet. The boiler room is 46 by 74 feet, having a cinder concrete roof and skylights between the boilers. Two smokestacks, one of brick, the other of steel, have a height of 120 and 140 feet, respectively. The former has an inside diameter of seven feet and the latter eight feet.

In the engine and generator room the machinery is compactly arranged, requiring the minimum number of steps for the attendants. A 20 and 40 by 48-inch Allis-Chalmers cross-compound Corliss engine is direct-connected to a 500-kilowatt 550-volt Westinghouse railway generator. This is the main unit and is partially shown in Fig. 2. This engine has a speed of 92 revolutions per minute. The steam and exhaust valve in the low-pressure cylinder is controlled by a separate set of eccentrics, and there is a safety governor and safety valve which will check the speed when it is five turns above normal. The flywheel weighs approximately 75,000 pounds and is belted to the main shaft.

One 16 and 30 by 36-inch Allis cross-compound condensing Corliss engine turning at 100 revolutions per minute is belted to the main line shaft, and a similar engine is direct belted to one 250-kilowatt 550-volt Westinghouse railway generator and one 200-kilowatt 2,200-volt Westinghouse alternator. These machines are belted in tandem. In addition to the generators already mentioned there are belted to the line shaft one 100-kilowatt 500-volt power generator, one 150-kilowatt three-bearing multipolar

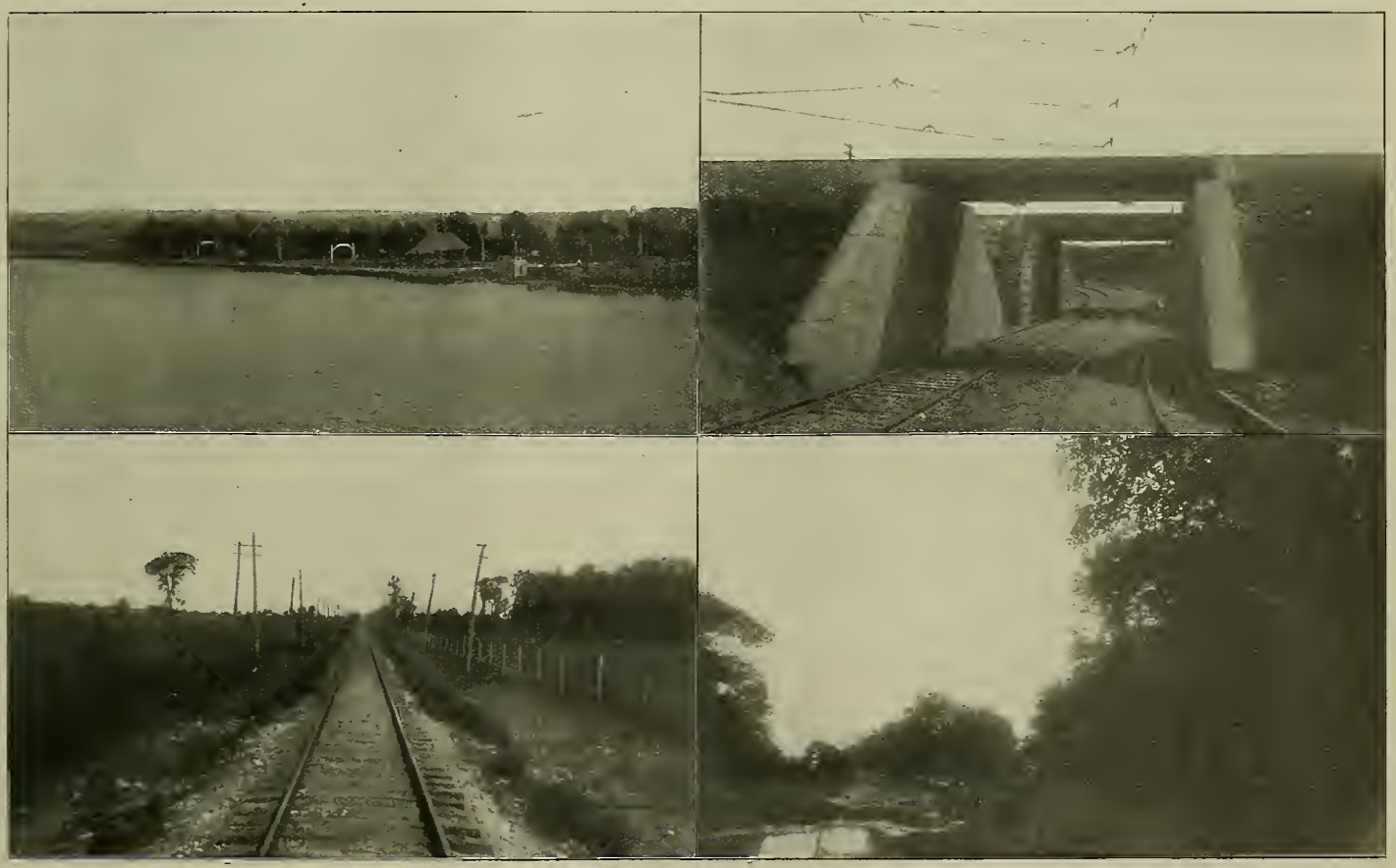


Fig. 3. View of Lake Park, Fond du Lac.
Fig. 4. Subway Under Steam Roads.
Fig. 5. Stretch of Track in Town of Friendship.
Fig. 6. View in Eldridge Park, Fond du Lac.

FOND DU LAC–OSHKOSH INTERURBAN RAILWAY.

Western Electric railway booster, one 120-kilowatt 2,200-volt Westinghouse alternator, one 200-kilowatt 2,200-volt Fort Wayne alternator and two 125-light Western Electric bipolar arc machines. One 75-kilowatt 550-volt Western Electric motor drives a 125-light bipolar arc machine.

There are four boilers used in the plant, three Aultman-Taylor double-deck type water-tube boilers with 4,400 square feet of heating surface each, and one Aultman-Taylor water-tube boiler with 3,100 square feet of heating surface. In connection with these is one Blake twin vertical condenser and one Dean vertical condenser.

The pumping system in the boiler room consists of a Stillwell-Bierce duplex marine-type boiler-feed pump, 10 by seven, one duplex horizontal Stillwell-Bierce service pump, six by eight by 10, one Dean boiler-feed pump, 10 by seven, and one 2,000-horse-power Stillwell-Bierce feed-water heater and purifier. The drip of the entire system returns to the boilers by the Holly return system.

Fig. 7. Interurban Car.

FOND DU LAC-OSHKOSH INTERURBAN RAILWAY.

The water for the plant is obtained from the Fond du Lac River about 4,000 feet from the plant, water being supplied through a 24-inch tile gravity main to a well to which are direct-connected all the pumps, condensers, etc. The supply of water is adequate and of good quality. City water is also connected in the power house for reserve.

A switch track is located alongside the power house with coal shed along the boiler room, where coal can conveniently be handled from the Wisconsin Central, Chicago and Northwestern or Chicago, Milwaukee and St. Paul railways.

Oil is supplied to the engines by a steel cylinder tank holding about three barrels of oil, placed on brackets in the brick wall. The oil is piped from this tank to all bearings and the waste is carried from the engine beds to the purifier tank under the engine floor, and after being filtered is pumped back to the original tank overhead.

The switchboards are located at the east end of the engine and generator room. The incandescent-lighting and power board contains three generator panels and two double-feeder panels, made of two-inch white Italian marble and equipped with Westinghouse type-F dead-beat long-scale instruments. Wagner oil switches and Westinghouse wattmeters are provided for each machine. The arc switchboard was manufactured by the Western Electric Company and is its standard plugboard of white Italian marble. It contains four machine terminals and eight circuit terminals, being made for 10,000 volts, which is the approximate pressure on the arc machines.

The railway and power switchboard contains 10 standard Westinghouse panels of white Italian marble, two inches thick. Except on the main generator panels, where Weston illuminated-dial volt and ammeters are used, Westinghouse dead-beat ammeters and voltmeters are installed.

The cables between generator and switchboard are all lead-encased and placed in tile ducts under the floors. The feeder wires pass directly from the top of the switchboard through brick walls to the overhead lines. All railway and power circuits are supplied with Thomson recording wattmeters, and all circuits leaving the station have lightning arresters.

Fig. 8 shows the car barn and office building, with the steel smokestack of the power house in the rear. The building is of brick and fronts 110 feet on Main Street and 170 feet on Rees Street. The car barn, which is one-story and has a composition asbestos roof of milled construction, contains four tracks with concrete pits under each track and room for two cars on each track over the pit. The repair shop is located in the rear with a pit track through its entire length. The rails and foundations of this pit are cut in sections, allowing any portion to be taken out and the car wheels dropped through to the pit below, from which they are brought through a trap door into the shop.

The office building is two stories high, with tile roof. Here the business of the company is transacted. It may be said that the company has a most complete system of accounting. Secretary F. B. Huntington has worked out many report sheets and blank forms, some of which are original and novel, so that the monthly exhibit is complete to the minutest detail. In the rear of the office are store and sales-rooms where supplies for the varied branches of the company's system are kept. Lounging rooms for the convenience and comfort of the employes are provided on the second floor, where the dispatcher also has his office.

Fig. 8. Office and Car Barns.

As before stated, the company, besides its extensive electrical business, furnishes gas for lighting and fuel throughout the entire city. It has installed about 1,500 gas meters, 800 gas ranges, 7,000 gas lights and 400 miscellaneous gas appliances.

The interurban railway of the Eastern Wisconsin Railway and Light Company is very popular in the community which it serves, partly on account of the good service and partly due to the courteous and gentlemanly conduct of the employes. Mr. T. F. Grover, vice-president and general manager of the company, under whose wise guidance the company has prospered, is also the president of the Northwestern Electrical Association. He knows the business thoroughly. It is entirely probable that the future will see the Eastern Wisconsin company extend its interurban line south to meet a similar road which will be built north from Milwaukee. If this is done, and when the missing link of the Chicago and Milwaukee Electric Railway Company is supplied, it will be possible to journey from Chicago to Fond du Lac by electric railway.

FIG. 9. POWER HOUSE OF FOND DU LAC-OSHKOSH RAILWAY DURING CONSTRUCTION OF STEEL STACK.

Automatic Thunderstorm Recorders.

In the Monthly Weather Review, issued by the United States government, Rev. J. Algué, S. J., director of the Philippine Weather Bureau, describes the first electric storm recorded automatically in St. Louis, Mo. Omitting the facsimile records and a few words relating to them, Father Algué's account is as follows:

"The thunderstorms of Friday, June 3, 1904, were unusually severe and fully realized the predictions of the local forecaster of St. Louis, Edward H. Bowie. In the Philippine Weather Bureau station at the World's Fair there are two lightning recorders—one devised by Rev. Father Frederic Odenbach, S. J., director of the meteorological observatory in St. Ignatius College, Cleveland, Ohio, which has worked there very satisfactorily since the year 1902, and another invented by Rev. Father Fenyi, S. J., director of the Kalocsa Observatory, Hungary, which is of the type of the one erected in the Manila Observatory in 1903. Father Odenbach's ceraunograph, as he calls his instrument, was not yet set for operation.

[An illustrated description of Father Odenbach's device, as then employed, was given in the Western Electrician of November 30, 1901. In that article records of approaching thunderstorms made in June, July and August of that year were given. So that the date of the successful employment of Father Odenbach's recorder should be 1901, rather than 1902, as Father Algué states.—Ed. W. E.]

"The Fenyi lightning recorder has been ready for work since June 2d. It has registered with great accuracy the electric storms of Friday, June 3d, and Saturday, June 4th. As the instrument is an entirely new one and works on the same principle as those for wireless telegraphy, it will be interesting to study the simultaneous records of this instrument and of some of the other meteorological instruments. The collector of the instrument consists of a copper wire which stretches horizontally between the poles at the summit of the two steel towers erected near the station and about 110 feet apart. The height of the horizontal wire is 105 feet. One extremity of the wire ends in the pole, and the other is brought from the other pole to the receiver of the recording instrument, the essential part of which is the coherer, which consists of two small chains of steel wire two inches long, through which the Hertzian current has to pass. The registering pen is attached to the armature of the magnet, which decoherizes the steel chains by knocking them. The pen at every movement of the armature makes a little mark perpendicular to the spiral on the cylinder, which moves by clockwork at the rate of 9½ inches per hour.

"A few words on the prevailing conditions in the weather before the storm occurred will be necessary. Two well-defined storm centers covered the region west of St. Louis, one to the west-northwest over Western Nebraska, and the other to the southwest over Northwest Texas and New Mexico. According to the weather map, thunderstorms were reported to the south-southwest, west and northwest of St. Louis, at an average distance of 400 miles, at 7 a. m. (central time) Friday, June 3d. About that time the sky was clear and fine in St. Louis, but clouds began to appear about 8 a. m., and cloudiness gradually increased until 9 a. m. According to the record of the wind's velocity, it increased from 9 to 10 a. m., the maximum being registered between 10 and 11 a. m. from the southwest. At 10:41 a. m. the first spark affected the coherer and the instrument began to work. No thunder could be heard. Rain began to fall at 10:30 a. m. and continued until noon at the rate of about two millimeters an hour, while electric sparks were registered; about 80 sparks occurred from 10:41 to 11 a. m. and about 140 from 11 a. m. to noon; at this time the intensity of the storm increased, as far as electric display and rain are concerned, but the wind abated decidedly up to two o'clock. Ten minutes after noon the electric display was terrific, sparks being registered almost

every second. Shortly before one o'clock the storm diminished and the wind veered to the southwest. Another electric storm, more intense than the former, developed a few minutes before two o'clock. Precipitation, which had ceased at about one o'clock, began again with renewed intensity at 20 minutes past one; the wind continued from the southwest up to 3 p. m., when it veered to the south again, followed by a very decided fall in atmospheric pressure. The last spark was registered at 4:31 p. m."

Starting Device for Induction Motors.

In order to secure close regulation and high efficiency, the armature windings of induction motors are ordinarily designed so as to have a low resistance; but when thus designed the starting torque is comparatively small and the current taken from the line at starting is large and considerably out of phase with the impressed electromotive force.

Various expedients have been resorted to for the purpose of securing a large starting torque combined with high efficiency under normal loads. For example, one arrangement is to provide a separate resistance which is arranged to be connected into the motor circuit at starting and gradually cut out as the motor comes up to speed. This arrangement, however, involves objectionable losses, and the space occupied by the resistance boxes is considerable. Moreover, since the additional resistance is in most cases entirely non-inductive, a very large resistance is required for cutting the current down to, say, its full-load running value, as is necessary in many cases. It has also been proposed to provide the rotor with a second winding of high resistance, which is used only during the period of starting, or to mount the resistance inside of the rotor spider, the resistance in the latter case being gradually cut out of the rotor circuit as the motor comes up to speed. The usefulness of the resistance, however, in either of these arrangements is limited to the period of starting, which, of course, in most motors forms a very small percentage of the total working period. Besides, it takes up space which could be more efficiently filled by material which might be active all the time and help to increase the efficiency of the service.

An invention, recently patented by Mr. Hans S. Meyer of Rugby, England, has for its object to attain a more efficient use of the resistance during both the starting and running periods and to reduce it in size to the smallest possible amount. To this end is provided, in addition to the ordinary low-resistance phase winding and in circuit therewith, a winding of comparatively high resistance, which is constructed of iron or other magnetic material, so that it will serve to conduct part of the useful magnetic flux of the secondary member during the running of the motor, acting in this respect in the same manner as the iron in which it is embedded. The two windings constitute a single winding having a low-resistance and a high-resistance portion. The high-resistance winding is arranged to be cut out of circuit during starting in the same manner as

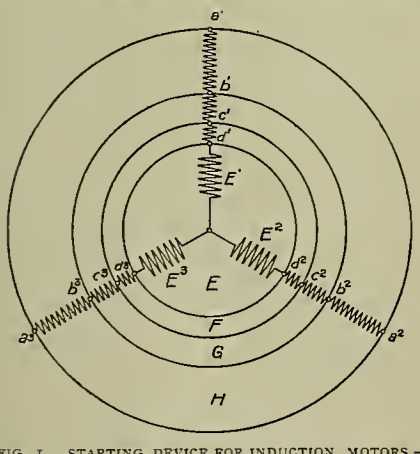


FIG. 1. STARTING DEVICE FOR INDUCTION MOTORS.—DIAGRAM OF MOTOR WINDING.

the ordinary resistance in the secondary circuit would be cut out.

According to one modification of the invention slots are constructed in the secondary member of sufficient depth to provide room below the ordinary phase winding for the auxiliary starting-resistance winding. This latter consists of iron wires insulated in a suitable manner from each other and from the main winding. The resistance winding is connected in series with the main winding, and its resistance is graduated in suitable steps, the extremities of each step in each phase being connected to the contacts of a suitable short-circuiting switch which may be worked either by hand or automatically and which is arranged to revolve with the rotor, thus avoiding the use of slip rings.

Fig. 1 illustrates diagrammatically the secondary winding of an induction motor constructed in accordance with the invention. Fig. 2 is a diagrammatic representation of a switch by means of which the high-resistance sections of the winding of Fig. 1 may be gradually cut out of circuit; and Fig. 3 is a view in cross-section of one of the slots of the secondary member, showing the dimensions and relative arrangement in the slot of the several sections of the winding.

Referring to the diagram, (Fig. 1) (E') (E²) (E³) represent the several sections of an ordinary low-resistance phase winding for the secondary member of an induction motor. These several sections, taken together, constitute a single winding.

The several sections of the resistance winding are indicated by the letters (F) (G) and (H), respectively. In starting, the connections for the winding (E) are through the several sections of the winding (F) (G) and (H), the terminals of the latter winding (a') (a²) (a³), being electrically connected together. The first movement of the short-circuiting switch operates to electrically connect the points (b') (b²) and (b³), and therefore to short-circuit the portion (H) of the resistance winding. The next movement of the switch operates to electrically connect the points (c') (c²) and (c³), and therefore to cut out of circuit the resistance section

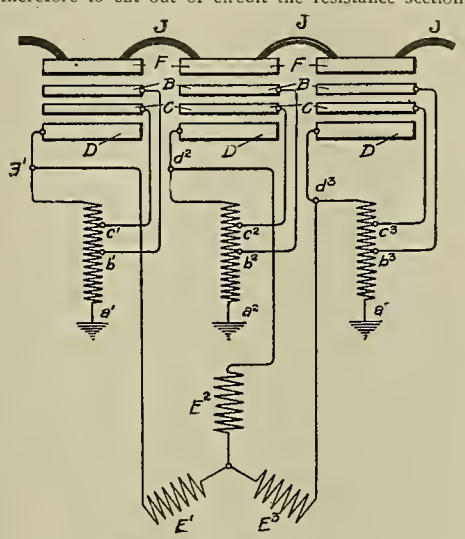


FIG. 2. STARTING DEVICE FOR INDUCTION MOTORS.—SHORT-CIRCUITING SWITCH.

(G), and the final movement electrically connects the points (d') (d²) and (d³), thus short-circuiting the winding (E) on itself without resistance in circuit. The arrangement of the winding in the slots of the secondary member is indicated in Fig. 3, in which the four square conductors occupying the upper portion of the slot constitute a part of winding (E) of Fig. 1 and the iron wires located in the bottom of the slot portions of the winding (F) (G) and (H) of Fig. 1.

The short-circuiting switch, by means of which the various sections of the resistance winding are cut out of circuit, may be of any desired construction, and in Fig. 2 is illustrated diagrammatically one of the constructions that may be employed. Referring to this figure, it will be noted that the points (d') (d²) (d³) are connected to contacts (D), the points (c') (c²) (c³) to contacts (C), and the points (b') (b²) (b³) to contacts (B). Other contacts (F) are provided, on which the movable contacts (J) of the short-circuiting switch normally rest. The points (a') (a²) (a³) are permanently electrically connected by grounding them on the framework of the secondary member, as indicated in Fig. 2. The contacts (J) of the short-circuiting switch are moved forward over the contacts (B) (C) and (D), in order to cut the resistance winding out of circuit in the manner already described in connection with Fig. 1. The arrangement of the contacts (B) (C) and (D), as shown in the diagrams, is such that the corresponding sections of the different phases of the resistance winding are cut out simultaneously; but evidently by slightly displacing the contacts marked by the same letter with reference to one another the passage of the switch contacts (J) might be made to cut out the corresponding sections of the resistance winding, successively, so as to give a greater number of resistance steps. The contacts (J) may be moved by hand, or they may be arranged to be moved by an automatic device responsive to changes in the speed.

The slots of the secondary member should be arranged in such a manner that the iron wire will fill the bottom part of the slot in the best possible manner to afford an easy path for the magnetic lines of force. The number of resistance steps and the size of the conductors composing the different sections of the resistance winding will, of course, be arranged according to the capacity and the individual design of any particular motor. In order that the resistance winding may be most effectively arranged, the cross-section of the conductors constituting it should increase gradually from the first step when the entire resistance winding is in circuit with the low-resistance phase winding, so as to give a resistance diminishing according to a geometrical

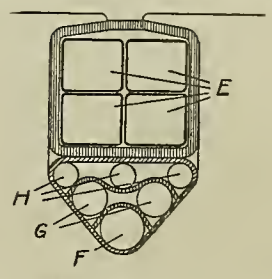


FIG. 3. SLOT CONSTRUCTION IN SECONDARY WINDING OF INDUCTION MOTORS.

progression, or in any other way that may be desirable.

The inductor motor being essentially a transformer, it will be understood that with the above arrangement of the resistance winding it is possible to keep approximately the same maximum current density on each step, for since all of the resistance wires are in series the current in the secondary winding at each step will be increasing relatively to the current in the primary inducing winding in proportion to the diminution taking place in the turns of the secondary circuit inductively acted upon by the primary flux, thereby requiring a larger cross-section of conductor at each step for the same current density. On the other hand, it is possible by this arrangement to greatly reduce the amount of resistance material required, since at the steps where large resistance is desired the current will be reduced in proportion to the number of turns added as resistance, and therefore a smaller cross-section of wire can be utilized, which means that its resistance increases as the square of the reduction in cross-section.

By increasing the depth of the slot in comparison to its width the current taken during the period of starting may also be reduced, owing to the increased self-induction which these slots introduce. This will reduce still further the resistance required for limiting the current at the starting, while the starting torque will not be materially diminished, as is the case in devices depending on the increased self-induction only.

While the motor is running, only the upper portion of the slot occupied by the main winding is effective, the remainder of the slot being occupied by wire which is cut out of circuit and only magnetically active, giving the equivalent of a shallow slot and low self-induction, which means an increased power factor during the normal operation of the motor.

The iron wire being part of the secondary circuit during starting will also have an actual resistance which, in proportion to the induced frequency, is much higher than the ordinary ohmic resistance of the circuit. This is due to what is commonly called the "skin effect," which is at a maximum at starting, when the frequency of the current in the secondary winding is the same as the frequency of the current in the primary and decreases as the motor runs up to speed, reaching a minimum when the speed of the secondary member approaches synchronism. Thus, in addition to the change in resistance provided by the short-circuiting switch and the resistance steps a reduction in resistance in proportion to the frequency is obtained. A further advantage is also obtained by using the useful magnetic material for obtaining impedance at starting instead of having a special iron core for obtaining such impedance.

As a result of violating a stringent Sunday-closing ordinance recently passed in Lexington, Ky., the operators of the power plant of the electric-light company were arrested last Sunday and the city might have been in total darkness, but the officials ordered the men to remain at their posts under all conditions. Some modifications of the ordinance are advocated by even the most strait-laced of Sunday observers.

WESTERN ELECTRICIAN

EVERY SATURDAY.

PUBLICATION OFFICES:
510 Marquette Building, · CHICAGO.
TELEPHONE, MAIN 1746.

Eastern Office, 193 Times Building, New York.
Telephone, 3806J Cortlandt.

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted. This paper is entered at the Chicago postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the **old address** as well as the new should be given.

CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING. THE WESTERN ELECTRICIAN—**the only general electrical paper published in the West**—thoroughly covers a territory *exclusively its own.* THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be furnished on application.

REMITTANCES.—All checks, drafts and other remittances should be made payable to the order of the publishers, the **Electrician Publishing Company,** and addressed to the offices of publication, Suite 510, Marquette Building (204 Dearborn Street), Chicago, Illinois, U. S. A.

CONTENTS OF THIS NUMBER.

Street-railway Service in St. Louis. Illustrated..... 281, 282, 283, 284
St. Louis and Suburban System..... 283
East St. Louis Electric Railways..... 283, 284
Chicago Street-railway Situation..... 284
Death of H. C. Payne..... 284
Fond du Lac-Oshkosh Interurban Railway. Illustrated..... 284, 285, 286
Automatic Thunderstorm Recorders..... 286, 287
Starting Device for Induction Motors. Illustrated..... 287
Editorial..... 288
Scientific and Engineering Congresses in St. Louis..... 289
Mr. Feilden Is Much Impressed..... 289
National Arm, Bracket and Pin Association..... 289
Michigan Electric Association..... 289
About Shellac..... 289
Electrical Exports for August..... 289
Leith to Have Electric Railways..... 289
Street-railway Conventions in St. Louis Next Week..... 289
The History and Development of Electric Railways By Frank J. Sprague. Part I. (International Electrical Congress)..... 290, 291
Prize for the Best "Trolley Song"..... 291
Bank Vault Opened by Electricity..... 291
The Production of Iron Ores in 1903..... 291
High-voltage Experiments at Niagara Falls..... 291
Ohio Telephone Notes..... 292
Michigan Telephone Matters..... 292
Telephone News from the Northwest..... 292
Independents Organize in Pennsylvania..... 292
Telephone Men..... 292
Extensions and Improvements..... 292
General Telephone News..... 292
Central Telephone Exhibit at St. Louis. Illustrated..... 293
American Telephones for Brazil..... 293
Manufacturers and Dealers..... 293
Planning a Telephone System. By Samuel G. McMeen. (Independent Telephone Association of the United States)..... 293, 294
World's Fair Visitors of Last Week..... 294
Electrical Extraction of Nitrogen from the Air. By J. Sigfrid Edstrom. Illustrated. (International Electrical Congress)..... 295, 296
New Shops at Montreal for the Canadian Pacific Railway 296
The Mechanical Equivalent of Heat Measured by Electrical Means. By Howard T. Barnes. (International Electrical Congress)..... 297
Thawing Ice in Water Pipes by Electric Heat..... 297
Congress Papers and Discussions..... 297
The Principles of Electrotherapeutics. By T. Proctor Hall, M. D. (International Electrical Congress)..... 298

DEPARTMENTS.

Correspondence..... 298, 299, 300
Great Britain..... 298, 299
New York..... 299
New England..... 299
Ohio..... 299
Michigan..... 299
Indiana..... 299, 300
Rocky Mountain States..... 300
Pacific Slope..... 300
Personal..... 300
Electric Lighting..... 300, 301
Electric Railways..... 301
Societies and Schools..... 301
Publications..... 301
Space Telegraphy..... 301
Miscellaneous..... 301
Trade News..... 301
Business..... 301
Illustrated Electrical Patent Record..... 301, 302

DATES AHEAD.

Michigan Electric Association (first annual meeting), Griswold House, Detroit, October 11th and 12th.
National Arm, Bracket and Pin Association (annual convention), St. Louis, October 11th, 12th and 13th.
American Street Railway Association (annual meeting), World's Fair grounds, St. Louis, October 12th and 13th.
Kansas Gas, Water and Electric Light Association (annual meeting), Leavenworth, Kan., October 18th and 19th.
Interstate Independent Telephone Association of America (annual convention), Chicago, December 13th, 14th and 15th.

VISITORS to the Louisiana Purchase Exposition at St. Louis who are interested in electricity or electrical literature are cordially invited to call at the booth of the Western Electrician, which is in Block 1 (Section 13) of the Palace of Electricity, just west of the main northern entrance to the building. Here will be found copies of the current issue of the paper, bound volumes of the Western Electrician from the first number, a careful selection of electrical books exhibited by the Electrician Publishing Company, and other objects of electrical interest. Chairs are provided for weary sight-seers, and an attendant will extend a hearty welcome to all readers or friends of the paper.

FREQUENT reports from Sweden indicate that the government of that country is thinking seriously of introducing electric traction throughout the entire system of state railways, employing for this purpose power from the numerous waterfalls that exist in that country. The high price of coal has much to do with this interesting possibility. For the purpose of securing funds to defray the expense of the change the government proposes to issue a large loan. American electrical manufacturers may get a share of the contracts when they are let. The Royal Railway Board of Sweden has been intrusted with the task of making experiments with electric motive power. A grant of about $117,000 has been placed at its disposal to further the experiments, and the outcome is awaited with much interest. If Sweden should adopt electric power for all existing railroads (now operated by steam) belonging to the state, the impetus given to electrical advancement would be a noteworthy one.

SENSIBLY arranged to cover five days without overlapping, the conventions of the American Street Railway Association and the affiliated organizations of the master mechanics and accountants will attract a large number of street-railway men to St. Louis next week. The programmes consist of comparatively few papers, and only forenoon sessions will be held, and these directly on the World's Fair grounds. This is a wise arrangement, and will leave the visitors free in the afternoons to study the exhibits at the Exposition, particularly in and about the Palace of Transportation, where the convention sessions will be held. There will be no convention display of exhibits, as the exposition answers the purpose of such a showing better than a temporary collection could do. There is no doubt that the conventions will be successful and well attended. The Cleveland Electric Railway Company is sending all its heads of departments at the expense of the company, we are informed, and other companies might follow this example with advantage, for unquestionably a great deal of valuable information may be gathered at these conventions by the exchange of experiences. This year the opportunity is enriched by holding the convention at the Exposition, with its collection of street-railway exhibits.

Eleven years ago, at the time of the Chicago World's Fair, the convention was held in Milwaukee, to be near the exposition of that year, but not of it, and there was a collection of convention exhibits. The present arrangement is undoubtedly wiser. It is a sad coincidence that the president of the American Street Railway Association elected in 1893 during the Chicago Exposition—Mr. H. C. Payne—should die just on the eve of the exposition convention of 1904.

CHICAGO asks of the voters of the state of Illinois, at the election of November 8th, approval of an amendment to the state constitution by which it can get the new charter which is so badly needed. In this movement the electrical men of the city are at one with all other good citizens in hearty approval of the proposed amendment, and, speaking for them and for itself, the Western Electrician urges all its readers in the state of Illinois to give their active support, by their influence, their advocacy and their votes, to this worthy project. The question is in no sense a partisan one. So far as we know, there is no opposition to the proposed new charter anywhere in the state. But it is necessary, for the adoption of the pending amendment, to get a majority of all the votes cast at the election; a majority of the votes cast on the proposition itself is not sufficient. This is a great undertaking. As has been well said by a former Circuit Court judge of Cook County: "It is not a mountain of antagonism that we have to overcome; it is the necessity of starting a current in the Dead Sea of indifference."

What is sought is a new charter broad enough and adequate enough to suffice for local-government needs. The present system is cumbersome and inadequate, with many taxing bodies, eight or nine township governments and justice courts having uniform jurisdiction over the whole of Cook County. It is entirely unsatisfactory and a serious embarrassment to the growth and progress of the city. An amendment to the constitution will give Chicago the power to make many needed changes—changes that will not only give the city the opportunity to become a larger city, but better still, give to the state a city that it will be a greater pleasure to live in, to do business in, and to entertain guests and strangers in. The change will affect no portion of the state except Chicago. Electric-light, electric-railway and telephone people throughout the state are numerous and influential. They are asked to give their help that this enabling act, in every way praiseworthy and desirable, may be passed.

TO WHAT extent the mariner's compass is affected by magnetic rocks along the shore has long been a moot question. Practical navigators declare their belief that in certain localities the compass is disturbed, and its reliability affected, by magnetic attraction on shore. This is alleged not only of various islands and promontories to be considered in ocean navigation but also of at least one dangerous point in the coastline of the Great Lakes in the United States. On the other hand, students of terrestrial magnetism are not entirely convinced that the compass deviations complained of are due to the cause assigned. Again, the information in relation to the duration and extent of these deviations is not as full and precise as might be wished for scientific study.

Renewed discussion of the question has been caused by the disaster to the Danish steamer Norge, which struck the island of Rockall, to the west of the Hebrides, on the morning of June 28th last, and was broken up with the loss of 600 lives. According to her course, the Norge should have been 25 miles to the south of Rockall, and the advocates of the magnetic-disturbance theory assume that it is impossible to account for the difference between the ship's real position and that of the reckoning without assuming a sudden and large change in the deviation of the compass. To substantiate this view, the depositions of two sea captains are given. Captain Hveysel of the steamer Carl says that on a voyage from the United States to Denmark he found, by careful solar and stellar observation, that when in the neighborhood of Rockall both the compasses of the ship had acquired a hitherto unknown easterly deviation of 10 to 11 degrees. A faint northern light was visible, and the captain attributed to this cause the magnetic disturbance. Toward midnight the compasses were observed to return to their normal deviation. The second evidence is that of Captain F. W. Horner of the British ship Elixir, who came into the vicinity of Rockall Island on a voyage from Florida to Linhamn, in Sweden. He found that between noon of one day and noon of the next, the compasses had deviated nine degrees. "I was steering," he says, "to pass 20 miles north of Rockall, and found by observation on June 25th that I had passed 45 miles north of it." If he had been on the south side of the island his ship would have suffered the same fate as the Norge.

With this testimony it seems to be reasonably certain that in the vicinity of Rockall's rocky eminence a marked disturbance of the compass needle has been observed in two or three instances. But if this deviation occasionally occurs, why does it not always occur? And if the magnetic attraction is constant, why has it not been observed and reported many times? Can it be assumed that the disturbance is intermittent in character? These are questions of importance to the safety of navigation. It is a serious thing if 600 lives were lost by an error of the compass for which allowance might have been made if the existence and extent of the magnetic area were known. It would seem that a series of comparatively simple tests in the vicinity of Rockall would determine the question, and one or more of the maritime powers should make the observations at an early day.

Scientific and Engineering Congresses in St. Louis.

The Congress of Arts and Science at the Exposition in St. Louis was successful in its broad purpose of bringing together on a harmonious basis followers of all the arts and sciences. All phases of human endeavor were discussed at the 120 sections into which the Congress was divided, by prominent scholars and investigators from all parts of the world. Electrical engineering was discussed at a meeting of that section in the Hall of Congresses. Prof. Arthur E. Kennelly of Harvard University presided at the meeting. He also read a paper entitled "The Relation of Electrical Engineering to the Other Sciences." A paper on "Problems of Electrical Engineering" was read by Prof. Michael I. Pupin of Columbia University. The department of physics met in Dormitory Hall. "The Physics of the Electron" was discussed by Prof. Paul Langevin, College of France, and Prof. Ernest Rutherford of McGill University, Montreal, Canada, spoke on "What Is Being Done and What Can Be Expected in Future Developments of the Work of the Electron." The possibilities of radium, thorium and uranium, the three substances now claiming the attention of scientists, were discussed, together with their relation to the sciences. Aside from those mentioned the papers of the Congress were of no special interest to electrical men.

The International Engineering Congress was in session in St. Louis this week under the auspices of the American Society of Civil Engineers. It was divided into eight sections. Section F, electrical, had papers promised by J. G. White of New York and Alexander Siemens of London on the "Substitution of Electricity for Steam as a Motive Power," and by L. B. Stillwell on "Electric Power-generating Stations and Transmission." Frank J. Sprague was chairman of this section. The various sections have their sessions in separate rooms in the Administration Building and the joint session was scheduled for Convention Hall in the same building.

Mr. Feilden Is Much Impressed.

A Washington dispatch dated October 1st is to the effect that President Roosevelt had an interesting talk on that day with Theodore Feilden, editor-in-chief of the Electrical Magazine of London. Mr. Feilden came to America as one of the visitors to the International Electrical Congress recently held at St. Louis, and, incidentally, has visited many of the industrial centers of the country.

"The president," he said, at the conclusion of his interview, "manifested the deepest interest in the developments of electrical science, and I found him wonderfully well informed on the subject.

"My trip to America has been a perfect revelation to me. We in England had heard and read a good deal about the development of electrical appliances in the United States, but before our visit we had no realization of the wonders of that development. The United States is far in advance of any other country in the application of electricity to commercial and industrial uses, although in recent years Italy has made distinct progress.

"Some of our delegates were so impressed by the opportunities offered in this country that they cabled to their families to join them here, and they will remain in America. We were sorry to lose them, but they could not resist the offers made to them."

National Arm, Bracket and Pin Association.

The second annual convention of the National Arm, Bracket and Pin Association will be held at St. Louis on October 11th, 12th and 13th. Members are requested to assemble at the Hoo-Hoo House at 10 a. m., and will then be notified of the place of meeting, after which they will adjourn to the Fair grounds for the afternoon. Every member and every manufacturer is earnestly requested to be present. Notices in the St. Louis daily papers will give the place of the second and third days of meeting. Arrangements for rooms have been made, and persons planning to attend are requested to notify the secretary, J. B. Magers, Madison, Ind. Rooms may be reserved at from 75 cents to $1.50 a day.

Michigan Electric Association.

The first annual meeting of the Michigan Electric Association will be held at the Griswold House, Detroit, on October 11th and 12th, beginning at 10 a. m. on the opening day. The executive committee has arranged a programme of talks and papers, and the Detroit companies will provide entertainment. Central-station men are invited to attend the meeting and to join the association. Social pleasures and sightseeing for the ladies will take a portion of each day. The association has now about 25 members, and the list is expected to be greatly increased at the Detroit meeting. E. F. Phillips of Detroit is president of the association and F. S. Hubbell of Milford is secretary.

About Shellac.

The rise in the prices of shellac has been the cause of some investigation among those interested in this trade. It is well known that lac is produced in almost every province in India, but principally in the central provinces, Bengal and Assam, from which the largest amounts exported are obtained.

True, it is produced in other districts, but from those sources is chiefly consumed in the local manufacture of bracelets, rings, beads and other trinkets worn as ornaments by the women of the poorer classes, and in the manufacture of wood lacquer work, which seems to have been begun in very remote times. Some very artistic work is now being done in this line.

Lac is the incrustation deposited by the lac insects on the branches of certain trees and is collected, as a rule, by the jungle tribes, who break off the branches on which it is deposited. In this state it is called stick lac, and is sold by the gatherers to local dealers, who sell it to the manufacturers of shellac or button lac, who put it through various processes, until it becomes the lac of commerce.

The United States and the United Kingdom furnish the principal markets for lac, taking by far the larger part of all that is produced. Smaller quantities are exported to Europe. Nearly all is shipped from Calcutta. The total importations in the United States during the last fiscal year amounted to 11,590,725 pounds at a total value of $2,713,687, which was received as follows:

Germany	13,644 pounds	$ 3,193
United Kingdom	2,965,008 pounds	755,117
British India	8,612,073 pounds	1,955,377

During the last 15 years there have been remarkable fluctuations in the amount exported from India. Since 1895 there has been a gradual reduction in prices, but during the last two years the product has been comparatively small, while the demand has largely increased. This increased demand is due mainly to the use of shellac in electrical work and in a minor degree for the making of gramophone records. This increased demand, the small production of the past two years, and the scarcity of stock have attracted speculators, which no doubt has further tended to advance prices. Another reason for the advances is the fact that the lac dye, which formerly represented the manufacturer's profit, has been replaced by aniline dyes, and the price of the lac has been increased in order to make up for the losses due to this falling off in the demand for dye.

The present high prices may stimulate production and reduce the prices, or the increasing demand may cause a further advance in prices. High prices may lead to the adulteration of shellac with resin, which has frequently been done, but it is said that the adulteration can always be detected by the smell.

Electrical Exports for August.

Electrical exports from the United States for the month of August amounted to a total value of $826,615. This is $402,691 less than the figure for August, 1903, when the value of electrical machinery and appliances exported reached $1,229,306. The deficiency is due to the exceptionally large amount of electrical appliances exported in August, 1903. This class of goods, which includes telegraph and telephone instruments, alone fell off by the amount of $475,656 in August of this year, as compared with August, 1903. Electrical machinery, on the other hand, shows an increase of $72,965 over August last year. The figures are as follows: Electrical appliances—August, 1903, $815,910; August, 1904, $340,254. Electrical machinery—August, 1903, $413,396; August, 1904, $486,361.

Following is a list of the principal buyers of electrical machinery from the United States and the value of the machinery which they imported for the month of August, 1904: United Kingdom, $156,855; British North America, $133,530; Germany, $40,105; Mexico, $38,060; Japan, $35,599; British Australasia, $27,461; Argentina, $9,400; France, $8,002; Cuba, $2,582; Philippine Islands, $2,525; British Africa, $2,485.

Leith to Have Electric Railways.

The Town Council of Leith, Scotland, has acquired the horse-car lines within the borough from the private company heretofore operating them, and proposes to reconstruct the system. Some weeks ago a deputation was appointed to examine tramways in England and obtain information regarding them. This deputation has returned to Leith from a tour of inspection and has recommended to the Town Council the adoption of a single-wire (overhead) electric system, the poles to be placed in the middle of the street, with an arm on either side. The style of car to be recommended is that used in Liverpool, having a movable cover over the top. The length of track of the Leith tramways is 5 1-9 miles (double). For further information, says the United States consul at Edinburgh, and for copies of specifications, etc., contractors should address the town clerk of Leith.

Street-railway Conventions in St. Louis Next Week.

The American Street Railway Association and affiliated societies will hold their annual conventions in St. Louis during the week beginning October 10th. The parent organization is to hold its meetings on October 12th and 13th. The American Railway Mechanical and Electrical Association will meet October 10th and 11th and the Street Railway Accountants' Association is scheduled for October 14th. All meetings will be held on the second floor of the Transportation Building, World's Fair grounds. The headquarters of the association will be at the Southern Hotel, where members can register and get their badges and other credentials, together with a complete programme of the meetings of the several associations and of all entertainments. The registration office will be in the lobby of the hotel and will be open Monday and Tuesday all day and on Wednesday morning.

The American Street Railway Association will meet at 10 a. m. on Wednesday, and President Francis of the Louisiana Purchase Exposition will address the gathering; also Mr. Rolla Wells, mayor of St. Louis. These speakers will be followed by Mr. W. Caryl Ely, president of the association, and Professor Goldsborough, chief of the Department of Electricity of the Exposition. The reports of the executive committee and of Secretary and Treasurer T. C. Penington will then be read.

Four papers will be read at this session. Two of these will be upon the steam turbine, one by J. R. Bibbins of Pittsburg, Pa., entitled "Steam Turbine Power Plants" and the other by Richard H. Rice of Schenectady, N. Y., upon "Steam Turbines." The other two papers are "The American Diesel Engine," by E. D. Meier, and "Transfers—Their Uses and Abuses," by Leon Jewell.

Following the reading of the papers will come the appointment of the nominating committee, after which discussion of the papers will take place.

Thursday's session will open at 10 a. m. with further discussion of papers read on the previous day, after which will come the committee reports, including the report of the nominating committee. Election of officers will then take place.

The American Railway Mechanical and Electrical Association will convene promptly at 10 o'clock on Monday, and a number of interesting papers will be presented. These, together with the regular business of the convention and the "question box," will occupy the time on Monday and Tuesday. The papers are: "Maintenance and Inspection of Electrical Equipment," by John Lindall, general foreman of shops of the elevated division of the Boston Elevated Railway Company; "Wheel Matters," by J. Millar, superintendent of rolling stock of the International Railway Company, Buffalo, N. Y., and the "Ideal Shop," by W. D. Wright, superintendent of equipment of the Rhode Island Company, Providence, R. I.

In connection with the Mechanical and Electrical Association and the Accountants' Association, an interesting feature will be the report of the joint committee appointed by these two associations to investigate the question of "Blanks for Shop Records and Accounts."

All entertainment features will be in charge of a committee of the Electric Railway Supplymen's Association. The committee in charge will hold its meeting at the Southern Hotel on Monday morning, October 10th. The members of this committee are: D. M. Blady, J. A. Brill, Calvert Townley, William B. Albright, Fred S. Kenfield, George J. Kobusch, J. R. Lovejoy, J. H. McGraw, W. J. Cooke and Scott H. Lewett.

It is expected that the coming convention will be a highly satisfactory one, as there is so much to be learned at the Exposition along electric-railway lines, outside of the convention sessions themselves. To help matters along, October 12th has been designated at "Street Railway Day" by the Exposition officials. As evidence that operating companies are taking more than ordinary interest, may be cited the fact that all heads of departments of the Cleveland Electric Railway Company will go to the convention at the expense of the company. A special Pullman car will be used to convey the officers and men to the meeting. The officers believe that the meeting and display will be of so much value to the men that it will be money well invested.

The total quantity of rubber exported from the Amazon River during the year 1903-04 amounted to 67,314,591 pounds, compared with 65,756,048 pounds in 1902-03. Of this amount 33,253,109 pounds went to the United States and 34,061,482 pounds to Europe.

The History and Development of Electric Railways.[1]

By Frank J. Sprague.

Part I.

Although the earliest recorded experiments date back three-quarters of a century, the electric railway is essentially of modern development, for it achieved a recognized position less than 20 years ago, long after the telephone, the arc and incandescent lamp and the stationary electric motor had been thoroughly established. This is but natural, for it is the logical outcome of the establishment of certain cardinal principles and practices in the kindred arts.

The first roads to carry passengers commercially were built in Europe, but the first railway experiments and the modern commercial impetus, as well as most of the essential and distinctive features of the art as it stands today, an example of almost unprecedented industrial development, are distinctively American.

Brandon, Vt., birthplace, and Thomas Davenport, blacksmith, father, are the names first on the genealogical tree of the electric railway, in the year 1834. A toy motor mounted on wheels, propelled on a few feet of circular railway by a primary battery, exhibited a year later at Springfield, and again at Boston, is the infant's photograph. This was only three years after Henry's invention of the motor, following Faraday's discovery 10 years earlier that electricity could be used to produce continuous motion.

From the records of Davenport's career, unearthed by the late Franklin Leonard Pope, this early inventor was undoubtedly a man of genius, deserving a high place in the niche of fame, for in a period of six years he built more than 100 operative electric motors of various designs, many of which were put into actual service, an achievement, taking into account the times, well-nigh incredible.

For nearly twoscore years various inventors, handicapped with the limitations of the primary battery, and in utter ignorance of the principles of modern dynamo and motor construction, labored with small result. About 1838, a Scotchman, Robert Davidson of Aberdeen, began the construction of a locomotive driven by a motor similar to that used by Jacobi in his experiments on the River Neva, which was tried upon the Edinburgh-Glasgow railway, and attained a speed of about four miles an hour.

In an English patent issued to Henry Pinkus in 1840, the use of the rails for current was indicated; also in a United States patent issued to Lilley and Colton of Pittsburg in 1847.

In 1847, Prof. Moses G. Farmer, late United States government electrician at the Newport station, one of the most learned and able of the early electric experimenters, operated an experimental model car at Dover, N. H.; and about three years later one Thomas Hall exhibited in Boston an automatically reversing car mounted on rails through which current was supplied from a battery. These are said to be the first instances in which rails were actually used as carriers of the current, as well as the first time where there was a reduction by gear from the higher speed on the motor to the lower speed of the driven axle.

About the same time Professor Page of our Smithsonian Institute, aided by a special grant from Congress, constructed a locomotive in which he used a double-solenoid motor with reciprocating plunger and flywheel, as well as some other forms. This locomotive, driven by a battery of 100 Grove elements, was tried the 29th of April, 1851, upon a railroad running from Washington to Bladensburg, and attained a fair rate of speed.

Patents issued in 1855 to an Englishman named Swear and an Italian named Bessolo, indicated the possibility of conducting current from a conductor suspended above the ground, and in 1864 a Frenchman named Cazal, patented the application of an electric motor to the axle of the vehicle.

From the experiments of Farmer and Hall a decade elapsed before the invention by Pacinotti in 1861 of the continuous-current dynamo, from which may properly be said to date all modern electric machines. These were developed in their earliest forms by Gramme and Siemens, Wheatstone and Varley, Farmer and Rowland, Hefner-Alteneck and others, and brought into existence the elements essential to any possible commercial success. Yet, notwithstanding that the principle of the reversibility of the dynamo-electric machine, and the transmission of energy to a distance by the use of two similar machines, said to have been discovered and described by Pacinotti in 1867—the same year in which Professor Farmer described the principle of the modern dynamo in a letter to Henry Wilde—and demonstrated independently at the Vienna Exposition by Fontaine and Gramme in 1873, many years more passed before the importance and availability of this principle were generally recognized.

From 1850 to 1875 is a long period, relatively, and yet there seemed to have been practically an entire cessation in the United States of electric-railway experimental work, until in the latter year George F. Greene, a poor mechanic of Kalamazoo, Mich., built a small model motor which was supplied from a battery through an overhead line, with track return, and three years later he constructed another model on a larger scale. Greene seemed to have realized that a dynamo was essential to success, but he did not know how to make one, and did not have the means to buy it.

Shortly afterward, in 1879, at the Berlin Exposition, Messrs. Siemens and Halske constructed a short line about a third of a mile in length, which was the beginning of much active work by this firm. The dynamo and motor were of the now well-known Siemens type, and the current was supplied through a central rail, with the running rails as a return, to a small locomotive on which the motor was carried longitudinally, motion being transmitted through spur and beveled gears to a central shaft, from which connection was made to the wheels. The locomotive drew three small cars having a capacity of about 20 people, and attained the speed of about eight miles an hour.

In the same year important experiments were carried on by Messrs. Felix and Chretien at the little village of Sermaize in France, to demonstrate the possibilities of the transmission of energy.

At Vienna, in the following year, Egger exhibited a model of an electric railway, the current to be supplied through the running rails. About the same time Messrs. Bontemps and Desprez were making a study of a scheme for replacing pneumatic transmission of dispatches by miniature electric locomotives in Paris.

The Siemens and Halske demonstration in Berlin was followed by others for exhibition purposes at Brussels, Düsseldorf and Frankfort, but no regular line was established until a short one, with one motor car at Lichterfelde, near Berlin, the first in Europe, or, in fact, in the world. This road was 1½ miles in length, used all-rail conductors, and was opened for traffic in May, 1881.

The motor was carried on a frame underneath the car between the wheels, and current transmitted from the armature to drums on the axles by steel cables. The car was of fair size, having a capacity of 36 passengers, and attained a maximum speed of about 30 miles. The electromotive force used was about 100 volts. This line was continued in regular service, but 12 years later the rail method of distribution was replaced by two conductors carried on top of poles, upon which ran a small carriage connected to the gear by a flexible cable.

Shortly after the same firm installed at the Paris Electrical Exposition of 1881 a small tramway about a third of a mile long, and used for the first time overhead distribution. In this case the conductors consisted of two tubes slotted on the under side, and supported by wooden insulators. In the tubes slid shoes, which were held in good contact by an underrunning wheel pressed up by springs carried on a framework supported by the conductors, and connected to the car by flexible conductors. The motor was placed between the wheels, and the power was transmitted by a chain.

About the same time Siemens constructed an experimental road near Meran, in the Tyrol, with a view of demonstrating the possibilities of electric traction for the St. Gothard tunnel, and later other small lines at Frankfort, Molding and elsewhere. These were followed by a comprehensive scheme for a combined elevated and underground road submitted to the city authorities at Vienna.

The invention about this time of accumulators directed attention to the possibilities of the self-contained car, and in 1880 a locomotive with accumulators was used at the establishment of Duchesne-Fournet at Breuil, and in the following year, Raffard, with a large battery of Faure accumulators, made experiments on the tramway at Vincennes.

In 1880 Dr. John Hopkinson, in describing the application of motors to hoists, proposed both for them and for tramways the simple series-parallel control for speed, a principle which, combined with resistance variation, later became universal.

Meanwhile, in the United States, two inventors, Stephen D. Field and Thomas A. Edison, began electric experiments almost simultaneously. Edison was perhaps nearer than any other on the verge of great possibilities had it not been that he was intensely absorbed in the development of the electric light, for he had, in the face of much adverse criticism, developed the essentials of the low internal-resistance dynamo with high-resistance field, and many of the essential features of the multiple-arc system of distribution. In fact, in 1880 he built a small road at his laboratory at Menlo Park, on which he ran a car operated by one of his earliest dynamos, from which the power was transmitted to the axle by a belt. One set of wheels was insulated, and the two rails were used for current. But, beyond taking out a few patents, and for a while acting in conjunction with Field, Edison did little in this particular field, and soon ceased to be a factor.

Perhaps more than to any other the credit for the first serious proposal in the United States should be awarded to Field. Curiously enough, patent papers were filed by Field, Siemens and Edison, all within three months of each other in the spring and summer of 1880. Priority of invention was finally awarded to Field, he having filed a caveat a year before. He had been actively interested in electric telegraphs, and in an account of his work published some 20 years ago, it is stated that he early constructed two electric motors, and had in mind the operation of street cars in San Francisco, but had not been able to do anything in the matter because of a realization that a dynamo must be used instead of a battery. In 1877, while in Europe, he saw some Gramme machines, and on his return two of them were ordered but not delivered. Later a dynamo was ordered from Siemens Brothers in London, which was lost, and this was replaced by another which arrived in the fall of 1878. Meanwhile, two Gramme machines were placed at his disposal, and shortly afterward an electric elevator was operated. In February, 1879, he made plans for an electric railway, the current to be delivered from a stationary source of power through a wire enclosed in a conduit, with rail return, and in 1880-81 he constructed and put in operation an electric locomotive in Stockbridge, Mass.

Pending the settlement of patent interferences between Edison and Field (the Siemens application, being late, was rejected), the two interests were combined in a corporation known as "The Electric Railway Company of the United States," and the first work of the company was the operation of an electric locomotive at the Chicago Railway Exposition in 1883. This locomotive, called "The Judge," after the late Chief Justice Field, ran around the gallery of the main exposition building on a track of about one-third of a mile in length. The motor used was a Weston dynamo mounted on the car and connected by beveled gear to a shaft from which power was transmitted by belts to one of the wheels. The current was taken from a center rail, with track return. A lever operated clutches on the driving shaft, and the speed was varied by resistance. The reversing mechanism consisted of two movable brush-holder arms geared to a disk operated by a lever, each arm carrying a pair of brushes, one of which only could be thrown into circuit at a time, and in such a way as to give the proper direction of movement.

Meanwhile, several other inventors were getting actively into the field of transmission of power and electric railways. In the summer of 1882 Dr. Joseph R. Finney operated in Allegheny, Pa., a car for which current was supplied through an overhead wire on which traveled a small trolley connected to the car with a flexible cable, and about the same time in England Dr. Fleming Jenkin proposed a scheme of telpherage which was developed by Messrs. Ayrton and Perry.

In the early part of the same year, the writer, then a midshipman in the United States Navy, who had in 1879 and 1880 begun the designing of motors, was ordered on duty at the Crystal Palace Electrical Exhibition at Sydenham, England.

While in London he became impressed with a belief in the possibility of operating the underground railway electrically. He first considered the use of main and working conductors, the latter being carried between the tracks, with rail return, but noting the complication of switches on certain sections of the road, conceived the idea of a car moving between two planes, traveling on one and making upper pressure contact with the other, those planes being the terminals of a constant-potential generating system. For practical application the lower of the two planes was to be replaced by the running track and all switches and sidings, and the upper plane by rigid conductors supported by the roof of the tunnel, and following the center lines of all tracks and switches, contact to be made therewith by a self-adjusting device carried on the car roof over the center of the truck, and pressed upward by springs.

In 1882 he applied for a patent on the first idea, which was but a variation from that shown in other patents, but the second laid dormant for nearly three years, because of central-station work, and the development of the application of stationary motors.

The storage battery still attracted attention, and in 1883 experiments were carried on at Kew Bridge, London. In the latter part of 1884 the Electrical Power and Storage Company of London, under the direction of Anthony Reckenzaun, began a number of trials. The same engineer repeated his work at Mill Wall, and later in Berlin. The car body in his last experiment was carried by two trucks, each of which was equipped with a motor driving one axle through a worm gear. Reversal was accomplished by using two sets of brushes, and speed was varied by using one or both motors; also by using the motors in series or parallel with a resistance to cut down sparking when making the change over.

Reckenzaun subsequently had charge of the experiments conducted by William Wharton of Philadelphia, in which both a Reckenzaun and a Sprague motor were used in 1886. Here series-parallel grouping of both batteries and motor circuits were used on the Sprague car, and a series-parallel and resistance variation of motors on the car operated by Reckenzaun and Condict.

Meanwhile, in the United States, Charles J. Van Depoele, a Belgian by birth and a sculptor by original trade, and an indefatigable worker, had become interested in electric manufacturing, and soon energetically attacked the railway problem. His first railway was a small experimental line constructed in Chicago in the winter of 1882-83, the current being supplied from an overhead wire. In the fall of

---

1. A paper presented before Section F of the International Electrical Congress at St. Louis, September 15, 1904.

Note.—The writer having been requested to prepare a paper on the subject of electric railways has done so with considerable reluctance because of his own connection with the art, and the difficulty under such circumstances in presenting events in a true perspective, unbiased by personal experiences. That such must be spoken of is, while embarrassing, somewhat necessary, and due allowances will, I trust, be made in my estimate of their importance.

1883, a car was also run at the Industrial Exposition at Chicago.

A year later a train pulled by a locomotive car, and taking current from an underground conduit, was successfully operated at the Toronto Exhibition to carry passengers from the street-car system, and again in the year following Van Depoele operated another train at the same place, using on this occasion an overhead wire and a weighted arm pressing a contact up against it.

Experiments were also carried on by him on the South Bend railway in the fall of 1885, where several cars were equipped with small motors, and also in Minneapolis, where an electric car took the place of a steam locomotive. Other equipments were operated at the New Orleans Exhibition, and at Montgomery, Ala., where the current was at first taken from a single overhead wire, which carried a traveling trolley connected to the car by a flexible conductor. Other equipments were put in operation at Windsor, Ont., Detroit, Mich., Appleton, Wis., and Scranton, Pa. In these several equipments the motors were placed on the front platforms of the cars and connected to the wheels by belts or chains. The cars were headed in one direction, and operated from one end only. In 1888 the Van Depoele company was absorbed by the Thomson-Houston, which had recently entered the railway field, and Van Depoele continued in its active development until his death in 1892.

Among the early American workers of this period none was for a time more prominent than Leo Daft, who, after considerable development in motors for stationary work, took up their application to electric railways, making the first experiments toward the close of 1883 at his company's works at Greenville, N. J., these being sufficiently successful to be repeated in November of that year on the Saratoga and Mount McGregor road. The locomotive used there was called "The Ampere," and pulled a full-sized car. The motor was mounted on a platform and connected by belts to an intermediate shaft carried between the wheels, from which another set of belts led to pulleys on the driving axles. A center rail and the running rails formed the working conductors. Variation of speed was accomplished by variation of field resistance, this being accentuated by the use of iron instead of copper in some of the coils.

In the following year Daft equipped a small car on one of the piers at a New York seaside resort; and a little later another one at the Mechanics' Fair in Boston, the motor for this last being subsequently put on duty at the New Orleans Exposition. In 1885 work was begun by the Daft company on the Hampton branch of the Baltimore Union Passenger Railway Company, where, in August of that year, operations were begun, at first with two and a year later with two more small electric locomotives which did not carry passengers themselves, but pulled regular street cars. A center and the running rail were used for the normal distribution, but at crossings an overhead conductor was installed, and connection made to it by an arm carried on the car and pressed up against it. The driving was by a pinion operating on an internal gear on one of the axles.

Daft's most ambitious work followed, when a section of the Ninth Avenue elevated road was equipped for a distance of two miles, on which a series of experiments was carried on during the latter part of 1885, with a locomotive called "The Benjamin Franklin." The motor was mounted on a platform pivoted at one end, and motion was communicated from the armature to the driving wheel through grooved friction gears held in close contact partly by the weight of the machine and partly by an adjustable screw device. This locomotive, pulling a train of cars, made several trips, but the experiments were soon suspended. This work was followed by street-railway equipments at Los Angeles and elsewhere, using double overhead wires carrying a trolley carriage.

Meanwhile, Bentley and Knight, after some experiments in the yards of the Brush Electric Company, at Cleveland, in the fall of 1883, installed a conduit system in August, 1884, on the tracks of the East Cleveland Horse Railway Company. The equipped section of the road was two miles long, the conduits were of wood laid between the tracks, and two cars were employed, which were each equipped with a motor carried under the car body and transmitting power to the axle by wire cables.

These equipments were operated with varying degrees of success during the winter of 1884-85, but were abandoned later. This work was followed by a double overhead-trolley road at Woonsocket, the motors being supplied by the Thomson-Houston company, and later by a combined double-trolley and conduit road at Allegheny, Pa.

In 1884 Dr. Wellington Adams of St. Louis proposed a departure in motor mounting which recognized the necessity of removing the motor from the car body and directly gearing it to the axle. In his plan the field magnets were carried by the pedestals, and enclosed the axle, on which the armature was to revolve, its motion to be transmitted by gearing. The method was impracticable, and found no application.

In 1884-85 J. C. Henry installed and operated in Kansas City a railway supplied by two overhead conductors, on each of which traveled a small trolley connected to the car by a flexible cable. The motor was mounted on a frame supported on the car axle, and the power was transmitted through a clutch and a nest of gears giving five speeds. In the following year a portion of another road was equipped. A number of experiments seem to have been conducted there, and on some the rails were used as a return. The collectors were of different types, and it is said that, among others, there was one carried on the car. The final selection was a trolley having four wheels disposed in pairs in a horizontal plane, carried by and gripping the sides of the wires. This feature, but using one wire and rail return, characterized a road installed by Henry in San Diego, Cal., opened in November, 1887.

In the early part of 1885 Sidney H. Short began a series of experiments on a short piece of track in Denver, which was followed by the construction, in conjunction with J. W. Nesmith, of a section of road for operation on the series system. These experiments were continued through 1885 and 1886, and were repeated at Columbus, but were doomed to ultimate failure because of the principle involved. Subsequently Short adopted the multiple system of distribution, and for a time essayed the use of gearless motors for tramway work, but reverted later to the geared type.

Meanwhile, work had begun in Great Britain, where the first regular road to be put in operation was that known as the Portrush electric railway, in Ireland, installed in 1883 by Siemens Brothers of London. Power was generated by turbines, and the current was transmitted by a third rail supported on wooden posts alongside of the track, the running rails constituting the return. The pressure used was about 250 volts.

This was followed in the same year by a successful, short road at Brighton, installed by Magnus Volk, the current being transmitted through the running rails. Then came the railway installed at Bessbrook, Newry, in 1885, under the direction of the Messrs. Hopkinson, and at Ryde, in 1886, in which latter year was also installed the Blackpool road by Holroyd Smith. In this latter case the conduit system was used with complete metallic circuit. The motor was carried underneath the car between the axles, and connected by chain gearing. Fixed brushes with end contact were used for both directions of running.

[To be concluded.]

Prize for the Best "Trolley Song."

The Detroit United Railway of Detroit, Mich., has made arrangements for another prize contest through which the management hopes to arouse interest in musical circles, and also, if possible, bring out the words and music of a song that shall fittingly represent the remarkable progress in the extension of the electric railway.

The prize is $200. The composition need have no reference whatever to the Detroit United Railway. It is to symbolize the great field of electric transportation. The author is to retain the copyright of his composition. It is, however, to be dedicated to the Detroit United Railway, which company retains the privilege of reproducing words and music in any publication and of using the song in any advertising literature. Words and music may be the joint effort of two authors, but words must fit music. No unattached verses or music will be considered.

The task of judging the merit of the compositions and awarding the prize will be left to a committee of three musicians. No names or addresses must appear upon any manuscript. A separate letter must accompany each contribution, which in the competition, will be designated by a number. The music must not be too pretentious or the verses too voluminous. The competition will be open for several months, the precise time limit to be stated subsequently. All contributions must be mailed or delivered to Mr. John H. Fry, Detroit United Railway, 12 Woodward Avenue.

Bank Vault Opened by Electricity.

The vault of the Franklin Savings Bank in Boston refused to open one day recently. It simply was one of those cases which happen about once in a thousand times, where the combination refuses to work. Finally electrical experts were called in and during the night they began their work. They were furnished with a detailed plan of the vault, and, by careful calculation, fixed upon just the particular point at which to begin operations to realize the best results with the least damage to the vault. They took a carbon and made an electrical connection between it and the wires of the Edison company outside the building. With a current amounting to 1,500 amperes they began to melt a hole through the door. The carbon soon grew white hot, and the light was so intense that the electricians were obliged to wear thick dark glasses to protect their eyes. For 2½ hours during the night the electricians continued at their work, at the end of which time they had bored quite a good-sized hole through 2½ inches of iron. But that did not actually open the safe, and further operations were postponed until morning. By the use of steel instruments an edge of one of the bolts on the inner surface of the heavy door was chipped off, and when this was done the bank officers and employes gathered about the vault to see the door swung open at 10:30 in the forenoon.

The method is an old one, but this particular application excited much attention in Boston.

The Production of Iron Ores in 1903.

Again the United States has surpassed all competitors in its yearly output of iron ores. This is the most important fact contained in the report made by Mr. John Birkinbine to the United States Geological Survey on the production of iron ores in 1903. The quantity of iron ore produced in the United States in the year ending December 31, 1903, was 35,019,308 long tons. This means a decrease of 534,827 long tons, or about 1½ per cent. from the maximum of 35,554,135 long tons in 1902. The quantity mined in 1903 is, however, the second largest recorded, and is greater than the combined totals for the year 1902 of Germany, Luxemburg and the British Empire, which are the nearest competitors of the United States. The data for 1903 for these countries are not yet available, but the same comparison will probably prove true for this year also.

The iron ore obtained in 1903 came from 22 states and two territories. Minnesota, Michigan, Alabama and Wisconsin were the leaders in production. Nevada was added to the list of producing states, while Vermont and Montana reported no ore mined in 1903.

The iron ore mined was of the four general commercial classes—red hematite, brown hematite, magnetite and carbonate. In 1903 the quantity of red hematite mined in the United States was 86.6 per cent. of the total for the country, and of that Minnesota contributed over one-half. Alabama was the most important contributor of brown hematite. The three principal states that mined magnetite in 1903 were New Jersey, New York and Pennsylvania. The red hematite showed a decrease of about one per cent. from the production of 1902, the brown hematite and the magnetite a decrease each of seven per cent. Only the carbonate ores, the least important class, showed an increase over the output of 1902. That increase amounted to no less than 26 per cent. As in 1902, all of this class of ore was obtained in Ohio and Maryland.

The Lake Superior district stands pre-eminent as a producer of iron ore. Its annual output exceeds that of any foreign country, and the average character of its ore is excellent. In the year 1903 the Mesabi and Vermilion ranges in Minnesota, the Marquette range in Michigan and the Menominee and Gogebic ranges in Michigan and Wisconsin produced a total of 26,573,271 long tons of iron ore. Of this ore the Mesabi range alone produced 51 per cent. In addition to the above-named ranges in the United States, a sixth, the Michipicoten range was opened in Canada in the year 1900, but its product in 1903, 223,976 long tons, is not included in the above data.

Of special interest in connection with the production of Wisconsin is the fact that the year 1903 witnessed the initial output of iron ore in the new Baraboo iron range, near the town of Freedom in the southern part of the state. These deposits of Bessemer ore which are within convenient railroad haul of the blast furnaces at Chicago may furnish important additions to the ore supply of these furnaces.

The state of Pennsylvania showed a decline of 22 per cent. from the total of 1902. This decline is due almost entirely to the diminished output of one of the large mines, the Cornwall Ore Hills, to which Pennsylvania has been mainly indebted for its position as a prominent producer of iron ores. New Jersey, on the other hand, showed an increase of nearly 10 per cent. over its 1902 production. The construction of several modern furnaces was the chief cause of the increased output in New Jersey, and it is probable that an augmented production may be expected in the near future.

The total value at the mines of the 35,019,308 long tons of iron ore produced in the United States in the year 1903 was $66,328,415, or $1.89 a ton, an increase of five cents a ton, or three per cent. over the value per ton in 1902, viz., $1.84. In 1903 the highest average value at the mine was placed on the Colorado iron ores, viz., $3.12 a ton, and the lowest on Texas ores, $1 a ton.

Iron ore to the amount of 980,440 long tons, valued at $2,261,008, or $2.31 a ton, was imported into this country in 1903 from Cuba, Canada, Spain, Newfoundland, Algeria, the United Kingdom, British Columbia, Belgium and Germany. It is evident from the relatively high value placed on the ores from some countries that the estimate is based on some other constituent than the iron contained in the ore. The total export of iron ore in the year 1903 was 80,611 tons, valued at $255,728. The greater portion of this went to blast furnaces located in the province of Ontario, Canada.

High-voltage Experiments at Niagara Falls.

Some time ago Mr. J. E. Aldred of Boston, Mr. James Ross of Montreal and Mr. Frederic Nicholls of Toronto jointly contributed a sum of money to enable Mr. Ralph D. Mershon to take up certain high-voltage experimental work, the results of which are to be made public in a paper by him. The preparations for this work, which will be done at Niagara Fall, N. Y., are about completed, and the work itself will soon be under way. It is proposed to take measurements on an experimental line up to at least 100,000 volts, and possibly as high as 200,000 volts.

Ohio Telephone Notes.

Pay stations may be established throughout Cleveland by the Cuyahoga Telephone Company, if the Board of Public Service grants the privilege to try experiments at two points. The idea is to place small automatic telephone boxes on the telephone poles, so that anyone desiring to use them may drop a nickel in the slot and secure the service at almost any point, as he may get any number he desires. At first, the management desires to place only two such boxes in operation, both in the residence district on Euclid Avenue.

The Union Trust Company of Cincinnati and the Dayton Savings and Trust Company of Dayton have purchased the $250,000 bond issue of the Home Telephone Company of Dayton at almost par. The company will retire bonds bearing a higher rate of interest.

In connection with the telephone system established in the Colonial Hotel in Cleveland, the Bell company has established a fire-alarm system that is quite unique. On receipt of a signal of fire a switch at the hotel switchboard may be turned and a small bell in each room will ring continuously. The company has equipped all of the 200 rooms in the hotel and established an up-to-date switchboard in the office, doing away with the old annunciator system.

Henry Greenler is the president of the Farmers' Telephone Company of Highland Township, Defiance County, which will have connections with 28 other systems of the same kind. A line may be built to Defiance to connect with the local system.

The Newark Telephone Company of Newark has declared a one per cent. quarterly dividend on common stock. A toll line to Gratiot has been opened and service is furnished to a number of subscribers.

The Oil Belt Telephone Company of Norwalk has been incorporated with a capital stock of $25,000, by H. E. Graham, J. R. McKnight and others.

The council of Miamisburg has granted a franchise to the Montgomery County Telephone Company, which is composed largely of Dayton men.

A number of the auxiliary companies of the Federal Telephone Company will pay a dividend the coming year. President Dickson believes that stockholders should have dividends as soon as the companies are earning a fair amount above the fixed charges. C.

Michigan Telephone Matters.

The Citizens' Telephone Company of Lowell has announced an increase in rates, to take effect on October 1st, from $9 to $12 per month.

A bitter fight is now in progress between the Michigan State Telephone Company and the Union Telephone Company in Owosso. The Union company has headquarters at Alma, with hundreds of miles of toll lines in the western part of the state. This company was organized seven years ago and is in a prosperous condition. The Bell interests started by cutting rural telephone rates to low figures, and then turning their attention to the city of Owosso. Mayor Stanley E. Parkhill, who is also president of the Union company, will resign the latter position, in order that another man may take his place directing the fight against the Bell interests. The Chamber of Commerce, which represents nearly all of the business in the city, has unanimously adopted a resolution declaring the two telephone systems an unnecessary burden, and that after October 1st the Union telephones will be used exclusively. The Bell company has only 90 telephones in Owosso not duplicated by the Union company, and the latter company is fast replacing or duplicating these.

The Reading Central Telephone Company has completed the arrangements with the Michigan State Telephone Company which gives the latter company the exclusive right to the local exchange in Hillsdale and allows the Reading company the rest of the county. The Michigan State Telephone Company transfers its local exchange in Reading to the local company, thus giving the latter a business of over 400 rural telephones in the county. This also gives the subscribers of either company free exchange between Hillsdale local and Reading local or rural lines. W.

Telephone News from the Northwest.

E. J. Cooper of Minneapolis is looking over the field with a view to building a telephone line between Two Harbors and Grand Marais, Minn., 110 miles. Grand Marais is on the north shore of Lake Superior, and has no railroad connection.

W. B. Bascom, new owner of the local exchange at Harvey, N. D., will rebuild the system on a central-energy basis.

A rural telephone line will be built by the Farmers' Telephone Company from Mansfield to Faulkton, S. D.

The Marion (Wis.) and Northern Telephone Company contemplates extending a line to Shawano.

Mager & Camden have installed a local telephone exchange for Walhalla, N. D., with a list of 60 subscribers.

The city engineer of St. Paul carried out his threats to remove the wires of the Twin City Telephone Company from Hague Avenue, between Victoria and Lexington. The telephone company secured a restraining order to prevent any further destruction of its lines and started repairs. After arresting a number of the workmen an agreement between the city and the company was reached to allow matters to rest until the hearing on the application for a permanent injunction.

The completion of the Tri-state Telephone Company's lines to La Crosse, Wis., from the Twin Cities resulted in a reduction of rates from 75 cents to 50 cents.

The Boone County (Iowa) Telephone Company has given a mortgage for $50,000 to J. H. Herman, as trustee, to secure five per cent. bonds issued to that amount.

The Emmet County Telephone Company has been organized at Estherville, Iowa.

The central station of the E. H. Martin Telephone Company of Webster City, Iowa, is being rebuilt.

E. N. Egge has purchased the Thornton (Iowa) telephone exchange.

The Mauston (Wis.) Electric Light and Power Company and the Mauston Telephone Company have consolidated as the Mauston Electric Service Company. P. D. Curran is president and A. W. Hasig secretary. R.

Independents Organize in Pennsylvania.

Pennsylvania Independent telephone men formed a state association at Harrisburg last week, when President J. B. Hoge of the National association addressed them. The organization was completed with the following officers: President, B. F. Meyers of Harrisburg; vice-presidents, R. E. Flinn of Pittsburg, Charles Griffith of Johnstown and H. E. Bradley of Philadelphia; treasurer, C. E. Wilson, Philadelphia; executive committee, B. F. Meyers of Harrisburg, C. E. Wilson and J. G. Splane of Pittsburg, Judge Robert E. Umbel of Uniontown, W. D. Barnard of Philadelphia, E. D. Scade of Johnstown, William B. Trask of Erie, B. G. Rudy of York and C. W. Kline of Hazleton; trustee, Ellis Orvis of Bellefontaine. The new association will be a member of the National association.

TELEPHONE MEN.

Judge J. M. Thomas, for several years president of the Independent Telephone Association of the United States, is lying very ill at his home in Irvington-on-the-Hudson, New York, and the physicians hold out no hope of his recovery. Mr. Thomas is one of the prominent figures in Independent telephony and the high regard in which he is held is shown by a resolution passed at the recent convention of the association in St. Louis, reciting "that, without detracting from the value of the services rendered the cause of Independent telephony by many others, the association recognizes in Judge Thomas one who has done more for this cause than any other living man."

James B. Hoge, the recently elected president of the National Independent Telephone Association, was born in Ohio in 1866. He became a railroad telegrapher and afterward embraced business pursuits. In Lorain, Ohio, he became interested in telephone work, later becoming connected with the Everett-Moore syndicate. The head of this organization, recognizing his ability, in 1898 made him secretary of the United States Telephone Company, when he moved to Cleveland. He still holds the position of secretary of the United States Telephone Company, and is also vice-president of the Federal Telephone Company. Mr. Hoge is a man of pleasant address, and although a busy man, is always ready to give attention to those who desire to consult him. He is married and has three children.

EXTENSIONS AND IMPROVEMENTS.

The Interstate Telephone and Telegraph Company will build a line from Pine City, Wash., through Thornton to St. John.

The Kansas City Home Telephone Company of Kansas City, Mo., has just secured a franchise for the suburb of Argentine, Kan.

The Southwestern Telegraph and Telephone Company has let the contract for improvements to its exchange building in Houston, Texas, to cost $15,000.

Work is progressing rapidly on the exchange and equipment of the Utah Independent Telephone Company at Ogden, Utah, and the management announces that the system is about ready for operation. A carload of instruments arrived reeently and Salt Lake and Ogden will be connected with 500 telephones to begin with.

Barber & Brailey of Toledo, Ohio, have secured control of the Independent telephone plant at Hot Springs, Ark., and will make important improvements at once. It is planned to construct quite a little underground work within the next few months. The switchboard capacity will also be enlarged and other work done. J. S. Brailey, Jr., and L. M. Flesh are in charge of the work.

The Pacific States Telephone and Telegraph Company will soon commence work on a new telephone building on Bush and Belden Streets, San Francisco. The building will be six or seven stories in height and will cost about $100,000. It will be used exclusively for operating purposes and will be equipped with the very best and most approved styles of apparatus. The structure is to be completed within a year.

GENERAL TELEPHONE NEWS.

The New Boston (Texas) Telephone Company is advertising its exchange for sale.

L. J. Pettijohn has been granted a franchise to put in a telephone system at Dodge City, Kan.

The Fairfax Telephone Company of Fairfax, Okla., has been incorporated with a capital stock of $10,000.

J. H. Young has been awarded the contract for building the telephone line from Gallup to Zuni, N. M.

The Lacy Telephone Company has been incorporated in Longview, Texas, with a capital stock of $25,000.

J. P. Wilkinson of Comanche, Tex., has succeeded to the entire business of the Comanche Telephone Company.

C. E. McHargue of Fulton, Kan., has sold his stock in the Osage Valley Telephone Company to Frank H. Niles.

The Home Telephone Company of West College Corner, Ind., has increased its capital stock from $4,000 to $25,000.

The Ontario (Canada) Municipal Association has passed a resolution favoring the purchase by the government of the trunk telephone lines.

The Lacey Telephone Company of Longview, Texas, has been incorporated with a capital stock of $35,000 by J. C. Lacey, E. Lacey, J. W. Yates and others.

The Kinloch Long-distance Telephone Company of St. Louis has increased its capital stock from $2,000,000 to $3,000,000, and will invest the increase in additional lines.

J. S. Haley of Independence, Mo., has just sold the Independent telephone exchanges in Warrensburg and Knobnoster, Mo., to the Kinloch Long-distance Telephone Company of St. Louis.

It is reported that a new telephone company has been incorporated at Colorado City, Colo., to be known as the El Paso Telephone Company and having a capital stock of $500,000.

The Ottumwa Telephone and Electric Company of Cleveland, Ohio, has been incorporated with a capital stock of $150,000, by J. A. Smith, E. A. Williams, Charles K. Carter, Fred L. Taft and G. M. Wagner.

C. W. Hinchcliffe of Tucson, Ariz., manager of the Arizona Telephone Company, has been in consultation with W. F. Holt, owner of the line at Imperial, Cal., with a view to the extension of the system.

The Osage Valley Telephone Company at its annual meeting at the main office in Fulton, Kan., elected A. J. Ball, president; E. T. Shaffer, vice-president; Frank H. Niles, secretary, and L. M. Byington, treasurer.

A subscription is being taken up for a telephone system in Vallejo Township, Cal. Ernest Ormsby is one of the promoters of the project. Telephone systems will soon be in operation in all the rural precincts near Petaluma.

The Kansas City (Mo.) Home Telephone Company has taken over the business of the Western Independent Telephone Company, which was the corporation under which the toll lines of the surrounding country were operated.

The Citizens' Telephone Company of Newcastle, Pa., the Union Telegraph and Telephone Company, and the Mercer County Telephone Company are included in a merger of all Independent companies of Western Pennsylvania and Western New York under the name of the Erie Telephone Company.

Among the telephone companies incorporated in Indiana last week were the following: Prairie Branch Telephone Company, Hancock County; capital, $130; directors, Jesse W. Beeson, Orlando Jessup, M. L. Jones, W. J. Swain and Harry Junken. Pullman Telephone Company, Elkhart, capital stock, $10,000; incorporators, Martin E. Crow, John K. Johnston. People's Mutual Telephone Company, Wolcottville; capital stock, $2,000; incorporators, A. L. Ehrleman, Daniel Stroyer, A. W. Muller.

The Lake Shore and Michigan Southern railroad has made the final connections in its telephone system which it has installed along its entire line from Chicago to New York. The line was established primarily so that officials in New York and Chicago could have a quick and satisfactory means of communication with each other and with all parts of the system. The line was not constructed with the purpose of employing it in place of the telegraph in train dispatching, but will be used extensively as an auxiliary of the telegraph system in the transmission of orders concerning the making up of trains and other similar details when the wires are not in service for more important long-distance conferences.

All the cable street railways in Kansas City are being replaced by electric lines. It is impossible to tell just how long it will be before traffic is resumed. Part of the track is being relaid with a specially devised rail on account of the heavy grade.

Central Telephone Exhibit at St. Louis.

Prominent among the telephone exhibitors at the World's Fair at St. Louis is the Central Telephone and Electric Company of that city. Fig. 1 gives a front view of the booth, which is located in the Palace of Electricity. The facade is decorated in white with gold trimmings, the company's name appearing in gold letters in the center. On each side is the well-known arrow trademark in red, white and blue.

The interior of the booth (Fig. 2) is decorated in red burlap to the chair rail, and above this the walls and ceiling are covered with a light green burlap. Small silk flags of all nations are used for further decoration of the side walls. All woodwork of the interior of the booth is white. On the side wall in the booth are shown all styles of telephone apparatus of this company's manufacture in various woods and finishes, there being five different finishes for each style of telephone. There are central-energy instruments with and without local battery, and bridging and series-magnet telephones in six different designs; also central-energy intercommunicating telephones, the "adjustaphone" in six different forms, and various designs of desk-telephone adjustment. There are also shown the Central giant extension bells, extension bells with condensers and regular types of extension bells.

On the pillars and pedestals of the booth are displayed the various types of Central protectors, in which the well-known patent-wrapped fuse is used. Here also are single and double-line fuse blocks, distributing boards, cross-connecting boards (plain and with test clips), self-soldering heat coils and a full line of the celebrated Becker terminal heads. The Central Telephone and Electric Company is proud of its success in the protector line and is making this department a prominent feature of its exhibit.

Fig. 1. Front View of Booth.

Fig. 2. Interior View.

CENTRAL TELEPHONE EXHIBIT AT ST. LOUIS.

In the center of the booth has been placed a powerful motor-driven punch press, on which will be shown the manners of making parts for the protectors, and workmen will assemble these parts on porcelain base blocks, which will be given to customers as souvenirs.

The company is also well provided with other souvenirs in the form of miniature watch-charm receivers, button pins with its trademark and the handsome instrument catalogue, in which are shown various views of the exposition exhibit buildings, the Cascades and World's Fair sculpture. The company extends a hearty invitation to all telephone men to visit it and make this booth headquarters while at the Fair, but to those prevented from doing so it will mail free of charge on request the souvenirs mentioned above.

The Central Telephone and Electric Company is the outgrowth of the business started by its president, Mr. J. S. Cuming, just nine years ago. At the present time the company occupies an entire building of three floors and cellar, having 50,000 square feet of floor space. The sales during the year 1903 amounted to just 20 times the amount of the first year's sales. The company adopted the policy of being able to furnish the telephone buyer with everything he may need. It has the St. Louis agency for the American Steel and Wire Company (bare iron wire), American Electric Works (paper-insulated telephone cable), General Electric Company's rubber-covered telephone wires, and other high-class supplies.

Mr. C. H. Wallis, the vice-president, is the general traveling representative, and is particularly well-known in Wisconsin and Kansas. He also has customers in Illinois, Arkansas, Indian Territory and Oklahoma. Mr. W. L. Moase, sales manager, is an old-time electrical man, though comparatively young in years. He served his apprenticeship with the old Detroit Electrical Works. Mr. J. A. Becker, superintendent, started with Mr. Cuming nine years ago and is still at it. He is the inventor of the Becker terminal head and has been in charge of the factory for several years past. Mr. Leo Brandewiede, secretary, is the financial man. Mr. W. F. Gradolph, telephone engineer, is well known as a practical telephone man of the first rank. He has been at it for 20 years; had his schooling with the Bell and has been connected with several leading Independent telephone factories. Mr. William Hahne, foreman of the switchboard department, is a "side partner" for Mr. Gradolph, and would rather trace a circuit than eat a good meal. Mr. Homer Wooldridge, foreman of the department of transmitters and telephone assembling, has personally made over 10,000 transmitters and knows when they are right.

American Telephones for Brazil.

One of the first telephone contracts awarded any Independent manufacturer in the United States from South America has recently been placed by the Comp. Telephonica do Estado de Sao Paulo, of Sao Paulo, Brazil. The equipment contracted for is for replacing and greatly enlarging the company's present system, which is to be extended to cover the entire city, having at present a population of nearly 100,000. The local telephone company was represented by Eduardo de Aguiar D'Andrada, chief electrical engineer of the Sao Paulo Railway Company, and Edgard de Souza, chief electrical engineer of the Sao Paulo Light and Power Company, who thoroughly investigated the systems and sample parts and passed on the tenders from manufacturers of large exchange equipments in the United States, and also of foreign manufacturers, and recommended the adoption of the International self-restoring drop full-multiple switchboard equipment. The contract, secured by the International Telephone Manufacturing Company of Chicago, consists of a 4,000-line capacity multiple generator-call switchboard, fully equipped for the immediate operation of 1,500 lines, including complete power plant, storage-battery set for busy test, pilot lamps, operators' instruments, etc., together with rack for main and intermediate distribution, lightning arresters and sneak-current protectors, all complete ready for installing.

MANUFACTURERS AND DEALERS.

A. J. Rousseau, representing the Automatic Electric Company, Chicago, is now making an extensive business trip throughout the territory south of the Ohio River. Mr. Rousseau's efforts in the Independent telephone field in general are well known and his work for "automaticity," although he has only been a short while in this branch of the field, is bringing his company excellent results.

The Independent telephone companies are rapidly coming to the conclusion that a great deal of revenue may be derived through operating private branch exchanges in certain localities. An instance of this is shown by the recent equipment shipped to the Topeka Independent Telephone and Telegraph Company, Topeka, Kan. This calls for a private-branch-exchange equipment for installation in the high school at Topeka. The subscribers' lines for private branch exchange are supplied with current from a local installation of dry batteries, this plan having been thought the most economical one by the Topeka company. The equipment further consists of a complete arrangement for incoming and outgoing trunk circuits. The switchboard was built by the American Electric Telephone Company of Chicago.

The Egerton Tramway Company opened its new electric-car system in Pictou County, Nova Scotia, recently, when the municipal authorities were taken over the trolley line. The line is eight miles long and connects the coal-mining and steel-manufacturing towns of Westville, Stellarton, New Glasgow and Trenton, with an aggregate population of 15,000. The roadbed and car equipment are said to be the finest in Eastern Canada. The system, including the power house and the trestle bridge across the East River, has been completed in six months.

Planning a Telephone System.[1]

By Samuel G. McMeen.

I suppose a good many of you are saying: "I hope it won't be a long story; I hope he has not put in a lot of figures." Well, it isn't; and I haven't.

If all the towns were about alike in the way their people are distributed over the town's territory; if the prices of materials did not change; if no improvements were made in machinery and supplies; if there were reasonable expectation that styles and fashions in telephone things would be constant; if it were just as easy to dig holes and ditches in the ground in one town as in another; if the people in one town were just as wealthy as in any other, and if the long-distance line system were now complete enough to cover the continent—then, planning a telephone system would be easy. In such ideal conditions a person with the telephone fever might place an order with the manufacturers for "one standard equipment of so many stations," and with the contractors for "one standard system of so many lines." And there would be a great final gratification in the fact that the real investment would be found very much like the original estimate—a condition which happens so seldom as to be quite striking when it does occur.

A certain gentleman who wanted to overhaul the plumbing in his house declined to give money to charity when requested. His reason was that he was about to spend several thousand dollars on his house, as the estimate alone was $350. Some of the people who have been attracted to the telephone business because it seemed to be cheap and easy may drop a tear of sympathy.

It is no news to say that a plan for a telephone system, whether it includes merely an exchange for a town or a toll-line system as well, must plan to build the system at the lowest possible cost in investment, and the lowest possible costs of operating the thing when done, keeping it in operating condition, replacing parts of it when they are worn out, and replacing other parts at just the time it is wisest to do so to get the advantages of newer and better ways. There is a real difference between the annual cost of keeping the thing in operating condition, ordinarily called "maintenance," and the annual cost of replacing parts which are no longer serviceable, due to their having worn out or become superseded by something better. It has been supposed that the cost of operation depends mostly on good management, and this is probably true; but the more recent development of automatic apparatus is causing some of the old timers in the business to sit up and take notice. I do not mean to say that it is always cheaper to make the connections by machinery than by hand, but that there is much more reason now to believe that such a result may be reached than there was five years ago.

To accomplish the lowest cost in investment does not always mean lower annual costs in maintenance, depreciation and operation. You have seen systems which impressed you as having come into being largely by accident; in some of these a little inspection of the accounts will show such annual sums of unnecessary outlay as are really adding substantially to the effective investment. As a fundamental principle, it is supposed to be best to run your business on your own capital; but there are many telephone exchanges in which borrowed money applied in betterments would pay interest on itself, and a substantial profit besides. This because of the greater saving, even though the borrowed investment did not increase the gross revenue at all.

Difference of opinion among telephone men as to the right number of offices to establish in a fairly large city have been supposed to be due to the natural tendency of men not to agree with each other. In large cities in Europe there exists a liking for

1. A paper read before the Independent Telephone Association of the United States at St. Louis, September 22, 1904. Mr. McMeen is a consulting telephone engineer in Chicago.

one central office, with a large number of lines. In the larger cities in the United States, it is quite usual to prefer a number of offices. The explanation is very simple. As telephone systems are now built, a very large part of the annual cost of merely owning the system a year at a time, is in the wire plant; and this in a large city of only reasonable density of population, varies strikingly with different arrangements of the lines in offices: when they are centered in one office it is quite the rule that the average length of line is greater than when part of the lines center in one office and other parts in others. It is true that where there are several offices in a city, these must be joined to each other by trunk lines; but as trunk lines are so heavily used, it is never true that the total amount of wire in subscribers' lines and trunks is as great with several offices as it is with one.

In the cities of Europe a great many more people live in a given space than here. The lines are therefore shorter. Labor is cheaper. And in some cases a one-office arrangement was chosen because the engineers made a bad guess.

If there were no other reasons to be considered, more than one office in a town would generally be cheapest; but, fortunately, or unfortunately, the cost for operators is always greater in the several-office arrangement than in that of one office. But in any town whatever, an arrangement can be found in which the total cost of owning and operating and keeping up the lines and offices, when taken as a whole, will be the least. In laying out a system of reasonable size, finding the number of offices and where they ought to be is one of the important considerations; and it is a condition which, if poorly established, can absorb a surprisingly large amount of money each year.

In a small city, one office is nearly always the best arrangement, and in the past it has been customary to assume that this would be so, and to plan accordingly, leaving the consideration as to what future arrangement might be best, to be taken care of by the future. It has resulted—and will result again—that it is found that the one office originally established is in a surprisingly bad place when the day does come that others must be opened. By being in a bad place I mean simply that when additional offices are established, this first one may be found by its location to be adding to the annual cost of owning, operating and keeping up the system.

In establishing any office, even if the exchange be small, wisdom of choice is required with reference to the location of the building, its size and its character. I have pointed out that the location of the building has an effect on the length of lines. It also has an effect on the fire risk, and sometimes there is also a risk from high waters. Service has been interfered with by fire in an adjoining building, even though there was no immediate danger to the central office itself. Whether the building be owned or rented, the arrangement of the apparatus in it is best when not only the exact location of future additions is taken into account, but when a growth of unexpected amount is provided for. Instances have occurred where a plan otherwise good has been found to be very bad because the growth was great enough to carry the switchboards against a wall which could not be removed and in which direction the building could not be extended.

The best central-office arrangement, other things being equal, is that which carries the entering cables, and those which are joined to them, through their runs with the greatest directness, and, therefore, at the smallest cost. In the larger offices a saving of a foot length in a cable run is a very considerable advantage.

As to choice among the many types of equipment now available, one may gain a great deal of information from the manufacturers, as they will tell you all about the good points of their own manufacture, and sometimes about the bad points of that of others. A great deal of light is thrown upon the situation and the embarrassment of choosing is much relieved by the application of a few simple but exacting tests to samples submitted by the manufacturers. In every case the prospective purchaser has a great advantage if he purchases in accordance with definite specifications covering his exact needs, because these things not only assist the manufacturer in knowing exactly what is called for, but assist the purchaser in protecting himself in case the things delivered are not satisfactory.

In all except the very smallest offices careful planning of the equipment will usually make a saving in the expense of operators. Where local and toll duties devolve on the same operator during quiet hours, economy and convenience may both be accomplished by an intelligent arrangement of the switchboard locations.

Since the first introduction of the lead-covered cables there has been a decrease in the use of bare open wire. Except as to the cost of the system, there is no reason why all wires should not be in cables. Where the development is very dense it is really cheapest to carry cables directly into the buildings, but in residence districts it is best to strike a happy medium between all-cable and all-open wire. Because a subscriber should be connected as soon as his contract is secured; because to do so means a line must be ready for him in advance; because the future development of the residence districts can be guessed with less exactness than the denser districts, it is necessary that the multiple-tap method of distributing-cable conductors be used at least in some degree. If intelligently applied the multiple-tap method also reduces the wire-plant cost below that of the more cumbersome open-wire treatment of line ends, with its attendant maintenance expense and annoyance of service interruption.

Like many other good things, however, the multiple-tap system may be practiced to excess. There is no involved mathematical formula which will answer the multiple-tap question for a given town, but it is possible and necessary as well to make comparisons between the costs of several arrangements for a given territory. And these comparisons should be made with care enough and patience enough to make certain that the best way has been chosen when a conclusion really is reached.

In recent times quite substantial changes have taken place in the costs of things which go to make up the wire plant. It is gratifying that this is so, because this part of the system has always been predominant in using up investment. No matter how cheap, however, the materials for line construction may become, the proportion of labor cost to the total cost of the constructed thing will remain large. As a comparison, it may be interesting to know that the equipment for central offices and subscribers may be installed for from five to 10 per cent. of its cost, while very many of the elements of line construction cost as much for labor as for material. A thing which the constructor, therefore, must plan toward is the elimination of labor wherever possible. There are two good results of such watchfulness—one is the natural keeping down of the total cost, and the other a higher final depreciated value. For if it costs a dollar to put a dollar's worth of copper in place, 50 per cent. is more than you can ever get out of it by selling it as junk. This is one of the reasons why placing cables underground has had such an effect on annual telephone costs. Two cables just alike, one on poles and one in ducts, may reasonably be expected to have an annual depreciation cost of several to one in favor of the underground cable; and this without taking into account the superior lasting qualities of the structure which cares for the latter.

Without citing further examples, I think I may generalize by saying that it is necessary to apply these and other simple rules to the planning of a telephone system for a town, and to lay out the course of action which when methodically pursued will bring the original estimate and the actual cost reasonably close together, not only as to the first investment but to the annual charges when in service.

Not the least important thing in preparing to make such a plan is to get on the ground and become saturated with the local facts. It is gratifying to find by experience that an outsider may get such a knowledge of a town by tramping over it, by consulting public records, and by diligent inquiry from those who know as to enable him to compile field notes almost as accurate as to the things he needs to know as those taken by the civil engineer in laying out a railroad. By this I do not mean merely finding out what is under the pavement, and where there are alleys and where none, because these are simple matters. The important thing is to get so many facts about the town as to enable correct guesses to be made as to where the future growth of the town will occur, about how fast it will go on, and in what direction it will push: what kind of houses will be built in this quarter and what kind in that; the probable change in the business area and its present tendency of expansion; is the street-railway system going to develop this residence area more than that, or will a new district spring up next year? One of the greatest helps toward reasonably correct conclusions in this plodding sort of investigation is to cut it up into such small pieces that the great quantity of estimates will prevent a serious error being introduced by a few bad ones. In 500 guesses the influence of one wrong one is not only relatively small, but each guess is easier to make with truth.

In all of these cases the elements of estimate are made with a view to determining not so much what the town is today, but what it will be at the end of a selected period. It is not difficult to build a system for the present for a town of known conditions. It is more difficult, and more important as well, to make the plan complete for the town which is to be, because it is that town which the system must serve. The only difference between the best methods of planning today and those which have been used heretofore is that the later method uses more care in details and realizes more fully the kinds of mistakes which are likely to be made. Perhaps it reflects little credit on the engineers, but it is distinctly to the advantage of their employers that they have made almost all the blunders that are possible to be made; and it goes without saying, of course, that a man of reasonable common sense will not make the same mistake twice. If they were only long-lived enough, this tendency might result in quite a perfect telephone condition being reached.

One of our prominent western civil engineers while visiting his uncle in New England attempted to answer persistent questioning as to what he did for a living by explaining the scope of his profession, how he and his brethren "harnessed the forces of nature to the benefit of man," and how, through their activity, intelligence and experience, man would ultimately reach his deserved proud position in command of the universe. The blushing modesty which inspired these restricted statements suffered a rude shock upon the query of his relative: "Ain't this engineering after all a sort of fancy business?" It is somewhat with the view of letting you into our confidence that I have made the foregoing admissions, for engineering telephone properties after all is really a simple, common-sense matter, the more successful as it involves the more patience and sound judgment.

So far as I have described the manner of such planning, it has been in the way of accomplishing minimum costs. It goes without saying that the minimum-cost plan must involve due consideration of the quality of service to be given. A plan which will not make good service falls short of its mission quite as would a manufacturing property which would not turn out good product. This brings me to the very important and widely neglected feature of planning all parts of a telephone system, whether in a town or between towns, so that it may ultimately form a part of a successful continental telephone system. I do not mean by this merely that a consolidation of telephone interests may take place. What I do mean is that any plan falls short of its mission which does not involve making all elements as nearly as may be such as will be serviceable and useful when the continent is covered with a complete network of long-distance lines, connecting exchange with exchange. You may answer that the day of such a system is so far away that it is foolish to waste money on it now. My answer is that the day in question is not so far away as many are thinking, and that it does not always mean an excess expenditure to take this into account. Further, in any telephone system which is wisely planned there are elements which ought to last so long as to be overtaken by the time of which I speak. It is no fancy dream to expect such a condition. We will agree on this if we will stop to think of what has been accomplished by the Independent interests already. I am advised that there is under consideration the construction of a considerable length of long-distance circuit of heavier copper than has ever been erected for any purpose of communication, and this by an Independent company. I can call to mind exchanges lying in the region of these excellent projected circuits from the stations of which I should be surprised to receive good speech even over lines of such cost and quality.

It may be that I have harped too much upon patience, persistence and common sense and not enough on experience and preparation. It is true, of course, that these are necessary also. If there is one thing which has been of value in developing the telephone business it is experience, and its application to the new things always arising. The successes that are to come will result from an intelligent use of what can be learned by a proper study of what has been done already.

World's Fair Visitors of Last Week.

Among those registered at the booth of the Western Electrician in Electricity Building at the St. Louis Exposition were the following-named: W. W. Hagerty, C. E., Coulport, Pa.; C. H. Brokmeyer, Booneville, Mo.; John H. Stone, Chicago; Edw. D. Brunner, Portsmouth, Ohio; S. P. Jennings, Pittsburg, Kan.; R. E. Taylor, Pittsburg, Kan.; Tomas Loveley, Colon, Panama; Custace J. Down, Harpendere, England; Bernard Withington, Manchester, England; Howell N. Higbee, Burlington, Iowa; George A. Knoblock, South Bend, Ind.; George Cook, Rube Criss, Ollie Hugerty, S. Vance and H. Lunau, Wheeling, W. Va.; Peter Diederich, Kansas City, Kan.; L. W. Archer, St. Louis; John Wilson, St. Louis; Lawrence Ruston and Allen Grimes, Terre Haute, Ind.; J. O. Heryford, New Orleans, La.; F. H. Hall, Grenada, Miss.; Lloyd Truscott, Decatur, Ill.; C. E. Cripe, Elkhart, Ind.; H. H. Cutler, Milwaukee, Wis.; J. W. Hudson, Purcell, I. T.; S. F. Dial and wife, Goliad, Texas; O. M. Burch and W. E. Burch, Hopkins, Mo.; Roy Miller, Independence, Iowa; E. H. Ely, Auburn, Neb.; F. Clark, St. Louis; E. Le Grand, Paris; J. W. Curtis, Middletown, Ohio; G. H. Kelsay, Wapakoneta, Ohio; W. C. Hawley, Salem, Ore.; A. L. Cleveland, Battle Creek, Mich.; A. L. Moore, Judsonia, Ark.; Dave Schertz, Herrick, Ill.; James A. Worsham, Seventysix, Mo.; J. E. Winfrey, Bluefield, W. Va.; Fred Ulalust, St. Augustine, Fla.; A. E. Dobbs and wife, Chicago; Dr. H. E. Wait, New York city; T. K. Nance, Ada Light and Power Company, Ada, I. T.; Clinton Crabbtree, Miller, S. D.; John W. Walters, Bluefield and Henton Electric Railway Company, Graham, Va.; E. A. Oden, Hareselle, Ala.; C. E. Floy, J. W. Daulton, Dayton, Ohio; William L. Tunber, Hernad 12, Budapest; Roy Phelps, Beardstown, Ill.; H. Kneerge, St. Louis, Mo.; W. R. Maddex, Terre Haute, Ind.; F. Clayton, Memphis, Tenn.; B. Durlaw, East St. Louis; Jacob Barth, Tamalco, Ill.; H. Clarkson, Topeka, Kan.; Titus Bartz, Reading, Pa.; L. E. Allen, Kansas City, Mo.; H. L. Stone, Tiffin, Ohio; L. A. Hoberdson, Canton, Ohio; Dr. R. Allmon, Pensacola, Fla.; B. A. Brown and W. W. Ritchie, Pierce Bluff, Ark.

John McDaniels of Bonner Springs, Kan., and others have incorporated the Bonner Springs and Kansas City Electric Railway Company, to operate between the two points, about 18 miles, and it is expected to make a summer resort of Bonner Springs.

Electrical Extraction of Nitrogen from the Air.[1]

By J. Sigfrid Edstrom.

One of the most important minerals ever discovered is the Chile saltpeter. The saltpeter earth "caliche" is found in Northern Chile in layers of from a half to four meters deep. It contains between 15 to 65 per cent. nitrate of soda ($Na\ NO_3$) and is changed in a number of factories in Chile into the so-called "raw saltpeter," which contains about 95 per cent. nitrate of soda, and is shipped in this form all over the world. The Chile saltpeter is chiefly used for manufacturing nitric acid and fertilizers. In the year 1901 the consumption of Chile saltpeter in Germany alone was 500,000 tons. Of this quantity 75 per cent. was used for fertilizers, 20 per cent. for the manufacture of nitric acid, three per cent. for the manufacture of nitrate of potash, and two per cent for the manufacture of sulphuric acid.

The demand for Chile saltpeter is increasing and the consumption growing heavier every year in spite of the rapidly rising prices. We may well ask if the saltpeter mines in Chile are inexhaustible. Several investigations have been made as to the extent of the saltpeter deposits in Chile, and the reports vary from 30 to 125,000,000 tons. We will probably come very close to the truth if we calculate that 100,000,000 tons still exist. When answering the question how long the deposits in Chile will continue to last, we must take into consideration two factors which primarily affect the life of the mines. First, the consumption, and second, the possibility of finding new saltpeter mines or means of manufacturing substances of equal qualities.

If we assume that the export of Chile saltpeter will develop at the same rate in the future as it has during the last 10 years, we can easily calculate how long the supply of the present mines will last. Fig. 1 shows graphically the report of Chile saltpeter

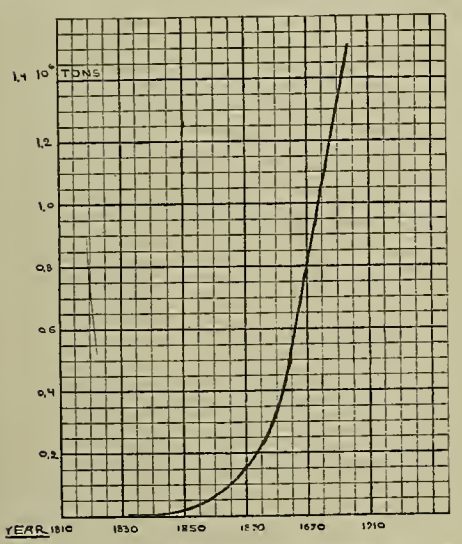


FIG. 1. ELECTRICAL EXTRACTION OF NITROGEN FROM THE AIR.—CURVE SHOWING INCREASE IN EXPORT OF CHILE SALTPETER.

during the years from 1830 to 1900. The export during the year 1900 was 1 1-3 million tons, and the yearly average increase during the last 10 years about 50,000 tons. Basing the future consumption on the figures given above the saltpeter mines would be exhausted somewhere about 1940.

Many efforts have been made to discover new deposits, but so far without success. Another way of counteracting the shortage of Chile saltpeter has been to substitute other chemicals, such as sulphate of ammonia for fertilizers, but this material is not to be had in sufficient quantities.

Some years ago experiments were made to produce the required nitrogen from the air by the application of bacteriology. The artificial production of an excess amount of bacteria in the earth and seeds tends to increase the power to absorb nitrogen from the air. The experiments have, however, not led to any rational and economical application of this method.

Under these circumstances it is not to be wondered that in several ways other means of producing compounds of nitrogen have been sought. The nitrogen which is contained in the air has been the source which has most naturally been turned to in seeking to produce a commercially useful article.

The Siemens & Halske Company of Berlin investigated a method invented by Dr. Frank for manufacturing cyanamide of calcium ($CaCN_2$). Originally carbide of calcium was heated and treated by a current of nitrogen. The nitrogen was received by carrying a current of air over glowing copper. The copper unites with the oxygen of the air and the nitrogen remains. Later the same results were obtained by carrying the nitrogen over a heated mixture of chalk and carbon in the same proportion as used in making calcium carbide.

The cyanamide of calcium has been tried as a fertilizer with good results. The method of Frank is as yet, however, only in its experimental state.

Most of the experiments for the manufacture of compounds of nitrogen are based on a compound with oxygen. Owing to the inert character of nitrogen it has been very difficult to bind and utilize the nitrogen of the air. As long ago as 100 years physical science knew, through the investigations of Priestley and Cavendish, that electric sparks through air caused the nitrogen and oxygen of the air to unite, and that nitric acid would be obtained as a product by this process. Toward the end of the last century this process was furthermore investigated by Wills, Plücker, Dewar, Lord Rayleigh and others, but it has been during the present century that investigations have pointed to a practical solution of the problem.

It was principally through the immense development of electricity that means have been provided for the solution of the problem. The first results from the experiments of oxidizing the nitrogen of the air were published by the Atmospheric Products Company, whose method was invented by Bradley and Lovejoy (Electrical World and Engineer, August 2, 1902). The apparatus used in carrying out this method consisted chiefly of a solid drum or cylinder with a large number of platinum points placed inside the drum. Within the drum another cylinder is placed with points outward. When the outer or inner drum is rotating the points come close to each other. The drums are connected to opposite sides of a high-tension direct-current system (8,000 to 10,000 volts). When the distance between the points is small electric arcs are formed between the points. Through the motion of the drums the arcs lengthen the break. As each arc under those circumstances naturally offers an exceedingly variable resistance, an inductive resistance is placed in series to regulate the current. Through the space between the two drums a current of air is sent, part of which is oxidized through the contact with the arcs. The fundamental idea of this invention is to obtain an electric arc of maximum length and minimum cross-section, in order to bring the largest possible volume of air into contact with the surface of the arcs. This determines the efficiency of the system, as the energy consumed in the arc is proportional to its volume. It is evident that this effort of subdividing the arc results in a device in which the multitude of arcing points required for large capacities forms an objectionable feature in practical application.

The efficiency of the Bradley and Lovejoy system has been said to be one ton of 70 per cent. nitric acid per kilowatt and year. This corresponds to about 700 kilograms of hundred per cent. HNO_3. Any further developments of this system have not been published so far as I know.

Another method has been proposed by de Kowalski and M. Moscicki. According to the publication in the Bulletin of the Société Internationale des Electriciens, June 3, 1903, his method consists of exposing the air to an oscillating electric arc with a pressure of 50,000 volts and a frequency of several thousand periods per second. The method uses the well-known combination of self-induction and capacity. Its efficiency is said to be one kilogram of HNO_3 per 15 kilowatt-hours, which corresponds to 580 kilograms HNO_3 per kilowatt and year. Also in this method the amount of energy needs to be largely split up, thus complicating the apparatus in order to get good efficiency when applying large amounts of energy.

A new method for the solution of the problem was invented about one year and a half ago by Prof. C. Birkeland and Mr. S. Eyde of Christiania. As far as now can be seen this method should give comparatively good results.

Professor Birkeland and Mr. Eyde based their arrangements on the well-known fact that the electric current in the arc and with it the arc itself can be

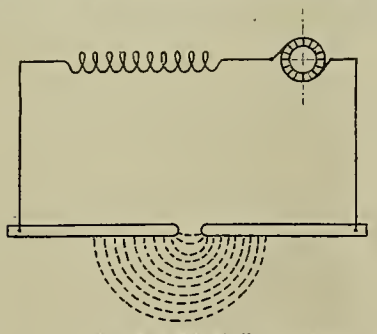


FIG. 2. APPARATUS OF BIRKELAND AND EYDE FOR EXTRACTION OF NITROGEN.

deflected by a magnetic field, the deflection being at right angle to the lines of force.

Based on this fact, Professor Birkeland and Mr. Eyde proposed a large number of arrangements, of which I will describe the one which seems to give the best results. In Fig. 2 are shown two electrodes, which are connected to the poles of the electric generator. The points of the electrodes are at such a distance that the pressure of the generator can maintain an arc between the electrodes. If a strong magnetic field is applied near the electrodes and at right angles to the direction of the electrodes, as shown in Fig. 2, the arc between the electrodes will momentarily be carried upward or downward, the direction of the current being for the moment from right to left or opposite.

For several reasons (one of which being the loss of pressure in the resistance connected in the circuit) the pressure will fall between the electrodes at the moment the arc is formed. The arc will be carried outward by the magnetic field and grow longer, as indicated by the dotted lines. Its resistance, consequently, rapidly increases until the pressure between the points is sufficiently high again to cause another arc between the electrodes. This arc having a lower

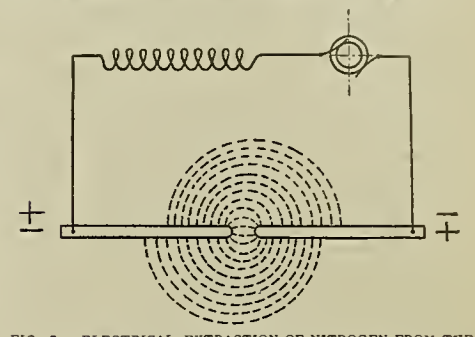


FIG. 3. ELECTRICAL EXTRACTION OF NITROGEN FROM THE AIR.—ARC FED BY ALTERNATING CURRENT: FIELD BY DIRECT CURRENT.

pressure than the first one, the current will all pass through it, and the first one is extinguished. The speed of the arc is so rapid, however, and the formation of the new arc so instantaneous, that the arc can be formed several thousand times a second. In the practical form of the ovens only some hundred arcs per second are used. These arcs are formed, carried outward and extinguished so rapidly that to the eye they appear as a disk of arcs.

If the magnetic field is excited by a direct current, and the generator delivers direct current for the arc, a continual series of arcs will be formed. These arcs move radially with a speed corresponding to the strength of the magnetic field. The striking points of the arc along the surface of the electrodes are also moving away from the points at the same speed. Thus the phenomena appear to the eye like a disk of arcs with the shape of almost a complete semicircle. The movement of the arc near the electrodes is usually more rapid at the negative than at the

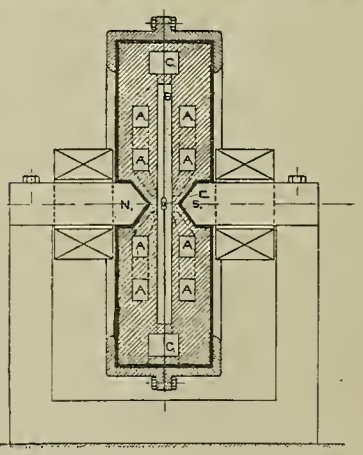


FIG. 4. ELECTRIC OVEN FOR PRODUCING NITROGEN FROM THE AIR.

positive electrode, shifting the center of the circular disk somewhat to one side of a line joining the electrodes. If the magnetic field is excited by alternating current and the arc is fed by direct current, the arcs will vibrate between opposite sides of the electrodes. This will also be the case if the arc is fed by alternating current and the magnetic field by direct current, in which case the phenomena will appear as indicated in Fig. 3. It is principally this arrangement which has been used.

Fig. 4 shows the electric oven complete in a vertical section at right angles to the electrodes. The air that is to pass the oven is forced through the channels (A), and from them into the arc chambers of the oven (B), around and in the neighborhood of the electrodes (E). Having passed this space from the center, and coming into the most intimate contact with the disk of arcs, the air passes out into the channel (C), and leaves the oven mixed with a certain percentage of oxidized nitrogen.

If we look closer at this oven and the principles according to which it works, we may easily discern the chief difference between this invention and the methods described before. The difference will be most strongly marked by quantitative results. While, with Bradley and Lovejoy and de Kowalski's methods, the energy in every arc must be lowered to the least possible in order to obtain an economical system, the method of Birkeland offers no objection to employing large amounts of energy in the disk of arcs. On the other hand, experiments have proved that the economical efficiency increases with the amount of energy employed at the electrodes.

One of the ovens, which is still in operation, has consumed from 75 to 200 kilowatts in the disk of

1. A paper presented before Section C of the International Electrical Congress of St. Louis, September 13, 1904. The author is an electrical engineer of Gothenburg, Sweden.

arcs between one single pair of electrodes, and lately an oven with a disk of arcs for 500 kilowatts has been built. The 200-kilowatt oven has been fed with alternating current of 50 cycles frequency and 5,000 volts pressure. From this will easily be seen that the amount of energy employed and the class of current in the arc, can hardly be compared with the current that may be used by other methods.

In spite of the large amount of current the electrodes in Birkeland's oven have up to the present been used without interruption for several hundred hours. Owing to the fact that the striking points of the arc move along the electrodes, the destructive influence of the arc is inconsiderable. The electrodes can, for this reason, be made of very cheap material, such as copper or iron, and have such dimensions that they can easily be cooled by means of air or water, keeping their temperature within reasonable limits.

The oven of Birkeland and Eyde is consequently a very simple, strong and easily operated piece of apparatus, even when working with a large amount of energy. Electric current from any ordinary standard machinery can be used for its operation.

In the oven of Birkeland and Eyde, which was built about a year and a half ago, a small amount of energy was used in the disk of arcs, only seven to 10 kilowatts. The efficiency of this apparatus was at first only 400 kilograms HNO_3 per kilowatt per year. The next ovens were constructed for an increased consumption of energy, and have now, through continual improvements, reached an efficiency of 900 kilograms HNO_3 per kilowatt per year. The energy referred to is the amount of energy in the disk of arcs itself.

This result has, of course, been gained after numerous difficulties and with many obstacles to overcome. I will not enter into the details of this work, but will only mention some of the factors that have been considered in connection with the improvement of the oxygen as follows: The degree of moisture in the impressed air, its temperature, its amount of oxygen, its amount of air impressed per kilowatt-hour, the different amounts of electric current used, the voltage of the electric current, the frequency, the ovens arranged in series and parallel electrically, as well as with regard to the impressed gases, the strength of the magnetic field, the insulation of the oven to prevent the loss of heat, the introduction of various contact substances.

The air coming from the oven contains about two of three per cent. of nitric oxide (NO). In order to be utilized it must be transformed into nitrogen peroxide (NO_2). This is done in a reaction tank of thin sheet iron enameled on its inner side.

From the reaction tank the gases go through an exhauster of clay, where they come into contact with drips of thin nitric acid. From here the gases pass on through the absorption system, consisting of four towers for water and one tower for a solution of caustic soda. In each tower the fluid is sent through the tower several times. The strongest acid runs always through tower No. 1, where the gases first pass, the next strongest through tower No. 2, and the weakest through tower No. 4. When the desired concentration is reached in tower No. 1 the acid is removed. The acid from tower No. 2 is then put into No. 1, from tower No. 3 into No. 2, and from No. 4 into No. 3. Through tower No. 4 new water is passed. The process thus works according to the counter-current principle. The alkali tower contains, as previously noted, a solution of caustic soda. The gases from No. 4 pass through this tower. The remainder of the gases is absorbed here, and a mixture of nitrate and nitrite of soda is formed. From this pure nitrite of soda is manufactured.

The acid taken from tower No. 1 is either concentrated by use of Valentiner apparatus and shipped, or is turned into nitrate of calcium or nitrate of potassium (potash).

The Birkeland process has been put into actual operation, and compounds of nitrogen are being manufactured. It is to be hoped that the process will prove economical, and thus one of the greatest needs of the present time—cheap nitrogen in bound forms—will be introduced on the market.

The need of fertilizers is unlimited. Some years ago, when calcium carbide was invented, numerous factories were built, and a great boom was given to the electrical industry. The market, however, proved too small, and the enterprise has languished. This can never occur with respect to the nitrogen industry, as the market is unlimited. Thus, if the industry is pushed forward, the electrical industry will benefit immensely. Moreover, all sources of energy will increase in value; waterfalls, situated in uninhabited parts of the earth will be utilized, and great central stations in cities will, in many cases, obtain a profitable load now lacking. The immense waterpowers being all utilized, power will become cheap, which again will benefit industry in general.

Thus, if the process proves to be an economical success, the entire world of agriculture and industry will profit—and the process thereby will be a benefit to all mankind.

A syndicate of Boston, New York and Pittsburg men are arranging to unite all the trolley lines at Wheeling, W. Va., and interurban lines as far northeast as Pittsburg. J. and W. Seligman and W. N. Color & Co. of New York and Gay Bros., Boston bankers, are mentioned as interested in the deal. Westinghouse and Pittsburg interests will look after the construction and new equipment.

New Shops at Montreal for the Canadian Pacific Railway.

An important addition to the mechanical and electrical equipment of the Canadian Pacific railway is rapidly approaching completion in Montreal in the shape of a series of new shops covering a total area of 832,000 square feet. The site is located in the eastern portion of the city on the direct line between Montreal and Quebec, and has an area of about 200 acres. The shops are to be called the "Angus" shops of the company, and in every particular represent the latest development of machinery and methods of operation. All the power is to be distributed electrically from a central power house by 600-volt three-phase alternating current at a frequency of 60 cycles, with the exception of several machine tools in the locomotive and frog shop as well as all the traveling cranes and foundry motors, which take direct current at 250 volts. The function of the shops is the maintenance and repair of existing equipment and the manufacture of new locomotives and cars. Another large shop plant is in process of construction at Winnipeg, Manitoba.

The Angus shops will probably be in full operation by the end of the current year, and were built to a large extent to avoid the payment of duties and to utilize home labor as far as possible rather than to purchase in the American market in as large quantities as in former years. Montreal is an advantageous center for manufacturing, especially during that season of the year in which the river St. Lawrence is open to navigation, coal being comparatively cheap and wages being at a lower rate than prevails in the West.

The principal buildings are: A locomotive machine and erecting shop, 162 by 1,166 feet, with a repairing capacity of from 400 to 500 locomotives per year, in addition to the construction of at least 75 new engines; a gray-iron foundry of 75 tons daily capacity; a blacksmith shop, drying kilns and a sawmill 126 by 500 feet; a cabinet shop 60 by 280 feet, and two passenger-car shops 100 by 672 feet; a freight-car shop 107 by 540 feet; a truck shop 82 by 434 feet, and a car machine shop 130 by 288 feet. The frog shop is 120 by 260 feet, and has equipment for making the frogs and switches to be used on the entire line of the road, and there is also a wheel foundry, with a capacity of 300 chilled wheels per day. The locomotive machine shop will handle all the boiler and tender work, and a riveting tower is installed in the eastern end of the building, together with the hydraulic machinery required in this work. About 25 per cent. of the roof area of the buildings is given up to skylights and a liberal supply of windows is provided in the side walls.

The power plant is located centrally on the grounds, near the planing mill, so that sawdust and shavings may be conveniently handled for burning in the boiler furnaces. An exhaust-fan system of shavings collection has been installed in the planing mill and the cabinet shop. There is also a large brick storage bin for surplus shavings near the power house. It has been asserted that when the freight-car shop and mill are operated at their full capacity of 30 box cars per day the shavings produced will be equivalent in heating power to about 18 tons of Cape Breton soft coal. A fire wall of brick separates the engine and boiler rooms, dividing the plant into two equal sections. The height of the building is about 40 feet, the length 160 feet and the width 100 feet. In appearance the engine room resembles a modern railway plant, with alternating generators for a city of perhaps 15,000 inhabitants.

The boiler room contains 1,964 horsepower in water-tube Babcock & Wilcox units, four of which are rated at 416 horsepower and one at 300 horsepower. The four smaller ones operate at 150 pounds pressure and the larger one at 300 pounds for locomotive testing. Hand stoking is employed with a Sturtevant induced-draft system operated by two 10-foot fans, making 200 revolutions per minute and connected with a steel stack 70 feet high and eight feet in diameter. There are two Green economizers and a 14-inch header, which is connected with each boiler. Reducing valves and a by-pass are installed to enable the higher-pressure boiler to be used with the others when it is not needed for locomotive tests. The feed pumps are 12 by seven by 12 inches, two in number, and were made by the Canada Foundry Company of Toronto. There are also two six by 3½ by six-inch Worthington pumps for feeding the high-pressure boiler. All the boilers are supplied with water through a feed-water heater. The ashes are dumped into hoppers discharging into cars operating in a tunnel beneath the floor. They are then carried by a lift to tracks on the surface and run to the waste pits.

In the engine room are three 750-horsepower and one 375-horsepower cross-compound horizontal Corliss engines, built by the Robb Engineering Company of Amherst, N. S. The three larger machines are direct-coupled to 500-kilowatt three-phase alternators, and the smaller engine directly drives a 250-kilowatt generator. The crane service is supplied from two 250-kilowatt 250-volt direct-current dynamos, the alternators, motors and dynamos being made by the Canadian General Electric Company. In the engine room is a handpower crane of 20,000 pounds capacity.

The distribution circuits are constructed of bare copper main feeders supported on structural steel poles. Inside the buildings cabinet panels are supplied for every 10 kilowatts of lighting and every 100 horsepower of motors wired. The main switchboard in the power house is now being set up, and when completed it will present a handsome appearance. It is of Canadian General Electric construction. The yards and shops are lighted by 400 110-volt Canadian General Electric enclosed arc lamps and by nearly 4,000 16-candlepower 110-volt incandescents. There are also 50 enclosed series arc lamps in the yards. Low-tension arc lamps are used in lighting the passenger-car shops.

Steam heating has been adopted for heating the shops. Tunnels run from the power house to different parts of the plant, the most distant point being about half a mile away. It has been estimated that the combined volume of the various buildings is 26,000,000 cubic feet, while from 25 to 50 per cent. of the wall surface is glazed, and there is a skylight percentage of 25, as previously noted. The requirements are in most cases a constant temperature of 65° Fahrenheit when the outside air is at —10°. About 200,000 feet of one-inch pipe in vertical coils, with cast-iron bases, is required for this service, the sections of pipe containing about 200 feet each. Fans are provided which will change the air in every building in about 20 minutes. In general the fans are located outside the buildings in separate brick structures. Both exhaust and live steam are piped in each set of heaters. In the locomotive and blacksmith shops the hot air is distributed in part by underground brick conduits. Generally, however, the distribution system consists of overhead galvanized iron ducts carried by the lower-chords of the roof trusses and having outlets through vertical pipes carried down the interior columns. The winter temperature at Montreal is so low that the heating problem presented considerable difficulty.

About 200 electric motors are used in the shops. All the machine tools, the cranes, car-transfer table, heating, exhaust and forced-draft fans are motor driven. Most of the motors are of the three-phase induction type, using current at 550 volts without transformers. Constant-speed motors are largely used, the alternating sizes ranging from 10 to 50 horsepower. The adoption of constant-speed machines was based upon the fact that uniform service is required of most of the tools. About 15 motors out of the 200 are for variable-speed operation. Groups of small tools are operated by overhead motors. The load factor for the groups of machine tools and the plant's capacity was taken at about 45 per cent., determined by tests on other installations.

A metallic-circuit telephone system is planned for the shops, with outside long-distance connections.

Special attention has been given to the fire-risk and water system. All buildings are equipped with the wet system of sprinkler heads, with numerous standpipes fitted with hose. About five miles of eight, 10 and 12-inch mains have also been laid around the shops with hydrants about 200 feet apart and the necessary hose. An additional mill water-supply system is installed also. The water system includes Worthington pumps of an aggregate capacity of 115,000 gallons an hour and two six-inch artesian wells 550 feet deep. The city mains are also connected to the plant, and there is a concrete reservoir and a 75,000-gallon steel tank on top of a 70-foot tower connected to the mill supply. Both sewer and surface drainage are employed.

When the new shops are completed they will constitute one of the most interesting engineering exhibits in Canada. Even now, when they are in partial operation, a trip to them is well worth while if one is in the city. K.

Letters patent have been granted John E. Bemiller and Emroy C. Weisensale of Hanover, Pa., on new and useful improvements in electric circuit-closers for fire alarms. The object of the invention is to insure an early and continuous alarm in case of fire, so that when placed in a hotel, factory, store or residence, there will be ample time for the occupants to escape.

The Mechanical Equivalent of Heat Measured by Electrical Means.[1]

By Howard T. Barnes.

No physical constant illustrates so clearly the uncertainty existing in the values of the electrical units as the mechanical equivalent of heat measured by electrical means. Of all the previous investigators using electrical means, we need only mention the work of Griffiths, Schuster and Gannon, and Callendar and Barnes. Professor Ames has given a most complete summary of the subject up to the time of the Paris Congress, and since then no fresh material has been contributed than was included in that report and the annexed report by Prof. E. H. Griffiths on the specific heat of water.

Griffiths, Schuster and Gannon used essentially the same method, which was that of Joule, with the mechanically developed heat replaced by suitable electrical means. Callendar and Barnes used a continuous-flow electrical method, which has been already fully described, and which is radically different from the method of Joule. Rowland used the method of Joule, while a continuous-flow method was adopted by Reynolds and Moorby. This gives us measurements of the mechanical equivalent, both mechanical and electrical, by the two methods of calorimetry.

The value now accepted as given from Joule's classical experiments is 4.173 joules in terms of a thermal unit at 16.5° C. This is expressed for a temperature interval measured on the nitrogen thermometer. Many corrections, which later improvements in calorimetry have shown it necessary to apply, are so large that very little weight can be attached to this value. Historically, however, the work is of the greatest importance and the general method devised by Joule has been the basis for the best determinations.

The work of the late Professor Rowland is without doubt one of the best direct determinations which has been made. These results extend over an interval of temperature between 5° and 35° C., although the measurements at the extremes of the range are not entitled to the same weight as those at the ordinary temperature. The uncertainty of the corrections become very great at the extremes of the range, but this was fully understood by Rowland. The values given in the original memoir have been corrected by others as various improvements in thermometry were made.

The recalculation and corrections made by Waidner and Mallory are probably the most accurate. The results quoted by these gentlemen are given in the following table:

10 degrees.	4.195 joules.
15 degrees.	4.187 "
20 degrees.	4.181 "
25 degrees.	4.176 "
30 degrees.	4.175 "
35 degrees.	4.177 "

The values between 15 degrees and 25 degrees are the most accurate, and although a minimum value of the specific heat was indicated at 30 degrees, Rowland did not lay much stress on the exact position of this point, on account of the uncertainty of the corrections.

To quote his own words: "The point of minimum cannot be said to be known, though I have placed it provisionally between 30 degrees and 35 degrees, but it may vary from that. . . . There may be an error of a small amount at that point (30 degrees) in the direction of making the mechanical equivalent too great, and the specific heat may keep on decreasing to even 40 degrees."

A very elaborate and exhaustive series of experiments has been made by Reynolds and Moorby to determine, by a direct-mechanical method, using a Reynolds brake and a steam engine, the energy required to raise water from the freezing to the boiling point. The value of the mean-mechanical equivalent which they obtained is entitled to a great deal of weight, from the minute accuracy of their measurements and the careful discussion of possible sources of error.

This value, which represents the energy required to heat a standard mass of water between two standard intervals of temperature is 4.1832 joules.

The method adopted by Griffiths was essentially that of Joule and Rowland, with a few minor changes, introducing electrical means of generating heat. In order to produce as large a temperature rise as possible, a minimum amount of water was used, with very vigorous stirring. This had the disadvantage of bringing up the correction for heat generated by stirring to a large percentage of the total heat supply.

An attempt was made to determine the variation of the specific heat of water between 15 degrees and 25 degrees.

The values obtained by Griffiths were:

15 degrees.	4.198 joules.
20 degrees.	4.198 "
25 degrees.	4.187 "

A similar electrical method was almost simultaneously applied by Schuster and Gannon. Small temperature intervals of two to three degrees were used with larger masses of water. This reduced the size of the stirring and cooling corrections, but increased the uncertainty in the temperature measurements.

Only one value was obtained, which was 4.1905 at 19.1° C.

A continuous method of electrical calorimetry was originally devised by Callendar and applied by Callendar and Barnes and by Barnes, to determine the variations of the specific heat of water.

In this method it was possible to reduce all the corrections to a negligible amount compared with the total heat supply, and the only heat loss to be considered, radiation, was eliminated by the method of calculation. The values obtained are contained in the following table:

5° C.	4.2105 joules.
10° C.	4.1979 "
15° C.	4.1895 "
20° C.	4.1838 "
25° C.	4.1801 "
30° C.	4.1780 "
35° C.	4.1773 "
40° C.	4.1773 "
45° C.	4.1782 "
50° C.	4.1798 "
55° C.	4.1819 "
60° C.	4.1845 "
65° C.	4.1870 "
70° C.	4.1898 "
75° C.	4.1925 "
80° C.	4.1954 "
85° C.	4.1982 "
90° C.	4.2010 "
95° C.	4.2038 "
Mean	4.18876 joules.

It at once becomes apparent, on comparing the values of the mechanical equivalent obtained by the electrical methods with the values obtained by the direct-mechanical methods, that a decided error exists in some of the units chosen for calculation. This has been very carefully discussed by W. S. Day, Waidner and Mallory, Barnes and Ames, and it has been shown that the Clark cell value used in all the calculations is in error. Fresh determinations of the Clark cell value by the absolute electrodynamometer have shown this to be true, and it has been found necessary to reduce the original value 1.434 volts at 15° C.

The values so far obtained for the Clark cell are as follows:

Glazebrook and Skinner	1.4342
Kahle	1.43285
Carhart and Guthe	1.4333

At present it is a question which of these two last values should be accepted.

On comparing the absolute value of Equivalent E, obtained by Griffiths, Schuster and Gannon, and Callendar and Barnes, it is at once apparent that a considerable difference exists. When reduced to the same value of the Clark cell, the two former measurements are brought into close accord and are both higher by two parts in 1,000 than the results by the continuous-flow method. It is impossible to say where the error lies. It may be admitted that no direct comparison was made between the Clark cells used by the writer and those used in the English investigations. It is unlikely that any serious difference existed, however, for a comparison of the English cells with the German showed no error of this magnitude, and both Griffiths' cells and those used by Schuster and Gannon did not differ essentially from the Cambridge standard. The cells used by the writer were checked several times by comparison with cadmium cells and the values of the ratios so obtained came 1.40658 and 1.40666, which are in absolute agreement with the German standards, and so indirectly with the English. There can be no possible room to doubt the resistance standards, since the writer possessed for comparison and standardizing his resistances 11 English standards, each with a signed certificate, and one German standard. The difference in Equivalent E by the modified method of Joule and by the continuous method is more likely due to the radical difference in the methods of calorimetry.

It may be questioned whether the separate determinations of the cooling effect by a special experiment and its subsequent application as a correction to calorimetric experiments, such as is adopted in Joule's method, can be relied on for any accuracy, even as great as one part in 1,000. This is about the order of error in previous calorimetric work carried out with a care that seems to warrant much better agreement. By the continuous method of calorimetry the radiation loss, which corresponds to the cooling correction, varied a great deal, and unless it had been carefully eliminated by the method adopted in carrying out the experiments, it would have produced large errors. In the writer's opinion the cooling correction is much more uncertain than has been realized before. From a careful consideration of the various experimental conditions in the writer's experiments, it is evident that between glass surfaces at least changes occur which modify the value of the heat radiation. Although the surfaces may remain the same over short intervals of time, they may change over long, and particularly when changes of temperature intervene. An inspection of the summary of the values of the radiation loss, given by the writer on page 253 of his original paper, illustrates the changes, both temporary and gradual, that took place in an hermetically sealed glass vacuum jacket.

When we compare the experiments of Rowland and those of Reynolds and Moorby we find that the difference amounts to one part in 1,000, in the same direction as that between the electrical method similar to Rowlands and the continuous method similar to Reynolds and Moorby. This seems to be evidence of some error in either of the two standard methods, as yet to be determined.

Whatever may be said in regard to the absolute value of the electrical measurements by the continuous method, the variation curve remains unaffected, yet if we assume Griffiths' or Schuster and Gannon's value of Equivalent E and work out the mean value from the variation curve, it would require a much larger correction to the Clark cell than seems justified by the absolute measurements of that quantity to bring it into accord with the mechanical measurements.

Absolute Value of the Equivalent.

In obtaining the value of the mechanical equivalent which will agree most perfectly with the mechanical measurements, it will be necessary to assume (a) the variation curve of the specific heat of water; (b) the absolute value of the Clark cell and the ohm. In the first assumption is involved Callendar's parabolic formula for reducing the platinum temperatures to the standard hydrogen scale, but it cannot be admitted that any error is introduced by this method of reduction. The last assumption involves the latest absolute values of these constants subject to revision.

Considering the direct determinations, first, Rowland's value at 15 degrees is 4.187 joules and at 20 degrees 4.181; Rowland's mean value between 0 degree and 100 degrees (assumption a) is 4.1889; Reynolds and Moorby's mean value directly determined between 0 degree and 100 degrees is 4.1832 joules.

Considering the electrical determinations in which the Clark cell is taken as 1.43325 international volts at 15° C., and the ohm as 1.01358 B. A. units, Griffiths' value at 15 degrees is 4.1927, and his mean value (assumption a) 4.194 joules. Similarly, Schuster and Gannon's value at 15 degrees would be 4.1931 and their mean value 4.195; Callendar and Barnes' values at 15 degrees and at 20 degrees are 4.1840 and 4.1783, and the average value 4.1859 between 0 degree and 100 degrees. Tabulating the results, we have the following:

Observer.	Value at 15.	Average value between 0 and 100.
Rowland	4.187	4.189
Reynolds and Moorby	.....	4.1834
Griffiths	4.1927	4.194
Schuster and Gannon	4.193	4.195
Callendar and Barnes	4.1840	4.1859

The average value given from Rowland's determinations would be equal to 4.189 joules also, had we assumed the absolute value at 20 degrees instead of that at 15 degrees for the calculation.

Taking the values of Rowland and of Reynolds and Moorby, given in the last column and averaging them, we obtain 4.1861 for the mechanical equivalent of the mean calorie which is almost identical with the number 4.1859 given from the electrical determinations of Callendar and Barnes. This does not include the values given by Griffiths or by Schuster and Gannon, but it appears from a study of the table given above that both these investigators are a little too high. To bring them into accord with the direct mechanical measurements would require a correction to the Clark cell and ohm, much larger than is justified by our present knowledge of these constants.

The value 4.186 joules in terms of the mean calorie seems to be the most probable both for the electrical and mechanical methods, and it would be advisable that this number be selected.

1. Abstract of a paper presented before Section A of the International Electrical Congress of St. Louis, September 12, 1904. The author was a delegate of the Royal Society of Canada to the Congress. He is a member of the faculty of McGill University of Montreal.

Thawing Ice in Water Pipes by Electric Heat.

In accordance with the suggestion of President Edgar at the Boston meeting of the National Electric Light Association, an investigation of methods in use for the thawing of ice in water pipes by electricity is now being made for the benefit of members. Mr. George S. Haley of Rutland, Vt., has been appointed by President Davis as a committee to report on this subject, and Mr. Haley has the work already well under way with a view of publishing results before freezing weather sets in. Mr. Haley contributed a very full and instructive article on this subject to the "Wrinkle" department of the Boston convention, having had considerable experience of his own in the use of electricity for this purpose, and his report, including the experience of companies under differing conditions, will be looked for with interest by members located in the zone of severe frost.

Congress Papers and Discussions.

Members of the International Electrical Congress of St. Louis can receive copies of any Congress paper or papers in which they are interested, and which were printed in advance, by applying to Mr. H. H. Humphrey, electrical engineer, Chemical Building, St. Louis, Mo. Mr. Humphrey has kindly promised to distribute these papers on application until the 10th of October. It is also announced that written communications, by way of discussion, from Congress members, upon any Congress paper, will be received by the general secretary of the Congress, Dr. A. E. Kennelly, Harvard University, Cambridge, Mass., up to October 15th.

The Principles of Electrotherapeutics.[1]

By Dr. T. Proctor Hall.

From the known physical, chemical and physiological effects of electric currents it is possible to draw fairly accurate conclusions as to their therapeutic uses; and when these data are combined with the results of clinical investigations the principles of electrotherapeutics are set forth ready for application for the relief of mankind. It is essential that the practician should have first a clear concept of the nature of an electric current. For this purpose the vortex theory of electricity and magnetism offers the simplest working hypothesis. According to this theory an electric current is a vortex ring, consisting of a bundle of chains of polarized and rotating atoms, each chain forming a complete circuit. Any substance, such as copper, which permits of the rotation of its atoms in such polarized chains is called a conductor. A substance, such as quartz, whose atoms are so firmly fixed in their relation to each other that no such continuous rotation is possible, is called a nonconductor.

When an electric current is passed through a liquid containing a salt in solution the end of the conductor from the positive (carbon or copper) pole of the battery is considered to be the road by which the current enters the solution (according to the fluid theory of electricity). It stands, therefore, at the source of the electric stream in the solution and is called the anode (up-road). The other electrode at the bottom of the stream is called the cathode (down-road) and is in direct connection with the negative or zinc pole of the battery. The molecules of the salt are polarized by the electromotive force, and one after another are split into two parts by the current. This splitting is called electrolysis. The two parts into which each molecule is split are called ions (wanderers). The splitting takes place in the same way as in the double decomposition of chemical salts, namely, into a basic part and an acid part. The basic parts move in the direction of the positive current (down-stream) toward the cathode, and hence are called cathions. The acid parts move in the opposite direction (up-stream) toward the anode, and hence are called anions.

The physiologic effects of a direct current are mainly in the vicinity of the electrodes. Since common salt is one of the most abundant of the salts in solution in the body, its behavior under electrolysis may be taken as a type of the changes produced by electricity in the tissues. Near the anode we have increased oxidization, and the hardening or astringent effect of the acid. Near the kathode we have deoxidization and the softening or dissolving of tissue by the alkali. Considering in particular the effect upon the smaller blood vessels, near the anode, these are constricted and ischemia produced; near the cathode they are dilated, causing hyperemia. Pain usually results from pressure upon nerve endings, and in such cases relief can be obtained by the astringent effect of the anode. Defective nutrition in any part is frequently due to defective blood supply, and in such cases can be improved by the hyperemic effect of the cathode. Either the acid or the alkaline effect may be made so intense as to cause destruction of tissue. For the removal of dermal defects (warts, moles, nevi, etc.) either electrode may be used. The anode forms a hardened mass of coagulum and connective tissue. The cathode softens and dissolves so that the abnormal growth is more readily removed by the lymphatics. The anode is therefore to be preferred where cutting off the blood supply is the essential part of the treatment, and the cathode where the removal of all traces of hypertrophied tissue is more important. The cathode is successfully used for the relief of urethal, rectal, esophageal and other strictures. A current so mild as not to produce any marked degree of inflammation is used repeatedly, and this gradually dissolves the constricted scar tissue.

The term phoresis is applied to the motions of the ions when made use of to carry medicaments into some particular part of the body. The motion of metallic and basic ions toward the cathode is termed cataphoresis, and the motion of the acid ions toward the anode anaphoresis. The amount of phoresis is dependent upon the intensity of the current, and has no direct relation to the electromotive force so long as the latter exceeds a few volts. Cataphoresis has been successfully used for the destruction of malignant tumors and the sterilization of adjacent tissues by heavy currents from amalagamated zinc needles.

When the current is alternating or when the polarity is frequently changed, phoresis takes place in alternate directions. The result, instead of being zero, is a scattering of both sets of ions throughout the tissues. Molecular diffusion then takes place much more rapidly than it would without the action of the current.

The remarks made up to this point regarding the polar effects of the electric current apply to direct currents only. When an alternating current is used there are no polar effects, provided the positive and negative portions of the current are symmetrical. The molecules are split into ions just as in the case of the direct current, but the ions have the opportunity of reuniting when the current is reversed. If the original molecules are stable under existing conditions this reunion takes place, leaving the chemical composition precisely as it was before. But such conditions are rarely, if ever, found in the tissues. The chemical changes by which the food is finally oxidized are constantly taking place. Electrolytic action facilitates these changes by assisting in the decomposition of molecules. Physiologically this means acceleration of metabolism. Therapeutically this stimulus is advantageous wherever metabolism is deficient, or where tissue debris has accumulated, or where local bactericidal infection occurs, or where abnormal growths are taking place. In all of these cases the completion of normal tissue changes removes the pabulum of pathological cells.

It is important in this connection to note that of the three essential life processes—nutrition, metabolism and elimination—the alternating current accelerates chiefly metabolism, and it is necessary to look closely after nutrition and elimination by other means.

Some of the most marked effects of electricity upon the human body are produced through sensation. These effects are not peculiar to electricity, but they have been to a very considerable degree overlooked by other therapeutists. The involuntary muscular system maintains its tone in part by the reflex action of the unnoticed sensory impulses which are continually received through touch, hearing, sight, etc. If these mild and general sensations are increased in intensity the reflexes become stronger. The blood vessels, for example, are constricted, raising the blood pressure, the heart beats more strongly, respiration is deeper, and there is greater tension in every part of the organism.

Locally these reactions may be used to great advantage. In case of local hyperemia, in which there is abnormal distension of the smaller blood vessels, a slight increase in the sensory reflexes in that region is frequently sufficient to cause a return to their normal size, which stop exudation and causes reabsorption of the exudate. If coagulation has not yet taken place this reabsorption is very rapid. The necessary stimulus may be given by brushing the skin with a soft feather or a camel's hair brush, or by passing the finger tips over it very lightly, or by tapping gently with a light stick, or by the lips of the mother who may "kiss the spot to make it well," or by the spray or breeze from a static electric machine. Similar effects may be produced near the surface by an astringent wash, and at a considerable depth under the anode by the direct current. Using a mild breeze from the positive electrode of a static machine the sensory and polar effects are combined. Bruises, varicosities, rheumatic swellings and similar painful hyperemic conditions are often promptly relieved by this treatment.

Upon the neuro-muscular system electricity acts directly to produce muscular contraction. These contractions are mainly caused by changes in the intensity of the current, and the more sudden the change the greater is the amount of contraction. For muscular effects it is important that the current changes be not too raipd to permit of complete relaxation, otherwise the circulation is impeded by the contractions and no benefit results. In treating the nerves the current changes may be made much more rapidly. When the changes are very rapid, say 5,000 per second, the conductance of the nerve for ordinary stimuli is temporarily lost.

The X-rays are believed to be electric waves corresponding to some extent to waves of light. Clinical observation is in harmony with the view that the effects of waves of light and electricity are very like those of alternating electric currents, especially high-frequency currents. There is first the stimulating influence upon metabolism. This may be mild, or strong, or destructive. In the second place there are the sensory reflexes already described. The treatment of abnormal growths by any form of electric wave is based upon the fact that as living organisms abnormal cells are less stable than normal cells. Consequently an irritation which is not sufficient to cause serious injury to normal cells may be strong enough to be destructive to abnormal cells. The essence of such treatment therefore consists in applying the stimulation so intensely as to cause gradual destruction of abnormal tissues, stopping short of serious injury to normal tissue.

If the abnormal tissues are of considerable size, as in pulmonary tuberculosis, large malignant tumors and degenerative conditions of the blood or muscular system, there is danger of systemic poisoning by toxins formed from the diseased tissues by the radiations. The treatments must then be at first short and mild, and increased slowly.

The form of radiation to be selected depends chiefly upon its power to reach the part desired. Sunlight and artificial lights penetrate the tissue to a slight degree and are therefore advantageous for surface treatment only. X-rays of low penetrative power, which are obtained from a low vacuum tube, can also be applied only at or near the surface of the body. Rays of high penetration which are obtained from a tube of high vacuum pass without difficulty through the soft tissues.

Radiations that pass entirely through the tissues are wasted. Only those that are stopped by the tissues do work there. Consequently the vacuum of an X-ray tube must be so adjusted that its rays reach the part to be treated, but do not pass through to any considerable extent. Then all the available energy is expended in the desired region. The more highly differentiated tissues, such as hair and sweat glands, are more quickly injured by X-rays than the less differentiated tissues.

1. Abstract of a paper presented before Section H of the International Electrical Congress of St. Louis, September 13, 1904.

CORRESPONDENCE.

Great Britain.

London, September 24.—The condition of things in Great Britain at the present moment with regard to electrical supply is one not calculated to bring an excessive amount of credit to municipalities. Several schemes have recently been promoted of such an unsound character from a business point of view that the Local Government Board, which has to sanction all loans for carrying out municipal undertakings, has refused them. It must be said, however, that such schemes have only been put forward in districts where there is a strong labor or radical political party. The wisdom of the Local Government Board, however, has been applauded by many persons of a municipal turn of mind, because, obviously, looking at the matter impartially, an electric supply scheme when launched by a local authority should be for the greatest good of the greatest number. In some of the schemes above referred to but a very small percentage of the inhabitants could afford to wire their premises, and consequently it does not seem fair to imperil the rates of a big percentage for the benefit of the smaller number. In addition to this, however, evidence is not wanting that such labor-dominated districts are incapable of efficiently managing an electrical undertaking when one is in their possession. Disputes between the councilors of such districts and their electrical officials have not been uncommon of late, and the enlightened representatives of a large London suburb recently remarked that all the training necessary for an electrical engineer could be acquired in a month.

On the broad question of municipal electric supply, however, it is satisfactory to note that the opinion is rapidly gaining ground that small suburban districts of a purely residential character are not profitable, and that to take a supply of energy in "bulk" from a large power company, if it is available—and nearly every large area of England is now covered by such a company—is more to the advantage of the ratepayers. Quite a large number of comparatively small municipalities throughout the country are adopting this course at present, and in more than one instance sufficient experience has been gained to prove the wisdom of such a policy.

Generally speaking, we in England are not usually credited with being what may be called "extremists." But an incident which happened in the Potteries district last week proves that even in England human nature can be made the creature of circumstances. At Handsworth, in Staffordshire, one of the subsidiary companies of the British Electric Traction Company had a dispute with the local authority over the lease of the local tramways which had been granted to it. The lines had not been put into operation and the local authority asserted that until the point at issue had been settled never a tram should be run. The company, on the other hand, had made all arrangements for dealing with the crowds attending a local football match and was equally determined to run the cars. The corporation, however, cut the source of supply, but quickly realizing the illegality of the action restored the connection. Its trump card, however, was yet to be played, for it immediately gave orders for its steam roller to proceed along the tram route, and rumor has it that the driver was told he need not fear dismissal if the roller broke down across the two tracks. At any rate, it broke down and no trams have been run since. The affair, however, has its serious side, for it emphasizes the growing antagonism between private and municipal trading, a state of affairs which the government has been asked many times to modify.

The system of locating ore by electricity was successful a few days ago on the property of the Barrow Hematite Steel Company. The system employed was that patented by Daft & Williams, and the spot where the mineral was actually found was within a few feet of that determined by the apparatus.

Apropos of the mention I made last week of Dublin, further troubles have arisen. The resident engineer now complains that the consulting engineer who has had charge of the undertaking during the last 12 months has not made sufficient provision for giving an adequate supply from the new three-phase station to the old area hitherto supplied upon the single-phase system. The change over actually took place nearly a year ago, but the resident engineer maintains that sufficient alteration to the old system of cables has not been made to meet the contingency of an increased load. At present the matter has not been dealt with by the corporation, but it seems distinctly serious that in a city of the magnitude of Dublin the electrical undertaking could not have been managed in a different manner, at any rate without the officials getting at issue over matters of administration.

For the present matters electrical are pursuing a normal course in St. Marylebone. After the storm and stress of the last two years the company has now been settled with and the municipal scheme is well in hand. An application has been made for adopting 220 volts continuous current as the standard pressure instead of the variety of pressures in existence under the old system, and for the present, at any rate, party strife no longer exists.

On many occasions has the direct control of the consumers' lamps by local electric-lighting authori-

ties been advocated by municipal electrical engineers, but on few occasions has the advice been taken. At present many a consumer burns his lamps too long and then blames the electric light, while in many cases, also, inefficient lamps are often installed. At Bradford, on the advice of the electrical engineer, free lamps were supplied to consumers, it being found that the extra consumers thereby secured more than paid for the cost of the lamps. Not many engineers have gone so far, but a recent report by the Tunbridge Wells engineer about hits off the general opinion. In this report it is advocated that the electric-light department should undertake the supply and maintenance of consumers' lamps, because the consumer thereby would be assured of an efficient and satisfactory light, good and economical lamps would always be used and the undertaking would always be in touch with the consumer. This matter was also dealt with in the presidential address to the Municipal Electrical Association this year, when a similar opinion was expressed. G.

New York.

New York, October 1.—The New York subway will be opened for public traffic on or before midnight of Thursday, October 27th. Certain members of the Board of Aldermen drew up plans some weeks ago for an official opening, including prayers, speeches, music, decorations and fireworks at an estimated cost of $50,000, but at yesterday's meeting of the board the proposed expenditure was voted down, and it was suggested that $5,000 would be a reasonable sum to expend for the occasion. The would-be festive ones declined the suggestion, and there, for the present, the matter rests, and it is probable that the subway will be opened in a plain, businesslike way by Mayor McClellan driving the first train. Perhaps a few speeches may be made, but there is not likely to be any decorations, music, banquet or fireworks.

The work of constructing the tunnel under Fulton Street, Brooklyn, is to be commenced in a few days. The big storekeepers on that thoroughfare allege that certain promises to them are not being kept, and they claim that they should be allowed an opportunity to study the plans before the work is commenced. The request is reasonable and will probably be complied with in some satisfactory way.

The newly completed Atlantic Avenue tunnel of the Long Island railroad has been officially inspected this week by the Atlantic Avenue Improvement Board. The inspection was satisfactory and trains are now running in the tunnel. This improvement will enable the Long Island railroad to abolish its surface line along the avenue, and the tunnel will be finally used for electric traction.

There are now in Manhattan and the Bronx a total of 1,383 public fire-alarm signal stations in addition to 2,886 private call boxes. These signals necessitate the use of 1,023 miles of conductors. The private boxes are under the control of the following corporations: Automatic Fire Alarm Company, Manhattan Fire Alarm Company, Special Fire Alarm Electric Signal Company and the Consolidated Fire Alarm Company.

There are now more than a thousand telephone connections in the various rooms of the Waldorf Astoria Hotel in this city. The main switchboard in the hotel is quite an important affair.

A new concern with a capital of $5,000 has been incorporated this week, with headquarters in this city, under the title of the New York and Montauk Telegraph Company. The directors are F. W. Miller, L. G. Johnson and B. L. Schuman. The company will install a telephone service in a district of Long Island, betwen Babylon and Oyster Bay.

In all the boroughs of Greater New York the sixteenth season of the free-lecture system of the board of education was started today. It has been found necessary to form 140 lecture centers so that no citizen will be beyond convenient reach. The lectures to a large extent have been arranged in courses, and reading in connection with the subjects of the lectures is encouraged. Among the courses offered are the lectures on electricity, physics, chemistry, astronomy and other branches of science courses, and single lectures on literature, art, music, architecture and other subjects of æsthetic and educational value, and an unusually large number of courses and lectures on history, sociology, travel and descriptive geography. Science will occupy a large part of the courses. Among the prominent lecturers on science will be Prof. Ernest R. von Nardoff, who will give a course of nine lectures on "Electricity and Magnetism" in the assembly hall of the board of education, Park Avenue and Fifty-ninth Street, on Wednesday evenings, beginning October 19th. In public school 51, 523 West Forty-fourth Street, on Monday evenings, beginning October 10th, Prof. Charles L. Harrington will give a series of 10 lectures on "Electricity," including such topics as "Wireless Telegraphy," "Dynamical Electricity" and "Roentgen Rays." W.

New England.

Boston, October 1.—The annual meeting of the Edison Electric Illuminating Company of Boston will be held October 11th, but it is understood that only routine business incidental to the annual election of directors and appointments will be transacted. A stock issue is contemplated, however, before the close of the calendar year, and a special meeting is likely to be called for the purpose, as the company has the privilege of putting out about 10,000 additional shares at $200 each on the authority obtained from the state commission last year.

Another important trolley-line purchase by the New York, New Haven and Hartford is announced, the Worcester and Blackstone Valley system having been acquired last month, and it is stated that a deal is in progress for the absorption of the Middletown Street Railway Company of Middletown, Conn. The Worcester and Blackstone Company is the third Worcester property thus secured by the steam-railroad corporation. It runs from Worcester to Whitinsville, a distance of 17 miles, and M. J. Whittal and Alfred Thomas of Worcester were the principal owners of the stock. It was capitalized at $60,000, but has assets of over $460,000. The capital stock of the Middletown company is $200,000, with $135,000 outstanding, and it is bonded for $180,000.

The Haverhill Electric Company has passed into the hands of the Malden and Haverhill people, who are promoting the project of a line between the two cities and who secured a charter from the Legislature for their enterprise, in spite of much opposition by existing lines. The capitalization of the company is $153,000, par value $100, and the price paid is said to have been $175 per share.

The phenomenal earnings of the popular fast-trolley line from Boston to Worcester continue to surprise those who were inclined to doubt the advisability of establishing such a line. The August report shows a gross of $55,866 and a net of $33,650. For the 12 months ended September 30, 1904, operating expenses are estimated at 56 per cent. of the gross earnings, which, it is thought, will have exceeded $400,000, yielding a surplus over operating expenses, taxes and interest of about $90,000.

The Boston Rapid Transit Commission expects to have the new East Boston tunnel all ready for use before January 1, 1905. Its total cost is $3,000,000. Predictions are made that the Boston Elevated Company will have trains running under the harbor to East Boston regularly before Christmas or New Year's at the latest.

A company known as the Dedham and Franklin Street Railway Company has been organized, with a capital of $100,000, to operate what was formerly the Norfolk Western Street Railway Company that went into the hands of a receiver several months ago and was sold on August 3d.

In western Massachusetts progress has been made on the plan to connect North Adams, Mass., and Bennington, Vt., by electric railway, the first contract being made last week at Williamstown, Mass. This will bring the Hoosack Valley road in this state to the Vermont boundary line. B.

Ohio.

Cleveland, October 1.—The fire department was utilized at Geneva a few days ago to keep workmen on the Cleveland, Painesville and Ashtabula Traction Company from filling the roadbed through the town with gravel instead of crushed stone.

Almost a dozen passengers on a southbound Scioto Valley Traction car on the Columbus-Lancaster line were injured in a collision last Wednesday evening. The passenger car and a combination baggage and work car came together at full speed on a curve. The baggage car telescoped the passenger almost half way. The cause seems to lie in the fact that the watch used by the motorman of the baggage car was half an hour late.

The property of the Scioto Valley Traction Company will soon be transferred from the control of the constructing pool to the stockholders, when the company will be organized and officers chosen. The whole business so far has been in the hands of the pool as a committee on construction, but they now want it off their hands.

Elliott Wadsworth, representing Stone & Webster of Boston, was in Central Ohio last week looking over traction properties. This firm does an expert business and Boston capitalists nearly always require a favorable report from them before they will agree to finance a proposition. Mr. Wadsworth spoke favorably of the traction properties about Columbus.

The Southeastern Ohio Railway, Light and Power Company has filed a petition asking for a franchise to operate on certain streets in Zanesville and proposes to offer a five-cent fare and six tickets for a quarter on its own lines within the city limits.

According to the report of the city electrician the cost of street lighting in Cincinnati for 1903 was $290,140.64, with $4,081.75 deducted for outages. There are 4,914 electric street lights in all.

It is stated that the people of Toledo are changing their attitude in regard to the franchise asked for by the Toledo Railways and Light Company. This has come about largely through the investigations made by the mayor and committees from the City Council and the Chamber of Commerce. It is stated that interest on the bonded indebtedness of the company, amounting to about $470,000 a year, is all that the owners have ever taken out of the receipts of the company, while no dividends have been paid on the capital stock of $10,000,000. Rumors have been going the rounds that the city solicitor is preparing an ordinance granting a franchise almost identical with that under which the Columbus Railway, Power and Light Company is operating. That would mean seven tickets for 25 cents with very liberal transfer system.

W. W. Platt, night engineer at the light plant in Coshocton, received a current of 4,500 volts one night last week. He was unconscious for a time but is recovering. His arm and hand were badly burned.

It is probable that the railway companies operating in Cleveland will soon file lists of their stockholders under an ordinance passed some time ago. The list of the Cleveland Electric has not been filed since the consolidation, two years ago.

The contract between the Toledo Railways and Light Company and the Toledo, Port Clinton and Lakeside, by which the latter is to enter Toledo over the former's tracks has been ratified. The Port Clinton road will use the tracks of the Lake Shore Electric between Toledo and Genoa.

The Hirsch Construction Company has contracted for the equipment for the Toledo and Indiana line from Wauseon to Bryan, a distance of 35 miles. The road is in operation from Toledo to Wauseon, 30 miles. It is built in accordance with steam-road specifications and has its own right-of-way, with land for power stations, depots and repair shops. One power station is maintained at Wauseon and another will be built at Stryker.

Colonel A. E. Boone has another scheme for an extensive electric-railway enterprise to be capitalized at $5,000,000. His plan is to connect a number of towns in Southern Ohio, West Virginia and Pennsylvania. O. M. C.

Michigan.

Detroit, October 1.—The Detroit, Ypsilanti, Ann Arbor and Jackson electric railway has won its tax case, and Judge Mandell has restrained the city of Detroit from collecting taxes on the rolling stock. The injunction restraining the village of Dearborn from collecting taxes was dissolved. The action was originally brought to avoid double taxation on property which is assessed at $168,000 in Dearborn and $125,000 in Detroit.

The rumor that the Ionia-Owosso portion of the electric line which is being engineered by E. M. Hopkins, to run from Pontiac to Grand Rapids, has been sold to the Grand Trunk railway is declared to be without foundation by that gentleman.

The town of Frankenmuth was very enthusiastic over the arrival of the first car which was run over the new Saginaw and Flint electric line from Saginaw to that point last week Friday. An entertainment was given in celebration of the event. Regular car service will be given from now on from Frankenmuth to Saginaw.

A great effort is being made by the Detroit politicians in favor of municipal ownership of street-railway tracks and opposing the granting of any franchises until the citizens of Detroit, by their ballots, decide what they want. Candidates are being asked their position in regard to street-railway matters, and it is expected that the people will be given a chance to take up the question of municipal ownership again.

J. E. Cochran, Jr., of Chester, Pa., is being held by the grand jury on charges preferred by E. D. Nelson, president of the Twin City Electric and Supply Company of Ironwood, the Ironwood waterworks, the Hurley waterworks and the Ironwood and Bessemer interurban street railway, for alleged misappropriation of funds in connection with the floating of $350,000 bonds of a new company, to be known as Gogebic Electric Company, which is an amalgamation of the above companies and which was capitalized at $400,000. C. G. W.

Indiana.

Indianapolis, October 1.—The contract has been let for a $10,000 addition to the Shelbyville Water and Light Company's plant. The plant will be opened January 1st.

A deed has been filed by which Victor M. Carr of Hartsville transferred 70 acres of land near Hartsville to the Columbus, Greensburg and Richmond Traction Company for a park site. The consideration was $2,000. Harris F. Holland, vice-president of the road, was in Columbus this week and started two new engineers out on the line.

Promoters of the Portland, Montpelier, Warren and Huntington Traction Company, desirous of planning an extension northward from Huntington, have returned from a trip to Goshen, Syracuse and other points. It is desired to complete a line by way of Columbia City and Syracuse to Goshen, so as to obtain traction-line connections into Chicago. A traction expert will be taken over the line in a few days. The line to Portland is understood to be financed. An effort will be made to interest Goshen people in the construction of the proposed road. Albert West of Montpelier, James Mills of New York and J. B. Kenner and W. A. Jones of Huntington have been in Goshen to consult with the Commercial Exchange, an organization formed to boom Goshen. The promoters were to build their road from Columbia City by way of Lake Wawasee, to Goshen. Montpelier has voted a $25,000 subsidy, which Huntington has duplicated. Warren is to contribute $10,000 to the fund. If the line is built Goshen will be asked to vote a subsidy.

Men have been working among farmers east and

north of Alexandria to obtain the right-of-way for the new electric line from Hartford City to Alexandria. The street upon which it will enter the city is just now interesting local merchants most, and the fact that it will be John, Church or Washington is sufficient to reawaken the rivalry of the time when the Indiana Union Traction Company wanted a franchise. The Indiana Union Traction has a grade to the east end of Washington Street, but has forfeited its franchise in the street by not building.

The ninth interurban railroad to come into Indianapolis is knocking for entrance. A petition for a franchise has been filed with the Board of Public Works by the Indianapolis, Newcastle and Winchester Traction Company. It was presented by C. E. Barrett. The new road wishes to come into the city by way of Twenty-first Street to Massachusetts Avenue, down this avenue to Tenth Street, and there join the tracks of the Indianapolis Traction and Terminal Company. H.

Rocky Mountain States.

Salt Lake City, September 30.—The Utah Light and Railway Company of Salt Lake City has completed plans for the construction and equipment of a new electrical transmitting station which will be provided with the latest electrical contrivances. The power will be transformed at the station to 4,000 volts.

The Postal Telegraph-cable Company has opened headquarters in Salt Lake City for the district comprising part of Wyoming, Montana and Utah, and it is announced by the district manager that the system will be ready to commence operation in a few weeks.

The power plant of the Wyoming Light and Power Company at the Falls of the Big Popo-Agie River is nearing completion. A fall of 500 feet is being utilized for the generation of power. A transmission line will connect mines with the plant for a distance of 18 miles, and Lander, the near town, will have an electric-lighting service when the plant is completed.

The American Falls (Idaho) Power, Light and Water Company has awarded a contract for two power houses, one to be built at Pocatello and the other at American Falls. The expenditure will be about $9,000, outside of the equipment, which will cost an additional $7,000.

Articles of incorporation of the American Falls (Idaho) Electric Company have been filed with the secretary of state. The capitalization is $1,000,000, and William Burke, Jr., John L. Burke and L. V. St. Clair of American Falls and R. H. Johnson and S. H. Hays of Boise are named as the directors. The company proposes the development of power on the west side of American Falls on the Snake River and the pumping of sufficient water to irrigate 4,000 acres of land. The project, it is estimated, will involve the expenditure of about $250,000. The plans of the corporation also include the construction of a dam 300 feet long and 30 feet high below the falls, where, it is expected, that 20,000 horsepower will be developed. The water to be used for irrigation purposes will be raised a distance of 200 feet and transmitted through canals and laterals. The work on the dam, however, will not be commenced until the installation at the falls of pumps for irrigation purposes. G.

Pacific Slope.

San Francisco, September 29.—M. V. McQuigg, who is interested in the Monterey Gas and Electric Company, is in town.

J. Cunningham of Alturas is in the city this week purchasing electrical supplies.

F. J. Somers, manager of the Century Electric Company of San Jose, is in San Francisco on business.

The Pacific States Telephone and Telegraph Company will soon erect a three-story brick building at Crocker and West Mission Streets, to cost $50,000.

The Stuger Electrical Works has opened an office at 343 Kearny Street, San Francisco.

The Petaluma and Santa Rosa Electric Railway Company is making rapid progress with the construction of the road. The grading is completed and the trolley wire is in place from Santa Rosa to Sebastopol and for 10 miles out of Petaluma. Some of the coaches have arrived and are now being placed on their running gear. The entrance to each coach is near the center, where passengers step into a vestibule. In one end is the smoking room and baggage apartments and in the other the seats for passengers. Each car is lighted with 50 incandescent lamps and fitted with air brakes and whistles. The coaches are of heavy pattern and are intended for a speed of 40 miles an hour.

O. A. Hale, as president of the San Jose and Palo Alto Interurban railroad, has filed with the supervisors of Santa Clara County the company's petition for a franchise to construct and operate an electric railroad on the Stevens Creek road from Saratoga Avenue at the Meridian corners, San Jose, Cal., to Stevens Creek, near the Fathers' villa. Bids for the franchise will be received by the board up to November 9th.

G. E. Wills, J. M. Nickum, D. M. Donaugh and W. W. Plimpton of Willsburg, Ore., have been appointed a committee from that town to act with committees from other localities on the question of the electric railway from Portland to East Oregon City. All the committees will hold a meeting in Milwaukee in the near future for the purpose of perfecting a permanent organization.

Henry M. Richards states that an electric line will be running from Medical Lake to Spokane, Wash., by July 1, 1905. His company, the Washington Water Power Company, has secured right-of-way, and the construction of the line will commence as soon as the minor details are concluded.

The Willamette Valley Railroad Company proposes to run an electric road from Eugene to Corvallis, Ore., and has applied to the City Council of Corvallis for a franchise to run its lines through the streets of the city.

The supervisors of Humboldt County, Cal., have adopted an ordinance granting to the Humboldt Transit Company a franchise to construct and operate an electric railway along the public highway of Humboldt County.

Surveyors of the Pacific Electric Railway Company are at work at Newport Beach, Cal., supposedly completing the survey of the right-of-way from the Huntington Beach to Newport upon the route where the road is expected to be constructed soon.

C. B. Mahaffey, engineer of the General Electric Company, with headquarters in Denver, is in Albuquerque, N. M., looking over the ground and discussing plans with the newly incorporated electric-power company for an immense plant to be erected at Albuquerque. The power plant is to be built north of the mills of the American Lumber Company. It is to cost $75,000 and it will generate between 1,500 and 2,000 horsepower. C. K. Durbin and W. S. Iliff are the principal movers in the enterprise.

The Kilbourne & Clark Company of Seattle, Wash., reports that in electrical supplies business has been active since the end of July and now is decidedly bright. This company has just entered into a contract to supply a 2,000-horsepower plant in Northern California.

It is rumored that the San Bernardino Traction Company of San Bernardino, Cal., will in the near future extend its line to Rialto. One of the plans of the company which will be immediately executed is the building of a line from Third Street, San Bernardino, for a cut-off to Redlands. A.

PERSONAL.

John Barclay of Detroit has been appointed superintendent of the Pontiac division of the Detroit United Railway, succeeding George Douglas, who has resigned to enter other business.

John Young, manager of the Glasgow municipal street-railway system, has been appointed manager of Yerkes' underground system in London, and the advocates of municipal operation of street railways are jubilant thereat.

Frank Hedley, who will be remembered as the general superintendent of the Lake Street and Northwestern Elevated Railroad companies of Chicago, and who has for some time been general superintendent of the Interborough Rapid Transit Company of New York, has been promoted to be general manager of the Interborough system. Mr. Hedley is the inventor of a number of devices for electric-railway operation.

George M. Willis, a member of the well-known firm of F. B. Badt & Co., consulting engineers, Monadnock Block, Chicago, has left for Salt Lake City in company with L. W. Pitcher, the secretary of the American Guaranty Company of Chicago. These gentlemen are looking after electric-railway interests and the building of new branches of the Salt Lake Southern railway.

J. C. Smith, local manager in Chicago of the Western Union Telegraph Company, has been made superintendent of a new district, to be known as the fourth district, western division, with headquarters at Dallas, Texas. Mr. Smith's new charge will embrace the lines and offices in Texas and Louisiana, and include Texarkana, Ark., which heretofore have been included in the second district.

The death of Senator George F. Hoar, which occurred at Worcester, Mass., on September 30th, removed from American public life a statesman of the first rank. Among the many social and educational institutions with which Mr. Hoar was connected was the Worcester Polytechnic Institute, which he helped to put on a solid foundation, and of which for many years he was one of the trustees. Senator Hoar delivered an interesting address before the students of Armour Institute in Chicago last year.

In its issue of October 1st the Electrical Review of New York says: "Mr. B. E. Greene, formerly editor of Electricity and recently in the life-insurance business, died suddenly at his home in Brooklyn on Wednesday morning of this week. Mr. Greene was recently operated upon for cancer of the tongue." This news will possess a sad interest for many electrical men, for at one time Mr. Greene had an extensive electrical acquaintance. He was a sort of free-lance in electrical journalism and attracted much attention by his attacks on the General Electric Company. He often secured inside information of surprising accuracy, and, although his work was destructive rather than constructive, it caused considerable stir seven or eight years ago.

Mr. Irving P. Lord, president and general manager of the Waupaca (Wis.) Electric Light and Railway Company, was in Chicago this week on his way to the St. Louis conventions and Exposition. Mr. Lord was accompanied by Mrs. Lord, and both are very pleasantly remembered by those who were fortunate enough to attend the Waupaca summer conventions of the Northwestern Electrical Association, of which Mr. Lord is a former president.

At the laying of the cornerstone of the new Orange Methodist church a few days ago in Orange, N. J., a photograph of Thomas A. Edison as Orange's leading citizen and an original phonograph record cylinder on which was the music of "Lead Kindly Light," together with a set of battery plates from the inventor's new storage battery, were placed in the copper box with newspapers and other articles of interest.

Clarence E. Dally, a young electrical engineer and chief assistant in the experimental laboratories of Thomas A. Edison, died at East Orange, N. J., on October 2d from the effects, it is said, of experimental work with Roentgen rays. He had suffered for a number of years, according to the newspaper account, from the effect of the many chemicals used in X-ray experiments and from the constant exposure of his hands to the X-rays in the preliminary work seven years ago.

The funeral at Copenhagen, Denmark, on September 29th of Prof. Niels Finsen was an impressive affair. Two kings, those of Denmark and Greece, were present, while princes and high ministers of state and leading scientists came to pay a last tribute to the dead man. Wreaths came from Emperor William, King Edward, Queen Alexandra and Count von Bülow. The crown prince of Denmark and Princess Waldemar, Karl and Hans were present. The coffin was hidden beneath flowers, and hundreds of doctors, medical students and patients followed it to the grave.

Mr. T. H. Tracy, recently appointed manager of the mining, crushing and cement-machinery department of the Allis-Chalmers Company, is well known to the mining interests of the country. Mr. Tracy designed, erected and operated as general superintendent the large plants of the North American Copper Company at Grand Encampment, Wyo., and in that position he remained until in February, 1904, he resigned in order to join the selling force of the Allis-Chalmers Company at the New York office. On June 1st he was promoted to his present position. In knowledge of the field, acquaintance with mining men and experience in practical affairs Mr. Tracy is unusually well equipped.

The Allis-Chalmers Company is perfecting its organization with great energy. Recent acquisitions are as follows: Charles S. Buell, mechanical engineer, who recently represented the Westinghouse Machine Company in Chicago, to be salesman and engineer in the power department; John F. Burke of Omaha, to engage in the sale of Corliss engines, electrical apparatus, etc., in that city; Wilbur M. Ruth, until recently assistant to the president of the Mesta Machine Company, Pittsburg, Pa., to be salesman and engineer at the Pittsburg office; M. C. Miller, formerly with the Westinghouse Electric and Manufacturing Company, to be connected with the electrical department; Charles F. Adae, lately manager of the Pittsburg office of the C. Lee Cook Company, added to the selling force of the New York office; S. H. Sharpsteen, for a number of years with the General Electric Company as salesman, to a similar position in the New York office; G. Fred Collins, who has an extensive acquaintance throughout the East among officials and engineers of large railroad and steel companies, to be special representative at the New York office; W. M. S. Miller, who was in the employment of the Westinghouse Electric and Manufacturing Company, to have headquarters in Chicago; R. L. Richardson, to become a member of the Pittsburg selling force; John V. Redfield, appointed to the sales staff of the Allis-Chalmers-Bullock interests at the Chicago office; James Ashworth, until recently engineer of the city of Chicago, in the department of water supply, to be salesman in the pumping-engine department; Otto Clyde Ross, lately in the employment of the Hartford Lead, Zinc, Mining and Smelting Company as engineer, to be engineer and salesman.

ELECTRIC LIGHTING.

The Monarch Lumber Company of Blaine, Wash., has purchased an electric-lighting plant.

The Wichita Falls (Texas) Electric Light Company has been incorporated with a capital stock of $15,000.

E. Quilitch of Alvarado, Texas, has sold his electric-light plant to the Alvarado Water, Light and Power Company.

The city of Broxton, Ga., has granted a franchise to A. G. Garbuta to operate an electric-light plant, the rate for arc lamps to be $70 per light a year.

The cities of Camilla and Tennille, Ga., will vote this month on a proposition to issue bonds for the

purchase of the electric-light plants and building and improving the waterworks system.

The Commercial Club of Lindsborg, Kan., has taken up the electric-light question and expects to interest some company in putting in a plant there.

An electric-light plant is being installed at the shaft of the Treadwell Coal Company, Sturgis, Ky. An electric-lighting system for the town is also proposed.

R. C. Malone and Frank Kell of Wichita Falls, Texas, and associates have incorporated as the Wichita Falls Electric Company for the purpose of supplying electric light.

The Luzerne County (Pa.) Gas Company and the Wyoming Valley Electric Light Company will be consolidated under the name of the Wilkesbarre Gas and Electric Light Company.

ELECTRIC RAILWAYS.

The management of the Syracuse Rapid Transit Electric Railway Company has decided to install coal stoves in the cars for heating purposes instead of having them heated by electricity, as heretofore. The cause of this is that on account of the heavier cars and additional rolling stock the present power plant cannot generate enough electricity for both motive and heating power.

The Metropolitan West Side elevated railway of Chicago opened its new terminal station on Fifth Avenue, October 3d, and 40 trains were run into the station during the day. Trains running into the new terminal are relieved of the necessity of going around the "loop," and there was a noticeable decrease of congestion resulting. The terminal station is located near the center of the wholesale district of the city, and a great many of the employes of the wholesale houses find it more convenient to go there than to a "loop" station, the trains for the West Side of the city being always crowded at that point.

The South Side Elevated Railroad Company of Chicago has issued its report to the State Railroad and Warehouse Commission for the year ended June 30, 1904. Receipts from passengers increased $142,091, or 9.4 per cent. Cost of conducting transportation increased $46,222, or 11.9 per cent. The item of $356,000 bills payable which appeared in the balance sheet is due to expenses incurred in connection with the extensions now under way. The whole number of passengers carried in the year was 32,916,280. Gross earnings amounted to $1,690,842. The expenditures for maintenance of way, maintenance of equipment, conducting transportation, loop rent, etc., brought the net earnings down to $742,744.

SOCIETIES AND SCHOOLS.

The 1905 convention of the National Electrical Contractors' Association will be held in Boston.

A bulletin of the Thomas S. Clarkson Memorial School of Technology contains among other things an address delivered by Francis N. Thorp, Ph.D., delivered at the annual commencement last June. The address was upon "The Opportunity of the Engineer," and is interesting, in that it embodies the views of one outside the profession.

Chancellor James A. Day of Syracuse University has announced the gift from Lyman C. Smith of Syracuse, N. Y., of an additional building for the Lyman Cornelius Smith College of Applied Science. Mr. Smith, four years ago, established the school, giving $750,000. The present gift enlarges the scope of the college by adding a model factory building, three stories high, 200 by 50 feet, for mining, engineering, and a mechanical laboratory. The original gift was a three-story stone building. The cost of the new structure is estimated at more than $100,000.

PUBLICATIONS.

The September issue of the Bulletin of the New York Edison Company, which appears monthly, is something more than a mere advertisement sheet for the company. The articles, which are not at all confined to happenings in New York city, make really interesting reading. This publication, it is worth noting, is edited by a woman, Miss Beckwith, who is also the press agent for the New York Edison Company.

The Bullock Electric Manufacturing Company's Monthly calendar for October bears a portrait of Joseph Henry, with an appreciative reference to his work.

Dean Bros.' Pump Works of Indianapolis are extensive manufacturers of condensing machinery and the company has just issued a handsome catalogue of this class of apparatus. The catalogue contains besides detailed descriptions and tables of sizes of pump and condenser machinery, a number of valuable tables, rules and examples for calculating condenser apparatus. A striking illustration is one showing the relative volumes of a given amount of water as water and as steam.

The Electric Storage Battery Company of Philadelphia has issued a little engineering-data pamphlet, giving facts about storage batteries and the Chloride accumulator in particular, as supplied for stations, railway plants, train lighting and for many other places. Some characteristics of the lead storage battery are given, and at the end of the pamphlet several pages of engineering tables and useful constants. The pamphlet has a durable celluloid cover and will be found convenient as a pocketbook of reference.

That excellent daily newspaper, the Jamestown (N. Y.) Morning Post, publishes a Third Anniversary Edition which is a creditable production. This special issue consists of 28 pages, with a striking title page and a number of well-executed illustrations. Jamestown has a population of 25,000 and many flourishing industries. Among these are the Hanson Electric Company, the Jamestown Electric Company and the Home Telephone Company. The last named has on its circuits about 2,500 instruments, while the local exchange of the New York and Pennsylvania Telephone and Telegraph Company (Bell) gives service to about 2,000 telephones. The Post's special number is dated October 1st. It bears evidence that modern newspaper service is appreciated by the alert business men of Jamestown.

SPACE TELEGRAPHY.

The French government is about to install a space-telegraph station on an island off the westernmost point of France. This will be used to communicate with incoming and outgoing transatlantic steamers. The War Department is also extending the use of space telegraphy. Experiments made at the Eiffel Tower recently permitted the army officials in Paris to carry on wireless communication with Dijon, 200 miles distant.

A recent San Francisco dispatch says that while cruising down the coast from San Francisco to Magdalena Bay, Lower California, Admiral Goodrich and the officers of the United States cruiser New York engaged in a chess game by space telegraphy with Captain Hubbard and the officers of the cruiser Boston. The ships were several miles apart, but there was no difficulty in communication, and the players made their moves almost precisely as though they had been on the same ship.

MISCELLANEOUS.

On complaint of Thomas A. Edison, the inventor, the United States Postoffice Department has issued a fraud order against the Thomas A. Edison Jr. Chemical Company of New York. Thomas A. Edison, Jr., is a son of the great Edison, and it is said that the company bearing his name seeks to obtain money by the sale of a "magno-electric vitalizer" consisting principally of an alleged electric battery. Young Mr. Edison admits that he has no scientific or inventive ability, according to the newspaper accounts, and his only connection with the concern is said to have been to draw a salary of $35 a week.

Chief Engineer John F. Wallace of the Panama Canal Commission gave a talk in Chicago a few days ago on the engineering work thus far done by the United States on the Isthmus. He said that the resident engineer and his assistants had endured considerable hardship, but as the result of their explorations a saving of $20,000,000 was already apparent from the plans formulated by the French engineers. The following are among the comments he made: "The American people's debt of gratitude to the French is that they showed us what not to do." "Panama is healthy, but no man who goes there and drinks champagne will keep healthy long." Six Chicago engineers, who will form part of the staff working on the canal, have just been engaged. They are: R. L. Drake, H. G. Halleck, E. C. Banta, E. C. Shoecraft, C. W. Wilson and John O. Taylor.

TRADE NEWS.

A newly organized company has taken charge of the electric-light plant of Mazatlan. The company will need a large amount of supplies, and quotations from manufacturers of electric supplies should be addressed at once to Señor José H. Rico, Mazatlan, Sinaloa, Mexico.

The Electric Controller and Supply Company of Cleveland announces the opening of its southern branch office at 509-510 Woodward Building, Birmingham, Ala. This company is now represented in New York, Philadelphia, Pittsburg, Cleveland, Birmingham, Ala., Denver, Colo., San Francisco and London, England.

Sealed proposals will be received at the office of the city clerk in the city of Lincoln, Neb., until October 18th for furnishing poles, lines and lighting circuits, boilers, engines, feed-water heater, boiler-feed pumps, electric generators, switchboards, series alternating arc-lighting regulators or transformers and arc lamps and constant-potential transformers, to be employed in the construction and equipment of a complete electric-lighting system of 328 street lights. Bidders may obtain copies of the complete plans and specifications by sending $5 to the city engineer. Separate bids will also be received for the construction of a power house and chimney for water plant at the Mockett well. Bidders may obtain copies of the complete plans and specifications by sending $7 to the city engineer.

BUSINESS.

The General Incandescent Arc Light Company, 529 West Thirty-fourth Street, New York, has been awarded the contract for 1,250 G. I. dust and watertight outlet boxes for the new John Wanamaker Building at Philadelphia, through the Pennsylvania Electric Equipment Company.

William Roche, manufacturer of the well-known "New Standard" dry batteries, has issued a new and enlarged catalogue of batteries and auto specialties. A copy of this catalogue will be gladly sent on application. It contains useful and interesting data to battery users. Mr. Roche reports an exceptionally large demand this season for his "Auto Gas" battery for gas-ignition work, and he is in receipt of many testimonials as to the high efficiency of this battery. Mr. Roche also calls especial attention to his vest-pocket flashlight.

The Hermann Manufacturing Company, 339-343 Larrabee Street, Chicago, is calling the attention of the electrical trade to the electric letters and signs of every description which it manufactures. The electric letters are made of sheet metal in sizes from five inches high to 15 feet high and nine feet wide. The company says that its signs are noted for their strength, being made in a special way of its own, strongly braced inside, and that the best receptacle only is used. The company will be glad to furnish quotations on any electric sign or letter work.

The National Electric Company of Milwaukee and the Hooven, Owen, Rentschler Company of Hamilton, Ohio, offer an opportunity to purchase their exhibit at Block 46, Machinery Building, Louisiana Purchase Exposition. This unit consists of a National revolving-field alternator of 1,500-kilowatt capacity, direct connected to a new Hamilton-Corliss vertical, cross-compound, condensing engine, running at 83 revolutions per minute. The entire equipment represents the latest development of engineering design, and may be seen in operation until the close of the Exposition.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued (United States Patent Office) September 27, 1904.

770,737. Third Rail for Electric Railways. Albert F. Chase, Haddonfield, N. J., assignor of one-half to Stanley W. Rusk, Philadelphia, Pa. Application filed March 17, 1904.

A conductor, for use in electric third-rail systems, consists of the combination with a depending contact portion and a superposed protecting shed, consisting of a flat portion with oppositely disposed overhead flanges. Downwardly inclined wings proceed from the flanges. (See cut on next page.)

770,744. Trolley. Samuel Fisher and Albert Sanders, Butler, Pa. Application filed June 27, 1903.

A harp supports a wheel upon a shaft having projecting ends, and a pole supports the harp. A pair of arms are loosely secured on the projecting ends of the shaft for rocking movement thereon and pins project through the ends of the shaft and are spaced from the arms. Guard wheels mounted on the upper ends of the arms project toward each other directly above the wheel, and links pivoted to the lower ends of the arms have their lower ends overlapping. A flexible means passes through the overlapping ends of the links whereby the lower ends of the arms may be drawn together to separate the guard wheels, and a spring is arranged between the lower ends of the arms for returning them to their normal position.

770,769. Block-signaling System for Railways. Chester T. Morey, Cambridge, Mass. Application filed May 12, 1904.

The combination consists of a normally broken circuit containing signals at each end of the block, with a mechanism at one end of the block for closing the circuit and a mechanism at the other end of the block for opening the circuit. Means are provided for maintaining the circuit between the operations of the two mechanisms.

770,792. Means for Telegraphing. John Beard, Livingston, Mont. Application filed April 27, 1904.

In the device are a base comprising a series of electric contacts separated by insulating material, a stylus having a metal end, a rolling contact carried by the metal end and a spring exerting a pressure upon the rolling contact to hold it against the metal end and insure the maintenance of electrical connection.

770,796. Apparatus for Separating Ore. Henry F. Campbell, Boston, Mass., assignor to the National Magnetic Mineral Separating Company of Maine. Application filed May 16, 1901.

In a magnetic separator means are provided for presenting an unobstructed surface at a due distance below the magnet for supporting and conveying the material under and past the magnet and through an uninterrupted field of the magnet. There are means for causing the

particles of ore to be mechanically agitated under the magnet in a direction other than that of the travel of the ore.

770,818. Locking Device for Switches. Max P. J. Nemmert, Wilkinsburg, Pa., assignor to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Application filed November 21, 1903.

A lock and support for electrical switches having one or more blades hinged at one end between suitable jaws has a movable plate located between the hinge jaws, the outer edge of which is cut away for a portion of its length.

770,865. Three-phase Ground Detector. Paul MacGahan, Pittsburg, Pa., assignor to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Application filed January 20, 1904.

A ground detector for three-phase electric circuits comprises three stationary vanes, a movable vane located in inductive relation thereto and means for mounting the movable vane which permit of its movement toward or from any of the stationary vanes. (See cut.)

NO 770,737.—THIRD RAIL.

770,873. Controlling Device for Electrical Lifts or Hoisting Mechanisms. Hugo Stahl, Stuttgart, Germany. Application filed July 11, 1903.

Apparatus for controlling electric elevators comprises the following: A main electric motor to operate the elevator car in both directions, an auxiliary electric motor, an auxiliary circuit containing the auxiliary electric motor, means to close the auxiliary electric circuit, means to open the auxiliary electric circuit, a main circuit containing the main electric motor, electric resistances, means adapted to be operated by the auxiliary electric motor to switch the resistance in and out the main circuit, a piston adapted to be moved by the auxiliary motor, a cylinder in which the piston tightly moves, an air-admission opening in the cylinder, a screw to regulate the size of the air-admission opening and an air-outlet valve in the cylinder.

770,911. Third-rail System. Leslie M. La Barr, Forest City, Pa. Application filed June 22, 1904.

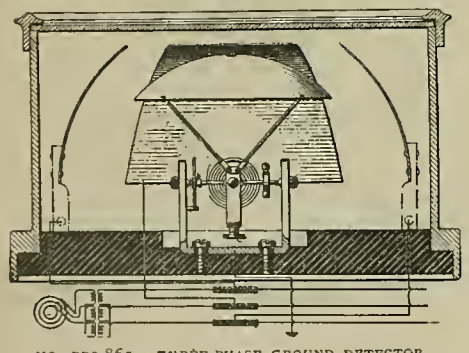
An inverted third rail, an adjustable support therefor and an insulating cover for the rail, the rail forming a support for the insulating cover, are the features. (See cut.)

770,922. Motor. Edwin S. Pillsbury and Edward Bretch, St. Louis, Mo., assignors to the H. E. Lindsey Electrical Supply Company, St. Louis, Mo. Application filed April 17, 1903.

The combination consists of a driven element, a source of electrical energy, and a main induction motor incapable of being started by energy supplied to it from the source. The motor is in driving connection with the driven element and in electrical connection with the source of energy. Means for starting the motor comprise an auxiliary conduction motor capable of being started by energy supplied to it from the source, the auxiliary motor being in driving connection with the driven element and in electrical connection with the same source of energy. Means whereby after the main induction motor has been started energy is cut off from the auxiliary conduction motor are provided. (See cut.)

770,923. Electric Motor. Edwin S. Pillsbury, St. Louis, Mo. Application filed July 27, 1903.

A field, an armature and a source of energy have means for first supplying the energy from the source to the armature and short-circuiting the field, and means for then cutting off the supply of energy to the armature and supplying the field with the energy from the source of supply.



NO. 770,865.—THREE-PHASE GROUND DETECTOR.

770,924. Electric Motor. Edwin S. Pillsbury, St. Louis, Mo. Application filed December 17, 1903.

In a motor a primary member and a secondary member have means for supplying commuted current to the primary member and means for supplying uncommuted current to the primary member. Means for short-circuiting the secondary member are provided.

770,951. Relay. John C. Barclay, New York, N. Y. Application filed January 23, 1904.

An armature and electromagnet are provided with means for operating, comprising main magnet coils for a main circuit and secondary magnet coils for a secondary circuit. Contact means for the secondary circuit operated by the motion of the armature and comprising means for breaking the secondary circuit in both extreme positions of the armature and for closing the secondary circuit during motion of the armature toward the magnet are other features.

770,960. Third-rail Insulator. Robert V. Dunbar, New York, N. Y. Application filed November 6, 1903.

An insulator has an insulating-block and a removable base adapted to rigidly engage the insulating-block and readily detachable from either side thereof.

770,962. Insulator. Jacob F. Gill, Northeast, Pa. Application filed June 2, 1904.

The insulator consists substantially of a body having a central vertical screw-threaded opening therein with vertical slots radiating therefrom, the lower parts of which slots are V-shaped and narrower at their junction with the central opening than at the periphery of the insulator. A screw-threaded plug fits the central screw-threaded opening, having its lower end concaved.

770,991. Incandescent Electric Material. August Voelker, Berlin, Germany, assignor to Société Anonyme Industrie Verrière et ses Dérivés à Bruxelles. Application filed June 2, 1904.

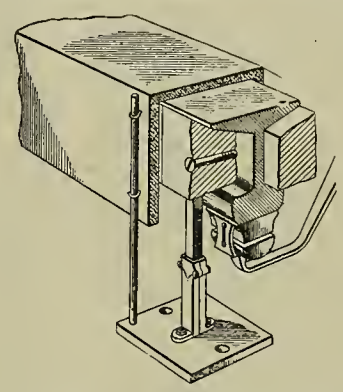
The process of manufacturing an incandescent electric material consists in granulating carbon until the grains are from substantially one to seven millimeters in size, next dividing the material so obtained into groups, the first group of which contains only grains of one millimeter in size, the second only two millimeters, and so on, and then graduating each of the groups by the addition of graphite or of silicates, depending upon whether the conductivity of the group is to be increased or decreased.

771,014. Safety Switch. George H. Hill, Montreal, Canada, assignor of one-half to Michael Joseph Doherty, Montreal, Canada. Application filed September 27, 1902.

In combination with a circuit to be protected are a branch circuit leading therefrom, a switch included in the main circuit, and means whereby the switch is opened. A bridge connected at one end to a point in the branch circuit and the other end thereof being normally open and adapted to make connection with another point in the branch circuit has adjustable means for retaining the open end of the bridge in variable adjacency to the last-mentioned point in the circuit. Electrical means are included in the branch circuit between the bridged points and are adapted to close the bridge upon abnormal conditions occurring in the main circuit.

771,027. Signaling System for Electrically Operated Railways. Lewis B. Stillwell, Lakewood, N. J., and Henry Latey, New York, N. Y. Application filed May 18, 1904.

A power line divided into separate sections has a number of signal circuits extending along the line, each of the signal circuits being local to a section of the power line. Alarm boxes connect with the signal circuits, which boxes contain mechanism which, when operated, actuates signal mechanism at both ends of the power-line sections



NO. 770,911.—THIRD-RAIL SYSTEM.

771,029. Crossing Signal for Railways. Eugene W. Vogel, Chicago, Ill., assignor to the Railroad Supply Company of Illinois. Application filed May 20, 1901.

In combination with the signal mechanism are insulated sections of track extending in both directions from the signal mechanism, a circuit including the signal mechanism and an interfering relay controlling the circuit. Track circuits are connected to the insulated track sections at either side of the signal mechanism for actuating the relay to operate the signal upon the approach of a train from either direction, and a circuit controller in the signal circuit and means for actuating the circuit-controller to discontinue the signal upon a train reaching the signal mechanism are other features.

771,030. Railroad Signal Circuits. Eugene W. Vogel, Chicago, Ill., assignor to the Railroad Supply Company of Illinois. Application filed September 20, 1901.

A number of signals having controlling means for each signal have a normally closed circuit comprising a wire conductor extending between pairs of signals and an insulated track rail also extending between pairs of signals. Means actuate simultaneously with the operation of the controlling means for each signal for breaking the circuit.

771,055. Machine for Making Accumulator Plates. Carl Francke, Schöneberg, Germany, assignor to Hans Heimann, Berlin, Germany. Application filed November 4, 1902.

The machine comprises a series of knife-like tools arranged to form simultaneously a series of contiguous grooves and fins between the grooves in the plate.

771,086. X-ray Tube. Carl H. F. Müller, Hamburg, Germany. Application filed March 15, 1901.

A vacuum tube having primary anode and cathode terminals located therein has a secondary cathode terminal located in the same vacuous space and a disk composed of a gas-evolving substance mounted upon the secondary cathode and responsive to a thermal change therein.

771,114. Switching Mechanism for Intercommunicating Telephone Lines. Albert K. Andriano and Hermann Herbstritt, San Francisco, Cal., assignors to the Direct Line General Telephone Company, San Francisco, Cal. Application filed January 14, 1901. Renewed April 7, 1902.

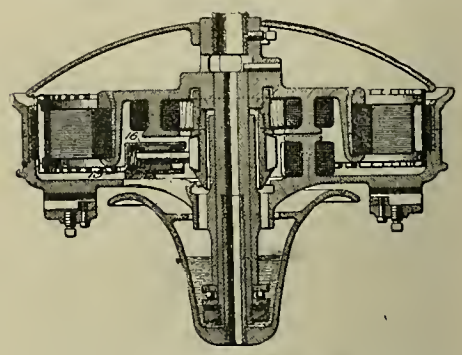
A number of stations are each provided with a local switch having a number of stationary line contacts and a movable contact adapted to connect the talking circuit thereof with a selected one of the line contacts. There are also circuit-closing devices in groups, each group containing as many contacts as there are stationary contacts in the local switch, all the circuit closers comprising the groups being connectible with the contacts in the local switch in numerical sequence.

771,135. Microphone. Ernest B. Fahnestock, New York, N. Y. Application filed October 25, 1902.

The combination consists of a supporting body, a diaphragm mounted at its center and having a flanged periphery, and a flexible body interposed between the supporting body and the flange of the diaphragm.

771,142. Annunciator. Thomas W. Gleeson, Boston, Mass., assignor to Abraham B. Coffin, Winchester, Mass. Application filed July 20, 1900.

The device consists of a pair of oppositely disposed electromagnets, an armature pivoted near its upper end, one face of which is adjacent to the two active poles of one of the magnets, the other face adjacent to the two active poles of the other, and a shutter counterbalancing the armature on an axis separate from the axis of the armature and swung to one position when the armature is attracted by the two active poles of one magnet, and resting in that position until a main switch is shifted to send a current through the coil of the other magnet.



NO. 770,922.—ELECTRIC MOTOR.

771,188. Pole-changer. William I. Thomson, Newark, N. J., assignor to the Safety Car Heating and Lighting Company of New Jersey. Application filed January 2, 1903.

In combination with a prime mover are a contact-making mechanism and a shaft, a member or members adapted to intermittently actuate the prime mover and having a constant connection with the shaft, and means for actuating the prime mover dependent upon direction of rotation of the shaft.

771,193. Electromagnetic Traction Device and Emergency Brake. Charles A. Wells, Chicago, Ill. Application filed May 11, 1903.

A magnetizable wheel, an electromagnet and a magnetizable shoe thereon and in circuit with the wheel have means whereby the shoe is normally held proximate to and out of contact with the rail when obtaining magnetic adhesion. The shoe when brought into direct contact with the rail is substantially non-rotatable relative thereto whereby it serves as an emergency brake.

771,206. Trolley-wheel Controller. Benjamin F. Jackson, Boston, Mass. Application filed August 15, 1902.

A trolley-rope controller comprises a casing having an axially disposed shaft, a drum on the shaft, a collar fitting into the drum and having a laterally enlarged flange, means for adjustably securing the flange to the drum, and a spring secured at its outer end to the collar and at its inner end to the shaft.

771,207. Apparatus for Registering the Supply of Electricity. Gisbert Kapp, Berlin, Germany. Original application filed November 19, 1897. Divided and this application filed December 31, 1897.

An electric-meter apparatus comprises means for changing the speed or rate of operation for different hours of the day.

EXPIRING PATENTS.

Following is a list of electrical patents (issued by the United States Patent Office) that expired on October 4, 1904:

370,794. Dynamo Electric Machine. W. Lahmeyer, Aachen, Prussia, Germany.
370,801. Electric Gas Lighter. J. J. McGowen, Ithaca, N. Y.
370,831. Electric Signaling Apparatus. J. P. Tirrell, Boston, Mass.
370,847. Resonant Attachment for Telephones. E. A. Balloch, Washington, D. C.
370,885. Fire-alarm and Police-telegraph System. A. M. Neeper, Pittsburg, Pa.
370,898. Telegraph Receiver. C. Selden, Baltimore, Md.
370,932. Electric Alarm Clock. E. J. Colby, Chicago, Ill.
370,955. Subterranean Electric-line System. G. W. Le Vin, Chicago, Ill.
370,978. Printing Telegraph. R. J. Sheehy, New York, N. Y.
370,992. Process of Treating Electric Arc Filaments. Edward P. Thompson, Elizabeth, N. J.
370,993. Incandescent Electric Lamp. Edward P. Thompson, Elizabeth, N. J.
370,994. Process of Evacuating Globes for Incandescent Electric Lamps. Edward P. Thompson, Elizabeth, N. J.
370,995. Process of Manufacturing Filaments for Incandescent Electric Lamps. Edward P. Thompson, Elizabeth, N. J.
370,996 and 370,997. Process of Evacuating Globes for Incandescent Electric Lamps. Edward P. Thompson, Elizabeth, N. J.
370,998. Process of Forming Filaments for Incandescent Electric Lamps. Edward P. Thompson, Elizabeth, N. J.
370,999. Manufacture of Incandescent Electric Lamps. Edward P. Thompson, Elizabeth, N. J.
371,000. Process of Bending Filaments for Incandescent Electric Lamps. Edward P. Thompson, Elizabeth, N. J.
371,001 and 371,002. Process of Treating Filaments for Incandescent Electric Lamps. Edward P. Thompson, Elizabeth, N. J.
371,003. Incandescent Electric Lamp. Edward P. Thompson, Elizabeth, N. J.
371,111. Conduit for Electrical Distribution. T. Wallace, New York, N. Y.
371,147. Railway Signal. P. Milroy, Jerauld County, Dakota.

WESTERN ELECTRICIAN

EVERY SATURDAY

Vol. XXXV. CHICAGO, OCTOBER 15, 1904 No. 16

Service Plant at the St. Louis Exposition.

The electrical service plant at the Louisiana Purchase Exposition carries all of the commercial operating and lighting load on the grounds and Pike, as well as a large part of the decorative night illumination of the main exhibit buildings; but it is of interest to engineers, not so much for its size as for its completeness. In the Western Electrician of February 6th last, under the heading "Power Supply at the St. Louis Exposition," was given the first illustrated account of this service plant, with an interesting picture of the four main generating units in course of erection. It will now be worth while to consider the plant as entirely completed and in daily operation. Fig. 3, on the next page, is a chart showing the general plan of the plant, which is placed in Machinery Hall and the Steam, Gas and Fuel Building.

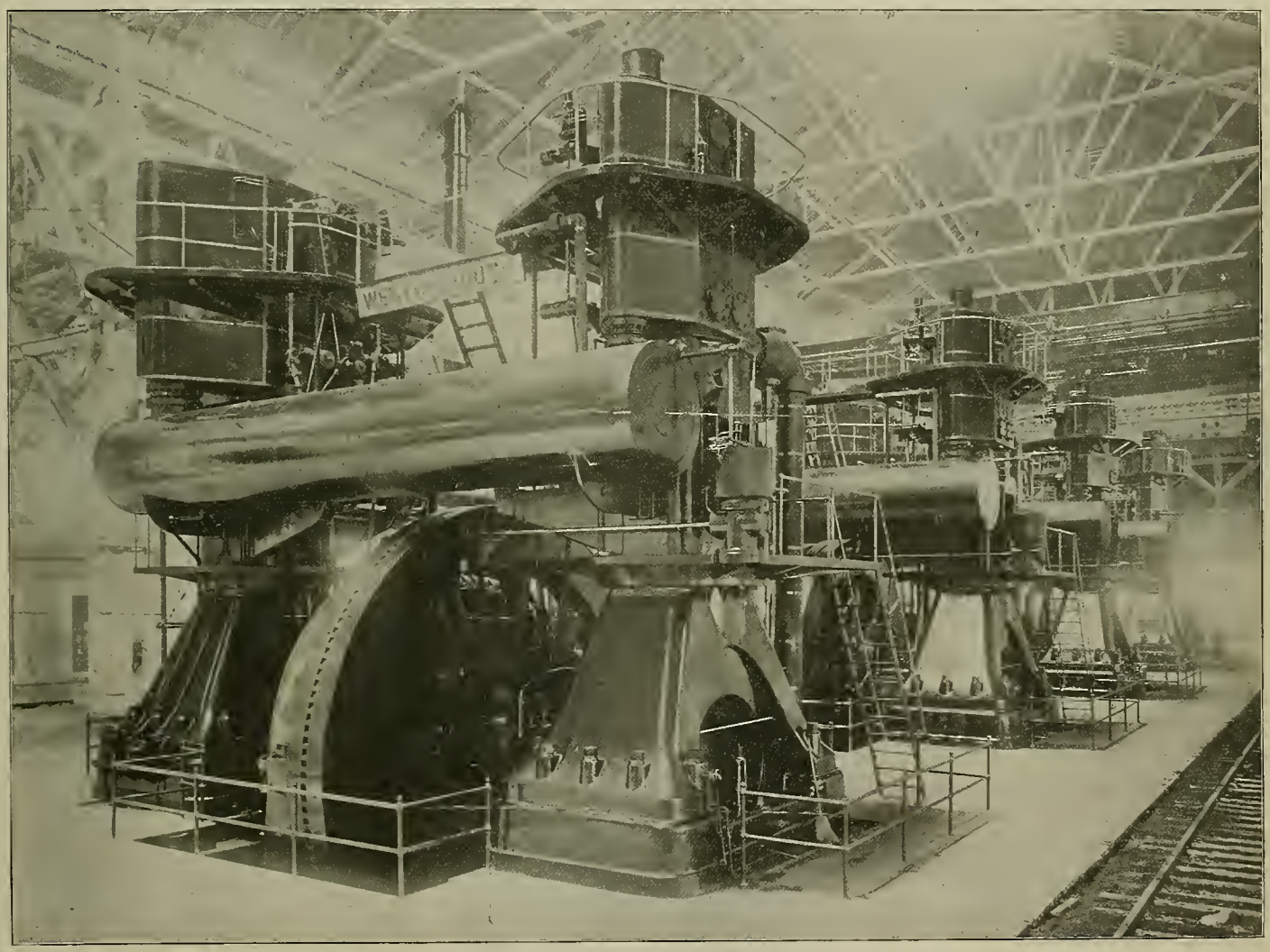


FIG. 1. SERVICE PLANT AT THE ST. LOUIS EXPOSITION.—THE FOUR MAIN GENERATING UNITS.

The four main generating units of the plant (Fig. 1) are alike in capacity and general design. The engines are of the vertical cross-compound type, built vertical to economize floor space, and compound in order to secure greater economy of steam, and operate at a speed of 85 revolutions a minute. As the generator and flywheel are mounted between cylinders, a connecting "receiver" is necessary, which is built of riveted boiler steel plate, and conducts the exhaust steam from the high-pressure cylinder to the inlet of the low-pressure cylinder. Rocking valves of the Corliss type are located directly in the cylinder heads, which connect with "side pipes" paralleling the cylinder walls, a trip release gear on the inlet and a toggle motion on the exhaust controlling these valves. The gear permits a maximum cut-off of three-quarter stroke, enabling each engine to sustain for short periods a load of 5,000 horsepower. The speed of the unit is controlled by an enclosed-type self-oiling centrifugal governor, adjustable while running for spring tension and sensitiveness. Fig. 2 is a view of the valve gear.

In order to operate the generators in multiple, a small motor is provided at the engine, which moves an adjustable weight on the governor mechanism. This motor is controlled from the switchboard, so that the engine speed may be adjusted until the incoming generator has been synchronized and connected to the system. An automatic speed limit is provided on the engines, which instantly closes the throttle should the safe speed be exceeded through breakage of the governor mechanism. This mechanism may be operated also by the engineer from the main floor by means of an electric switch.

The generators, which are rated at 2,000 kilowatts at the usual temperature rise, are of the engine type, revolving-field construction, with laminated armatures and fields, the armatures strap-wound in partially closed slots, and the fields wound with copper strap on edge. In order to obtain access to the winding the entire generator frame may be moved out of position parallel to the shaft. Three 80-kilowatt 125-volt Westinghouse engine-type units furnish exciting current for the generator fields.

The three 2,000-horsepower Westinghouse induction motors which operate the Cascades pumps, estimated to have a capacity of 90,000 gallons of water a minute, are started very gradually at the advertised hours throughout the day and evening, the current being slowly raised to normal, the starting rheostats under Festival Hall, because of the exceptionally large size of the motors, having very many steps. Integrating and indicating wattmeters at the ends of the cables in Machinery Hall record the motor load when the Cascades are in operation.

All main and exciter engines, as well as auxiliaries, in Machinery Hall, operate condensing, two complete central condensing equipments being installed, each of 7,000-horsepower capacity and serving one-half of the plant. They are of the Worthington elevated jet or "barometric" type, provided with entrainers and rotative "dry-air" pumps for removing air from the condenser cones. Both horizontal and vertical types of pumps are in operation, one of the three being held in reserve.

Two complete systems of steam mains, 12 inches in diameter, convey steam to the main engines. The mains are carried beneath the floor in pipe galleries, anchored firmly to prevent creeping, and supported upon rollers to accommodate expansion and contraction. Entrained water collecting in the boiler-room piping is drained out and automatically returned to the boilers by a steam loop and Holly gravity return, which may be seen in continuous operation in the boiler room.

Steam is furnished by 16 400-horsepower Babcock & Wilcox water-tube boilers of the forged-header type, set two boilers in a battery. The tubes and drums are carried by steel frames independent of the brick setting. Two 10-inch loop steam mains, each connecting four batteries of boilers, deliver steam to the two 12-inch mains, which carry the steam to the main units in Machinery Hall.

The firing of the boiler plant is accomplished by means of Roney mechanical stokers (Fig. 4), each group of four stokers in line being driven by a small Westinghouse standard engine, through suitable gearing. The stoker embodies the principle of the narrow rocking grate, stepped at such an angle as to facilitate a uniform descent of fuel from the coking arch at the top to the dumping gate at the bottom, the coking arch, which embodies the principle of the reverberatory furnace, being highly instrumental in securing perfect combustion of the volatile distillates contained in bituminous coal. On the Ex-

position grounds the production of smoke is discountenanced, and careful observations of the smoke from the stoker chimneys are made at intervals during the day's run, for purposes of comparative record.

Each group of four batteries of boilers is served by an independent induced mechanical-draft equipment. Each equipment is provided with two fans, each capable of operating the boilers at their full capacity. A damper, by means of which either bar may be cut in or out of service, is so arranged that, if desired, both fans may be run simultaneously.

Across the central portion of the western wall of the Palace of Machinery, overlooking the generators which supply lights and motors throughout the Exposition, extend two large galleries in which are located the apparatus by means of which the dynamos are regulated and controlled and their current distributed to every building in the grounds. This board was designed and constructed by the Westinghouse Electric and Manufacturing Company. Fig. 5 is a good picture of it.

The control or operating section, located in the upper gallery, consists of 29 panels of selected blue Vermont marble, two inches thick, highly polished, and supported by an angle iron frame. Each panel is 90 inches high, divided into two parts, the lower marble slab in every case carrying the integrating wattmeter for the generator or feeder to which the

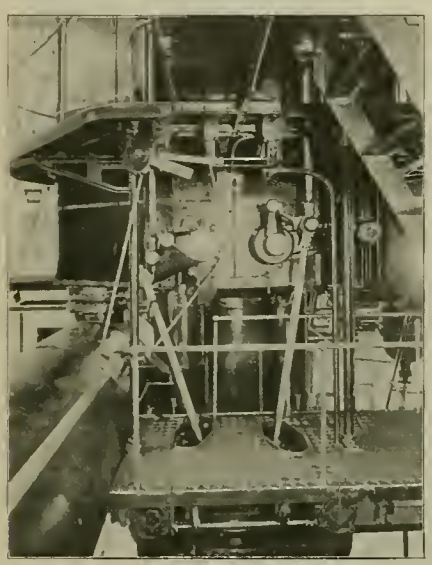


FIG. 2. VALVE GEAR OF ONE OF THE 3,500-HORSEPOWER MAIN ENGINES IN EXPOSITION SERVICE PLANT.

panel is assigned. For the three-phase circuit from each generator and to each feeder, there is a separate panel from which is operated the apparatus necessary for its individual control. The generator panels are 32 inches in width, the feeder and exciter panels 24 inches. The total length of the controlling switchboard is 62 feet.

At the extreme left, facing the board, the first three panels control the three 125-volt direct-current engine-driven exciter sets. The arrangement includes a single set of buses, to which all the exciters may be connected in multiple and from which current is led to the generator fields. Each panel is equipped with direct-current ammeter, main switches, exciter field rheostat and mechanism for the distant control of the electrically operated single-pole equalizer switch, which is mounted on a pedestal near its exciter set.

Attached to panel No. 1 is a set of swinging arms on which are mounted three type-F alternating-current voltmeters, arranged so they may be connected to any generator, two type-D direct-current voltmeters for the exciters, two frequency meters and one type-B synchroscope.

Panels 4, 5, 6 and 7 are equipped for the control of the large alternators in the service plant. Panels 4 and 5 were constructed by the General Electric Company and are duplicate in every respect, each containing three alternating-current ammeters, one direct-current ammeter, two single-phase indicating wattmeters, one polyphase integrating wattmeter, one power-factor meter and operating devices for the motor-driven field rheostats and motor-operated main switches. The instruments on panels 4 and 5 and on panel 29 and the apparatus in the circuits which they control were furnished by the General Electric Company. With the exceptions noted, all apparatus and instruments are of Westinghouse standard design and construction.

As has been indicated, the generator field rheostats are all motor-operated and controlled from the generator switchboard panels. From these panels, by means of motor-operated adjustments on the engine governors, the speed of the generators is also controlled and may be varied at the will of the operator and the synchronizing of an incoming machine easily and accurately performed.

The switchboard is provided with two sets of three-phase high-potential bus bars. Panels 9 and 10 are arranged to measure and record the output of the entire station, each being connected to one set

FIG. 3 GENERAL PLAN OF SERVICE PLANT AT ST. LOUIS EXPOSITION.

of buses and equipped with three ammeters, one polyphase indicating wattmeter, one polyphase integrating wattmeter and two static ground detectors.

Of the 20 remaining panels, 17 are designed for the control of the primary high-potential feeder circuits leading from the generating plant to the transformer stations throughout the Exposition. Each panel is equipped with three type-F ammeters, one type-A polyphase wattmeter and mechanism for the control of the electrically operated switches in the feeder circuit.

Panels 21 and 22 were originally arranged to connect either set of bus bars to the lines of the Union Electric Light and Power Company of St. Louis, as the service plant was not designed to supply all the light and power required by the Exposition. This, however, has not been necessary as the service plant has been equal to all ordinary demands of the Exposition and the additional power required has been easily obtained from two of the larger generating sets on exhibit in the Palace of Machinery, proper connections being made through these panels. The power required of the exhibit machines has been but a small fraction of their rated capacity, and that but for an hour or two each day, during the extreme peak of the load.

Panel 22 was constructed for the purpose of introducing resistance into the "decorative circuits" or feeders which supply current to the lamps illuminating the exterior of the buildings in order that they might be gradually brought up to full power, or dimmed, at the will of the operator. As yet, the resistance arrangement has not been put in service, as it has been found feasible to control the illuminating effect by direct variation of the generator voltage, one machine being set apart for the "decorative circuits."

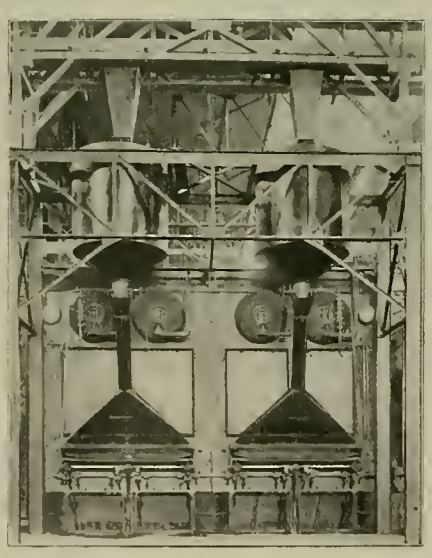


FIG. 4. VIEW OF BOILERS AND STOKERS, EXPOSITION SERVICE PLANT.

The instrument transformers are mounted on the gallery floor, below the bus bars, each in its own compartment between soapstone barriers. Other switchboard apparatus is protected in similar ways. The whole construction is exceedingly substantial and thoroughly fireproof. The instrument circuits are protected by long enclosed fuses, and disconnecting switches of the hook type are inserted in every main circuit, though, naturally, they are never intended to open a circuit under load.

The electrically operated oil circuit-breakers for the generator and feed circuits are mounted for the most part in the upper gallery, behind and to the sides of the controlling panels. A few are mounted in the lower gallery.

For each generator there are two three-pole electrically operated oil-break circuit-breakers of the non-automatic type, one for each set of bus bars, with interlocking devices so arranged that it is impossible that both be closed at the same time. The switches furnished by the Westinghouse company are standard type-C non-automatic, distant-control, electrically operated circuit-breakers; those furnished by the General Electric Company of corresponding construction, but operated by small direct-current motors.

For each feeder circuit two main three-pole switches are furnished, one for each set of buses, interlocked to prevent misconnection. Fig. 6 shows wire connections and barriers for the service-plant switchboard.

In the design of the service plant, no important feature of a modern central station was omitted. The Niles electric traveling crane over the main-engine units in the Palace of Machinery is of 40-ton carrying capacity and bridges a span of 80 feet. It is equipped with three Westinghouse motors—one of 20-horsepower capacity, to drive the bridge, being located at about the center of the girder, and two, one of 20-horsepower capacity for hoisting and one of five horsepower for moving the trolley, being secured to the trolley itself. The motors are controlled from the crane cab, and current at 110 volts is supplied from the exciters for the main-engine units.

Second Electric Railroad in Peru.

The electric railroad between Lima and Callao, the second enterprise of its kind in Peru, is in operation. Like its predecessor, that between Lima, Chorillos and other nearby seaside resorts, the Lima-Callao road is equipped with American machinery and handsome American cars, both open and closed. The roadbed and track were laid by an American firm.

The new road, which is run by the overhead-trolley system, covers the 8.6 miles between Lima and Callao in a little over 20 minutes. It runs cars every 15 minutes and has lowered by one-half the fares formerly existing on the steam railroad. The new railroad has thus far been unable to obtain permission to run through the principal streets of Lima, and therefore stops at Union Street (the chief commercial artery), where it connects with the city horse cars, but it is believed that the obstacles to electric traction through the streets of Lima will soon be removed. The road runs through the main streets of Callao, and has besides a prolongation of some mile and a half to La Punta, a seaside resort a short distance farther down the coast.

The new road is remarkably popular and is so much traveled as to make the acquisition of additional rolling stock a necessity. It fills the want of frequent and cheap communication between the capital city and its port, which, although a separate municipality, is and has for many years been a commercial suburb of Lima.—From United States Consul Gottschalk, Callao, Peru.

The gross earnings of the St. Louis Transit Company for the month of September amounted to $1,051,452.13, as compared with $635,109.65 in September, 1903, a gain of $416,342.48.

Decatur Meeting of the Illinois State Electric Association.

The fifth annual convention of the Illinois State Electric Association was held at Decatur on October 6th and 7th. It was the largest and perhaps the most successful meeting ever held by the organization. Nearly 100 delegates and guests were present and the supply houses were well represented. The St. Nicholas Hotel, which met the requirements of the assemblage in a satisfactory way, was headquarters, and the meetings were held in the rooms of the Elks Club.

The first session was convened according to programme at 10 o'clock, and after the disposition of routine business reports of officers were heard. President W. E. McCollough of Beardstown gave a pleasing talk and the report of the treasurer, Mr. D. Davis of Litchfield, showed the organization to be in a thrifty condition. Eight applications for membership were received and all were favorably acted upon. The new members are: Morrisonville Electric Light Company, Freeport Electric Company, New Electric Company of Mount Carroll, El Paso Electric Light Company, Effingham Electric Light and Power Company, H. B. Grove, Elmwood Electric Light Company, and Citizens' Gas, Electric and Heating Company of Mt. Vernon. The matter of fire insurance on electric-light plants was brought up, and after being discussed at some length was referred to the insurance committee.

In the afternoon the programme was resumed in order, the feature of this session being the discussion of topics from the Question Box. There were no papers presented, it having been arranged to confine the programme to a discussion of the Question Box. There were 32 questions, relating to engines, generators, motors, distribution, regulation, testing, overhead and underground work, lamp efficiency, transformers, meters, etc. These questions were printed in advance in a little book, with blank spaces for the answers. The discussion was good and brought out valuable points.

The evening of the first day was spent by the delegates as the guests of the Decatur Railway and Light Company at the Opera House to witness the play, "Buster Brown." After the play special cars were in waiting and conveyed the party to the plant of the H. Mueller Manufacturing Company, where an excellent "Dutch lunch" was served. An orchestra was in attendance, and there were addresses by Messrs. Mueller, ex-Senator Shumway and Lyman Stiles.

On the second day the meeting was concluded at noon. The Question Box was again taken up and the remaining business of the association was transacted. At this meeting resolutions were passed upon the death of E. P. McClure of Rushville, who died during the year. Resolutions of thanks were also passed to the Decatur Railway and Light Company, the Elks Club, the H. Mueller Manufacturing Company, city of Decatur and the city press.

The following-named officers were elected: President, E. B. Hillman, Warsaw; first vice-president, Xenophon Caverno, Kewanee; second vice-president, R. H. Abbott, Petersburg; third vice-president, J. A. Carothers, Pontiac; fourth vice-president, E. S. Hughes, Olney; secretary, D. Davis, Litchfield; treasurer, C. A. Vallette, Edwardsville; executive committee, W. B. McKinley of Champaign, J. N. C. Shumway of Taylorville, S. D. Davis of Rock Island, H. E. Chubbuck of Ottawa and Frank J. Baker of Chicago.

At two o'clock on the afternoon of the second day the delegates and visitors were the guests of the Illinois Traction Company, and were taken in special interurban cars over the line to Riverton, where the fine new power house was inspected. From Riverton the party was taken by the same company to Springfield, where it was met by special cars of the Springfield Railway and Light Company, in charge of Manager Emil G. Schmidt, who entertained the visitors while in that city.

Secretary Chubbuck is deserving of credit for his good work in behalf of the association. Arrangements as to the time and place of the next meeting were placed in the hands of the executive committee.

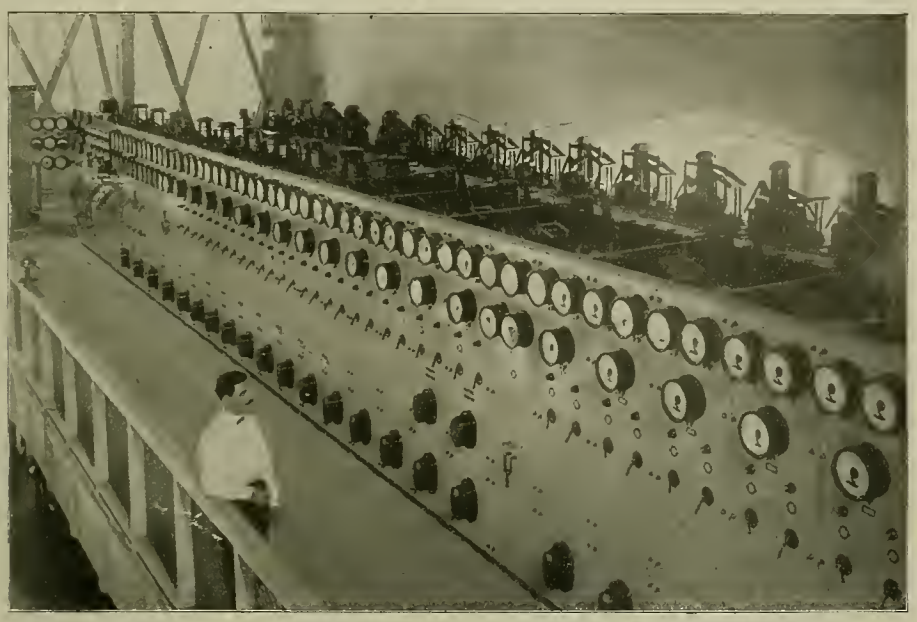


FIG. 5. EXPOSITION SERVICE-PLANT SWITCHBOARD.

Vapor Lamp with Radio-active Material.

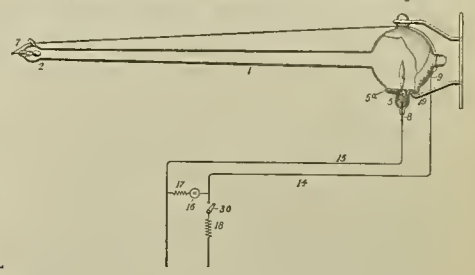
The greatest resistance to starting mercury-vapor lamps appears to be located at or about the negative electrode, and various means have been employed for providing an initial breaking down of this resistance. In his experiments Mr. Peter Cooper Hewitt has noted the fact that after the initial negative-electrode resistance has been broken down or removed and during the operation of the lamp the resistance at the negative electrode is modified by certain phenomena which manifest themselves in a physical manner, as by a flame proceeding from the negative electrode. He has found it advantageous to provide means for removing this flame from the direct path of the current between the electrodes, as it contributes practically nothing to the light-giving capacity of the lamp, but may add to its resistance. This negative flame appears to be identical, in a measure at least, in its behavior with "projected matter" as produced in Crookes tubes, which on being reflected from a reflector in the tube takes the form of X-rays or negative rays, which are akin to negative rays emitted by radio-active substances.

FIG. 6. WIRE CONNECTIONS AND BARRIERS FOR SERVICE PLANT SWITCHBOARD, ST. LOUIS EXPOSITION.

Mr. Hewitt has therefore patented an invention which involves the utilization of a source of negative rays in connection with the lamp in such manner and position as to reduce the negative-electrode resistance.

The accompanying illustration is a vertical section of a lamp embodying the general features of the invention, showing also the operating circuits and the starting apparatus in diagram.

Referring to the diagram, (1) represents the inclosing chamber of the lamp and (2) represents the positive electrode of a continuous-current lamp, which will be described for convenience. This may be of various different materials, but for the present purposes it may be considered to be made of iron or chromium. It is held in its position and connected by means of a leading-in conductor (7), designed to be connected with one side of an electric circuit. The negative electrode is here shown as consisting of a small quantity of mercury, as shown at (5). A conductor (8) leads from this electrode through the wall of the lamp, and means are provided for connecting this conductor with an electric circuit.



VAPOR LAMP WITH RADIO-ACTIVE MATERIAL.

In the neighborhood of the negative electrode there is placed a quantity of radio-active material, as indicated at (5a), or other substance capable of emitting the so-called "negative" rays. This material may be placed in a groove or pocket (19), formed in the glass near the electrode (5).

The lamp is connected in circuit with any suitable source of electricity, the conductors (14) and (15) leading therefrom being shown as connected, respectively, with the conductors (7) and (8). A main switch (30) may be located in one of the main conductors, as (14).

In instances where the radio-active material is insufficient entirely to overcome or remove the initial negative-electrode resistance by reason of the low voltage used it may be desired to provide some means for impressing an initial potential somewhat higher than that of the operating potential of the lamp. For this purpose a quick-break switch (16) is employed for making an electrical connection through a resistance (17) in shunt to the lamp, a reactive coil (18) being connected in the conductor (14) in such position that current flowing through the shunt circuit will traverse the reacting device. Upon suddenly breaking this shunt circuit the reactive device will momentarily impress a higher electromotive force upon the terminals of the lamp. In case, however, the radio-active material employed is sufficient practically to remove the initial negative-electrode resistance, then the device for impressing the initial higher potential will not be required.

In some cases it has been found useful to provide means for removing the static charge of the lamp. This may be conveniently accomplished by placing a band or coating (9) of conducting material upon the outer surface of the lamp near the negative electrode and connecting this by a separate wire or by a portion of the wire (14), as shown, with the leading-in wire (7). In some cases, however, with the radio-active material this device may not be required.

The rays called "negative" rays need not be considered identical in all respects with X-rays, nor the projected matter produced in Crookes tubes; but the rays which are useful for the purposes of the present invention are similar to the phenomena mentioned.

National Electric Light Association.

The place of meeting of the convention of the National Electric Light Association for 1905 is still undecided. Ex-President H. L. Doherty is untiring in advancing the claims of Denver. A decision will probably be reached next month.

The "Proceedings" of the Boston convention are now nearly ready for distribution. They cover about 1,300 pages, and are issued in two volumes. These volumes are not only the most important in respect to size ever issued by the association, but the character of the papers, reports and discussions is proportionately valuable. As the book will be furnished only to members of the association, it will be worth the while of any central-station company not already a member to make application at once.

Phase Transformation.

Alexander D. Lunt of Schenectady, N. Y., has devised a method of transforming three-phase current into 12-phase current, or the reverse, which should be useful in connection with rotary converters in which the armature heating is less the greater number of phases there are on the alternating-current side of the machine.

In practice Mr. Lunt makes use of three transformers, each of which is provided with one winding connected to the three-phase system and three other windings connected to the 12-phase system. In all there are nine windings connected to the 12-phase system, and these windings are so interrelated that their electromotive forces may be represented by a double delta superposed upon a double Y.

Fig. 1 is a representation of the invention (which by the way, is patented and assigned to the General Electric Company) and Fig. 2 a diagram of electromotive forces.

The phase transformation is performed, preferably, by a set of transformers having primary windings differing in number from the secondary windings. In Fig. 1 three transformers are shown, having primary windings (A) (B) (C), connected, respectively, to three-phase mains, each primary being provided with three secondaries, two of which are identical in current-carrying capacity and number of

Fig. 1

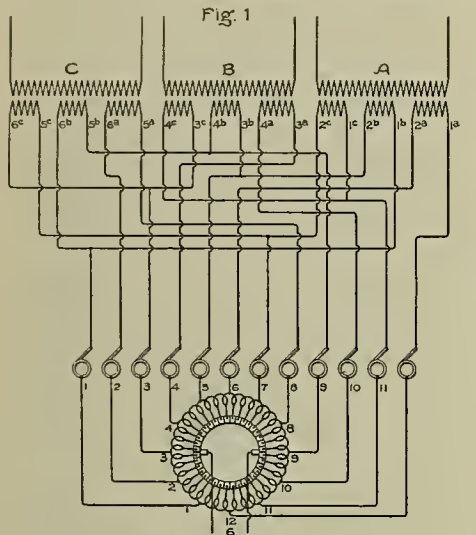
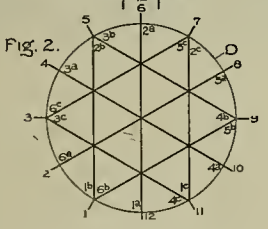


Fig. 2.



PHASE TRANSFORMATION.

turns, while the third has a slightly larger number of turns. Of course if 12-phase current is to be converted into three-phase the windings will be reversed in function, those connected to the three-phase mains being their secondaries and the others primaries. In the present arrangement all of the secondaries are connected to a rotary converter in such manner as to supply 12-phase currents thereto. For convenience the armature winding of the converter is represented in Fig. 2 by the circle (D), while the points of connection of the winding are indicated by the radial lines which emanate therefrom at regular intervals, as shown, and which are numbered to correspond with the similarly numbered taps connected to the conventional representation of the armature winding in Fig. 1. The phases of the different electromotive forces acting upon this winding are indicated by the combination of radii and triangles within the circumference of the circle in Fig. 2.

In making up the connections between the transformers and the converter armature the first step is to connect in delta three of the secondaries of the several transformers, this connection being made in the ordinary manner. In the drawings this delta connection starts at (1^b), through the transformer winding to (2^b), then through a transformer winding on the next phase from (3^b) to (4^b), then through a transformer winding of the remaining phase from (5^b) to (6^b), and then back to (1^b). This connects the electromotive forces of the windings in delta, and from points in the connections joining the transformer windings leads extend to points on the converter armature separated from each other by one-third of the polar pitch.

Referring to the diagram representing the converter armature, it will be seen that the connections from the secondary terminals (1^b 2^b) lead to the taps (1) to (5), which in Fig. 2 connect to points joined by the chord designated, correspondingly, as (1^b 2^b). In like manner the secondary (3^b 4^b) is connected to the taps (5) to (9) spanning the corresponding chord (3^b 4^b), while the remaining secondary of the delta is connected across the chord (5^b 6^b), thus completing one delta arrangement of electromotive forces acting upon the converter armature.

The next step is to connect up another delta, but in this case with two of the sides reversed in order to obtain a six-pointed-star arrangement represented by the two superposed and relatively reversed deltas indicated in Fig. 2. To enable the connections to be readily traced, it may be stated that parallel sides of the two deltas should have the same polarity at their corresponding ends. Thus, for example, the side (1^b 2^b) of one delta and the parallel side (1^c 2^c) of the other delta should have their similarly extending ends of the same polarity.

The numbers (1) and (2) as applied to the secondaries in transformer (A), indicate the opposite polarities, while the exponents (a) (b) (c) distinguish between the respective secondaries. A similar lettering is used in connection with the other two transformers. In making all connections between the transformer secondaries in Fig. 1 a convenient guide may therefore be secured by similarly lettering the diagram of electromotive forces in Fig. 2. Thus the secondary connected to the taps (1) to (5) across the chord (1^b 2^b) has its terminal (2^b) at the left-hand end of the winding as indicated. The similar secondary (1^c 2^c) should therefore have its corresponding terminal (2^c) of the same polarity indicated by the application of the reference letters (2^c) to the left-hand terminal. In a similar manner all the parallel chords are designated by corresponding reference letters, whereby the proper sequence of connections may be readily made by consulting the diagram thus lettered. To connect up the second delta, the connections through the various transformers will therefore start at (1^c), through the winding to (2^c), then through the winding (5^c 6^c), and then through the remaining winding (3^c 4^c), back to the terminal (1^c), thus completing a reversed delta. Three connections lead therefrom and are joined to corresponding points of the converter armature, as indicated by the taps (3) (7) (11). Thus, to illustrate, the tap 7 (shown in Fig. 2 as leading to the intersecting ends (2^c) and (5^c) of two chords) is connected to their correspondingly lettered transformer terminals in Fig. 1. When it is understood that the apexes of one delta lie midway between the connections of the apexes of the other delta no difficulty will be found in making the connections to the proper points in the converted armature.

To complete the 12-phase connections to the rotary converter, the remaining secondary windings are connected so that each secondary spans a diameter and is symmetrically connected with relation to the other secondaries whereby the points of connection of one secondary are displaced by an angle of 60 degrees from each of the other secondaries. The points of connection are, however, chosen so as to lie midway between those of the double deltas, thereby constituting therewith a 12-phase relation of electromotive forces acting upon the armature. In making the connections it is only necessary to remember that the double-Y connections, represented in the drawings by diameters, magnetize in the same direction as the chords parallel thereto—that is to say, the adjacent ends of each diameter—and its two parallel chords should be of the same polarity. Thus the adjacent ends (2^b) and (2^c) of two parallel chords are connected, respectively, to windings whose left-hand terminals are similarly designated. The coil across the diameter (1^a 2^a) must magnetize in the same direction as the parallel chords and is therefore connected with its left-hand end (2^a) to the tap which lies between the connections of the ends of the chords parallel to this diameter.

It will be evident that the currents flowing in the windings of the phase-changing transformers are normally in phase with the electromotive forces generated in the respective windings. The windings therefore are not burdened with wattless currents and may thus be made smaller than would be necessary in a system of phase transformation in which a flow of wattless current is inherent.

Although for purposes of explanation it has been assumed that three-phase current is converted by the apparatus shown into 12-phase current and supplied to a rotary converter, it will of course be obvious that the reverse operation is within the invention. In the latter case direct current would be fed into the rotary converter, by which it would be transformed into 12-phase current and then by the arrangement of transformers shown, into three-phase current.

Alternating-current Motors.[1]

By Charles Proteus Steinmetz.

In the last years a number of types of alternating-current motors have become of interest, which, while not new in their general principles, but antedating even the polyphase induction motor, have been for some time overshadowed by the latter, due to its greater simplicity, resultant from the absence of the commutator, and its constancy of speed.

With the rapid extension of the application of

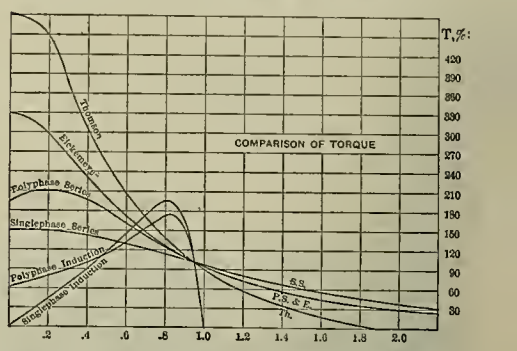


FIG. 1. ALTERNATING-CURRENT MOTORS.

electricity, alternating-current motors were demanded for railway and similar classes of work, which give high-starting torque efficiency and high efficiency over a wide range of speed; that is a speed-torque characteristic similar to that of the direct-current series motor. The characteristic of the alternating-current induction motor, however, is that of a constant-speed motor, and indeed the polyphase induction motor can theoretically be considered as an adaptation of the direct-current shunt motor to alternating current, as I have shown elsewhere. By the introduction of the commutator almost any speed-torque characteristic can be produced. A number of types of such commutator motors have been produced and more or less developed, but thus far practical experience has not yet advanced so far as to weed out the less desirable types. To enable a critical judgment of their relative advantages and disadvantages I shall endeavor in the following to give a general theory of the alternating-current motor, applicable alike to the induction and commutator motors.

The starting point of the theory of the polyphase and single-phase induction motor usually is the general alternating-current transformer, and from the equations of the general alternating-current transformer the induction-motor equations can be developed. Coming, however, to the commutator motors, this method becomes less suitable.

In its general form the alternating-current motor consists of one or more stationary electric circuits magnetically related to one or more rotating electric circuits. These circuits can be excited by alternating currents, or some by alternating, others by direct current, or closed upon themselves, etc., and connection can be made to the rotating member either by collector rings—that is, to fixed points of the wind-

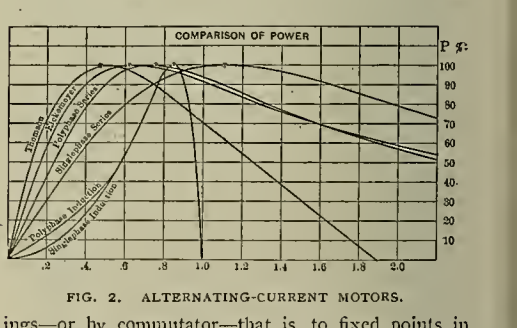


FIG. 2. ALTERNATING-CURRENT MOTORS.

ings—or by commutator—that is, to fixed points in space.

The alternating-current motors can be subdivided into two classes—those in which the electric and magnetic relations between stationary and moving members do not vary with their relative positions and those in which they vary with the relative positions of stator and rotor. In the latter a cycle of rotation exists, and therefrom the tendency of the motor results to lock at a speed giving a definite ratio between the frequency of rotation and the frequency of impressed electromotive force. Such motors, therefore, are synchronous motors.

The main types of synchronous motors are as follows:

(1) One member supplied with alternating and the other with direct current—polyphase or single-phase synchronous motors.

(2) One member excited by alternating current,

1. Opening and concluding paragraphs of a long paper presented before a joint meeting of Sections B and F of the International Electrical Congress at St. Louis on September 13, 1904. The author is electrician of the General Electric Company.

the other containing a single circuit closed upon itself—synchronous-induction motors.

(3) One member excited by alternating current, the other of different magnetic reluctance in different directions (as polar construction)—reaction motors.

(4) One member excited by alternating current, the other by alternating current of different frequency or different direction of rotation—general alternating-current transformer or frequency converter.

No. 1 is the synchronous motor of the electrical industry. Nos. 2 and 3 are used occasionally to produce synchronous rotation without direct-current excitation, and of very great steadiness of the rate of rotation, where weight, efficiency and power factor are of secondary importance. No. 4 is used to some extent as frequency converter.

[Premising that he will discuss only "that type of motor in which the electric and magnetic relations between the stator and rotor do not vary with their relative positions and the torque is therefore not limited to a definite synchronous speed," the author then investigates, mathematically, the characteristics of the polyphase induction, single-phase induction, single-phase condenser, polyphase shunt, polyphase series, single-phase series, compensated series (Eickemeyer), directly compensated, inductively compensated, and Thomson repulsion motors. A number of diagrams are given. The concluding portion of the paper and the last two diagrams—which are, in a manner, summaries of the others—follow in full.]

In the diagrams showing as instances the characteristic curves of different types of motors—polyphase and single-phase induction, polyphase series, single-phase series, compensated series or Eickemeyer motor, and repulsion or Thomson motor—the constants have, so far as possible, been chosen so as to represent the same motor structure, that is, to permit a direct comparison of the types, one and the same motor is assumed as operated as any of the different types, after making the changes in its electric and magnetic disposition necessary for this purpose.

In comparing the power factors it is interesting to note that the maximum power factors of the commutator motors are decidedly higher than those of the corresponding induction motors, and that, therefore, the same power factor as in the induction motor can be secured in the commutator motor with a much larger air-gap between the stator and rotor. This is a very decided advantage, especially for railway work where induction motor air-gaps are mechanically extremely undesirable and unsafe.

In Figs. 1 and 2 are shown, for comparison, with the speed as abscissæ, the torque and power of all the different motors. In Fig. 1 all the torque curves are reduced to equal torque at 95 per cent. of synchronism. In Fig. 2 all the power curves are reduced to the same maximum output. Not too much stress, however, must be laid on these comparative curves, since the characteristics of each motor may be varied to a considerable extent by the design, as, for instance, a motor designed for the highest possible efficiency, or highest starting torque, or best power factor, etc. Some general conclusions, however, can be drawn from these curves.

In the induction motors the torque curve is rising with the speed, in the commutator motors decreasing. The commutator motors, therefore, give maximum torque in starting and at low speed. The induction motors are operative efficiently only in a narrow speed range below synchronism, but unstable below

SIGNAL TENT, OHIO NATIONAL GUARD.

tbis—that is, the motor either slows down and comes to rest or accelerates with increasing rapidity until it approaches synchronism. At synchronism the torque and power of the induction motor reverse. High torque at low speeds can be secured only at a sacrifice of efficiency by armature resistance.

The induction motors are, therefore, essentially constant-speed motors.

The repulsion motor shows the highest starting torque and the most rapid decrease of torque and power with increase of speed and reaches zero torque and power at a definite speed.

The single-phase series motor shows of all the commutator motors the lowest torque in starting, the highest at high speed—that is, its torque decreases least with increase of speed, so that in the case illustrated it almost approaches a constant-torque motor.

The compensated motor is intermediate between the repulsion and series motor, but rather nearer to the former at low and to the latter at high speeds; that is, its torque is high in starting and at low speeds, but does not fall off as rapidly at high speeds as that of the repulsion motor.

To conclude, then, the induction motors are essentially constant-speed motors. The repulsion motor is a low-speed motor, the series motor a high-speed motor, while the compensated or Eickemeyer motor is intermediate between the repulsion and series motor, approaching the former at low, the latter at high speeds.

Telephone Scouts of the Militia.

By R. G. Grayne.

The modern militia army is equipped with a first-class corps of telephone scouts, arranged on similar plans to the corps of the United States Army. The writer visited the recent military maneuvers of the National Guards of the states of Indiana and Ohio, and the Signal and Telephone Corps of these encampments were found to be well equipped and well drilled. The service has been built up to a remarkable degree in the last four or five years. The great need of an established Signal Corps for the National Guard, as well as for the United States Army, became evident during the Spanish-American war. Since then the telephone scouts have been in training according to the rules of the regular army, with the result that today the corps is well organized.

In the United States Army the officers' organization of the corps consists of a chief signal officer, with rank of brigadier-general, a colonel, a lieutenant-colonel, five majors, 16 captains and 16 lieutenants. The organization in the National Guard is practically the same. The scouts in the game of war in the recent

CARRYING POLES FOR TELEPHONE LINES IN SIGNAL SERVICE.

maneuvers proved their efficiency. They were present in all of the marches and sham battles, and they acted as if they were on a real battlefield.

The scouts belong to the Signal Corps. It is their duty to go out in front of the advance and establish lines of communication. In taking certain positions on hills for the purpose of making an advance toward the enemy's lines it is necessary for the commanding officer of the column to keep in touch with all parts of his column, and to learn the locations of the lines of his foe. Therefore, the scouts are kept hurrying from hilltop to hilltop to establish signal stations. The signal flags may be seen in motion all along the lines at prominent points. The Signal Corps man who is detailed for this service must be exceedingly agile, for it often happens that he must climb difficult points. Sometimes he must get into a tree in order to use the flag, so that the other party may observe it from across the ravine or the river.

Often the scout is in danger of capture. The scouts of the enemy are also out and at work, and the guards which are patrolling may run across one of the scouting parties and capture all. Several times during the Ohio and the Indiana game of war I noticed that the signal stations of scouts suddenly ceased signaling, because of capture by the enemy. The scout must be cautious, and though he has to make his presence public by exhibiting the signal flag, so that his side may see it, and thereby make a target of himself, it is his duty to endeavor to conceal his actions as much as possible. In order to prevent the enemy from reading the signals a secret code is usually used.

It is the mission of the modern scout to carry the lines of communication along with him to the front in all advances of the expedition to which he belongs. This enables the commanding officer of the column to keep in touch with his base, where the reserves are stationed and where are the supplies of ammunition, subsistence stores, medical supplies, etc. Therefore, the scouts usually have one or more pack animals for the transportation of wires and instruments. Poles are cut along the way or trees are used in their natural positions. Sometimes wire is taken which is prepared for laying direct on the ground for temporary use. It is seldom that a transportation escort or other wagon can be taken, as the head of the column almost always advances over new territory, where the roads are unopened and trails are bad.

In most of the advances made during the tours of the National Guard the men themselves carried coils

PORTABLE TELEPHONE STATION IN THE FIELD, OHIO NATIONAL GUARD.

of wire, instruments, signal flags and general supplies. When the head of the column arrives at the scene of action, the various regiments, troops and batteries are assigned to different positions, according to the needs of the situation. The line of advance then becomes three or four miles long. The country is usually dotted with elevated points or trees, and the signal men take advantage of these for positions for signaling. The main scout station will be near the commanding officer. Other stations will be quickly established the full length of the line, and in the rear and at safe points in the advance. Then the messages begin to go and return via the signal codes and flags. "Ask Colonel Smith if the right flank of his regiment joins the left flank of the Fourth Regiment," and so on; and in a few minutes the message is transmitted and the answer is received and the commanding general is aware that there is no break in the lines where the two regiments join, as sometimes happens. Similar communications go and are received every few minutes, and the commanding officer knows just where his troops are and how stationed, even though they be in the underbrush in the valleys where he cannot see them. Any movement on the part of the foe is observed by advance scouts and sent back from tree top to tree top or hill to hill to the commanding officer. The lines of wire, if established, run to the rear to the reserve and camps at the base, and word can be sent from the field by the operator at the side of the general for medical supplies, ammunition, stores, reinforcements, etc.

I observed curious sights of scout parties with one or two hired laborers, and the latter conveying telephones on their backs. Trailing behind was a single-conductor wire, and quick progress was made—in fact, as fast as the men could walk. When the point is reached for the use of the instrument, a hatchet or a bayonet is stuck into the earth, and the exposed top is wrapped with the wire and the necessary ground connection is thus effected. I saw also that some of the scouts made good use of barb-wire fences for this purpose. The distance to which the men go with the telephones for this purpose is limited to the coil of wire. But in case of necessity several persons might carry coils. I saw officers and non-commissioned officers carrying extra coils on the march. I served several years with regular troops in the Philippines, and at first we had no such facilities. Later in the war, the scouts were in evidence, and their good work helped greatly.

Aside from war purposes, the field telephones and the scouts are of great service. It was only a few hours after our arrival in the National Guard encampment of Ohio that the corps had telephone instruments up and in working order. These instruments connected the different divisions, brigades and corps. Lines extended from the brigade headquarters to the different regimental, hospital, engineering and other headquarters. One day a bad storm prevailed and the lightning injured several men at the telephone instruments. The Signal Corps immediately went to work, and although wires, instruments and tents were blown over, and in some cases the wires burned off, communication was soon re-established, with every man working in the rain until the lines were up.

WESTERN ELECTRICIAN

EVERY SATURDAY.

PUBLICATION OFFICES:
510 Marquette Building, • CHICAGO.
TELEPHONE, MAIN 1746.

Eastern Office, 193 Times Building, New York.
Telephone, 3806J Cortlandt.

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted. This paper is entered at the Chicago postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the **old address** as well as the new should be given.

CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—**the only general electrical paper published in the West**—thoroughly covers a territory *exclusively its own.* THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be furnished on application.

REMITTANCES.—All checks, drafts and other remittances should be made payable to the order of the publishers, the **Electrician Publishing Company,** and addressed to the offices of publication, Suite 510, Marquette Building (204 Dearborn Street), Chicago, Illinois, U. S. A.

CONTENTS OF THIS NUMBER.

Service Plant at the St. Louis Exposition. Illustrated. 303, 304, 305
Second Electric Railroad in Peru 304
Decatur Meeting of the Illinois State Electric Association 305
Vapor Lamp with Radio-active Material. Illustrated 305
National Electric Light Association 305
Phase Transformation. Illustrated 306
Alternating-current Motors. By Charles Proteus Steinmetz. Illustrated. (International Electrical Congress) 306, 307
Telephone Scouts of the Militia. By R. G. Grayne. Illustrated 307
Editorial 308
American Railway Mechanical and Electrical Association. (Annual convention in St. Louis, October 10 and 11, 1904) 309, 310, 311
President Olds' Address 309
The Ideal Shop. By W. D. Wright. With discussion. Illustrated 309, 310
Wheel Matters. By J. Millar. With discussion 310
Maintenance and Inspection of Electrical Equipment. By John Lindall. With discussion 310, 311
Street-railway Tests at World's Fair 311
The History and Development of Electric Railways. By Frank J. Sprague. Part II 312, 313
International Engineering Congress 313
Damages Given for Death by Electric Shock 313
All Parties Favor Charter Amendment 313
Michigan Telephone Matters 314
New England Telephone News 314
Southeastern Telephone Developments 314
Ohio Telephone Notes 314
The Telephone on the Pacific Slope 314
Telephone News from the Northwest 314
General Telephone News 314
Automatic Telephone Purifier. Illustrated 315
Measured-service Meter for Telephones. Illustrated 315
Protector Litigation 315
Marconi Talks About Space Telegraphy 315
Electrical Purification of Drinking Water. By John W. Langley. (International Electrical Congress) 315
The Carbon Cell. By Prof. Dr. F. Haber and Dr. L. Bruner. (International Electrical Congress) 316
Induction Sparker for Gas Engine. Illustrated 316
League of American Municipalities 316
Whitney Hot-wire Measuring Instruments. Illustrated. 317
Stage Plug and Receptacle. Illustrated 317
Telegraph Lines in Mexico 317
Unique Advertising Card. Illustrated 317
Book Table.—Hall's "Manufacturing Cost" 317
Rotary Converters and Motor-generators. By W. C. L. Eglin. (International Electrical Congress) 318, 319
Work of the Reichsanstalt 319
Telephoning "Want Ads." 319

DEPARTMENTS.

Correspondence 319, 320, 321
Great Britain 319
New York 319
New England 319, 320
Texas and Mexico 320
Ohio 320
Michigan 320
Southeastern States 320
Northwestern States 320, 321
Pacific Slope 321
Personal 321
Electric Lighting 321, 322
Electric Railways 322
Automobiles 322
Power Transmission 322
Societies and Schools 322
Publications 322
Miscellaneous 322
Trade News 322, 323
Business 323
Illustrated Electrical Patent Record 323, 324
Special Mention 324

DATES AHEAD.

Kansas Gas, Water and Electric Light Association (annual meeting), Leavenworth, Kan., October 18th and 19th.
Interstate Independent Telephone Association of America (annual convention), Chicago, December 13th, 14th and 15th.

ONE of Mr. Steinmetz's valuable contributions to the Proceedings of the International Electrical Congress was his paper on "Alternating-current Motors." This is a long paper—it would fill about seven pages, or 21 columns, of the Western Electrician, if printed in full—with a number of diagrams, and abounding in mathematical formulæ. It is an investigation of the characteristics of alternating-current motors, carried out with Mr. Steinmetz's characteristic brilliancy and thoroughness. The results arrived at are of much interest, and these and the introduction to the paper are given in this issue of the Western Electrician. At the end the author gives, for comparison, curves of the torque and power of all the different motors considered. These interesting diagrams are reproduced in the abridgement of the paper which is given in this journal. They are worthy of study. The author concludes that the induction motors are essentially constant-speed motors. The repulsion motor is a low-speed motor, the series motor a high-speed motor, while the compensated or Eickemeyer motor is intermediate between the repulsion motor and the series motor, approaching the former at low speeds and the latter at high speeds. With the impending application of the alternating-current motor to railway work these conclusions assume especial importance. They will be given due weight by all students of the art.

TELEPHONE companies operating in the country districts should consider whether they may not add to the value of their service by the free dissemination of weather forecasts to their subscribers. We take it, from an article recently published in the Monthly Weather Review, which is issued by the Weather Bureau, that the United States government will be glad to co-operate by furnishing the telephone companies, on request, the information desired. This information may be obtained daily from the nearest forecaster, either by telephone or telegraph, for any portion of the United States, and thus disseminated by the telephone company to its patrons. Mr. William G. Burns of Springfield, Ill., who is the author of the article in question, and who is a section director for the Weather Bureau, notes that all progressive exchanges maintain an information operator, and as the weather and its changes form a vital subject of interest to the rural communities, the information operator is not well equipped without this intelligence. In extending the telephone service the fact that the weather information is available to its subscribers may often be the determining factor in inducing an irresolute farmer to enroll. It has been planned to offer the service to telephone exchanges, and then to notify the public, through the press, that the information is available. Under the growing operation of connecting the exchanges into large systems it may not be necessary to send telegrams to all, but, by careful selection of well-located centers, a large territory may be covered by relaying the information from one exchange to another.

This plan is already in operation from Cincinnati as a center, we believe, and it is worthy of extensive adoption.

Now a healthy youngster of two years of age, the American Railway Mechanical and Electrical Association, an auxiliary of the American Street Railway Association, has amply justified its existence by its works. Its annual convention of 1904 was held on the St. Louis World's Fair Grounds on Monday and Tuesday of this week and is reported in this issue of the Western Electrician. It will be seen that the papers and discussions were eminently practical and useful and that such an organization cannot fail to be of real value to its members. The subjects discussed were "The Ideal Shop," "Wheels," "Maintenance and Inspection of Electrical Equipment," and the like. The attendance was good, and a large proportion of those present participated actively in the proceedings. Mr. E. W. Olds of the Milwaukee Electric Railway and Light Company had the satisfaction of presiding over a good convention. His successor in the presidential office is Mr. C. F. Baker, superintendent of motive power and machinery of the Boston Elevated Railway Company, who takes the reins at a time when the young association has already made a creditable record for itself. With the help of Mr. Walter Mower of Detroit, the capable secretary, he should be instrumental in aiding the association to grow in size and in its chosen career of practical helpfulness.

The American Street Railway Association and another of its offspring, the Street Railway Accountants' Association, held their meetings this week also, but after the sessions of the Mechanical and Electrical Association. These conventions will be reported in the Western Electrician next week.

No living American, probably no living man, is a greater authority on "The History and Development of Electric Railways" than Frank J. Sprague, and it is a satisfaction to lay before the readers of the Western Electrician Lieutenant Sprague's paper on that subject, prepared for the International Electrical Congress held in St. Louis last month. The paper is printed in full in this journal; the first half appeared last week and the concluding portion is given in this issue. It gives the history of an art which has had a stupendous development and in which Mr. Sprague has played a conspicuous part, for which he was fitted by his inventive ability, his energy and courage and his persistence and resourcefulness when confronted by apparently overwhelming obstacles. Mr. Sprague is one of the comparatively few electrical inventors who have been successful in reaping the rewards of their labors. He has won honors and, we hope, riches. He deserves these distinctions, for, although he is only one of many men whose work contributed to the development of the electric railway, he seems to have been pre-eminently the one who pushed the thing through to a workable, practical success. He believed in electric traction when others were doubtful or incredulous, and he stuck to his belief with an admirable tenacity that has been of distinct benefit to human progress. Therefore, Mr. Sprague is well qualified to set forth a history of the growth of the art of electric railroading, for he has bumped over the rough places of discouragement as well as partaken of the zest of triumph. In his paper he treats the work of others with fairness and has made a valuable contribution to the records of electrical invention.

ELECTROTHERAPISTS of repute are giving attention to the possibilities of employing electric current in attacking microbes which cause inflammation or other pathological effects in the human body. Thus Dr. S. Shatzky sent a paper to the recent International Electrical Congress (Section H—Electrotherapeutics) on "The Action of the Constant Current on the Vitality of Microbes." His observations lead him to conclude, first, that the constant current exercises in the interpolar space a modifying influence on the vitality of the microbes; second, that currents of 25 to 30 milliamperes exercise in 1½ to two hours an action varying from a weakening to an entirely deadly effect in their virulence, and, third, that generations which develop from microbes galvanized [subjected to the electric current] in this manner develop a lesser vitality than their generators. Why this is so is not known, but Dr. Shatzky appears satisfied of the fact. He thinks the electrolytic properties are predominant. It is known that the microbes, although they have a great death-resisting capacity, are quite easily affected by exterior influences, and the author conjectures that in the center in which the microbes are suspended the changes caused by the current—an increase in acid and alkalis—must influence the vitality of the microbes. "In this case," he says, "the action of the current can be compared to that of sunlight, which, as has been determined, exercises through its chemical action on the center a strong influence in retarding the growth of the microbes." And, further. "It can be concluded that the action of the current on the microbes living in the animal body is identical to the one which I observed in my experiments [on cultures]. In this manner the importance of the current as a therapeutical agent in inflammations becomes considerably greater. The current not only increases the resistance capacity of the tissue cells against the harmful agent, but also acts in inflammations of a microbe origin directly on the microbes themselves, by reducing their vitality."

The non-medical reader who has some acquaintance with electrical phenomena will be likely to finish the reading of Dr. Shatzky's paper still unconvinced. A good deal of the reported action of the current between the electrodes rests on assumption. However, the investigation is interesting and may become important. The author promises to continue his experiments, and he certainly deserves credit and encouragement for his original work.

STREET-RAILWAY CONVENTIONS IN ST. LOUIS.

Members of the American Street Railway Association and its affiliated societies, the American Railway Mechanical and Electrical Association and the Street Railway Accountants' Association of America, were on hand bright and early at the Southern Hotel, St. Louis, on Monday, October 10th, and the hotel lobby presented a very animated appearance. The day opened unpropitiously, with a heavy downpour of rain, but early in the forenoon the clouds disappeared and the weather, though warm, was pleasant.

Registration and the securing of badges were in order the first thing in the morning at the hotel. The headquarters of the Street Railway Association and the supplymen's committee were in one corner of the lobby and were the center of attraction. Secretary T. C. Penington and several assistants saw to the wants of the members of the Street Railway Association, giving to each an appropriate badge and a neat transportation book of detachable coupons to be used upon the lines of the St. Louis Transit Company, and issued by the courtesy of that company. Mr. Edwin H. Baker, chairman of the finance committee, performed a like service for the supply men.

Meanwhile out at the World's Fair grounds the American Railway Mechanical and Electrical Association was proceeding with its own affairs at the Convention Hall in the Transportation Building. In this issue of the Western Electrician the proceedings of Monday and Tuesday will be given, which includes the sessions held by this organization. The report of the remainder of the week's doings, including the parent association and accountants' conventions, will be given next week.

Monday's Sessions of American Railway Mechanical and Electrical Association.

Owing to delay the members and visitors of the Mechanical and Electrical Association did not begin to arrive at the convention hall at the appointed time, but by 11 o'clock enough had arrived and registered for the opening of the meeting.

President E. W. Olds of Milwaukee called the meeting to order, and by his side on the platform was the secretary of the association, Mr. Walter Mower of Detroit. John I. Beggs of Milwaukee and St. Louis, in an address of welcome, spoke eloquently upon the benefits of organized effort on the part of street-railway companies, and in general upon the progress which street and interurban railways are making, especially in Wisconsin.

Mr. W. Caryl Ely of Buffalo, president of the American Street Railway Association, followed Mr. Beggs. He said that associations of the nature of the one he was addressing were primarily for the interchange of thought and for the purpose also of enabling the members to relieve their minds upon the many vexing problems which arise in their daily practice. They help co-operative effort, and he felt that this getting together of representatives of the different interests, from the presidents down, was almost the salvation of the business.

A change, he further stated, has been taking place for some years past in the American Street Railway Association. It began with the branching off of the accountants and was marked again last year by the formation of the Electrical and Mechanical Association. Now the superintendents of way are knocking at the door for admission. Where will it all end? Probably by the formation of another association, that of the "way" men, with some dependence, however, upon the parent organization.

Mr. Ely also lauded the promoters of the Exposition, saying that anyone who could conceive and execute an exposition like that at St. Louis was capable of carrying out any undertaking on earth for the betterment of mankind. He was then presented with a gold badge by President Olds similar to those reserved for the members of the executive committee.

President Olds' Address.

President Olds next read his address, which was thoughtfully prepared. The following paragraphs, quoted from the address bring out the points which the speaker wished most to emphasize:

"The importance and magnitude of the interests represented by our association impel me briefly to present for your consideration a number of the more important matters."

"A glance at the exhibits in this building must impress you with the rapid progress that has been made in the development of transportation facilities. Not only do we see wonderful development in the steam locomotive but the street cars of today compared with those of but a few years ago are certainly palaces on wheels."

"When this association was first organized it was thought best to confine the membership entirely to mechanical and electrical men. I think this is a mistake. It is of equal importance to those having the way and transportation departments in their charge that they be well informed regarding the equipment, its care and maintenance. We find that other departments need to be represented and are knocking at the door for admission to our association. We must realize that our interests are nearly identical with those of other departments.

"The object of this association is to treat of mechanical and electrical subjects and exchange views and ideas upon the best methods of maintenance and operation. To do so intelligently we must be well informed regarding the work required of our cars and motors.

"There is also an agitation upon the part of some of the other departments for reorganization of the parent association, to be so arranged that each department will have its own sub-organization, under the control and direction of the parent body.

"I can but feebly voice the feelings of every member of this association when I say that our meeting in this grand old city of St. Louis, surrounded by exhibits from all parts of the world, will be most enjoyable and profitable to us. Our meetings being called upon the first two days of the week, the temptation will be very strong to put in your time sightseeing rather than attending the meetings. I would personally request each one to take hold of the matter in an earnest manner and not only be present yourself but use your influence to have others attend and take an active part in the meetings, remembering that we are here in the interests of the companies we represent. Our meeting at Saratoga last year was a grand success, and under the conditions I have mentioned, why should not this be even better?"

"We all recognize that the work of the Accountants' association has been and is now of the greatest importance to our companies, making the classification of accounts and reports nearly uniform, they being recognized as standard by the railway commissioners. The joint paper upon 'Shop Accounts and Records' gotten out by a committee of the Accountants' and our own association we believe is a step in the right direction, not only looking to uniform system of records and accounts but to a more uniform system of doing the work. By referring to the records and accounts of the steam-road master car builders and master mechanics we find them very complete, the same rules governing the repairs upon cars in all parts of the country; and it is gratifying to note that a large number of electric roads are following more or less closely their methods."

"As yet but little has been done regarding the exchange of freight between steam and electric railways. I fully believe that the time is not far distant when freight will be received by electric roads and delivered to the steam roads in carload lots the same as is now practiced by all steam roads. This would necessitate the construction of our roadway and track in such a manner that steam cars can be as successfully operated on the electric lines as on the steam railways.

"It is also very important that the motormen understand their equipment. To be successful there should be a uniform method in their instruction and examination. But a short time ago, should a locomotive engineer wish to change from one road to another, his examination as to ability would have been different in a great many respects from that on the road he was leaving. At the present time, if he be able to pass an examination upon a road operating in Maine and should he apply for a position in California, the examination would be practically the same, the qualifications for locomotive engineer being the same in all parts of the country."

"There are, however, a great many other matters than those previously mentioned that call for our earnest individual attention. The method of conveying the current from the trolley wire to our motors by the use of the present trolley wheel, pole and base is but a makeshift and very unsatisfactory. I realize that it is a very hard problem, but at the same time 'where there is a will there is a way,' and I believe that you will be able in some manner, in the not very distant future, to overcome the troubles with it that we now experience."

"Emergency brakes is a matter that has received but very little attention from street-railway operators, and is one of great importance.

"The design and construction of street-railway cars and trucks is more or less crude, and they should be changed to have a maximum amount of strength with minimum weight; at the same time we must not overlook the fact that they are to be attractive, safe and comfortable for our patrons."

"Let me again call your attention to the fact that the interests of all are nearly identical, and as success is the goal for which we are striving, it is essential that we become familiar with the work and requirements of all other departments of street-railway work."

This ended the forenoon session, which was adjourned until the afternoon at 2 p. m.

Opening Business of Afternoon Session.

After luncheon President Olds called the meeting to order and said in his opening remarks that the door was always open to the "men with the red badges," the supply men, and that they are "jolly good fellows."

The report of the executive committee was read by Secretary Mower. Since the first report 47 members have been added and no company has withdrawn. The balance of cash on hand is satisfactory.

Several communications were sent in by members who could not be present.

The matter of the proposed amendments to the constitution was taken up. The president suggested that Article 3, Section 1., be accepted according to the proposed amendments, and a motion, after some discussion, was made and carried to that effect.

Another subject discussed was the holding of office by supply men. Mr. W. O. Mundy of St. Louis thought a precedent should be established that no supply man can hold an office in the future. President Olds thought that the ruling of a year ago was sufficient to cover this, and, further, that supply men would probably not care to hold office any way.

Regarding the question of the superintendents of way, it was thought advisable to get them into the Mechanical and Electrical Association, if possible, this year, appoint suitable committees from their number and lay out papers for threshing out the questions which arise in their particular line and which are of vital interest to the association. Then, if next year it was deemed necessary to form a separate association, such steps could be taken.

A motion was then carried to the effect that the name of the organization remain the same for the ensuing year.

The Ideal Shop.

The first paper to be read was that of Mr. W. D. Wright upon "The Ideal Shop." Mr. Wright is superintendent of equipment of the Rhode Island Company of Providence, R. I., and showed by his paper and his part in the discussion that he was a master of his subject. Mr. Wright's paper is here given in full.

"The writer wonders if it would ever be possible to build an ideal shop for street-railway work to meet all conditions. Local surroundings must necessarily govern to a certain extent the plans and construction of such a building, and the details of arrangement for the various departments and the necessary apparatus and fittings must vary according to the different methods employed in doing the work on different roads. So it appears that in the face of these varying conditions we can only consider under the head of 'The Ideal Shop' a general plan for its layout, subject to changes which the local conditions would make necessary. In fact, the subject of this article might have been more properly: 'A Few Suggestions for an Ideal Shop.'

"In the first place, 'Let there be light,' as it was in the beginning. This matter should have due consideration from the beginning to the end of the plans. Daylight is one of the greatest blessings we enjoy. Why shut it out? It costs nothing, and we cannot have too much of it in our shop if it is of the right quality. Men can do more work and better work because of it, and any extra expense incurred to obtain abundance of good light in a workshop is money well spent.

"To this end, I think all will agree, that the ideal shop should consist of a building or buildings one story high.

"An arrangement of buildings which appeals to me as one that would be convenient, light and reasonable in cost consists of two one-story buildings on either side of a transfer track. This plan is laid out regardless of size or shape of lot, although this condition we will probably never enjoy in actual practice. I should prefer a depth of building sufficient to accommodate two double-truck, or three single-truck cars on a track, which would permit of shifting a car without disturbing more than one or two others.

"For the main buildings I would advise brick construction, with a plank roof, covered with tar and gravel. The roof covering the transfer track can be built entirely of metal, in which case the two main shop buildings would not be connected by any inflammable material.

"Granolithic cement makes a good, clean and durable floor. The only objection that I know of is that workmen, when obliged to stand on it all day, complain that it affects their feet and legs. Grooved rails should be used with this floor to prevent chipping by the wheel flanges. Tracks should be well spread, to give plenty of room between cars. I have found 13-foot centers to be very comfortable.

"Partitions separating the different departments can be built of a single layer of four-compartment vitrified building tile, which can be taken down easily, as changes and extensions become necessary, and used over again.

"Swing windows, operated from the ground floor by a system of rods and gears, will give both light and ventilation to this portion of the building. I find swing doors with two truss rods to be most serviceable and durable. They take up room when open, however, and no doubt for this reason many would prefer the metal shutter.

"Heating, I think, can best be accomplished by steam, unless the climate is mild, when a hot-air circulating system might be preferable. A good sprinkler system should be installed in the shop buildings with a hydrant system for hose in addition.

"Of course, our ideal shop would be fitted with the most approved types of cranes, air hoists and general machinery for doing good work expeditiously, and a storage yard adjoining will be found quite necessary for wheels, scrap iron, etc., and should contain a good platform scale."

In the discussion of the paper Mr. Mundy took exception to the policy of putting two or three cars

on a single track in the shop. Any car, when being repaired, should be in such a position that it could be removed at once without moving other cars, as would be the case if several were on one track. Mr. Wright agreed to this, but said that with many cars to repair this would be impossible, as it would require a shop of enormous size.

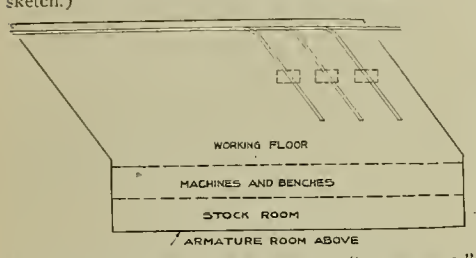
Mr. Mundy also thought that working from a pit should not be done more than is necessary, as a workman cannot work to advantage when peering upward. This change, however, as brought out in the discussion, is impossible, due to the fact that no standard truck is at present made which will allow of this.

H. H. Adams criticized a shop plan which Mr. Wright presented with his paper, saying that in the plan the winding room was too far from the machine shop. The stock room should also be as near the center as possible. Mr. Wright replied that the arrangement of these details must vary with the methods of doing work in different shops.

Mr. Baker remarked that the building of a shop allowing of 40-foot cars on the transfer tables was unwise, as no one knew when they would be required to carry 50-foot cars. He also thought that the machine and wood shops should be situated at right angles to the main shop.

M. O'Brien, who has had extensive experience in a shop designed by Mr. Mundy, was asked by the latter gentleman to pick it to pieces in the presence of the company, so that he, the designer, might learn thereby. Mr. O'Brien, however, to Mr. Mundy's evident disgust, could find but one fault. The armature room should have been located on a second floor instead of on the ground floor.

Mr. Mundy then showed on the blackboard how he would lay out a "triangular" shop; that is, one in which the tracks are laid out "on the bias." (See sketch.)



STREET RAILWAY REPAIR SHOP DESIGNED "ON THE BIAS."

The advantages of such a plan are that the cars are arranged singly upon the tracks and can be moved at any time without disturbing other cars being repaired.

Wheel Matters.

Following the paper on "The Ideal Shop" Mr. J. Millar, superintendent of rolling stock of the International Railway Company, Buffalo, N. Y., read one paper upon "Wheel Matters," which is here given almost in full.

"The question of the proper type and maintenance of wheels used under interurban cars which are operated over city streets for any considerable distance, also over more or less special work, has developed into a problem of great importance to the master mechanic.

"The ordinary chilled-iron wheel with one-inch flange is ruinous to special work in the city. We formerly used a 500-pound chilled-iron wheel with 2½-inch tread and three-fourths-inch flange on our Lockport division, and a 450-pound wheel with the same tread and flange on the Niagara Falls division. With both of these wheels we had an unlimited amount of trouble with chipped flanges, having to remove many of them for this reason before they were half worn out, and in several instances after making but a few trips. As a matter of precaution, I found it necessary to have all wheels carefully examined each trip at both ends of the lines.

"We are now using two types of wheels under our interurban cars—steel-tired and rolled-steel wheels, with 2½-inch tread and seven-eighths-inch flange. The rolled-steel wheels have given very fair results, with the exception of a few which have had to be removed on account of defective plates. As to flange wear, the results with both have been very good. The rolled-steel wheels made an average of 35,000 miles before they were taken out to be turned up for the first time, and a few have been turned up the second time, with an average of 25,000 miles for the second run. We have only one car equipped with steel-tired wheels that has been in service long enough to get any definite data as to wear of flange and tread. These wheels have been in service about 5½ months and have made 34,960 miles."

"The flange is lower after having been in service than it was originally, although I use a brake-shoe that does not wear on the flange. This I attribute to the special work inside the city limits, the depth of the groove not being enough to maintain a seven-eighths-inch flange. However, we now have no more broken or chipped flanges, and, as a factor of safety, they are far better than the chilled wheels. The only examination necessary now is for flange wear, which is done in the car stations, whereas, as is stated above, chilled wheels had to be examined each trip at both ends of the lines.

"With both the steel-tired and rolled-steel wheels, I find that the flanges wear thin on one side of the car, while on the opposite side they are in good condition, necessitating their removal to be turned up sooner than the natural wear would warrant. This I attribute to a large extent to the constant running of the car from the same end, which is well known to cause irregular wear.

"There are two arguments strongly in favor of the steel-tired and rolled-steel wheels—first, the factor of safety; second, their freedom from flat spots. During the 14 months we have had them in use I have not had to remove a single pair on account of being flat.

"In summing up steel-tired and rolled-steel wheels, I will say that the additional safety obtained from their use is of itself enough to warrant their adoption by all roads using high-speed interurban cars.

"As to chilled wheels, in following up the evolutions of cast-iron chilled wheels from the time of the old horse-car days when with many 'a wheel was a wheel,' it has been very interesting to note the changes in size, shape and weight, and it has convinced me that the changes have been a betterment to all matters pertaining to rolling stock. We are today using far better wheels than ever before; the mileage derived from cast-iron chilled wheels has in the last few years more than doubled itself. This is evident from the fact that the manufacturers have, during the last decade, raised their guaranteed mileage from 20,000 to 40,000 miles, which in itself indicates that progress in wheel manufacture has kept pace with other improvements pertinent to electric railroading.

"I have had the mileage taken of 1,458 cast-iron wheels (of the 400-pound type standard for our city cars) which were removed during the last two years. These wheels made a total of 58,340,478 miles, or an average of 40,014 miles per wheel. Of this number 24 were removed on account of having been broken, 186 for chipped flanges, and the balance, 1,248, were worn out.

"In regard to flat wheels, if, when first noticed, a good wheel-truing shoe is applied, much trouble can be warded off, but if too flat for a wheel-truing shoe, grinding down on a grinding machine is the only remedy.

"My experience with the grinding of chilled wheels, and after considerable study, prompts me to state that I strongly advocate their being reground, providing the regrinding is done in time, though I am aware that quite a number of heads of mechanical departments are of an adverse opinion. It is impossible for me to give accurate figures here as to the length of time required to grind flat spots out, owing to the variance in the flats themselves; however, on averaging the time, I can safely say that to regrind a pair of wheels on account of 'slid flat,' with a spot about 1½ inches long, will take about 30 minutes actual grinding.

"In pressing wheels on axles a competent man is an absolute necessity, as the result of carelessness is obvious to all acquainted with the work. He must be accurate in the mating of wheels applied to an axle, and, as nearly so as possible, the four wheels in a truck.

"The pressure required to press wheels on the axle depends entirely on the quality of metal used in the wheels; also on the axles. The average pressure I use, however, is 30 tons.

"In the above I have set forth a few matters which have developed in my experience, and hope that they will provoke comment and discussion, which will of themselves be of material benefit to all interested."

In the discussion following H. J. Lake of Munroe, Ind., said that the time is coming when rapid service on interurban lines will call for steel-tired wheels. One of the greatest faults of cast wheels is sliding and burning, the burning causing the wheels to chip. In his experience, 50,000 to 60,000 miles is the average life of a cast wheel.

Mr. Baker said that, though the manufacturer grinds the wheels with an emery shoe the shoe follows the irregularity of the wheel, and if, as is often the case, the pole is not in the center of the wheel, a concentric wheel will be turned out in spite of the grinding.

S. G. Boyle of Louisville, Ky., said that his experience had been that wheels should be trued once a year, and that one man can true five pairs per day. Mr. Baker, in reference to this question, said that on the Boston elevated railway they trued the wheels once in two weeks, but this was necessary because of sharp curves which wore the wheels rapidly and caused much noise.

With the close of this discussion the meeting was adjourned for the day.

Tuesday's Proceedings of Mechanical and Electrical Association.

Maintenance and Inspection of Electrical Equipment.

After a few opening remarks by President Olds the proceedings of Tuesday were opened by the reading by Mr. Alfred Green of the paper on "Maintenance and Inspection of Electrical Equipment," by John Lindall. The author is general foreman of shops of the elevated division of the Boston Elevated railway. The following paragraphs are taken from the paper and although referring more especially to elevated-railway practice, still they are of a nature to be beneficially studied by operators of surface roads as well.

"The difference between success and failure in the maintenance and inspection of electrical equipment very often means dividends or no dividends. Therefore, it behooves the responsible head of this department to give much thought and careful study to this part of the work, ever bearing in mind the old maxim, 'A stitch in time,' etc., which is never better applied than in the care of electrical equipment."

"The education of the motorman may not be considered as within the scope of this paper. It is, nevertheless, a fact that the manner in which the car is handled has a very material bearing on the maintenance of the electrical equipment; therefore its care should begin at this point. The mechanical department should work hand in hand with the operating department for the proper education and discipline of the motorman and the running down of ignorant and careless handling of equipment. The advancing of controller too quickly, running on resistance points, unnecessary reversing, failing to cut out defective motor, the substitution of 'any old thing' for a fuse, improper closing of switches, running at high speed through water, and running with both power and brakes on, are a few of the things that bring trouble and expense to the electrical equipment. Money expended for the instruction and inspection of motormen is, in the opinion of the writer, well spent.

"Defects in the equipment, however slight, should be promptly reported to the proper authority, and in such a manner that they cannot be overlooked. This can best be accomplished by a system of written reports, and instead of the motorman or conductor turning in a car with the verbal report that 'This car is on the bum; it was no good when I took it,' they should be required to report on a form, provided for that purpose, the nature of the defect, and, in case of serious trouble, the location on the line at which it occurred, with a brief statement of the conditions of operation, etc., at that time."

"The proper recording and tabulating of defects is very essential to the successful maintenance of equipment. Simply recording the various failures each day is not sufficient, as the value lies in being able to make quick comparisons, by week, month or year, and to see at a glance whether the various failures are on the increase or decrease, and calling attention to the points which are the most in need of improvement."

"One of the most important factors that we have to deal with in this problem is the education of electrical inspectors and repairmen. The writer is of the opinion that sufficient attention has not been given to obtaining, instructing and retaining in the service competent men, and when we consider that about two-thirds of the cost of maintenance is chargeable to labor account, it certainly seems that too much consideration cannot be given to this point.

"The development of good men to care for the equipment has not kept pace with the development of the equipment itself. Therefore, greater inducements should be held out to attract reliable and capable young men to the service. This is not merely a question of wages; congenial surroundings are necessary. I have recently had occasion to visit certain shops and car barns, the equipment of which was comparatively new, yet the conditions were such that no self-respecting man would stop in them. Shops should be properly laid out for the work, kept clean, well lighted, and heated in cold weather. The work necessarily being dirty, lockers for clothing, as well as ample toilet accommodations, should be provided, which would enable the men to leave the shops in a clean and respectable appearance."

"Master mechanics and foremen, in figuring to accomplish the greatest amount of work today, should also consider the question of making men for the needs of the future, and should make it a point to have men fitted for any vacancy that may occur. They should realize that there is even more credit in turning out good men than there is in turning out good work, and a man who will not impart knowledge to his subordinates, for fear that they will know as much as he himself knows, is not worthy of the position which he holds. Men should be taught why as well as how to do work, and to work from cause and effect. They should read the effects to find causes, and not guess at them. A controller which has flashed shows, just as clearly as if photographed, the position of the cylinder at the time of the trouble (if care is taken to note the evidence before it is destroyed), and it is then easy to determine whether it is a case of hot-touch, insulation breakdown, or lack of current-handling capacity.

"The practice of some companies of supplying railroad literature to lobbies, for the use of motormen and conductors, cannot be too highly commended, but I would suggest that if this privilege were extended to inspectors and repairmen, it would be appreciated and bring good returns. Of course, the periodicals would not be read during working hours, but should be made to some extent circulating—one man taking a paper to his home for a day or two, then passing it along to another man. In this manner an opportunity would be afforded for men to keep posted on the latest improvements and practices, and it would also stimulate an interest in their work.

"The inspection of electrical equipment, whether

it be on a time basis or mileage plan, should be systematic, and not considered as something to be done when it is convenient and let go undone when it is not."

"Under the system of inspection on the Boston Elevated Railway surface lines, trolley, switches, controllers and motors are inspected after three days' service, with the exception of brushes and armature grease cups of some of the older motors, which are in severe service and are inspected every day. In general, this inspection is as follows:

"Trolleys, to see that pole is straight and securely fastened, that the harp is tight in the pole, and that there are at least three days' wear in the wheel; that contact springs, washers, bushings and spindles are not seriously worn and are properly lubricated.

"Controllers, to see that they are clean and properly lubricated; that contacts make and break at proper points; that fingers and tips are sufficient for at least three days' wear, and that they are not rough and cutting; that cut-out switches work properly, and that wires are firm and show no evidence of heating at terminals.

"Main switches, fuse boxes and lightning arresters, to see that contacts are sufficient and in good condition, and that wires are secure in terminals.

"Resistances, to see that they are not seriously burned; that they are secure, and connections firm.

"Motors, to see that connections and leads are secure and not chafing; also that brushes are not broken and are good for three days' wear; that the brush-holder insulation is clean, and sufficient tension in springs; that commutators are clean and smooth; that bearings are properly lubricated; that there is sufficient clearance between armatures and pole pieces; that pinion and gears are tight; that motor-gear case and axle-collar bolts are tight, and that the casings are not cracked."

"It frequently occurs that an inspector finds a part of the equipment which would require considerable time to repair properly, and, in order to avoid the necessity of hurried or make-shift repairs or inspection, the system in vogue on the Boston Elevated does not require the inspector to do anything but inspect and make very light repairs. Equipment requiring extra attention is reported to the foreman, who details repairmen to that work; therefore no excuse is accepted from inspectors for allowing equipment to go by which is in need of attention. They are held strictly responsible, and are required to report, over their signatures, the numbers of the cars inspected each day—which practically amounts to a written guarantee of their work."

"It may not be out of place to mention at this time a change which we have made in the usual type of contact fingers and cylinder plates. It is not necessary for me to call your attention to the very small percentage of copper which is actually consumed from plates and fingers of the cylinder type of controllers, as compared with the amount which is scrapped, on account of the necessity of maintaining the points of contact at their proper degree for the successful operation of the controller, or to the serious proportion in which this expense grows with the increase of current to be handled. I will, however, ask you to consider this in connection with a very simple but effective means of reducing this cost, which has been found in the adoption of tips for both contact plates and fingers, making it necessary to renew only that part which is consumed or damaged by the arc in breaking current. The fingers are made of cast bronze, of about the usual shape, and are recessed on the inside, at the end, to receive the copper tip, which is secured by two C. S. machine screws. The tip copper is drawn in bars of the required cross-section, and the only work necessary is the cutting in proper lengths and drilling and tapping for the two machine screws. The application of the plate tip is still simpler. New plates are not required, as the old plates with the ends worn to the limit are put in a milling machine and the ends cut off and a groove cut for interlocking with the tip, which is drawn of proper shape and cross-section, so the only work necessary on it is the cutting off in the required lengths, the same kind of tip being used on all controller plates. This device has been in successful operation for nearly a year, and has been patented.

"To the men responsible for the maintenance of motors there is probably nothing which has given more worry, or been so thoroughly non-responsive to local treatment, as motor flash-overs. In the writer's experience this trouble developed with multipolar motors and the higher speed and voltages, and has been present more or less in all motors of this type, under the above-mentioned conditions. Elevated service with multiple-unit system and third-rail feeders, etc., is particularly favorable for producing conditions which contribute generously to the combination effecting flash-overs, and it frequently occurs that motors on all the cars in a train flash over at the same time. Engineers are at present giving this matter thorough study. The principal remedy appears to lie in increasing the size of the motor, so as to render it less sensitive, and we trust that in the near future motors will be manufactured which will not flash over. This will surely effect a considerable saving in their maintenance, as burnt brush-holders, springs, armature and field coils, resulting from flash-overs, is not a small item."

A lively discussion followed the reading of this paper, which was opened by William Pestell of New York. He did not agree to the proposal of instructing the motorman minutely in the knowledge of mechanical parts of his car, as the necessary time was not counterbalanced by the results obtained. Tabulation of defects, he thought to be essential to the proper care of equipment, and many defects could be run down by the aid of such tables. In the operation of cars it is found that one man may have an abundance of a certain form of trouble and another man may have trouble of a different nature, and by the aid of tabulated records of trouble the defects of each man may be brought to his notice more forcibly, and he will be quicker to respond with better service.

The street-railway accountants, although they regard their work as nearly accomplished in the few years they have been in existence as an organization, in Mr. Pestell's mind have only entered upon the most usefulness. In this matter of maintenance they can be of the utmost benefit to the street-railway interests. In the matter of clean and wholesome quarters in the shop he thought too much stress could not be laid upon this, as it means a better class of workmen and better work. The same is true of providing reading rooms and supplying the men with the current literature pertaining to their work.

Mr. Pestell also took up the matter of controller troubles, and believed that now that the day of heavy double-truck cars with four motors is here, the controller is too heavy and cumbersome to have on the front platform and advocated the use of some system of multiple-unit control in which the wiring is underneath the car body. Especially is this true with open cars. The method of the Boston Elevated railway of renewing the contact tips of controllers he thought a good one to follow, as controllers are a large item of expense. Flashing over of motors is lessened by putting several small motors on a car, rather than having two large ones.

W. D. Wright thought it to be advisable for a motorman to either "O. K." his car upon bringing it in or out as the case may be and require him to stand back of his decision.

H. A. Johnson asked the question if anyone knew of a new motor flashing over. In his experience he never knew of this, the flashing always occurring in old motors where the insulation was defective.

Alfred Green wanted to know how far the motorman should be instructed as to the principles of his apparatus, and asked D. F. Carver to answer the question. Mr. Carver said that, theoretically, as much as possible. In his experience, however, the lack of new men made it impossible to carry this to as great an extent as was desired on his road, that of the Public Service Corporation in Jersey City. They are very much pleased, however, with the way the men have taken hold and they appear very desirous of learning. They have the motorman punch on a ticket the trouble that he thinks there is in his car, and although he may not always get it right, a surprising amount of trouble is run down in this way.

J. S. Doyle of the Interborough Rapid Transit Company briefly described the "school" cars which his company has instituted. The controller and air-brake mechanism is shown in section, so that the men may study it, and a system of questions and answers has also been prepared. It is their intention to give yearly examinations to the motormen.

W. H. Adams of Minneapolis said that their greatest trouble had been in getting trained and educated motormen fast enough. About the time they got them well trained and thoroughly familiar with the apparatus they were gone. Time is the essential feature when a car is out on the line, and it may not always be the best plan to require the motorman to be able to repair his own car, as the line may become blocked. As to tabulating results, he thought that a car should be able to run a certain number of miles on the average without a "pull in" for repairs. By having a record of motormen who have to "pull in" it is possible to locate the peculiarities of certain ones in this direction, and so remedy the fault.

D. F. Carver of Jersey City, N. J., said that putting an ammeter before the motorman to teach him to save current was beneficial. They had tried that on his system (Public Service Corporation). They first had the man take the car out in the usual manner; then they put on an ammeter and had him run it as near the same way as possible. The story of the ammeter was usually sufficient.

President E. W. Olds, Milwaukee: Higher speed requires better equipment and higher voltage. Equipment good for 500 volts is not trustworthy at 600 volts, which is fast becoming common practice. Not only motormen, but repair men as well must be more efficient. The former should be able to locate trouble at once, and if out on a long interurban line not wait to be pushed in.

Nominating Committee.

After the discussion of this paper the president appointed a nominating committee, consisting of W. O. Mundy of St. Louis, Alfred Green of Rochester, J. Millar of Buffalo, W. D. Wright of Providence, R. I., and W. K. Evans of Minneapolis.

Afternoon Session.

The question box was the first subject under discussion Tuesday afternoon. It was thought advisable to read each question and the printed answers and then allow the members to express their opinions. This plan was carried out, and those who took a prominent part in answering were A. B. Metcalfe, W. D. Wright, Alfred Green, President Olds, J. S. Doyle and M. O'Brien. There were 23 printed questions, and answers had been received to nearly all.

A committee of the American Street Railway Association, at a session on the previous day, in connection with a committee from the Accountants' association and one appointed by President Olds, had formulated resolutions relating to the reorganization of the executive committee of the first-named organization so as to include the presidents of the affiliated societies in the committee. This resolution was brought up before the convention at this time to be voted upon, so that all might be in accord in the matter. The resolution was accepted by the association as read.

Election of Officers.

The report of the nominating committee was heard and the following-named gentlemen were nominated, and elected, for the various offices.

President—C. F. Baker, Boston.
First vice-president—H. H. Adams, Baltimore.
Second vice-president—John Millar, Buffalo.
Third vice-president—F. G. Simmons, Milwaukee.
Secretary and treasurer—Walter Mower, Detroit.
Executive committee—D. F. Carver, Jersey City, N. J.; J. S. Doyle, New York city; C. C. Lewis, Schenectady, N. Y.; W. H. McAloney, Denver, Colo.

A vote of thanks was then extended to President Olds, who responded feelingly, saying among other things that he considered it one of the brightest spots in his career to be able to preside over four meetings held on the Fair grounds, with its many attractions and have at the same time an average attendance of 90 members.

The new president then took the chair and after a few remarks by the newly elected officers the meeting was adjourned.

Street-railway Tests at the World's Fair.

In a conspicuous corner of the convention hall in the Transportation Building, St. Louis Exposition, during the street-railway conventions of this week was to be seen some of the work of the Street-railway Test Commission, which has been busily engaged throughout the summer taking and working up data upon street-railway operation, which, when ready for the public, should prove valuable. Prof. B. V. Swenson of the University of Wisconsin, who is associated with Prof. H. H. Norris of Cornell University and Prof. H. T. Plumb of Purdue University, was on hand during the convention to greet his friends. Others who worked on the tests and who were present during the week were C. E. Carter, W. J. Crumpton and W. Spaulding.

On of the most important tests which the commission will undertake will be that upon wind resistance. This work has not been done, but will be undertaken soon on the lines of the Indiana Union Traction Company, where a speed of 50 or 60 miles an hour can easily be obtained. Plans have been prepared for the test car, which are of much interest. The car will consist of a truck and platform, and on this platform, which has a rail truck, the body of the car will be placed, on wheels. The front end of the car body is made, not as a part of the body but as a freely swinging section, which will act against a dynamometer as the resistance of the air on the front pushes it back. This front will be made in various shapes for the purpose of experiment. Such forms as a parabola, V-shape and round and flat surfaces will be used. It is hoped by this means to obtain data of real value upon the resistance of the air at high speeds. The car will be rolled off the truck and the truck run with and without a wind-shield to ascertain the wind resistance on the truck alone under varying conditions.

The commission has for several weeks past been engaged in the tests of various types of electric-railway apparatus submitted for investigation. For the shorter tests, requiring no extended runs, a section of test track has been erected alongside the Transportation Building, representing the highest type of track and overhead construction. Here tests of motor-tractive efforts, controlling systems, etc., are conducted. Among the first tests carried out were investigations of the action of alternating current in rails of standard section. Another interesting test is that of the air-brake system used by the St. Louis Transit Company, which uses the storage air-brake system. The tests now under way and in contemplation include investigations of various types of motor, various systems of control and various designs of truck and equipment.

In a destructive fire in the business portion of Winnipeg, Can., a few days ago the main telegraph office was destroyed.

The History and Development of Electric Railways.

By Frank J. Sprague.

Part II.

Reverting to work in the United States, Sprague again took up the electric-railway problem, and in 1885, before the Society of Arts, Boston, advocated the equipment of the New York elevated railway with motors carried on the trucks of the regular cars, and work was actually begun on the construction of experimental motors. Shortly afterward a regular truck was equipped, and a long series of tests made on a private track in New York city. In May, 1886, an elevated car was equipped with these motors, and a series of tests begun on the Thirty-fourth Street branch of the road.

These motors may be considered the parent models of the modern railway motors. They were centered through the brackets on the driving axles, connected to them by single-reduction gears, and the free end of the motor was carried by springs from the transom, the truck elliptics being interposed between this support and the car body. The truck had two motors; they were run open, had one set of brushes, and were used not only for propelling the car but for braking it. The motors were at first shunt-wound, but later had a correcting coil in series with the armature at right angles to the normal field, to prevent shifting of the neutral point. The car was operated from each end by similar switches, current at 600 volts was used, and increase of speed was effected by cutting out resistance in the armature circuit and then by reducing the field strength. This enabled energy to be returned to the line when decreasing from high speed. It being impossible to interest the railway management, the experiments were finally suspended. Soon afterward a locomotive designed by Field had a short trial on the same section of the elevated.

Sprague then turned his attention to building a locomotive car of 300-horsepower capacity, each truck to be equipped with two motors, each having a pair of armatures geared to the axle, but this evidently being ahead of the times, and the possibilities of street-tramway traction becoming evident, these equipments were abandoned, and he began the development of the type of motor finally used in Richmond, one crude form of which was first used in storage-battery experiments in Philadelphia, and others in New York and Boston, in 1886. One of the elevated motors was put into service at the East Boston Sugar Refinery, and continued so for some time.

Reviewing the conditions at the beginning of 1887, statistics compiled by Mr. T. Commerford Martin show that, including every kind of equipment, even those a fraction of a mile long and operated in mines, there were but nine installations in Europe, aggregating about 20 miles of track, with a total equipment of 52 motors and motor cars, none operated with the present overhead line or conduit, and seven cars operated by storage batteries, while in the United States there were only 10 installations, with an aggregate of less than 40 miles of track, and 50 motors and motor cars, operated mostly from overhead lines with traveling trolleys flexibly connected to the cars. These were part Daft, but principally Van Depoele roads. Almost every inventor who had taken part in active work was still alive. The roads, however, were limited in character, varied in equipment, and presented nothing sufficient to overcome the prejudices of those interested in transportation and command the confidence of capital. The whole electric-railway art may be termed, and was, in fact, for some time afterward, in an experimental condition, and some radical step was necessary to overcome the inertia which existed, and inaugurate that development which has been so remarkable.

This came in the spring of 1887, when the Sprague Electric Railway and Motor Company took contracts for roads at St. Joseph, Mo., and Richmond, Va., the latter covering a road not then built, and including a complete generating station, erection of overhead lines and the equipment of 40 cars each with two 7½-horsepower motors, on plans largely new and untried. The price, terms and guarantees were such as to impose upon the company extreme hazards, both electrical and financial. The history of the Richmond road has been too often written to dwell upon it at any length here. Suffice it to say that, after experimental runs in the latter part of 1887, it was put into commercial operation in the beginning of February, 1888, and for a year there followed an experimental period of development which taxed the technical and financial resources of the company to the limit. But it won out, and Richmond, by common consent of history, now stands as that pioneer road which, more than any other, was effective in the creation of the electric railway as it stands today.

The general features characterizing it may be briefly summarized as follows: A system of distribution by an overhead line carried over the center of the track, reinforced by a continuous main conductor, in turn supplied at central distributing points by feeders from a constant-potential plant operated at about 450 volts, with reinforced track return. The current was taken from the overhead line at first by fixed upper-pressure contacts, and subsequently by a wheel carried on a pole supported over the center of the car and having free up-and-down reversible movement. Motors, one to each, were centered on the axles, and geared to them at first by single, and then by double, reduction gears, the outer ends being spring-supported from the car body, so that the motors were individually free to follow every variation of axle movement, and yet maintain at all times a yielding touch upon the gears and absolute parallelism. All the weight of the car was available for traction, and the cars could be operated in either direction from either end of the platform. The controlling system was at first by graded resistances affected by variation of the field coils from series to multiple relations, and series-parallel control of armatures by a separate switch. Motors were run in both directions with fixed brushes, at first laminated ones placed at an angle, and later solid metallic ones with radial bearing.

The well-nigh heart-breaking experiences and the alternation of good and bad performances are largely matters of personal history, but the results accomplished soon commanded the attention of those interested in the street transportation, most prominent among whom at that time was Henry M. Whitney, president of the West End Railway of Boston, who was considering the adoption of the cable. He consented to come to Richmond, and, accompanied by his associates, stopped also at Allegheny City to see the underground conduit of the Bentley-Knight company. The demonstrations made for his benefit were conclusive, the cable was abandoned, and orders given for trial installations on both the overhead and underground systems to run from the Providence depot in Boston to the suburb of Allston. A winter's run resulted in the abandonment of the conduit and the adoption of the overhead-trolley system, the principal orders for equipment going to the Thomson-Houston Company, which, having absorbed the Van Depoele company, was now pushing work energetically. Mr. Whitney's decision had a vital bearing upon the commercial development of electric railways, and from that time there followed a period of extraordinary activity, in which for a time two companies, the Sprague Electric Railway and Motor Company and the Thomson-Houston Electric Company, were the principal competitors. There was a continuous improvement and increase in the size of apparatus. Form-wound armatures, proposed by Eickemeyer, replaced irregular windings, and metallic brushes gave way to carbon, this single change, initiated by Van Depoele in 1891, going a long way toward making the art a success. Cast and wrought iron yielded to steel, two-pole motors to four-pole, double-reduction gears to single, and open motors to closed, protected only by their own casings. In 1892 combined series-parallel and resistance control was adopted, when the Thomson magnet blow-out was successfully applied to controllers by Mr. Potter, and this was a most effective agent in reducing the troubles of operation.

The progress of the electric railway, however, was not unimpeded, for no sooner had the Richmond road started than there was emphasized a series of disturbances on the telephone lines, which threatened the use of the rails for return, and brought on a conflict with the Bell Telephone Company, far-reaching in its character and involving new legal questions. At that time it was almost universal practice for the telephone to be installed with single circuits and earth return. Already the service had become most unsatisfactory, because of the multiplicity of electric installations of various kinds, with consequent leakages, trouble from induction and variations in earth potential. To the hissing and frying incident to the system as installed was now added the hum of the motor, and exaggerated differences of potential at the ground connections.

The first attempt to meet this was made in Richmond by the superintendent of the exchange, who disconnected from the ground and joined all return wires to a common circuit. This obviated most leakage troubles, but did not get rid of the troubles of induction. Numerous lawsuits followed in nearly half the states of the Union, the telephone companies attempting to force the railways to use double overhead circuits, and the railway companies demanding their share of the heritage of the earth. The trolley contentions were in the main successful, and individual metallic circuits, vital to successful operation, and without which the long-distance telephone is impracticable, were adopted, for which condition of affairs the electric railway may be thanked.

The work accomplished at Richmond, the widespread advertising of the equipment and the rapid spread of electric railways in the United States commanded the attention of the Old World, and work was begun in Italy, Germany and elsewhere along the same lines, but it was not until a number of years later that there was any general adoption of the electric railway in the more conservative countries.

Meanwhile, the Sprague Electric Railway and Motor Company was absorbed in 1890 by the Edison General Electric, which later combined with the Thomson-Houston company and others in the General Electric.

For the next six years the record of the electric railway is that of industrial development, practically as indicated in the improvement of apparatus, and the replacement of horse and cable power on existing lines and the creation of new ones. Electric operation on tramways having become established, there naturally followed more ambitious attempts in limited applications of electricity to heavier work.

In November, 1890, a line on the South London road, which was originally designed for cable, was opened, the trains being pulled by electric locomotives equipped with a pair of gearless motors having armatures mounted on the axles of the drivers.

In February, 1892, Sprague offered to install on the New York elevated road a train to be operated by a locomotive car, and also one with motors distributed under the cars, and to make an express speed of 40 miles an hour. A year later the Liverpool overhead railway was put in operation. Here the trains were composed of two-car units, each car having one motor, the two being operated by hand control.

In the spring of the same year, 1893, the Intramural Railway was constructed at the World's Fair, the equipment being supplied by the General Electric Company. Four motor cars with hand control were used to pull three trail cars, and a third-rail supply with running-rail return was adopted. Two years later the Metropolitan West Side elevated road in the same city was equipped on the same general plan, except using two motors instead of four. In May, 1896, the Nantasket Beach road, a branch of the New York and New Haven railway, was put in operation, and in September the Lake Street elevated of Chicago began electrical operations. In November of the same year, electric service was instituted on the Brooklyn Bridge, the motor cars being used to handle the trains at first at the terminals, but later across the bridge.

There were few attempts, however, to replace steam on regular roads, and only occasionally were electric locomotives used for special reasons. Among the earlier ones built were one of 1,000 horsepower, about 1892-94, designed by Sprague, Duncan and Hutchinson for Mr. Henry Villard for experimental operation on lines out of Chicago, which was never undertaken, and the still larger locomotives built by the General Electric Company, which began operation of the trains in the Baltimore and Ohio tunnel in 1895.

For a long time the conduit system, after its abandonment at Allegheny and Boston, remained quiescent, and all work was practically with the overhead trolley. In 1893 a short line was tried in Washington on the Love system, but it was not until the following year that work was begun in New York on the Lenox Avenue line, and carried to that successful conclusion which warranted its widespread adoption in that city, under the auspices of William Whitney and Henry Vreeland, and soon after in Washington under Connett, although a line had been in operation at Budapest for some time. All this, of course, was largely because of the necessary cost of the heavy construction, and because street-railway managers would not and could not undertake any such investment except under most favorable traffic conditions, and then with the additional restriction of a prohibition of the use of overhead wires.

It was about this period that there began that rapid introduction of interurban railways, which was soon aided by applying the developments which had been made in polyphase transmission by Ferraris and Tesla, and in rotary transformers by Bradley and others, and which has had such an influence upon steam-railway operation, and been so instrumental in knitting together urban and rural communities.

The first practical proposal, using high-tension transmission, seems to have been made in 1896 by Bion J. Arnold, in plans for a road to run from Chicago to the Wisconsin lake region, and although this road was never built, the general plans were utilized for a line actually put into operation about two years later, which was the forerunner of the standard practice of today by means of which the limitations of distance have been so effectively reduced.

In 1896 Sprague again sought the opportunity to make a demonstration on the elevated railway in the form of a proposition to the management to equip a section of the line, and operate a train of cars on a new principle, the "Multiple-unit." Although the advantages of the system, such as higher schedules, reduced weights, variable train lengths, more frequent trains, distributive motive equipment and increased economy were presented, and supplemented by an offer to equip the whole system, no response whatever was made. A similar proposal repeated seven months later met with like fate, but in the spring of 1897 he made a contract with the South Side elevated railroad, in Chicago, to equip the line on this plan in lieu of the locomotive-car plan, then under consideration.

This system has now become so widely known that any detailed description of it is unnecessary. Generally speaking, however, it is essentially the control of controllers, by means of which cars equipped with motors and controllers for them are operated from master switches through a secondary line, with provision for so coupling up cars that from any master switch all cars can be operated, irrespective of number, order or end relation, or whether all or only part of the cars are equipped with motors.

The first equipment was for 120 cars, and the first public demonstration was made in July, 1897, at Schenectady, on a full train of cars which had been sent from Chicago for that purpose. A regular train was put into operation before the close of the year, and within a few months steam operation was entirely replaced.

As originally equipped, the main controller consisted of a magnet-operated reverser and pilot-motor-driven cylinder, operated semi-automatically and with throttle restraint through a secondary line and relays from master switches on the platforms. A number of variations have since been developed, such

as operating the reverser and cylinder by air pistons electrically controlled, or breaking the main controller up into several magnetically operated parts, and all forms of equipment are now in operation. The essential principle of the system, however, has not been changed, and it has become standard wherever required to operate electric trains at high schedules. Equipments have grown from 100 horsepower per car to 2,200 horsepower per locomotive, for in the largest work under way, that of the New York Central, the locomotives are to be controlled on this plan.

The necessities of tunnel traffic on the one hand and a grave accident on the other have, curiously enough, centered in New York the largest two electric transportation problems, namely, that of the operation of the Pennsylvania tunnel and terminals, and, more extensive still, that of the New York and Hudson River railroad for 35 miles out from its terminals. The general requirements are so exacting and the installation of the latter under such difficult continuous working conditions that they will prove of historic interest, and be influential in determining the disposition of many terminal problems.

Up to comparatively recent times most of the electric railways, including those just mentioned, have been planned for operation with continuous-current motors at moderate potentials, but this has often required the conversion of alternating current transmitted at high potential into continuous current at low potential through the medium of transformers and rotary converters. While this bids fair to be the practice for some time, there are, of course, certain objections which are apparent, and the best energies of many of the ablest electrical engineers have for some time been bent upon solving the problem of operating directly with alternating currents. Among the most active and successful of these have been the Ganz Company, whose Valtellina line, equipped on the polyphase plan for the Italian government, is of special interest. Among other noteworthy installations are those under the auspices of the German government on the Zossen military line, where the highest record for speed of a car carrying passengers, about 126 miles per hour, has been made during the last year, the current being collected from the three overhead wires by sliding contacts.

The multiplicity of conductors, however, distinctly militates against this, as any general solution of the larger railway problems, quite independently of other limitations affecting trunk-line transportation, and hence single-phase operation, using one overhead conductor with track return, is being energetically prosecuted. Among the workers who have sought solution and been active in invention along this line, as well as one of the earliest and most persistent advocates of single-phase railway operation, is Mr. Arnold, who has developed an electropneumatic plan in which is combined on a locomotive a constant-speed single-phase alternating-current motor with reversible air pumps and a storage tank, by which starting and running can be controlled by compressed air, with a more even demand upon the capacity of the line. Arnold's experiments, a long time delayed from various causes, are now being subjected to the actual tests which will demonstrate the practicability of this scheme. Meanwhile, becoming alive to the limitations of past practices and the increasing demands of the art, the engineers of the various manufacturing companies in the United States and Europe, among whom must be especially mentioned Finzi, Lamme, Eichberg and Steinmetz, are developing the single-phase, alternating-current motor along two general lines. One is by using a series motor of special construction, current being supplied from the secondary of a transformer carried on the car and operated at moderate frequency. Another form is that originally proposed by Thomson, and known as the "repulsion" type, in which the field is supplied directly at high potential, and the armature is short-circuited upon itself and operates at low potential. An alternative of this form is that developed by European engineers, in which a variable potential is delivered to the armature from a transformer, the field being supplied direct from the line. One desideratum is, of course, to be able to operate, both from high-potential alternating and low-potential continuous currents, and this may now be considered as accomplished.

It is unnecessary to go into the many variations or details of these various schemes. Suffice it to say that all are being submitted to the crucial test of commercial operation, and the overcoming of difficulties of the early days of electric railroading warrant expectation that a great measure of success will likewise be attained on these new lines, and that another bar to the wider spread of electric-railway operation may be speedily removed.

This paper will not be burdened with detail statistics, but to illustrate in a general way the growth of the electric railway it should be noted that three years after the inauguration of the Richmond road there were in operation or under contract in the United States, England, Germany, Italy and Japan, not less than 325 roads, representing an equipment of about 4,000 cars and 7,000 motors, with 2,600 miles of tracks, on which there was made a daily mileage of not less than 400,000 miles, and three-quarters of a billion of passengers were carried annually.

By the end of 1903, in the United States alone, there was a total of over 29,000 miles equipped, 60,000 motors and 12,000 trail and service cars in service and the passengers carried ran into billions.

What the electric railway has done may only briefly be referred to here, but the writer may be permitted to repeat the substance of remarks written some nine years ago, for it has become a most potent factor in our modern life, and left its imprint in the indelible stamp of commercial supremacy. It has given us better paved streets, greater cleanliness, more perfect tracks, and luxurious, well-lighted and well-ventilated cars; and with the higher speeds it has made possible the extension of the taxable and habitable areas of towns and cities in a much greater ratio than is represented by the increase of speed.

It has released from drudgery tens of thousands of animals, and increased the morale of transportation employes. It has given employment to an army of men, and hundreds of millions of capital. It has improved and extended the telephone service by forcing the abandonment of ground circuits. It has built up communities, shortened the time between home and business, made neighbors of rural communities, and welded together cities and their suburbs.

Will it replace the steam locomotive?

Perhaps the best answer is that "its future is not in the wholesale destruction of existing great systems. It is in the development of a field of its own, with recognized limitations, but of vast possibilities. It will fill that field to the practical exclusion of all other methods of transmitting energy; it will operate all street-railway systems, and elevated and underground roads; it will prove a valuable auxiliary to trunk systems; but it has not yet sounded the death-knell of the locomotive any more than the dynamo has that of the stationary steam engine. Each has its own legitimate field, which will play its proper part in the needs of all civilization."

[*The end.*]

International Engineering Congress.

The International Congress of Engineers, under the auspices of the American Society of Civil Engineers, was held in St. Louis last week, October 3d to 8th. Eleven foreign countries were represented and the delegates and their families attending numbered 861 persons, as follows: North America, 727; Europe, 110; South America, 10; Asia, 10; Australia, four. Twenty-eight meetings were held and the total membership of the societies represented at the Congress is about 3,500.

The preliminary meeting was opened by Henry S. Haines of Detroit, member American Society of Civil Engineers and chairman of the committee in charge. He stated that the original plan had been to have a congress including other engineering organizations, but as these had declined the invitation to join, for satisfactory reasons, the responsibility had fallen to the civil engineers. The papers presented were therefore largely on civil-engineering subjects. President Charles Hermany of the American society delivered the address of welcome, followed by F. J. V. Skiff, who represented President Francis of the Exposition. Sir William White, K. C. B., F. R. S., president of the Institution of Civil Engineers of Great Britain, was introduced and gave an excellent address, in which he spoke of the progress and achievements in engineering. In the course of his remarks he said that the tendency in engineering practice is to specialization; this is pre-eminently the necessity of the situation, yet all departments of engineering practice are interdependent, and the works of the structural engineer, the mechanical engineer and the electrical engineer are equally prominent and must be employed judiciously. Following Mr. White were speakers from France, Germany, Argentine Republic, Russia and Austria.

On Monday, after the general meeting, the Congress was divided into eight sections, which met separately each day during the week. Many valuable papers were read at these meetings and the discussion was enthusiastic. Section F, electrical, was presided over by Frank J. Sprague of New York. One of the papers read in this section which brought out considerable discussion was that of L. B. Stillwell of New York, on "Electrical Power-generating Stations and Transmission." Mr. Stillwell, it may be remarked, was also a member of the committee in charge of the arrangements for the Congress.

The American Society of Civil Engineers held its annual meeting at one of the sessions, at which President Hermany delivered the annual address. In referring to the proposition for a union engineering building, Mr. Hermany thought that the course of the society in voting down the idea was a wise one. He spoke at some length on the definition of the word "engineer," and, in his remarks, which were largely upon the professional character of the engineer's work, stated that engineering to a large extent involves the practice of art. The place and time of next year's meeting will be decided by the directors. A letter ballot was announced, which favored Cleveland, Ohio.

During the week many social gatherings took place, among them being the entertainment furnished by the Engineers' Club of St. Louis and the reception given the members of the Congress by Col. C. M. Watson at the British Pavilion.

Damages Given for Death by Electric Shock.

In the case of Maria Enzler against A. P. and A. J. Goddard, in Freeport, Ill., a jury in the Circuit Court gave the plaintiff a verdict for $3,500 last month. Mrs. Enzler sued for $5,000 damages for the death of her husband from electric shock two years ago. At that time the defendants were leasing the street-railway, power and lighting plant in Freeport. John Enzler was employed by them in the car barn. George M. Willis of F. B. Badt & Co., Chicago, who, as an electrical expert, testified for the plaintiff, gives the following synopsis of the case, which carries with it a useful lesson.

In the discharge of his duties John Enzler had to clean the cars of the company and grease the motors and axles each night. In the performance of this work it was necessary for him to use a flexible cord having at the end a 16-candlepower incandescent lamp. This cord was connected to an extension plug on the side wall of the barn, and the extension plug connected to a wiring system in the barn, in turn connected with a 10-kilowatt transformer, having a primary voltage of 2,080 and a secondary voltage of 104. This transformer also supplied an adjacent vinegar factory and other customers.

John Enzler was found lying on his back dead about nine o'clock at night, grasping the flexible cord in his hand, and all the lights remaining burning in the barn when he was so found. He was the only man working in the barn and had probably been dead over an hour when found. The man who discovered him saw sparks spluttering from the flexible cord to Enzler's hand. He jerked the cord out of Enzler's hands with a stick, and the cord, in touching the ground, which was of cinders, gave off spluttering sparks. Doctors were called, but artificial respiration failed to restore life. One hand which grasped the cord was badly burned; no burns were discovered on the feet or at any other part of the body. It had been raining hard earlier in the day, but it was clear at nine o'clock in the evening.

On the secondary circuit connected to the same transformer, at nine o'clock of the morning of the same day, an employe of the vinegar factory was using a similar flexible cord, standing on the earth floor, and was shocked into 20 minutes of unconsciousness, and his hand was badly burned. Later, about four o'clock of the same day, at the same vinegar factory, another man was shocked, and still later, about six o'clock, another man was shocked severely.

"This fatal accident," says Mr. Willis, referring to the death of John Enzler, "was undoubtedly caused by the primary high-potential voltage getting on to the secondary wires, probably through a short-circuit or leak in the transformer. No safeguards for the protection of human life, such as grounding the secondaries, etc., had been used by the defendants, and they were charged with gross negligence."

All Parties Favor Charter Amendment.

All the county clerks in Illinois have received from Secretary of State James A. Rose the official statement of the constitutional amendment which will be on the special ballot of the November election. This statement includes a copy of the amendment and the interpretation of it by Attorney-general Hamlin. Both the amendment and interpretation have been widely published throughout the state, and the construction placed on the amendment by the attorney-general leaves no room for any suspicious voter to fear that there is someting dangerous in it. It is in reality a simple proposition. If adopted it will enable the Legislature to grant Chicago broader charter powers in managing her local affairs. It does not and cannot relieve Chicago from any obligations to the state, and is not so intended. Before being adopted by the Legislature the amendment was long and carefully considered by the judiciary committee of both House and Senate, and if there had been anything lurking in it to the disadvantage of the state at large it would have been detected.

A proposition that is endorsed in the platforms of the Republican, Democratic and Prohibition parties and strongly advocated by their campaign speakers is not, apparently, open to objection.

The Buffalo, Batavia and Rochester (N. Y.) Electric Railway Company has been incorporated with a capital of $3,500,000 to construct and operate a surface electric railroad 65 miles long, from Williamsville, Erie County, to Rochester, with a branch to Akron, Erie County. This road will compete with the New York Central.

Michigan Telephone Matters.

The Michigan State Telephone Company, at a meeting of the general officers in Boston, in which the Boston, Chicago, New York and Detroit interests were represented, decided to declare the usual quarterly dividend of 1½ per cent. The report of President W. A. Jackson showed the company to be in good condition, both physically and financially. Improvements are being made rapidly and the business is very satisfactory.

The Co-operative Telephone Company of Detroit has just established direct copper connections with Toledo, giving Detroit over 9,000 Independent telephones connected with the Union Telephone Company, and also having connections with other exchanges in Ohio and Indiana having over 400,000 subscribers. Low rates are to be put in effect.

The Independent Telephone Company of Marshall is understood to have been sold out by its principal stockholder, F. A. Stuart, to the Michigan State Telephone Company. This local company was organized three years ago as a result of an increase in rates by the Michigan Telephone Company. An up-to-date exchange was established, the rates being $20 for business houses and $9 for residences. The new company practically put the Michigan company out of business as far as local business was concerned. Although the latter company continued to operate an office, most of its business was on the long-distance line. The Michigan State Telephone Company has, however, turned its attention to Marshall and sent R. L. Trewin there to fix things up in the Bell office. It now looks as if the Bell company would soon have a monopoly in the telephone business of the town.

The Delray council has been asked for a telephone franchise for the Wegner-Hall Construction Company of Detroit. This company proposes to establish a plant capable of taking care of 500 subscribers, and to charge the following rates: Business places, $30; residences, on a two-party line, $24; on a four-party line, business places, $24; residences, $20. These prices are for local connections. For Detroit connections the prices would be somewhat higher.

A new telephone line is being surveyed from Pointe Place, a few miles north of Toledo, to Monroe Beach. This line will run along the beach of Lake Erie and will make a convenient route for the numerous cottage dwellers who live along the beach. It is understood that the system will operate only during the summer season.

The farmers of Newton and Leroy Townships have organized a co-operative telephone company for maintaining a house-to-house system, with an office and switchboard at Newton Center. It is understood that all the farmers in these townships have entered into the scheme. To avoid expense, the wires will be run on top of the fences, poles being used only where the wire crosses roads.

A number of farmers southwest of Gaylord have combined and will organize a telephone company for the purpose of establishing wire communication with Gaylord. W.

New England Telephone News.

The New England Telephone and Telegraph Company was the purchaser about a week ago of the entire block of business structures bounded by High, Batterymarch, Wendell and Oliver streets in Boston. The site comprises two estates, whose total assessed value is about $280,000, comprising 12,746 feet of land, with buildings thereon, four and five stories in height. The property is located only a short distance from the telephone headquarters now occupied jointly by the American Telephone and Telegraph Company and the New England company, but it is secured in anticipation of future needs rather than for immediate use.

Arrangements for an important telephone deal in the locality of Stonington, Conn., are reported. The Westerly Automatic Telephone Company, an Independent corporation operating in Westerly, R. I., will acquire the business of the Providence Telephone Company in the towns of Westerly, Hopkinton (except the village of Hope Valley), Richmond and Charlestown in Rhode Island, and also the business of the Southern New England Telephone Company in the towns of Stonington and North Stonington, in Connecticut. The Pendleton Hill extension in Connecticut will also be included in the arrangement. The Westerly company will then become a licensee of the American Telephone and Telegraph Company and a sub-licensee of the Providence Telephone Company. The Rhode Island and Connecticut companies will receive payment in the stock and rights of the Independent company. The Boston corporation will retire from the field. B.

Southeastern Telephone Developments.

The Graniteville (S. C.) Telephone Company has been commissioned, with $3,500 capital, by W. A. Giles, T. H. Rennie and G. L. Knight. It will extend to several nearby towns.

The Bowen Telephone Company has secured connections with the Southern Bell at Fitzgerald, Ga., and is now able to furnish connections to nearly all parts of the state of Georgia.

The Southern Bell Telephone Company, which recently bought out the systems at Salisbury and Spencer, N. C., is now at work rebuilding the two plants, and the new system will be standard in every respect when it is completed.

The Kernersville (N. C.) Telephone Company has been chartered with a capital of $5,000 to build a local exchange and lines to any part of the country. W. C. Linville of Kernersville, F. W. Lubert of Waterbury, Conn., and others are interested. L.

Ohio Telephone Notes.

Increase in rates in Millcreek Valley by the City and Suburban Telephone Company of Cincinnati has resulted in a decision by the Business Men's Club, made up of members from Elmwood Place, Carthage and St. Bernard, to take the instruments out and petition the councils of the various towns to grant franchises to Independent companies or some company that will serve all. A meeting was held last week, when representatives of the company were present, and quite a spirited debate took place, but they failed to convince patrons that the increase is warranted.

Two portable telephones have been installed in the lunch rooms of the Chandler & Rudd Company, Cleveland, for use of patrons. Seventy plugs are arranged at intervals along the tables, so that telephones may be used at any seat. This is the first lunch place in the city to be equipped in this manner, though in some places the plan has been quite generally adopted.

An increase from $10,000 to $50,000 has been made in the capital stock of the Central Ohio Telephone Company of Centerburg.

After the Dayton Savings and Trust Company had instituted a suit to compel the Columbus Savings and Trust Company to yield the trusteeship of bonds of the Home Telephone Company of Dayton the Columbus bank conceded the point and an order was entered to that effect. The Dayton bank secured a large block of the bonds some time ago.

A temporary restraining order was refused the Cuyahoga Telephone Company in its case against the company operating the Hotel Euclid, in which it was sought to prevent the hotel people from discarding the use of the system, for which the Cuyahoga company holds a contract. Some time ago some trouble occurred and the company ceased to use the Cuyahoga service in its rooms and contracted with the Bell. The latter installed its service.

Handsome gains are being made almost every month over last year's business by the United States Telephone Company. The surplus for August was $3,866.65 in comparison with $2,555.78 for the corresponding month in 1903. The gain in receipts was about $3,000, almost half of which is shown in the surplus. C.

The Telephone on the Pacific Slope.

C. M. Taylor, Emmet Henderson and other citizens of Waitsburg, Wash., are discussing the matter of building a city telephone system.

Superintendent P. J. Lynch of Visalia, Cal., has received word that the telephone system in that city is to be rebuilt entirely.

The directors of the Home Telephone Company at Riverside, Cal., have decided to issue bonds in the sum of $500,000, half of which will be expended at Riverside at once in the installation of a plant and building.

The Clarkston Independent Telephone Company has asked the council of Clarkston, Wash., for a franchise to construct a telephone system in that city. It is proposed to extend the line to Asotin and Anatone. Work will begin at once if the matter is favorably considered by the council.

Some of the material to be used in the extension of the telephone system from Phœnix, Ariz., into California, to connect with the Sunset system, is now en route to Phœnix. General Manager Hinchcliffe of the telephone company states that improvements are to be made in the service at Phœnix.

The construction of the new telephone line from Dayton, Wash., to J. H. Romaine's ranch, about seven miles from the city, will begin at once. J. H. Romaine, George Jewett, F. C. Romaine and N. James are interested in the project. The company has been named the Happy Flat Telephone Company. The line will be constructed along the Starbuck Road. A.

Telephone News from the Northwest.

A local telephone exchange is projected at Good Thunder, Minn.

The Merton Rural Telephone Company has been organized near Owatonna, Minn.

The Redwood County Rural Telephone Company will install a local exchange for Belview, Minn.

The telephone connection between Albert Lea, Minn., and Emmons has been restored after being discontinued for several months, the Emmons company building a line through from Emmons to Albert Lea. The trouble with the Western Electric Company, which has lines in Albert Lea, is now settled amicably.

The exchange of the Bangor (Wis.) Telephone Company has been badly damaged by fire. The company had just moved to new quarters and completed connecting up the board about an hour when fire broke out. A contract has been placed with the Vought-Berger Company of La Crosse for a new board of 200 drops.

The Dwelle Telephone Company of Lake City, Minn., is extending a rural line to Jacksonville and Oak Center.

The lines of the Independent Telephone Company of Yankton, S. D., and the Missouri River Telephone Company have been connected at Tyndall, S. D., giving Independent long-distance service between Yankton and the towns of Charles Mix County. Other Independent lines are being extended.

The Iowa Telephone Company will soon begin extensive improvements on its system at Dubuque. A new exchange building will be erected and all wires put underground.

The Mutual Telephone Company is at present operating two exchanges at Des Moines, Iowa, but will abandon the old one as soon as the new one is completed sufficiently to handle the entire business alone. The Emmet County Telephone Company has been formed and will ask for a franchise at Estherville, Iowa.

The Mutual Telephone Company will make extensive improvements on its exchange at Manson, Iowa.

The Bell Telephone Company is building a new line from Waverly to Hampton, Iowa. R.

GENERAL TELEPHONE NEWS.

J. Moore has been granted a telephone franchise at Glasgow, Mont.

It is said that the project for a municipal telephone plant in Brantford, Ont., has been dropped.

A telephone line will be constructed from Raleigh, N. C., to Clayton by the Raleigh Telephone Company.

J. P. A. Anderson, president of the Madrid (Iowa) Telephone Company, has invented a lightning arrester.

C. Potter has resigned as manager of the telephone system at Oskaloosa, Iowa, and has moved to Montana.

Elmer S. Randall, telephone inspector at Augusta, Me., was killed recently by coming in contact with an electric-light wire.

W. L. Miller and associates of Ringwood, Okla., have incorporated as the Star Telephone Company, with a capital of $1,000.

Clifford Baumbach, secretary and treasurer of the Iron Range Telephone Company at Crookston, Minn., has organized a banking and loan company for Indian Territory.

The Missouri Independent Telephone Company, with a capital of $10,000 and headquarters at Liberty, Mo., has been incorporated by Logan Woodson, Pascal Parker, S. H. Woodson and associates.

The Hazen (Ark.) Electric Light and Telephone Company, which was recently organized, has asked for a franchise to construct a local and long-distance telephone system. Later on the company will erect an electric-light plant.

The Bell Telephone Company has applied for a franchise at Clarkston, Wash., where it has been doing business under permission from the water-power company. The Clarkston Independent Telephone Company will also ask for a franchise.

The city authorities of Kansas City, Mo., chopped down a number of the poles of the Bell telephone company, recently, because they were put up without a permit. There is a suit pending against the company for a pole tax, which is being fought.

The Telephone and Telegraph Company of New Jersey has been incorporated with a capital of $250,000. The chief office is in Jersey City, and the incorporators are Alfred E. Holcomb, Harry H. Brigham, George H. Minster, Samuel S. Moore and Robert Bain.

The Chicago Telephone Company reports a gain of 1,056 telephones for September. The company now has in service in the city and country 113,704 instruments. A new exchange building on Washington Street, which is to cost several hundred thousand dollars, will be commenced before the end of the year. The money for meeting this expenditure was provided by the last sale of stock.

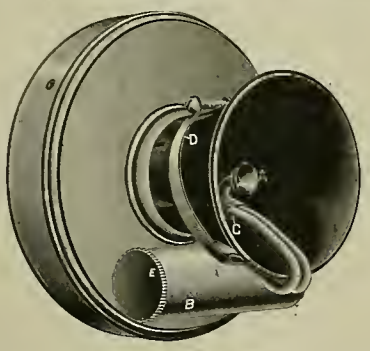
R. W. Kemp, consulting telephone engineer of Wellington, Kan., has been promoting several rural telephone lines which center in Wellington, and as soon as the Chickaskia Mutual Telephone Company completes its lines (which will be over 60 miles in length) this company and the South Haven Mutual Telephone Company, the Ninniscah Valley Telephone Company, the Braman Mutual Telephone Company and the Oklahoma and Kansas Telephone Corporation will unite upon mutual terms.

In an advertisement in the daily papers the Bell telephone company of New York city prints the following conversation between a Frenchman and an Italian in the Waldorf-Astoria, who were impressed with the excellence of the hotel system, which connects with the local, suburban and long-distance lines of the Bell system: "Would that we had a system like this in Europe," said the Frenchman. "You tell the girl you want so and so, and in a little while she says 'Number three,' and you talk, but in France and Italy to telephone is as much trouble as taking a bath."

Automatic Telephone Purifier.

Automatic telephone purification and deodorization are accomplished by a disinfecting telephone mouthpiece which is manufactured by the Couch & Seeley Company of Boston. It is a compact, ornamental attachment for telephone mouthpieces, made of metal, nickel-plated, and can be applied to any telephone by turning one screw. By referring to the accompanying cut, the operation of the purifier may be understood.

Upon speaking into the telephone, the force of the sound wave enters the funnel at (A), exerting pressure through the small tube upon the disinfectant-



AUTOMATIC TELEPHONE PURIFIER.

impregnated air in cylinder (B), which is consequently expelled through the second tube at outlet (C) into the back of the transmitter, where, it is said, it thoroughly deodorizes and disinfects every corner and crevice.

The strap and bolt (D) are to clamp the purifier firmly upon the mouthpiece; cap (E) is to be removed when refilling cylinder (B). One filling of the cylinder will last about six months, when, by removing the cap, it may be refilled.

Measured-service Meter for Telephones.

Measured-service meters for telephones have at last passed beyond the experimental stage, it is confidently asserted, and many are now in actual use.

FIG. 1. MEASURED-SERVICE METER FOR TELEPHONES.—SUBSCRIBER'S APPARATUS.

Fig. 1 is an illustration of a meter manufactured by the Measured Service Company of Chicago. A permanent record is made of each call, the meter being operated by the patron himself, and leaving no possibility of dispute by him. The counter cannot be "beaten," it is said, the buzzer signal being given to the operator after the meter record has been made. Statements can be obtained in the central office over the wire at any time desired of the total number of calls used for a given period, thus allowing the company to give patrons credit, rendering them statements each month or quarter for the actual service rendered.

A brief explanation of the working of the device is as follows: A small instrument (Fig. 1) is placed at the subscriber's station. When a connection is made the calling subscriber pulls a lever, which throws a buzz over the wire, notifying the operator that he has registered. This call is shown on the face of the meter. At the end of a certain period when it is required to take statements the record-taker or central-office machine is placed in connection with the subscriber's device and the subscriber is called and asked to turn a crank. This operation takes a statement on a tape by Morse code at the central office of the number of calls made since the last reading. The system has the advantage of allowing the subscriber to know how many calls he is making and does away with the detail of keeping track of the calls at the central office, and is at the same time completely under the control of the telephone company. Fig. 2 is a complete diagram of connections for a central-energy system.

The machines are strongly made, accurate and durable. Their maintenance cost is practically nothing, and attachment is made without any extra wiring. One portable statement-taker will do the work for an entire exchange. The plan is applicable to both local and common-battery systems and party lines.

Protector Litigation.

The position of the American Electric Fuse Company in relation to protector litigation is set forth in the following statement, made by that company:

"The United States Patent Office recently made a decision involving the rights and claims of William Kaisling and Frank B. Cook, relating to self-soldering heat coils. The American Electric Fuse Company of Chicago is the exclusive licensee under all the Kaisling patents, and it is the American Electric Fuse Company protector which is involved.

"William Kaisling made application for a patent on what is known as the Kaisling self-soldering protector. Frank B. Cook asked that an interference be declared between Kaisling and the Cook patents. This was done by the Patent Office, and Kaisling moved to have the interference dissolved, the principal contention being that no interference in fact existed.

"After a preliminary and final hearing, in which both parties were represented by their attorneys, and after full hearing had been had of the evidence, the Patent Office, on August 12, 1904, rendered the final decision in the following language, sustaining Kaisling's claim of no interference with Cook:

" 'Motion was brought by Kaisling to dissolve the above entitled interference on the ground that no interference in fact exists, and because Cook has no right to make the claim forming the issue. Some time thereafter Cook filed exactly the same motion. No attention can be paid to Cook's motion, for the reason that it was not filed in due time, as provided by Rule 122.

" 'It is thought that there is no interference in fact between the two parties on the subject-matter defined in the issue. Kaisling does not show any means for restoring the parts to normal position after the solder has been softened. In Kaisling's device the parts are set in a different position after the solder has been melted, so that the fuse may be removed and turned around and inserted in such a position that it will again operate on an excess of current. The word "restoring" can only mean to bring the parts back to their original position. In Cook's device this is done. The interference is therefore dissolved on this ground.

" 'The motion to dissolve on the ground that Cook has no right to make the claim of the issue is denied. The issue reads directly on Cook's device, whereas it does not read on Kaisling's device.'

"The limit of appeal expired on September 1st, and the decision is therefore final, and bars Frank B. Cook from any future claim upon the Kaisling protector. The decision, it should be noted, rests upon the ground that no interference in fact exists, this being the broadest ground upon which a patent case can be decided. The wording of the decision indicates the breadth of the Kaisling patents, and the American Electric Fuse Company states that suits will be instituted against all present and future infringers.

"The Kaisling protector, by the terms of the decision, is absolutely free from the patent claims of Frank B. Cook or any other person. It is thus the only heat coil now being manufactured which is not in litigation."

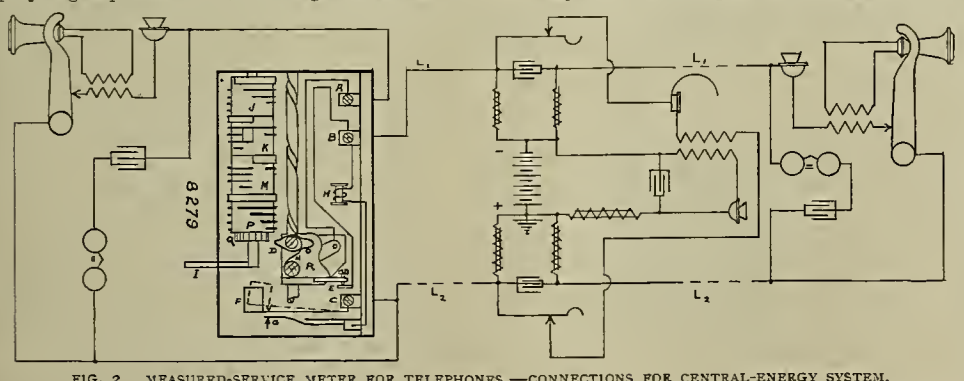


FIG. 2. MEASURED-SERVICE METER FOR TELEPHONES.—CONNECTIONS FOR CENTRAL-ENERGY SYSTEM.

Marconi Talks About Space Telegraphy.

William Marconi is quoted in the daily press as follows: "We should have our transatlantic service from Glace Bay, Nova Scotia, to Poldhu, England, operating on a commercial basis about the first of the new year. At the present time our instruments are installed on 60 ocean-going vessels, but of these only two have the long-distance instruments that operate up to 2,300 and 2,400 miles. The other long-distance sets of instruments will shortly be installed.

"So far we have paid little attention to the land service, although we are operating for the English navy department a service from England to Gibraltar, the messages passing over a greater part of Spain. Something may also be done with land service in Canada for the Dominion government. During the balance of this year our time will be quite fully occupied with improvements in our Glace Bay station, and not until we are perfectly sure of our ability to maintain this service effectively and continuously on a commercial scale will it be thrown open to the public."

Electrical Purification of Drinking Water.[1]

By John W. Langley.

This paper deals with the sanitary purification of water for domestic purposes.

Attempts to destroy bacteria by the direct action of electric charges did not result in any marked success. Milk was the fluid used, and static charges as high as 150,000 volts from condensers of one-seventh of a microfarad capacity were sent through 20 cubic centimeters in sterilized vessels, but the milk so treated soured only six hours later than a sample of the same milk not electrolyzed.

Substantially the same results followed the application of alternating currents of 500 volts having a frequency of 66 cycles for 10 minutes.

It has long been known that electricity has a lethal action on bacteria through the chemical changes produced by electrolysis. As long ago as 1892 work on the purification of sewage mixed with sea water was carried out on a commercial scale near Yonkers, N. Y. Here the chlorine produced from the salt in the water was the germicide, the electrodes being carbon and iron plates. This process has also been recently applied in England on a scale of nearly a million gallons a day, iron plates at both anode and cathode being used.

The most successful method of electrolysis for drinking water is by the use of aluminum plates as electrodes. A plant for this purpose is working commercially in Cleveland, Ohio. The electrolyzer is a rectangular iron box. The aluminum plates are held in grooves in a slate lining. The application of 20 amperes at 15 volts, or 300 watts, in the form of a continuous current, produces sufficient electrolysis to purify 500 gallons per hour of Lake Erie water. The water flows in a continuous stream from the city supply through the apparatus. The action is to produce aluminum hydroxide, which, as has been long known, combines chemically with the coloring matter and most of the organic matter, and mechanically entangles all solid particles, including bacteria and fungi. The water issuing from the electrolyzer is milky from suspended aluminum hydroxide and passes to a filter filled with crushed quartz, which arrests the solid matter. The effluent from the filter is colorless and of great brilliancy.

Chemical analyses show the albumenoid ammonia to be greatly reduced, usually upward of 75 per cent., and is brought down well within the limits specified by the Michigan State Board of Health, which calls for a greater degree of purification than generally called for by other states. The free ammonia is always increased, because of the electrolytic action changing a portion of the dangerous albumenoid ammonia (or of the nitrogenous matter which produces it) into the harmless free ammonia. The dissoloved oxygen is increased and the organic matter which reduces permanganate of potash is diminished about one-half. No important change is made in the chlorine, but the temporary hardness due to bicarbonate of calcium is almost completely removed.

The action on the bacteria is very satisfactory. These are reduced on the average 97 per cent., and several analyses have shown a reduction of over 99 per cent. Moreover, those which pass the filter are of the harmless water-bacteria type, for in no instance in six months of continuous commercial operation has a single colon bacillus been found, though the lake water generally contains them. This result has been substantiated by weekly and semi-weekly bacterial tests.

The electrolysis evolves much hydrogen and a smaller portion of oxygen than the two-to-one ratio due to the composition of water. As the apparatus is under the city pressure, these gases are partially dissolved, so that the purified water is more fully aerated than the original lake water, which adds greatly to its palatability and to its hygienic value.

1. A paper presented in Section H of the International Electrical Congress at St. Louis, September 13, 1904. The author is a professor in the Case School of Applied Science, Cleveland.

The Carbon Cell.[1]

By Prof. Dr. F. Haber and Dr. L. Bruner.

Among the various attempts to construct galvanic cells in which an electric current is produced by the consumption of carbon there is none that has been of greater interest than the experiment of Jacques, who proposed the cell consisting of the following:

Carbon—fused sodium hydrate—iron.

This cell has been the subject of experiments by numerous investigators, especially Mr. C. J. Reed in America and Messrs. Liebenow and Strasser in Germany. Experiments which we ourselves have conducted show that the true nature of this cell is different from what it was supposed to be.

Let us consider first the behavior of each of the electrodes separately. The iron electrode in the fused sodium hydrate is gradually covered with a protecting layer or skin of the oxide. As soon as this has been produced the iron is no longer attacked, while previously it went into solution in the fused salt as iron oxide, with the development of hydrogen gas. This protecting skin can be produced rapidly if the iron is dipped for a short time into fused saltpeter, and subsequently carefully freed from the saltpeter by means of water. The iron thus coated with this protecting skin is called "passive" because the fused sodium hydrate produces no further changes on it.

This passive iron represents an oxygen electrode on which the atmosphere oxygen acts similarly, but better, than on a platinized platinum electrode dipped into an aqueous conducting solution. This action of the oxygen is brought about by the presence of sodium manganate, which is always present in small quantities in fused commercial sodium hydrate, and especially when in contact with iron, and its presence can easily be proved chemically. Quite pure sodium hydrate, when fused and in contact with commercial iron, will contain some manganese, because a small quantity of manganese forms a normal part of commercial iron and gets into the fused salt when the iron is attacked by the sodium hydrate previously to the production of the passive state. By means of the atmospheric air it becomes a manganate.

The passive iron, as an unattackable electrode, can be replaced by another indifferent electrode, as, for instance, by platinum, and without changing the force and the method of action of the electrode in fused sodium hydrate containing manganese.

If platinum is placed into pure sodium hydrate the potential at the electrode is uncertain. A very small quantity of a manganate suffices to give rise to a different value, which does not change during a further addition of a manganate up to two per cent. of the weight of the sodium hydrate.

If the added sodium manganate is reduced by forcing in some hydrogen or carbon monoxide, or by the addition of sodium oxalate or sodium formate, quite an extraordinary change will take place in the potential. But by forcing in some atmospheric oxygen the original value of the potential is again reached.

In these experiments the potential of the platinum electrode is thus brought about by the absorption of oxygen. If a permanganate is added to fused sodium hydrate, oxygen will be evolved and the potential will, contrary to the other case, be brought about by the evolution of oxygen. These potentials are measured most simply by letting the syphon of a decinormal-electrode terminate in a small vessel containing concentrated sodium hydrate, which is in electric contact with the fused salt which is to be tested, by means of a rod of solid sodium hydrate. In all the measurements the fused salt was in a large silver crucible. The observed values are collected in the following table for different temperatures. The temperature was measured thermo-electrically:

Centigrade degrees.....	312	336	360	388	412	472	532
Potential in volts against decinormal-electrode...	—0.265	—9.294	—0.314	—0.333	—0.353	—0.431	—0.472

These values were measured with a platinum electrode, a small quantity of the manganate being added to the sodium hydrate. Numerous tests showed that absolutely equal values of the potential are obtained with an electrode of passive iron. An earlier opinion from other sources, namely, that the presence of certain steps in the oxidation of the iron in the fused salt is of importance in the behavior of this electrode, is not proved to be correct.

Let us no wconsider the carbon electrode.

When a carbon electrode is tested in the way above described for iron and platinum, all possible values can be observed between — 0.6 and — 1.5 volts toward the decinormal-electrode. With closer study one finds that the potential approaches the value — 1.5 volts more and more, the more rapidly the carbon is attacked in the fused sodium hydrate with the evolution of gas. This attack is less the denser and the more graphitic the carbon is. Electrodes which are treated by the process of the International Acheson Graphite Company, therefore, remain very far from this value, — 1.5 volts. Ordinary arc-light carbons on the other hand can generally be made to produce a free-gas evolution when the fused salt in which it is dipped is heated to above 500° C. They then reach quite or nearly the value — 1.5 volts and remain at this value when the fused salt in which they are dipped is cooled to the point of solidification. But as the accompanying evolution of gas gradually diminished at a lower temperature (about 350 degrees), the potential will simultaneously change; it will diminish to the value — 1.3 or — 1.2 volts, etc.

The gas which the carbon electrode evolves in the hot fused sodium hydrate is hydrogen gas.

If, instead of the carbon electrode, a platinum tube is dipped into the fused sodium hydrate and pure hydrogen gas is led through it into the liquid, one obtains with a strong current of gas the potential — 1.5 volts, and this will be the case at all temperatures between 500 degrees and the point of solidification of the fused salt. If the current of hydrogen gas is made weaker, the value — 1.5 volts will not be reached; the figures will be smaller. The potential of the carbon in the fused sodium hydrate is, according to this, not determined directly by the carbon, but by the hydrogen which the action of the carbon on the fused salts sets free. The temperature produces no effect on the potential within the given wide range, but the rapidity of the evolution of the hydrogen is of great importance.

Before we recognized this connection between the two we had held a different conception concerning the process at the carbon electrode. We supposed that a formic acid salt or an oxalic acid salt, or carbon monoxide were produced, and that these materials determined the potential at the carbon electrode. We, therefore, tested the action which an addition of the two named salts or of the introduction of carbon monoxide had on the fused salt, and on the behavior of the platinum electrode which is dipped into the fused salt. We found by chemical investigations that former statements in the literature were confirmed, according to which oxalates and formates in an excess of fused sodium hydrate, pass over freely into carbonate and hydrogen gas. Formates may be assumed to be a combination of carbon monoxide with sodium hydrate, and oxalates may be assumed to be a combination of carbon monoxide with an alkali carbonate. We assumed, therefore, that carbon monoxide with sodium hydrate could also produce hydrogen and sodium carbonate. We found this to be definitely proved to be a fact, when we led carbon monoxide through a silver spiral heated to 350 degrees, in which there was fused sodium hydrate. The following reaction is thereby obtained with great ease:

$$Co + 2\,NaOH = CO_2Na_2 + H_2.$$

It can be proved by means of thermodynamics that the oxalate, the formate and carbon monoxide, when they act as such on the electrode, should manifest their potentials, which exceed — 1.5 volts. Such potentials, however, were never observed. On the other hand it was found that all three materials as such were inactive at the electrode, and that it was only the hydrogen evolved by them which charged them and brought their potential more or less closer to the value — 1.5 volts, according to the rapidity of the release of the gas. According to these principles we are in a position to say that the so-called Jacques carbon cell is a hydrogen-oxygen chain, in which the oxygen of the air, by the intermediate action of the manganates at the iron electrode, acts with the hydrogen released by the carbon from the fused salt at the other electrode. The power of this element depends on the consistency of the carbon. If the latter is loose and capable of producing hydrogen gas evolution, one obtains those values which are found when one deducts — 1.5 volts from the above-mentioned values for the oxygen electrode. As, for instance, (— 0.265 + 1.5), that is, + 1.24 volts at 312° C., and (— 0.472 + 1.5), that is, + 1.03 volts at 532° C.

Thermo-electric phenomena take no part in the production of these electromotive actions. For these forces do not depend in the least on the materials iron and carbon, but only on the gases oxygen and hydrogen, and the same platinum tube shows alternately the force of the iron and the carbon electrode, if at constant temperature we pass through it oxygen and hydrogen respectively.

The element under discussion is without importance from the practical standpoint, because during its action the valuable carbon electrode and the equally expensive sodium hydrate are changed into cheap soda, only to obtain a little hydrogen which acts electromotively.

From the theoretical standpoint such a hydrogen-oxygen chain offers very much of importance. It is differentiated from the old well-known Grove hydrogen-oxygen chain, in that it is not liquid water, but a solution of water in fused sodium hydrate, which is produced by its action.

The relation which Helmholtz has proved for the connection between the electromotive force of reversible galvanic chains and the reaction heat of the process which produces the current enables us to calculate the heat of reaction in the present case. This is shown to be 81,650 gram calories per gram molecule of water produced. But as the formation of a gram molecule of water vapor at the range of temperatures of the experiment sets free approximately 58,650 gram calories, it follows that the evolution of heat which accompanies the absorption of a gram molecule of water vapor by a very large quantity of fused sodium hydrate has a value of approximately 23,000 gram calories. This high value arises from the fact that fused sodium hydrate holds the last traces of water with unusual tenacity, as has already been shown by others.

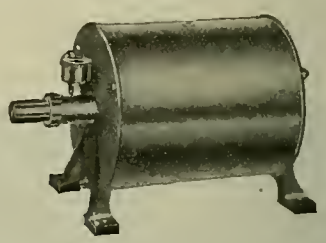
One can carry out the theoretical conception on the basis of the Helmholtz relation above given in still another way. One can, for instance, suppose at the start that an equilibrium exists between a fused salt containing water, and the vapor pressure of the water above it. In this way one arrives at the conception that the action of our chain depends on the change of the atmospheric oxygen, which has a pressure of 0.2 atmosphere, and the hydrogen which has an atmospheric pressure, into water vapor of a pressure corresponding to the state of equilibrium above the water containing the fused salt. When we integrate the above-mentioned differential equation of Helmholtz, and for comparison consider the known values of the force of the Grove gas chain, we can calculate the vapor pressure above the fused sodium hydrate at different temperatures. The carrying out of these theoretical calculations requires a more extended representation of the case, and this departs too far from the intention of this discussion to be embodied here. One can find it in an extended treatment of the subject which will appear in the German language in the Zeitschrift für Elektrochemie. The result of the calculation is that the vapor pressure above fused sodium hydrate at 300 degrees is extremely small and increases with increasing temperature. The fused mass is, therefore, especially hygroscopic near its point of solidification, and the force of the hydrogen-oxygen chain at this temperature is the highest. That the force of the Jacques carbon cell increases with the temperature is not in contradiction with this, but is explained according to our former statement by the fact that the evolution of hydrogen by the carbon increases in rapidity very quickly with increasing temperature.

1. A paper presented before Section C of the International Electrical Congress at St. Louis, September 23, 1904. The authors are connected with the Technical High School at Carlsruhe, Germany.

Induction Sparker for Gas Engines.

A type of "butt" or contact sparker has been introduced by the F. Bissell Company of Toledo, Ohio, known as the Security induction sparker, which embodies an induction generator furnishing alternating current for the production of the spark.

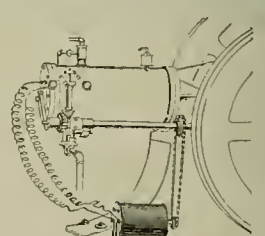
The device has no motor nor brushes, with their attendant troubles. The voltage is high, eight to 10



INDUCTION SPARKER INCLOSED IN PROTECTING CASE.

volts on slow speed and 15 on high speed. This is a small variation, considering the extreme fluctuations in engine speed. Fifteen volts will not burn the points. The output is 10 amperes, giving a very good spark and making ignition sure.

Strong and compact in construction, the machine



ONE METHOD OF MOUNTING INDUCTION SPARKER.

is easily attached directly to engine, floor, wall, ceiling or elsewhere. It is thoroughly enclosed and protected from dirt, oil and dust and will stand ordinary moisture. The wiring is direct from the sparker to the engine, using no coil, on account of the voltage being sufficient as generated by the sparker itself.

League of American Municipalities.

The eighth annual meeting of the League of American Municipalities was held in East St. Louis, Ill., on October 4th and 5th. During the two days the members discussed papers on many subjects pertaining to the government of cities. The management of the East St. Louis and Suburban Railway Company placed a number of trolley cars at the disposal of the delegates and their friends, who were taken over the entire interurban system. On October 6th the League met with other civic organizations in the Town Hall in the Model Street at the World's Fair grounds. After the address of President James N. Head of Nashville, a number of papers were read. A memorial session to the late Samuel M. Jones, mayor of Toledo, Ohio, was addressed by Allan A. Turner of Toledo, W. D. Morgan of Georgetown, S. C., and John MacVicar of Des Moines.

Whitney Hot-wire Measuring Instruments.

Attention is again being given to hot-wire instruments, which were at one time almost exclusively used for electrical measurements. The Whitney Electrical Instrument Company is now introducing a new line of these instruments, designed to eliminate the imperfections of the earlier types.

Fig. 1 is a diagram of the working parts. A wire (a b) of high resistance, low temperature coefficient and non-oxidizable metal is secured at one end to a plate (c), passed around a pulley (d) secured to a shaft (e), and its free end brought back again and mechanically, though not electrically, attached

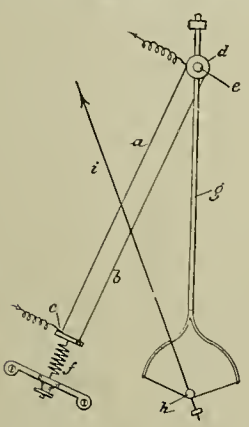


FIG 1. DIAGRAM OF HOT-WIRE MEASURING INSTRUMENT.

to the same plate (c). Plate (c) is kept under stress by the spring (f), which constantly tends to pull it in a direction at right angles with the axis of the shaft (e), and is so guided that it can be moved in that one direction only. To the shaft (e) is likewise secured an arm (g), bifurcated at one end and counterweighted at the other. Between the extremities of the bifurcated ends of the arm (g) is another shaft (h), on which there is a small pulley and to which is attached the needle (i) that gives the desired indications. A fine silk fiber is attached at one end to one of the arms of (g), then passes aroond the pulley and the shaft (h), and finally has its other extremity secured to the other arm. The arms are springy and serve to keep the silk fiber taut. The current to be measured flows through the wire (a) only, entering and leaving as indicated by

FIG. 2. PORTABLE HOT-WIRE VOLTMETER.

the arrows. Evidently, when (a) is heated by the passage of current, it expands, which, as (a) and (b) were originally under the same tension, makes the tension of (a) relatively less than that of (b), and equilibrium can be restored only when the pulley (d) rotates sufficiently to again equalize the strain. The rotation of (d), of course, carries (g) with it, and (g) in moving causes the silk fiber to rotate the shaft which carries the needle. If the temperature of the air surrounding the instrument changes, (a) and (b) are affected alike, and their resulting equal expansion simply results in a movement of the plate (c) back or forth in its path without any tendency to rotate the pulley.

The advantage of the above construction is, first, that the member which compensates for the expansion of the active wire, due to the temperature changes of the surrounding atmosphere, is not only of the same material as the expansion wire itself, but is actually a piece of the same wire, and hence has exactly the same mass and physical characteristics. Second, in former types of hot-wire instruments, the method of operation involved keeping the expansion wire under high stress by means of springs, this expedient taking up the slack in the wire as it expands. These springs are commonly applied to the axis that carries the indicating hand, and their tension is hence multiplied manyfold by the systems of levers, sagging wires or whatever expedient is adopted to magnify the motion of the wire from the few thonsandths of an inch that it elongates to the inches that the index must sweep over. In the Whitney instruments it will be noted that the only tension on the wire is that of the spring (f), which, in practice, is found to be only a small fraction of that necessitated hy the older construction. The less the wire is stressed, the less will naturally be the fatigue, and hence the less the error due to this cause. The Whitney company does not claim to have entirely eliminated fatigue by this modification, but repeated tests have so far failed to disclose an error due to that cause of over three-quarters of one per cent., and this error entirely disappears if, after being left in circuit for a few minutes, the current is temporarily disconnected, the instrument needle adjusted to zero by the simple means provided for that purpose, and current again turned on.

The objection of great liability to burn-out on relatively small overloads is met by the fact that the new instruments seem inherently more sensitive and are hence normally worked at a lower temperature. This margin of safety is such that it is stated that an overload sufficient to cause the indicating needle to swing over 120 degrees beyond the extreme normal limit of the scale when the cap is removed may be carried continuously without even affecting the calibration.

Zero adjustment used in this new line of apparatus is also novel. The conventional method of adjusting zero errors in hot-wire apparatus consists in varying the stress on the active wire by moving one of the abutmets to which the wire is attached—a procedure which is objectionable in that the wire is a member which should be tampered with as little as possible. In the new instruments the entire moving system, diagrammatically shown in Fig. 1, is mounted on a single hase plate that is free to rotate over a small angle around a heavy shaft secured to it immediately below and in line with shaft (h), around which the needle swings. By means of a lever secured to this base plate and projecting slightly beyond the cap that covers the mechanism the position of the needle relative to the scale may be altered at will without interfering with the wire in any way.

While already nearly dead-beat in its action, the instrument is provided with an auxiliary damping device, not shown in Fig. 1. This consists of an aluminum disk secured to the shaft to which the needle is attached and swinging between the jaws of a small permanent magnet.

The instruments are made in both portable and switchboard patterns of any range from three volts and 200 milliamperes upward. The ammeters are all worked on shunts which are contained inside of the instrument case in the small sizes and are separate in the large ones. An idea of the sensibility can be obtained from the statement that the ammeters work on shunts giving a drop of but 200 millivolts.

Machado & Roller of New York city, who are the general sales agents for Whitney electrical instruments, report that they have already received a gratifying number of inquiries and orders and that the commercial performance of the meters shipped has been satisfactory. An illustration of a portable voltmeter of this class is given in Fig. 2.

Stage Plug and Receptacle.

Stage lighting as it has been developed in recent years requires apparatus of special design and of the best construction. The accompanying illustration is of a stage plug and receptacle manufactured by the J. Lang Electric Company of Chicago, and it

STAGE PLUG AND RECEPTACLE.

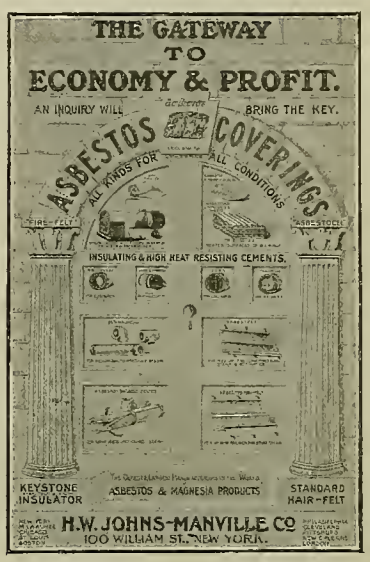
possesses the admirable property of being made entirely of fireproof material. It is substantially constructed and the wires may be attached and detached with ease. This plug has been passed by the National Board of Fire Underwriters, and the company holds forth as a further proof of its safety and reliability that it is recommended by the Department of Electricity of the city of Chicago as meeting with all the requirements of the city's revised ordinances.

Telegraph Lines in Mexico.

In his recent message to the Mexican Congress President Diaz says: "With regard to the telegraph lines, I have to inform you that the newly strung lines of the federal system aggregate 1,500 kilometers. Nine new offices have been opened, and a subterranean cable 1,500 meters long has been laid between the city of Campeche and the station of the Gulf subterranean cable. The system of communication by wireless telegraph between Cape Haro, state of Sonora, and Santa Rosalia, Lower California, has continued to be operated with fair success. The earnings of the federal telegraph lines, as compared with the previous fiscal year, have increased more than 10 per cent., and the service of drafts has been continued to be continually expanded to meet the public demands, so that now nearly one-half of the 435 offices of the system have been authorized to provide the service in question."

Unique Advertising Card.

The accompanying illustration is a good representation of one of the advertising display cards which are mailed upon application by the H. W. Johns-Manville Company of New York city, with the exception that the colors are lacking. The cards bear



UNIQUE ADVERTISING CARD.

the title "The Gateway to Profit." The one shown in the picture shows "Asbestos fire felt," "85 per cent. magnesia," "Asbestocel" and other pipe and boiler coverings in the actual colors of the goods. The other card represents "Kearsarge," "Moboline" and "Vulcabeston" and several other kinds of packing, also in colors. As intimated on the card, "an inquiry will bring the key" to this gateway.

BOOK TABLE.

MANUFACTURING COST. By H. L. C. Hall. Detroit, Mich.: The Book-keeper Publishing Company. 1904. Pp. (4¾ by 7⅛ inches) 191. Illustrated. Price, $3.

Never before in commercial practice has there been so great a demand for the application of system to the conduct of business. It is not enough nowadays that the accountant of a manufacturing concern shall be able at certain intervals to submit a bare statement of profit or loss, of sales and expenses. Details must be given which shall serve to show the manufacturer how to meet competition and get a fair return upon his investment. It is important that he should know the final cost of each unit of manufacture, and systematic methods alone may be relied upon to supply his need. Such methods it is the effort of the author of this book to describe and explain.

Chapters, or sections, as the divisions of the work are called, are devoted to organization; the relation between cost accounts and general accounts; loose-leaf and card systems of cost-accounting records; time record and pay-roll systems—in short, to whatever relates to the important matter of cost-finding. To all this Mr. Hall brings experience and conscientious effort, and it is to be doubted if much could have been added to his subject-matter to increase the usefulness of the book.

The writer's recognition of the limitations of his task will be appreciated by those readers who believe that hard-and-fast rules may not be set down for the guidance of those engaged in the production and selling of merchandise, nor for those whose work it is to keep a record of such transactions. It is often a matter for the exercise of shrewd judgment to apportion items of general expense equitably upon the cost sheet, particularly where the output of a factory is varied in character. In such work the carefully prepared forms and the methods suggested in Mr. Hall's book should be helpful.

Rotary Converters and Motor-generator Sets.[1]

By William C. L. Eglin.

In the distributing systems of the electric-supply companies in the United States the demand for low-tension direct-current service is usually of the first importance. The distribution is underground by means of three-wire network and fed from sub-stations located near the load centers, the sub-stations being connected by means of high-tension alternating-current feeders from the main generating station, which is located where the best facilities are available for economical operation. The sub-stations are usually provided with a storage battery, and in some cases with an auxiliary steam equipment, which is used in the event of emergency or for extraordinary loads during the winter months. In most cases, however, where auxiliary steam apparatus is used, it forms part of an old generating station which has been changed to a sub-station.

The percentage of the total load converted for direct current varies widely in different localities, and in the larger supply companies it varies from 30 per cent. to 100 per cent. Some of the leading companies also supply power to the sub-stations of street-railway companies, and others have a 500-volt power circuit, although most of the direct current is supplied on three-wire 230-volt systems.

In all cases the percentage of the total load converted from alternating current to direct current is large, so that an effective, reliable and efficient means of transforming alternating current to direct current is essential. The three methods available for this purpose are rotary converters, motor-generator sets and rectifiers, the first two only of which are available at present for transforming large currents.

Rotary Converters.

A rotary converter is similar to a direct-current generator, with taps made on the armature winding and the addition of collector rings so as to introduce alternating current. In a single-phase rotary converter these taps would be made 180 degrees apart; for two-phase, 90 degrees, and similar arrangements for multiphase systems. In most of the larger rotary converters using three-phase systems the phases are split so as to use six phases on the rotary converter, and in that way increase the capacity of the machine. The efficiency of the rotary converter is higher than the direct-current generator, for the reason that part of the current passes directly through the windings. The rotary converter must be operated in synchronism with the generator, and when started from the alternating-current side has all the characteristics of a synchronous motor. The rotary converter may be either shunt-wound or compound-wound. The voltage at the direct-current end of the shunt-wound type depends upon the voltage of the alternating current delivered to the collector rings, and practically cannot be varied without varying the alternating current impressed on it. Varying the field strength has the effect of changing the power factor, making the current either leading or lagging without materially changing the voltage delivered on the direct-current end. This necessitates some form of regulator on the alternating-current side so as to control the voltage on the direct-current end of the rotary. There are two methods, either the introduction of induction regulators in the alternating-current leads on each phase of the rotary, or dial switches on the stepdown transformers, which vary the ratio between the primary and secondary winding. The stepdown transformers are arranged so as to deliver the proper voltage for the electromotive force desired on the direct-current side of the rotary; and therefore a rotary-converter equipment consists of stepdown transformers, regulators and the rotary converter, with the necessary switches and safety devices.

Means must be provided for starting the rotary converter and bringing it to synchronous speed. The rotary may be started from either end, preferably from the direct-current side. When starting from the alternating-current side the current required exceeds the full-load current usually from 50 to 100 per cent.; and some means must be provided for controlling this large current; also the field must be cut out until synchronous speed is obtained.

When started from the direct-current side the machine is started similar to the direct-current motor with variable resistances in the armature circuit, which is gradually cut out as the machine accelerates in speed. The rotary is then synchronized with the alternating-current generator similar to the operation of paralleling two alternators. Starting arrangements may be common for a number of rotaries, and this is arranged for by switches on the switchboard.

A third method which has been used on large rotary converters is the starting motor, using an alternating-current motor of the induction type to bring the machine up to synchronous speed. When only one rotary converter is in use and direct current is not available for starting, and the rotary is therefore started from the alternating-current side, care must be exercised to test the polarity, as it is very probable it may be reversed. This can usually be rectified by opening the switch on the alternating-current side, allowing the machine to slip a pole.

The rotary converter meets all of the commercial conditions demanded of it, and is capable of delivering current on the direct-current side from 110 to 600 volts. It can be operated on varying frequencies from 25 to 60 cycles successfully. Rotary converters operate better at the low frequencies for reasons which will be discussed later.

In the early introduction of rotary converters difficulties were met which were principally due to hunting, usually caused by variations in the angular velocity of the generator. This caused a swing action of the revolving part of the rotary converter, which generally increased unless some means were provided to dampen this effect. The effect of hunting causes excessive sparking of the brushes, and when hunting becomes excessive the machine will flash over at the commutator and short-circuit the direct-current side of the machine; and unless safety devices are provided the machine is liable to be destroyed. The difficulty of hunting has been overcome by the addition of bridges between the poles of the machine. The design of these bridges was capable of being varied so as to increase the dampening effect required. The first form was a copper bridge placed between the poles, but it was found that additional dampening effect was required. The poles were then undercut and copper bridges were extended under the pole tips. The most powerful form consisted of a copper bridge imbedded in the pole face. The addition of bridges usually reduced the efficiency of the machine; rarely, however, exceeding one to 1½ per cent. The proper remedy for hunting is naturally the removing of the cause by obtaining a uniform rotation of the generator, which can be accomplished by the combination of an effective governor and the necessary flywheel effect on the engine. Hunting does not seem to take place when the generators are driven by either steam or water turbines. A number of rotary converters have failed, owing to the killing of the field, due either to the circuit being open or to the effect upon the field caused by disturbances on the alternating-current side, thus allowing the machine to exceed its normal speed, or, in other words, run away. These failures have required the installation of auxiliary apparatus and of safety devices, which are usually installed as follows:

A circuit-breaker on the direct-current side is arranged to trip with excessive overload, which cuts out the rotary in the event of it flashing over at the commutator, and speed-limiting devices trip the circuit-breakers on the alternating-current and direct-current sides. In some cases the alternating-current side of the rotary is provided with an overload and reverse-current circuit-breaker which trips when the current is reversed; or, in other words, when the rotary is running inverted, supplying alternating current to the line and taking direct current from the sub-station.

There are a number of different forms of speed-limiting devices, both electrical and mechanical. One form of electrical device consists of a differential relay, one set of coils being connected to the alternating-current bus and the other set to the collector rings. In the event of the rotary exceeding its speed, the frequency at the collector rings will increase, causing an unbalance at the relay and tripping the circuit-breakers. The mechanical devices usually consist of some governor attachments which make contact in the event of the shaft running above its normal speed and tripping the circuit-breakers. Various arrangements of the field wiring so as to allow combination separate and self-exciting connections have been tried so as to prevent errors on the part of the operators.

The study of the rotary converter from an operating standpoint early indicated that the machine had a high inherent efficiency; that the voltage and load could be easily regulated and the power factor adjusted to suit the best operative conditions of the system, and that the first cost of the outfit was comparatively low. For these reasons it was extensively used, especially for frequencies of 25 cycles.

Motor-generator Sets.

Before the rotary converter had been fully developed a number of these machines were installed on systems with frequencies of 60 cycles; and at this frequency the difficulties due to hunting were greatly increased, and in some cases satisfactory operation could not be obtained. This led to the introduction of the motor-generator sets. The first motor-generator sets were installed so as to obtain the most reliable equipment irrespective of the cost or efficiency. These equipments consisted of a low-voltage multiphase induction motor, direct connected to either one or two direct-current generators mounted upon a common base. The motors were arranged with stationary coils and squirrel-cage winding on the rotor, and they were similar in most respects to the small motors which have been used successfully for a variety of purposes. The generators were of standard design and the motors were built to suit the speed of the generator; the motor being supplied with low-voltage current from stepdown transformers. On account of using induction-type motors the difficulties due to hunting were removed, and the operation in the sub-station was further simplified by having no electrical communication between the direct and alternating-current sides, thus removing the dangers of the machine running away.

The motor-generator sets can be started either from the direct or alternating-current side by using the generator as a motor and placing a variable resistance in the armature circuit similar to the method used in starting the rotary converter. When the set is started from the alternating-current side some current-limiting device is introduced in the alternating current leading to the motor. It has been found of advantage in practice to synchronize the larger motor-generator sets so as to prevent any sudden rush of current when throwing the motors on the system. As the usual methods of synchronizing are not suitable for this purpose, a disk with white and black stripes it attached to the shaft and with an arc lamp connected to the alternating-current bus, the set can be readily synchronized and at synchronous speed the black and white stripes are readily visible. By the attachment of mirrors to the pillow blocks of the various motors, each set can readily be synchronized by the switchboard attendant. Bringing the machine to synchronous speeds is not essential, although it is recommended for the larger size units; that is to say, machines of 400 kilowatts or larger. It has been found advantageous to start both generators and rotary converters from the direct-current side with a starting bar operated by hand, thus reducing the amount of current required to overcome the friction of rest about one-half. This is often important when the sub-station is heavily loaded and the current is drawn from it to start additional machines. It also reduces the size of the starting resistance. For example, 400-kilowatt motor-generator sets or rotary converters may require from 400 to 600 amperes to start them from rest, providing the machines have been standing for some time, and thus allowed the oil to squeeze out between the bearing and the shaft. With the assistance of the starting bar this current can be cut down to 200, and not exceeding 250 amperes at 230 volts.

The operation of these motor-generator sets was all that could be expected of them and was satisfactory in all respects; but, on account of their inefficiency and high first cost, improvements were demanded.

A very rational step was the abolishment of stepdown transformers and the substitution of a high-tension winding for the low tension on the motors; the introduction of one 250 to 300-volt generator instead of two 125 to 150-volt generators, and, in some cases, the substitution of a synchronous motor for an induction motor.

The use of the high-tension winding on the motor removed the necessity for and cost of the stepdown transformers, and more than compensated for the additional floor space required by the motor-generator set. Regulators on the alternating-current side were unnecessary—the voltage on the direct-current generators being readily controlled by a rheostat on the shunt field—and the operation was simplified, allowing the equipment to be handled by the regular class of dynamo operators, this being of great importance in large systems, as it requires less time to train the operators. Disturbances on the alternating-current side of the system have little effect on the motor-generator sets and are of such a character that they are easily provided for by protecting devices.

The objection to motor generators, especially those of induction type, is the low power factor, which increases the losses in the feeders. The losses in the feeders are usually a small part of the total loss, so that this in many cases is not important.

The first cost of motor-generator sets is usually somewhat higher than of rotary converters, particularly in the large sizes. The actual difference, however, is not so great as generally supposed. The relative costs of the various sizes are shown in the following table:

Comparative Table of Costs.

Capacity.	Rotaries with Transformers and Regs. 25 Cyc.	60 Cyc.	25 Cyc. Synch. Mt. Gen.	25 Cyc. Ind. Mt. Gen.	60 Cyc. Synch. Mt. Gen.	60 Cyc. Ind. Mt. Gen.
1,000 Kw....	1.00	1.05	1.05	1.10	1.03	1.08
500 Kw....	1.00	1.00	1.05	1.05	1.00	1.00
250 to 300 Kw.	1.00	.95	1.00	.95	.95	.95

This is based on quotations by the same manufacturer of rotary converters and motor-generator sets of 25 and 60 cycles, with a 25-cycle rotary converter with transformers and regulators as a unit.

The following table shows the efficiency of a 400-kilowatt 60-cycle rotary converter and a 400-kilowatt 60-cycle motor-generator set with both high and low-voltage motors. These tests were made at the works of the manufacturers and show that even at high frequencies the rotary converter is more efficient than the motor-generator set:

Comparative Efficiency.

2-phase, 16 poles, 400 KW., 450 revs., 230 to 300 volts rotary.
2-phase, 60 cycles, 5,000 volts primary, 210 to 160 volts secondary, static transformer.

Per cent. Load.	Combined Efficiency. At 210 volts.	At 160 volts.
100	89.6	90.5
75	88.0	88.9
50	84.3	85.5
25	73.0	75.3

Motor generator set:
D. C. 10 poles, 400 KW., 450 revs., 125 to 150 volts.
A. C. 16 poles, 560 KW., 450 revs., 380 volts.

Per cent. load.	Combined efficiency at 150 volts.
100	82.0

Motor generator set:
D. C. 10 poles, 400 KW., 450 revs., 230 to 300 volts.
A. C. 16 poles, 560 KW., 450 revs., 220 volts.

Per cent. load.	Combined efficiency at 300 volts.
100	84.9

Motor generator set:
D. C. 10 poles, 400 KW., 450 revs., 230 to 300 volts.
A. C. 16 poles, 560 KW., 450 revs., 5,500 volts.

Per cent. load.	Combined efficiency at 300 volts.
100	86.9

After these machines were installed in the sub-

1. A paper presented before Section E at the International Electrical Congress at St. Louis, September 12, 1904. Mr. Eglin is an engineer of the Philadelphia Electric Company.

stations a series of tests were made, using the same observers and the same instruments (the instruments which were checked between tests), so as to obtain the all-day efficiencies when operating under commercial conditions; the rotary converters being placed in one sub-station and the motor generators in another, but both supplied from the same generating station. It would appear from these tests there is no practical difference in the commercial efficiency between the high-voltage motor-generator set and the rotary converter, and, as was to be expected, the low-voltage motor-generator set was the most inefficient.

ALL-DAY EFFICIENCIES UNDER COMMERCIAL CONDITIONS.

	Type of machine.	Load.	H.P.	Eff.	—Power Factor— A.Ph.	C.Ph.	Av.
	Ind. Motor	Empty	0	0.0	0.0	48.9	23.0
	Quarter phase ..	¼	140	72.9	67.1	86.4	76.7
No. 1.	H. P., 560.....	½	280	82.1	83.6	92.8	88.2
	Volts, 220	¾	420	85.3	86.4	90.4	88.4
	Amp., 1,150	Full ld.	560	85.4	88.7	92.1	90.4
	Ind. Motor	Empty	0	0.0	3.9	29.1	16.5
	Quarter phase ..	¼	140	72.7	56.9	69.7	63.3
No. 2.	H. P., 560	½	280	81.2	77.4	82.5	80.0
	Volts, 6,000	¾	420	84.7	82.5	86.2	84.3
	Amp., 47	Full ld.	560	85.9	85.6	88.9	87.3
	Rotary	¼	134	70.9	99.2	106.0	102.6
No. 3.	Quarter phase ..	½	268	77.2	100.5	105.1	102.8
	K. W., 400 ...	¾	402	80.4	97.4	102.4	99.9
	Volts, 250	Full ld.	536	84.1	97.6	98.0	97.8

CONCLUSIONS.

The type of machine to be installed in sub-stations depends principally upon the frequency of the system and the importance of reliable and continuous service. The frequency to be used depends upon other conditions which are outside the scope of this paper.

In cases where the largest percentage of the output of the generating station is to be transformed to low-tension, direct-current, 25-cycle rotary converters should be installed on account of their higher efficiency and lower first cost. The very large number of these machines which are now in successful operation proves conclusively their reliability and effectiveness. In mixed systems, and where the percentage of current transformed for low-tension distribution is small, motor generators are desirable. With higher frequency, particularly 60 cycles, it has been shown that motor generators compare favorably in efficiency and are much more reliable and simple in their operation.

Work of the Reichsanstalt in 1903.

An interesting account of electrical work done by the Physikalisch-Technischen Reichsanstalt of Charlottenburg, Germany, during 1903, is given in a recent issue of the Elektrotechnische Zeitschrift. During the period referred to a large number of tests were made on alternating and direct-current voltmeters, current meters, wattmeters, electricity meters, etc. Direct and alternating-current motors and transformers were also tested. Various materials, including oils, varnish, porcelain insulators and tubes, wires and cables, were subjected to tests. Of 107 Clark cells 36 deviated from the standard (German) voltage of 1.4328 by amounts varying between nothing and 0.0004 volt; 48 showed variations between 0.0004 and 0.0007 volt; 13 between 0.0007 and 0.0010 volt, while in five cases the errors were more than 0.0010 volt. A large number of metals used in the construction of electric machinery were tested as to their magnetic properties. Several firms have now succeeded, it appears, in producing iron with excellent magnetic properties, but having at the same time a comparatively high electrical resistance (0.5 ohm for a rod one meter long and a section of one square millimeter); such iron would have, of course, relatively small eddy-current losses. It was also observed that a sample having a maximum permeability need not necessarily show a high permeability at the foot of the permeability curve. Photometric tests of various kinds of lamps and accessories were carried out. The lowest consumption per mean spherical candlepower (German unit) among the arc lamps with colored arcs was found to be 0.37 watt. Osmium lamps were tested at 38 volts and showed very economical figures, which, moreover, varied but little with time. In June the lighting commission which was formed at the time of the Paris Exhibition held a meeting at Zurich, and the most interesting subject with which this commission occupied itself was the fixing of the relative values of the light units employed in various countries. Although investigations with regard to this subject are still going on, it was decided to fix the relative values temporarily as follows: One Carcel lamp = 10.9 Hefner candles; one 10-candlepower pentane lamp = 11.4 Hefner candles.

Telephoning "Want Ads."

The most recent improvement to the system early installed by the Chicago Daily News for telephoning want ads in to the paper from dozens of remote branch offices about the city is credited to the evening Journal of Wilmington, Del., some weeks ago, which has utilized the coin telephones in that city. Persons wishing to place a "want ad" in the Journal simply call telephone 33 and drop a quarter into the slot, telephoning their copy and also paying for the "ad" in advance. As many as 1,000 want ads have been telephoned to the Chicago Daily News in one day. Five hundred branch offices receive the ads and 10 telephones are used at the office of the paper to take them.

CORRESPONDENCE.

Great Britain.

London, October 1.—Ever since Mr. Yerkes came to England and took in hand the electrification of the Metropolitan District Railway and the various tube railways in connection therewith, it has always been the avowed intention of placing all orders for the necessary materials in the hands of English manufacturers. Up to the present this has been done without difficulty, but the somewhat startling announcement was made a few days ago that an order for 100 steel motor cars and carriages for the Baker Street and Waterloo tube railway had had to be placed in America, owing to British makers being unable to accept the contract through lack of plant. Who the firms were who refused the contract has not come to light, but although the daily papers accept the explanation, it is only natural that engineers and the technical press are distinctly sceptical as to the accuracy of the statement. Both by the technical and daily press, however, a request has been made for an explanation by those makers who apparently refused the contract, but so far this has not been forthcoming. The above explanation was given by Mr. Chapman (formerly of Chicago), Mr. Yerkes' engineer, to a representative of an evening paper, but a fuller one is awaited with interest.

The announcement made a short time ago that the Huddersfield corporation had devised a truck for hauling coal upon the municipal trolley-tramway system has revealed other instances here of the carriage of goods and minerals by means of specially designed trucks with the trolley attachment. Thus coal is delivered by a similar means upon the large systems of electric tramways roundabout Birmingham, and upon the Liverpool corporation tramways salt is carted from the docks in trucks designed in a similar manner. A large number of corporations and companies have parliamentary powers to undertake such work, but the instances in which they have been put to practical use are very few indeed. The difficulty appears to have been in designing a suitable frame to take the electrical equipment and at the same time to allow of sufficient loading and unloading facilities. But this appears to be capable of being overcome, and a considerable development of this class of traffic in large commercial centers is looked for. Already on many tramway systems an extensive business is done in the carrying of small parcels.

The instances in which the National Telephone Company and local authorities have come to loggerheads are not infrequent. At Swansea a difficulty of another kind to the usual bone of contention, viz., the placing of the company's wires underground, has arisen. The two parties in this instance cannot agree as to the terms upon which intercommunication between their respective systems shall take place. The Swansea corporation has an exchange in operation under a lincense by the postmaster-general. One of the terms under which these licenses are granted is that the company's license in the same district shall be extended so as to expire simultaneously with the municipal license, and in return for this concession intercommunication between the two systems is stipulated. According to the corporation, the company has acted in an unreasonable spirit, and proceedings are to be taken in the courts to enforce the terms of the license.

Many references have been made recently to the extra vigilance now being displayed by public departments in regard to municipal trading in this country. Another instance worthy of record is the activity at present being displayed by the Board of Trade with regard to the large number of old electric-lighting provisional orders which have been lying dormant for several years. In these days of large power companies many small local authorities which own orders which are very old, when questioned as to the likelihood of their order being put into force, seek refuge in the excuse that they are waiting for such and such a power company to commence supplying. In many instances this is accepted as a valid excuse, but in other cases inquiries on the spot have induced the Board of Trade to revoke the orders, several having been served in this manner during the last few months. This is as it should be, for it has been the custom in the past for local authorities of small size to hold electric-lighting powers without any idea of putting them into force, but simply in order to prevent a company coming into their districts.

The second system of surface-contact tramways in Great Britain is now in course of construction at Lincoln, the particular surface-contact system being the "G. B.," which has already been described in the Western Electrician. The lines are at present horse tramways and are being reconstructed. It is to be hoped that the progress of the scheme will be accompanied with less discussion and inconsistency than was the case at Wolverhampton, although, as a matter of fact, the Lorain company seems to have scored a victory here, inasmuch as all the horse lines have been reconstructed and are working apparently quite satisfactorily. The electrical engineer to the Wolverhampton corporation is enthusiastic in the cause, and at the convention of municipal electrical engineers this year, he stoutly defended it.

The Northeastern Railway Company is now having trial runs of the electric locomotives which it is proposed to employ for goods traffic upon a portion of its electrified lines in the Newcastle district. These locomotives are equipped with both overhead trolley and a shoe for third-rail working. During a trial this week a load of 390 tons was hauled. G.

New York.

New York City, October 8.—Vice-president Edward P. Bryan of the Interborough company entertained a large number of newspaper men on Monday, giving them a record-breaking trip through the new subway. The journey of eight miles from City Hall (Brooklyn Bridge) to One-hundred-and-forty-fifth Street was made in exactly 17 minutes. On Thursday a number of prominent railroad men were taken on a similar trip and the time for the distance was 50 seconds less. Harlem was reached in less than 11 minutes.

General Manager Hedley of the Interborough Rapid Transit Company announces that as soon as the platforms on the Third Avenue elevated line can be lengthened seven-car trains will be run. It is admitted that the present passenger accommodation on this line is at least 30 per cent. less than the requirements, and that even if the opening of the subway decreases the traffic by 20 per cent. the present six-car trains would still be overcrowded.

President August Belmont of the Interborough Rapid Transit Company has appointed Charles A. Gardiner as general attorney for the company. Mr. Gardiner already holds a similar position with the Manhattan Railway Company.

There are indications that when the Pennsylvania railroad develops its Long Island railroad property much importance will attach to Jamaica and Mineola, now comparatively unimportant traffic centers. Jamaica is likely to become an important car yard, the Pennsylvania railroad having recently purchased a section of 100 acres there; while Mineola, which is to be the locale of a new race track, is destined to be connected with Long Island City, and subsequently by tunnel with Manhattan by means of a four-track electric way. Electric trains and motor cars will probably be running to Mineola some time next year, and it is estimated that the tunnel under the East River will be completed by January 1, 1907.

The New York and Long Island Traction Company, which has already nearly 40 miles of trolley lines in Nassau County, L. I., commenced on Thursday the construction of an extension line into New York city. This line will come into the borough of Brooklyn through Woodhaven, and will ultimately connect with the Kings County elevated railroad.

Staten Island has a new electric-lighting company, with headquarters at Tottenville, which was incorporated this week to operate in all parts of Richmond County. The capital is $25,000. The men behind the concern are W. E. Cook, W. H. Gahagan and J. F. McCarthy of Brooklyn.

A corporation in which A. A. King, Henry Heilwig and Charles Busch are interested has the title of the American Non-metallic Storage Battery. Headquarters are in New York city, and the authorized capital is given at $25,000.

The newly incorporated Edmonstone Company of New York city will manufacture telephones and similar appliances. The capital of the concern is $100,000, and the directors of record are Bouton Thompson, D. M. Miers and J. E. Ruston.

The Hoosick Falls (N. Y.) Generating Company, to work a gas and electric-power plant, has been incorporated by E. R. Case of New York city and associates. The capital of the concern is $25,000.

The New York and New Jersey Telephone Company has been busy of late in making extensions in various towns and villages on Long Island. At the Patchougue exchange a new switchboard is to be installed, and in connection with calls through this exchange many toll rates have been increased. In return for the increased cost five minutes are now allowed for a conversation as against three minutes hitherto.

A large number of Brooklyn telegraphers banded together as members of the Onnolee lodge of the Order of the Iroquois, foregathered last week for a social evening. Vice-president Brannin was the chief speaker. D. W. W.

New England.

Boston, October 8.—The Edison Electric Illuminating Company of Boston is negotiating with the city of Newton for rights of location in that municipality, and has signified its willingness to pay a stipulated sum for the privileges sought.

At a hearing held recently by the Massachusetts railroad commissioners the Haverhill and Boxford Electric Railway Company's project for a new line from Haverhill to Boston was strongly opposed by the Boston and Northern Electric Railway Company and by counsel for the Boston and Maine railroad, both of which will be paralleled by the new route to a large extent.

Cambridge residents who object to an elevated railway from Boston to their city have been holding meetings lately to discuss the subject, and a subway is advocated by them instead of the overhead structure, which was authorized by the state Legislature, and will be built to Harvard Square before many months unless the grant is amended. The hitch comes in the fact that the "elevated" franchise is unlimited, whereas the advocates of a subway pro-

pose governmental ownership and a short lease to the railway corporation.

The Middletown Street Railway Company was sold on October 1st to the Consolidated Railway Company at the rate of $15 per share, the transfer of stock to take place October 20th. By this purchase the Consolidated company materially strengthens its position in Connecticut transportation affairs, and the project of another trolley route, with through service from New York to Boston, via Hartford, New Haven, Middletown and other important Connecticut cities seems to be pretty effectually blocked for the present, with the situation so broadly controlled by the New York, New Haven and Hartford and its Consolidated auxiliary.

Advices from New Haven, Conn., were received in Boston this week to the effect that the De Forest Wireless Telegraph Company, which intends to operate between New York, New Haven and Boston, began last Monday the erection of a station in New Haven on Hallock Avenue. B.

Texas and Mexico.

Austin, Tex., October 6.—Business men of Bryan and College, Texas, have taken hold of the project of building an electric railway between the two towns. The state agricultural and mechanical college is situated at College, and it is thought that the road would be a paying enterprise. W. E. Saunders, president of the Business League, can give information in regard to the project.

W. M. Waterman of Timpson, Texas, has purchased the local electric-light and power plant. He will move it to his lumber mill and will install additional machinery, with the view of enlarging and improving the service.

The Concho Water Power Company has completed the construction of a dam across the South Concho River, one mile south of the town of San Angelo, Texas, at a cost of $20,000, and is installing machinery at its power plant. This plant will furnish electrical energy to operate the San Angelo Electric Light Company's dynamo and the San Angelo waterworks pumping station.

The electric-light and power plant at Alvarado, Texas, has been sold by A. J. McQuatters to the Alvarado Water, Light and Power Company. The new owners will move the plant to the waterworks pumping station and make improvements.

W. F. Potter, representative of the syndicate of Chicago men who are promoting the building of an interurban electric railway from Dallas to McKinney, says that it has been determined to extend the line to Bonham. All preliminary arrangements for the construction of this road have been completed and the contract will soon be let. It will be about 100 miles long and will traverse the most populous section of the state.

Harold H. Miller, secretary of the Occidental Construction Company, has applied to the City Council of Mazatlan, Mexico, for a concession for the construction and operation of a system of electric street railway in that city. This company has taken preliminary steps toward building an electric railway between Mazatlan and the city of Culiacan, state of Sinaloa. Lewis Warfield is general manager of the company.

The American syndicate which recently purchased the two street-car lines in Monterey, Mexico, will take formal possession of the properties in a few days and will immediately begin the work of converting them into electric-traction lines. The syndicate will extend the merged system over many new streets and into the suburbs. It is also proposed to build a suburban resort which will be reached by one of the electric lines.

It is stated that the large electric power plant and transmission enterprise which is to be established in the state of Chihuahua, Mexico, will involve the expenditure of more than $1,000,000 gold. Under the terms of the concession, which has just been granted the promoters of the project by the Mexican government, all necessary machinery and construction material may be imported free of duty. The Conchos River Power Company has been organized to carry out the project. The John F. Kelly Engineering Company of New York is said to be interested in the enterprise. The proposed power plant will be established on the Conchos River, near the town of La Joya.

Rodrigo Rincon Gallardo is installing an electric-light and power plant on his hacienda, situated about two miles from Mixcoac, Mexico. The plant will operate manufacturing concerns, and a transmission line will be built to Mixcoac and light furnished to private consumers.

Samson Long has applied to the Mexican government for a concession to install a large electric power plant on the Amacusac River, near Jojutla, Mexico.

Many reforms are being made in the management of the Mexican Electric Tramway Company's lines in the City of Mexico. The entire system has been divided into four divisions, each of them being placed under the direction of a superintendent, who is held strictly responsible for the operation of cars on his division. The new plan went into effect on September 1st and is giving satisfaction. The surveys for the proposed extensions of the system into Atzcapotzalco and the Spanish cemetery have been completed and submitted to the Mexican government for approval, preparatory to the commencement of construction work. The company has also had plans made for new repair shops at Indianilla. It is also proposed to change the Banos line from animal to electric traction in the near future.

The electric street-railway line which runs to the Mexican Central railroad depot from the center of the city of Aguas Calientes, Mexico, has been formally inaugurated with appropriate ceremony.

The electric-light plant at Durango, Mexico, is to be greatly enlarged. New machinery will be installed and additional lights placed in the city streets.

M. D. Watson and J. R. Bickerdike of Chicago, Ill., have applied to the Mexican government for a concession to build and operate an electric railroad from the Santa Amarilla copper mines, owned by them, to the port of Navidad, Mexico. H.

Ohio.

Cleveland, October 8.—Statements have been made that the debts of the Miami and Erie Canal Transportation Company will shortly be provided for through the work of the committee appointed some time ago and the suit in court will be dismissed, as there will be no further contentions. The Cincinnati creditors, represented by Harry Probasco, seem to be more in line with the others than ever before, since it has been found that such a fight as they put up will result in little else than the expenses they incurred. The claims against the company are being settled at the best figure obtainable, and when they are all in the reorganization committee will go to work to get the company on its feet. The persons who are furnishing the money for payment of debts and for completing the canal line to Dayton will receive bonds that will bear interest after five years. It is believed that such an arrangement will put the company in position to do business on a paying basis.

The Northern Ohio Traction and Light Company had a car of horses from Akron to Cleveland this week. Owing to the novelty of the live-stock car on a traction road, considerable attention was attracted. However, the business was taken care of in a most satisfactory manner. Two years ago the Lake Shore electric shipped a car of horses over its line, but since then not much has been done in the live-stock line.

Surveys for the lines of the Sandusky Southwestern Railway Company have been completed, and the first installment of funds for its construction will be received shortly. A. Koons of Indianapolis has been awarded the contract for the construction of the system. The proposed lines connect Lima and Bellefontaine, Wapakoneta and Kenton, and Ada and Kenton. F. O. Oleson of Wapakoneta is the manager of the company and G. A. Smith of Kenton, secretary.

A franchise has been granted the Springfield, Washington Court House and Chillicothe traction line by the Village Council of South Charleston.

Opinion prevails that activity in traction interests will be resumed next year, with Cleveland, Columbus and other cities as a center. This may not mean roads built out of these cities, but managed by business men who reside in them. Ohio banks have disposed of a large amount of bonds to eastern houses in a quiet way, and are in excellent condition to look after other enterprises.

A trust deed for $2,000,000 has been filed with the Columbus Savings and Trust Company by the Columbus, Urbana and Western, to secure bonds, the proceeds to be used in completing the road.

The council of Norwood is working on another franchise ordinance for the Cincinnati and Columbus Traction Company, the mayor having vetoed the first one, because he considered it too broad in some of its provisions.

A plan has been decided upon for taking the Eastern Ohio Traction Company out of the hands of a receiver, it is said. An assessment of $15 per share on the stock will be made, and this will give about $375,000. This will be sufficient to pay the debts and give the company money for considerable improvement, of which it is badly in need. For the last few months the road has had a good business, although it now needs more cars than it has. The milk and package business has increased to a considerable extent. In a short time it will have a new entrance to Cleveland, and this will be a great advantage. Stockholders are signing the agreement to the assessment, and it is thought that the company will shortly be able to take possession of its property again.

The Wooley Electric Manufacturing Company of Lima has been incorporated with a capital stock of $200,000. L. G. Wooley, G. V. Guyton, J. E. Lowry, W. B. Jack and J. W. Hatfield are the incorporators.

A free hack service has been established at Troy by the Dayton and Troy and the Dayton, Troy and Piqua lines, to transfer patrons to their stations.

The United Electrical Manufacturing Company of Newburg has been incorporated with a capital stock of $50,000 by H. J. Robinson, J. L. Marlton, T. V. Conway, Eugene Quigley and others.

It is stated that the tracks of the Toledo Urban and Interurban Railway Company in Toledo will be completed by December, when the Toledo, Bowling Green and Southern will enter the city over its lines.

The directors of the Cincinnati Chamber of Commerce have decided to have an electric-light plant placed in the basement of their building for the special purpose of furnishing their own lights.

W. L. James, an attorney, has been appointed receiver of the Dayton and Kenton Railway Company.

Service has been inaugurated on the Ft. Wayne, Van Wert and Lima Traction line, between Lima and Delphos. The line may be opened as far as Van Wert this year.

The Phœnix Electric Company of Phœnix has been incorporated with a capital stock of $5,000 by W. A. Smith, G. C. Webster and others. O. M. C.

Michigan.

Detroit, October 8.—A. H. Stanley, superintendent of the New Jersey Street Railway Company, is visiting in Detroit. Mr. Stanley was formerly general superintendent of the Detroit United Railway Company, and he but recently left that system to take charge of the New Jersey company. He is of the opinion that the Detroit system is better equipped than the company he is now with, as it has no hilly country to contend with, but the company has the advantage of not being bothered with politics and newspapers.

The Detroit, Monroe and Toledo Short Line now announces that through-car service will commence between Detroit and Toledo on November 1st, running from the Russell House in this city to the central portion of Toledo. It is expected that the run will be made in about two hours.

The Saginaw-Bay City interurban electric line will inaugurate a freight business between the two valley cities. The company has obtained a franchise and will lease freight sheds in both cities. A few additional sidetracks will be put in to enable cars to be loaded without interference with passenger traffic. Mr. Thomas E. Evens has been made freight agent at Saginaw, and Charles Coyle at Bay City.

The new Battle Creek and Grand Rapids electric line proposes to put in a 30-minute service between Grand Rapids and Gull Lake, in opposition to the Michigan Traction Company's line, by which a change of road is necessary at Augusta.

The surveyors for the new Detroit, Lapeer, Pontiac and Northern electric line are surveying the road at Caro and are planning to have a natural-grade separation at the crossing of the Michigan Central railroad at Caro. The Michigan Central crosses a deep ravine near that city, and it is planned to have the new line utilize the ravine.

The Detroit United Railway Company is experimenting with the welding of steel rails with the new Goldschmidt thermit process. The thermit composition is mainly composed of finely ground chips of steel, wrought iron and aluminum, the latter in greatest proportion. An ordinary metal mold in two sections and fastened with two clamps is placed around the joint to be welded. Around this is thrown some loose earth to prevent the escape of any molten metal. A firepot resting on tripods is placed immediately above the mold and the composition placed in it and raised to a temperature of 4,300 degrees. Then it is run from the firepot into the mold, and within two minutes the rail ends are brought to a fusing point and are so welded as to constitute one continuous rail. The welding is simple, and the work is being done on the Grand River line without stopping the operation of the cars. C. G. W.

Southeastern States.

Charlotte, N. C., October 8.—The new water and electric-lighting plants at Greenville, N. C., will soon be under construction. For this purpose $65,000 worth of bonds were sold recently.

The Covington (Ga.) Chamber of Commerce has been fully organized and will endeavor to interest foreign capital in the development of the great water-powers in the southern part of Newton County, Ga.

W. A. Carlisle, chief engineer in charge of the Gainesville and Dahlonega (Ga.) electric railway, has resigned his work to take up construction work again. W. H. Slack of Marietta, Ohio, has assumed the duties of chief engineer and secretary of the company.

The erection of the new electric-light plant at Hartwell, Ga., has been started, its erection being in charge of Fred Nardin of Anderson, S. C.

The High Point (N. C.) Interurban electric railway has secured additional franchises allowing it to run its lines over the roads of Davidson County or from High Point to Thomasville or Lexington, N. C. A survey of the proposed lines must, however, be submitted to the county commissioners, by whom the franchise was granted. L.

Northwestern States.

Minneapolis, Minn., October 8.—Charles N. Rierdon has opened an establishment for the sale of electrical supplies at Stillwater, Minn.

F. D. Woodbury of Minneapolis and others are talking of building a trolley line from Hutchinson, Minn., to Lake Lillian.

It has been voted to build an electric-light plant at Kellogg, Iowa.

The new electric-light plant at Florence, Wis., has been completed.

A trolley line will be built from Racine, Wis., to Corliss.

The Westinghouse company is considering the advisability of building a branch plant at West Allis, a manufacturing suburb of Milwaukee, Wis.

C. D. Warren has been appointed receiver of the Michigan-Lake Superior Power Company, to succeed B. F. Fackenthal, of Philadelphia. The move is made with a view to straighten out the tangle, due to the collapse of the Consolidated Lake Superior

Company. All properties are being brought under one management, to decrease expenses and increase profits.

The new office building of the Menominee and Marinette Street Railway Company has been completed at Menominee, Mich.

The Great Northern Power Company announces that its plans for a power plant on the St. Louis River, near Duluth, Minn., are maturing and that the work of construction will be commenced shortly.

The Oshkosh Gas Light Company of Oshkosh, Wis., is contemplating the purchase of the Oshkosh Electric Light and Power Company's plant. The plant is estimated to be worth about $215,000. The light company has just installed a large steam turbine at its plant at a cost of $30,000.

A new engine and dynamo will be purchased for the electric-light plant at Princeton, Minn., and the capacity of the plant will be doubled.

It has been voted that the city establish a municipal electric-light plant at Waverly, Iowa.

The Interurban Railway Company has let the first contracts for grading on its proposed line from Des Moines to Adel, Iowa.

The Rhinelander (Wis.) Power Company has closed a conditional contract with the National Electric Company of Milwaukee for two 400-kilowatt generators and the accessory machinery.

An electric railway from Two Rivers, Wis., to Green Bay is assured, the Knox Construction Company building from Green Bay to Mishicot and the Higgins Company from the latter place to Two Rivers.

The Public Water Company has awarded the contract for installing an electric-light plant at Ottumwa, Iowa, to the Blackhawk Electric Company of Clinton, Iowa.

The annual meeting of the North Dakota Electrical Association was held October 4th and 5th at Fargo.

The Polar Star Electric Company of Faribault, Minn., will double the size of its capital and enlarge its light plant.

O. F. Forbes has resigned as manager of the Pipestone (Minn.) Electric Light, Heat and Power Company. R.

Pacific Slope.

San Francisco, October 6.—Messrs. Schocken and Weber of Sonoma, Cal., have decided to build an electric railway from the quarry near that place to deep water, at some point to be determined, about seven miles below town.

The transformer house at the junction of Castro and San Francisco Roads, belonging to the United Gas and Electric Company of San Mateo, was burned to the ground last week, and left the citizens of Mountain View without lights.

The Chico Railway Company has commenced the construction of an electric road at Chico, Cal. The work is being done under the direction of Engineer Simmon.

The franchises secured by John McQuade for an electric road in King and Snohomish Counties, Wash., have been transferred to the Seattle, Everett and Skaggit Electric Railway Company. The officers of the company are: President, W. H. Goldson; vice-president and treasurer, P. J. Farlow; secretary, Edwin S. Gill. The money for building the road has been raised and as soon as plans are completed the work will be rushed.

The Edison Electric Company will shortly install a new engine and boiler at the power house in Santa Barbara, Cal.

The county commissioners of Multnomah County, Oregon have granted a franchise to Seneca Smith, H. S. Stone, James G. Gill and others for the construction of an electric railway from Montavilla to Fairview and Troutdale, Ore. Work is to be commenced within a year, and the road is to be completed within 18 months from date.

C. J. Walker, E. B. Griffith, M. J. Shaul and others have formed a company for the purpose of supplying Oceanside, Cal., with light. A plant is to be erected at a cost of $25,000.

It is expected that a large electric plant will be constructed in the mountains below Oregon House, near Marysville, Yuba County, Cal., to furnish power for the dredges which are to be installed in the Yuba River above Marysville by the W. P. Hammon syndicate.

Arthur Gunn, president of the Wenatchee Electric Light Company, has been in Cashmere, Wash., recently, looking over the field with a view to constructing a line from Wenatchee to Cashmere. A canvass of the town will be made in the near future.

The North Mountain Power Company is working on the pole and wire line in Trinity County, Cal. Preparations are being made for the construction of the auxiliary transmitting station on the water front between X and Y Streets, Eureka, Cal. The Humboldt County Water and Power Company is also to construct an auxiliary plant, work to be commenced within a short time.

Dr. F. O. Rhoads, secretary of the Stanwood Chamber of Commerce, at Stanwood, Wash., has been in Bellingham, Wash., recently, in an endeavor to have an electric-lighting plant put in at Stanwood. The citizens of Florence, Cedarhome and Sylvana, all within five miles of Stanwood, are also seeking electrical facilities.

C. E. Cochran of Union, Ore., attorney for the Eastern Oregon Development Company, states that the crew of surveyors, under Arthur Brown, has completed the preliminary survey for the electric road for the entire route around the valley and to Elgin, and they have gone to the Minam River in the interest of a site for obtaining waterpower to generate the necessary electricity. Mr. Cochran states that the financing of the road is entirely satisfactory.

The Junction City Manufacturing Company has decided to light its plant at Junction City, Ore., with electricity, and will purchase a larger engine and dynamo and furnish light for the city, provided the citizens will subscribe for 300 lights at rates charged other towns.

It is the intention of the Humboldt Lumber Mill Company to install a new electric-light plant of 600 lights capacity at Korbel, Cal. The purchase of a new dynamo will be necessary.

The trustees of Alameda, Cal., have authorized the clerk of the board to advertise for bids for new machinery for the city light plant.

The two rival electric railways of Santa Cruz, Cal., the Santa Cruz and the Santa Cruz, Capitola and Watsonville electric lines, have been consolidated and will hereafter be operated by one company. W. R. Porter is president of the new company and F. S. Granger general manager. The capital stock is $750,000. The company intends to run a new branch line from Pacific Avenue to the Odd Fellows' Cemetery and the powder works. A.

PERSONAL.

H. B. Kirkland, general sales manager of the American Circular Loom Company, was in Chicago last week.

Myer S. Blumberg of Oberg & Blumberg, contracting electrical engineers of New York, was a recent visitor to Chicago.

Arthur S. Ives, C. E., of R. D. Wood & Co., Philadelphia, manufacturers of pumping machinery, spent a few days of last week in Chicago.

Charles B. Squier, a member of the firm of Manning & Squier, pioneers in the zinc business of America, died at his home, in Rahway, N. J., on October 6th.

J. R. Curtice of Cleveland has been made general superintendent of the Cleveland, Painesville and Ashtabula electric road, the office of general manager having been abolished. Mr. Curtice has gone to work to get the property into good shape before cold weather comes.

William H. Kelsey, an old telegrapher, and at one time superintendent of the Waukegan (Ill.) division of the Postal Telegraph-cable Company, died in Chicago on October 10th. Mr. Kelsey, who of late had resided in Waukegan, was a great traveler and helped to lay several of the ocean cables.

J. DeSmet Maguire has resigned his position as special representative of the National Electric Company of Milwaukee to assume the presidency of the American Electric and Controller Company of New York. Previously Mr. Maguire was assistant electrical engineer of the Metropolitan Street Railway Company of New York and president of the Magnet Wire Company.

Calvin Roulet, widely known as an enterprising salesman for the Osburn Flexible Conduit Company of New York city, has resigned his position to assume charge of the electrical department of the Texas Fire Prevention Association, with headquarters in the Scollard Building, at Dallas, Texas. Mr. Roulet assumed this new position on October 1st. He is eminently fitted for the place and will undoubtedly do himself credit.

The body of Postmaster-general Henry C. Payne was interred in Forest Home Cemetery, Milwaukee, on Sunday last, the casket being under an escort of 200 letter-carriers. It is estimated that 25,000 persons viewed the remains at the City Hall. Mr. John I. Beggs was one of the honorary pallbearers, the list also including Secretaries Morton, Metcalf and Wilson of Washington, D. C. Aside from a number of small annuities and bequests, Mr. Payne's estate, valued at $700,000, will be divided almost equally between his widow and sister.

Mr. Joseph Vater of Budapest, Hungary, chief manager of the Royal Hungarian Technical Office of Telegraphs and Telephones, remained in the United States some time after the International Electrical Congress, inspecting large telephone exchanges, with a view to gaining ideas to be put into his home system. Mr. Vater was in Chicago last week and was impressed with the two large systems here. He was shown through the larger exchanges of the Chicago Telephone Company by President Wheeler. Some of the telephone manufacturing plants were also visited, and, among others, the plant of the Western Electric Company was inspected.

Major-general Charles E. Webber of London died on September 23d, aged 66 years. He founded the old Society of Telegraph Engineers, now the Institution of Electrical Engineers, of which he was president in the year 1882. In May last the Council of the Institution paid him the honor of electing him to be an honorary member. He was a prominent member of Section G at the meeting of the British Association, which was held at Cambridge this year, and for part of the time, in the unavoidable absence of the Hon. C. A. Parsons, he presided over the proceedings. He was a juror of several electrical exhibitions between 1880 and 1890 and for some four or five years he was either managing or consulting engineer and director of the old Anglo-American Brush Electric Light Corporation. He was at one time chief engineer of the City of London Electric Lighting Company, and had been on the board of the Chelsea Electricity Supply Company almost from its commencement. The funeral service was attended by a considerable number of the late general's colleagues on the Council of the Institution of Electrical Engineers, among them being Alex. Siemens, Professor Ayrton, Dr. Swan, Dr. S. P. Thompson, Dr. Fleming, J. E. Kingsbury, W. M. Mordey, W. H. Patchell, F. Gill, S. Morse, Major O'Meara, R. E., and F. H. Webb.

ELECTRIC LIGHTING.

Spring Lake Village, Mich., has voted in favor of installing an electric-light plant.

An electric-light plant and system of waterworks is contemplated by the city of Monroe, Ga.

W. N. Horner, representing Chicago persons, has purchased the electric-light plant at Jefferson City, Mo.

The electric-light plant at Roswell, N. M., was flooded by a recent rise of water, and the machinery was badly damaged.

Bids are being invited by the city of Hartwell, Ga., for the equipment of the electric-light plant which the city will install.

About $10,000 is to be expended in the near future on the improvement and extension of the electric plant and system at Little Rock, Ark.

The Edison Electric Illuminating Company of Topeka, Kan., has asked for a 30-year franchise to do business in Topeka, as its old franchise will soon run out.

H. L. Millner of Morganton, N. C., has been granted a franchise for the construction of an electric-light plant and system of waterworks in Lancaster, S. C.

A resolution looking to immediate action in the construction of a municipal light plant at Covington, Ky., was voted down by the City Council a few evenings ago.

The town of Eupora in Webster County, Miss., is to have an electric-light system furnished by a private corporation. The improvement represents an investment of about $10,000.

The Borough Council of the city of Braddock, Pa., has made a new contract with the Allegheny County Light Company for 120 arc lights for five years at $75 each per year.

The Springfield (Ill.) Electric Light and Power Company will vote on October 17th on the matter of consolidating the Springfield Electric Light and Power Company with the Springfield Light, Heat and Power Company.

The Common Council of Marshall, Mich., at a special meeting gave the electric-light commissioners authority to install the machinery for a new system of alternating-current street arc light to replace the old lamps which have been in use since 1890.

H. M. Byllesby & Co., Chicago, have been appointed engineers and consulting managers of the Oshkosh Gas Light Company of Oshkosh, Wis. This company has purchased the plant of the Oshkosh Electric Light and Power Company, formerly owned by the United Electric Securities Company of Boston.

The question of municipal ownership of the public lighting service in Charlottetown, P. E. I., is now under consideration by the City Council. At a recent meeting the council authorized the clerk to call in the services of an electrical expert to investigate the local situation and report upon the possibilities of a municipal plant. The DeLano Osborn Engineering Company of Toronto and Montreal has been engaged to prepare plans and specifications and estimates of costs of a suitable plant. As soon as the report of the engineers is in the hands of the council action will be taken.

The Second Baptist Church in Philadelphia has its name spelled out in letters formed of electric lamps, set in the improved method, so that the sign is visible from both directions. In addition to the sign on the church front there is a smaller one at Girard Avenue directing attention to the church below. The signs are lighted on all occasions when there are services in the building. Other churches have had ornamental-iron lantern signs in use for a long time, but the Second Baptist is the beginnner in Philadelphia in making a bid for bigger assemblages by the use of the strictly up-to-date electric signs.

Eng Kheng, a Chinese boy in the Penang Free School, in a "composition" published in the London Electrical Review gives his ideas about the electric light as follows: "The electric is a pretty light of all the other. We have just seen the electric light

in Penang on the 1st of July. The electric light began to put by Howarth Erskine. The electric light is very useful, because all the people like it. When the time at six o'clock the electric light is lighted up. The electric light is just the same of moon bright. The tube was used to carry lights to the lamps. The electric office of Penang is in Kwala Kangsa Road. In the office there is a fan for stimulating the people in the office."

ELECTRIC RAILWAYS.

The Manhattan Transit Company, which proposes to operate electric omnibuses in New York city, is inviting specifications and blueprints for electric vehicles to carry 24 passengers. The company's office is at 250 East Forty-eighth Street.

A new street railway a little over two miles in length is to be constructed at Ithaca, N. Y., by the newly incorporated Ithaca and Cayuga Heights railway. The line will cost about $50,000 and is in the hands of three local men, J. T. Newman, C. H. Blood and C. H. Hull.

H. L. P. Northrup and others have been granted a franchise to build and operate an electric railroad in Wellington, Kan. This road will be a part of the electric line that runs from Arkansas City, Winfield and Geuda Springs. Work is expected to be begun about the first of the year.

The Tennessee, Georgia and South Carolina Railway Company has applied to the courts of Whitfield County, Ga., for a charter of incorporation, with $3,000,000 capital stock, for the purpose of building an electric railway from Clayton, Rabun County, Ga., through Union, Fannin and Towns Counties, Tenn., to Chattanooga. W. B. Fink and others of New York city and J. A. Jones and associates of Blueridge, Ga., are the incorporators.

The Real Estate Association of Salt Lake, Utah, has appointed a committee of five to present a resolution to the council of that city pledging its support to B. Mahler and associates for the construction of an electric railway through Salt Lake, and recommending that the council grant the necessary franchises. Mr. Mahler states that the cost of the construction and equipment of the road would be $4,500,000, and that if the necessary franchises were obtained in Salt Lake and Ogden, the work of construction would be begun at once.

At an early date a new system of street railways will be inaugurated in Belfast, Ireland. The present horse cars will be replaced by electric cars at a cost of over $4,000,000. There are now about 40 miles of rails in and about the city, and it is still a matter of controversy whether these rails will be heavy enough for the new traction, but as the system will be extended, 10 or 12 miles of new rails will be required in any case. The present cars will be discarded and replaced by 100 or more new electric cars. The bids for these have not yet been published by the city corporation.

The board of directors of the Springfield, Lincoln, Bloomington, Pekin and Peoria (Ill.) Electric Railway Company has called a special meeting for December 6th at the Illinois Hotel in Bloomington, for the purpose of changing the name of the company and to increase the capital stock from $300,000 to $900,000. It is the intention of the company at present to obtain power from the McKinley interurban lines from the power house at Riverton, near Springfield. Practically all the right-of-way of the company is contracted for, and only in a few separate cases is there any delay.

Considerable importance is attached in Oakland, Cal., to the consolidation of the new Webster Street and Park Railway Company, whose electric lines are nearing completion in that city and the Oakland Transit Consolidated system. A new company with a capital of $7,050,000 has been incorporated under the name of the Oakland Traction Company. This consolidation gives the travelers transfer privileges and enables them to reach the parks and outlying districts more conveniently from all parts of the city. The directors of the new company are about the same as those which controlled its predecessor.

The St. Marys (Pa.) Street Railway Company has been incorporated with a capital stock of $42,000. The immediate object of the company is the construction of an electric railway in St. Marys. Later the line will be extended to Kersey, Pa., a distance of six miles. The officers of the new company are: President, H. C. Stackpole; vice-president, D. B. Anderson; treasurer, J. S. Speer. These officers, with H. A. Speer and G. P. Fryling, constitute the board of directors. The preliminary work has been commenced. Mr. J. S. Speer, it may be added, is the general manager of the Speer Carbon Company and has a wide electrical acquaintance.

AUTOMOBILES.

The Horseless Age estimates that there are about 39,000 automobile cars in use in the United States.

The English consul-general at Frankfort, Germany, says that the last automobile exhibit at Frankfort was so successful that at its conclusion steps were taken to get the next German automobile exhibit at Frankfort. In general, he says, it may be said that the public prefers German machines. At any rate, in the future any manufacturer of automobiles who wishes to compete with Germany must be on the alert, since the automobile industry is one in which the Germans, with their application of industrial science, excel.

POWER TRANSMISSION.

An electric power station is to be built in Santos, Brazil.

W. L. Young and Emma Young of Filmore and George Forbes of Olean have organized the Genesee Valley Power Company with a capital of $25,000 at Olean, N. Y.

The Pacific Power Company has been incorporated in Minnesota with a capitalization of $1,000,000. Most of the capital interested is from Minneapolis. It is vaguely asserted that it is proposed to utilize the power from waterfalls 200 miles from San Francisco, Cal., by which 30,000 horsepower can be generated. The canal for the supply of water has already been dug, and it is expected that it will take at least two years more before the plant will be in working order. G. E. Maxwell of Minneapolis is president and G. B. Darling secretary.

SOCIETIES AND SCHOOLS.

The progress made by the Virginia Polytechnic Institute since its reorganization in 1891 is given in an article by Prof. J. M. McBryde, Jr., published in the Manufacturers' Record. The attendance has grown from 383 in 1901 to 727 last season. There are nine courses offered, among them being electrical, civil and mechanical engineering.

The freshman class enrolled this year at the University of Wisconsin number 765 students, of whom 261 have entered the college of engineering. The total enrollment in the college of engineering now numbers 725. Professor Daniel W. Mead takes charge of the newly established department of hydraulics and sanitary engineering.

PUBLICATIONS.

Uncommonly well executed is the new catalogue of valves issued by the Chapman Valve Manufacturing Company of Indian Orchard, Mass. It is printed upon a pale yellow paper and is neat in appearance. The catalogue contains besides numerous illustrations of various types of valves a partial list of the company's customers.

Along with some other literature, the Sterling Electrical Manufacturing Company of Warren, Ohio, is sending out a folder giving some good points about the proper commercial rating of incandescent lamps. "A Bright Little Tip" is the title of another folder, while still another, which sets forth the merits of the company's product, states that Sterling speical lamps are "16" just as sure as eight and eight are 16. A circular from the same company compares the candlepower and voltage of Sterling lamps with that of other makes.

The Central Electric Company, Chicago, has just issued a new price-list applying to its general catalogue. The price-list is a neat little book of 116 pages and is intended merely as a supplement to the general catalogue. The company is authority for the statement that a number of radical changes have been made in prices, and the book now shows the latest market value in force, as well as lists of all important new goods. All holders of the Central Electric Company's general catalogue who do not receive a copy of the new price-list are requested to write for one.

"The Romance of Prince Bonbennin Bonbobbin-Bonbobbinet" is the title of a little booklet published by the Denver Gas and Electric Company of Denver, Colo., which is sent free to its customers. It is one of a series in which the plot seems to be laid about a gas water heater. This company uses the mail freely in keeping itself ever before the public in the community which it serves, and in the literature which it sends to patrons and prospective customers are found such original and witty hints about its products as not only insure their being read but, what is more important, pave the way for new customers. Gas, coke and gas heaters are being especially pushed by the company just at this season. Representatives are always ready to follow up inquiries.

Bullock alternating-current generators and motors, both belted and direct-coupled, are described and illustrated in Bulletin No. 1027, issued by the Bullock Electric Manufacturing Company of Cincinnati last month. The pamphlet is a good example of crisp technical business literature, with clear pictures that form a valuable addition to the text. The following quotation from the bulletin will be of interest: "The design of Bullock alternating-current machinery has proven a singularly successful one. Not being handicapped by a large stock of old and antiquated designs and patterns, and having obtained the best engineering talent in the country, we were in a position to develop our line of alternating-current apparatus along the most modern principles and experience. Bullock alternating-current apparatus was first placed upon the market in the early part of 1900. Since this time we have designed and installed over 300,000 kilowatts capacity of alternating-current machinery. We are prepared to build alternators in units up to 10,000 kilowatts in size, and at the present time are building several of 5,0000-kilowatt capacity. We recently installed a 3,125-kilowatt alternator for the Cincinnati Gas and Electric Company, which is the largest 60-cycle generator ever built. We are at the present time building the largest frequency changer (for the Shawinigan Water and Power Company) ever built, its rating being 5,400 kilowatts."

MISCELLANEOUS.

The opening of the International Industrial Exposition at Cape Town, South Africa, has been postponed until December 1st.

At the works of C. A. Parsons & Co., Newcastle-on-Tyne, recently, two men were engaged in testing a turbine set, when one of them was killed while the other was momentarily absent. The supposition is that the unfortunate man touched one of the brushes in attempting to put on a new driving cord to connect up the speed counter. There were no marks on the body except a cut on the fingers, evidently caused by the driving cord. The electromotive force of the machine was only 300 volts. At the inquest Mr. Gerald Stoney, manager of the works, informed the coroner that although he himself had received shocks from as high pressures as 4,000 volts he was still alive. A verdict of accidental death was returned, and the jury added that no blame could be attached to anyone.

The Technische Woche suggests that the explosions of balloons just on reaching the ground may be accounted for electrically. The balloon, when floating free in the air, and consequently insulated from earth, may store up electricity generated by the friction produced on throwing ballast out. As soon as the balloon reaches the ground, this quantity of electricity may give rise to a spark sufficient to start the explosion. This idea would seem to be confirmed by the following simple experiment. A basket of any shape is taken to represent the balloon, and from it is suspended, by means of silk threads, an iron box full of very dry sand. The box is connected to the electroscope. If now the sand is allowed to flow out, the gold leaves will be seen to separate, and it is not unlikely that, if the experiment were continued long enough, a spark would be obtainable.

Among recent installations for heating and ventilating public buildings is that for the Worcester City Hospital at Worcester, Mass. The arrangement in the New Ward Building is typical of the Sturtevant system. A Sturtevant fan draws the fresh air from the top of the building, a distance of about 45 feet from the ground, through brick flues and into galvanized-iron ducts to the tempering coil, where the chill is taken from the air. It is then drawn through the fan, which runs at a slow speed, and forced through the heater-containing coils. By means of mixing dampers, automatically controlled, the air is mixed to a desired temperature and is forced by the pressure from the fan through the distributing ducts to the different rooms. To assure positive ventilation in the rooms a Sturtevant electric-propeller fan located in the basement draws the air through registers in the floor into galvanized-iron ducts and discharges it outside.

TRADE NEWS.

G. E. Gray has purchased the Thomas Gray Electrical Company's business in Leavenworth, Kan.

The Swedish import duty on dynamos, electric motors and transformers, or parts thereof, has been increased to 15 per cent. ad valorem.

The Braden Plumbing and Electric Company of San Antonio, Texas, has been succeeded by the Braden-O'Neill Plumbing and Heating Company.

Thomas E. Valentine and New Jersey associates have incorporated the Valentine Electric Sign Company, with headquarters at Atlantic City, N. J. The capital is $25,000.

A recent customs decision of the Australian commonwealth is to the effect that electrical materials, such as sparking plugs, fitted with or without porcelain, being part of a spark coil, are dutiable as electrical machinery and appliances, not elsewhere enumerated at 12½ per cent. ad valorem.

The Swedish General Electric Company of Vesteras, Sweden, has appointed Mr. Guillermo A. E. Larsen of the City of Mexico its general representative for the republic of Mexico. The company manufactures all kinds of electrical machinery and controls patents of its inventions. It controls some fine iron mines and employs about 2,000 men at its factories.

The organization meeting of the supply and machinery dealers in the North, East and West which was to have been held in Cleveland, Ohio, on October 18th and 19th has been postponed, the new dates not yet having been decided upon. The meeting will be held in Cleveland and due notice of the time and place will be given.

Sealed proposals will be received at the Treasury Department, office of the supervising architect, Washington, D. C., until November 3d for the installation of a conduit and electric-wiring system for the post-office and courthouse at Athens, Ga. Drawings and specifications may be obtained at the Treasury De-

partment or at the office of the superintendent of construction at Athens.

The Department of Railways and Canals, Ottawa, Canada, is inviting bids for the deepening and widening of the channel east of the Vidal shoal of the upper channel of the Sault Ste. Marie Canal, Ontario; also for the foundations for the proposed big elevator to be erected at Port Colborne, Ontario, and bids for lighting by electricity the Carillon and Grenville canals.

The department of the state railways of Roumania will award contracts for enlargement of the electric plant at Bukharest and for materials and machinery required for electric lighting and furnishing power for the new railway workshops in that city. The department will also receive proposals for supplying machine tools required by the state railways. The German consul at Belgrade reports to his government that within the last year a considerable number of electric plants and other industrial establishments have been built in Servia. The consul advises manufacturers to send expert representatives to Servia to study conditions on the spot.

BUSINESS.

Sales Manager L. P. Sawyer of the Buckeye Electric Company of Cleveland was again in Chicago last week. Incidentally, it may be said that Mr. Sawyer is a sales manager that believes in being out in the field where "the fight is the hottest," and as a consequence he spends the bulk of his time on the road; the rapidly increasing sales of Buckeye lamps show the wisdom of this policy.

The Northern Electrical Manufacturing Company of Madison, Wis., recently shipped to the New York Edison Company 34 of its variable-speed motors, operating on the Northern two-wire field-control system. These motors will be directly coupled to blowers for cooling the transformers in the various substations of the company. There were also shipped recently nine small Northern motors to be installed in the sub-stations of the Brooklyn Rapid Transit Company. This makes a total of 75 Northern motors now in use by the two companies, aggregating 1,500 horsepower.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued (United States Patent Office) October 4, 1904

771,222. Clip for Electric Switches and Method of Making Same. Charles C. Badeau, Swissvale, Pa. Application filed June 1, 1903.

A method of making a clip for electric switches consists in longitudinally bisecting a piece of tubing of conducting material for a portion of its length and flattening each of the separated portions.

771,235. Automatic Fire-alarm Transmitter. William L. Denio, Rochester, N. Y., assignor of one-half to Hobart F. Atkinson, Rochester, N. Y. Application filed January 20, 1904.

A fusible link is so situated in reference to a spring-actuated train of gears as to normally prevent their movement. The fusible material, however, upon melting with heat releases the gears and they in turn intermittently open and close an electric-alarm circuit.

771,237. Reactance Coil. John J. Frank, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed February 2, 1903.

Operating features of the device consist of a movable core, two concentric coils for each of two legs of the core, and cross connections between the coils such that the inner coil on each leg of the core is in series with the outer coil on the other leg of the core, the two sets of series-connected coils being connected in multiple with each other.

771,238. Multiphase Transformer. John J. Frank, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed February 6, 1904.

In a multiphase transformer are combined coils for each phase, connections joining one terminal of one coil of each phase to a common point, connections joining another coil of each phase to a separate common point and multiphase leads extending from the remaining terminals of the coils.

771,239. Electric Switch. Ernest L. Gale, Sr., Yonkers, N. Y. Application filed February 8, 1904.

A movable contact is adapted to be moved into and out of contact with a stationary contact mounted upon a yielding support which will hold the latter under usual conditions but will release it when it is subjected to an abnormal strain.

771,240. Socket for Electric Lamps. Edwin R. Gill, Yonkers, N. Y. Application filed June 27, 1903.

A socket for incandescent lamps comprises an attachment section and a lamp section, each provided with conducting points, a nut attached to the attachment section and electrically connected to one of the points, and a screw operating with the nut to attach the two socket parts together while serving as an electric conductor.

771,246. Alternating-current Motor. Arthur W. Henshaw, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed February 11, 1903.

A two-phase motor has its primary coils permanently connected in two independent windings and so arranged that by a change of the coupling of the windings to the source of current the number of poles may be correspondingly changed.

771,249. Apparatus for Electric Heating. William S. Horry, Niagara Falls, N. Y., assignor to the Union Carbide Company, Niagara Falls, N. Y. Application filed June 28, 1904.

Apparatus for electrically heating a body of conducting material comprises the means for causing different phases of a polyphase current to flow along paths which converge to a common point within the body and for progressively shifting the path of the phase of maximum electromotive force. (See cut on next page.)

771,250. Apparatus for Electric Heating. William S. Horry, Niagara Falls, N. Y., assignor to the Union Carbide Company, Niagara Falls, N. Y. Application filed June 28, 1904.

Electric-heating apparatus for electrically heating a circular body of conducting material comprises a source of polyphase current and active terminals placed substantially in contact with the body at such points around its periphery that different phases of the current simultaneously flow between several of the terminals and along paths which cross each other through the body.

771,259. Electric Fixture. George L. Martin, New York, N. Y. Application filed February 2, 1903.

An electric-light fixture comprises an outlet box composed of one piece of metal and having a flange intermediate of the interior walls, an annulus mounted on the flange, a lamp bulb and base secured to the annulus, a globe screwed into the top part of the box and in engagement with a gasket and a guard screwed on the exterior of the box.

771,260. Field-magnet Core. Charles R. Meston and Herbert I. Finch, St. Louis, Mo., assignors to the Emerson Electric Manufacturing Company, St. Louis, Mo. Application filed March 21, 1904.

A field-magnet core consists of laminations whose polar projections have faces of varying widths, each lamination being a counterpart of the other. The polar projections have faces of varying widths adjacent to the faces of different widths on the co-operating laminations.

771,266. Electric Meter. William H. Pratt, Lynn, Mass., assignor to the General Electric Company, Schenectady, N. Y. Application filed February 16, 1903.

A rotary member is immersed in mercury and magnetic means resist the upward thrust on the member, due to its immersion in the mercury.

771,269. Centrifugal Switch. Henry G. Reist, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed March 26, 1903.

A revolving armature body has projecting flanges at its ends. A resistance is formed in a coil and supported within one of the projecting flanges, and an automatic switching device for the resistance is supported at the other end of the armature body.

771,274. Electric Brush. Albert T. Sanden and Victor Sence, New York, N. Y. Application filed February 27, 1904.

An electric pile is connected to the brush, the pile comprising metallic plates insulated in pairs. The pairs and insulating layers of suitable material have portions pressed outwardly and registering one with the other to maintain the plates firmly in position in the pile.

771,284. Dynamo-electric Machine. Charles P. Steinmetz, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed April 30, 1900.

An inductor and two sets of coils are relatively movable with respect to the inductor and all acted upon by the same poles of the inductor. The coils of one set are alternately arranged with respect to the coils of the other set.

771,285. Dynamo-electric Machine. Charles P. Steinmetz, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed January 25, 1904.

The novel feature of the machine is that commutator leads formed of thin strips of resistance material and the insulation filling the spaces between the strips form a compact mass.

771,293. Alternating-current Induction Motor. Andrew E. Averrett, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed January 26, 1903.

Primary coils on one member are connected to a source of single-phase current; short-circuited secondary coils are placed on the other member. Tertiary coils in inductive relation to the other coils have a greater number of turns than the number of primary turns connected across the source, and a phase-shifting device is connected to the tertiary coils.

771,295. Lighting Electric Trolleys. Walter Burling, Grand Rapids, Mich. Application filed July 11, 1904.

A small electric lamp is placed on the trolley pole near the wheel and is so placed in a battery circuit that it may be lighted to aid in replacing the trolley wheel upon the wire at night.

771,297. Insulator. Cummings C. Chesney, Pittsfield, Mass., assignor to the Stanley Electric Manufacturing Company, Pittsfield, Mass. Application filed May 16, 1903.

Two concentric tubular insulator walls are associated with a cylindrical reservoir formed by the walls. A cap for the reservoir is supported by the inner of the walls.

771,299. Apparatus for Regulating Electric Currents. Reginald C. Clinker, Rugby, England, assignor to the General Electric Company, Schenectady, N. Y. Application filed January 24, 1903.

A regulator for a polyphase-electric system comprises an inducing and an induced polyphase member, one of the members being fixed and the other movable. Separate windings on the members are connected respectively in series between the supply lines and the work and in shunt between the lines. Means are provided for automatically controlling the relative position of the inducing and induced windings in accordance with the load on the system. (See cut on next page.)

771,302. Torque-testing Device. Alvarado Le Roy Ellis, Swampscott, Mass., assignor to the General Electric Company, Schenectady, N. Y. Application filed March 13, 1903.

A torque-testing device comprising a hollow support carries a reference plate, a pivoted index lever and balance arm adapted to be folded in substantial parallelism with its axis, and a reversible end-piece carrying means for securing the support to a base.

771,307. Means for Protecting Electric Conductors. Edward M. Hewlett, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed February 9, 1903.

An electric circuit has an inductance in a section thereof with means for breaking the circuit between the inductance section and its source of excitation. Means are added for automatically closing the inductance portion of the circuit upon itself.

771,313. Electric Switch. Charles E. Lombard, Pittsfield, Mass., assignor to the Stanley Electric Manufacturing Company, Pittsfield, Mass. Application filed September 19, 1903.

Combined with a reservoir containing oil are contacts submerged therein, a pivoted switch member movable in a horizontal plane and adapted to engage the contacts, and a longitudinally movable rod adapted by its movement to operate the switch member.

771,314. Phase Transformation. Alexander D. Lunt, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed July 31, 1900.

A method of producing 12-phase current consists in combining like-phase electromotive forces derived from one phase of a three-phase system, with like-phase electromotive forces derived from each of the other phases of the system, causing currents to flow in phase with the electromotive forces and deriving 12-phase current therefrom.

771,317. Alternating-current Transformer. Walter S. Moody, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed January 31, 1903.

In a system of phase transformation there are two transformers having teaser and main windings respectively, and coils on the two legs of the core of each transformer connected in parallel circuit.

771,323. Iron-clad Electromagnet. David Perret, Neuchatel, Switzerland. Application filed April 21, 1904.

An iron-clad electromagnet is made up of a solid core of magnetic material extending the whole length of the energizing coil and a yoke of magnetic material secured to one end of the core and extending above the other end of the core. The energizing coil is between the core and the yoke and a spring-controlled armature is placed within the yoke and at all times completely outside of the coil.

771,325. Collector Ring. Henry G. Reist, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed May 23, 1901.

The collecting device comprises a metal support, a collector ring having pockets around its inside periphery, and separate metal-supporting plugs engaging the support and fitting in and insulated from the pockets.

771,334. Third-rail Insulator. Samuel B. Stewart, Jr., Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed May 31, 1902.

Combined with a twin support of insulating material is a cap carried by each arm of the support, and a metallic rail connected to each of the caps.

771,332. Induction Coil. John Splitdorf, New York, N. Y. Application filed February 23, 1904.

A spark coil having the usual primary and secondary windings is connected with a pair of condensers, one of the condensers being connected in parallel with the vibrator and the other condenser being connected in parallel with the engine make-and-break device.

771,340. Process of Etching. Thomas C. Van Housen and William A. Meyers, Chicago, Ill. Application filed July 24, 1903.

Improvement in the art of etching consists in electrically connecting the article to be etched with another element of different electrical potential to form a galvanic couple, applying to the article to be etched a composition protecting the covered parts from the action of the bath, supporting the couple in a bath which is both an etching fluid and an electrolyte and also passing electric current from an external source through the galvanic couple and electrolyte.

771,346. Protective Device for Parallel Feeders. Leonard Wilson, Pittsfield, Mass., assignor to the Stanley Electric Manufacturing Company, Pittsfield, Mass. Application filed November 2, 1903.

In combination with parallel feeders is a movable member, opposing windings adapted to pull the member in opposite directions and arranged to be energized by the currents in the respective feeders, and switches controlled by the member and adapted to open the circuit of the feeder carrying the smaller current.

771,347. Control System for Parallel Lines. Leonard Wilson, Pittsfield Mass., assignor to the Stanley Electric Manufacturing Company, Pittsfield, Mass. Application filed November 20, 1903.

Parallel transmission lines and a generator connected thereto embody a device operative upon unbalancing of current-flow in the lines, a device operative upon a predetermined excess current-flow in the generator, and means dependent upon the devices and adapted to open the circuit of one of the lines. (See cut on next page.)

771,351. Electrical Hoisting Apparatus. Eugene B. Clark, Chicago, Ill., assignor to the Otis Elevator Company, New York, N. Y. Application filed January 23, 1902.

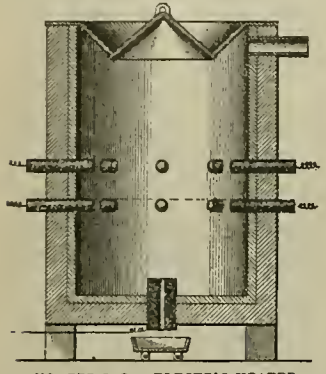
Hoisting mechanism comprises the following elements: A hoisting motor, controlling mechanism therefor, automatic mechanism for operating the controlling mechanism, manual mechanism for operating the controlliog mechanism, and means for bringing into use either the manual or the automatic operating mechanism.

771,400. Electric Programme Clock. Edward E. Stone, Portland, Maine. Application filed March 14, 1904.

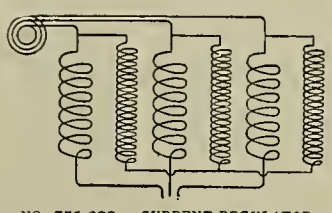
Details are described.

771,423. Trolley Wheel. Joseph N. Drake, Cincinnati, Ohio. Application filed December 15, 1903.

The trolley wheel is mounted on a rotating head.



NO. 771,249.—ELECTRIC HEATER.



NO. 771,299.—CURRENT REGULATOR.

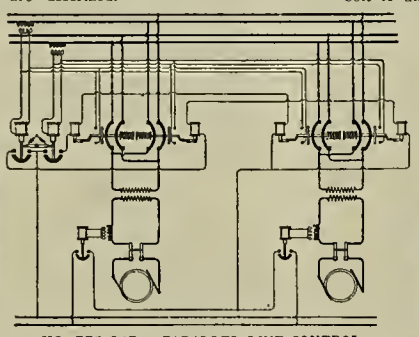
An electromagnet of high resistance is placed in series with the trolley and the motor wiring.

771,533. Electric Railway. Alexander Churchward, New York, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed February 20, 1903.

Features of interest in the system are a sectional conductor, a feeder and electromagnetically actuated switches for normally connecting the feeder to the sections of the conductor. The actuating coils of each of the electromagnetically actuated switches are controlled by a relay, the actuating coil of which is in series with the switch of the next section in advance, whereby each switch-actuating coil is de-engerized when current is being taken from the next section in advance.

771,547. Thermostatic Finger-piece for Pushbuttons. Willis E. Harmon, Mechanic Falls, Me. Application filed December 26, 1903.

Mechanical parts are described.



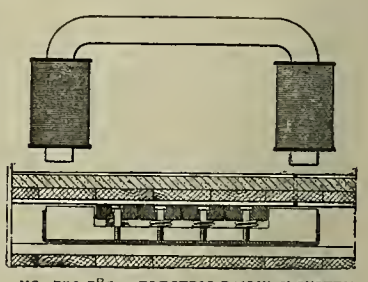
NO. 771,347.—PARALLEL LINE CONTROL.

771,748. Electric Time Alarm. William H. Robins and John F. Jacoby, Minneapolis, Minn., assignors to the American Bank Protection Company, Minneapolis, Minn. Application filed April 7, 1903.

Clock mechanism is arranged to close an electric-alarm circuit at a predetermined period of time.

771,749. Burglar Alarm. William H. Robins and John F. Jacoby, Minneapolis, Minn., assignors to the American Bank Protection Company, Minneapolis, Minn. Application filed April 7, 1903. Renewed January 25, 1904.

An electric-alarm circuit is closed through the door bolt if an attempt is made to move the bolt.



NO. 771,785.—ELECTRIC-RAILWAY SYSTEM.

771,424. Electric Heater. Cassius M. Fisk, Napoleon, Ohio. Application filed March 5, 1904.

Curved clamping members are carried by each section of the heater casing and serve to engage the socket of an incandescent lamp and hold it from movement in any direction.

771,436. Time Circuit Controller. Robert A. Moore, Huntsville, Ala. Application filed September 10, 1903.

In a working circuit having a pair of alternately operating batteries, each having one pole connected to the other side thereof, is a switch armature connected to the other side of the working circuit, and electrodes between which the switch armature operates, each connected to one pole of one of the batteries. A time mechanism comprises a fixed conductor and a traveling conductor, a spring to engage the switch armature with one of the electrodes, and an electromagnet to engage the armature with the other electrode, and having its windings included in a local circuit with the conductors of the time mechanism make-and-break.

771,468. Air-cooled Electric Machine. Leo Falk, Baden, Switzerland. Application filed November 18, 1903.

In combination with an electric machine and a casing completely enclosing it is a second casing having an inlet and an outlet and completely enclosing the first-named casing. A rotary air circulator is arranged to maintain a current of air in the space between the casings.

771,472. Trolley Harp. John Hensley, Huntington, Ind. Application filed May 5, 1904.

A trolley harp and its wheel contain contact springs carried by the harp and having elongated openings through which the wheel spindle passes. Movable washers are carried by the springs through which the wheel spindle also passes.

771,408. Electric Battery. Isaiah L. Roberts, New York, N. Y., assignor to the Economic Electric Company, New York, N. Y. Application filed October 14, 1903.

In an electric dry battery are a positive element, a negative element, a depolarizing agent and means whereby the oxygen consumed in the operation of the battery is replaced by oxygen from the air.

771,510. Safety Coupling for Electrical Wires Connecting Railway Coaches. John G. Thomas and David E. Lewis, Scranton, Pa. Application filed October 2, 1903.

A coupliog for electrical wires comprises a pair of members made from insulating material, one of the members having a central projection and the other a cylindrical flange adapted to encompass the central projection of the first member.

771,523. Circuit Controller for Electrically Propelled Vehicles. Bert Aikman, Chicago, Ill. Application filed August 31, 1903.

A trolley conductor extends along the line to furnish the current. Traction motors with their regulating resistances are connected with a series-parallel controller.

771,569. Socket for Incandescent Electric Lamps. George B. Painter, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed October 9, 1899. Renewed September 22, 1900.

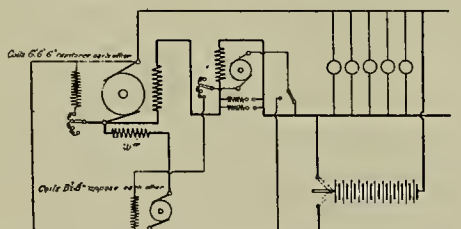
The insulating base is formed with a narrow chamber opening into both ends and with transverse holes in opposite walls for the spindle journals of the actuating mechanism.

771,646. Process of Obtaining Metals. Franz von Kügelgen, Holcombs Rock, Va., and Heinrich Danneel, Breslau, Germany, assignor to the Wilson Aluminum Company, New York, N. Y. Application filed July 29, 1903.

The process consists in electrolyzing a haloid of an alkali in the presence of an oxide of a metal, thus obtaining the metal, an oxide of the alkali and the halogen, and maintaining a supply of the haloid and the oxide by adding fresh quantities as they are decomposed.

771,676. Telegraph Call System. Jesse S. Snead and William O. Ballard, Atlanta, Ga. Application filed March 17, 1904.

Combined with a supporting post is a disk having a depending journal fitted in the post, a feeding arm to rotate the disk in one direction and a spring to hold the arm in engagement with the disk, the spring being connected with the journal of the disk to rotate it in a reverse direction.



NO. 771,710.—STORAGE-BATTERY CONNECTIONS.

771,683. Electric Ignition Device for Internal-combustion Motors. Charles W. Svenson, New Britain, Conn., assignor to the Corbin Screen Corporation, New Britain, Conn. Application filed June 17, 1903.

A spark-plug comprises a relatively stationary annular member, a rod mounted longitudinally and a revoluble disk having sparking points carried at the outer end thereof adjacent the annular terminal.

771,710. System of Electrical Distribution. Rufus N. Chamberlain, Depew, N. Y., assignor to the Gould Storage Battery Company, New York, N. Y. Application filed March 19, 1903.

Operated by a generator and a booster in series relation are a consumption circuit connected with the generator, a charging circuit, a storage battery and means operating upon the battery circuit alone for transferring the battery from the consumption circuit to the charging circuit upon the generator voltage reaching the proper amount. (See cut.)

771,785. Electric-railway System. William G. Lowrie, New York, N. Y., assignor to the International Electric Traction Company. Application filed June 21, 1901.

The system embodies a continuous conductor, a horizontally opposite discontinuous conductor, each section of which is electrically connected with a corresponding section of a discontinuous feed-rail, a trolley movable along the line of the conductors under the influence and corresponding to the movement of a car magnet, the trolley having an armature of magnetic material for the magnet and a bridge of conducting material forming an electrical connection between the continuous conductor and the sections of the sectional conductor. (See cut.)

771,791. Lamp Socket. Duny A. Schutt, Peru, Ind. Application filed May 16, 1901.

Details are described.

771,786. Phase Transformation. Alexander D. Lunt, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Original application filed July 31, 1900. Divided and this application filed April 5, 1902.

Combined with a number of three-phase transformer windings are a 12-phase dynamo-electric machine and connections between the machine and the windings such that the electromotive forces of the windings may be represented by a double delta superposed upon a double Y.

EXPIRING PATENTS.

Following is a list of electrical patents (issued by the United States Patent Office) that expired on October 11, 1904:

371,161. Insulating Clamp for Electric Conductors. T. E. Adams, Cleveland, O.
371,189. Voltaic Inner Sole. G. A. Fullerton, Boston, Mass.
371,199. Electric Spinning or Twisting Machine. A. S. Kimball and G. L. Brownell, Worcester, Mass.
371,202. Electric Wire Conduit. J. Lynch, Washington, D. C.
371,241. Telephone System and Apparatus. G. T. Woods, Cincinnati, O.
371,244. Primary Battery. M. Bailey and J. Warner, London, England.
371,253. Electric Locomotion. L. Daft, Plainfield, N. J.
371,256. Apparatus for Forming Sheet Metal by Electro-deposition. E. Emerson, Providence, R. I.
371,260. Telephone Switch. Wm. M. Goodridge, Highland Park, Ill.
371,331. Apparatus for the Transmission of Electrical Energy. G. Kornmuller, Ghent, Belgium.
371,336. Means for Supporting Overhead Conductors. G. W. Mansfield, Cleveland, O.
371,356. Electrotherapeutic Belt. W. L. L. Pierce and W. J. Pierce, San Francisco, Cal.
371,358. Secondary Battery. A. Reckenzaun, London, England.
371,436. Method of and Apparatus for Starting Electric Motors. L. Daft, Plainfield, N. J.
371,443. Reversing Mechanism for Electric Motors. F. E. Fisher, Detroit, Mich.
371,445. Electric Signaling Apparatus. W. Glasgow and S. S. Stevens, Chicago, Ill.
371,524. Induction Coil. E. Smith, Peoria, Ill.
371,531. Method of Operating with Electrical Conductors. J. E. Watson, Louisville, Ky.

SPECIAL MENTION.

Superior service from Chicago to Pittsburg, Baltimore, Washington, Philadelphia and New York, via Pennsylvania Lines. For rates and full particulars address C. L. Kimball, assistant general passenger agent, No. 2 Sherman Street, Chicago.

To those who are not in close touch with the large amount of work being done by the government in the line of equipping its different department divisions with telephone apparatus, it will be interesting to know that the American Electric Telephone Company of Chicago has recently supplied the United States government with switchboard exchange equipments, divided into 12 different divisions. Six switchboards were sent to different points in Virginia, one switchboard to Wyoming, one to New York, three to different points in California, and still another to the District of Columbia. This indicates a great activity on the part of the government officials to adopt the telephone as a means of communication.

Weber electric wiring specialties, consisting of rosettes, cut-outs, receptacles, etc., are made the subject of a catalogue recently issued by Henry D. Sears of Boston, who is the general sales agent for this product. The highest grade of porcelain is used in the construction of these articles and good fits are obtained by care in the workmanship.

Eugene Munsell, president of the Mica Insulator Company of New York, writes: "We recently learned that a report has been circulated among the users of Micanite that the Mica Insulator Company had been manufacturing what is known as amber plate by using India mica in the center with a coating of amber mica on the outside. We take this opportunity to assure the trade that these reports are absolutely false and are only made with a view to injuring our business. Our company has been in existence 12 years, and during this period every piece of insulation that we have turned out has been exactly as represented. We have never sold any amber Micanite that did not consist entirely of the best amber mica we could purchase. We guarantee all our amber plate to be made from pure, soft Canadian amber splittings. We have our splitting factory in Ottawa and have the pick of the softest and best mica mined. We take this opportunity to request our friends not to give credence to any reports of this nature, and we believe that the reputation we have earned in the last 12 years for honesty and fair dealing will be sufficient refutation of any such malicious charges."

WESTERN ELECTRICIAN

EVERY SATURDAY

Vol. XXXV. CHICAGO, OCTOBER 22, 1904 No. 17

Street-railway Men in Convention at the World's Fair.

In some respects the street-railway conventions held last week in St. Louis were a success; in others the requirements for a good meeting were lacking. The fact that meetings could be held day after day upon the Exposition grounds with a fair attendance and fairly successful results is evidence that a portion of the delegates, at least, wished to attend to business and accomplish the ends for which the meetings were called. But last week's conventions to a great extent demonstrated the fact that an exposition city is not the place to hold meetings of this sort. There was too much to see at the Fair. Many who came as delegates are busy men, and the convention possibly offered the only opportunity to visit the Exposition. Be that as it may, there certainly was manifested at the meetings an atmosphere of unrest and a desire to get out; the members were slow in arriving, many apparently wishing to "do" a building or two before coming to the convention hall, thereby delaying the opening of the sessions, and the average daily attendance was not what it should have been for the number registered.

However, St. Louis probably drew a larger number to attend the convention than almost any other city that could have been selected. Over 200 members of the several associations representing street-railway companies were registered; of the supply men, about 350 were in attendance, and there were over 200 ladies registered as guests, making in all nearly 800 persons.

A detailed report of the conventions of the American Street Railway Association and the Street Railway Accountants' Association is given on pages 331, 332 and 333 of this issue.

The Street Railway Association, in making its choice of officers for the ensuing year, wisely decided to retain as its president Mr. W. Caryl Ely of Buffalo, who has performed his duties so well in the past. Mr. Ely is president of the International Railway Company of Buffalo and was one of the original promoters and incorporators of the Niagara Falls Power Company. It was he who conceived the idea of combining into one system all of the electric railways in Buffalo, Niagara Falls, Tonawanda and Lockport, with the electric roads on the Canadian side, and with the suspension bridge at Lewiston and Queenstown as a means of connection, which plan has been successfully carried out. A lawyer by profession, Mr. Ely is one of the foremost promoters of street railways and has done much for the cause. He was also connected with the management of the Pan-American Exposition, being a director, chairman of the transportation committee and a member of the executive committee.

W. CARYL ELY OF BUFFALO, PRESIDENT OF AMERICAN STREET RAILWAY ASSOCIATION.

C. F. BAKER OF BOSTON, PRESIDENT OF AMERICAN RAILWAY MECHANICAL AND ELECTRICAL ASSOCIATION.

Identified with somewhat different activities, the new president of the American Railway Mechanical and Electrical Association, Mr. C. F. Baker, is well qualified for his position. He is the superintendent of motive power and machinery for the Boston Elevated Railway Company and has made himself thoroughly familiar with the practical side of this department of street-railway work, having given much thought and study to it. He is an authority in matters concerning the master mechanic's department and the association has made a good choice in selecting him for its president.

W. G. Ross, the new president of the Street Railway Accountants' Association of America, is a street-railway man of recognized standing in the Dominion of Canada, Montreal being his home, and he will no doubt take hold of the work energetically, for the importance of this association is growing more manifest year by year. Mr. Ross is managing director of the Montreal Street Railway Company.

DELEGATES AND VISITORS AT THE CONVENTION OF THE AMERICAN RAILWAY MECHANICAL AND ELECTRICAL ASSOCIATION AT ST. LOUIS EXPOSITION ON OCTOBER 11, 1904.

Central-station Advancement in Boston.

At the annual meeting of the stockholders of the Edison Electric Illuminating Company of Boston on October 11th the annual report for the fiscal year ended June 30, 1904, was presented. It shows:

	1904.	1903.	1902.
Gross receipts	$3,125,516	$2,667,808	$2,460,158
Expenses	2,009,691	1,183,085	1,510,427
Net	$1,115,825	$984,723	$949,731
Other income	37,396	35,502	25,981
Total net	$1,153,221	$1,017,225	$975,712
Interest and dividends	1,075,813	955,971	859,614
Surplus	$77,408	$61,254	$116,098

Lamps and motors connected June 30th compare as follows:

	1904.	1903.	1902.	1901.
Incandescent lamps	627,441	493,402	442,034	247,955
Arc lamps	9,358	8,196	8,548	2,503
Motors, horsepower non-connected	24,150	20,801	19,130	10,651

Of the above increase in lamps and motors during the last fiscal year 72,745 incandescent lamps, 760 arc lamps and 218 horsepower of motors were added in the purchase of the Milton Light and Power, the Dedham Electric, Blue Hill Electric, the Framingham Electric, the Natick Gas and Electric, the Greendale Chemical and Electric Light and the Somerville Electric Light companies. The remainder, 61,294, incandescent lamps, 402 arc lamps and 3,121 horsepower of motors, is the increase in new business for the year.

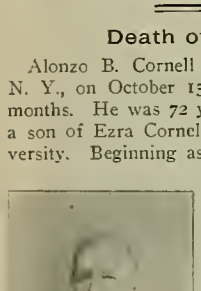
President Charles L. Edgar says: "The results obtained by the purchase of the suburban companies, as well as the growth of the combined companies during the year, have been satisfactory. The property of the Somerville Electric Light Company has been purchased and a contract has been entered into with the Chelsea Gas Light Company for supplying that company with all its electricity until such time as the final purchase of its electric property is consummated. The status of the Newton and Watertown Gas Light Company and the Woburn Light, Heat and Power Company has not changed during the year."

The new turbine power station, which has been building during the last two years, is practically completed, and two 6,500-horsepower units have been installed. Property has been leased at No. 40 Summer Street and at No. 56 Chatham Street for additional sub-stations, and a storage battery is now being installed in the latter place. The old generating stations in Canton, Milton and Needham have been discontinued and the Dedham station turned into a sub-station. It is proposed to discontinue the generating station in Framingham and to change the Natick station into a sub-station as soon as the transmission lines are completed. The Somerville station will continue to operate for some time.

In December last a 10 per cent. increase in the capital stock of the company was issued, of which all but 46 shares was taken by stockholders. Notes have been issued from time to time as payments on the new station became due, and the stockholders will probably be called together some time during the coming winter to authorize the issue of another 10 per cent. of capital stock; authority to issue this amount having already been granted by the state board of gas and electric-light commissioners.

Death of A. B. Cornell.

Alonzo B. Cornell died at his home in Ithaca, N. Y., on October 15th, after an illness of several months. He was 72 years of age. Mr. Cornell was a son of Ezra Cornell, the founder of Cornell University. Beginning as a telegraph operator, he was connected with the telegraph nearly all his life, having been a director in the Western Union from 1868 to 1899. He was governor of New York state from 1880 to 1883.



A. B. CORNELL

For several years Mr. Cornell was vice-president of the Western Union company, and in 1875 he was acting president. His father was the superintendent of construction for Prof. Morse's first line of telegraph between Washington and Baltimore. Ezra Cornell continued for many years to be one of the most extensive and successful promoters and builders of telegraph lines in America. He amassed a large fortune. He was one of the founders of the Western Union Telegraph Company, and for 20 years was the largest individual stockholder of that company. His son Alonzo became a telegraph operator in 1846, when but 14 years of age. As operator, manager, superintendent, director, vice-president or acting president, he was identified with the telegraph service for 53 years.

In politics, Governor Cornell was active as a Republican for many years, although of late he had retired from public view.

Notes on Experiments with Transformers for Very High Potentials.[1]

By Harold B. Smith.

The attention of the writer was first directed toward the problems involved in the production and application of high potentials of low frequency by certain of the exhibits at the Chicago Exposition of 1893, and particularly by the discussion before the International Electrical Congress of 1893 on power transmission.

As a result of this interest, during the college year 1893-94, in connection with the direction of the School of Electrical Engineering at Purdue University, two senior students at the university designed and constructed, under the writer's supervision, a small transformer (Fig. 1) to give an effective secondary potential of 10,000 volts.

This transformer was constructed with but slight knowledge of the difficulties involved, and was a failure except for the many valuable lessons received from successive attempts to operate it under the proposed conditions.[2] The following year this transformer was reconstructed by two senior students at the university and was operated for some time before a final breakdown occurred, but there could be no hope for the final success of such a transformer.

Following a suggestion by Tesla, in a paper before the Institution of Electrical Engineers, paraffin oil was heated, and by means of an air pump drawn into a closed metal-lined box containing the core and windings. The oil apparently penetrated to all the surfaces of the core and windings, and it is probable that, so far as this part of the work is concerned, good results were secured; but, unfortunately, rubber insulation was used on the secondary winding, and this was promptly softened by the oil.

While this transformer was a failure in all respects, except that it led to success with later transformers, no responsibility for this failure should rest upon the four young men who assisted in its design and construction, as the writer was responsible for the important features of the design, and the failure should be assumed by him alone.

FIG. 1. 10,000-VOLT TRANSFORMER OF 1893.

On account of the pressure of many duties and the interruption of this work occasioned by the acceptance of the chair of electrical engineering at the Worcester Polytechnic Institute in 1896, this work was not continued until the college year 1897-98, when two graduate students in electrical engineering at the Institute, under the writer's direction, undertook the design and construction of a 150,000-volt transformer, which was completed early in the spring of 1898. The experiences with the transformer of 1894, the succeeding interval of four years for occasional study of the various causes of its failure, together with many valuable suggestions from Prof. J. O. Phelon of the Worcester Polytechnic Institute and the remarkably able manner in which the two men who were engaged upon this work carried out the details of the design and construction, account for the thorough success of this second transformer.

A reference to this transformer, which had a ratio of voltages of 1 to 1,500, and an illustration showing its construction, appear in the Transactions of the American Institute of Electrical Engineers in a note communicated by the writer to the discussion of the paper by Steinmetz on the "Dielectric Strength of Air." More detailed descriptions of this transformer appear elsewhere, so that no extended description need be given here. However, a statement of experience with this transformer for the last six years may have some interest and value.

For several years the transformer was in fairly constant experimental service in the laboratories of the Institute on work which involved operation at potentials as high as 190,000 effective volts, and for many days was operated for 10 hours per day at 175,000 effective volts. Nearly a year ago, this transformer was sold to be used for commercial testing by a company manufacturing insulators, and information has been received recently of its continued satisfactory daily service, at potentials ranging up to its rated capacity.

This transformer was exhibited at the Saratoga (1903) convention of the American Street Railway Association, and at this time several coils of the secondary winding were injured in shipment and had to be replaced. With this exception, practically no difficulty has ever been experienced in its operation. It was designed primarily for experimental work in the laboratories of the Worcester Polytechnic Institute, and many details of construction would naturally be changed in a design intended for commercial service, although the general features of the design have demonstrated their reliability for this class of work.

In the fall of 1899, two seniors in electrical engineering at the Institute undertook the development of a transformer for still higher potentials, and in the spring of 1900 produced, under the direction of the writer, a transformer designed for a secondary potential of 230,000 volts at 60 cycles per second;

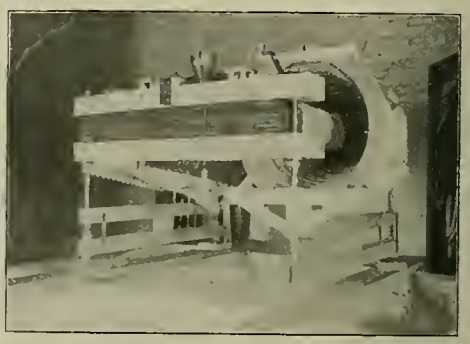


FIG. 2. 500,000-VOLT TRANSFORMER OF 1901.

but, under test, this transformer failed to develop potentials higher than 210,000 effective volts at the terminals of the secondary circuit.

Failure to operate this transformer at higher potentials may be attributed, in part, to an absence of knowledge at the time of its design of phenomena which occur at the higher potentials and which had not been observed in the operation of the 1898 transformer below 175,000 volts. In part, the failure of this transformer may also be attributed to defects introduced by frail construction and faulty design of the windings, as the transformer was regarded as a purely experimental affair, and expensive construction was avoided whenever possible and in too great a measure for satisfactory results. However, as in the case of the 1894 transformer, failure to accomplish the results anticipated led to a closer study of the phenomena involved in this class of work, and to success later in the production of a transformer for even higher potentials.

During the college year 1900-01, four graduate students[1] in electrical engineering at the Institute undertook the design and construction of a 500,000-volt transformer, at the suggestion and under the direction of the writer. This transformer (see Fig. 2) was in operation early in May, 1901, and at that time developed a secondary potential, at 60 cycles per second, which was capable of disrupting a 48-inch (1.22-meter) air gap between sharp needle points.

As this is undoubtedly the first transformer, and, so far as the writer is informed, the only transformer which, up to the present time, has, with a single transformation or even with several transformations by a number of transformers, secured low-frequency potentials in the neighborhood of one-half million effective or three-quarters of a million maximum volts, a brief description may be of value.

The design of this transformer called for a ratio of transformation of 1 to 2,520, at 60 cycles, and a maximum core density of 8,600 gausses, when at a secondary potential of 500,000 effective volts. The primary winding consisted of 46 turns of heavy stranded conductor—23 turns on each core—in series for a primary potential of 200 volts, 60 cycles, giving a maximum magnetic flux of about 1,600,000 maxwells at full rated voltage. The secondary winding was subdivided into 66 coils, each of which was further subdivided by cotton tape into four sections. There was a total of 115,920 turns of No. 32 B. & S. double cotton-covered wire in the secondary winding. Each coil was wound in a spool turned from thoroughly seasoned white pine of the very best quality, and carefully selected stock. The outside diameters of the spools ranged regularly from 16 inches up to 32 inches.

The middle of the secondary winding was connected to the core and to the primary winding, and carefully earthed in most of the work which has been done with this transformer, although it has been operated on a number of occasions without earthing the secondary circuit. The primary circuit, supplied with current from a generator which may be regulated as desired, was always earthed for the protection of the operator.

This transformer has been used for three years upon work of investigation connected with various thesis subjects upon which students at the Institute have been engaged, together with some work carried

1. A paper (somewhat abridged) presented in Section B of the International Electrical Congress at St. Louis, September 13, 1904. The author is professor of electrical engineering at Worcester Polytechnic Institute.

2. Primary, 1,000 volts; secondary, 10,000 volts; frequency, 140. Primary had 248 turns. No. 14 B. & S., and secondary 2,840 turns No. 22 B. & S. Core made of No. 16 iron wire.

1. R. S. Beers, F. R. Davis, E. H. Ginn, W. J. Quinn. Thesis, "The Design, Construction and Test of a 500,000-volt Transformer." Worcester Polytechnic Institute, 1901.

out personally by the writer upon the dielectric properties of air and oils. During this time, it has been found necessary upon two or three occasions to cut out a few faulty coils of the secondary winding; but when it is stated that this winding contains about 125 miles (about 200 kilometers) of No. 32 B. & S. wire which was not wound in layers, although each coil may develop from 8,000 to 9,000 volts, this is not surprising. Tests made with this transformer indicate that, with the substitution of a modification of the secondary winding which has been introduced by the writer in transformers of more recent design, a potential of not less than 750,000 volts effective, or over a million volts maxi-

FIG. 3. HIGH-POTENTIAL LABORATORY OF WORCESTER POLYTECHNIC INSTITUTE.

mum, can be secured from this transformer. As soon as suitable opportunity presents itself it is proposed to make this change. The transformer is located in a separate transformer house on the campus of the Institute (Fig. 3) at some distance from other buildings on account of the fire risk occasioned by over a thousand gallons (3,800 liters) of oil required for insulating the secondary winding.

On May 27th of this year an order was placed with the writer for a 200-kilowatt, 300,000-volt transformer, which was shipped to its destination July 18th, and has recently been placed in operation and accepted by the purchaser.[1] As this transformer was designed along lines which will permit its operation at considerably more than its rated voltage and power output, and probably constitutes the largest transformer yet built for very high potentials, the writer has been permitted to give the following brief description:

Fig. 4 shows an assembled view of the transformer core and secondary winding, ready to be immersed in the oil contained in the transformer tank. The connections to the primary and secondary circuits are so arranged as to permit full rated power output at secondary potentials of either 75,000, 150,000 or 300,000 volts, 60 cycles. The maximum ratio of primary and secondary turns is 316, as the primary is designed to be supplied from a 1,040-volt generator. The secondary contains about 33,000 turns of about 42 miles (about 68 kilometers) length of conductor.

On August 15th work was begun upon two transformers which are not yet finished, but of which some information can be given. Fig. 5 shows one coil of the secondary winding, which contains 280 turns of double cotton-covered wire having a section of copper of 0.004 inch by 0.05 inch.

These transformers have been given a preliminary rating of 200,000 volts, but have been designed along lines which should permit of their operation at potentials considerably above this value.

One of the transformers is provided with a removable yoke, so as to permit of its experimental use as an induction coil of large output, when so desired, and both transformers have been provided with extra leads, so as to permit of a variety of combinations for experimental work at the Institute on single, two and three-phase circuits of very high potential. One hundred coils, such as the one shown in Fig. 5, will constitute the secondary winding of each of these transformers, so that each secondary will have a length of about 25 miles (about 40 kilometers) of wire.

Electric-railway Situation in Connecticut.

The annual report of the state treasurer of Connecticut shows that for the first time since trolley development began the tendency toward expanding revenues from street-railway taxes was arrested during the last fiscal year. The contributions of the electric-railway corporations to the state treasury for the year aggregated $250,379, a figure smaller by $1,760 than the amount for the preceding year. Up to the last fiscal year the annual public revenues from this source have displayed a steady and substantial increment, and they grew from $72,952 in 1895 to $252,139 in 1903, when they attained their maximum. The recession of the last year is attributable largely to the decrease in the market value of the securities of the Connecticut Railway and Lighting Company, whose financial operations were impaired by the costly strikes in Waterbury and Bridgeport. The receipts from taxes on steam-railroad corporations for the last year amounted to $1,083,648. That amount surpasses the figure for any previous year and it is equivalent to about one-third of the yearly expenses of the state government.

1. The Locke Insulator Manufacturing Company, Victor, N. Y.

Michigan Electric Association.

Convened for its first annual meeting, the Michigan Electric Association met at the Griswold House, Detroit, on Tuesday, October 11th, upon the call of E. F. Phillips, president, and F. S. Hubbell, secretary and treasurer. About 50 owners, managers and presidents of electrical plants throughout the state were in attendance at the meeting. The session was begun at 10 a. m. Mr. E. F. Phillips of Detroit, general manager of the Peninsular Electric Company, and who is also connected with the Detroit Edison Company, is one of the prime movers and organizers of this association. Mr. F. S. Hubbell, owner of the Milford Electric Company, was mainly instrumental in bringing about the organization, and he has acted as temporary secretary of the association, with Mr. Phillips as president, pending the formal organization. There were a number of supply men in attendance at the meeting. The purpose of the organization is to promote the welfare of those engaged in the electric-light and power business throughout the state.

In his opening address President Phillips made a review of the difficulties encountered in organizing the society and gave credit to Mr. Hubbell. He also recommended that the executive committee for the ensuing year keep close watch on legislative matters, as acts of importance to every central-station company or railway were liable to be passed. He directed particular attention to the Maybury bill, by which it is proposed to confer upon incorporated cities the right to regulate prices to be

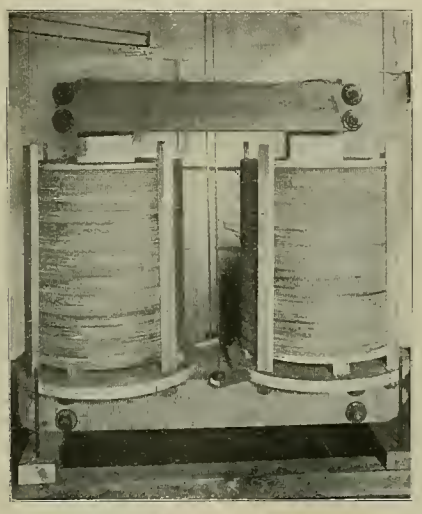


FIG. 4. SIDE VIEW OF 200-KILOWATT, 300,000-VOLT TRANSFORMER OF 1904.

charged by corporations and others engaged in the street-railway, gas, water-supply, telephone or electric-light business. This bill has been printed and sent to every manager or council in every city in Michigan, with a special request that every means within their power be used to secure its passage. The speaker also touched upon the municipal-plant question as one being worthy of attention. He is satisfied that the analysis of many of the reports published would show a greater cost than appeared on the surface or as actually indicated by the published report. An effort should be made to obtain reliable information.

Prof. J. A. Allen of the University of Michigan opened the programme by reading a paper on "Steam Economics," followed by Prof. G. S. Williams of the same institution, who chose as his subject "Waterpower." Each paper was followed by a discussion, and proved of practical value to the members. Professor Williams dilated upon the various ways in which streams might be used to operate small electrical plants. At the afternoon session E. R. Roberts read a paper on "The Nernst Lamp as a Factor in Commercial Lighting." The reading of this paper (presented in abstract on pages 336 and 337) was vigorously discussed by Alex Dow, manager of the Detroit Edison Company, and F. W. Wilcox of the General Electric Company of Harrison, N. J. Mr. Wilcox also read a paper on "Economies in the Practice of the Incandescent Lamp," which was the last paper of the day. In the evening a dinner was given at the Griswold House, after which the association attended the performance at the Lyceum Theater.

On Wednesday morning a general discussion took place and also the election of officers, which resulted as follows:

President—E. F. Phillips, Detroit.
Vice-president—W. A. Foote, Jackson.
Secretary and treasurer—J. E. Davidson, Port Huron.
Executive committee—For one year, B. C. Cobb of Saginaw, A. M. Hemphill, Jr., of Ann Arbor; for two years, Alex Dow of Detroit, S. O. Freshney of Muskegon.
Financial committee—F. S. Hubbell, Milford; E. F. Phillips, Detroit; A. R. McKinnon, Cheboygan.

The next meeting place was not decided upon by the association, its selection having been left to the executive committee, which will meet at some future date for that purpose.

The principal matter of discussion, besides the subjects mentioned, was the question of rates, which are widely at variance. Samuel C. Mumford, assistant treasurer of the Detroit Edison Company, read a good paper on "The Elements of Cost which go to Make Up the Selling Price," and there was an informing discussion. An abstract of this paper is given elsewhere in this issue.

During Wednesday afternoon the gentlemen were guests of the Detroit Edison Company, of which Alex Dow is manager, and were taken to the Delray power house, to inspect an institution of which the citizens of Detroit are justly proud. The ladies were taken for a delightful automobile ride around the city and about Belle Isle. On Tuesday afternoon the Detroit Edison Company had entertained the wives of the delegates with a trolley ride about the city. The successful entertainment of the ladies by the Detroit Edison Company was very largely due to the efforts of Mrs. E. F. Phillips, wife of the president of the association, and there is no doubt that a large attendance of ladies will be insured for the next meeting if this feature is to be made a permanent one. As a whole, the convention was a great success and of much benefit to the members.

National Arm, Pin Bracket and Association.

The National Arm, Pin and Bracket Association met, as was announced, at the Hoo-Hoo House, St. Louis, on the morning of October 11th, and there being only a few members present, an hour and one-half was spent in a discussion as to the price that should be adopted for the welfare of the association, after which the members partook of a lunch served at the Lumbermen's Club, and then spent the balance of the afternoon in seeing the sights at the Fair.

On Wednesday, the 12th, the association met at the same place, with Mr. C. H. Huston, president, in the chair. A motion was made and carried to appoint a member in each locality where much manufacturing is done to correspond with the manufacturers and otherwise get statistics from them, to be reported to the central committee, which is composed of the president, secretary and treasurer of the association. These special representatives were appointed as follows: C. H. Huston, for Tennessee, Georgia, Alabama and North and South Carolina; W. H. Wallaham, for Maryland, West Virginia and Virginia; Marcellus Joslyn, for Missouri, Wisconsin and Illi-

FIG. 5. COIL OF 200,000-VOLT TRANSFORMER OF 1904.

nois; J. B. Magers, for Indiana, Michigan, Ohio and Kentucky; H. A. Culver, for Arkansas, Mississippi, Texas and Indian Territory.

Upon discussion, it was found that a standard price for the delivery of goods to each point was favored, but, after further discussion, this matter was left to the committee to further investigate by corresponding with the members and outside manufacturers. After some minor discussions the association adjourned to meet at the Lindell Hotel at 7 p. m. At this meeting the report of the secretary was read and approved, and the following-named officers were elected: President, C. H. Huston; vice-president, Daniel Ravenell; secretary, J. B. Magers of Madison, Ind.; treasurer, E. J. Noblett, Chicago. It was decided that the next meeting be held in October, 1905, at Baltimore, Md.

The American Diesel Engine.[1]

By E. D. Meier.

Many of your members will remember certain papers published some years ago in regard to the merits of a new invention in prime movers, called the Diesel motor. The claims set forth as to the economy of this device were so large and far-reaching that most practical men received them with a shrug of the shoulders. They were, nevertheless, not only true, but somewhat understated. From the small Diesel motor of 20 horsepower, which gave these remarkable results, has grown, by a natural process of evolution, the American Diesel engine of today, at present built in sizes from 75 horsepower to 450 horsepower.

A short explanation of the working of this engine may be permissible, as many, no doubt, have forgotten the former explanation, while to others the matter may be entirely new.

The Diesel engine is essentially an oil engine, and not a gas engine. Gas engines and previous oil engines which acted on the gas-engine principle have all in common the explosion of a charge. This charge is a mixture of a given quantity of gas, or of a given quantity of oil vaporized so as to act as a gas during the process, combined with a quantity of air varying from seven to 11 times the volume of the gas or vapor. It was well known that some previous compression would add to the economic results of the explosive action. But in all cases the power was obtained by an explosion, which, from the moment of ignition, was beyond control of the operator or of the governing mechanism of the engine. This fact limited the efficiency of all governing devices which could be applied, and troubles with the igniter caused other irregularities, so that even where local conditions made the gas engine (or

225-HORSEPOWER THREE-CYLINDER DIESEL ENGINE AT WORLD'S FAIR.

vaporized oil engine) the worthy competitor of the steam engine, uncertainties of its operation threw doubt on the wisdom of the substitution. Furthermore, a cheap gas, necessitating the installation of a large and cumbersome producer plant, was the only escape from such costly fuels as gasoline or kerosene.

The Diesel engine made the use of the cheapest liquid fuel, such as crude oil, fuel oil and distillates, possible. To these recent experimental developments promise to add the waste product from gas works, known as light water gas tar.

The Diesel engine works on an entirely new principle. First of all, it dispenses with the so-called charge or mixture, which in all explosive engines must vary only between the limits of one gas to seven air and one gas to 11 air. Its cycle is the same as the gas engine, the well-known Otto cycle. There its similarity with the gas engine ends absolutely; in everything else it follows the precedent of the steam engine.

Its first stroke is a suction stroke, drawing in a cylinder full of pure, clean air; on the second stroke it compresses this to a tension and consequent temperature sufficient to ignite any fuel which may be injected into it; at the beginning of the third stroke a small quantity of fuel oil is injected into this red-hot air as a spray by a jet of highly compressed air, and thus, in a completely pulverized state, the fuel meets and mixes with the hot compressed air in the cylinder, burning completely and during a period of time exactly regulated by the governing mechanism of the engine, generally through one-tenth part of the stroke, subsequent to which the stroke is finished by the expansion of the burnt products. The fourth stroke discharges these products of combustion and leaves the cylinder empty and ready for another suction stroke.

It is evident that the work expended in compressing the cylinder volume of pure air is given off again to the shaft of the engine during the combustion or motor stroke, so that the loss is simply the frictional loss during the compression stroke.

The Diesel engines, which are furnishing all the electric light and nearly all the power for the German Tyrolean Alps at the World's Fair, St. Louis, furnish 100 horsepower hours on the switchboard while running at loads varying during the day from one-quarter to full load with a consumption of only 7½ gallons of common fuel oil from Whiting, Ind. At three cents per gallon this means a hundred horsepower per hour at 2¼ cents, or 100 kilowatts per hour at 3.15 cents. While in some localities such fuel oil or crude oil, delivered in carload lots, may cost as high as four cents per gallon, it is readily furnished in many localities contiguous to oil fields at three cents, and even two cents per gallon.

The regulation in the Diesel engine is not dependent on hit or miss, but can be followed up or down the scale as closely as in a steam engine. In the latter it is a question of cutting off more or less from a pretty large volume of steam at each stroke. In the Diesel engine it is the finer one of cutting off a more or less minute quantity of oil from the small volume delivered by the fuel pump at each stroke. It is accomplished by direct action of the governor on the suction valve of the fuel pump, which is held open during a greater or less portion of the pressure stroke, and thus the pump delivers the exact quantity of oil required during each motor stroke of the engine. While the mechanism is necessarily smaller, and more delicate than in the steam engine, it also requires less power and its effect is more immediate.

There remains only the drawback, common to all four-cycle engines, that there is but one motor stroke for every two revolutions. For electric-light work triple-cylinder engines and heavier flywheels successfully overcome this, while for electric-railway work resort is had to still larger flywheels and six cylinders by coupling two triple-cylinder engines at the two ends of the same dynamo shaft.

Discussion.

C. O. Mailloux said that he had been studying the Diesel engine for several years and was intensely interested in it. Mr. Meier, however, had given him a much clearer idea of its operations than he had ever had before. He wished to know what the prospects were for turning out large-sized engines of this kind. Mr. Meier replied that 400 to 500 horsepower were the largest they were then putting in. Two engines are used, having in all six cylinders, the dynamo between the two. It is hoped to get up to units as high as 1,000 horsepower before long.

1. Abstract of paper read before the American Street Railway Association in St. Louis, October 13, 1904.

Electrical Distant-control Apparatus.

Movable parts of machinery are often so situated as to render their control by hand impracticable, and mechanical devices for accomplishing this may be too cumbersome to allow of efficient operation. Electricity may be applied for this purpose to advantage, as shown by its use for the operation of track switches in railroad yards and in various other ways. Max R. Hanna of Schenectady, N. Y., is the patentee of a device for this purpose, which he has assigned to the General Electric Company.

The invention is applicable to controlling the position of the brushes of the motors on a car or train or controlling the position of the movable contacts of rheostats or other regulators and also to the control of many other movable devices. Though the following description applies to controlling the brush position of motors, the invention is in no way limited to this particular application.

In Fig. 1 (S) represents the field or stator of a motor connected through the switch (s) and the line-wires (1) and (2). The rotor (R) is provided with a commutator (C), on which bear the brushes (b). Brush-holder ring (B) has gear teeth cut on its lower side, which are engaged by the worm (D), driven by pilot-motor (M). Thus, as motor (M) revolves, (B) will be rotated in one direction or the other, depending upon the direction of rotation of motor (M), and the brushes (b) will be shifted. Brush-holder ring (B) carries two movable contacts (d) and (d'), which are secured to ring (B), but insulated therefrom and from each other. These movable contacts engage the segments of the stationary commutator (E), which is secured to the frame of the machine. The segments of stationary commutator (E) are connected through the conductors (3) to (9) to the controlling switch (F). The movable contacts (d d') are connected to two terminals of the motor (M), the other terminal of the motor being connected to the controlling switch (F). Controlling switch (F) comprises 10 stationary fingers (f') to (f^{10}) and 10 movable contacts (g') to (g^{10}). With the controller in the position shown and with switch (s) closed there is no tendency for the motor (M) to rotate. By the diagram it is seen that the current from motor (M) is flowing in parallel through the two leads connected to (d) and (d').

The motor is so arranged that when the current is flowing through both of these leads there is no tendency for the motor to rotate. Now if controlling switch (F) is moved in one direction or the other—as, for instance, toward the left until contact finger (f^2) engages contact (g^2)—it will be seen that the circuit through movable contact (d') is broken, since the connection from switch (s) through the controller (F) has been shifted from contact finger (f') to contact finger (f^2), and consequently from conductor (6) to conductor (5). Movable contact (d) is in engagement with the commutator segment to which conductor (5) is connected. Consequently current will flow from the motor through movable contact (d) alone. The motor will revolve, rotating brush-holder ring (B) in a counter-clockwise direction and will continue to revolve until movable contact (d') makes contact with the segment to which conductor (5) is connected. At this instance both movable contacts (d) and (d') are in contact with the same segment. Consequently current again flows through the two in parallel, and the motor ceases to rotate. As controller (F) is shifted to another position the same operation is repeated.

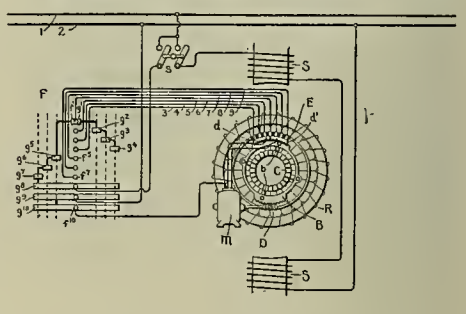
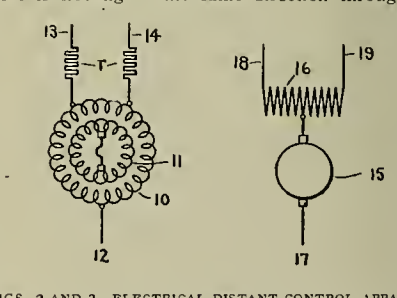


FIG. 1. ELECTRICAL DISTANT-CONTROL APPARATUS.—DIAGRAM OF CONNECTIONS.

Thus it will be seen that each position of the controller corresponds to a certain position of the motor brushes, and by simply moving the controller to any one of its positions motor (M) will automatically bring the brushes of the large motor to the proper position and will then stop. Furthermore, it is evident that the brush-shifting devices and pilot motors for any number of main motors may be connected to a single controlling switch (F). The brush position of any number of motors may be controlled from a single point.

Fig. 2 shows a form of motor adapted to perform the functions of the pilot motor (M) when the source of supply for the pilot motor is alternating current. The motor, as shown in Fig. 2, has a primary member (10) and a secondary member (11), provided with short-circuiting commutator brushes. Two leads (13) and (14) are provided for connection to the movable contacts (d) and (d') in Fig. 1. The motor acts as a repulsion motor when either lead (13) or (14) is carrying current, the line of magnetization of the primary member being displaced in one direction or the other from the line of the short-circuiting rotor brushes. When current is flowing in the same direction through both leads, the resultant magnetization is parallel to the line of the short-circuiting rotor brushes, and consequently there is no tendency to rotation. Resistances (r) may be inserted in the leads (13) and (14) to reduce the amount of current flow.



FIGS. 2 AND 3. ELECTRICAL DISTANT-CONTROL APPARATUS.

Fig. 3 shows a motor adapted to act as a pilot motor when the source of supply for the pilot motor is direct current. The motor has an armature (15) and a field (16), the armature being connected to the middle of the field and the leads (18) and (19) to the two ends of the field winding. If current is flowing in both leads (18) and (19), the magnetic effects of the two parts of the field oppose each other, and there is no tendency to rotation. If either of the leads alone is carrying current, one-half of the field (16) is operative and the motor revolves in one direction or the other, according to which half of the field is energized.

Differential Registering Kinemometer.

By Emile Guarini.

Following researches and experiments touching the starting and mounting in parallel of two alternators —researches and experiments which led to the recognition of the fact that abrupt changes in the velocity took place, the extent of which it was important to determine—the Société Internationale des Electriciens (the International Society of Electrical Engineers) offered a prize for the construction of an apparatus able to register 1/250 of a revolution of an engine running at an angular velocity of 125 revolutions per minute. In consequence of this offer Mr. J. Richard of Paris conceived the idea of constructing a practically controlled isochronic regulator, and of making a kinematic system which would enable all speeds to be placed in equilibrium by returning them to zero. He had already constructed prior to this a kinemometer, which is pretty generally in use, for determining the angular velocity of engines. This instrument gives the quotient of the space traversed, divided by the time. This result is attained by means of two surface plates rotating in opposite directions, and carrying along with them a friction roller operated by a system of helical and tangential gearing.

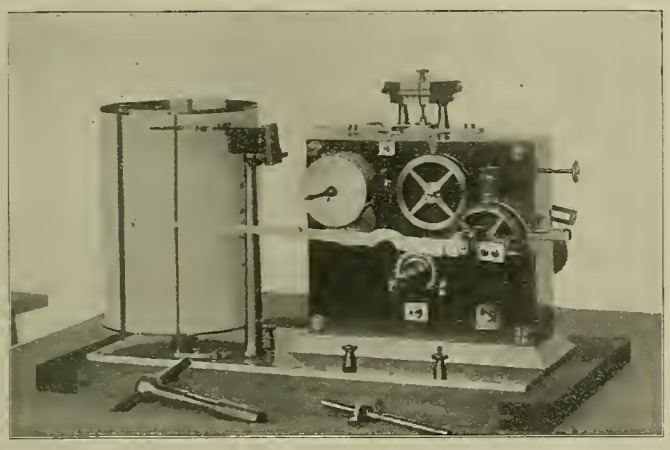
The special aim of this new apparatus is accurately to determine the various angular fluctuations continually engendered during the revolution made by a machine. This interesting appliance will, undoubtedly, enable the industrial world to make some very important observations in connection with the abrupt variations in speed which occur on starting and coupling alternators in parallel. A brief description may here be given of its construction.

A clockwork mechanism, rendered uniform by an isochronic regulator, transmits its motion to two interconnected friction surface plates. Upon the shaft of the balance gear there is placed a needle, provided at its extremity with a pen that rests upon a registering drum. The apparatus is motionless when the angular velocity is regular, but when it increases slightly the needle of the registering apparatus is raised a little. To render the entire system motionless again it suffices to turn a small knob and a graduated arm, connected thereto, indicates the angular velocity in the number of revolutions and fractions thereof per second, while the stylus of the registering device inscribes the variations in degrees of the circle. The whole of the circumference is represented by a travel of the registering needle of about 83 centimeters. Upon the paper a travel of 0.5 millimeter can be very easily read off, and it will thus be apparent that 1/250 revolution is represented by 3.3 millimeters.

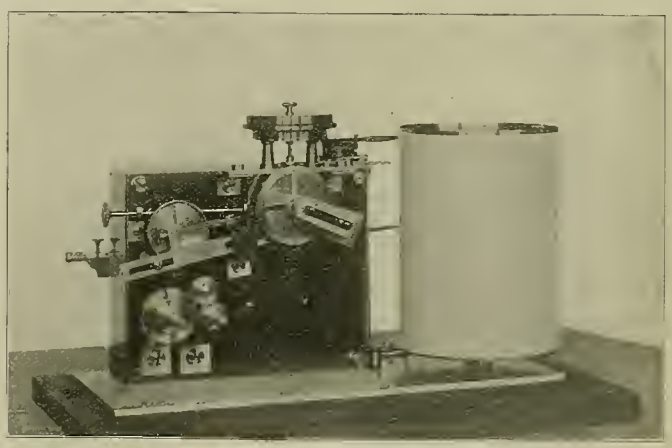
In order to regulate this apparatus recourse has been had to a heavy flywheel, which, after being placed in motion by a machine, revolves with great regularity. After waiting till full control has been established known errors are created by means of a differential system governed by a lever traversing the field of a dial-plate divided up into divisions of a circle. It thus becomes possible to verify the divisions indicated by the apparatus.

The method of operation is of the simplest kind. When it is desired to know the regularity of a machine, the apparatus alone is placed in motion. Care is taken to see that the seconds hand travels exactly over 60 divisions in 60 seconds. If in advance or in arrear a turn or two is given, by means of a suitable tool, to the screws controlling the regulator springs. It is necessary that the needle should always travel with perfect regularity. The shaft of the machine is then connected to the axle operating the shaft of the differential mechanism, and the speed is equilibriated by the aid of a milled knob, which, by means of a tangential screw, carries along with it a carriage upon which there is mounted on one side an axle and pinion, and, on the other side, a friction roller that is slightly compressed by a system of plates, which, in their turn are governed by the isochronic regulator. The pinion, in its turn, controls the differential mechanism. The milled knob thus serves to cause the friction roller to approach or recede from the center of the plates and to give it a speed that will counterbalance that of the engine. By means of a spring pedal the needle of the registering device, which has two slide blocks, is afterward caused to engage a finely toothed crown wheel mounted upon the axle of the differential mechanism. The slightest variation is revealed by an upward movement of the needle, if the angular velocity of the engine increases, or by its descent if such velocity decreases.

Thus, as may be gathered from the above short description, the new apparatus introduced by Mr. Jules Richard has for its main object to reveal the various angular deviations that continually occur in an industrial driving engine between its own shaft and that of a similar ideal motor running at the same mean angular velocity as the engine under consideration, but still observing a perfectly uniform movement.



Front View.



Rear View.

DIFFERENTIAL REGISTERING KINEMOMETER.

Elements of Cost Which Go to Make Up the Selling Price of Electric Current.[1]

By Samuel C. Mumford.

It is necessary to adopt some kind of differential-rate scheme, if you wish to put yourself in a position where you can offer and furnish current at a gradually reducing price. You must charge more for the "short haul" than for the "long haul." It costs just as much to load and unload for one as the other. We must know what it costs to get ready to produce and distribute electricity into which cost enter taxes, rents, insurance, interest on bonds, interest on floating debt, general expenses, cost of maintenance and repairs, and everything which is required to keep the system in shape, whether in operation continuously or not.

Obviously, now, with all these expenses to be met before the machinery is started, the cost of operation for one hour a day, say, between five and six o'clock at night, when nearly every customer is using some electricity, is greater than in the second, third, fourth and following hours, when the only additional expenses are for actual generation and distribution, the latter a trifling expense. A rate can be figured out which will require the customers (taking them collectively) to pay their share of all these regular or fixed expenses, together with the cost of generation and distribution plus a moderate profit, in from one to two hours' average use per day. After this result is obtained it only remains to make a rate which shall cover the cost of additional supplies, wages, etc., for generation and distribution, with a margin of profit thereon.

Rates should always be as simple as possible in any business. Customers readily grasp this differential-rate idea. It is surprising to see how readily they appreciate its advantage for them. They are constantly trying "to get more of that current" at the low rate and throwing out other illuminants.

We charge 16 cents per unit (equal to 20 lamp-hours) for the first 60 hours' use of the maximum demand of a customer, per month, billing the excess of current used at five cents a unit. We give a discount of 10 per cent. on bills up to $50, 15 per cent. for $50 to $100, and 20 per cent. on bills of $100 and over.

We make two exceptions to the above "open" or standard rate. When a customer will contract to pay at 16 cents per unit for a certain amount of electricity for at least 30 hours per month, whether he uses it or not, we charge the excess used above 30 hours at the lower rate.

We make another exception to the standard rate in our continuous factory power, which is sold at five cents a unit, with the customary cash discounts. This is about the same as the regular 30-hour demand rate, mentioned above, would work out, the lamp-renewal expense being, of course, omitted.

We have increased our business tremendously in the last five or six years, and while the service has been maintained at a high standard—and extended as well—we lay a great deal to adopting this differential system, which seems adapted to almost any condition.

We ascertain the "demand," or maximum use by customer at any one time, as follows:

Connected Load.—Where the maximum demand is really equal to the connected load.

Demand Meters.—These record the highest number of amperes used at any one time. (We have used a recording amperemeter which shows the variation in load right through the 24 hours. This is only used, however, on suspected current thieves and for difficult investigations, where a leak is apparent from customer's statement. The advantage in its use for such cases is obvious.)

Residence Demand.—Based on number of rooms in the house.

I can best show the working of our differential-rate system by an example. Say a customer uses 1,000 units of electricity, equal to 20,000 lamp-hours in a month. He has 100 lamps installed. On our "open order" he would pay for the first

600 units at 16 cents	$96.00
400 units (balance) at five cents	20.00
	$116.00
20 per cent. discount	23.20
Net bill	$ 92.80

Had he used 2,000 units, he would have been charged for

600 units at 16 cents	$ 96.00
1,400 units at five cents	70.00
	$166.00
20 per cent. discount	33.20
Net bill	$132.80

In the first case he pays 9.28 cents per unit; in the second 6.14 cents. Thus the rate per unit gradually reduces, though, of course, never below the second or lower rate.

As the average use per day of the company's maximum capacity increases, the opportunity is offered to extend business and ward off competition by reduction of rates. This may be done by a reduction of the higher rate, in which case a more liberal use of electricity by people of moderate means is the result. In the second case business is developed among large consumers.

There are many objections to a fixed rate per unit. There is the old familiar bugbear which arises every time you charge a man a certain sum when he could use more light for less money. Then there is the constant pressure for special rebate. Any special private rebate is dangerous, whether granted by a railroad, a commercial house or a lighting company. It tends to destroy the integrity of grantor and grantee and to make a hodgepodge of the business.

1. Abstract of a paper read before the Michigan Electric Association at Detroit on October 12, 1904. The author is assistant treasurer of the Detroit Edison Company.

The Chicago and Milwaukee Electric Railway Company, in its report for the month of September, shows gross earnings of $53,711 and operating expenses amounting to $17,395. The net earnings show an increase of $5,215 over September, 1903.

WESTERN ELECTRICIAN

EVERY SATURDAY.

PUBLICATION OFFICES:
510 Marquette Building, · CHICAGO.
TELEPHONE, MAIN 1746.

Eastern Office, 193 Times Building, New York.
Telephone, 3806J Cortlandt.

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted. This paper is entered at the Chicago postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the **old address** as well as the new should be given.

CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—**the only general electrical paper published in the West**—thoroughly covers a territory *exclusively its own.* THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be furnished on application.

REMITTANCES.—All checks, drafts and other remittances should be made payable to the order of the publishers, the **Electrician Publishing Company,** and addressed to the offices of publication, Suite 510, Marquette Building (204 Dearborn Street), Chicago, Illinois, U. S. A.

CONTENTS OF THIS NUMBER.

Street-railway Men in Convention at the World's Fair. Illustrated 325
W. Caryl Ely. Portrait 325
C. F. Baker. Portrait 325
Central-station Advancement in Boston 326
Death of A. B. Cornell. Portrait 326
Notes on Experiments with Transformers for Very High Potentials. By Harold B. Smith. Illustrated. (International Electrical Congress) 326, 327
Electric-railway Situation in Connecticut 327
Michigan Electric Association 327
National Arm, Pin and Bracket Association 327
The American Diesel Engine. By E. D. Meier. Illustrated. With discussion. (American Street Railway Association) 328
Electrical Distant-control Apparatus. Illustrated 328
Differential Registering Kinemometer. By Emile Guarini. Illustrated 329
Elements of Cost Which Go to Make Up the Selling Price of Electric Current. By Samuel C. Mumford. (Michigan Electric Association) 329
Editorial 330
American Street Railway Association. (Convention at St. Louis, October 12 and 13, 1904) 331, 332
Street Railway Accountants' Association. (Convention at St. Louis, October 13, 14 and 15, 1904) 332, 333
Facsimile Letter Writing by Wireless 333
Steam-turbine Power Plants. By J. R. Bibbins. Illustrated. With discussion. (American Street Railway Association) 334, 335
Steam-turbine Power Plants. By J. R. Bibbins. With discussion. (American Street Railway Association) 334, 335
World's Fair Visitors of Last Week 335, 336
The Nernst Lamp as a Factor in Commercial Lighting. By E. R. Roberts. Illustrated. (Michigan Electric Association) 336, 337
Ohio Telephone Notes 337
Telephone News from the Northwest 337
Southeastern Telephone Developments 337
Independents Must Deal with City Council in Cincinnati 337
Long-distance Connections with Kansas City 337
General Telephone News 338
Manufacturers and Dealers 338
Police Telephone Call Boxes in New York City. With portraits of M. R. Brennan and F. C. Mason 338
Annual Report of Western Union Telegraph Company .. 339
Electrical Securities Corporation 339
Electric Derail System 339

DEPARTMENTS.

Correspondence 339, 340, 341
Great Britain 339
New York 339, 340
New England 340
Southeastern States 340
Ohio 340
Michigan 340
Northwestern States 340, 341
Pacific Slope 341
Personal 341
Electric Lighting 341
Electric Railways 341, 342
Power Transmission 342
Societies and Schools 342
Publications 342
Telegraph 342
Miscellaneous 342
Trade News 342
Illustrated Electrical Patent Record 342, 343, 344

VISITORS to the Louisiana Purchase Exposition at St. Louis who are interested in electricity or electrical literature are cordially invited to call at the booth of the Western Electrician, which is in Block 1 (Section 13) of the Palace of Electricity, just west of the main northern entrance to the building. Here will be found copies of the current issue of the paper, bound volumes of the Western Electrician from the first number, a careful selection of electrical books exhibited by the Electrician Publishing Company, and other objects of electrical interest. Chairs are provided for weary sight-seers, and an attendant will extend a hearty welcome to all readers or friends of the paper.

ACCORDING to the views of a recent writer, the street car is doomed sooner or later to give place to the automobile. He gives as the grounds for his reasoning that five years ago there were but few automobiles, while during the last 12 months the output is alleged to have exceeded the value of all the locomotives built in America by $20,000,000. He gives as a further reason that the cable car, once the popular means of transportation in cities, has almost disappeared, giving place to the electric car, which, in the ordinary course of events, must be superseded by more modern means of travel; this means to be the automobile. That this prophecy will be fulfilled seems hardly likely. No matter what the means of locomotion, the steel-rail track will always prove, in all probability, the best path for a vehicle to travel, with the exception of the air, and the least consuming of power. For economical operation, the combination of dirt, asphalt or macadam roads, all more or less rough, and rubber-tired or other forms of wheels will never be able to supplant the street car, because of the much greater amount of power required for operation. This is also leaving out of account the economies effected by generating the power in a central station.

IN a paper on the "Radioactivity of Mineral Oils and Natural Gases," by Prof. J. C. McLennan of Toronto University, presented to the recent International Electrical Congress at St. Louis, there is an interesting estimate, on the assumption that the active emanation present in natural gas is produced from radium, of the amount of the latter requisite to account for the conductivity observed. The highest conductivity observed in Professor McLennan's observation was that obtained with the gas from a well near Brantford, Ont. The author gives a calculation to show that every 5,000,000 cubic feet of gas produced by the well would correspond to the existence of radium at its source of approximately the amount contained in one gram of radium chloride. The discovery of a natural gas so highly charged with a radioactive emanation as that observed presents a number of interesting features. It is possible that other gases still more highly charged may be found, and as it should not be difficult to concentrate the active constituent, additional light may be thrown by this means upon the various stages of the process of disintegration brought forward and developed by Rutherford and Soddy as an explanation of radioactivity. The presence, in the natural gases studied, of nitrogen in such large proportions, should also not be overlooked. Professor McLennan thinks that it is possible that a portion of this gas, on closer examination, may prove to be helium, and if so, additional support will thereby be gained for the disintegration theory.

IT is doubtful whether the advantages of exposition conventions outweigh their disadvantages. The advantages are the attractions of the Exposition as a drawing card to secure large attendance and the opportunity to study the exhibits. But, on the other hand, the very attractions of the big show serve to distract the attention of delegates and visitors from the business which brings them together. The street-railway conventions at the St. Louis World's Fair last week furnish a case in point. Manfully the gentlemen in attendance, or many of them, strove to withstand the allurements outside the convention hall. During the first two days, when the master mechanics were in session, the attendance was good and the discussions were lively and participated in by a considerable proportion of those present. But as the week wore on, at the conventions of the American Street Railway Association and the Street Railway Accountants' Association, it became more difficult to hold the attention of the delegates down to business. There was, it is true, a large attendance at the meetings of the parent association on Wednesday and Thursday, but there seemed to be a general restlessness and anxiety to get away. But four papers were presented on these days, and these were but meagerly discussed. Two of these related to steam turbines—one from the Westinghouse and the other from the General Electric point of view—and a third had to do with the Diesel engine. Considerable business was transacted, however, one commendable act being the modification of the curious censorship resolution of last year, by which not the "proceedings" but simply the "verbal reports of discussion" are to be censored hereafter before publication. A still more sensible course would have been to rescind the archaic procedure altogether, for censorship smacks of the terrors of wartime, while, happily, in this year of grace, we have nothing more warlike in the United States than the muffled thunders of a presidential campaign.

MICHIGAN has been added to the number of states possessing organizations of central-station men. After two preliminary meetings the Michigan Electric Association held its first full-fledged convention in Detroit last week, with an attendance of about 50 owners and managers of electrical plants throughout the state. The organization is due largely to the energy and enterprise of Mr. E. F. Philipps of Detroit and Mr. F. S. Hubbell of Milford. Mr. Philipps, who is widely and favorably known to central-station men throughout the country, was elected to the office of president, having acted as chairman of the meetings previously held. Several good papers were read, and there was intelligent and interesting discussion of them. Especial attention was given, very naturally, to the subject of rates, in the equitable adjustment of which associations of central-station men are particularly useful to their members. An abstract of Mr. Mumford's practical paper on this subject is given in the present issue of the Western Electrician. The Detroit Edison Company was attentive to the delegates, and there was especial entertainment for the ladies, of whom a gratifying number were in attendance. Altogether, the new organization had reason to be well satisfied with its first convention. The Michigan Electric Association is heartily welcome to the fraternity of electrical organizations, and we trust that its career will be as successful as its first convention leads one to believe.

THE interesting suggestion that the steam turbine be combined with the reciprocating engine for power-station work was again made in the discussion of the turbine papers presented before the convention of the American Street Railway Association last week. In a recent paper Mr. W. L. R. Emmet brought out the same point. Since, he says, the best steam turbines so far developed give degrees of economy about equal to those of the best steam engines, and since the turbine works in a larger field of available energy, it may naturally be inferred that the steam engine within its own range of action is more efficient than the steam turbine, and this to a certain extent is true. This fact naturally suggests a combination which undoubtedly has a large field of application, namely, the use of low-pressure steam turbines taking exhaust steam from existing reciprocating engines. The most advantageous conditions for the combined use of reciprocating engines and steam turbines, continues Mr. Emmet, will be found in existing steam plants where reciprocating engines are used to operate electric generators separately or in parallel. In such plants low-pressure steam turbines can be installed and can be arranged to take steam directly from the exhaust pipe of engines without valves or governing mechanisms. The steam turbine should operate a generator adapted to connection in parallel with that driven by the engine. A turbine designed for operation under these conditions would be an ideally simple affair and its maintenance and care would add little to the cost of station operation. There are many large stations in which the introduction of such turbines with proper condensing facilities, it is contended, would increase the output as much as 30 per cent. without any increase of the fuel consumption or change in the boiler plant. The cost of installing such turbines with complete condensing facilities should not exceed $60 per kilowatt of capacity added to the station, adds Mr. Emmet.

It will be interesting to observe to what extent this combination is adopted by power-station managers. Perhaps, after all, the turbine is destined not to supplant the piston engine in large electrical generating plants, as some of its advocates declare, but to work alongside of it, and in conjunction with it.

AMERICAN STREET RAILWAY ASSOCIATION.

The American Street Railway Association held its twenty-third annual convention on October 12th and 13th on the grounds of the Louisiana Purchase Exposition in St. Louis. Convention Hall in the Transportation Building, as with the Railway Mechanical and Electrical Association convention on the two preceding days (reported in the Western Electrician last week), was the place of meeting. Several men of note were in attendance at the opening session and favored the delegates with addresses, which were commendatory of the association and the interests which it represents.

President W. Caryl Ely of Buffalo called the meeting to order and presented as the first speaker the Hon. D. R. Francis, president of the Louisiana Purchase Exposition, saying that it was due to his efforts that the Exposition was held in St. Louis.

President Francis' Welcome.

President Francis then addressed the assemblage, and before his speech was concluded there was probably not one of those present who had not a clearer and better conception of what it means to plan and execute such an undertaking and of the ideal toward which its promoters were striving—the education of all comers. As a preface to his subject Mr. Francis said that he was there not only as president of the Exposition but as a street-railway man as well. About 10 years ago he made his first venture in the construction of electric railways by the building of a line east of the river near St. Louis. This line was extended until it reached the city of Alton, and eventually will very likely extend to the Atlantic Coast and possibly to the Pacific!

When he made his trip to Europe in the interests of the Exposition he thought that an intramural railway at the Fair was an assured thing; a line which would be inside the grounds but which would connect with the city transportation system and be operated by it. When he came back he found that the plan had been abandoned. People even thought the crowds within the grounds could be handled by automobiles. The only thing remaining therefore was to build an electrically operated railway which should be owned by the Exposition. This was done and everyone who has visited the Fair knows the result.

The gauge of this road is four feet 8½ inches as against the standard gauge of four feet 10 inches of the city street-railway lines. The road has been in operation every day except Sundays since its completion, and no one has been killed and no more than three injured by it. It has carried on the average 55,000 persons a day, or nearly 55 per cent. of the paid admissions to the grounds, and is altogether one of the best sources of revenue which the Exposition company has.

Without electric street railways, Mr. Francis further stated, they never could have operated the Exposition, and all this goes to demonstrate what a factor railways are becoming to the progress of the community. A new epoch is marked by them. The Exposition was therefore very proud to welcome the representatives of such a great industry, and that industry has by no means as yet reached its peak. One of the great problems confronting the builders of the Exposition was that of getting the visitors, to and fro between the city and the grounds, and there was at first a seeming want of confidence on the part of the public in the ability of the street-railway companies to do this. But the people have stood back of the street-railway companies and given them their good-will and the companies in their turn have demonstrated their capability.

Mr. Francis made an excellent speech, which was appreciated. President Ely thanked him for his words and went on to say that St. Louis was fortunate in securing such a man to be at the head of the Exposition. It is a hard position to fill. A man must practically give up his business and family life for several years to accomplish such a work. Mr. Francis has entered into the spirit of the work in a most stirring manner and "has made a name and fame which will be perpetuated as long as English tongue speaks English words."

Prof. Goldsborough's Welcome.

Prof. W. E. Goldsborough, chief of the Department of Electricity, was next introduced. In speaking of the Exposition work in the line of electricity Prof. Goldsborough said that the main feature in the beginning was the exhibition of processes and the question was how these processes were to be presented in the best way to appeal to the engineer on the one band and the scientist on the other. He then went over briefly the things of interest to be seen at the Fair from an engineering point of view. In the Machinery Building the units are not of the very largest, but there are a large variety which are of the most modern kind. He regretted that there was no great gas engine, as was anticipated.

In the Electricity Building the object was to show operation and to have no piling up of exhibits of idle machinery. Among the most interesting and most valuable exhibits to study was that of the National Bureau of Standards. This probably contains the best collection of calibrating instruments ever brought together and has been of the greatest value to the jury of awards in pursuing its work of judging the merits of the various types of machinery.

He thought it might be well to investigate the exhibits of space telegraphy, inasmuch that some day the operators of very long interurban lines might need to use it to communicate between the main office and cars out on the line.

The promoters of this great Exposition have had to measure their strength against the many problems which have arisen. The unwritten history of electrical engineering is one of great achievements, but the trials by which these have been accomplished are buried in the hearts of those who have grappled the great questions of their lives.

Mayor Wells' Welcome.

Another speaker on this occasion was Mayor Rolla Wells of St. Louis. He was delayed for a short time, but arrived immediately after President Ely had finished his address. Mayor Wells looked upon the street-railway men as his colleagues, for during his early years he was engaged in the work. His father constructed the first street railway west of the Mississippi. This was a horse-car line built in St. Louis and put in operation July 4, 1859, and Mayor Wells, then 22 years of age, was made general manager of the company. He believed that the success which the Exposition has achieved has been due largely to the intelligent interest which has been taken in it by the owners and managers of the street-railway systems in St. Louis.

President Ely's Address (Abstract).

The American Street Railway Association year now drawing to its close has witnessed many things of supreme interest to the electric-railroad world. During the present year the New York Central and Hudson River Railroad Company has matured its plans for the electrification of its great trunk lines entering the city of New York and the lines radiating therefrom for a distance of 35 miles; the Pennsylvania Railroad Company has determined upon the electrification of that section of its line which will enter the city of New York in two great subterranean tunnels underneath the waters of the Hudson River; the Schenectady Railway Company has begun the operation of cars propelled by means of single-phase alternating-current motors in regular service carrying passengers, and the General Electric Company at the recent meeting of the New York State Street Railway Association at Utica has exhibited in practical operation a car propelled in part over the tracks of a city system by direct current and in part over connecting interurban lines with the single-phase alternating current. Purchases of street and interurban electric-railway systems of considerable magnitude have been made by the New York Central and Hudson River Railroad Company in the central portion of the state of New York, and this great corporation has announced its intention of electrifying a portion of its West Shore railroad tracks in connection with the street and interurban railway systems thus acquired.

The electrification of the Manhattan Elevated railway system, which was finally completed in June, 1903, in which month the last steam train was taken off, has during the last year enabled a direct comparison to be made between the operation of the system by electricity and steam. It has been determined that the substitution of electricity has increased the carrying capacity of the road 33 per cent., as indicated by the actual increase in car mileage; the passenger traffic has been increased 30 per cent.; the operating expenses have decreased from 55 per cent. of the gross receipts in 1901 to 45 per cent. in 1903, and all obnoxious vapors, smoke, steam and cinders incidental to steam-locomotive operation have been eliminated from the streets traversed by the railways of the system. The wisdom of the enormous expenditure of money necessary to make the change has been fully demonstrated by the benefits which have inured not only to the people of the city but to the intelligent management which at such great cost made the change.

This great system, which carries nearly a million of passengers each day, has been leased to the Interborough Rapid Transit Company, which during the last four years has been engaged in constructing underneath the city of New York a vast system of subways, which are now completed, and a portion of which will be put in operation during this present month. This system comprises 15 miles of subway and five miles of elevated structure, providing for 63 miles of single track to be electrically operated by the protected third-rail system and trains operated by the multiple system of train control. But little over four years have been occupied in the construction of this great work, and when the difficulties encountered beneath the streets and the buildings of the great metropolis are taken into consideration in connection with the magnitude of the work itself it is to be doubted if the record made in this construction has ever been equaled in the history of engineering or construction achievements.

For a number of years past there has existed a feeling and an opinion that the growth of the interests which had come to be represented by this association required a remodeling of the form and scope of our organization and its work. The first visible effect of this growing feeling was the formation about eight years ago of the Street Railway Accountants' Association of America, an auxiliary association with a membership comprised of the accountants of the different companies, members of this organization.

Within the last three years the feeling has been further evidenced by the organization of another auxiliary association, the American Railway Mechanical and Electrical Association, with a membership composed of the mechanical and electrical engineers of our companies.

During the last year the project of still another subsidiary organization, with a suggested membership of electric-railway engineers and superintendents has been actively agitated through the medium of correspondence between various officials of different companies and to a limited extent in the columns of the technical press. The discussion of the advisability of the formation of this third auxiliary association or of rendering the same unnecessary by enlarging the scope of the American Railway Mechanical and Electrical Association sufficiently to include not only the engineers and superintendents of way, but also several other important branches of the business wherein the need of investigation, comparison and discussion had come to be recognized has finally involved the discussion of the main question, namely—that of a reorganization of the parent body. A very ingenious and well-considered suggestion in this regard emanated from the superintendent of construction and maintenance of way of the Milwaukee Electric Railway and Light Company. An outline of that plan was printed in the street-railway papers several months ago and has been quite extensively commented upon.

At Saratoga last fall there was an open and avowed expression of desire for a change in the method of conduct of association affairs and the scope of association work, and a discussion of nearly two hours' duration in the session of the executive committee brought out warm expressions of hope for work along new lines and not a single voice was raised in opposition. Later on debate upon the subject was precipitated during the discussion of one of the papers in the convention and reference to the minutes of the last convention reveals the fact that while several of the leading members of our profession spoke in favor of a change, not one person spoke against it. The discussion in the convention resulted in the matter being duly referred to the executive committee with broad power to act. The first branch of the case taken up by the executive committee was a proposition to relieve the association of the duty of preparing space and arranging the details of the installation of the exhibits of manufacturers of electric-railway supplies held annually at our conventions and in connection therewith. This duty has of late been almost, if not quite, the most onerous and difficult devolving upon the secretary's office and has consumed the greater amount of that officer's time. The supplymen's exhibition has grown gradually from small beginnings and latterly has come to be one of considerable importance, occupying a large amount of room, and the preparation of space and making of arrangements for the accommodation of such exhibits. Allotting space to individual exhibitors and collecting the revenues therefrom has called upon the officers of the association for the performance of duties not within the scope of the work of the association as the same is defined by the constitution and by-laws. The proposition to rid the association of all care in relation to this exhibit and to leave it to the supplymen themselves was informally discussed at Saratoga, and several energetic and intelligent gentlemen at once took great interest in the matter and effected an informal organization to take up the work in an orderly and effective way, and proceeded to sound the manufacturers as to their views. Upon investigation it was found that the manufacturers themselves for the most part were perfectly willing to take the burden off our hands and to assume and perform the whole task without any cost of time or money to this association. In May last a formal organization was effected and a committee was organized representing the technical press and a number of prominent manufacturers. This committee formulated a circular explanatory of their plan and distributed the same extensively, with the result that a large number of manufacturers have already come forward and joined the association and others have expressed their intention so to do. It is proposed that the function of this Manufacturers' Association will be to take the entire charge of making the annual exhibit, and in addition to this the manufacturers' committee has suggested that it would be their desire to do something in the way of entertainment, subject in every way to the wishes of the officials and executive committee of this association and with their complete sanction and co-operation. This matter has received the sanction of your executive committee and a report will be made to this convention expressing the satisfaction of your executive committee with the change.

It would be quite proper to mention at this time the fact that this manufacturers' committee procured the beautiful badges for this convention and presented them to our association, and also provided the attendance of Reeves' celebrated band of Providence throughout the entire convention week to supply music at our various meetings and entertainments.

Furthermore, all of the entertainment which is noticed in the voluminous programme of the convention has been provided by this committee. All of this has been done with the knowledge and approval of your executive committee.

The desirability of this change which is now suggested by your executive committee seems so obvious as to require no argument or explanation from me. When this association in convention assembled shall have approved of this action of your executive committee and the holding of this exhibit shall have been entirely divorced from the work of the association, then the association will be in much better condition for the performance of its legitimate work.

Reference has been made by me to the creation of certain subsidiary or auxiliary associations and the desire for the creation of still others. This thing cannot go on indefinitely or we will be confronted with a large number of organizations, each pursuing its solitary way unmindful of the others, until finally all will be chaos and we will be involved in an intricate maze of technical work, the value of which, owing to its chaotic state, will largely be lost. We should therefore, it would seem, at this time take up the matter of a reorganization of the entire work. I will not attempt to outline any plan for such reorganization or reformation of the lines of work. That should undoubtedly be left to the committees of the different organizations, working together with great care and deliberation and taking all the time necessary to bring about a satisfactory result. Since assembling here for this convention representatives of the auxiliary associations have met with your executive committee and important action has been taken in this regard, which will be duly reported for your approval.

A careful inspection of the proceedings of the conventions of the last few years reveals the fact that the most of the time of each convention has been occupied with the reading and discussion of papers embracing subjects which for the most part relate to the small technicalities of the business, nearly all of which might have been profitably committed to proper auxiliary and subsidiary organizations. Broad fields of co-operative effort in the most important lines of our work have remained almost untouched. It becomes immediately apparent upon investigation and discussion of the situation that we might profitably enter upon the discussion of the greater questions affecting our welfare. The confusion of laws throughout the country affecting our corporations is a matter to which we might well devote attention. There are also such great questions as taxation, municipal ownership of street railways, franchise rights and obligations, statutory laws affecting our class of companies, municipal laws and ordinances, and other questions of importance to which your minds will readily refer. The collection and preservation of data tending to throw light upon the problems of great importance that confront us is also a matter deserving of attention, and in this regard it would seem that through the medium of the secretary's office and of appropriate standing committees an invaluable collection of data could be made and permanently preserved in such form as to be conveniently accessible to any member of the association upon merely making request of the secretary. If the work of the secretary's office should be made continuous there would thus grow up in time a vast repository of valuable statistical and historical information readily available as matter of right to every member. This branch of the work alone, if properly prosecuted, would render membership in this association so valuable that it is difficult to understand how any street-railway corporation would feel justified in remaining outside of this association. It is our duty to keep in step with the changes in conditions that confront and surround us; we must be in synchronism with the spirit of things; we must not hesitate to make necessary and beneficial changes, nor should we be deterred by our consideration of the past.

Executive Committee Report.

Following the president's address, the report of the executive committee was read by Mr. T. C. Penington, secretary of the association. The report was for the most part the ordinary routine business of the committee. At a meeting of the committee on October 11, 1904, at the Southern Hotel, a resolution was passed which was of considerable importance. During the last few years many have thought it desirable to rearrange the lines and methods of work of the association and its auxiliary organizations, in order, through the medium of these auxiliary organizations and such others as may be formed to widen the scope of the parent association. These views led to the adoption of the following resolution:

"Resolved, That it is the sense of the executive committee of the American Street Railway Association, in a formal meeting assembled, that it is desirable that a closer working arrangement should be effected between the different organizations conducting street-railway work, and to that end be it further

"Resolved, That the executive committee of the American Street Railway Association hereby recommends to its convention about to be assembled such amendments to its by-laws as may be necessary to provide for increase in the size of its executive committee sufficient to accommodate as members thereof, by virtue of their office, the presidents of such auxiliary organizations engaged in street-railway work as may be approved and fostered by the American Street Railway Association; and be it further

"Resolved, That the American Street Railway Association be requested to commit all matters and things concerned in bringing about the above-named objects to its executive committee, with power to act."

Action upon the report of the executive committee was postponed until the next day.

Other Business of Wednesday.

Before the close of this session Mr. J. C. Hutchins of Detroit offered a resolution to the effect that that part of a resolution passed at the Saratoga convention last year requesting the technical press to refrain from the daily publication of the proceedings be rescinded. This caused much discussion pro and con, but action on the matter was deferred until the next day.

President Ely then appointed as the nominating committee the following-named gentlemen: J. C. Hutchins of Detroit, C. S. Sergeant of Boston, Robert McCulloch of St. Louis, H. M. Littell of Chattanooga, and John I. Beggs of Milwaukee.

Votes of thanks were then extended to the St. Louis Transit Company for its courtesy and to the telephone companies, which contributed free telephone service at the Southern Hotel during certain hours of the day.

Thursday's Proceedings.

First on the programme for Thursday was the report of Secretary and Treasurer T. C. Penington. There were, on August 24, 1903, 206 member companies. Since then there have been nine new companies added and 19 lost by suspension or withdrawal, leaving the present membership 196. The financial statement showed a good balance to the credit of the association.

Next the matter of press restriction, which was left over from the preceding day, was taken up. W. W. Bean of St. Joseph, Mich., offered a resolution to the effect that, instead of the word "proceedings" in the resolution adopted at the Saratoga convention, the words "verbatim reports of discussions" be used, which was adopted.

Committee Reports.

The resolution in the report of the executive committee which related to the bringing closer together of the parent association and the affiliated organizations was next reread, so that the members might have it fresh in their minds before acting upon the report of the executive committee.

Mr. C. O. Mailloux of New York wished the matter discussed. He felt some apprehension at the increasing number of auxiliary organizations and feared lest they become so numerous that the "tails wag the dog." He would like to see some system of control adopted in which the parent body should be to the branch organizations somewhat as the federal government is to the state governments. One central organization with sections was his idea. The way things are going now the relation is not close enough and by-and-by the dependent organizations may take powers upon themselves which they should not have.

The report of the committee was adopted.

The members of the committee which has had charge of the Standard Code of Rules for the Government of Conductors and Motormen consists of E. G. Connette, T. E. Mitten, W. S. Harrington, Robert McCulloch and John J. Stanley. This committee had rearranged and renumbered the existing rules so as to allow of the insertion of special rules which may be desired by any company without disturbing the regular order. To this end the rearrangement of the Standard Code is made under three separate heads, as follows: General rules, rules for conductors, and rules for motormen. Additional rules are are to be numbered and given their proper places under the headings of the standard rules.

H. H. Vreeland then offered a resolution providing the appointment of a membership committee to use special efforts to secure new members. He made the statement that there are 600 street-railway companies operating in the territory covered by the association, out of which number only 196 are members of the Street Railway Association.

A committee had been appointed to confer upon the prices of steel rails. John I. Beggs of Milwaukee and St. Louis was the chairman of the committee. No report was handed in, however.

Reading of Papers.

The first paper presented for the consideration of the convention was that of Richard H. Rice upon "Steam Turbines." Mr. Rice pointed out the things of greatest importance in his paper by way of introducing the subject for discussion. This paper, with the main points of the discussion, appears on pages 333 and 334.

J. R. Bibbins followed Mr. Rice with a paper on the same general subject, an abstract of which is also given in this issue, together with important parts of the discussion.

The paper upon "The American Diesel Engine," by E. D. Meier, was one of the most interesting presented, and many questions were asked the author regarding this form of prime mover, which, though it has been known since 1897, is just now reaching the stage of practical development. Mr. Meier preferred not to read or abstract his paper, but to speak extemporaneously upon the various points contained therein and leave himself open to questions. An abstract of the paper and discussion is given on page 328.

Leon Jewell was not present to read his paper upon "Transfers—Their Uses and Abuses," but the subject was opened for discussion by President Ely, who gave some of his experiences in Buffalo in his connection with the street-railway system there. He said that they are cheated right and left, and he believed, always would be until some way could be found to get at the public pride. He thought, further, that a ticket of the nature of the steam-railroad ticket, with detachable coupons, would be a good thing. Half the people do not understand what some of the present transfers mean or say, and indeed some lawyers when these transfers are brought into court cannot explain what they are intended to show.

John I. Beggs of Milwaukee thought that the president's plan of having a coupon transfer would be impracticable, because the conductors would be unable to handle 700 or 800 of the coupon tickets or transfers, which would necessarily be quite bulky.

Mr. Vreeland said they had been testing the transfer system in New York for years. The topography of the city is such that the abuse is not as great relatively in that city. As a general rule, it is wellnigh impossible to get the courts to impose fines or penalties upon street-car conductors for taking advantage of transfer systems to cheat the company.

Election of Officers and Concluding Business.

Adopting the report of the nominating committee, these officers were elected:

President—W. Caryl Ely, Buffalo (re-elected).

First vice-president—Elwin C. Foster, New Orleans (re-elected).

Second vice-president—John I. Beggs, Milwaukee.

Third vice-president—Robert McCulloch, St. Louis.

Secretary and treasurer—T. C. Penington, Chicago (re-elected).

Executive committee—The president and vice-presidents and John J. Stanley of Cleveland, Ohio, Howard F. Grant of Seattle, Wash., C. G. Goodrich of Minneapolis, Minn., F. G. Jones of Memphis, Tenn., and W. C. Harrington of Camden, N. J.

The thanks of the association were extended to the manufacturers' committee for the excellent entertainment provided. The noted Reeves Band of Providence, R. I., furnished music before the opening of each session during the week and also at afternoon and evening concerts. Receptions were held on various nights at the Electricity Building and Machinery Hall. Thursday evening was known as "ladies' night," a theater party being given in honor of the fair visitors. On Thursday the Gould Storage Battery Company served an excellent luncheon at its booth in Electricity Building, which was much appreciated. There was no association banquet, as in former years.

Street Railway Accountants' Association of America.

President F. E. Smith called the Street Railway Accountants' Association to order at 3:40 p. m. on Thursday, October 13th, at Convention Hall in the Transportation Building. After roll-call, to which a goodly number responded, the minutes of the last meeting were read and then the president delivered his address.

In reference to the joint meeting to be held on the morrow with the Street Railway Mechanical and Electrical Association, President Smith said that it was an innovation and was the first in his knowledge to be held between the accountants and operators of either electric or steam railways, and should be productive of good results. The accountants, he said, are beginning to evince more and more desire to learn something of operating methods.

Stress was laid upon the necessity for some form of railway accounting which should be international in character. The world is much smaller in one sense than it was a few years ago, and some method of accounting should be adopted which would be uniform the world over. The National Association of Railroad Commissioners holds the Street Railway Accountants' Association in high esteem, as is shown by its asking that the president appoint a committee of three to attend its conventions as delegates.

Following the president's address, came the report of the secretary and treasurer, W. B. Brockway. During the year the association has gained 28 new members and lost 16. The membership is now 148 in good standing. One source in loss of members during the last few years is the merger fever which has swept over the country, two or more companies combining and leaving thereby only one member company. The report was unanimously adopted.

Elmer M. White then read the report of the department of blanks and forms, which was of considerable interest. Mr. White has arranged a collection of blanks and forms used by a great many different companies, amplifying the work which was started by Mr. Brockway in 1899. This collection is now in permanent form, the blanks under certain classifications being pasted in large scrap-books to be easily studied. There are 14 of these books, 13 of them 20 by 30 inches and one 30 by 30 inches, all carefully indexed. The collection represents the blanks and forms used by about 80 different companies and contains almost 20,000 different pieces of paper. Mr. White then went on to describe the meth-

ods he pursued in collecting and arranging the blanks. His daughter did nearly all the pasting and indexing of the books. This was all interesting and the collection of books was spread out on tables in the convention hall for those interested to study. President Smith then appointed the nominating committee.

JOINT MEETING WITH THE MECHANICAL ASSOCIATION.

On Friday morning a joint meeting of the Street Railway Accountants' and the Railway Mechanical and Electrical associations was held. President Smith, President Baker and Mr. Olds were on the rostrum. The joint meeting was for the purpose of discussing the report on "Blanks for Shop Records and Accounts" which had been prepared by the joint committee, consisting of H. H. Adams of Baltimore, H. E. Farrington of Chelsea, Mass., H. M. Pease of Buffalo and W. G. McDole of Cleveland.

The report was divided up into sections covering, respectively, the forms pertaining to the condition of equipments while in service or under repairs; accounting for work done by the mechanical department, and forms pertaining to shop records. These different sections were discussed separately, the general trend of the discussion being toward the details and not toward the broad and fundamental questions involved in the report. The report was finally adopted as read.

CLOSING BUSINESS ON SATURDAY.

Reports of committees were heard the first thing on Saturday morning, being the report of the executive committee and of the committee on street-railway accounting, prepared and read by C. N. Duffy of Chicago.

Statistician A. L. Judson of the New York Street Railroad Commission was present and addressed the meeting. He said he had not missed a meeting of the Accountants' association since the beginning. He made the statement that the question was asked him by the Association of Steam Railroad Accounting Officers what they would do when electricity supplants steam as a motive power, and the answer he gave them was that the street-railway men already had a good association which would be ready at any time to furnish them with an adequate system of accounting which would fulfill their requirements. He further said that the general feeling in the East is that the time is not far distant when electricity will take the lead.

The nominating committee then reported and named for the different offices the following: President, W. G. Ross of Montreal; first, second and third vice-presidents, respectively, Frank R. Henry of St. Louis, Isaac McQuilkin of Emerson, Ind., and J. W. Lester of Worcester, Mass.; secretary and treasurer, W. B. Brockway of Yonkers, N. Y.; executive committee, F. E. Smith of Chicago, G. B. Willcutt, Arthur Linn of Utica, N. Y., and P. S. Young of Newark, N. J.

Mr. Brockway declined to serve longer as secretary. He has filled the position for several years and he finds the strain upon his health is too great. He will continue, however, to perform the duties of his office until January 1st, the executive committee filling the vacancy on or before that time.

Facsimile Letter Writing by Wireless.

A newspaper in Naples, Italy, publishes a letter of Engineer Gregorio Pansa to a friend about a new invention of his own which is quite extraordinary. He says: "I think that my invention is destined to render the greatest benefit to the postal service, which is ever more and more complicated, and demands a large staff of employes and means of transport. My system unites in one the telegraph, the telephone and the means of reproducing the handwriting by a wireless apparatus. The instrument, using the conventional Morse alphabet, reproduces perfectly the writing of the sender of the letter with the rapidity of an ordinary telegraph instrument, and with the reproduction of 1,200 words an hour. This is all automatic, even the putting into and sealing the envelope at the receiving station, so that no indiscreet human eye can by any possibility know the secrets of the letter. Thus from London to New York, or any other long distance, an autograph letter will be received and delivered on the same day that it is sent, with the same secrecy as at present, in the same way that one will be able to hear at that distance the voice of a friend. The great quantity of words which can be transmitted in an hour by my apparatus will render possible a low tariff, less than the telegraphic, with the advantage of sending an autograph letter, and not a dispatch, as with the latter one can never be sure of the identity of the sender." If all this is true—which the skeptical will greatly doubt—Mr. Pansa has made a remarkable invention.

The commissioner of patents has decided that where a person has conceived the principle or plan of an invention and is working under a contract with another person to perfect it for the benefit of both, and that other person suggests an improvement ancillary to the plan and preconceived design, the first person is entitled to claim the device, including the improvement, and is entitled to the patent.

Steam Turbines.[1]

By Richard H. Rice.

The field of usefulness for the steam turbine as a prime mover is not confined to large units. The first turbines of Parsons and of Curtis were small, but on account of the improvement in economies to be effected by the mere increase in capacity, development rapidly proceeded in this direction. The small units have not been neglected, however, and various sizes of small units directly connected to generators have been produced and placed in commerical operation. The problems of design which have to be solved in the small units are of a somewhat different character from those inherent in the larger sizes. In order to keep the dimensions and cost of apparatus at a proportionate figure the diameters of bucketwheels must be kept small, and this leads to a comparatively high speed. These speeds must be chosen with reference to the possibilities of generator design in order that the units may be direct-connected. Therefore a proper balance must be struck between the requirements of the turbine and those of the generator. The speed necessary in the small units (from 1,800 to 5,000 revolutions per minute) give rise to a set of conditions not met with in large units, and certain differences in design have arisen from this fact.

The Curtis principle is useful in keeping speeds of rotation down, and all the Curtis turbines are made without gearing for connection to generators. The accompanying table gives the sizes developed below 500-kilowatt rated capacity with the principal particulars of the design. A number of these small units are in commercial operation and giving good satisfaction and a still greater number are in course of manufacture.

Rated Capacity, K. W.	Speed of Shaft, R. P. M.	Condensing or Non-condensing.	No. of Stages.	Current.	Poles.	Voltage.
1½	5,000	Non-cond.	1	Direct Cur.	2	60
15	4,000-4,500	" "	1	" "	2	80-125
25	3,600	" "	1	" "	2	125-250
75	2,400	N-c. & Cond.	2	" "	4	125-250
100	3,600	Cond.	3	Alterot. Cur.	2	2,300
150	2,000	N-c. & Cond.	3 and 4	Direct Cur.	4	125-250
300	1,800	N-c. & Cond.	3 and 4	D.C. and A.C.	4	250-500 and 2,300

It will be noted that attention has been devoted to the development of both non-condensing and condensing types, the three smaller sizes being for non-condensing service solely.

Some of the special problems which require solution on these sizes are balance, construction and lubrication of bearings, flexible couplings between turbine and generator for sizes of 75 kilowatts and above, and the commutator construction on direct-current apparatus. It is possible to balance the turbine parts statically with success, to operate at the speeds given, since the wheels may be balanced individually and collectively and the metal of each wheel is disposed in the form of a flat plate. With the generator, however, this condition is not present, and furthermore we have the liability of the generator or winding undergoing some change after being put into service, due to heating and other causes. For this reason it is necessary to balance the generator parts by rotating them in a vertical position and suspended by a flexible shaft. The rotating parts in this system of balancing take up rotation about the center of gyration of the system and by the addition of balancing weights at various points this center is made coincident with the center of rotation of the shaft. Two balancings of generator parts are usually necessary—one before, the other after the generator has been subjected to a heat run and a high-speed run, the latter being made at a speed which is somewhat higher than the normal running speed of the unit. Due to the symmetrical shape of the Curtis buckets a very small amount of end thrust has to be taken care of; whatever thrust exists being due to accidental variations in bucket or nozzle shapes, and this is easily taken up by hardened steel thrust washers placed on each end of one of the bearings. No balancing pistons are necessary.

The question of bearings is of course a very important one and has been made the subject of a great deal of investigation. The bearings now in use are supported on spheres, so that the bearings are self-aligning. The linings are made in two parts and lubrication is effected by forced feed from a pump which is geared to the main shaft of the turbine and supplies oil at a pressure of from three to six pounds per square inch. The circulation of the oil is constant, passing from the pump to the bearing, thence to a reservoir in the pump chamber, from which it again goes to the pump. It has not been found necessary to provide any cooling arrangement for the oil and a very small amount of make-up oil is necessary.

The 15-kilowatt set was first used for train-lighting service and a number are now in use for this purpose. Some are placed on the buffer beam of the locomotive and others are installed in the baggage car. The latest forms are also so equipped as to be capable of being put on top of the boiler just in front of the steam dome when desired. The conditions of service are widely different on the locomotive and in the baggage car. In the former case the turbine is supplied with steam at 175 to 200 pounds pressure and exposed to great variations of temperature. Some trouble was experienced last winter with the sets mounted on the buffer beams, due to congealing of the oil circulation, but this was overcome by the use of a special oil. It is not expected that this trouble will be met with in the sets which are mounted on top of the boiler. Dust and cinders are very troublesome on the locomotive, and the machine is enclosed as much as possible, to prevent their access to the vital parts. It is, however, necessary to take in a large quantity of air for the purpose of cooling the generator, and this air necessarily carries with it a certain proportion of fine dust, which, however, does not prevent satisfactory operation.

In the baggage car the turbine is normally supplied with steam at 80 pounds pressure, but for various reasons the pressure actually realized varies from this figure down to 40 pounds. While the turbine can be kept cleaner and is less exposed to temperature changes, it must be cared for by entirely unskilled attendants. The most of the train-lighting sets now installed are placed in this manner, and the fact that their operation is satisfactory is good evidence of the small amount of care needed.

Some of the 25-kilowatt sets are also used for train lighting in the baggage car, and both these sets are well adapted for the excitation of the fields of large generators, as well as for general purposes. The floor space required is small, the regulation is equal to that of reciprocating engines, and the sets are automatically lubricated and require little attention.

The 1½, 15 and 25-kilowatt turbines are governed by throttle valves, these being of the piston type, moved directly by a very sensitive and powerful centrifugal governor with spring. The nozzles are therefore supplied with steam at pressures varying with the load. The governor joints are supplied with knife edges and do not require lubrication. All of these machines are of the single-stage type, having a single group of nozzles with single sets of buckets, consisting of three rows of moving buckets with corresponding rows of stationary buckets.

The larger sizes are multi-stage and have only two rows of moving buckets per stage. The method of governor control on these larger sizes is somewhat different from that just described. One or more nozzle groups are supplied with steam from a single poppet valve, and a sufficient number of poppet valves is supplied to furnish the total number of nozzles necessary for developing the capacity of the turbine. Each poppet valve is therefore the means of controlling the admission of steam to one or more nozzles, and the governor, by means of an intermediate mechanism, opens or closes a succession of poppet valves, as the demands of the load require.

Two types of intermediate mechanism for operating these poppet valves have been developed and constructed. The 75-kilowatt turbine is supplied with one of these types, consisting of a hydraulic cylinder, the controlling valve of which is directly actuated by the governor. A movement of the controlling valve caused by a change in the speed admits oil to one side or the other of the piston of this cylinder, and a movement of the cylinder results, through the intermediate mechanism, in the opening or closing of corresponding poppet valves. While the governor remains in any given position the hydraulic cylinder is also stationary, and is locked in its position by confining the oil in both ends of the cylinder. A movement of the governor produces a corresponding movement of the hydraulic piston, and when this movement has taken place the parts come to rest. There is sufficient lost motion and spring in the parts to insure that the valve, when opening or closing, will be moved suddenly a sufficient amount to prevent too much throttling at the valve, and the nozzle works therefore at high efficiency at all times.

The 150-kilowatt turbine is supplied with a mechanical valve gear, the valves being actuated by gearing which derives its motion from the main shaft. The governor control operates a mechanical device which produces the same effect on the poppet valves as that above described.

It will be noted from the table that nearly all these machines are constructed with direct-current generators, with a comparatively small number of alternating-current sizes. Other sizes of alternating-current sets will be constructed in due course. The operation of direct-current commutators at the speeds in question has necessitated the development of various special features in the commutator. Carbon brushes are used throughout, the best form of brush being one which has been treated with a lubricant, and with this form of brush commutation is very satisfactory. On account of the high speed and great length of the commutator bars they are provided with nickel-steel shrink rings at the ends and middle of their lengths to prevent deflection. These rings are shrunk on over insulation and provide a very effective means of supporting the commutator bars, and also have the advantage of giving a greater wearing depth of copper than the usual construction. The steam-consumption curves of these small turbines differ somewhat in characteristics from those of large turbines of the same type in

1. Paper read before the American Street Railway Association at St. Louis, October 13, 1904. The author is connected with the General Electric Company.

having a comparatively high steam consumption at light loads. This is because the fixed losses, such as bearing friction and windage of the wheels, are a greater proportion of the total output.

All of these turbines are of the horizontal type, the vertical type commencing with the 500-kilowatt and proceeding upward. The three smaller sizes given in the table have two bearings. The turbine wheels are overhung on the end of the shaft, and the shaft is in one piece, with the turbine and armature both mounted on it. Beginning with the 75-kilowatt size and upward, the shafts are in two pieces and the sets have four bearings.

In the small sizes, where the wheels are overhung, the front end of the case may be taken off to obtain access to the wheels and intermediates, and in the larger sizes, where four bearings are provided, the upper half of the casing is removable for the same purpose.

In the four-bearing sets the generator and turbine shafts are united by a flexible coupling, which permits some little inaccuracy in the alignment of the two shafts, without affecting the operation of the set. After extended experience with various forms of these couplings, a construction involving the use of metal parts only has been found to be the most satisfactory. This coupling is a modification of the Oldham coupling, the necessary flexibility being secured by the use of links turning on pins.

Some progress has been made in the application of turbines to driving other forms of apparatus than electric generators. This problem involves the finding of satisfactory methods of speed reduction to fit the turbine for coupling to slow-moving apparatus. Some of our small turbines are in operation with a belt drive, with a fair amount of satisfaction. Other forms of gearing are under construction and experiment, and it is safe to predict that we shall soon be able to couple the smaller sizes at least of our turbines to slow-moving apparatus with satisfaction.

The demand for small units is large, and in cases where electricity is to be generated the steam turbine, judging from experience with the turbines described, seems to fill the requirements better than any form of reciprocating engine in general use. While these machines are by no means perfected, they are practical and satisfactory machines, and will carry any character of load, variable or steady, with good regulation and economy.

Under variable loads these turbines undergo no deterioration in economy. The steam consumption for average load falls upon the curve obtained by testing with steady loads, while it is well known that reciprocating engines fall off in economy under these conditions. The steam consumption of reciprocating engines has reached about its lowest point, while that of the turbines is constantly being improved. The performances given in this paper must be regarded simply as starting points from which improvements already in sight will proceed in the direction of better efficiency.

Discussion.

C. O. Mailloux of New York city gave for the benefit of the members some of the observations he had made on a recent extended trip in Europe with the object of studying more especially turbine-driven machinery. There he found direct-current generators running at speeds from 3,000 to 4,000 revolutions a minute, and there seemed but little difficulty encountered in their operation. Carbon brushes are preferable for this sort of work. Sparking, when it occurs, is principally due to unbalancing. Mr. Mailloux was glad to see that a line of small turbines is being developed in this country as they are being developed in Europe. One of the principal uses found for them over there is for boiler-feed pumps.

W. H. Abbott then asked if there would be danger arising from entrained water passing through the pipes and into the turbine. To this Mr. Mailloux replied that he knew of no case where this had happened and did not see how it was possible if superheated steam were used. He knew of a 250-kilowatt turbine operated from exhaust steam from a 1,500-horsepower engine with complete success, there being no trouble from entrained water.

Mr. Hopkins had some experience at Columbus, Ohio, with a 500-kilowatt turbine which drew steam from a long pipe line, depending upon superheat to keep the moisture from the steam. The turbine stood idle all day, and of course when it was started up at night more or less water got into the buckets, but no bad results were noticed due to this.

Mr. Mailloux said that turbine manufacturers do not claim the very highest efficiency for their machines. It is a well-known fact that they run more economically on lower pressures, and it has therefore been proposed to use a steam turbine and a reciprocating engine in series, utilizing the high-pressure steam in the reciprocating engine where it will act most efficiently and operating the turbine from the exhaust. But operators must not scheme too much to reduce their coal bill at the sacrifice of other things, for the coal bill is really a very small item in the expense of operating a plant. To this Captain Robert McCulloch said that with them (the St. Louis Transit Company) the coal bill seemed bigger than anything else.

Steam-turbine Power Plants.[1]

By J. R. Bibbins.

A good index of merit or demerit is found in the general trend of engineering practice. It is, therefore, of interest to observe present practice in regard to three important points in turbine work—steam pressure, superheat and vacuum. Data obtained from 46 turbine plants, varying from 400 to 40,000-kilowatt capacity, have been conveniently tabulated in Table A, under three broad groupings, comprising electric-lighting, power and electric-railway plants, in order to observe whether practice differs in different fields. All of the plants are equipped with Westinghouse-Parsons turbines, and are either in operation or building, and the list comprises almost every form of power application.

Table A.—Turbine Plant Equipment.

Limits of Capacity.	General Summary. Number Plants.	Kilowatt Capacity.	Per Cent. of Total Capacity.	Pressure. Per Cent. of Capacity.	Limits of Pressure.	Superheat. Per Cent. of Capacity.	Limits of Superheat.	Vacuum. Per Cent. of Capacity.	Limits of Vacuum.
Light and Power Plants.									
0 to 1,000	4	2,100	12.5	72.1	150–175	40.1	100–150	87.5	27 to 28
1,000–2,000	4	4,900	29.3	22.4	175–200	37	0	7.1	28+
2,000–4,000	3	9,750	58.2	5.4	125–150	22.4	0 to 100	5.4	26 to 27
				.....	200+	.....	150+	.....	26–
Total	11	16,750							
Average	1	1,523							
Power Plants.									
0 to 1,000	14	7,550	38.2	59.6	150–175	47.8	0	37.6	27 to 28
1,000–2,000	4	5,750	29	38.4	125–150	28.7	0 to 100	35.6	28+
2,000–3,000	1	2,000	10.1	2	200+	23.5	100–150	22.7	26–
3,000–5,000	1	4,500	22.7	.....	175–200	.....	150–200	4	26 to 27
Total	20	19,800							
Average	1	990							
Electric-railway Plants.									
0 to 1,000	5	3,000	2.8	59.4	150–175	44.8	150–200	48.6	26 to 27
1,000– 2,000	2	2,700	2.5	39.8	175–200	42.8	100–150	39.6	27 to 28
2,000– 5,000	2	4,000	3.7	0.75	125–150	12.5	0	11.2	28+
5,000–10,000	2	11,000	10.3	.....	200+	.....	0 to 100	0.75	26–
10,000–25,000	3	46,500	43.4						
25,000–50,000	1	40,000	37.3						
Total	15	107,200							
Average	1	7,150							

Total number of plants 46
Total capacity ..... 143,750 kilowatts
Average capacity ..... 3,125 kilowatts

Comparative results are expressed in the tables below, both in per cent. of total plants and in per cent. of total capacity under consideration. The latter evidently is of greatest importance. In all plants the limits are found to be:

Pressure ..... 125 to 200 pounds.
Superheat ..... 0 to 180 degrees.
Vacuum ..... 24 to 28 inches.

General Average.

	1st Majority. Basis of Per Cent of Total No. Plants.		1st Majority. Basis Per Cent. of Total Plant Capacity.		2d Majority. Basis—Per Cent. Capacity.	
Pressure most generally used	150lbs.	50%	165lbs.	36%	175lbs.	32%
Superheat most generally used	0°	46%	100°	38%	150°	20%
Vacuum most generally used	27"	37%	26.5"	35%	27½"	27"
Pressure most generally used (25-lb. range)	150–175	79%	150–175	61%	175–200	32%
Superheat most generally used (50° range)	0–100	54%	100–150	40%	150–200	33%
Vacuum most generally used (1" range)	27– 28	46%	27– 28	45%	26– 27	37%

It is evident from the above that practice in the average plant is far different from that upon a basis of total capacity. Thus the former indicates no superheat; the latter, 100 degrees.

In the special fields practice differs somewhat from that given above:

	1st Majority.		2d Majority.	
Electric Railway. Basis capacity only.				
Pressure most widely used	165lbs.	47%	175lbs.	40%
Superheat most widely used	100°	42%	150°	35%
Vacuum most widely used	26½"	47%	27½"	35%
Pressure most widely used (25-lb. range)	150–175	59%	175–200	40%
Superheat most widely used (50° range)	150–200	45%	100–150	43%
Vacuum most widely used (1" range)	26– 27	49%	27– 28	40%
Light and Power.				
Pressure most widely used	150lbs.	38%	160lbs.	25%
Superheat most widely used	0°	37%	100°	32%
Vacuum most widely used	27"	88%	28"	7%
Pressure most widely used (25-lb. range)	150–175	72%	175–200	22%
Superheat most widely used (50° range)	0–100	59%	100–150	40%
Vacuum most widely used (1" range)	27– 28	88%	28+	7%
Power.				
Pressure most widely used	150lbs.	46%	140lbs.	23%
Superheat most widely used	0°	48%	100°	24%
Vacuum most widely used	27"	36%	28"	36%
Pressure most widely used (25-lb. range)	150–175	60%	125–150	38%
Superheat most widely used (50° range)	0–100	87%	100–150	24%
Vacuum most widely used (1" range)	27– 28	38%	28+	30%

Comparing with the general average, it is evident from agreement with the latter that electric-railway practice has greatly influenced the general practice, and averages the highest in all particulars, excepting, perhaps, vacuum. The values representing "second majority" show the general tendency toward higher operating conditions.

1. Abstract of paper read before the convention of the American Street Railway Association at St. Louis on October 13, 1904. Mr. Bibbins is connected with the Westinghouse Machine Company.

Electric-lighting plants, although beneath the average on pressure and superheat, excel in the matter of vacuum.

Power plants also exceed the average in the matter of vacuum. The second majority pressure is lower than the first; which is presumably due to the fact that steam turbines have been largely applied to factory driving in the form of extensions to power systems already in use, while the majority of lighting and railway plants have been designed with the use of turbines in view. The comparatively low average vacuum in railway plants (26.5 inches) is due to two important stations now building for heavy traction. Outside of these a higher vacuum is generally used.

Much uncertainty seems to exist at the present time concerning the relative value of high vacua and superheat. By the term relative is here meant not a specific gain in steam consumption per se, but the net saving to the power station at the coal pile.

Is high vacuum or superheat essential to economical performance, and, if not, why employ them? The reason is not far to seek. In steam-turbine work a distinctly new problem has arisen in the shape of enormous steam velocities and correspondingly high surface and peripheral speeds. If left unchecked, the fluid friction results in much lost power and more or less rapid depreciation. In some forms of turbines, more particularly the Parsons, these speeds have been reduced through compounding to such a point as to largely reduce the effects of steam friction. In all forms the loss from this and other sources may be greatly reduced by employing high vacuum and superheat. The former permits the low-pressure section of the turbine rotor to move in a more rarefied at-

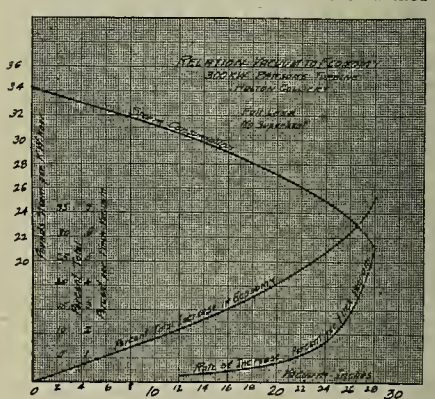


FIG. 1. STEAM TURBINES.—TESTS SHOWING EFFECTS OF VACUUM.

mosphere, and the latter serves to defer the "dew point" or beginning of condensation of steam during its expansion, thus eliminating to a large degree the detrimental effects of friction due to entrained moisture at high surface speeds.

But, although essential in some types, it is by no means so in the Parsons turbine, as is evidenced by the several installations working under 25-inch and 26-inch vacuum and no superheat, and with excellent economy. The principal reason for the almost universal adoption of these economic expedients is the ease with which the turbine avails itself of these advantages.

The nature of the saving due to vacuum and superheat has been revealed by tests. Figs. 1 and 2 show the effects of vacuum. In the former the test covers vacua from 0 to 26.5 inches; in the latter from 25 inches to 28 inches. The drooping of the curve of steam consumption at the right (Fig. 1) clearly shows the relative advantages of the last few inches of vacuum. The curve, "Rate of increase per one inch of vacuum," shows this still more clearly. With 21-

inch vacuum the gain is but one per cent. per inch; at 26½ inches it is 3½ per cent., and at 28 inches 5½ per cent., the last point being, however, estimated.

A test upon a large Westinghouse-Parsons turbine between 25 inches and 28 inches, shown in Fig. 2, indicates somewhat different characteristics, viz., a proportional relation. This, however, might have been the case with the above results if plotted to a larger scale and carried up to the same limits. Here the benefit from vacuum at half load is considerably greater than at a slight overload, viz., five per cent. per one inch in the one case and three per cent. in the other.

The effect of superheat on economy is as striking as that of vacuum. In Fig. 3 the steam consumption was reduced 23 per cent.—from 16.45 to 12.66 pounds per electrical horsepower at full load—by raising the vacuum three inches and superheat 140 degrees.

From these curves and other data on Westinghouse-Parsons machines, it is apparent that, although

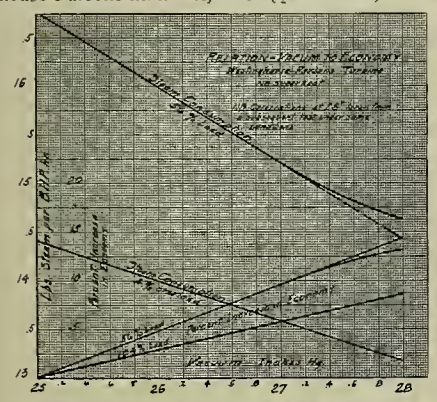


FIG. 2. STEAM TURBINES.—TESTS SHOWING EFFECTS OF VACUUM.

wide variations exist, in round numbers 100 degrees superheat will insure an increase in economy of about 10 per cent., and one inch vacuum (between 25 inches and 28 inches) 3.5 to four per cent., depending somewhat upon the load.

Upon this assumption we may estimate the net saving resulting from the use of high vacuum. In Table B three cases have been calculated, embracing possible or typical conditions of service and cost of fuel. A 2,000-kilowatt plant has been chosen, containing two 1,000-kilowatt units. By raising the vacuum two inches—from 26 inches to 28 inches—a saving in coal results amounting to 3.5, 2.6 and 1.3 tons per day in the three respective cases. The extra cost of high-vacuum condenser equipment will, however, be about $2 per kilowatt capacity, or $4,000. Deducting the interest and depreciation (12½ per cent.) on this investment from the fuel savings, a net saving is determined which represents an interest rate of 115 per cent., 27 per cent. and three per cent., respectively, on the increased investment in high vacuum. The increased power requirements of the new equipment will presumably reduce these percentages by one per cent. to five per cent., according to the price at which power is charged, but the estimates, although largely tentative, certainly point to high vacuum as an excellent investment where high plant economy is imperative.

TABLE B.—RELATIVE ECONOMY OF HIGH VACUUM.

Case.	I.	II.	III.
Conditions of operation.....	Good Coal Continuous Service.	Med. Coal Continuous Service.	Poor Coal Day Service.
Capacity plant.....Kilowatts	2,000	2,000	2,000
Daily run.....Hours	24	24	10
Yearly run.....Days	365	300	300
Average load.....Kilowatts	1,500	1,000	1,000
Price coal per ton (2,000 lb.)	$4.00	$2.00	$1.00
Evaporation (actual)....Lbs.	9½	8	7
Average economy.....Lbs. water per kw.-hr.	23	22	22
Raise vacuum.....Inches	26 to 28	26 to 28	26 to 28
Water saved per kw.-hr. Lbs.	1.84	1.76	1.76
Water saved per day....Lbs.	66,240	42,240	17,600
Coal saved per day.....Tons	3.49	2.64	1.26
Gross saving per day.....	$13.96	$5.28	$1.26
Gross saving per year.....	$5,095	$1,584	$378
Extra cost of condenser.....	$4,000	$4,000	$4,000
Interest 5 per cent., depreciation 7½ per cent.....	$500	$500	$500
Net saving per year.....	$4,585	$1,084	$122
Net saving per year, capitalized at 5 per cent.....	$91,900	$21,680	$2,444
Net saving as interest on increased investment in 2 inches extra vacuum.....	114.9%	27.1%	3.05%

Granted the beneficial effects of high vacuum, do the auxiliaries require excessive power to render them commercially impracticable? Fortunately, we are able to present results from two plants which throw some light upon this subject. At the Broad Street station of the Citizens' Light, Heat and Power Company, Johnstown, Pa., the condenser auxiliaries are driven from a single steam cylinder—that of the rotative air pump. By indicating this cylinder at normal speeds the total power input was obtained. Although observed in indicated horsepower, the results were reduced to a basis of equality with turbine output, in order to obtain commensurate percentages. At less than one-fourth load, the total power consumption was less than five per cent. of the station output, and it progressively decreased to 2½ per cent. at full load. It may be inferred [from curves of results] that at a load of 800 kilowatts, which is the full rating of the condenser, the power consumption will approximate two per cent. of the turbine output. And it must be borne in mind that even this percentage is not entirely chargeable, as all steam auxiliaries exhaust into an open feed-water heater in which the heat of the exhaust steam is regained.

Similar observations casually made on a 2,000-kilowatt Curtis turbine equipment at the Louisiana Purchase Exposition indicate the same relations, although a higher power consumption. All auxiliaries are driven by constant-speed induction motors supplied from the high-tension bus-bar through step-down transformers. The power input is assumed constant for all loads, as this is approximately the case. At full load the auxiliaries required seven per cent. of the total power output, five per cent. for the circulating pump and 1.6 per cent. for the air pump. It is probable that the percentages might be largely reduced were it possible to more closely proportion the speed of auxiliaries to the turbine load, as may be done in the Johnstown plant. The equipment is also laboring under unexpected high temperature of cooling water, frequently 85 degrees, which renders it difficult to obtain the high vacuum which could be held under normal conditions. The most important point is, however, that the power consumption of turbine auxiliaries is moderate and constantly decreases with the load.

An important requisite in the maintenance of a high vacuum is the absolute exclusion of entrained air. This air may find its way into the condensing system from many sources—through the feed water and steam, through air leaks in piping and through packing glands improperly sealed. A minute opening will have a remarkable effect in lowering the vacuum unless the air is removed before reaching the condenser. This is usually accomplished by a single or double-stage "dry" air pump.

Another important factor in securing a high working vacuum is the elimination, as far as possible, of friction in the exhaust piping leading from turbine to condenser. As is well known, the volume of steam increases with great rapidity at high vacua, thus requiring extremely large exhaust piping. Considerations of convenience, however, frequently outweigh those of engineering precision, thus tending to decrease the size of exhaust piping, although at the expense of considerable increase of friction and resultant loss of vacuum. An instance where this matter has been given attention is the replacement in the Manhattan station of the former jet condensers by those of the barometric type connected directly to the engine exhausts. Although this arrangement was adopted partly on account of the height of the engine exhaust, it nevertheless is reported to have resulted in higher engine vacuum. In turbine work where 28-inch vacuum is employed the volume of steam is from 50 to 100 per cent. greater than with the usual engine vacuum. This fact emphasizes the necessity of locating the condenser as near as possible to the turbine, and the desired arrangement has been accomplished by placing the condenser immediately beneath the turbine, an arrangement which

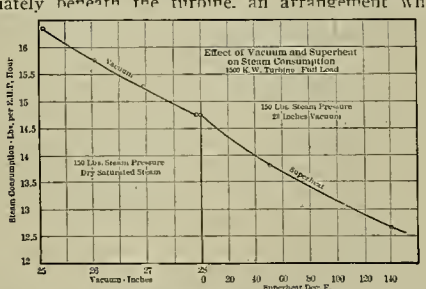


FIG. 3. STEAM TURBINES.—TESTS SHOWING EFFECTS OF VACUUM AND SUPERHEAT.

has never before been possible with any other form of steam engine.

Following out the ideas previously mentioned, a number of plants with various-sized units have been drawn up for the purpose of indicating the possibilities of compactness in arrangement of condenser and auxiliaries. Three sizes of turbines have been chosen for illustration—viz., 400 kilowatts, 1,000 kilowatts and 5,500 kilowatts—four units being included in each plant as constituting a typical and desirable arrangement in a modern power station.

In a 400-kilowatt plant a central condenser is employed with rotative two-stage dry-air pump and a centrifugal circulating pump driven by a small high-speed steam engine. A gate valve in each turbine exhaust permits independent control of each unit, and at light loads the circulating water can be readily decreased in proportion by throttling the pump engine. A small reciprocating hot-well pump returns the condensation directly to the boiler feed. A vertical loop in the circulating-water-outlet pipe serves to keep the condenser full of water and the tubes covered at all times.

In a 1,000-kilowatt plant independent condensers are employed, with, however, practically the same arrangement as in the smaller plant, with the exception that a single air pump serves two units. By cross-connecting the air piping the two air pumps may be arranged for relay service. Each condenser is provided with its own circulating-water pump. By locating the several condensers alternately at one side or the other of the line of exhaust outlets, sufficient space is available for withdrawing and replacing condenser tubes, which would evidently not be the case if all were located upon the same side.

In a 5,500-kilowatt plant concrete piers are employed, supporting the bed-plate of the turbo-generator unit at points beneath the three journals. As before, the condensers are located directly beneath the turbine, whose outlet in this case, for convenience and compactness, is of approximately rectangular cross-section. By placing them at the angle shown, space is left for the removal of condenser tubes. In plants of this size concrete-lined conduits would, presumably, be used to convey cooling water to and from the condensers.

In all of these condenser arrangements an independent atmospheric exhaust outlet with relief valve is provided for each unit; thus in the case of loss of vacuum from any sources the turbines are capable of continuing operation non-condensing. It is also desirable to employ a fluted copper expansion joint in the exhaust riser. The turbine casing is thus relieved of any strain due to expansion and contraction of the riser, which is, of course, firmly supported from beneath by the condenser. This, however, becomes unnecessary in the 5,000-kilowatt equipment, on account of the shorter connection between turbine and condenser.

The soundness of engineering judgment in taking a step so radical as the adoption of steam turbines is invariably reflected in the entries in the station log and the monthly cost sheet. If opinions were unanimous concerning the several factors comprising the true cost of power, and such figures were generally available, it would not be difficult to formulate legitimate conclusions as to the precise commercial standing of the steam turbine. But data relating to investment and other fixed costs are not easily obtainable, and, in fact, not infrequently neglected altogether in determining the cost of power. Even the various factors constituting the operative costs, such as fuel, wages, supplies and repairs, are not always available in segregated form. In many industrial plants one boiler equipment furnishes steam for electric power generators, in conjunction with steam engines and special processes. These facts render an accurate analysis of power costs an extremely difficult if not impossible matter.

DISCUSSION.

Mr. Bibbins, in giving an abstract of his paper, showed a curve of a test on a turbine running at 100 per cent. overload. A primary valve in this case controlled the inlet of steam up to full load. From there on up to the greatest overload a secondary valve was used as a means of control. Curves of operation show that the economy of steam turbines is greatest at full load, but that great overloads can be carried by them if necessary.

W. H. Abbott wished to know if open or closed feed-water heaters should be used to exclude air. Mr. Bibbins replied that he could not answer from personal experience, but that it was apparent that the more the air could be excluded from the cycle the more efficient would be the operation. Mr. Hopkins said that in two stations which had come under his observation there was no difference in the operation of the air pump with open and closed feed-water heaters.

World's Fair Visitors of Last Week.

Among those registered at the booth of the Western Electrician in Electricity Building at the St. Louis Exposition last week were the following named: M. E. Wittie, Chicago, Ill.; C. H. Endebroch, Trenton, N. J.; W. W. Ware, Alexandria, Ind.; M. C. Turpin, Philadelphia, Pa.; M. C. Wilsen, Oaktown, Ind.; Louis J. Chamberland, Rolla, Mo.; George S. Eddy, Kansas City, Mo.; Dr. W. H. Crowder, Kansas City; G. H. Ferrall, Beulah, Wyo.; Geo. F. Soinberger, Sydney, N. S.; J. E. Jefferies, Alexandria, Ind.; E. Norton, Londonderry, O.; Ivan E. McFornich, Grant, Pa.; George A. Upson, Galesburg, Ill.; M. M. Wood, Schenectady, N. Y.; Theodore P. Bailey, General Electric Company, Chicago, Ill.; J. B. Douglass, Dayton, Ohio; James H. McGraw, New York; Henry H. Norris, St. Louis; L. Bram, Jr., Jackson, Miss.; W. Martin Jones, Jr., Rochester, N. Y.; Frank P. Torrence, Springfield, Ohio; J. B. Reynolds, Abingdon, Ill.; O. F. Fischer, Houston, Minn.; W. D. Tomas, Chicago, Ill.; A. V. Potter, Houston, Texas; L. H. Hannah, Clinton, Mo.; Chas. Harrison, Trenton, Mo.; Harley Higdon, Dunlap, Mo.; C. H. Reid, Waterford, Mich.; J. P. Alexander, Pittsburg, Pa.; Louis Humphreys, Elkville, Ill.; H. N. Fulwider, Iola, Kan.; Charles D. Walker, Muncie, Ind.; L. J. Gassett, Brunsburg, Ky.; Louis Hill, Milwaukee, Wis.; Fred S. Miles, Syracuse, N. Y.; H. L. Hanson, Burke, Idaho; Louis B. Lodge, Cuyahoga Falls, Ohio; Jack S. Johnson, Cuyahoga Falls, Ohio; Ray D. Sperry, Boonville, N. Y.; C. F. Wheeler, Chicago, Ill.; Edward Blair, Chicago, Ill.; A. H. Dilks, Kansas City, Mo.; S. J. Gorman, Kenault, Ill.; Jno. McKindley, East Carondelet, Ill.; M. Enge, East Carondelet, Ill.; William N. Miller, Kenton, Ohio; E. J. McInnes, Nevada, Mo.; H. W. Young, Chicago; Mr. and Mrs. J. S. Speer, St. Marys, Pa.; Mr. and Mrs. G. P. Fryling, St. Marys, Pa.; Mark P. Goodlett, St. Louis; W. H. Finney,

Neosho Falls, Kan.; Frank Clark Cosby, Standard Underground Cable Company, Boston, Mass.; C. T. Manley, Laurel, Ind.; Jno. B. Doolittle, Missouri and Kansas Telephone Company, Hannibal, Mo.; Charles H. Smith, Lebanon, Pa.; G. R. Reid, Piedmont, Mo.; T. E. Hughes, Standard Underground Cable Company, Philadelphia, Pa.; Henry E. Clark, Claxby, Mo.; P. St. Johns, Hannibal, Mo.; H. A. Kellogg, Genoa, Ill.; George Monroe, Johnstown, Ohio; A. Ellwanger, Danville, Va.; J. J. Fleming, Jerseyville, Ill.; Winnie Fleming, Jerseyville, Ill.; Don Vandercook, Grand Rapids, Mich.; Frank J. Trandt, Milwaukee, Wis.; Kerl Squires, Piermont, Ohio.

The Nernst Lamp as a Factor in Commercial Lighting.[1]

By E. R. Roberts.

The "glower," or the part which gives the light, is the distinguishing feature of the lamp. It is made in the form of a small rod of white, porcelain-like material, about one inch long and 1-32 of an inch in diameter. Fastened to each end of the glower are platinum lead-wire terminals. At ordinary temperatures the glower is practically an insulator, but becomes a conductor when heated to about 700° Centigrade. This means, of course, that the resistance constantly decreases as heat is applied. After current starts to flow no further heating from the external source is necessary, as the I²R energy supplied by the current is not only sufficient to maintain the glower in an incandescent state, but causes the resistance to decrease still further with a consequent increase in current. This cumulative action, if not arrested in time, causes the current to rapidly attain a very high value, and the glower finally breaks down or flashes out. It therefore becomes necessary to place in series with the glower a resistance having a positive temperature correction: just opposite to that of the glower. This resistance, which we call the ballast, consists of a very fine wire of pure iron, suitably mounted in a hermetically sealed glass tube, from which the air has been exhausted, and replaced with an atmosphere of hydrogen. This prevents oxidation of the iron and still serves as a medium to conduct the generated heat from the wire. The ballast is so dimensioned throughout that with a rise in voltage above the normal operating point of the lamp, there is a rapid increase of the ballasting resistance. In figures this amounts to about 140 per cent. for a rise of 15 per cent. in line voltage. While this effectually protects the glower against momentary fluctuations of 25 per cent. above normal lamp voltage, the ballast is liable to injury if the lamp is operated at more than five per cent. overload continuously. On well-regulated circuits, where the lamp will not be subjected to an overload exceeding five per cent. for any length of time, the life of the ballast is practically indefinite and its characteristic and function are not appreciably impaired with age. This can hardly be said of the glower; like all other sources of light, there is gradual decrease in the intensity of the rays emitted. Before being used the surface of the glower presents a smooth, white, porcelain-like or chalky appearance; after being in service, say 500 hours, this surface is rough and crystalline in appearance. It is this change in the structure of the glower, from an amorphous to a crystalline state, that is supposed to cause a rise in its resistance. The resultant decrease in candlepower, from its rated value on a constant-potential circuit, should not exceed 20 per cent. in 800 hours.

In the early part of the life of the lamp there is a decrease in intensity and the rated candlepower value is not reached until after about 25 hours' run; for instance, while the rated candlepower of the single-glower lamp is 50, the initial candlepower would average 60. This initial excess is not contracted for and may be considered as a gift to the consumer.

Being composed of rare oxides, incapable of further oxidation, the glower does not require a vacuum, and, in fact, the presence of as much oxygen as is found in the atmosphere is necessary for its successful commercial operation. In vacuum the glower is rendered much less stable and requires a correspondingly greater amount of ballasting resistance. Hydrogen and nitrogen have the same effects in a lesser degree, while the characteristics in air and oxygen are practically identical. Operating on direct current the glower exhibits all the characteristics of a solid electrolyte, and its life is greatly shortened. Its life may be prolonged somewhat by reversing the current at intervals, which probably accounts for the fact that when operated on alternating current the life increases with the periodicity or number of current reversals.

In the automatic lamp, which is the commercial type of lamp now on the market, the glower is brought to a conducting temperature by means of an electric heater, consisting of fine platinum resistance wires, wound on porcelain tubes; the whole being coated with a white, refractory paste which acts as a protection to the windings against the intense heat of the glower, and also as a light-reflecting surface. The heater is thrown in and out of service by an automatic cut-out, which in turn is actuated by the glower current. Fig. 1 shows the connections in a three-glower lamp.

1. Abstract of a paper read before the Michigan Electric Association at Detroit on October 11, 1904. Mr. Roberts is connected with the Nernst Lamp Company.

Contrary to the practice abroad, the American company has adopted a standard glower, taking 0.4 ampere at approximately 210 volts, and lamps of different intensities are made by varying the number of glowers. In this connection it may be mentioned that the manufacturers have recently developed and are about to market a four-glower lamp, which will have the same external appearance as the present six-glower unit. This lamp will be equivalent, in watt consumption, to that of the standard five-ampere multiple alternating-current arc lamp, and should prove to be a very popular unit for general commercial lighting.

It may be seen from the accompanying table, which gives a list of the present standard Nernst units, together with their respective wattage and light intensities, that the efficiency increases with the number of glowers. This is readily accounted for by the resistance temperature characteristic of the glower, and the fact that the several glowers tend to heat each other; this mutual heating effect being, of course, greater as the number of glowers is increased.

Unit.	Wattage.	Mean Hemispherical Candlepower.
One-Glower lamp.....	88	40.2
Two-Glower lamp.....	176	86
Three-Glower lamp.....	264	131.7
Four-Glower lamp.....	352	185
Six-Glower lamp.....	528	292.5

While the above units are operative only on 220-volt alternating current, the latter four units—viz., the two, three, four and six-glower lamps—may be adapted to 110-volt alternating-current circuits by means of an auxiliary device, termed the "converter coil." This piece of apparatus finds its greatest use in mixed installations where it is not desired to alter the line voltage; for instance, a merchant has his store lighted throughout by 110-volt incandescents and he wishes to avail himself of the white Nernst light for displaying his colored fabrics in the show

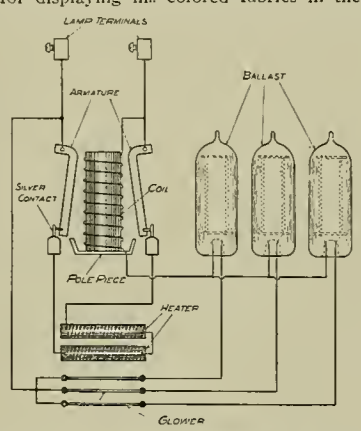


FIG. 1. CONNECTIONS IN THREE-GLOWER LAMP.

windows without disturbing the other part of his system. With the aid of a converter coil the solution is obvious.

Unlike the incandescent lamp, the frame and connections of the Nernst lamp form a permanent structure having an indefinite life, but its perishable parts have from time to time to be renewed. Of these the ballast has a life so long, averaging about 25,000 hours, that in an organization for maintenance it plays little part. The heater has also a very considerable life, the period averaging about eight months in ordinary use. The glower, however, like the incandescent-lamp filament, has a practically definite term of use, at the end of which it would be advisable to replace the glowers whether burned out or not. Eight hundred hours is given as the guaranteed average life on 60 cycles.

Two systems of maintenance for the Nernst lamp have been employed. In the one, all the installations within a certain radius are maintained for a fixed sum per month from a central maintenance bureau, which may be directly in control either of the Nernst Lamp Company or the central station on whose circuits the lamps are operating. This department of the lighting company is analogous to the meter department which is now becoming an auxiliary to all well-managed lighting plants. Such an organization involves the services of an inexpensive class of help, consisting of an inspector, who alone or with one or more assistants in the case of the larger plants, operates the maintenance system, visiting all installations periodically; for example, commercial installations may be visited weekly and residential installations once per month, the user being instructed how to act in contingencies which may arise during the absence of the inspector. A complete stock of Nernst lamp parts is carried in the repair department. The work to be done here is so simple, owing to the careful provision made in the design of lamp details for easy renewal that a boy or girl can, in a short time, acquire the necessary skill. In some central stations, where the Nernst business has not yet assumed extensive proportions, the labor item may be reduced to a minimum by having the arc trimmer include the Nernst maintenance in his regular duties.

The second system is especially applicable to the larger installations and those in isolated localities. In these cases the maintenance work may be entirely taken care of by the building janitor or electrician who has previously received some instruction and training either at the company's works or from an expert repairman. Suitable quarters would be provided in the building in which a limited stock of repair parts and facilities for renewal work would be available.

The total cost of maintenance under these conditions will be comparatively low, provided the maintenance work is executed in a systematic manner; a certain portion of the day being given to a complete inspection of all lamps installed, the repairing of defective holders being afterward done in the repair room.

The results obtained from a number of reliable sources where the maintenance of the Nernst lamp is carried out on a systematic basis show that the cost ranges from 0.35 to 0.7 cents per kilowatt-hour. This, we find from available data, also represents the average cost of arc maintenance.

In a most interesting paper presented by Alex Dow before the recent International Electrical Congress, when referring to the up-to-date practice of the Associated Edison Illuminating companies, he says: "Under our present conditions for each kilowatt-hour sold to customers for use in incandescent lamps our expense for lamp renewals is between 0.3 cent and 0.4 cent." Taking 0.35 cent as an average figure and adding the indefinite item of labor, it would appear that the gap between the total cost of incandescent maintenance and that of arc or Nernst maintenance is not so wide as a great many think. Furthermore, considering the fact that the kilowatts expended in the Nernst lamps give twice the effective illumination that they do in the incandescent, the cost of Nernst maintenance per effective candlepower-hour would be even less than that for incandescent lamps.

The statement occasionally heard coming from inexperienced individuals, that the Nernst lamp requires skilled labor for its successful operation, is true only in the sense that arc trimmers are skilled, and is entirely false if intended to convey the idea of expensive labor. A young man acting as inspector and foreman at $65 per month assisted by a boy acting as trimmer at 18 cents per hour and a girl for the holder repair work in the station at 14 cents per hour should be capable of handling the Nernst business of a central station amounting to 300 kilowatts in Nernst lamps of mixed types.

It would seem to be high time for illuminating engineers to get together and decide upon a definite and proper basis from which a comparison of the relative illuminating powers of modern illuminants may be made.

An arc lamp has both a nominal and an actual rating, the latter being based on photometric measurements, and the two differ widely. The rating of incandescent lamps is based on photometer measurements obtained while the lamp is rotating on a vertical axis, while the Welsbach and flat-flame gas lights are rated in accordance with measurements obtained in the direction of maximum intensity. Obviously the present commercial rating of these illuminants is absolutely unreliable because of the lack of a fair basis of comparison. There remain the mean spherical and mean hemispherical values of intensity to choose from; many say the former should be used, others prefer the latter. If a lamp is to be regarded as a mere producer of light, the mean spherical value is undoubtedly the proper selection. On the other hand, if the lamp is regarded as a producer of useful illumination, opinion is gaining ground that the mean lower hemispherical value is the one desired. Comparing, for example, two lamps, each suspended near the ceiling of a reading room, the one throwing all its light in the upper hemisphere, the other all its light in the lower hemisphere, while the total amount of light given off, or the mean spherical candlepower, might be the same in each case, there would be no hesitancy in selecting the latter as the superior illuminant. This statement is even more true for outdoor lighting, as the upward light would be entirely lost in space, whereas in the room the ceiling might reflect back 25 per cent. of the light for useful purposes. Again, assuming it were possible to blacken the side of the sun which is turned away from the earth, that is to say, the surface of its most distant hemisphere, its mean spherical candlepower would be reduced one-half, without impairing its value to the earth as a producer of daylight. From the standpoint of utility, therefore, it is obvious that the mean lower hemispherical candlepower is by far the better basis for comparison.

That the six-glower Nernst lamp is a more efficient illuminant than either the alternating-current or direct-current multiple-enclosed arc is theoretically shown by the following figures taken from Professor Matthews' report presented at the twenty-sixth convention of the National Electric Light Association:

Illuminants.....	Six-Glower Nernst.		Multiple A. C. Arc.	Multiple D. C. Arc.
Glassware.....	Clear Globe.	Opal Globe.	Opal Inner Clear Outer.	Opal Inner Clear Outer.
Voltage.....	226	226.5	110	110
Current.....	2.4	2.4	6.29	4.9
Watts.....	542	543	417	539
Power factor.....	1	1	.6	1
Mean hemispherical C.P.	289	258.6	167	239
Watts per mean hemispherical C. P.....	1.88	2.10	2.53	2.25

From an inspection of the accompanying curves (Fig. 2), which are also taken from the above-men-

tioned report, and a preceding report of the same committee, it is evident that for many practical purposes, such as the lighting of reading rooms, offices, stores, etc., the Nernst lamp holds an advantage which is not shown by the above table. Referring to the curves, the following data are given:

Curve 1—110-volt, A. C. con. potential arc, 6.3 amp., 417 watts.
Curve 2—110-volt, D. C. con. potential arc, 4.9 amp., 529 watts.
Curve 3—6.6-amp. D. C. series arc, 71.6 volts, 469 watts.
Curve 4—6.6-amp. A. C. series arc, 65.4 volts, 382 watts.
Curve 5—Six-glower Nernst lamp, 220 volts, 528 watts.
Arcs—Opalescent inner and clear outer globe.
Nernst lamp—8-inch sand-blasted globe.

Obviously, a desk, table or store counter, under a lamp with a light distribution represented by curve 5, will receive a much greater volume of light than would be received from a lamp whose light distribution is represented by curves 1 or 2. The mean zonal efficiencies over the lower 45-90-degree zone, which for the curves 1, 2 and 5 amounts to 3.02, 2.46 and 1.43, respectively, would represent approximately the actual results.

Recently some work has been done at the Nernst

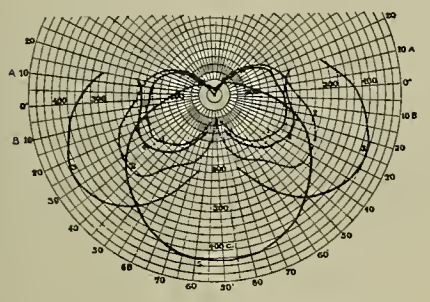


FIG. 2. CURVES OF ILLUMINATION.

Lamp Works in Pittsburg toward obtaining a more practical comparison of modern electric illuminants along the lines originally suggested by Mr. Wurts. A room approximately 20 by 40 feet was divided by means of an opaque curtain into two compartments, each 20 by 20 feet, and both compartments furnished in an exactly similar manner, the only difference being that one compartment was lighted by Nernst lamps of different types and the other with arc, meridian and incandescent lamps. The illuminants in both rooms were arranged to the best possible advantage for each particular illuminant for effective illumination; each particular type of lamp being separately connected to a common switchboard carrying an indicating wattmeter which, in turn, may be quickly connected to any particular circuit. The one room may thus be lighted by any one type of Nernst lamps, and the other by the arc, meridian or incandescent lamps at the same time, so that an observer stationed at the intersection of the dividing curtain and the wall may compare the general illumination of the two rooms. The average opinion of a number of observers as to the respective merits of the lamps was based upon the general appearance of the rooms under the illumination furnished and special visual tests in each room. While the work is yet in an uncompleted state, the results so far point to the following conclusions:

The one-glower Nernst is equivalent in effective illuminating power to three 16-candlepower incandescent lamps.

The three-glower Nernst is equivalent in effective illuminating power to 9½ 16-candlepower incandescent lamps.

The six-glower Nernst is equivalent to 20 16-candlepower incandescents.

The six-glower Nernst is somewhat better in effective illuminating power than the 7¼-ampere multiple alternating-current enclosed arc.

The new four-glower Nernst is equivalent in effective illuminating power to the 6.6-ampere multiple alternating-current enclosed arc.

It is now generally conceded that the color of the Nernst light is closer to that of sunlight than that of any other illuminant, and instead of attempting, at this time, to support this statement by a discussion of spectroscopic data, it may be mentioned that the directors of the Fine Arts exhibit at the Louisiana Purchase Exposition selected and are now using the lamp to light the Art Palaces. Naturally this advantage in color, combined with those of steadiness, economy and neat appearance, would also tend to make it especially adapted to store lighting, and one need not be an optimist to foresee a promising future for the lamp in this particular field.

While there have been close on to 400,000 glower units placed in service in the United States for various classes of lighting, it will not be attempted at this time to set forth the special adaptability of the Nernst lamp for each class of commercial lighting. With the exception of stage and electric-sign lighting and a few other special uses for light energy, the legitimate field of the Nernst is practically identical to that covered by other modern illuminants.

The electric clock in the basement of the Berlin observatory, installed there by Professor Foerster in 1863, is enclosed in an ari-tight glass cylinder, and has frequently run for a period of two and three months with an average daily deviation of only 15-1,000 of a second.

Ohio Telephone Notes.

A motion to advance has been granted by the Supreme Court in the case of the state against the Toledo Home Telephone Company, instituted by the attorney-general. All briefs must be in by January 10th, when the court will take the matter under consideration and render a decision as soon as possible. The suit involves the old question as to whether a telephone company may charge a rate in excess of that stipulated in the franchise agreement between it and the city. The Toledo company found that it could not operate a large and modern system at the figures the City Council had seen fit to limit it to and raised the rates in some instances. The state seeks to make a test case of this. Several courts have already decided that a city council has no power to regulate the rates of a telephone company any more than it has to fix a price upon a yard of cloth or a pound of butter. It is claimed that if the Supreme Court upholds this contention that it will absolve all public-service corporations from agreements as to rates they have made with cities and which most of them recognize as binding. For this reason a strong fight may be made against it.

A cable containing 400 pairs of wires is being installed in the New England Building at Cleveland by the Cleveland Telephone Company (Bell). This is the largest cable ever used in the city, all others heretofore used being 200-pair or smaller. It is said that a cable with 600 pairs will be placed in the new Rockefeller Building, which may be completed some time next year. It is believed that larger cables will have to be used for all the big office buildings. The cables run directly from the exchange to the buildings.

Linemen employed by the Home Telephone Company at Norwalk have gone on a strike for higher wages. They ask for $45 a month and expenses through the winter.

Twenty-seven business men in the towns of Millcreeks Valley have ordered the City and Suburban Telephone Company to remove their telephones from their places of business on the ground that the agreement is broken by the recent increase of rates. It is believed that the Village Council of Lockland will grant the Queen City Telephone Company a franchise at the next meeting.

S. H. Mendenhall, C. Mendenhall, Charles Eisley and others have organized the Botkins Telephone Company at Botkins with a capital stock of $20,000.

Pittsburg wholesale merchants who recently made a trip through Ohio over the Pennsylvania lines had a convenience in their coaches that is rather novel. At each seat a telephone instrument was attached and when the train reached a town the instruments were connected up with long-distance lines and the merchants had a talk with their own offices or with their homes if they desired. It is said the innovation was quite a success.

A dividend of five per cent. has been declared by the Northwestern Ohio Telephone Toll Line Company, an increase of one per cent. over previous dividends. The company has had a good business and keeps its service well up to the standard. It is largely owned by the Barber and Brailey people.

It is said that the long-distance lines between Cleveland and Kansas City will be connected up shortly, so that service with the Southwest may be had. This will be a great step forward for the Independent interests.

President F. S. Dickson of the Cuyahoga Telephone Company (Independent), Cleveland, says he believes that within a year the company will have 20,000 subscribers. At present about 13,000 instruments are in use in comparison with 8,000 a year ago. The increase in keeping up and the service is gaining all the time in quality. C.

Telephone News from the Northwest.

E. J. Cooper of Minneapolis proposes to build a telephone line from Two Harbors to Grand Marais, Minn.

The Edinburg (N. D.) and Gardar Telephone Company is building a line between the towns named in the title.

The Valley Telephone and Telegraph Company has been granted a local franchise at De Pere, Wis.

J. J. Greaves of Glencoe, Minn., is establishing a local telephone exchange at Silver Lake, Minn.

The Farmers' Mutual Telephone Company may put in a system at Iowa Falls. This would mean three systems there, and a telephone war would be inevitable.

The Iowa Telephone Company is putting in a new line from Oskaloosa to Davenport.

The Wisconsin Telephone Company is rebuilding its telephone system at Fond du Lac. Most of the wires will be put underground and a more modern switchboard installed.

The Barnum (Iowa) Telephone Company has been incorporated with a capital of $10,000. J. W. Hagans is president and C. F. Bryan secretary.

D. M. Neill of Red Wing, Minn., has been granted a franchise for a competing local exchange at Red Wing. He will connect with the Consolidated Telephone Company's long-distance line and will also build rural lines.

The war between the city of St. Paul and the Twin City Telephone Company over the poles on Hague Avenue has been ended by an agreement whereby the overhead wires are to be removed by July 1, 1905.

The Clearwater (Minn.) Telephone Company will install a local exchange at once, and will connect with the long-distance line of the Northwestern Telephone Exchange Company. R.

Southeastern Telephone Developments.

The Maplesville and Selma Telephone Company of Alabama has been organized at Selma with $4,000 capital to install local telephones, and also at Maplesville and intermediate points.

The Southern Bell Telephone Company is reported to be attempting to secure control of the Raleigh (N. C.) Telephone Company, where both now operate plants. The latter says that it will not sell out to the Bell, which recently secured control of the Interstate telephones at Raleigh.

N. C. A. Sauls has been elected superintendent of the Colleton County (S. C.) Telephone Company, which is putting in a line from Colleton to Cottageville.

The Graniteville (S. C.) Telephone Company has been chartered, with $3,500 capital, by W. A. Giles and others to run lines to several neighboring points.

The Raleigh (N. C.) Telephone Company has announced the construction of a line to Clayton, N. C.

The Southern Bell Telephone Company having secured control of all outside connections at Laurinburg, N. C., has notified the Independent company that the latter cannot get connections outside after a short time of notice expires. The Bell company has also offered to rent the Independent system. L.

Independents Must Deal with City Council in Cincinnati.

Judge Littleford of the Common Pleas Court in Cincinnati has reversed the decision of Judge Nippert of the Probate Court giving the Independent Telephone companies the right to lay conduits in the streets of Cincinnati. Judge Nippert entered a decree defining the mode and manner in which the Queen City Telephone Company could occupy and use the streets and alleys for the construction of its lines. Over the contention of the city and the Bell company, Judge Nippert held that the Independent company came to the city with a charter grant from the state by virtue of legislative action giving it franchise rights of occupancy of the streets. It was, therefore, the province of the court to determine only how the company should be permitted to utilize those streets. This decision seemed to sustain the franchise claim of every Independent company having articles of incorporation from the state department. The city contended that the Board of Council having refused to give a franchise and having failed to reach an agreement with the companies permitting them to occupy the streets, it was not within the province of the courts to intervene, the right sought being one for administrative determining. Judge Nippert held this contention not to be good, and recognized the legislative franchise, under it defining and restricting the manner and mode of street occupancy. From this decree the city solicitor appealed to the Court of Common Pleas, and at the same time filed a bill of exceptions in support of an action on error. The case came before Judge Littleford and the decision was reversed.

The Fitzsimmons Telephone Company, an Independent organization, has, it says, a Probate Court franchise granted to it in 1896 for a term of 25 years, which seems to offer an opportunity of entrance to Cincinnati for both local and long-distance Independent telephone lines. Cincinnati Independent telephone interests may possibly be centered in the Fitzsimmons company, which already operates an exchange.

Long-distance Connections with Kansas City.

Representatives of the Kansas City Home Telephone Company and the Western Independent Telephone Company met last week in Kansas City and finished the negotiation whereby the Home Telephone Company carries the long-distance lines of the connecting Independent companies. Those present at the meeting were: E. L. Barber, Wauseon, Ohio; James S. Bailey, Jr., Toledo, Ohio; Lee Benoist, St. Louis; Arnold Kalman, St. Paul, Minn.; J. J. Heim, O. C. Snider and Hugh C. Ward, Kansas City. The subject of extending the lines from Ottawa, Kan., through the oil fields of Kansas and Oklahoma was discussed and practically agreed upon. Mr. Ward of the Home Telephone Company said: "The Independent telephone business is prosperous. Our company has gained 600 subscribers a month since May last, and long-distance calls are increasing in the same proportion."

The Marshall (Mich.) Independent telephone exchange, to which allusion was made in the Western Electrician of last week, has finally been purchased by the Citizens' Telephone Company (Independent) of Grand Rapids, and not by the Michigan State (Bell) Telephone Company, as was rumored. This will give Marshall two telephone systems.

GENERAL TELEPHONE NEWS.

The Barnum Telephone Company of Barnum, Iowa, has been organized and has a capital stock of $10,000.

The Farmers' Mutual Telephone Company of Coats, Kan., has finished its rural system of about 50 telephones.

The Pratt Telephone Company of Pratt, Kan., has completed its toll line to Greensburg, Kan., a distance of 35 miles.

The Schooler Bros. Telephone Company at South McAlester, I. T., has been incorporated with a capital stock of $100,000.

The Washington Mutual Telephone Company of Washington, Kan., has been incorporated with a capital stock of $2,500.

The Southwestern Telephone Company of Anthony, Kan., has built a toll line to Duquoin, Kan., to connect with the Kingman Telephone Company.

The Granby and Neosho Telephone Company of Granby, Mo., has been incorporated with $3,000 capital by J. J. Cummins, George M. Spangle, John Kingston and others.

Manager William Buchholtz of the Northwestern Telephone Exchange Company at Mankato, Minn., is to be promoted to a position in the Twin Cities. He is to be succeeded by Mr. Eaton of Benson, Minn.

The Pioneer Telephone Company has begun work on its new plant in Muskogee, I. T. The estimated cost of the new system is $50,000. The Pioneer company owns nearly all the toll lines in Indian Territory.

The Maplesville and Selma Telephone Company has been incorporated by H. N. Rider, L. C. Elevash, E. E. Todd, T. M. Crumton and others, with $4,000 capital to construct a telephone line from Selma, Ala., to Maplesville, Ala.

The Kiowa Telephone Company, of which Amas Jones is manager, is building a toll line to the western part of Barber County, Kansas. This line is being built expressly for the cattlemen, as there is no house along the line for the entire route of 38 miles.

Representatives of the Kansas City Home Telephone Company and the Western Independent Telephone Company met in Kansas City, Mo., recently to transfer all holdings to the former company. It was announced that the Independent lines would be extended into the Kansas gas and oil fields from Ottawa, Kan.

The Home Telephone Company of Bowling Green, Ky., is arranging to build an exchange at Woodburn, and connections will likely be made with Smith's Grove, Morgantown and some other places. The company has a good system in Warren County and is seeking to improve it in every way possible. Over 600 telephones are now in use in Bowling Green aside from the outside connections. C. A. Edwards of Huntington, Ind., who is one of the leading owners of the company, has been in that section the past few days looking over the ground.

A contract has been closed between the Hudson River Telephone Company and the Glen Independent Telephone Company, operating 3,500 telephones in Montgomery and Fulton counties, New York, by which the latter will use the long-distance lines of the Bell company. Reports indicate that the Bell people are making every effort to close contracts with a number of other Independent companies in that section in order to prevent the Independent long-distance companies from getting a foothold. It is quite probable that there will be a warm contest for the control of the local Independents.

MANUFACTURERS AND DEALERS.

A company has been formed by D. M. Newbold, Jr., of Baltimore, Md., for the manufacture of a telephone call-recording device.

The Independent Telephone Manufacturing Company of Madison, Wis., has been formed by former employes and members of the Standard Telephone Company, which removed to Milwaukee.

The Acme Electric and Telephone Company of Chicago has been incorporated for the manufacture of electrical appliances. The capital is $10,000 and the incorporators, A. B. Schaffner, Harry Goodman and A. Kreis.

The Eureka Electric Company is just issuing from the press its new 1905 catalogue. This catalogue embraces the company's well-known line of telephone apparatus, and will be mailed to any company desiring a copy, upon application.

The Topeka Independent Telephone Company of Topeka, Kan., since its organization in 1901 has experienced a remarkable increase in business. Since the original installation it has been necessary to increase the capacity at least once every nine months. The American Electric Telephone Company of Chicago, which furnished the original equipment and additional increases, has just completed the construction of another section of switchboard for the Topeka exchange, and the Topeka company is now giving service to almost 2,500 subscribers.

Police Telephone Call Boxes in New York City.

In the matter of police telephone call boxes the city of New York, or rather the borough of Manhattan, is about 20 years behind more progressive American municipalities. But at last a system of police telephone call boxes, to the total number of 661 instruments, is now in course of installation in that city. These boxes are being provided solely in connection with the police precincts in the borough of Manhattan, which so far has been without any such system, although a system of call boxes has been in operation in Brooklyn since 1884, and a few boxes were put in on Staten Island about two years ago. Thus far the boxes have been put up in 21 out of a total of 29 precincts. The total cost to the city for this service is to be $20,855.20 a year, exclusive of the salaries of the police officers engaged exclusively in telephone work.

M. R. BRENNAN, SUPERINTENDENT OF TELEGRAPHS, NEW YORK CITY.

These new call boxes are attached to buildings where convenient, and are placed at the corners of intersecting streets. Within each box is an ordinary telephone transmitter and receiver, worked from a central battery. There are six telephones on a circuit, and it is planned to have at least one box on each patrolman's post, or at the intersection of two contiguous posts, the officers on duty having to report to their respective precincts at hourly intervals. The main use of the boxes, however, is for emergency calls, patrol wagons and ambulances, or even as a supplementary alarm for fires. It is estimated that when all the boxes are installed the total number of calls from the boxes will exceed 2,000,000 per annum. Under certain conditions, also, the police commissioner allows the keys of the boxes to be in the custody of private persons, such as hotel clerks, the managers of banks and clergymen. Certain banks and private institutions have also their own private police-call boxes connected directly with the nearest precinct, in addition to the alarm-call boxes provided by corporations who supply a special patrol service as a precaution against fire and robbery.

The call boxes are connected with a switchboard at the local precincts, and between each precinct and the Mulberry Street headquarters there are direct telephone connections originally put in about 25 years ago, but which have been continually modified since their installation. Twenty-five years ago there were but two operators employed at Mulberry Street and a total telephone force of five; but today the force numbers 55, and eight switchboard operators are on duty during the day, and five at night. The superintendent of telegraphs is Mr. M. R. Brennan, who is now in charge of all the police telephones in Greater New York. Mr. Brennan entered the service of his bureau nearly 26 years ago as an operator. He rose gradually though all grades, and in 1889 had achieved the position of assistant superintendent for Manhattan and the Bronx. In 1894 he was appointed superintendent, and on the consolidation in 1898 of the five boroughs now comprising Greater New York Mr. Brennan was called upon to bring all the police telephones under a unified system.

Mr. Frank C. Mason, who is now officially known as assistant superintendent of telegraphs, was formerly superintendent of telegraphs for the city of Brooklyn, but on the amalgamation of Brooklyn with New York, the Brooklyn bureau was subordinated to the Manhattan headquarters. All the telephone work done in Brooklyn up to 1898 was therefore directly under Mr. Mason's control, and, although his official title has been changed, his duties have remained practically the same. Mr. Mason is the founder and a former president of the International Association of Municipal Electricians. He has a wide acquaintance among electrical men all over the United States.

The switchboard operators are selected from the ordinary police sergeants, roundsmen and patrolmen, and are appointed on account of their detailed knowledge of the city, especially in regard to the locations of hospitals, public buildings and fire stations. They must also be able to reply firmly but courteously to the thousand and one inquiries addressed to the police station which have no real concern with official business. Besides the official staff, there is an outside force of linemen, battery-men, etc.

The New York Police Department has now in operation 1,333 miles of telephone wires, of which 562 miles are located in Manhattan, 598 in Brooklyn, 116 in Queens Borough, and 59 in Richmond (Staten Island). In the borough of Manhattan the police telephone wires are almost in all cases underground, and of late these cables have required considerable repairs, owing to the building and construction operations in constant progress. In some cases the cables have suffered to such an extent that they will have to be replaced. In the Bronx Borough all the wires are overhead, but provision has been made in the current estimates for laying them underground. In Brooklyn, with the exception of a few thousand yards of wire in the vicinity of the old Smith Street headquarters, all the wires are either on poles or are attached to the structure of the elevated railways. A contract has, however, just been signed with the Safety Insulated Wire and Cable Company, to the amount of $54,000, for placing the Brooklyn wires in conduits. The wires in Richmond and Queens boroughs have all been put in during the last two or three years, and it is not anticipated that they will require much attention for some time to come.

In Brooklyn, there has been a system of call boxes in use since 1884. The Brooklyn boxes are not, generally speaking, of a modern type. They were originally put in on the report of Mr. Mason, who studied the Chicago system as in vogue in 1884, and recommended a type of call box, which is a combination of a telephone and automatic call box. When the officer opens the box the recording circuits are closed and the dial switch has to be moved to "ambulance," "fire," "telephone" or "wagon," as the case may be. The recording apparatus at the precinct makes dots on the recording tape to correspond, and a fraction of time is saved by the fact that the switchboard operator can call up the proper department more expeditiously. A good deal of the Brooklyn equipment is practically worn out, but it is being systematically replaced, and last month a new six-panel switchboard was installed at the new State Street headquarters. This was supplied by the Western Electric Company, and erected by the police electricians.

The records of telephone box calls in Brooklyn have been kept for several years. During 1903 there was a total of 1,761,626 recorded calls, all entered upon the precinct and headquarters blotters. There were in addition over 200,000 official messages transmitted between the different precincts, for all official orders are transmitted over the telephone. By an ingenious method of switching on all the precincts with headquarters a message intended for every precinct can be transmitted in a very brief space of time.

FRANK C. MASON, ASSISTANT SUPERINTENDENT OF TELEGRAPHS, NEW YORK CITY.

If any member of the general public has occasion to telephone to the police he goes to the nearest private or public telephone and asks central for "police." He is promptly connected with the nearest police headquarters, and by the terms of the telephone company's franchise no charge is made for the message. The caller, if it is necessary, will be connected over the police circuits with any precinct, either over the local wires or over the trunk wires that connect the different boroughs.

Articles of incorporation have been filed for the Bloomington, Clinton and Decatur Electric Railroad Company at Bloomington, Ill. The capitalization is $50,000, and among the incorporators are W. R. Carle of Wapella, Harry Shlaudeman of Decatur, L. R. Murphy of Clinton, Thomas N. Leavitt of Maroa and H. W. Knight of Kansas City, Mo.

Annual Report of Western Union Telegraph Company.

President Robert C. Clowry of the Western Union Telegraph Company last week presented his annual report for the year ended June 30, 1904. This document shows that the capital stock stands unchanged at $97,370,000. The bonded debt is $25,504,000. The revenues of the year were $29,249,390 and the expenses $21,361,915. The net revenue was $7,887,475. After deducting bond interest, there was left $4,868,071 for dividends and $1,861,704 for surplus. The surplus now stands at $14,881,428. There was an increase of $81,704 in the revenues of the year and of $408,700 in the expenses. Of the last-named amount, $195,374 was in maintenance and reconstruction of lines, including nearly $100,000 for repairs to the company's transatlantic cables, and $183,254.93 was in operating and general expenses, including removal and improvement of offices, etc.

The net growth of the plant was, in poles and cables, 2,833 miles; in wires, 66,193 miles; in offices, 338. Of the total of 1,155,405 miles of wire in the company's system at the close of the year, 290,507 miles were of copper, an increase in copper during the year of 44,257 miles. The cost of new construction was $2,465,779.69.

Among other measures for improving the service adopted during the year was the establishment of a general division for the southern states, with headquarters at Atlanta, Ga. Three districts in other divisions which had grown too large for careful supervision were divided and two new districts created out of them, one with headquarters at Dallas, Texas, and the other at Hartford, Conn. At Boston, Mass., Wheeling, W. Va., and several other places arrangements were made to reconstruct and remodel the main offices. The leases of the main offices at Philadelphia and Cincinnati expired during the year, and as arrangements could not be made for their renewal the company moved into new and modern buildings secured by long leases at both places.

The substitution of dynamos for primary batteries has been continued so far as practicable, and where power could not be obtained to operate dynamos, storage batteries have been employed. Such changes were effected at 15 important battery centers during the year. The new method of generating current is not only more efficient than the old but so much cheaper as to save during the first year nearly the entire cost of making the changes.

Contracts covering 2,512 miles of railroad were closed during the year.

The balance sheet places the total assets at $145,538,894.

On June 30, 1904, the company had 23,458 offices, 199,350 miles of poles and cables and 1,155,405 miles of wire. It transmitted 67,903,973 messages during the year—a decrease of 1,886,893 from the number in 1903. The average tolls per message were 31.7 cents and the average cost to the company 26.1 cents.

Electrical Securities Corporation.

The New York Tribune says that on October 13th the Electrical Securities Corporation was incorporated in the office of the secretary of state with a capital of $3,000,000. The principal office is in Schenectady, and the purpose of the corporation is to manufacture and deal in electrical, gas, water and steam-power machinery. The stock is divided into $1,000,000 preferred and $2,000,000 common. The directors are W. C. Lane, Pliny Fisk, Wilbur C. Fisk, F. L. Eldridge, Oscar L. Gubelman, G. M. Cumming, W. M. Barnum, C. A. Coffin, William C. Cox, Adolphus Smedberg, Jr., Paul S. O'Connor, Robert Maclay, William T. Kaufman and F. W. Walz of New York; E. T. Stotesbury of Philadelphia, Gordon Abbott and James J. Storrow of Boston, M. B. Johnson of Cleveland, M. J. Perry of Providence, R. I., Edward C. Palmer of Morristown, N. J., Harry S. Babcock, Jr., of Flushing, L. I., S. M. Hamill, H. W. Darling and E. R. Coffin of Schenectady, N. Y.

Electric Derail System.

The Chicago and Northwestern railroad has installed at a cost of $30,000 at Lake Shore Junction, near Chicago, an electric switch and derail system to guard against wrecks. Mechanism in the depot, by means of levers and switchboards, controls five switches and five derailing devices, the electricity being generated by a five-horsepower gasoline engine, which charges a 56-cell storage battery, which supplies a constant current. An approaching train signals its coming when a mile and a half away through an extra raised rail at the side of the track. This rail is pressed down by the wheels of the engine, forming a contact which produces a current and sounds a buzzer at the depot, also dropping the name of the division on the switchboard apparatus. When a train has the right-of-way the derailing apparatus is set automatically so as to throw any trains on the other routes from the track in case they approach the junction.

The directors of the Springfield, South Charleston, Washington Court House and Chillicothe (Ohio) Electric Railway Company at a recent meeting increased the capital stock of the company from $50,000 to $1,500,000.

CORRESPONDENCE.

Great Britain.

London, October 8.—A sufficiently long period of working by electric traction upon the Mersey railway has now elapsed for a definite opinion to be expressed as to the result of the change over from steam working. This line is a comparatively short one, running under the River Mersey at Liverpool, and, from various causes, important among which was the asphyxiating atmosphere due to the steam locomotives, the line was for a considerable period in a very parlous condition. The Westinghouse company came along and agreed to reconstruct the line for electric traction upon certain terms—I believe it was not a cash transaction—and now, up to June 30th of this year, the working expenses have been reduced by 42 per cent.; i. e., from 30.1d. to 17.35d. But to this must be added that for 17.35d. per train-mile practically all the traffic that is likely to come on to the line can be accommodated. The total traffic receipts per mile at present average two shillings. The increase in passengers carried for the first half year of 1904 was 40 per cent., as compared with the first six months of 1903. The results, therefore, are in every way satisfactory, and no doubt the figures just published will be well studied by all the steam-railway managers of the country.

After having held what was given out as its final sitting, it is now announced by the Royal Commission on London Traffic, which came into existence in April, 1903, that further evidence will be heard. If the policy of the last two years be persisted in—viz., that no new underground-railway schemes for London be promoted until the Royal Commission has laid its final report before Parliament—it would appear that no such schemes will be proceeded with this year, as the parliamentary notices, etc., have to be deposited in a few weeks' time.

The unexepected decease of Major-general Webber has removed a well-known figure from the electrical ranks of Great Britain. Honored largely as being one of the actual original founders of the British Institution of Electrical Engineers, Major-general Webber never ceased to take an extraordinarily keen interest in the welfare of engineering societies, and only a few weeks prior to his death was discussing the papers read before Section G of the British Association at Cambridge. During the last few years of his life, since the passing of the Telegraphs (Telephone) Act, 1899, he was greatly interested in telephony.

It is announced that a conference of the parties to the all-British Pacific cable will take place in London next month. Whether the financial position of the undertaking is to be discussed is not stated, although from the figures given out a few weeks back, this would not appear unlikely. One point to be discussed is the amount charged for terminal fees in Australia.

In the government space-telegraph bill which was passed at the end of the last session of Parliament, October 1st was the date mentioned as the date upon which applications for licenses under the act had to be made. It has now transpired that no special form of license has been printed, but that a list of questions as to the nature and extent of the installations which it is proposed to carry on have to be sent in by every applicant to the postmaster-general.

In certain provincial towns of Great Britain there appears to exist a growing antipathy to the running of electric tram cars on Sunday. A number of fashionable watering places have adopted such a policy, although, from the visitors' point of view, it is not the most desirable one. In most cases the stoppage of the cars on Sunday has been at the instigation of the municipality without any plebiscite of the inhabitants having been taken. In one case this week, however, the inhabitants themselves, as the result of a poll, decided that the cars should not run. In other places, the tramways only work for a few hours in the morning and a few hours in the evening.

The Belfast corporation recently obtained an act of Parliament to acquire the horse tramways in the city which belonged to a company, and at the same time to equip them for electric traction. Whether profiting by the somewhat unfortunate experience of its neighbors at Dublin, in connection with their electric-light undertaking or not, can only be conjectured, but the fact remains that the Belfast corporation decided not to employ a consulting engineer, but to leave the work in the hands of its own officials. Thus the tramways manager will advise as to rolling stock, the borough engineer as to track and the electrical engineer as to electrical equipment. It has been decided to employ the overhead system, although a communication was received from Wolverhampton explaining the Lorain surface-contact system.

Very little is heard nowadays concerning municipal telephony, and but few fresh licenses are being taken up. The Portsmouth corporation, however, which has now had an exchange in operation for a short time, is making application for permission to borrow an additional $100,000 for the purpose of extensions.

Whatever may be the cause, there appears at present to be a certain industrial depression in Great Britain, which some of the older established manufacturing firms find it difficult to avoid. A scheme is in hand for the reconstruction of the well-known firm of Ferranti, Ltd., while in the annual report of Willans & Robinson, the makers of the well-known high-speed engine, a state of affairs is revealed which is causing anxiety to the directors. In some quarters it is felt that foreign competition is not the culprit this time, and that the cause must be looked for nearer home.

The huge generating station which the Birmingham corporation is to erect is now being proceeded with. There will be 22,000 kilowatts of plant, which, it is estimated, will cost $2,500,000. The scheme, however, will be put into hand in sections, so that extensions can be systematically and easily carried out. At present the whole of the ground is being cleared.

G.

New York.

New York, October 15.—The arrangements for the opening of the subway are not yet very definite, but there will be a gathering at City Hall on Thursday, October 27th, some time in the afternoon, when Mayor McClellan will formally take over the undertaking from the contractors. The question of music, fireworks and decorations is still unsettled, as well as the hour when the general public will be permitted to ride in the cars. A suggestion to charge 25 cents for a ride for the first few hours is finding favor, the proceeds to be devoted to the men's pension fund. The rapid-transit commissioners have been examining the equipment of the subway and have found everything for the running of trains to be in good order. Several parties of specially invited representatives of local business associations have been riding on the experimental trains, which continue to run with smoothness. No schedule has yet been adopted, but several tentative schedules are being tried.

Trolley tracks are now laid over the Williamsburg Bridge, and on Tuesday morning a construction car crossed the bridge under electric power. The promise to have cars running by November 1st seems likely to be fulfilled. Brooklynites, however, are still uneasy about the delay in completing arrangements for the trolley connections over the bridge. The local Manufacturers' Association will discuss the matter next Wednesday. Allegations are also made that the Brooklyn Rapid Transit service on the Fulton Street line is not as good as it was three years ago.

The Edison Electric Illuminating Company of Brooklyn announces that on and after January 1, 1905, the present rate for current, which is 20 cents a kilowatt-hour, less discounts, will be superseded by the following schedule: Daily consumption, first two hours, 15 cents a kilowatt-hour; second two hours, 10 cents; third two hours, 7½ cents; succeeding hours, five cents. This is said to be equivalent to a general all-round reduction of about 20 per cent. and will place the price for current within the reach of many persons who have not hitherto utilized it. Mr. W. W. Freeman, the secretary of the company, states that the company now supplies current to every theater in Brooklyn and to most of the large buildings. Generally speaking, among all classes of consumers the demand is increasing at the rate of 25 per cent. a year. Small consumers' bills range from $2 to $10 a month.

Much indignation has been aroused by the determination of the Department of Lighting and Electricity to cut off electric current from all public schools which are not lecture centers. This is asserted to be a measure of economy, but on the other hand the Board of Education will have something to say, for it originally put in electric lights for very cogent reasons affecting the health and eyesight of the children.

The Queens Borough Volunteer Firemen's Association has been considering the subject of obtaining an electric automobile in place of its present horse hose wagon. A test has been made with a car which runs 35 miles with one battery charge at 14 miles an hour. The estimated annual cost for current for fire purposes is but $25.

The annual report of the New York and Long Island Traction Company, which has a system of trolleys in the vicinity of Hempstead, L. I., shows increased business. The number of passengers carried was 923,209, and only two persons were injured. The gross earnings for the 12 months ended June 30th were $59,710, as against $34,289 for 1903. The surplus was $8,109.

E. S. Taylor of the Brooklyn Rapid Transit Company is now engaged in giving a course of lectures on electricity to the motormen and other employes of the company at the Brooklyn Rapid Transit Club House in East New York. The lectures are free and are supplemented by a number of social agencies, such as physical culture and educational classes.

The Department of Bridges will shortly advertise the contract for the electrical equipment of the new lift bridge over Newtown Creek, Brooklyn. The devices required must be such that either or both arms of the bridge can be operated from either end.

A complete electrical equipment is to be put into the new public school No. 80, near Neptune Avenue, Brooklyn.

P. H. Spies and his associates have organized the

Spies General Electric Manufacturing Company, with a capital of $25,000 and headquarters in this city.

A revision of telephone rates at various points on Long Island served by the New York and New Jersey Telephone Company has resulted in considerable increment of business. Reductions have been made on 17 out of 46 lines. Subscribers connected with any of the company's exchanges can now communicate with about 225,000 instruments. Notwithstanding these reductions and greater facilities, the Merchants' Association of New York city is investigating the subject of equitable rates and is asking for the tariff to be regulated by legislative enactment. Mr. U. H. Bethell, the general manager of the company, welcomes the investigation and promises to place every facility in his power at the service of the association. D. W. W.

New England.

Boston, October 15.—The success of the Boston and Worcester railway has encouraged the promoters of the proposed Boston and Providence electric road to push forward their plans with all possible celerity. The projected railway will be under practically the same management as the Boston and Worcester, and will utilize the same route from Boston to Newton Highlands. Thence through Needham, Dover, Walpole, Norfolk, Wrentham, the Attleboros and Pawtucket, it will run over a new double-track road, for which contracts have been made, in part, and work is to be begun on its construction early in 1905. The estimated cost is $3,000,000, half of which will be in a stock issue and the other half in bonds. The location for the power house and details of equipment are now under consideration.

By a collision on the Blue Hill electric railway at Canton, Mass., last Monday night, Motorman Frank Smith was killed, the motorman of the other car was badly injured, and seven passengers were shaken up considerably, although escaping serious results. Smith's car got beyond control on a downhill run, and jumped the track at a siding. The vestibules of both cars were demolished.

At the annual meeting of the Edison Electric Illuminating Company of Boston, on Tuesday last, the directors were re-elected, with George S. Silsbee added to the board as the successor of Isaac T. Burr, deceased.

The new Western Massachusetts Street Railway Company, having secured the necessary local rights and the assent of the state Highway Commission, will begin construction work immediately on that portion of the new line between Westfield and Huntington, a distance of 16 miles.

At a special meeting of the Berkshire Street Railway Company, held on October 7th, an additional bond issue of $200,000 was authorized, making the total bonds $1,000,000, the same as the capital stock, the new issue to be subject to the approval of the railroad commissioners of Massachusetts.

Negotiations are in progress for the purchase of the Lowell and Boston railway, which runs from Woburn, via Burlington, to Billerica, and for making connections in Woburn, so as to give a through line between the cities for which the company is named. The road has not paid, being merely a feeder heretofore, but the Boston and Northern Street Railway Company, which contemplates acquiring it, would only need to build a 100-foot connection in Woburn Square to bring the Lowell and Boston into direct continuity with its Boston and Woburn service. The question of price is the principal matter at issue.

Three lighting companies are competing for the franchise for electric-light service in South Deerfield, Mass., namely, the Greenfield Electric Light and Power Company, James B. Bridges & Co. of South Deerfield and the South Deerfield Gas Company, which would like to enter the electric-light field.

Another step was taken in the movement for the new trolley line from Haverhill to Boston, on October 10th, when the deal was completed whereby a transfer of the stock of the Haverhill Electric Company to the promoters of the new line took place. Directors were chosen by the new owners as follows: President, Charles H. Tenney, Hartford, Conn.; secretary, Horace P. Wood, Boston; Henry A. Tenney, Everett, Mass.; Frank P. Roger, Dedham, Mass.; Oakes Ames, Milton, Mass.; Edward M. Bradley, New Haven, Conn.; Samuel A. York, New Haven, Conn. The treasurer is A. P. Tenney, Boston; assistant treasurer, J. B. Forest, Boston. B.

Southeastern States.

Charlotte, N. C., October 15.—The use of water-power electrically was tried for the first time in the history of Atlanta, Ga., on Monday, October 10th, when power from the Bull Sluice Shoals on the Chattahoochee River was turned on to help drive the cars of the Georgia Electric Company. The great power is being developed by the Atlanta Water and Electric Power Company, the available power being placed at 14,000 horsepower.

The electric plant at Spencer, N. C., for the Southern railway shops will supply light and power for the entire grounds. The work is under the supervision of Electrician W. S. Sweet.

The Asheville (N. C.) Milling Company has contracted with the W. T. Weaver Power Company for the necessary electric power from the French Broad River to operate the plant.

It is announced that the Postoffice Department has under consideration the use of the electric railways in the hauling of mail matter between the main office and the sub-stations in Atlanta, Ga.

It is reported that H. L. Millner of Morganton, N. C., has relinquished all claims to the light and water franchise granted him by the town of Lancaster, S. C., in favor of Col. T. Y. Williams, and Col. Leroy Springs of Lancaster, who will likely establish the two systems in the town.

The town of Buford, Ga., has voted $20,000 electric-light and water bonds, of the $1,000 denomination, to run 20 years, and bearing five per cent. interest.

The town of Greensboro, Ga., will vote on November 8th on the question of issuing electric-light bonds for a municipal plant in the town. L.

Ohio.

Cleveland, October 15.—The application of the Cleveland Electric Railway Company for a permanent injunction against the city to prevent the assignment of the Kinsman Street franchise to the Forest City Railway Company was heard by Judge Wing of the United States Circuit Court on Saturday. The Kinsman Street and West Side lines were consolidated as the Woodland Avenue line under a grant from the city, and Judge Sanders, representing the company, argued that the franchise extension operated to extend all the lines with which it connects. If this is true, the Kinsman Street franchise does not expire until 1908. A decision adverse to the Cleveland Electric would deprive it of the use of one of its most valuable lines and put the franchise into the hands of a company that has not yet showed much signs of life in a financial way. Mayor Johnson is fighting the Cleveland Electric, as usual.

Commissioners of Clark County have granted the Springfield, Washington Court House and Chillicothe line a liberal franchise, with the understanding that the road will be built as soon as possible. The road will pass through South Charleston and several other good towns.

A new trailer will be put on trial on the Cleveland lines in a few days, and if it proves satisfactory, more of the cars will be ordered for the purpose of relieving the pressure during the morning and evening rush. It was designed by engineers of the Cleveland Electric. The car will be without front and rear platforms and will have a side entrance, being built low down to the track to make entrance and exit easy. It will consist of two sections, one of which will be used as a smoker. The car is large, and will result in a great improvement in the service if the jerking usual to trailers can be eradicated.

A list of stockholders of the Cleveland Electric Railway Company has been filed with the city officials. It consists of 591 names. Among these are most of the prominent business men of the city and many women. People scattered over a large portion of the country are reported as stockholders.

Work has been begun on a new plant for the Toledo, Bowling Green and Southern road at Findlay, where it is the intention to generate current for the entire road. The building will be 120 feet wide and 150 feet long. A special meeting of the stockholders will be held at Findlay on Monday, October 24th, for the purpose of canceling contracts with the Toledo Railways and Light Company and the Maumee Valley Railway Company, over whose tracks the cars have been entering the city of Toledo. The road will hereafter enter over its own tracks, thus making a saving of at least $15,000 a year.

The Roberts & Abbott Company of Cleveland has plans and specifications of the Michigan and Indiana Traction Company on file in its office for the use of bidders on the contract. The road will run between Battle Creek and Lansing. This engineering firm will also have charge of the Toledo and Jackson Railway Company, which will build a road between Toledo and Jackson, Mich.

The Ohio penitentiary officials are considering the introduction of an automatic device that will relieve them of the duty of turning the switch for electrical executions.

G. Cathcart has resigned as superintendent of the plant of the Bellevue Light and Power Company, to become private secretary of John W. Moore of Cleveland, owner of the plant. John Scullen succeeds him as superintendent.

Frank Greenwald, an electrical supply dealer of San Francisco, was in Cincinnati a few days ago in connection with the purchase of goods. He is making a trip through the East, looking over the latest inventions and appliances.

Several gangs of men have been put to work on the extension of the Scioto Valley Traction line between Circleville and Chillicothe. It is the intention to complete it as soon as possible, and it will probably be in operation by the first of next July. The company will do its own track-laying and string its own wires.

It is reported that the Eastern Ohio Traction Company will double-track its line from the end of the Cleveland Electric tracks to Noble Road, the coming summer, about two miles in distance.

Because of various objections, the roads belonging to the coupon bureau of the Ohio Interurban Railway Association will not be required to give a bond to guarantee payment for the mileage of other roads used each month. Instead, they will each appoint a trustee, probably one of their own officers, and the money received for coupons will be paid over to him as the coupons are taken up. At the end of each month the trustees will settle with all the roads using coupons, including their own. In case of trouble of any kind occurring, no road can be behind more than one month under this plan. It is the intention to have the books out in December, if possible. So far, the Lake Shore and Cleveland and Southwestern are the only Cleveland roads to join the bureau, but most of those about Columbus and in the southern part of the state are members.

The record made by the Sandusky Gas and Electric Company for the last year has been very good, considering the fact that natural gas has been substituted for artificial and that on a commission basis from the Logan Natural Gas Company. Considered alone, the receipts from the gas business have fallen off, but the lighting business in general has held its own. It is thought the company will be in as good condition next year as it has ever been. This is an Everett-Moore property. O. M. C.

Michigan.

Detroit, October 14.—The Detroit United Railway is erecting one of the largest car barns in the state. The history of the street-railway operations shows a continual moving of the large barns used to store cars toward the ends of the different lines as the growth of the city and the extension of the city limits progress. This barn will be constructed half a mile beyond the city limits and will take the place of the old Jefferson Avenue line barn. The new barn will have 3,072 feet of wall, 5,000 feet of track and will be 750 feet long. A valuable feature of the structure will be its absolute fireproof qualities. The only wood in the building will be that used in the front doors and all steel used in its construction will be embedded in cement.

The city of Monroe will test the legality of electric railroads to carry freight, such as coal, brick, etc. The Detroit, Toledo and Monroe Short Line Electric Company has been incorporated under the general railroad law, but has a franchise in Monroe to operate a street railway only. This franchise would not allow it to carry more than packages in a baggage car.

The Thornapple Electric Company is constructing a dam, which will be 40 feet in elevation from the riverbed at LaBarge, near Caledonia.

The Detroit lighting commission has called the attention of the City Council to the fact that its books have not been audited since June 1, 1904. In the opinion of the commission they should be audited monthly, and the council is asked to provide the necessary funds.

The Detroit and Bay City Traction Company has incorporated, with a capital of $1,000,000. This company will displace the Detroit, Pontiac, Lapeer and Northern electric railway, which has recently secured a franchise in Bay City, and which proposes to build a line to Pontiac through Caro. A new franchise will be asked for in Bay City, and the company will go on with the work of securing the necessary right-of-way.

The Negaunee and Ishpeming Street Railway Company and the Negaunee Gas Light Company have been consolidated under the name of the Marquette County Gas Light and Traction Company of Ishpeming, with a capital of $400,000.

The Detroit, Ypsilanti, Ann Arbor and Jackson Electric Railway Company is pushing preparations for fast service over its line between Detroit and Jackson as rapidly as possible. The fact that the fast cars will stop only at designated stations, with extra switches at meeting points for the locals to lay out on to let the fast trains go by, will enable the company to cut off three-quarters of an hour between these two cities. No difference will be made with the local cars, which will stop at all points. C. G. W.

Northwestern States.

Minneapolis, October 15.—M. S. Mordant may be granted a franchise for installing an electric-light and heating plant at Creston, Iowa.

The Keota (Iowa) Lighting Company has changed hands, J. F. Kolkman of Sigourney being the new president and manager, and Pearl Kolkman, secretary.

A large power plant is projected by eastern capital to be built at Minnesota City, and which will furnish commercial lighting and power for Winona, Minn., and other neighboring towns. It may also eventually furnish power for several proposed trolley lines.

An ordinance has been introduced at Omaha, Neb., looking to the issuance of $500,000 bonds for the purpose of establishing a municipal electric-lighting plant.

The electric-light and water plant at Waseca, Minn., will be entirely remodeled at a cost of about $4,000.

E. V. Haser of St. Paul, Minn., has sold his electric-light plant and mines at Havre, Mont., to H. W. Turner and M. Hebgen of Butte.

The Hackworthy Construction Company has completed the new electric-light plant at Wausau, Wis. The plant cost about $50,000.

At the general election of November 8th a vote

will be taken on the proposition to grant a franchise at Red Oak, Iowa, to the Red Oak Electric Company for a power and heating plant.

The City Council is considering the advisability of purchasing the electric-light plant at Stillwater, Minn.

The Electric Light and Power Company of Shenandoah, Iowa, has sold out to the Shenandoah Artificial Ice, Power, Heat and Light Company, of which J. J. Dunnegan is president. R.

Pacific Slope.

San Francisco, October 14.—The United Railroads of San Francisco are to build huge car shops on Ocean Avenue, according to a report of the company. It is the intention both to repair and build electric and cable cars. A complete machine shop for the repair of electric motors, a much-needed improvement, is planned.

The Southern Pacific Railroad Company is immediately to install three large electric motors at the West Oakland yards, to operate all the machinery in the different shops. Under the present system, with steam as the motive power, the shafting in all three departments must be run, even although only one department is used. The motors will remedy this drawback.

The National Electric Company of 455 Sutter Street is to do the electric wiring in the Dana Building for $1,883.

The Stanislaus Power Company has filed articles of incorporation. The capital stock is fixed at $5,000,000, and San Francisco is selected as the place of business. The incorporators are mainly San Francisco business men, and are as follows: Sidney Sprout, J. P. O'Brien, Max L. Rosenfeld, E. E. Peabody and J. A. Thomas. The object is to supply parts of central California with electric power, and valuable water rights have been secured.

The company recently incorporated to construct an electric road from Oakland to Marysville, Cal., is found, it is asserted, to be backed by H. E. Huntington, the magnate, who has made success of electric roads in the southern part of the state, and it is thought that the construction of the road is a certainty.

J. C. Martin & Co. have opened at 117 New Montgomery Street. They handle railway, marine and power-plant specialties, and are agents for Martin's metallic flexible conduit.

Preliminary steps will be taken at once by the Board of Trustees of Alameda, Cal., toward securing new machinery to be installed in the electric-light plant.

Colonel Henshaw and his associates intend to construct a power plant to furnish electricity for light and power purposes as soon as a franchise is granted. It is probable that lines will be run to Chico, Oroville and Marysville, Cal.

The prospects are bright for an electric-trolley line connecting the cities of Modesto and Riverbank, and the Bald Eagle ranch, the site of the packing house to be erected by the McHenry Company. The electric-road promoters will go before the next meeting of the Board of Supervisors of Stanislaus County, Cal., and will ask for a franchise along the county road.

S. Shocken and Oscar T. Weber have applied to the Board of Supervisors of Sonoma County, Cal., for an electric-railway franchise from Sonoma to tidewater at Embarcadero.

The Northern Electric Railway and Navigation Company has been incorporated by J. M. Miller, E. J. Miller, W. H. Buster and others. The capital stock is $3,000. The object of the company is to construct an electric railway from St. John's on the west side of the Sacramento River to Colusa, Cal., a distance of 31 miles, with a connecting branch running from Butte City to Chico, Cal., a distance of 20 miles.

Engineers are surveying a line from Miles to Spokane, Wash., for an electric railroad for the Spokane Power and Transportation Company. Jules Pricket of Spokane is president of the company.

The council of Haines, Ore., has granted J. F. O'Bryant a franchise to conduct an electric-light and power system within the corporate limits of the town. Machinery will be ordered at once, and it is expected that the plant will be in working order within 90 days.

The International Telephone Company will start construction work at once on the proposed line from Bellingham, Wash., to Victoria, B. C., via the San Juan archipelago. There will be 70 miles of land wire and 15 miles of cable. The cost will be about $100,000.

J. J. Crofut of Portland, Ore., who is interested in the Tucker Power Company, has been at Hood River, Ore., recently. The company proposes to erect a power plant at the Tucker Bridge, five miles up Hood River. At Chenoweth, five miles below Hood River, Engineer Oliver of the Columbia River Northern has been running surveys for the purpose of locating a power plant. It is reported that a dam will be located up the Little White Salmon River, and water conveyed to the top of the bluff, and a power house constructed for generating electricity, which will be transmitted to Portland.

The Santa Maria Light and Power Company is arranging to put in an electric road between Santa Maria and Guadalupe, Cal.

Frank C. Ross states that the preliminary surveys have been completed for the proposed electric road between Tacoma and Olympia, Wash.

The preliminary surveys of the Willamette Valley electric road have been completed from Corvallia to Eugene, Ore.

Dr. D. Gochenauer and four other citizens of San Diego, Cal., have called a meeting of business men to discuss the proposition of forming an association to underwrite half the bonds of an electric freight and passenger railroad from San Diego to Imperial, and to adopt plans to secure the aid of the people. The plan also includes the construction of a road to San Bernardino and running a line of steamers from San Diego to connect with the Tehuantepec railroad in Mexico.

J. M. Bodine of Elberton, Wash., has secured the contract for grading the roadbed for the electric railroad from Colfax to Palouse, Wash. The directors of the road say that the work will be rushed to completion.

The Tuolumne Electric Company has been incorporated by R. W. Hersey, C. W. Quilty, J. J. Dunne and others of San Jose, Cal. The capital stock is $200,000. Articles of incorporation have been filed at Sonora, Cal. A.

PERSONAL.

C. C. Warren, president of the Warren Electric Manufacturing Company of Sandusky, Ohio, was in Chicago last week, revisiting the scenes of his old triumphs and calling on his many friends in this city.

John Hollingshead, the English literary and theatrical man, who died in London on October 10th at the age of 77, is credited by some with being the first to introduce (in 1878) the electric light in England.

Gen. William A. Bancroft, president of the Boston Elevated Railway Company, accompanied by Herbert A. Pasho, division superintendent of the road, left Boston on Thursday of last week for a trip abroad, sailing from New York on Friday. Their purpose is to inspect the subway and elevated systems of the principal European cities.

Dr. Louis Duncan of the electrical engineering department of the Massachusetts Institute of Technology, Boston, has resigned his professorship by reason of his appointment as electrical engineer to the New York Rapid Transit Commission. Dr. Duncan, who was formerly an officer in the United States Navy, is a past-president of the American Institute of Electrical Engineers and one of the leading electric-railway engineers of the country.

It is stated on what seems to be good authority that Horace E. Andrews will not retire at present as president of the Cleveland Electric Railway Company because of his connection with the traction interests of the New York Central. The development of the New York Central traction work may become so large and important within the next few years that it will take the entire time and attention of Mr. Andrews, and should this be the case, he may retire when it becomes necessary. At the present time, however, this time has not come.

The many friends of the late James W. Godfrey of New York, who for many years was one of the most popular electrical salesmen in the country, will hear with interest that his widow has been awarded $30,000 by the Supreme Court of New York state as compensation for his death. Mr. Godfrey came to his death by accident in November, 1901, while driving along St. Nicholas Avenue. The street was undergoing repair, and insufficient warning of its condition was held to be responsible for the death of Mr. Godfrey, who at the time was sales manager for the India Rubber and Gutta Percha Insulating Company.

ELECTRIC LIGHTING.

Alfred Wolters is erecting an electric-light plant at Schulenburg, Texas.

The Fort Smith (Ark.) Light and Traction Company has increased its capital stock to $1,000,000.

The plant of the Thermopolis Electric Light Company at Thermopolis, Wyo., has been destroyed by fire.

H. M. and E. P. McIver are contemplating the establishment of an electric-light plant at Foreman, Ark.

The Jackson Light and Power Company has applied for a franchise to construct an electric-light and power plant in Jackson, Tenn.

The Delaware Water Improvement Company has been incorporated with a capital of $150,000 and will construct a waterworks and electric-light plant in Newcastle, Del.

The City Council of St. John, New Brunswick, may decide to purchase the plant which provides electric lights for the west side of the city and run it as a civic enterprise.

The Consumers' Electric Company of New Orleans, organized some time ago by Jules Dreyfous, Charles Godchaux and Gus Lehman, Sr., is arranging for the erection of a plant after plans by Emile Weil, who will supervise construction. The largest engine will have 6,500 horsepower.

The Kaw Valley Telephone and Electric Light Company is about to begin building an addition to its electric-light plant in Bonner Springs, Kan.

The Nebraska Electric and Fixture Company of Omaha, Neb., has secured a contract for the complete installation of an electric-light system at Geneva, Neb. Work will be commenced immediately.

The La Grange Service Company, Chicago, with a capital of $100,000, incorporated by Buell McKeever, G. C. Madison and Harry Dunbaugh, has for its object the operation of heat, light and power plants.

The borough of Dallastown, Pa., has voted to install an up-to-date system of street lighting. The project won by 116 to 70 votes. Arc lights will be provided, and the current will be furnished by the York Haven power plant.

The Baltimore Electric Power Company has been incorporated with an authorized capital stock of $2,500,000 to utilize the franchise granted by the city of Baltimore to the Maryland Telephone and Telegraph Company for the construction and operation of an electric-light and power plant. The incorporators of the company are John T. Stone, president of the Maryland Casualty Company; David E. Evans, president of the Maryland Telephone and Telegraph Company; Henry W. Webb, vice-president and general manager of the Maryland Telephone and Telegraph Company; Robert F. Bonsal, treasurer of the Maryland Telephone and Telegraph Company, and William P. Spring, auditor of the Maryland Telephone and Telegraph Company.

ELECTRIC RAILWAYS.

The Leavenworth Electric Railway Company will soon be running its cars to the Junction in Kansas City, Mo., over the Metropolitan tracks.

The Business Men's Association of Darlington, Wis., is pushing the enterprise of building an electric railway for carrying passengers and freight between Dubuque, Iowa, and Madison, Wis. The distance is 77 miles, while the nearest railway communication now is 131 miles.

It is reported that the Nashville (Tenn.) Railway and Light Company has been granted rights-of-way for the extensions on the Nolensville turnpike and Murfreesboro turnpike extensions and the Jefferson Street line to Eighth Street, in West Nashville. Engineers are at work on the survey.

According to reports from Green Bay, the officers of the Knox Construction Company have stated that so far as the Knox company is concerned there is no foundation for the story to the effect that the merger of all the electric railroads in the Fox River Valley from Fond du Lac to Green Bay is the purpose of a movement now under way.

The report of the business of the St. Louis Transit Company for the third quarter of 1904, ended September 30th, filed with the city register, shows that the number of trips made was 1,754,652 and the number of passengers carried 61,861,515. During the corresponding period of last year the company made 1,398,932 trips, carrying 39,308,027 passengers.

The construction of an extensive electric-railway system in Mississippi is proposed by the Magnolia Electric Railway and Power Company of Magnolia, Miss., which has just been incorporated with a capital of $250,000 by J. H. Price, C. V. Ratcliff and L. E. Schilling. The electric line is to be built from Summit to Magnolia, passing through McComb City, Whitestown and Fernwood.

At the annual meeting of the Greenfield (Mass.) and Turners Falls Street Railway Company the reports showed that the gross earnings for last year were $66,000. Owing to the severity of last winter, the net surplus is smaller than it was a year ago. During the year 1,460,000 passengers were carried, which is 200,000 more than the previous year. Owing to commutation tickets the gross receipts were only $3,000 more than the previous year.

The noise of the elevated trains on the downtown loop in Chicago has caused much controversy and suits have been brought against the operating companies for damages. Plans for deadening the noise have been proposed at various times. Richard Morgan of Dwight, Ill., has appeared before the local transportation committee of the City Council to talk upon the nuisance and will soon prepare plans for the consideration of the committee. He asserts that he assisted in planning the first elevated-railway construction in this country.

A. B. Cleveland of Geneva, Ohio, has been appointed receiver of the Cleveland, Painesville and Ashtabula Railway Company in a suit brought by Jethro G. Mitchell of Toledo. Mr. Cleveland is the president and general manager of the company, and the suit and appointment of a receiver will not interfere with the operation of the road, which is in service between Geneva and Ashtabula. Mr. Mitchell is one of the directors. He says that the construc-

tion company did not comply with its contract and that the railway company is insolvent.

The great network of underground electric railways in Paris, known by Parisians under the name of the Metropolitan, is nearing completion. Out of the eight lines for which concessions have been granted three will shortly be in operation, while work is being actively pushed ahead on four others.

Until recently all rail bonds used in electric traction work in Great Britain were imported. Now an English firm announces that "traction engineers may now not only have the satisfaction of using home-made goods, but have the advantage of getting anything special in length or design attended to promptly, without the loss of time that would necessarily be involved in referring such matters abroad."

POWER TRANSMISSION.

The Grand Ronde Electric Company of LaGrande, Ore., has been incorporated with a capital of $100,000 by T. R. Berry, L. F. Schuele and others.

D. O. Mills and E. A. Wickes, both of New York, and William B. Rankine of Niagara Falls, are the directors of the newly incorporated Suburban Power Company of Niagara, N. Y., organized for the purpose of distributing electric current in Niagara and Erie Counties. The capital is placed at $10,000.

The Archibald Brady Company of Syracuse, N. Y., has been awarded the contract for the construction of a power station at Mendon, Vt., to cost $120,000. It will be used in connection with the great reservoir built at Chittenden, Vt., by the Chittenden Power Company and will develop from 2,000 to 4,000 horsepower.

SOCIETIES AND SCHOOLS.

At the meeting of the Railway Signal Association held in the Transportation Building of the World's Fair last week the following-named officers were elected: President, J. C. Mock of the Michigan Central railroad, Detroit, Mich.; vice-president, Lawrence Griffith, Lehigh Valley railway, New York city; secretary and treasurer, H. S. Balliet, Bethlehem, Pa. Niagara Falls was selected as the place of next year's meeting.

Mr. Homer E. Niesz of the Chicago Edison Company, whose appointment as editor of the Question Box for the National Electric Light Association was recently mentioned in the Western Electrician, proposes to get into communication with every central station in the country, if possible, and to reach every member of the companies interested in presenting either questions or answers. By beginning the work so early as this, Mr. Niesz will be able to sift both questions and answers thoroughly and to make a selection of such as will be of greatest interest to the greatest number of managers.

PUBLICATIONS.

A booklet telling all about the lubrication of axles may be had from the Joseph Dixon Crucible Company of Jersey City, N. J., being especially devoted to that product of the company known as Dixon's everlasting graphite axle grease.

The Stanley Electric Manufacturing Company has put out a new bulletin on its polyphase induction motors. The bulletin contains considerable interesting information concerning these machines and diagrams of connections for the starting compensator. The various taps brought out from the compensator windings are proportioned to cover a wide range of starting torque and current, so that by connecting the proper tap to the switch the compensator may be adapted to almost any condition. A special attachment is provided with the compensator switch, so that when the motor is started the compensator switch must first be thrown to the starting and then to the running position; and this last move must be made quickly, with the result that the motor will not be given an opportunity to slow down appreciably before it is connected to the full potential.

A bulletin devoted to multiphase, engine-driven, revolving-field generators has just been issued by the Fort Wayne Electric Works of Fort Wayne, Ind. Descriptions and illustrations of this class of machinery are given in the bulletin, together with type AE rheostats, which are used in connection with the alternators. The generators listed in this bulletin are 60-cycle machines, wound for 2,300 volts, although other voltages may be supplied. The ratings are from 60 kilowatts to 400 kilowatts.

Quite an elaborate catalogue from the Dayton Manufacturing Company of Dayton, Ohio, is devoted to the Silvey storage battery. A new line of stationary cells has been put out, furnished in round glass jars. The company has lately purchased the entire business of the Columbus Storage Battery Company of Columbus, Ohio. Different kinds of Silvey batteries are manufactured, including types designed for portable or car-lighting, for central-station use, for isolated plants, sub-station batteries, etc.

A new booklet, entitled "Light Where Needed," comes from McLeod, Ward & Co., who deal in Kinsman lamp specialties. Of particular merit is the new fixture shown in the booklet, known as the 18-A. This has been designed to meet the demand for a cheaper fixture, at the same time being practical and serviceable. It is made on the principle of the orchestra lamp, also manufactured by the company, one half of the cylinder revolving around the other half, so that the opening for light may be almost closed and extended as much as desired.

TELEGRAPH.

In his annual report for 1904, Brigadier-general Frederick Funston, commanding the Department of the Columbia, says that "the construction and maintenance of the Alaskan military telegraph line has been of almost inestimable value in maintaining communication between headquarters and the various posts in Alaska and incidentally of great service to the residents of Alaska, especially as the mail service in the interior is necessarily slow and uncertain."

The Great Northern Telegraph Company contracted on September 26th with the Danish government for the establishment of a cable line to Iceland. The company pays all the expenses of the cable, which is to be ready in two years. The Danish and Icelandic governments pay a subvention of $25,000 a year for 20 years to the company. Permission has been obtained from the British government to land a cable in the Shetland Islands, and this will be in communication with the existing cable from Shetland to Scotland. From Shetland a cable will be laid via Thorshavn, in Faroe, to the east coast of Iceland.

MISCELLANEOUS.

Edward Carey, a wireman employed by the General Electric Company at Lynn, Mass., received an electric shock at 2,300 volts a few days ago. He was knocked to the ground and rendered unconscious. But the injured man recovered consciousness on the way home in an ambulance and was able to walk into his house. His left arm was partly paralyzed by the shock, temporarily at least, so that for the first 24 hours or more after the accident he felt no pain. Thereafter, however, the numbness began to leave his arm and the pain set in. At the last account the physicians feared chiefly that the shock might bring about a nervous collapse, aside from which it was thought likely that Carey would recover.

It is reported that the French Society of Manufacturers has offered a prize of $1,200 to the inventor of the best apparatus for "gauging the current of an electrical conductor." The competition is open until December 31, 1904. It is said that particulars of the competition may be obtained upon application to the president of the society, whose address is 3 Rue de Lutece, Paris, France.

All arrangements for the formal tests of the first of the 40 New York Central electric locomotives are now completed at Schenectady. The tests will probably begin in a few days. The locomotive has been hauled to a point near Hoffman's Ferry. A stretch of nearly five miles of track between Schenectady and Hoffman's Ferry has been equipped with a third rail for the tests. In order to put the locomotive to thorough tests and show what it will be able to do with the big New York Central passenger trains a heavy train of cars will be used.

The constitutional amendment to be voted on in Illinois on November 8th is considered of vital importance to Chicago. Efforts were made for several years before the Legislature was induced to submit such an amendment to the people, and should it be lost through the indifference or negligence of the voters, the work will all have to be done over again. Judges of election are required to account for the special ballot, and this is considered a great aid in inducing the voters to mark it properly and hand it back to the election judges. The amendment must have a majority of all the votes cast in the state in order to be adopted.

The electrical equipment of the new battleship Georgia, recently launched, is particularly complete. This ship belongs to the most powerful class afloat. It is 435 feet long, 76 feet 10 inches beam and has a displacement of 15,000 tons. Two 100-kilowatt generators and six 50-kilowatt generators will furnish the electrical equipment for six 50-inch searchlights, 1,000 incandescent lamps and for every purpose for which electricity will be used. Important accessories on the craft include an evaporating and distilling plant for converting salt water into fresh, ice plant, laundry, machine shop, electric-signaling communication throughout the ship, telephone, space telegraphy, air-compressing plant and complete coaling gear.

TRADE NEWS.

Charles H. Royal of Camden, N. J., and four associates have incorporated the United Power and Water Development Company with a capital of $100,000.

Knut Guelson has secured the contract for installing a complete electric-lighting plant in the Martin Luther Orphans' Home, located at Stoughton, Wis.

The Empire Wire Company announces that its main office is now located at its factory in Rome, N. Y. The company will be obliged if all communications are addressed to it there.

H. R. Wilson, formerly St. Louis agent for the Stanley Electric Manufacturing Company, has just been appointed assistant manager of the Rossiter-MacGovern Electrical Company, St. Louis, by Manager J. A. Pierce. Mr. Wilson brings with him an extensive electrical acquaintance and experience and will doubtless be a most efficient lieutenant for Mr. Pierce.

The municipality of Shanghai, China, is inviting proposals until March 31, 1905, for the construction and working of 24 miles of electric railways, on the trolley system, double or single. Conditions of contract and other information may be obtained upon application to Pook & Co., agents for the municipality, 63 Leadenhall Street, E. C., London, England.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued (United States Patent Office) October 11, 1904.

771,802. Power Transmission. Victor S. Beam, East Orange, N. J., and Charles L. Clarke, New York, N. Y. Application filed April 16, 1904.

A constant-speed driving motor and a driven mechanism of an induction motor intermediate thereto serves, when driven by the constant-speed motor above synchronous speed, as a variable-speed clutch for transmitting the power of the driving motor to the driven mechanism. (See cut on page 344.)

771,818. Wireless Signaling Apparatus. Lee De Forest, New York, N. Y. Application filed May 28, 1904.

A localizer of the source of wireless signaling waves comprises a collection screen mounted to be turned about a vertical axis. A ground connection therefor and an electrical translating mechanism has its wave-sensitive member in series between the screen and its ground connection.

771,819. Wireless Signaling Apparatus. Lee De Forest, New York, N. Y. Application filed May 28, 1904.

In a conductor having its principal component extending horizontally, and short as compared with one-quarter wave length of the received waves, are means for turning the conductor about a vertical pivot. An electrical translating device is associated with the conductor.

771,820. Protecting Device for High-frequency Apparatus. Lee De Forest, New York, N. Y. Application filed June 9, 1904.

The combination, a portion of which is subject to high-frequency electrical surgings, consists of an earth connection employing therein a condenser and located between the portion which is subject to the surgings and other portions of the apparatus. (See cut on next page.)

771,853. Telephone-call Recorder. Henry Abbott, New York, N. Y. Application filed August 17, 1901. Renewed March 7, 1904.

A recorder, comprising a register, has a platen that is movable to print from one of the register parts, and means to move the other of the register parts to print therefrom.

771,858. Commutator. John H. Brown, Reading, Pa. Application filed January 7, 1904.

The commutator is composed of cylindrically grouped parallel commutator plates of uniform thickness and involute curvature and interposed insulating slips, all held in solid contact and with the edges of the plates forming a brush-engaging surface.

771,868. Automatic Brush Adjuster. William H. Freedman, Burlington, Vt. Application filed August 18, 1903.

In a rectifying apparatus is combined a commutator, a set of brushes, a movable element carrying the brushes, and means operated directly by and through the phase displacement of the current for shifting the brushes in accordance therewith.

771,872. Furnace for the Manufacture of Steel. Gustave Gin, Paris, France. Application filed June 30, 1903.

A hearth inclosed by and movable relatively to the furnace structure has two non-carbon electrodes to connect it with a source of electrical energy, and has an open channel in which the iron is placed to be treated while at rest, the electrodes being the terminal points of the channel.

771,875. Overhead Trolley-wire System. Coloman de Kandó, Budapest, Austria-Hungary. Application filed October 14, 1903.

Two wires of the same polarity constitute together one supply conductor, the wires being attached alternately to successive points of suspension and forming alternating loops. Means are supplied to connect the sagging central parts of the loops to the upwardly curving parts of the adjacent looped wires.

771,891. Protective System for Electric Conductors. Leonard Andrews, Hastings, England, assignor to the Stanley Electric Manufacturing Company, Pittsfield, Mass. Application filed April 15, 1903.

Duplicate feeders, a differential choke coil connected to the feeders, a magnetic core, two windings connected

to the feeders and adapted to assist each other in producing a flux in a portion of the core only upon the unbalancing of current flow in the choke coil, one of the windings being connected to the opposite polarity of the system, a secondary coil mounted upon the portion of the core, and a switch arranged to be operated upon the passage of current through the secondary coil are features of the system.

771,897. Call-signal Apparatus for Telephone Exchanges. William W. Dean, Chicago, Ill., assignor to the Western Electric Company, Chicago, Ill. Application filed January 14, 1902.

A retaining magnet adapted to hold the calling key in its operative position when once actuated has an energizing and a neutralizing winding, and a circuit including the energizing winding of the magnet, established in registering contacts of the plug and spring jack in making connection with the line, has means controlled through the agency of the switch at the sub-station for sending current through the neutralizing winding.

771,902. Machine for Winding Coils. John J. Frank, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed January 21, 1901.

A mandril for winding coils of wire is described.

771,907. Electric Arc Lamp. Charles E. Harthan, Lynn, Mass., assignor to the General Electric Company, Schenectady, N. Y. Application filed March 11, 1902.

In a twin arc lamp having two pairs of carbons are a solenoid, a core therefor, clutches for a carbon of each pair connected to the core and operated simultaneously by the solenoid, and two legs secured together with insulation between them depending from the frame, each forming the negative lead for a carbon.

771,908. Electric Heater. Harry E. Heath, Windsor, Conn., assignor to the General Electric Company, Schenectady, N. Y. Application filed February 12, 1904.

A heating device or unit inclosed within a chamber is provided with openings on different levels to create a draft of hot air, and a secondary chamber is arranged at the discharge end and provided with feed openings for an induced flow of cooler air.

771,916. Lamp Receptacle. Andrew A. Moffitt, Pawtucket, R. I. Application filed November 14, 1903.

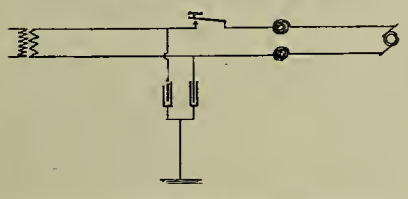
A device for preventing short-circuiting of electric lamps comprises a cup portion of non-conducting material. A block of conducting material adapted to contact with the side of the lamp is located on a different horizontal plane from the center contact for the lamp, the two contacts being separated by a vertical space.

771,917. Wave Transmitter. Roberto L. de Moura, New York, N. Y. Application filed February 9, 1903.

In a system of signaling without connecting wires are an induction coil and a discharge circuit connected to the secondary of the coil. A circuit interrupter and a source of current are connected to the primary of the coil and there are means to actuate the circuit interrupter to make and break the primary circuit in accordance with sonorous vibrations, whereby current pulsations may be produced in the primary corresponding or approximating to the sounds by which they are produced.

771,932. Alternating-current Meter. William H. Pratt, Lynn, Mass., assignor to the General Electric Company, Schenectady, N. Y. Application filed March 3, 1903.

A core is provided with a potential coil and slot or air gap in the magnetic circuit of the core. Polar projections are located on the core on either side of the slot or air gap, a current coil having a separate core opposite to the polar projections of the first-named core, and a movable member is disposed between the cores.



NO. 771,820.—PROTECTOR FOR HIGH-FREQUENCY APPARATUS.

771,946. Means for Supporting Telephone Receivers. Frank W. St. John, Coshocton, Ohio. Application filed April 27, 1904.

A coil spring connected with a pivotally supported arm carrying the receiver is adapted to have its tension increased proportionately as the arm is turned from a vertical to a horizontal position. Means are provided to hold the receiver in any adjusted position.

771,958. Controller. Montraville M. Wood and Henry Geisenhöner, Schenectady, N. Y., assignors to the General Electric Company, Schenectady, N. Y. Application filed April 4, 1904.

The device consists of a variable resistance, a switch arm biased toward an off position co-operating therewith, and a single electromagnet having a single winding and arranged to hold the arm in any position to which it is moved when the circuit conditions are normal and to release the arm in case of either an overload or underload.

771,968. Electrostatic Instrument. Francis H. Bowman, Lynn, Mass., assignor to the General Electric Company, Schenectady, N. Y. Application filed November 25, 1903.

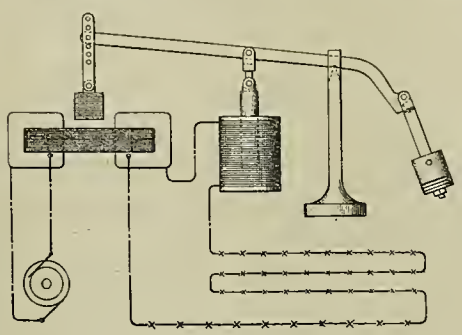
Two confronting conducting surfaces forming the fixed and movable members of the instrument, and means for varying the area of active surface are described.

771,972. Telephone Toll-line System. William W. Dean, Chicago, Ill., assignor to the Western Electric Company, Chicago, Ill. Application filed January 14, 1902.

Some of the features are: A calling and a called line and a plug circuit at the central office for uniting the lines, a toll device at the sub-station of the calling line adapted for manual operation by the subscriber, a blocking switch in the plug circuit at the central office adapted when actuated to render the apparatus of the calling line inoperative for telephonic purposes, a supervisory relay associated with the called line in the plug circuit at the central office and controlled by a switch at the called station, a circuit for the blocking switch controlled through the agency of the supervisory relay, whereby the blocking switch is actuated upon the response of the called subscriber, a releasing device adapted when actuated to counteract the blocking switch and restore the apparatus of the calling line to operative condition, a supervisory relay associated with the calling line in the plug circuit at the central office, a circuit for the releasing device controlled by the supervisory relay, and a switch adapted to be actuated in the operation of the toll device to change the electrical condition of the circuit.

771,983. Insulated Joint. Percy Holbrook, New York, N. Y., assignor to the Weber Railway Joint Manufacturing Company, New York, N. Y. Application filed December 28, 1903.

An insulated rail joint, comprising the meeting ends of rails and bolt plates for maintaining them in alinement, is described.



NO. 772,096.—ALTERNATING-CURRENT ARC-LIGHT REGULATOR.

771,987. Electric Crane. Harry A. Lewis, Norristown, Pa., assignor of one-half to Alan D. Wood, Conshohocken, Pa. Application filed December 30, 1903.

The combination consists of an electric motor, a line circuit in which the motor field and armature are normally included, a switch normally out of the circuit and having connections for short-circuiting the motor armature and adapted to short-circuit the armature in response to the limit lift movement, and a controller adapted to reverse the motor connections and provided with circuit connections for short-circuiting the switch to permit of running the motor to lower the moving part.

771,988. Incandescent Electric Lamp. Jesse R. Lovejoy, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed December 11, 1901.

A double-filament lamp is described having a shell contact to which both filaments are connected and two eccentrically positioned insulated contacts on the end of its base for the respective filaments. A separable transfer plug is provided to engage a standard socket, the plug extending the shell contact of the socket to the shell contact of the lamp base, and having a contact mounted eccentrically to engage either contact on the base. (See cut.)

771,989. Electric Switch. Frederick Mackintosh, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed October 19, 1897.

An insulating support, a pivoted switch lever on one side thereof, a pivoted operating lever on the other side, intermeshing gearing between the two, an elastically mounted contact, and a detent for arresting the latter when the operating lever is shifted until energy is stored to quickly separate the contacts constitute the device.

771,996. Measured-service System for Telephone Exchanges. Frank R. McBerty, Evanston, Ill., and James L. McQuarrie, South Orange, N. J., assignors to the Western Electric Company, Chicago, Ill. Application filed February 23, 1904.

A service meter at the sub-station has a manually operated rebate lever and a switch contact operated in the movement thereof. A rebate-controlling magnet has a connection switch at the central office, and a locking circuit for the magnet established by the connection switch is completed by the rebate-lever contact.

772,002. Electric Clock. Theodore A. Schlueter, Oakland, Cal. Application filed February 7, 1903.

The clock has a tilting weighted escapement-actuating lever and an electromagnet and armature. Contact points are carried by the lever and the armature whereby the magnet is energized, the armature attracted, the lever tilted, and the contact broken. A second slidable contact energizes the magnet if the first contacts fail to act.

772,008. Insulated Joint for Railroad Rail Sections. George A. Weber, Stamford, Conn., assignor to the Weber Railway Joint Manufacturing Company, New York, N. Y. Application filed June 4, 1901.

Details are described.

772,009. Insulated Joint for Railroad Rail Sections. George A. Weber, Stamford, Conn., assignor to the Weber Railway Joint Manufacturing Company, New York, N. Y. Application filed June 4, 1901.

Details are described.

772,010. Insulated Rail Joint. George A. Weber, New York, N. Y., assignor to the Weber Railway Joint Manufacturing Company, New York, N. Y. Application filed November 23, 1903.

Details are described.

772,011. Insulated Rail Joint. George A. Weber, New York, N. Y., assignor to the Weber Railway Joint Manufacturing Company, New York, N. Y. Application filed November 24, 1903.

Details are described.

772,023. Automatic Telephone-exchange System and Apparatus. Albert M. Bullard, New York, N. Y., and Louis A. Falk, Boston, Mass., assignors to the American Telephone and Telegraph Company, New York, N. Y. Application filed January 26, 1904.

A suspension telephone switch, a signaling key and an intermittent interrupting device are all associated with the main circuit at the sub-station; the switch being adapted to close the metallic circuit and energize both relays. The interrupter is adapted to open the metallic circuit to de-energize the ringing relay, and to establish and intermittingly interrupt a grounded circuit composed of one side of the metallic circuit and including the source of current and controlling relay. The signaling key is adapted when depressed to steadily close the grounded circuit to maintain the excitement of the controlling relay, and to open the metallic circuit and de-energize the ringing relay.

772,024. Automatic Telephone-exchange System and Apparatus. Albert M. Bullard, New York, N. Y., and Louis A. Falk, Boston, Mass., assignors to the American Telephone and Telegraph Company, New York, N. Y. Application filed February 12, 1904.

The apparatus is adapted to become operative upon the closure of the bridge by the automatic switch causing the relays to close independent local circuits through the retaining magnet, and upon the subsequent manipulation of the selecting key to de-energize the selecting polarized line relay, opening one of the independent local circuits and closing another local circuit through the selecting magnet.

772,051. Indicator for Electric Snap Switches. Charles G. Perkins, Hartford, Conn. Application filed October 15, 1903.

A rotatable switch has openings in the cover through which appear the words which indicate the condition of the circuit.

772,067. Electric Controller. August Sundh, Yonkers, N. Y., assignor to the Otis Elevator Company, East Orange, N. J. Application filed July 20, 1904.

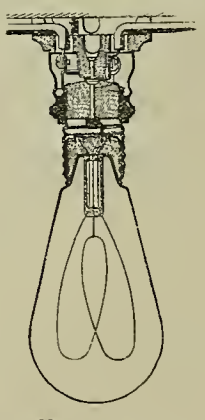
The controller has a rotary shaft provided with contacts, and stationary contacts in the controller co-operate with the rotary contacts. A retarding device is connected to the rotary shaft and means controlled by the shaft modify the effect of the retarding device.

772,084. Hoist. Thomas E. Brown, New York, N. Y., assignor to the Otis Elevator Company, East Orange, N. J. Application filed April 21, 1903.

A carriage adapted for travel up and down an incline has a cable for effecting its travel. A holding device for the carriage is mounted on the incline and comprises a catch and an electromagnetic device for moving the catch to disengage it from the carriage.

772,086. Electric Elevator Apparatus. Eugene R. Carichoff, East Orange, N. J., assignor to the Otis Elevator Company, East Orange, N. J. Application filed July 29, 1903.

A dash pot is constructed to operate with varying degrees of retardation in the movement of a switch. Opposing springs of different strengths are connected to control the operation of the contact, the stronger spring being connected to actuate the contact in one direction, and the weaker spring acting as a centering device.



NO. 771,988.—INCANDESCENT LAMP.

772,087. Trolley. Henry B. Clarke, Chicago, Ill. Application filed November 9, 1903.

An axially disposed short restoring wheel is positioned alongside of the trolley wheel and a rotably movable guard is positioned alongside the restoring wheel and provided with an inwardly inclined guiding periphery.

772,096. System of Electrical Distribution. Josef H. Hallberg, New York, N. Y. Application filed October 26, 1903.

A regulator for alternating-series arc-light systems embodies in its construction means for automatically and simultaneously varying the induced current without altering the number of active coils of the secondary of the transforming apparatus employed and the impedance in the distributing circuit in which the regulator is connected. (See cut.)

772,102. Electroplating Apparatus. Willis R. King, New York, N. Y., assignor to the Hanson and Van Winkle Company of New Jersey. Application filed February 8, 1904.

The apparatus described consists of a tank, a pair of electrically connected supporting bars in the tank and a suspension frame.

772,107. Rail Joint. Monroe D. Leebow, Sheridan, Pa. Application filed August 6, 1904.

An insulated rail joint is described having insulating material secured to and in contact with each of the rail webs beneath the tread and on the upper face of the base.

772,123. Lead-containing Cell for Secondary Batteries. Vincent G. Apple, Dayton, Ohio. Application filed June 3, 1903.

A lead containing cell for secondary batteries is formed in a single piece without seam or joint, made of lead cast under pressure while in a softened or molten condition.

772,143. Electric Brake for Vehicles. Alfred Green and Fred A. Strail, Rochester, N. Y. Application filed September 3, 1903.

The braking system comprises the following elements: A trolley circuit, an operating handle, a first electromagnet for applying the brakes electrically, a sand box having a valve therein and a second electromagnet for operating the valve and a spring for holding the valve normally closed, means whereby the motion of the handle first cuts into circuit with the trolley the exciting windings of the second magnet and also the exciting windings of the first magnet through a resistance which is gradually cut out by the forward movement of the handle. Means are provided whereby a further movement of the handle cuts out the trolley circuit and connects the exciting windings of the magnets in series with the armatures of the motors on the car, but first in parallel and then in series with each other.

772,172. Rail Bond. William E. Oakley, Millbury, Mass. Application filed January 2, 1903.

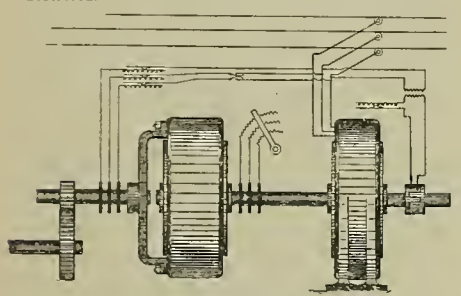
The bond consists of a pair of terminals of one metal and an electrical connecting wire or cable of another metal, and has portions of the metal of the connecting wire or cable distributed through the mass of the terminals.

772,188. Rail Bond. Edward G. Thomas, Waltham, Mass. Application filed March 26, 1903.

A laminated rail bond comprises a substantially U-shaped flexible portion, having its arms extending in the same direction from the bend of the U. Attaching means are located on the arms respectively, at unequal distances from the bend.

772,189. Method of Attaching Rail Bonds to Rails. Edward G. Thomas, Waltham, Mass. Original application filed March 19, 1903. Divided and this application filed July 29, 1903.

A method of securing the rail bond to the rail is described.



NO. 771,802.—POWER-TRANSMISSION APPARATUS.

772,190. Lightning Arrester. Percy H. Thomas, Pittsburg, Pa., assignor to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Application filed February 6, 1903.

Two of three discharge terminals are separated by a spark gap and connected to corresponding terminals of the pieces of apparatus to be protected and forming spark gaps with the third terminal, which is connected to ground, the two discharge terminals also forming spark gaps with the corresponding terminals of the other set.

772,200. Device for Replacing Fuses. Herbert G. Addie, Cresco, Iowa. Application filed April 4, 1904.

A box comprising a fuse-holding magazine and having an extension adapted to receive the fuses singly from the magazine and hold them in operative position within the electric circuit is described.

772,213. Electric or Telephonic Transmission. Henri Carbonnelle Uccle, near Brussels, Belgium. Application filed July 20, 1904.

An apparatus for increasing and transmitting undulatory electric currents is described.

772,215. Process of Manufacturing Glowers, Luminants and Filaments for Electric Incandescent Lamps. Francis M. F. Cazin, Hoboken, N. J. Application filed March 2, 1903.

The process of preparing luminants for incandescent lamps consists in squirting suitable material into the inner air-evacuated space of the bell jar of an air-exhausting apparatus, drying the squirted fillet by means of the rarefication of the air within the bell jar and forming the portions into the desired longitudinal shape.

772,235. Electric Igniter for Explosive Engines. William B. Hayden, New York, N. Y. Application filed February 15, 1904.

An electrical igniting device for explosive engines has means for varying the time of ignition of the explosive charge.

772,257. Electric Arc Lamp. Ralph Scott, Wilkesbarre, Pa., assignor of one-half to Marcus A. Miller, New York, N. Y. Application filed October 14, 1903.

A coil, a core within the same, a movable carbon support actuated by the core, a casing inclosing the coil, a flange on the casing, a non-metallic resistance supported by the flange, a carbon support beneath the first-mentioned support, and electrical connection between the coil and the last-mentioned support and between the first-mentioned support and the casing are the principal parts.

772,277. Current-controlling System. Arthur C. Eastwood, Cleveland, Ohio. Application filed June 4, 1904.

The coils of the switches are connected so that the voltage of the current applied to them depends on the counter electromotive force of the motor, current at the same voltage being successively applied to operate each of the coils as the motor is accelerated. (See cut.)

772,278. Electric Automatic Block-signal and Safety System. George P. Finnigan, Greene, N. Y. Application filed May 1, 1902.

An electric signaling member in each block is provided with an electrical supply for automatically energizing the signaling member, the trip arm and the relays.

772,282. Sleet Cutter and Contact for Electric Railways. Charles T. Leonard, Leonardo, N. J. Application filed February 29, 1904.

A revoluble contact and cutter wheel has its faces disposed in meeting relation and forming a peripheral cutting edge. There are means for mounting the cutter wheel and presenting it in operative relation to an electrical conductor.

772,288. Ventilated Coil for Electrical Apparatus. Newitt J. Neall, Edgewood Park, Pa., assignor to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Application filed January 20, 1904.

The coil comprises a suitably insulated conductor wound in a number of layers, each having a number of turns, and non-conducting material forms diagonal ventilating ducts between the layers.

772,291. Automatic Circuit-closer. Hermann G. Pape, New York, N. Y. Application filed May 17, 1904.

A hollow handle has a loose ball confined therein and a detachable plug closing one end of the handle. Fixed and movable contact elements mounted on the plug have their point of contact substantially at the axis thereof, the ball being disposed to urge the movable element into engagement with the fixed element when the handle assumes an upright position. A stop is disposd to prevent the ball from moving an appreciable distance away from the movable contact element.

772,298. Trolley-wire Support. William H. Spiller, Aurora, Ill., assignor to the Wilcox Manufacturing Company, Aurora, Ill. Application filed February 2, 1904.

Details are described.

772,308. Telephone Meter. Henry Abbott, New York, N. Y. Application filed August 17, 1901.

A registering mechanism comprising a dial and index is actuated in connection with a telephone for taking separate imprints from the dial and index.

772,310. Mouthpiece for Telephone Transmitters. Ira S. Ashe, Philadelphia, Pa. Application filed June 18, 1904.

A number of mouthpieces are constructed so that any one can be brought into operative relation with the transmitter.

772,313. Electric Controller. Arthur W. Harrison, Los Angeles, Cal. Application filed August 24, 1903.

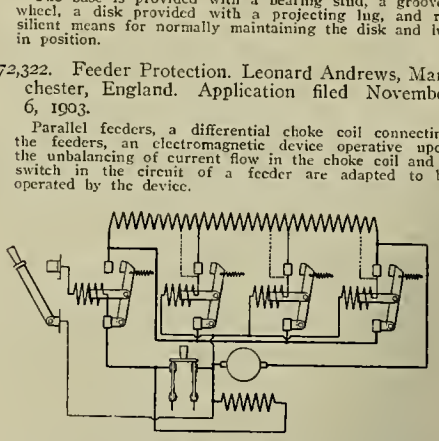
A pivoted contact frame has separately removable contact-carrying bars provided with contacts adapted to engage one end of the brush. A star wheel is adapted to engage the roller on the brush frame and a stationary contact is adapted to engage the other end of the brush.

772,321. Trolley. Perry Anderson, Sharpsburg, Pa. Application filed June 20, 1904.

The base is provided with a bearing stud, a grooved wheel, a disk provided with a projecting lug, and resilient means for normally maintaining the disk and lug in position.

772,322. Feeder Protection. Leonard Andrews, Manchester, England. Application filed November 6, 1903.

Parallel feeders, a differential choke coil connecting the feeders, an electromagnetic device operative upon the unbalancing of current flow in the choke coil and a switch in the circuit of a feeder are adapted to be operated by the device.



NO. 772,277.—CURRENT CONTROLLING SYSTEM.

772,327. Cut-out for Rural Telephones. Richard E. Pedigo, Lucas, Iowa. Application filed April 23, 1904.

A lightning arrester and cut-out system for rural telephones is described.

REISSUES.

12,273. Electric Circuit-closer and Breaker. Thomas H. McQuown, Biggsville, Ill. Original application filed September 26, 1902. Patented January 19, 1904, No. 749,743. Divided and application for reissue filed July 7, 1904.

The details of an electric circuit closer and breaker are described.

12,274. Electrical Warp Stop Motion for Looms. Frederic Kip, Montclair, N. J., assignor to the Kip-Armstrong Company of New York. Application filed August 13, 1904.

In the apparatus is a device for automatically closing the circuit when a warp thread breaks.

EXPIRING PATENTS.

Following is a list of electrical patents (issued by the United States Patent Office) that expired on October 18, 1904:

371,536. Brush Shifter for Dynamo-electric Machines and Motors. E. H. Amet, Chicago, Ill.
371,555. Anti-induction Device. J. Curran, Portland, Ore.
371,557. Means for Preventing Induction on Electrical Conductors. S. C. Drew, Boston, Mass.
371,559. Electric Meter. R. N. Dyer, East Orange, N. J.
371,570. Socket and Key for Incandescent Lamps. J. J. Fisher, Allegheny, Pa.
371,583. Electrical Registering Device. A. S. Hobby, Cinnati, Ohio.
371,640. Electric Alarm and Recorder for Oil Presses. E. W. Thompson, Charlotte, N. C.
371,655. Electromagnetic Brake Apparatus. G. T. Woods, Cincinnati, Ohio.
371,664. Electric Forceps. J. Brannan and William E. Stone, Denver, Colo.
371,681. Conductor for Electric Wires. J. Grant, Omaha, Neb.
371,696. Electric Alarm Clock. Simeon P. Meads, Oakland, Cal.
371,720. Electrical Indicator. M. Waddell, New York, N. Y.
371,752. Electric Call or Signal Apparatus. C. W. Foster, Galveston, Texas.
371,755. Vibrating Rheotome. J. R. Hard, New York, N. Y.
371,757. Telephone Holder. A. L. Hott, Cincinnati, Ohio.
371,808. Joint for Lead-covered Cables. R. S. Waring, Pittsburg, Pa.
371,840. Electric Circuit Connection. S. Heffner and J. H. Phillips, Pottsville, Pa.
371,869 Coin-operated Electrical Weighing Scale. E. R. Whitney, Manchester, N. H.
371,876. Fire-alarm Telegraph. C. Burgher, Boston, Mass.
371,893. Electrical Distribution and Charge of Secondary Batteries. F. King, Fiiham, County of Middlesex, England.

SPECIAL MENTION.

Dr. Emil H. Grubbe of 52 State Street, Chicago, announces that, in addition to his lecture courses, he is able to offer unexcelled facilities for private instruction in all electrotherapeutic subjects and especially X-ray work.

The Pittsburg Special, via Pennsylvania Lines, leaves Chicago daily at 7:30 p. m.; arrives at Pittsburg 7:45 next morning. Sleeping car for Youngstown and Newcastle on this train. Tickets and full information at city office, 248 Clark Street, Chicago.

The simplicity of the handsome new office building of the B. F. Sturtevant Company at Hyde Park, Mass., brings it into harmony with the shop buildings, bearing, however, a more stately appearance. It is about 45 feet wide and 125 feet long, with four stories and a basement. One-half of the basement is occupied by the printing plant and its stock room. Another portion is used as a lunch room for the office force, while the heating and ventilating apparatus is also located in the basement. Naturally, the building is heated and ventilated by the Sturtevant fan system. The galvanized-iron heat flues are built into the walls and convey the heated fresh air through register openings into the various rooms.

The Wagner Electric Manufacturing Company of St. Louis invites electrical men visiting St. Louis to call, either at the factory or at the company's World's Fair exhibit, or both. The month of October and the early part of November will be advantageous for comfortable sight-seeing, and if there is any way in which the Wagner company can add to the pleasure of electrical representatives while in the city of St. Louis, it will consider it a privilege to be called upon. Mr. W. A. Layman is the general manager of the company.

The Kaisling self-soldering protector, manufactured by the American Electric Fuse Company, has been adopted by the Merchants' Mutual Telephone Company of Michigan City, Ind., for use with the new switchboard equipment to be installed by the Stromberg-Carlson Telephone Manufacturing Company. The contract calls for 800 pairs, immediate installation. The Kaisling protector was selected upon its merits. The American Electric Fuse Company especially congratulates itself upon getting this order, because at the time the order was taken the customer did not have the opportunity of seeing anything more than a rough sketch and crude hand-made sample of the Kaisling protector.

The Fres-Ko Chemical Company, Fort Wayne, Ind., manufacturer of Fres-Ko soldering paste, commutator compound and soldering stick, reports a rapidly increasing demand for its products among electric-light stations afflicted with commutator "diseases" and among artisans desiring a reliable soldering paste or stick. In introducing this commutator compound the Fres-Ko company manufactures one brand of compound for direct and another for alternating-current machine service. The Fres-Ko alternating-current compound is a practical scouring compound which keeps the collector rings smooth and free from greasy or sandy surface and cleans them thoroughly. The direct-current compound is one no less positive in solving the electrician's cares and anxieties. This direct-current compound is specially and differently prepared by the company's chemists for direct-current commutators. To be fully appreciated, however, a personal trial of the compound is necessary, for, as the company puts it, "One never knows what's new in good things until a trial—then the surprise."

WESTERN ELECTRICIAN

EVERY SATURDAY

Vol. XXXV. CHICAGO, OCTOBER 29, 1904 No. 18

Electrically Operated Warship Models at the Naval Show on the "Pike."

A large majority of the exposition visitors at St. Louis who have witnessed the naval show on the "Pike" are probably unaware that everything connected with the reproduction of the Battle of Santiago is operated by electricity, even to the firing of the torpedoes, which, toward the end of the realistic engagement, blow some of the miniature ships into a thousand pieces.

For the benefit of those who have not seen this interesting spectacle a description of it may be necessary. The show is one of the attractions on the "Pike" and is intended to illustrate in as realistic manner as possible the maneuvering of a fleet of warships and also the destruction of the Spanish squadron by the American ships in the Battle of Santiago. A lagoon some 300 feet long by 200 feet wide lies in front of the observer and represents that part of the Caribbean Sea adjacent to the harbor of Santiago. At the side of the lagoon opposite the spectators' seats rise the heights of the frowning Cuban coast, as is well shown by the illustration on this page. Two harbor entrances are to be seen—one that of Santiago, the other that forming the base of the American fleet, which, at the beginning of the "war" part of the performance, is blockading the port of Santiago, and "bottling up" the Spanish squadron in the harbor of that city. The models of the warships—particularly of the American vessels—are excellently well executed, with the general contour, disposition of funnels, turrets, fighting tops, etc., in exact imitation of the originals. Battleships are lead-colored, cruisers white and torpedo-boats black. The ships are self-contained and move about the waters of the miniature ocean with precision and ease. Smoke issues from the funnels and from the muzzles of the guns when there is firing, either in salutes or in action. A number of ships are represented which have been built since the Spanish-American war, as the battleships Missouri, Illinois and others, and the whole fleet takes part in the opening maneuvers of "Peace," but there are also the New York, Brooklyn, Oregon, Olympia and other favorites of the war, and it is the battle-scarred veterans on which the fighting falls. During the first half of the performance the United States ships appear and go through various naval maneuvers. The second half represents the battle. A Spanish merchantman tries to run the blockade and is destroyed. The Spanish fleet then appears and the battle is on; the cannonading is terrific; ships are set on fire and burn to the water's edge; others are torpedoed and sunk, and the battle finally ends with the American force triumphant.

How this is all accomplished will be of interest, and a visit to the sheltered harbor behind the scenes throws considerable light on the subject. There are 28 of the miniature ships in all, built on a scale of exactly 1 to 25; the ships thus range in length from 15 to 24 feet, and they draw about 2½ feet of water. From the keel to the upper deck the depth is about four feet in the battleships and, of course, somewhat less in the cruisers. This gives ample room for the man that operates the ship to sit inside and handle his apparatus, his head passing up into a turret, through apertures in which he is enabled to see out and guide his ship. As he sits in his little compartment beneath the deck, conveniently arranged at his left hand is the keyboard for controlling the light circuits on the ship. Here are also located the fuses, charging plugs and steering wheel. On the right-hand side is the switch for controlling the motors and also the resistances.

Each boat is supplied with a one-horsepower motor of special design, which drives the propeller shaft by means of a pigskin friction wheel. The use of this is to prevent the moisture, which would be likely to creep in and follow along the propeller shaft, from getting to the motor. The constant wetting of the motor, due to leakage, if an ordinary gearing were used, would in time impair the insulation, though the motors may be submerged in water several days and run perfectly when they are taken from the water.

Current for the motor and lamps is supplied by a 36-cell storage battery, also of special design, and giving a pressure of 65 volts. Two hours are required to charge the battery. Like the motor, the battery may be submerged in water for a long period of time without injury. It often happens that one of these vessels is sunk (not in battle, but from some injury) and all that is necessary is to pump the water out and repair the leak, when the motor and battery are ready to perform their duty again. Inside each boat there are six eight-volt lamps, on the masts three or four eight-volt lamps, while on strings extending from mast to mast there are 24 eight-volt lamps. As already stated, the circuits of these lamps are controlled from a keyboard within the operator's reach.

On page 346 is presented a simple sketch showing approximately the arrangement of the harbor and giving a general idea of how the ships are stationed "behind the scenes." There are two entrances to the "harbor," through which the ships advance and retire during the performance. Each ship has its own point for tying up, or dock. The charging plant is in a room at one corner. There is a switchboard with one panel for each ship located at the rear. From this board any or all the ships may receive their charging current at the same time. The board is fitted with the necessary switches and instruments, there being an ammeter and voltmeter for each panel. Near the (spectators') left entrance to the harbor is a repair floor with the necessary tools.

A great amount of powder is burned during the performance. Each ship is supplied with four rapid-fire guns, which fire from the turrets. They are of about .45 caliber and 350 shots are fired from each boat during a performance, which lasts nearly an hour.

During the first part of the show there are exhibitions of target practice and torpedo practice. To make this latter seem realistic small mines are submerged near the target, which are fired by means of an electric circuit when the proper time arrives, throwing up columns of water a hundred feet in the

ELECTRICALLY OPERATED WARSHIP MODELS AT THE NAVAL SHOW ON THE "PIKE."

air. The crowning feature at the close of the battle is the blowing up of several Spanish ships. These ships, of course, contain no occupant and are of a cheap, flimsy construction. They are towed into their places by ropes and each contains a charge of powder sufficient to blow them to fragments when the charge is exploded by current sent through an electric circuit which operates a simple sparking device.

One of the interesting features is a small submarine boat, which takes part in the show. In the exhibition at St. Louis this boat does not go entirely out of sight, due to the fact that the basin

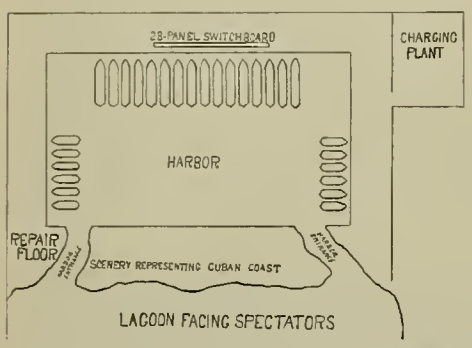


DIAGRAM OF HARBOR AND LAGOON OF THE NAVAL SHOW.

is shallow and the bottom covered with mud, the suction of which would be liable to hold the boat down. In other places where the show has been given and there has been a concrete bottom to the basin the boat has been made to disappear entirely and stay under 1½ hours with a man inside. It is made with a double bottom and water can be pumped into or out of the space between by a small centrifugal motor-driven pump, carried on board, causing the vessel to rise or sink at the will of the operator. The electrical equipment is similar, with the exception of the pumping apparatus, to that on the battleships and cruisers.

Altogether the show is an interesting one, not only in a spectacular way, but also as embodying much of educational and technical interest. It is the product of one man—Mr. David Goldstein—who has designed the models after actual warships now afloat and worked out the designs for all the electrical equipment. Naval shows have been given at the London Exposition in 1898, Paris in 1900, Düsseldorf in 1902, Hanover in 1903, and St. Louis in 1904. No small amount of skill is required to manipulate the ships, which, without an error, go through the maneuvers of a fleet at sea, and 15 days are required to drill a new man in the performance of his duties before he is allowed to take part in one of the performances.

Ries Patent for Electric Elevators In Litigation.

The case of the Otis Elevator Company versus the Barth Manufacturing Company was argued before the United States Circuit Court of Appeals in Chicago on October 21st. The Otis Elevator Company was the complainant and asserted that the Ries patent, No. 356,963, covers broadly all forms of electric-elevator systems and therefore that the defendant, and, indeed, all other manufacturers of such apparatus, infringe. The defendant answers that, in the first place, the Ries patent involved is not a pioneer patent, and therefore not entitled to claim broadly originality in this class of apparatus. Furthermore, the defendant asserts that the claims, even if they had the advantage of priority, are not broad enough to cover the general field of electric elevators. The case was brought up from the United States Circuit Court for the Eastern District of Wisconsin, where Judge W. H. Seaman held that the defendant's apparatus did not infringe. The complainant was represented by Frank T. Brown of Brown & Darby and the defendant by W. Clyde Jones of Jones & Addington, both of Chicago. Decision was reserved.

Conduit Deal in Philadelphia.

The Philadelphia Electric Company, of which J. B. McCall is president, has purchased the conduits of the Keystone Telephone Company. The price is reported to have been $2,500,000, and the Keystone company is to pay $112,000 annually for the use of the conduits. The Western Union Telegraph Company is also to pay an annual rental of $13,000 for certain conduits. The proposed ordinance giving the Philadelphia Electric Company the exclusive rights of electric lighting in the sections where the conduits are laid will have to be signed and sealed before the money is paid over.

Production of the Diamond in the Electric Furnace.

By A. De Courcy.

Among the processes of nature which are being imitated by artificial means none is more striking than the production of the diamond in the electric furnace by Prof. Henri Moissan. These experiments, which were begun some years ago, are now being carried out in the laboratory of the Sorbonne, at Paris, with great success. Mr. Moissan commenced the work by a careful study of carbon in all its known forms, including the diamond and different forms of graphite occurring in nature; also the graphites which are produced at a high temperature in the electric furnace.

He came to the conclusion that the diamond is produced by the crystallization of carbon under high pressure in the lower strata of the globe. How to reproduce these conditions was the question. He proposed to dissolve carbon in a liquid matter in fusion and then by cooling allow it to crystallize under a high pressure. Cast iron in fusion in the electric furnace is found to dissolve large quantities of carbon. When the mass cools it increases in volume in passing from the liquid to the solid state, and this causes a strong pressure inside the mass. The carbon then separates out in the form of graphite or transparent crystals, which are found to be diamonds. These particles are usually of microscopic size.

In the first experiment, 200 grammes of Swedish iron was put in a small carbon crucible. On top was placed a layer of powdered charcoal. The crucible is placed in the electric furnace. With a current of 60 volts and 350 amperes the heat lasts for three to six minutes. The furnace is opened

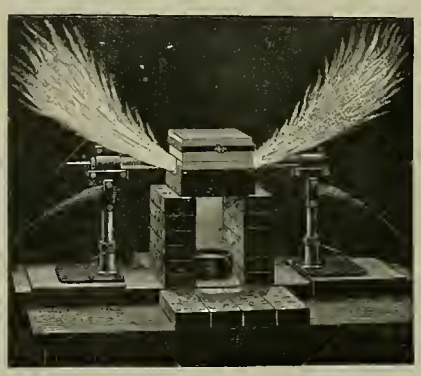


FIG. 1. ELECTRIC FURNACE IN WHICH ARTIFICIAL DIAMONDS ARE PRODUCED.

and the crucible taken up with a pair of tongs and plunged into a bucket of cold water. The metallic mass when cold is treated with acids, which dissolve most of it. The residue contains different forms of graphite and also black and transparent diamonds. Although the transparent crystals are of microscopic size (a few of them, however, reach one-half millimeter or 0.02 inch) they have all the characteristics of the diamond and resemble the minute diamonds found in nature; their clearness is remarkable sometimes. Some of the specimens have rounded angles, others appear as broken fragments. Cubes and different crystalline forms are seen, also irregular forms. The density corresponds with that of the diamond, being near 3.5. The crystals will scratch the ruby very deeply. They burn in oxygen with scarcely a trace of ash and produce carbon dioxide gas. No substance but the diamond will answer to these three tests of density, hardness and combustion in oxygen.

The electric furnace is of the well-known type brought out by Prof. Moissan. It consists of a large block of chalk with a circular cavity in the center, which contains the crucible. The carbons are laid in grooves and the arc is formed just over the crucible. A top cover of chalk closes up the furnace. The length of the arc is regulated by sliding the carbons in or out by hand.

The first experiments yielded but a minute quantity of the crystals, and it was only after long and careful tests that enough of them could be collected to make the observations. Mr. Moissan then looked for a method by which he could obtain the crystals in greater number. He succeeded in doing so by several different processes. In one experiment sugar charcoal is strongly compressed in a cylinder of soft iron, which is closed by a screw plug of the same metal. The cylinder is four centimeters long and one centimeter inside diameter. The thickness of the metal is about one centimeter. In the electric furnace is melted a quantity of soft iron in a crucible, from 50 to 200 grammes. This operation requires but a few minutes. The cylinder containing the carbon is quickly introduced into the melted iron. The crucible is then taken out of the furnace and plunged into a bucket of water. In this way he brings about the rapid formation of a layer of solid iron. When the layer is at a low red heat the crucible is taken ou tof the water and allowed to finish cooling in the air.

When the mass which is thus formed is broken, a layer of iron is found at the outer part, then comes a less carbonized metal and in the center is a portion containing a large percentage of carbon, in which are found the small diamonds. In this way Mr. Moissan obtained both black and transparent diamonds. One of the latter measured 0.4 millimeter in its greatest length. It answers to all the tests for the diamond. Black diamonds were also obtained in this way.

It seemed in these different experiments that the speed of cooling had a predominating influence on the formation of the crystallized carbon. When the crucible of the first experiment was cooled in water, the layer of water vapor which formed around it prevented the actual contact between the red-hot crucible and the water, and so prevented the heat from being conducted off. The cooling at first is carried on rather by radiation. To give a more rapid cooling it was thought best to cool the liquid metal by conduction. A certain quantity of iron is melted in the electric furnace and saturated with carbon. The cooling bath is formed of melted lead, which is kept about its fusing point, 325° C. The crucible filled with liquid iron at 3,000 degrees is immersed quickly to the bottom of the melted lead.

As the iron is lighter than the melted lead it separates from the crucible in small masses of spherical form, which rise through the bath and come to the surface. (When the iron is saturated with carbon in the electric furnace it becomes so viscous that the crucible can be overturned and it will not run out. But as soon as it cools, the metal becomes more liquid and gives up carbon in the form of graphite.) The globules of iron which float on the surface of the bath are collected. The lead is dissolved off by nitric acid and the iron is treated as before to separate the diamonds.

The amount of crystals is somewhat larger by this method and it is noticed that the transparent diamonds are especially clear and brilliant. The markings on their surface closely resemble those of rough diamonds. One of these transparent diamonds, whose diameter reached 0.57 millimeter, has the form of a triangle, with rounded corners. Its limpidity is perfect. The surface is covered with irregular impressions having the aspect of small cubes. It is interesting to note that this specimen, three months after its formation, was found to be cracked, and soon broke into three pieces. Some of the diamonds from the Cape show the same peculiarity, and the analogy is striking. This action must, no doubt, be attributed to the strong pressure which was brought to bear upon the mass at the time of its formation. The samples of diamond prepared by this method of cooling in metal presented some interesting shapes. In most cases

FIG. 2. MOISSAN ELECTRIC FURNACE CLOSED.

the surface of the crystals is smooth and brilliant; at other times it resembles shagreen leather. All of them show the luster which is characteristic of the diamond, and when a beam of light is let fall on them they shine with a brilliant glow.

In a new series of experiments it was desired to diminish the volume of the fused iron and to cool it much more quickly. The ideal experiment was to bring the iron into the form of a sphere and then exert a great pressure upon it. Such a result could be obtained with small masses of iron, letting them fall into a bath of mercury, which would cool them very rapidly. The experiment was carried out with an electric furnace of the above type. In the bottom is a circular hole six centimeters in diameter for the metal to run out. The carbon electrodes had a diameter of five centimeters. The positive one was

hollow, and into it slid an iron rod, which could be adjusted as desired. The furnace (Fig. 1) was fixed on two brick supports and below it was placed an iron vessel containing 10 centimeters of mercury, with water above it of twice that depth. The arc is formed between the carbons with a current of 1,000 amperes at 60 volts. When the furnace commences to work normally (at the end of two or three minutes) the iron rod is advanced slowly into the arc. The metal is melted and becomes rapidly saturated with carbon. The fused metal then falls through the lower opening in the form of shot. The incandescent spheres fall into the vessel through the water and to the bottom of the mercury, which rapidly cools them. The experiment is easy to carry out, and several pounds of the iron shot can be obtained in a short time. Black and transparent diamonds are found in these globules. The latter occur in very small crystals, but they have a remarkable regularity.

FIG. 3. MOISSAN ELECTRIC FURNACE OPEN SHOWING CARBONS AND CRUCIBLE AFTER PRODUCTION OF DIAMONDS.

Another method of producing the crystals was by the rapid cooling of a mass of liquid iron saturated with carbon, by using an iron cylinder. The latter was 18 centimeters long by 14 in diameter and had a three-centimeter hole bored in it to 12 centimeters depth. This hollow cylinder could be corked by an iron stopper, which fitted into the opening. The cylinder was placed upright in a bucket partly filled with water. About 400 grammes of iron was melted in the electric furnace and saturated with carbon. The liquid metal is run into the cylinder and the opening quickly corked by the iron stopper. In this case the cooling is very rapid. The outer mass of iron is then turned off in a lathe and the interior part treated to separate the diamonds. This method gives the best results and the crystals are obtained in larger quantities. Some of the specimens are of a very fine quality and perfectly transparent. By using a copper cylinder of the same size the cooling is more rapid and the quality of the diamonds is still better.

Fig. 2 shows the Moissan furnace closed. In Fig. 3 the furnace is shown open, with carbons and crucible, as it appears after the operation.

Western Electric Personnel.

Several changes have been made recently in the staff of the Chicago organization of the Western Electric Company. Mr. J. W. Johnston, who has been on the general staff as treasurer for some five or six years, has assumed the duties of Chicago manager. He will be aided in his work by two assistant managers—Mr. C. E. Mitchell, who has for some years filled the position of assistant to President E. M. Barton, and Mr. H. A. Halligan, who is taken from the position of chief clerk at Chicago to assume his new duties. Mr. Halligan will be in direct charge of clerical, stock and other service departments, while Mr. Mitchell will become responsible for the power and lighting-apparatus business in its various departments, the telephone and supply sales departments and the purchasing and advertising departments. Mr. F. V. Bennis, who has acted as assistant treasurer on the general staff and has been located in New York, has been relieved of his duties there and has been transferred to Chicago, where he will assume some of the important work in the financial department which Treasurer Johnston has laid down. Mr. Phillip Darlington, formerly superintendent of the Sprague Electric Company's shops, who far the last few months has been traveling abroad, has returned to America and has become attached to the Chicago staff of the Western Electric Company as superintendent of the new shops at Hawthorne, where, it is reported, that the company will begin operations in power and lighting work the early part of next year.

The North Mountain Power Company is installing an electric-light plant near Junction City, Cal., for the purpose of supplying light and power to Eureka, and Humboldt Counties.

The Weissmann Electric "Pearls."

By Alfred Gradenwitz.

A very ingenious form of electric glow lamps for decorative purposes has been designed by Mr. G. Weissmann of Paris. The new lamp allows of chandeliers, garlands and other electric-light designs being formed readily and according to any desired pattern. The lamps are insulated by "pearls," so as to be free from any socket, and with bare conductors.

The glass pearls serving for insulation are threaded on the conductors, so that the latter, while conveying the current, will serve as mechanical supports of the glass pieces used for decoration. This arrangement is shown in Figs. 1 to 3. The pearls (b_1 b_2), Fig. 1, threaded on the conductors, are sufficiently crowded to avoid any discontinuity between them and to obtain the complete insulation of the conductors (c). Where a lamp is to be fixed, the ends of the branched-off wires are wound on these conductors, as shown in Fig. 3, the joint being covered by special pearls with widened holes. A hook (K) at the end of the branch wires serves for fixing the lamp, while a big "pearl" (P), sliding around the glass rod (t) and being lifted up to (P_1) for making connections, secures the insulation of the hook. As regards the lamp (A), it is fitted with two wires insulated by the pearls (p) (a), and terminating in two loops (o).

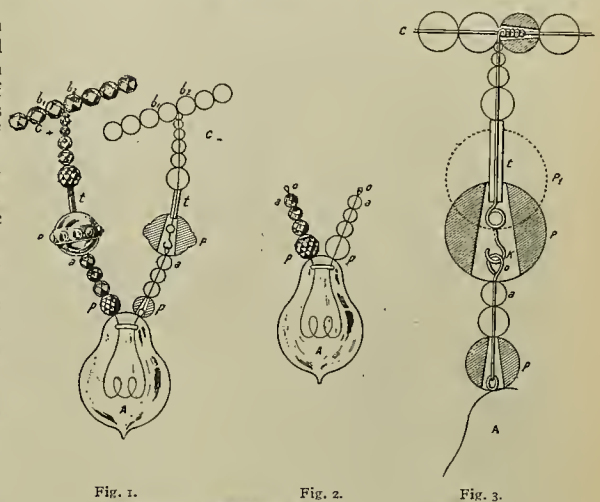
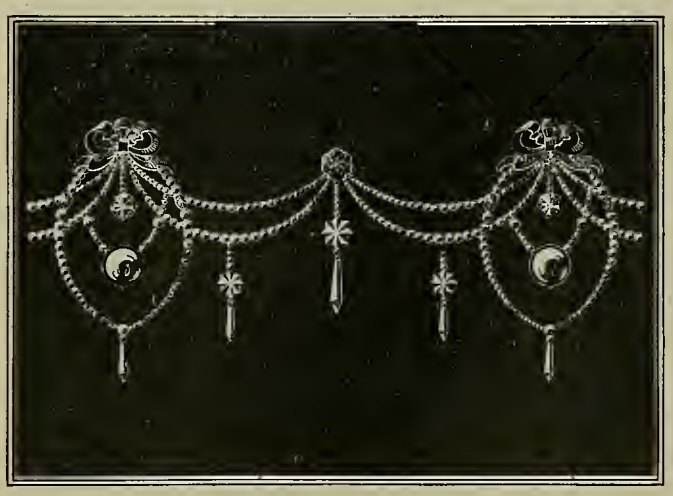


Fig. 1. Fig. 2. Fig. 3.

DETAILS OF WEISSMANN ELECTRIC "PEARLS."

For the suspension of the wires it is obviously of importance that the insulating body be so designed as not to drop on the branch wires when the suspended glow lamp is being removed. The end of the wire, on becoming disengaged, is automatically covered in virtue of the weight of the pearl or else the effect of a spring. The contact will for the same reason be more intimate than in the case of the contact points being bare. As the covering of the contacts is effected quite automatically, the connection of any branch wires ot the main conductors is made readily and in a rather simple way; even in the case of oscillations of the conductors, the contacts will not be interrupted.

It is obviously possible to form any kind of garlands constituting a continuous row of pearls, beginning from the glow lamp bulb, without any conductive parts being visible. This will allow of numerous effects being obtained that were formerly quite impossible, this being especially important for the manufacture of lusters. The "pearls" or insulating bodies may be made of glass, crystal or any other insulating substance, while being of any desired shape.



ELECTRIC "PEARLS" USED IN DECORATIVE LIGHTING.

A further advantage of the pearl light is the fact that the air circulating freely between the wires and the insulating body, no dangerous heating effects, as in the case of rubber-insulated wires, will be possible.

Among the further advantages of Mr. Weissmann's lamp is the practically unlimited flexibility of the conductors, the insulation by a fireproof substance that is not liable to be acted on by moisture, the absence of any socket opaque to light rays, and the special facilities of arranging, altering and disconnecting luminous garlands of any desired pattern.

Lightning Strokes in the Open Field.

It is commonly supposed that lightning strikes only elevated objects. In fact, on page 478 of the Monthly Weather Review for October, 1902, Prof. John Trowbridge of Cambridge, Mass., shows how difficult, if not impossible, it is for lightning to strike down upon a smooth plane surface of water. Of course, the waves of the ocean and the irregularities on what is called a plane surface of land may occasionally be struck by lightning, and two cases of this kind have lately come to our notice.

In July, 1899, Mr. Morton Henry, on a farm near New Bethlehem, Pa., was in an open field, without trees near by, having only the horses, the plow, and a boy at hand. He and the boy sheltered themselves under the shoulders of the horses during a light shower from an insignificant-looking cloud. The horses were killed instantly and the men rendered unconscious.

On July 10, 1903, Mr. Sylvanus Summers and his son, Clinton Summers, were loading hay on their farm seven miles northeast of Canton, Ohio. The sky was somewhat threatening and light thunder was heard in the distance. There was no local rain, the storm was apparently far away, the sun was shining through rifts in the clouds, the hay wagon was passing between two small piles of hay, when the lightning struck it, killing the horses and Mr. Clinton Summers and prostrating the others. The hay did not catch fire, and there were only slight burns on the horses, but Mr. Summers' clothing was ignited in several places. No thunder of any consequence was heard after that belonging to this particular stroke, and no rain fell at this locality, although it rained shortly afterward about a mile farther north.

These are cases against which it is impracticable to provide, since no one cares to wear a wire cage, such as electricians recommend as a perfect protection for houses and powder magazines. We must accept them as corresponding to the legal term "an act of God," or an "inevitable necessity occurring by reason of the operations of nature unmixed with human agency or human neglect."—Monthly Weather Review.

"Noise Cure" for Chicago Elevated Roads Rejected.

The City Council local transportation sub-committee considering abatement of the noise of the Union Loop in Chicago has encountered difficulties which indicate a fight by the elevated companies before any radical remedial measure is attempted. The plan of Engineer J. B. Strauss providing for encasement of the elevated structure in concrete and using longitudinal ties embedded in a cushion of sand was deemed impracticable.

Superintendent E. C. Noe of the Northwestern and the Chicago and Oak Park Elevated Railway Companies, thought that it would stand for a time, but would ultimately crack and let water and snow through to the steel, causing rust and the final ruin of the structure.

Engineer Strauss asserted that the objection of the concrete cracking was made repeatedly by engineers when concrete construction was first inaugurated, but has since been overcome. He challenged his opponents to name another objection. They pleaded that the elevated structure will not bear additional weight with safety and that the noise cannot be reduced in volume.

Phonetic Interrupter for Space Telegraphy.

An ingenious apparatus for the transmission of intelligence through space has been patented by Roberto Landell de Moura, a Brazilian, residing in New York city. Heretofore when signals were to be transmitted the transmission has been accomplished by means of manually operated apparatus. In some cases this has been replaced by automatic mechanism; but the manipulation of a key also requires a certain amount of skill and experience in the operator. According to Mr. de Moura's invention, electrical oscillations and flickerings of light are produced by means of sonorous vibrations, which may be those of the human voice or of other sounds; these electrical or light oscillations so produced are

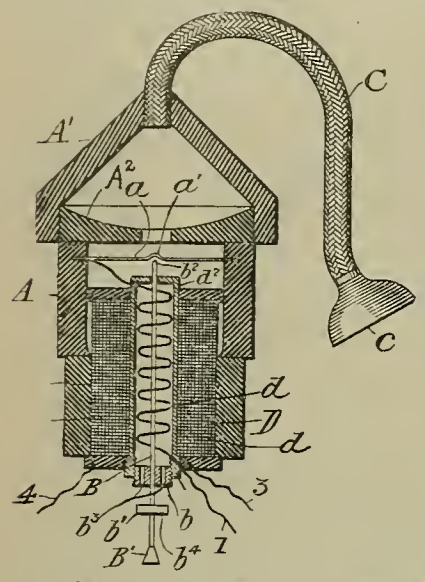


FIG. 1. PHONETIC INTERRUPTER FOR SPACE TELEGRAPHY.

used for telegraphing or telephoning through space. In order to produce the two kinds of oscillations mentioned the inventor has devised an arrangement of circuits and certain apparatus denominated a "phonetic interrupter."

The phonetic interrupter consists, essentially, of a pair of contacts responsive to the tones of the voice or to vibrations communicated from any source controlling the primary circuit of a high-wound induction coil whose primary is connected to the primary of a Ruhmkorff coil for transmitting. The sonorous vibrations at the interrupter are transformed into electric or light waves, which, upon passing to the receiving station, are there received and caused to affect suitable apparatus whereby they may render themselves apparent through the medium of a telephone receiver, a lamp, a Morse register, or the like.

Fig. 1 is a sectional view of the phonetic interrupter, with the parts shown in full. Fig. 2 is a diagram showing the connections of the apparatus in detail.

Referring to Fig. 1, (A) is a non-conducting case or shell provided with a cap (A'). This cap is formed so as to enclose a resonating chamber, at the bottom of which lies a perforated disk (A^2), corresponding to the mouthpiece of the ordinary telephone, and fulfilling the same function when the cap (A') is removed. Lying beneath the disk (A^2) and supported by the shell is a diphragm (a), having at its central point a slight depression (a').

Arranged within the shell and supported between suitable heads is an induction coil (D), having the primary winding (d) and the secondary winding (d'), with a core of soft iron (d^2). This core is made hollow, and within it lies a central spindle (B), supported at its upper end by the perforated end of the core and at its lower end adjustably held therein by means of the nut (b'), threaded into the lower end of the core, and the guide (b^4). The spindle has a head (B'), by which it may be manipulated, the function of the adjustment being to permit the air gap between the tip of the spindle and the diaphragm to be arranged so that the vibrations of articulate speech will cause a regular, rapid, and continuous moving and breaking of the circuit.

Fitted to the apex of the cap (A') is a flexible tube (C), with a mouthpiece (c). When the apparatus is to be used, the user speaks, according to a predetermined code or in such other manner as may be agreed upon, into the mouthpiece (c). The sonorous waves propagated through the tube and passing through the central aperture of the cap (A^2) impinge upon the diaphragm (a), producing a corresponding vibration, whereby, if the adjustments have been correctly made, a very rapid series of makes and breaks or successive contacts will take place between the diaphragm and the tip (b^3), corresponding in frequency to the waves originating them. These makes and breaks produce impulses or variations of current in the primary circuit.

In Fig. 2 (F) is a Ruhmkorff or other high-power induction coil adjusted to produce a spark of some length—say, from one-quarter inch upward. The primary winding (f) of this coil is connected in a circuit (15) (16), containing the main battery (M) and the phonetic interrupter (A). The secondary winding of the coil (F), which is marked (f'), is connected by wires (7) and (8) to the terminals (21) and (20) for the radiating bodies or wires, which may be the usual or any special desired form of aerial conductor, with or without earth on one side. Adapted to be bridged across this circuit (7 8) by the closing of the switch (S') on its contact (s') is a pair of sparking terminals (11) (12), the bridge wires being marked (9) (10). A condenser of suitable capacity is also connected across the secondary circuit. The primary circuit passes from the Ruhmkorff coil to the primary terminals of the induction coil (D) in the phonetic interrupter. The secondary winding is connected in a local circuit (19), which contains a telephone receiver, and the primary circuit contains a lamp (E) which may serve for both sending and receiving messages. A condenser (G) of suitable capacity is also bridged across the primary circuit.

The operation of the system is as follows: For transmitting Hertz waves corresponding to sonorous vibrations the switch (S') is closed, the switch (S) is opened, and the operator proceeds to produce sounds in the desired manner into the mouthpiece of the phonetic interrupter. A succession of impulses is thus produced in the primary circuit of the coil (F), whose effect is increased by the presence of the condenser (G), which takes up the extra current, assists in the rapid demagnetization of the core of the induction coil, and also prevents sparking between the diaphragm and the tip terminal. These impulses in the primary, which are very rapid, with proper adjustment reaching between 500 and 900 per second, produce very high potential impulses in the secondary. To produce oscillations of light by means of the interrupter in the sending station the natural human voice is used, preferably because the flickerings produced, corresponding in form and frequency to the initial sounds and being properly retranslated

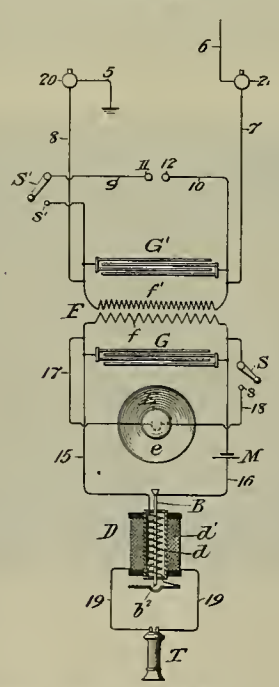


FIG. 2. PHONETIC INTERRUPTER FOR SPACE TELEGRAPHY.—DIAGRAM OF CONNECTIONS.

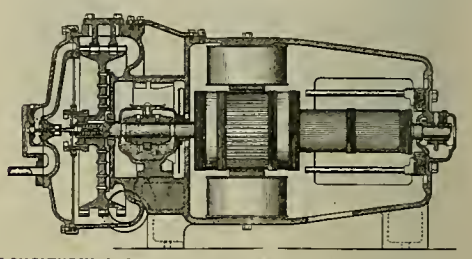
through the agency of suitable apparatus at the receiving station, enable the original sounds to be recognized more or less perfectly, and while many words or tones can be recognized for their own intrinsic value, as well as for any arbitrary code value that may be assigned to them apart from this, a sufficient number of distinctive words can be selected to make a complete and very efficient code.

Obviously as a substitute for the human voice other sources of sonorous vibrations may be employed. Thus to produce electrical oscillations by means of the same interrupter there may be used at the sending station a source of sound consisting of a musical instrument similar to a small organ, having a set of reeds or pipes with controlling devices and one or more acoustic tubes connected to the mouthpiece of the interrupter tube. The diaphragm of the interrupter being thus strongly vibrated, causes oscillations of light or electricity, which may be received after transmission by means of any suitable sensitive device.

Horizontal Turbo-generator for Train Lighting.

Small steam-turbine generators for isolated plants, and especially for train lighting, are in considerable demand, and designers and manufacturers, particularly in Germany and the United States, are devoting attention to these small-sized sets. In this development W. L. R. Emmet, the well-known inventor, of the General Electric Company, has collaborated with Oscar Junggren, also of Schenectady, in the design of the outfit illustrated herewith in longitudinal section.

The turbine and generator are made as simple and compact as possible and are combined by means whereby they may be supported on the floor, side



LONGITUDINAL SECTION OF TURBO-GENERATOR FOR TRAIN LIGHTING.

wall, or ceiling, or other support, at the same time preserving the proper relation of the oil wells and other parts.

In the turbine casing, which has a detachable cover, is located a throttle valve for controlling the admission of steam to the expanding nozzle. The character of the nozzle can, however, be changed to suit the requirements. The opposite side of the casing is provided with a cylindrical exhaust chamber and a recess, into which extends the main bearing of the machine. It will be noted that the vertical wall of the recess is situated in close proximity to the wheel. The object of this is to reduce the size of the exhaust chamber and also to give room for the reception of the bearing. By this means the machine as a whole can be made very compact in its longitudinal dimension.

Mounted on the main shaft is a bucketwheel having a number of rows of peripheral buckets for fractionally abstracting the velocity of the steam. In the present instance three of these rows are shown; but the number can be varied. Between the rows of wheel-buckets are stationary intermediate buckets arranged in segmental form and carried by a support, detachable from the outside of the casing.

In order to prevent the steam from leaking out around the shaft the wheel is provided with radially extending vanes which create a small difference in pressure between their inner and outer ends. To state the matter differently, there is a pressure within the shell which is slightly above atmosphere. Hence there is a tendency for the exhaust to escape around the shaft. To obviate this, a means is provided which creates such a pressure as will balance or substantially balance that of the shell. By this means it is possible to obviate the use of a packing. The exhaust chamber is provided with one or more discharge pipes.

The generator is provided with a casing, having a projection or neck formed integral therewith and engaging with the wall of the turbine casing adjacent to the recess. Between the projection and the turbine casing is a shoulder which assists in preserving the alignment between the turbine and the generator. The inner wall or surface of this projection is cylindrical, and mounted upon it is an adjustable bearing for the main shaft. It will be noted that only two bearings are provided for the machine and that the bucketwheel is overhung. The bearing at the left is provided with a base, having a cylindrical surface engaging with the curved surface on the neck or projection. Between the bearing and the projection is a tongue and groove, to prevent the bearing from moving longitudinally on the neck. The bearing is wholly supported by the neck or projection; but a portion of it extends into the recess formed in the turbine casing.

Mounted on the shaft and adjacent to the vertical wall of the generator casing are a number of radially

extending fan blades, which suck air from within the casing and discharge it outwardly through the opening formed in the neck. In this manner the generator is kept cool, and by placing a fan between the turbine and generator the transmission of heat from the former to the latter is to a very large extent obviated. The bearing is secured in place by bolts.

The generator casing is provided with two openings. One is normally covered when the machine is in operation and is intended to facilitate inspection and adjustment of the brushes. The other is commonly open when the machine is in operation and acts as a ventilating hole, so that an air circulation can be produced by the fan. The latter, in addition to creating a circulation in the generator casing, also tends to cool the bearing by discharging a current of relatively cool air over it.

The New York Subway Ready for Use.

Frequent references have been made in the Western Electrician to the subway of the Interborough Rapid Transit Company, chief among which were the articles upon "The New York Rapid Transit Railway," by Sydney W. Ashe, and "Power Equipment of the Rapid Transit Company" in the issues of January 2, 1904, and September 17, 1904, respectively. If the plans which have been made are carried out successfully the subway will have been opened to the public before this issue has reached

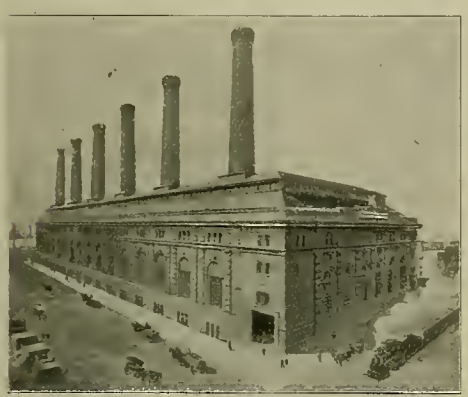


FIG. 1. POWER HOUSE FOR NEW YORK SUBWAY.

its readers. According to the programme a simple ceremony is timed to take place at one o'clock on Thursday, September 27th, in the afternoon, at the City Hall, when Mr. Alexander E. Orr, president of the Rapid Transit Commission, will formally announce that the West Side subway is complete and safe for public traffic. Mayor McClellan will accept the structure on behalf of the city and will immediately turn it over to Mr. August Belmont as president of the Interborough Rapid Transit Company. A large number of invitations, including one to President Roosevelt, have been issued, and the rest of Thursday afternoon will be taken up in inspecting the subway itself. The general public will not be permitted to ride until the stroke of midnight, when the regular schedule of trains will be put into operation.

The Union League Club of New York had a free ride October 21st through the subway as guests of the Interborough company. The party, which filled up two trains of eight cars each, numbered among its members Cornelius N. Bliss, Colonel Henry B. Wilson and other distinguished clubmen, all of whom expressed admiration for what they saw. On the previous day the Brooklyn Chamber of Commerce, 1,200 strong, had a ride and expressed unstinted praise for the entire system.

Officials of the New York Fire Department have been examining the subway, and Fire Chief Croker reports that everything is as perfect as possible from the point of view of fire prevention. The subway fire alarms are so connected with police headquarters that in event of a fire in the subway the power is shut off in a long section of the tunnel, and it cannot be turned on again until the fire brigade reports that the fire is extinguished.

Fig. 1 of the accompanying illustrations is a view of the exterior of the new power house which was described in the second of the articles above alluded to. By examining Fig. 2, which is a view looking lengthwise through the building, a clear idea will be gained of the relative positions of the various apparatus, including the boilers, coal-handling apparatus, generators, steam piping, etc. The combined maximum capacity of the coal bunkers is 18,000 tons. The six chimneys shown in Fig. 1 are of 15 feet inside diameter and each stands 225 feet above the grate bars.

Three-phase current from the power house is conveyed through a high-potential cable system to eight sub-stations containing the necessary transforming and converting machinery. These stations are numbered from 11 to 18. Fig. 3 shows a longitudinal section of station No. 14, which contains a typical installation. The units in these sub-stations are of 1,500 kilowatts capacity each, with the ability to

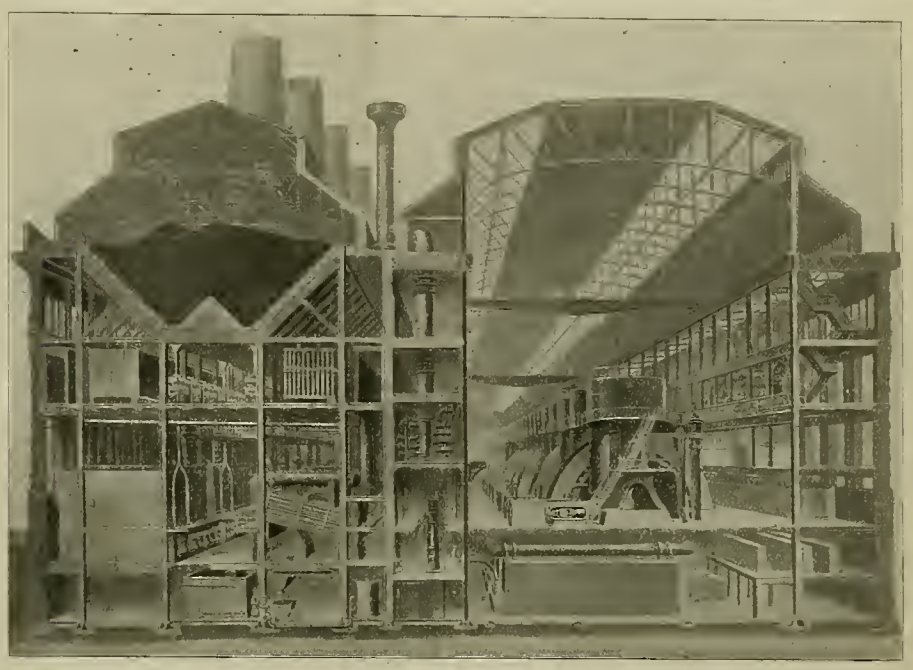


FIG. 2. CROSS-SECTION OF NEW YORK SUBWAY POWER HOUSE IN PERSPECTIVE.

carry 50 per cent. overload for three hours. The lots upon which the sub-stations are built allow of an ultimate capacity of eight such units. The switchboard is located at the rear of the sub-station and a central shaft affords excellent light for the operating room.

A novel and important feature of these sub-stations is the location in separate compartments of automatic circuit-breakers for the direct-current feeders. This plan will effectually prevent damage to other parts of the switchboard equipment when circuit-breakers open automatically under conditions of short-circuit. It also tends to limit the danger to the operator and therefore gives confidence and

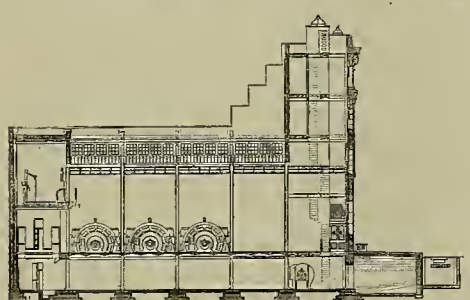


FIG. 3. LONGITUDINAL SECTION OF SUB-STATION FOR NEW YORK SUBWAY.

accuracy in the manipulation of hand-operated switches.

The three-phase cables from the power house are carried through tile ducts from the manholes located in the street directly in front of each sub-station to the back of the station, where the ends are connected directly beneath the oil switches.

The cable used for conveying energy from the power house to the sub-stations aggregates approximately 150 miles in length. The cable is composed of three-stranded copper conductors, each of which contains 19 wires. The diameter of the stranded conductor thus formed is two-fifths of an inch.

Fig. 4 illustrates the method of distribution to the contact rails, showing the contact rails, the positive and negative feeders and the rail returns, the latter being shown at the bottom of the diagram. All negative feeders as well as positive are cables of 2,000,000 circular mils section and lead-sheathed. The electrical separation of the several contact rails and the positive feeders connected thereto secures an important advantage in permitting of the use at the sub-stations of lower currents than would be practicable were all contact rails electrically connected.

Ohio Interurban Line 240 Miles Long Proposed.

Reports from Cincinnati indicate that a project is well under way for building a traction line from that city to Toledo on an almost direct line, a distance of 240 miles. J. M. Morgan, with an office in the Traction Building at Cincinnati, is at the head of the movement, and it is said that a trust deed for $6,000,000 to cover cost of construction has been on file in Hamilton County for several weeks. Mr. Morgan is reported to have said that all right-of-way between the two cities has been secured and that the construction work would be commenced in the spring. It is proposed to make the track as heavy as steam roads use, and, with good cars, the through trip can be made in five hours and 45 minutes. The road will be known as the Cincinnati, Toledo and Detroit Short Line, although it is expected to build only from Cincinnati to Toledo. Cincinnati, Toledo and eastern capitalists are said to be backing the enterprise. Some of the towns through which the line will pass are Hamilton, West Elkton, Gratis, Eaton, West Manchester, Jefferson, Greenville, Rossville, New Weston, Gilberts, Carthagena, Celina, Mercer, Rockford, Ohio City, Van Wert, Paulding, Defiance, Jewell, Napoleon, Liberty, Neapolis, Colton, Whitehouse and to Toledo.

Drainage Canal Waterpower Plant.

The contract has been let for the turbine waterwheels to be used in the power house near Joliet, Ill., where the waterpower of the Chicago Drainage Canal will be developed. The wheels will be used for driving four generators of about 6,500 horsepower each and also two exciters of 200 horsepower each. The contract, which will require about one year

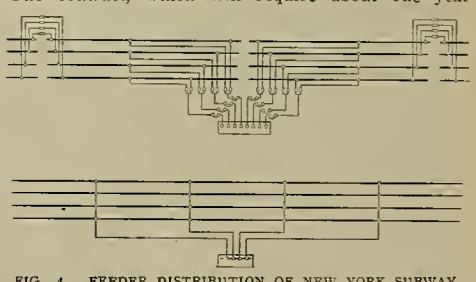


FIG. 4. FEEDER DISTRIBUTION OF NEW YORK SUBWAY.

for completion, goes to the Wellman-Seaver-Morgan Company of Cleveland, and was awarded by the board of trustees of the Sanitary District of Chicago. Many foreign as well as American makers were in the field.

Electrical Inspectors Lester L. Kingsbury and Clarence Ransom, in a recent report to Building Inspector Preston of Baltimore, Md., stated that in one half day 122 ticker wires had been removed. The inspectors had exciting times in some instances in performing their work.

WESTERN ELECTRICIAN

EVERY SATURDAY.

PUBLICATION OFFICES:
510 Marquette Building, · CHICAGO.
TELEPHONE, MAIN 1746.

Eastern Office, 193 Times Building, New York.
Telephone, 3806J Cortlandt.

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted. This paper is entered at the Chicago postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the **old address** as well as the new should be given.

CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—**the only general electrical paper published in the West**—thoroughly covers a territory *exclusively its own.* THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be furnished on application.

REMITTANCES.—All checks, drafts and other remittances should be made payable to the order of the publishers, the **Electrician Publishing Company,** and addressed to the offices of publication, Suite 510, Marquette Building (204 Dearborn Street), Chicago, Illinois, U. S. A.

CONTENTS OF THIS NUMBER.

Electrically Operated Warship Models at the Naval Show on the "Pike." Illustrated....345, 346
Ries Patent for Electric Elevators in Litigation.... 346
Conduit Deal in Philadelphia.... 346
Production of the Diamond in the Electric Furnace. By A. De Courcy. Illustrated....346, 347
Western Electric Personnel.... 347
The Weissmann Electric "Pearls." By Alfred Gradenwitz. Illustrated.... 347
Lightning Strokes in the Open Field.... 347
"Noise Cure" for Chicago Elevated Rejected.... 347
Phonetic Interrupter for Space Telegraphy. Illustrated. 348
Horizontal Turbo-generator for Train Lighting. Illustrated....348, 349
The New York Subway Ready for Use. Illustrated.... 349
Ohio Interurban Line 240 Miles Long Proposed.... 349
Drainage Canal Waterpower Plant.... 349
Editorial.... 350
Kryptol, a New Substance for Electric Heating. By Frank H. Mason. Illustrated.... 351
Electric Terminal of Paris-Orleans Railroad.... 351
World's Fair Visitors Last Week.... 351
Good Speed on Electric Railway.... 351
Pioneer Work of the Telluride Power Company. By P. N. Nunn. (International Electrical Congress)..352, 353
Electrification of Erie Lines in New Jersey Contemplated.... 353
Single-phase Alternating-current Motors. By Herbert P. Andrews. Illustrated.... 354
Lundell-Lozier Department of National Electric Company.... 355
New Pole-line Fuse Box. Illustrated.... 355
Oil Switch for High Voltages. Illustrated.... 355
Electric Lighting in the City of Mexico.... 355
The Telephone Problem in Large Cities. By F. J. Dommerque. (International Electrical Congress).... 356
Telephones in Railroad Train.... 357
Telephone Men.... 357
John M. Humiston. Portrait.... 357
Telephone News from the Northwest.... 357
Bell Telephone Output for September.... 357
Telephone Status in New England. By Vinton A. Sears. (Communication).... 357
General Telephone News.... 357
Awards to Three Great Electrical Companies.... 357
Testing Guy Anchors with Rhiele Machine. Illustrated 358
Book Table.—"Interborough Rapid Transit".... 358
The Prussian System of Electric Train Lighting. By Carl Roderbourg. (International Electrical Congress.)....358, 359

DEPARTMENTS.

Correspondence....359, 360, 361
Great Britain.... 359
New York.... 359
New England....359, 360
Dominion of Canada.... 360
Ohio.... 360
Michigan....360, 361
Northwestern States.... 361
Rocky Mountain States.... 361
Pacific Slope.... 361
Personal.... 361
Electric Lighting.... 362
Electric Railways.... 362
Automobiles.... 362
Societies and Schools.... 362
Publications.... 362
Space Telegraphy.... 362
Miscellaneous.... 362
Trade News.... 362
Business....362, 363
Illustrated Electrical Patent Record....363, 364

DATES AHEAD.

Electrical committee of the Underwriters' National Electric Association (annual meeting), 32 Nassau Street, New York city, December 7th.

Interstate Independent Telephone Association of America (annual convention), Auditorium Hotel, Chicago, December 13th, 14th and 15th.

MUNICIPAL-OWNERSHIP advocates are apparently greater talkers than readers, for a newspaper dispatch from Webster City, Iowa, announces that "The Daily Graphic Herald of this city, the municipal-ownership newspaper, has suspended publication. The paper was featured all over the country as the only municipal daily in the United States." This seems to indicate a deplorable lukewarmness on the part of the faithful. Talk is cheap, but one has to "dig" to pay subscription rates. Many of the municipal-ownership promoters appear to think, read and talk in geometrical ratio.

VISITORS to the Louisiana Purchase Exposition at St. Louis who are interested in electricity or electrical literature are cordially invited to call at the booth of the Western Electrician, which is in Block 1 (Section 13) of the Palace of Electricity, just west of the main northern entrance to the building. Here will be found copies of the current issue of the paper, bound volumes of the Western Electrician from the first number, a careful selection of electrical books exhibited by the Electrician Publishing Company, and other objects of electrical interest. Chairs are provided for weary sight-seers, and an attendant will extend a hearty welcome to all readers or friends of the paper.

MR. NUNN's paper on "Pioneer Work of the Telluride Power Company," which was read by the author at the recent International Electrical Congress at St. Louis and which is presented in full in this issue of the Western Electrician, is as interesting as the traditional romance, of much historical value and of high technical worth. The Telluride plant was the forerunner of all the commercial transmission plants, and the history of its achievement is a proud record of human progress. With simplicity and dignity, Mr. Nunn tell his story well. He knows how to use the English language effectively—an accomplishment to which many engineers have not attained. The paper should be assimilated by every reader of the Western Electrician.

IN connection with the announcement that the Board of Railway Commissioners for Canada is endeavoring to get the railway corporations of the Dominion to agree to certain precautions for the reduction of liability to railroad accident, reference was made by the chairman of the board to the recent shocking accident in the Grand Trunk tunnel at Sarnia, Ont. The chairman stated that one means of preventing the recurrence of such loss of life in the tunnel disaster was to substitute the use of electric motors for the haulage of trains through this tunnel, and the commission "would urge the imperative necessity of this suggestion being adopted by the Grand Trunk Railway Company, which must itself be impressed with the desirability of employing electric instead of steam traction at this point on its system." One would think so indeed! There can be no valid objection to the electric haulage of railroad trains in tunnels, where the safety of passengers is accepted as the paramount consideration of operation rather than the payment of dividends on watered stock.

ONCE more attention is directed to the importance of American manufacturers registering their trademarks abroad. It will come as a surprise to many who are manufacturers and owners of trademarks and are interested in foreign trade to learn that in certain countries abroad any resident there may apply for and secure by registration a trademark which he may have noticed in use in connection with articles imported into that country and which is not registered. By securing the registration of such trademark in his own name he practically stops the original manufacturer and his agents from dealing in such articles bearing the registered trademark. In some countries the manufacturer has the chance of establishing his right to the trademark by proving to be the original user thereof, but the expense involved in taking such proceedings becomes a serious consideration. Some manufacturers have preferred to register a new mark, thereby losing the benefits that go with a trademark that may have been used and extensively advertised for a number of years, and should the person who has pirated the trademark apply or use it in connection with inferior goods it tends to lower the people's idea of the standard qualities produced by the firm affected.

WHEN one stops to consider the haphazard methods by which, with a few exceptions, American trade has been extended in foreign parts, it is somewhat surprising that our exports of manufactured goods have attained the large proportions shown by the returns of the Bureau of Statistics of the Department of Commerce and Labor for the last few years. American cotton, foodstuffs and petroleum may possibly need no exploitation in foreign markets, but in the domain of manufactures we have keen, eager and well-trained rivals. That in competition with Great Britain, Germany and other countries we secure an appreciable proportion of the world's trade in manufactures is due more to the excellence of our wares and the ingenuity and inventive ability of our citizens than to our foresight, patience and shrewdness as traders. In one view this state of affairs is flattering to the American agricultural machinery, office furniture, sewing machines, typewriters, shoes, telephone apparatus, or what not, which have made their way with so little scientific exploitation. But it remains a matter for sincere regret that we have made so little study of the peculiarities of foreign markets and the best means of selling goods in them. We are keen at developing the best means of merchandizing at home, but we are strangely indifferent to the results that may be obtained by similarly well-directed effort abroad. In this matter we may well look to Germany for instruction. In that country commercial schools have been developed to an extent unknown elsewhere. It is probable that these schools have been as potential as the technical schools in bringing about the industrial expansion of Germany. We have fairly good technical schools, but no commercial schools at all; our "business colleges" are quite different. These German commercial schools, as we learn from Dr. Rose, the British consul at Stuttgart, are divided into three classes, the lower or continuation schools, the secondary commercial schools, and the commercial universities. The studies are modern languages, commercial calculations, commercial intelligence and reports, office work, correspondence, commercial geography, elementary physics and chemistry, knowledge of goods and materials, freehand drawing, and in the higher branches political economy, insurance and statistics and social and legal subjects. The initiative for the foundation of the commercial universities has been taken by the chambers of commerce and municipalities and not by the governments of the German states. The progress made in Germany in the development of commercial instruction can be best demonstrated by a comparison of the present conditions with those which prevailed 12 years ago. In 1892 there existed 175 commercial schools of all descriptions; today this number has increased to 429, without counting private schools. The number of pupils in 1892 was 12,000; today more than 48,000 may be counted. Special notice should be directed to the great attention devoted to foreign languages, and most especially to English. Profiting by the instruction given in these commercial schools, a large and constantly increasing number of German merchants are able to draw up their own catalogues and circulars in English without extraneous aid, and so contribute to the export of German goods. Dr. Rose concludes by saying: "This thorough schooling in languages tends, moreover, to deepen the tendency of the young German merchant to regard the whole world as his commercial inheritance. That this tendency exists, and will in the future increase instead of diminish, is evident to those who have followed Germany's rapid change from a mainly agricultural to a mainly industrial nation, with the consequent vital necessity of maintaining and increasing her exports."

It is evident that there is a lesson for the exporters of the United States in these German commercial schools. Why are there not such schools in Chicago, New York, San Francisco and other industrial centers? Electrical manufacturers of the United States should take an enlightened interest in the subject. The electrical export trade of the United States is now about $10,000,000 per annum, but with intelligent work it could be greatly increased. The probable reward is worth the necessary effort.

Kryptol, A New Substance For Electric Heating.[1]

By Frank H. Mason.

Among the notable recent German inventions in the field of applied science is an electric-resistance material for heating purposes, to which has been given the name "kryptol." The exact method of its preparation and the proportions of its ingredients employed are not disclosed by the specifications of its patent, but it is a mixture of graphite, carborundum and clay so combined as to form a loose granular mass or powder of four grades or degrees of coarseness, which are severally best adapted to different heating operations.

The property of kryptol, upon which its efficiency depends, is the fact that it offers to an electric current the requisite degree of resistance to generate a high degree of heat without destruction to its own substance. The method of its operation is illustrated in Fig. 1. This is simply a chamotte or earthenware plate inclosed at its edges in a wooden frame and bounded at two opposite sides by carbon electrodes which rest upon the plate and are connected by insulated wire conductors with a current supply, forming, when the break between the electrodes is closed, an electric current. Upon the chamotte plate, which is usually about two feet square, but may be of any convenient size, is loosely strewn the granulated kryptol to a depth of about an inch. This, when the kryptol is laid continuously across the plate, forms the electrical connection between the two electrodes and closes the circuit. When, however, the kryptol is brushed or scraped aside so that an open, uncovered space is formed through the layer across the plate, the circuit is broken and the apparatus remains, so to speak, dead. If now the kryptol is brushed into the open space so as to form a connection between the two masses lying against the electrodes on either side the circuit is at once restored and the kryptol forming this thin connecting layer begins to sparkle and glow, becoming in a

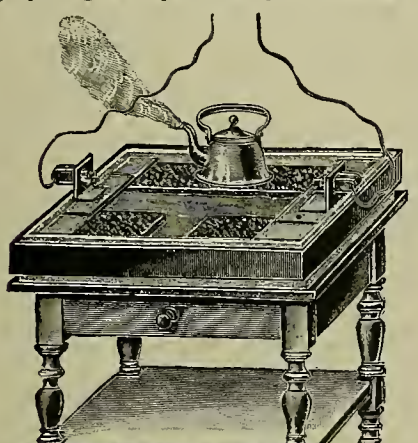


FIG. 1. KRYPTOL COOKING STOVE.

few moments incandescent and generating a heat that will raise cold water to boiling in three or four minutes.

A peculiarity is that the incandescent action takes place only at the places where the layer of kryptol on the plate is thinnest, and it is therefore easily possible to create heat just in the place where it is wanted and not elsewhere, for in this case the thick bed of granular material on other portions of the plate remains cool and impassive and may be touched or stirred by the naked hand with entire impunity. The finer the grains of kryptol the less active is the incandescence, and it is for this reason that the four different grades or numbers of the material are made, to be used as may be required in generating different temperatures.

This extreme tractability by which the temperature can be absolutely regulated by increasing or diminishing the strength of the current or by altering the thickness of the kryptol layer, one or both, renders it applicable to a large variety of practical uses, among which some of the more important are as follows: For heating street cars, hallways, sleeping and other rooms, and laboratories where a continuous uniform warmth is essential. The apparatus (Fig. 2) includes a simple cast-iron flanged radiator, the interior lining of which is glazed so as to insulate the kryptol mass with which it is filled. At each end is an electrode, usually of gas carbon, connected with wires carrying a current of four to five amperes and about 120 volts, which is an ordinary voltage for lighting systems in this country. Such a heater, which can be put under a car seat or beneath the floor, where it is out of sight, can easily be managed by the conductor or motorman, can generate and maintain indefinitely any desired temperature, and can be used without refilling for weeks together, would seem to solve, technically, at least, the problem of street-car heating in cold climates. The radiator is made with a close-fitting cover, for it is found that the kryptol endures unimpaired much longer in a closed chamber than in the open air. A radiator in daily use requires filling with fresh kryptol once in about three months.

This process lends itself with great convenience to all the finer smelting operations in scientific and industrial metallurgy. These operations may be carried on by means of a small crucible furnace, which consists of an iron shell with an enamel lining filled with coarse-grained kryptol, in the center of which is hung a movable graphite crucible, in which any temperature up to 2,000° Cel. (3,632° F.) may be generated. With a current of 15 amperes, nickel,

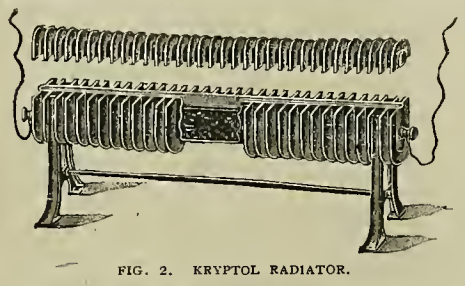


FIG. 2. KRYPTOL RADIATOR.

the smelting point of which is about 1,600° C., may be fused in about six minutes.

Some of the steel and cutlery manufacturers in Westphalia are experimenting with kryptol with a view to its employment for tempering, annealing and case-hardening steel and iron bars, knives, scissors and other implements. Such processes would become thereby automatic and independent of the skill of the workman.

For chemical laboratories the new material has already been adopted by the University of Berlin, the Technical College at Aix la Chapelle, the Imperial Health Office at Berlin, and other state institutions. When used in ovens and heating devices of various patterns it enables the chemist to heat substances to any desired temperature and to maintain an unvarying degree of heat for an indefinite period. In elementary organic analysis it is frequently necessary to heat parts of the substance under examination to different temperatures and to leave another portion not heated at all. For this purpose a simple but effective apparatus has been devised. It consists of an iron frame on which is laid a firebrick trough or gutter, glazed inside and filled with kryptol. In this is laid the combustion pipe, which may be a glass tube, containing the material to be treated. The current being sent through the whole even mass of kryptol heats the tube uniformly throughout its length; but when it is desired to heat one portion to a high temperature it is only necessary to scrape the kryptol aside and reduce the thickness of the layer under that part of the tube, when it at once begins to glow with accelerated heat, while the temperature of the other parts remain unchanged. If it is desired to withdraw or exclude the heat entirely from the central part of the tube, two copper forks, which slide along a brass conductor, are introduced into the kryptol, which take up the current and pass it by the conductor over the intervening space, leaving the kryptol and that section of the tube cold and excluded from the heating operation.

As the ingredients of kryptol will withstand any temperature up to 3,000° Cel., its use for heating up to that limit is restricted only by the nature of the material of which the furnace and crucible are composed. Being itself a poor conductor of heat, it retains its warmth for a long time, and on account of its cleanliness and absolute tractability offers a key to a new and convenient system of cooking and of warming dwellings and other buildings wherever electric currents can be cheaply generated and supplied.

[This method of electric heating is of interest, but apparently it would not be very economical. The objection to electric heaters now in use is almost entirely confined to the cost of operation, compared with the direct combustion of coal or gas. Judging from Mr. Mason's account, kryptol would be open to this objection in even greater degree than enamel-embedded resistance wires or other existing forms of transforming electrical energy into radiant heat.—Ed. W. E.]

The Toronto Electric Railway Company has introduced on its system a testing car, which, it is believed, will not only save labor, but, what is far more important, will be the means of preventing many accidents. The car is so constructed that it registers every defective joint, rail or crossing and every weakness or escape of current, or other defect in the system, as it travels along the car routes. This register is so complete, also, that as soon as the car runs into the barns, the exact places where the defects exist are shown, and a repair wagon can go straight to the point.

Electric Terminal of Paris-Orleans Railroad.

The installation of electric locomotives and motor cars on the Paris-Orleans railroad has proved so satisfactory that an important extension was decided upon some time ago and further additions have been made to the generating and sub-station equipment and to the rolling stock. The Paris-Orleans was the first French steam trunk road to attempt electric terminal operation, and in 1900 opened an extension to the Quai d'Orsay, operating all the trains to the new terminus electrically.

The generating station contains two 1,000-kilowatt groups, two 500-kilowatt sub-stations and two sets of storage batteries. The locomotives used are similar to the Baltimore and Ohio locomotives, having a central cab with sloping ends. Each locomotive has four 225-horsepower motors mounted on heavy trucks built by the American Locomotive Company. The installation was made by the French Thomson-Houston Company, and the greater part of the machinery, especially the locomotives, is of American make, mostly from the General Electric Company.

Three powerful new locomotives have been added to the original installation of eight. These are of the baggage-car type with a cabin at each end and a compartment for baggage in the middle. The cabins contain the controllers and the usual circuit-breakers and measuring instruments. The motor leads and the contact leads pass through brass flexible tubing, and connection boxes are provided for the motor leads. Five motor cars equipped with Sprague-General Electric type-M control have also been added. These have cabins at each end and intermediate are the baggage compartment and 34 seats for third-class passengers. The whole of the train-control apparatus is mounted in these cabins. Similarly to the locomotives, the motor leads and the shoe-leads are passed through flexible tubing, and motor-connection boxes are used. The gear ratio is 3.08 to 1. The cabling used in both locomotives and motor cars is covered with asbestos braid, slate-colored. Paint is used on the asbestos to avoid abrasion from chafing, etc.

The extent of the new branch from Paris is 15 miles, and a total of over 200 trains daily will be operated at speeds varying from 30 to 45 miles per hour. Time for express trains will be about 25 minutes or less, including one or two stops. The all-station or local service will take from 35 to 40 minutes. For this service the motor cars will be used exclusively. There are two trains, comprising seven or eight trailers, fitted for use with the motor cars, one of which will be at each end of the train. All the apparatus, especially the rolling stock, is of American pattern. In connection with this plant it is said that the Pennsylvania Railroad Company is using the Quai d'Orsay terminus as a model for its new station in New York.

World's Fair Visitors of Last Week.

Among those registered at the booth of the Western Electrician in Electricity Building at the St. Louis Exposition last week were the following-named: F. A. Dwight, Goddard, Kan.; Dwight Cole, Goddard, Kan.; John C. Cavanaugh, Niles, Mich.; E. O. Meyers, Verona, Ky.; James E. Pyle, West Chester, Pa.; J. P. Florrington, M. D., Winston, N. C.; W. L. Clouse, National Machine Company, Tiffin, Ohio; M. L. Smith, Marshalltown, Iowa; N. F. Obright, Chicago; Alfred M. Cohan, Cincinnati, Ohio; H. G. Atwood, Minneapolis, Minn.; Martin Neilan, Sioux City, Iowa: Anatol Gollos, main switchboard, World's Fair; F. E. Greenman, Heinze Electric Company, Lowell, Mass.; J. M. Walton and wife, Memphis, Tenn.; Samuel T. Hutton, Chicago; L. R. Knidenier, Des Moines, Iowa; Ernest Shafer, Brookville, Ohio; Albert Scheible, George Cutter Company, Chicago; C. E. Carr, Milford, N. Y.; S. J. Glass, Starup, Ark.; Erie Seymour, Bavaria, Kan.; Bruce Lewis, Bavaria, Kan.; C. A. Simpson, Chicago, Ill.; Sam Shingleton, Shelbyville, Tenn.; Roy E. Downer, Buffalo, N. Y.; George Burroughs, Elmira, N. Y.; H. J. Kendig, Covington, Ky.; J. F. Muething, Covington, Ky.; All. J. Robe, Covington, Ky.; Yashikagn Ota, Nagaya, Japan; M. L. K. Leeder, Sydney, N. S. W., Australia: Miss Leeder, Sydney, N. S. W., Australia; Miss Douglass, Sydney, N. S. W., Australia; J. C. Allison, Londonderry, Ireland.

Good Speed on Electric Railway.

The "Lima Limited" on the Western Ohio railway line (electric) ran as a double header from Dayton to Lima, 80 miles, in two hours and four minutes on Friday of last week. The cars carried a wedding party. On the return trip the cars left Lima at 9:40 p. m. and arrived in Dayton at 11:52 p. m., making the time two hours and 12 minutes, said to have been the best night run ever made over an electric railway. This is said to have been better time by 20 minutes than the Detroit flyer on the Cincinnati, Hamilton and Dayton steam railroad has ever made over the same distance. The schedule time of the fast electric car is 150 minutes between the two points. A portion of the trip is made over the Dayton and Troy system.

1. From a report prepared by the United States consul-general at Berlin and dated September 17, 1904.

Pioneer Work of the Telluride Power Company.[1]

By P. N. Nunn.

During the winter of 1890, the year preceding the famous Frankfort-Lauffen experiment, apparatus was installed for the first commercial, high-pressure, alternating-current power transmission of the world. From that beginning has grown the Telluride Power Company.

The mining district surrounding Telluride, San Miguel County, Colo., is at the same time one of the most rugged and one of the richest in the Rocky Mountains; but its inaccessibility and the consequent cost of producing power caused the financial failure of many important enterprises in the early days of its history. The statement made in the Annual Report of the Treasury of the United States, in 1901, that "For the growth of its mining industry San Miguel County is indebted to the Telluride Power Transmission Company more than to any other agency," is borne out by the fact that at the present time all of the important mines and mills of the district are operated by power furnished by this company.

The Gold King mill, situated at an altitude of 12,000 feet, where the cost of fuel for steam power had become prohibitive, was the first to be operated by means of this power. This property had been attached in 1888 to satisfy a continued deficit in operations. Mr. L. L. Nunn, the attorney retained by the owners, found that this deficit was largely due to the enormous cost of power, and that there would have been a handsome margin if power could have been furnished at not more than $100 per horsepower-year. Down in a deep gorge of the valley, over 2,000 feet lower, but less than three miles away, two mountain streams formed at their confluence the South Fork of the San Miguel River, offering cheap and continuous power. A stay of proceedings was secured; and, as a means of transmitting this power, cable drive, compressed air and continuous-current electricity were all investigated. The limitations of each were apparent, while the advantages of alternating current and higher pressures became gradually recognized, and a decision was reached to attempt their use. This decision was due less to the immediate saving in copper than to a keen sense of the limitation of continuous, and faith in the final success and ultimate superiority of alternating, current.

During the investigation which followed, while selecting apparatus, little but incredulity or ridicule was encountered. Eastern investors in the enterprise were annoyed by predictions of prominent engineers, and discouraged by their insistence that the experiment would prove a miserable failure and the expenditure go for naught. It was said that there was no alternating-current motor; that oil insulators must be used, and that the line must be fenced in. However, a generator and a motor for 3,000 volts and of 100 horsepower each were ready for trial in the fall of 1890. Difficulties caused by ice at 40 degrees below zero, by speed control over unusually high water pressure, by avalanche, by blizzard, by electric storms unknown in low altitudes, and scores of others, now generally forgotten but then most serious, marked every step of progress. Notwithstanding all of these, unqualified success from the beginning caused gradual and constant growth, until at the present time the Telluride company and its allied industries have six power stations and nearly a thousand miles of line in Colorado, Utah and Montana.

Following its pioneer power transmission, it made practical experiments as early as 1895 with pressures which have never, even yet, been exceeded, and for three years it operated commercially the highest pressure transmission of the world. Thus the record of its work becomes an important chapter in the history of power transmission; but it must readily be seen that the limit of this paper precludes the possibility of describing, even in the briefest terms, all, or even a substantial part, of its pioneer work.

The initial installation, purchased through Mr. F. B. H. Paine, comprised a generator installed in a rough cabin upon the site of the present Ames station and belted to a six-foot Pelton wheel, under 320-feet head, and a motor at the mill 2.6 miles distant. The two were identical Westinghouse single-phase alternators of 100 horsepower, the largest then made. The generator was separately excited, while the motor was self-exciting. Each carried a 12-part commutator and was slightly compounded through current transformers upon opposite spokes of its armature. The latter were ironclad, or "T"-toothed, wound with 12 simple coils in cells of fullerboard and mica. Switchboards were matched and shellacked pine sheathing, and the bases of instruments were dry hardwood. Only voltmeters and ammeters were used, both of the solenoid and gravity-balance type, in black-walnut cases with window-glass fronts. Circuits were closed with jaw switches and opened by arc-light plugs. The line carried two No. 3 bare copper wires, mounted upon short Western Union cross-arms and insulators. The copper cost about $700, or about one per cent. of the estimated cost for continuous current.

The main motor was brought to synchronous speed by a single-phase induction starting motor, which received its current at full line voltage. The current taken was more than full-load current of the main motor. This starting motor even required starting by hand, its torque being zero at starting, and so feeble at low speeds that when cold it could only with the greatest difficulty be persuaded to pull up to speed its belt and loose pulley. Nor could it at speed start the main motor without help, and even then it became so hot that its short-circuited secondary frequently burned out.

Another motor of 50 horsepower was soon added. While in other respects similar to the first, this motor was intended to be self-starting, with armature and field in series through a current transformer; and, on account of its frightful flashing, it was fitted with a special eight-part commutator of non-arcing metal. This feature, however, proving a failure, was soon replaced by a separate starter.

The need of wattmeter or power-factor indicator not having been at that time recognized, motor-field charge was adjusted for least main current. This current was accepted as having unity power factor, and therefore as the measure of actual power.

Everything was extremely simple, from water-wheels to motors; and, except for lightning, the plant ran smoothly and steadily 30 days and more without a stop. The report made in the East by associates of the enterprise that at Telluride a hundred horsepower was being successfully transmitted nearly three miles over No. 3 copper, with less than five per cent. loss, was received with the utmost incredulity.

During the autumn of 1892 a 600-horsepower generator of the same characteristics was installed, and a 250-horsepower motor for the mill on Bear Creek, 10 miles from the generator. Early in 1894 a 50-horsepower, and during the fall a 75-horsepower motor were placed in Savage Basin, 14 miles from the power house. The former was soon replaced by a 100-horsepower, and in 1895 a 100-horsepower motor was set up at Pandora.

Except as to size, these motors were substantially identical. The 250-horsepower motor was badly designed, and the pole-pieces were of cast iron. Its starting motor was insufficient, and was therefore soon replaced by one having split-phase secondary with external resistances. Marble, with brass trimmings, replaced wooden-base instruments, and such elegance demanded highly polished slat switchboards of paraffined oak. Imposing marble rheostats were mounted at switchboards like keyboards upon grand organs. Fuse blocks, the only protective device, became marble slabs with duplicate aluminum strips. The first synchrophone came with the 75-horsepower equipment.

Owing to its altitude and geographic position, the Telluride district is peculiarly subject to atmospheric disturbances. Over a hundred distinct discharges have been counted within a single hour, and lightning caused more discouragement than any other obstacle. A neighboring continuous-current plant, transmitting a little more than a mile, carried several extra armatures; and even then it was so frequently compelled to close down during the daily storms of the rainy season, that the company was eventually bankrupted. The alternating plant might have suffered a similar fate, had it not been for its "T"-toothed armatures and replaceable coils, eight of which were successively burned out and replaced on one motor within a single week. To get a coil into place, and its oak keys driven home, required such bending, clamping and pounding as inevitably resulted in injury to insulation, and only by the greatest care could replaced coils be made to stand a test adequate to the 3,000 volts employed. For protection from lightning several types of manufactured arresters, then various original devices were tried, ending with a simple gap in series with a score or more of fuse blocks in parallel, arranged about a radial commutator switch, turned from point to point, as the fuses were blown by successive discharges. From the first these conditions caused the greatest apprehension as to the commercial success of electric power transmission, until Mr. Alexander J. Wurts, during a stay of several months with the company, gave the protection of the now well-known non-arcing arrester.

No transformers were used between machines and line, the largest transformers at first being two-kilowatt or 40-light. Aside from the effects of lightning, even today 3,000 volts upon the winding of small high-speed armatures requires first-class insulation. Frequent grounds were prevented by deep insulating foundations of paraffined wood. To prevent short-circuits within the coils, their cells, just before placing, were poured full of shellac, and the entire armature afterward baked for several days. By this means the 50-horsepower motor ran a full year without trouble in a room dripping with moisture.

A lighting transformer received in 1891 was rated at five kilowatts. Theretofore transformers had been rated in lights, and generators in horsepower. This transformer was immersed in engine oil, and marks an epoch in the company's history. Lightning frequently punctured it, causing its fuses to blow, without other apparent injury. It remained in service for years. All others were soon likewise immersed. Four 500-light, dry Stanley transformers, purchased in 1892 for lighting Telluride, were broken down by the thunderstorms of the following spring. When repaired these also were immersed in engine oil, and gave no further trouble during the three years they remained in service.

Alternators were paralleled at Telluride in the spring of 1893, and thereafter they were so operated with full load upon the smaller, and regulation upon the larger machine.

Manipulation at switchboards or at brushes involved direct handling of 3,000 volts, a rather high switchboard pressure even now. It was a rule that every attendant keep one hand in his pocket while working with the other. It is pleasant to record that during these years no loss of life and but few accidents occurred.

There being no other circuit-breakers, it was necessary when a motor dropped out of step to break the circuit with the single arc-light plug. This always drew a heavy, vicious arc, which on the big motor frequently held to the full length of the six-foot cable, and then sometimes required a whiff from the attendant's hat. When not broken promptly, it frequently involved the entire switchboard and shut down the plant.

Duties of this nature required considerable skill and cool heads, and in order to operate the plant continuously, night and day, 15 or 20 competent attendants were required. To fit young men for these positions a course was arranged, during which they were taught something of machinery, of shopwork in metal and wood, and of wiring, insulating and repairing, while receiving such assistance in daily study as conditions permitted. A technical library, including the electrical papers, and a conveniently fitted testing room were always open. Each student was then given a short laboratory course in graphic treatment of alternating-current theory. This is said to have been the first systematic effort made by a corporation to train its employes for responsible positions.

Although the plant as a whole was an unqualified commercial success, no explanation need here be made as to why it was replaced by the induction system as soon as the latter had been perfected. This marks the limit of the most extensive single-phase, synchronous plant ever operated. With but one or two motors, its operation was not difficult; but each motor added to the system brought increased demand for care and skill. The causes of difficulty were not understood then as now, nor was the effect of power factor fully appreciated. Lack of both wattmeters and power-factor indicators left the adjustment of field charges to the judgment of the operators. The power factor of each motor being dependent not only upon its own adjustment but upon that of all, the closest attention and co-operation were necessary, in marked contrast with the simplicity of operation of induction motors. Disturbances due to starting motors were especially trying, and the unqualified success attained, notwithstanding defects of apparatus and system, is attributed now, far more than then, to the skill and vigilance of the operators in this new and fascinating field.

The Tesla system, substituted for the synchronous in 1896, comprised two 600-kilowatt, 60-cycle, 500-volt, two-phase generators, direct-connected to wheels under 600 and 900 feet head, respectively, and an equal capacity of raising and reducing transformers and of two-phase, 220-volt induction motors. The 12 100-kilowatt, step-up transformers were connected in pairs, two-phase three-phase, for three-phase, 10,000-volt transmission. These transformers were worthless; all broke down within a year, and one or more were always undergoing repairs. Breakdowns occasionally caused sufficient explosion to lift a cover, or splash the oil. The woodwork soon became saturated, and hot metal from the nearby main fuses frequently started fires, endangering the wooden power house. A masonry transformer house in two compartments was therefore constructed, and into it the transformers were moved—this being the first known case of isolation of oil transformers on account of fire risk.

The power house at Ilium, situated six miles below Ames, on the same stream and using the same water, was built in 1900, and contains one 1,200-kilowatt, revolving-field, General Electric generator, direct connected to two impulse wheels under 500 feet head. Transmission lines extend both to the Ames station and to points of distribution, providing the insurance of duplicate transmission. Any section of line can be cut out for repair, or either power house shut down, without interrupting the service. Junctions other than generating and distributing points are equipped with open air switches, mounted upon standard line insulators and operated from platforms similarly insulated, and have proven invaluable.

Junction houses at distributing centers provide for a branch line to each customer, which is equipped with switches, fuses and a set of five record-making instruments—a voltmeter, two ammeters and two wattmeters. The power company thus secures upon its own property a continuous, accurate and satisfactory record of each load.

The long spans crossing canyons and divides surrounding Savage Basin may be worthy of note. These divides are bare ridges at an altitude of 13,000 feet, inaccessible in winter, and swept by frequent snowslides. Spans up to 1,150 feet are used, in order to reach safe points for supports. A number of these supports, although simple and inexpensive,

1. A paper read before Section D of the International Electrical Congress at St. Louis on September 16, 1904. The author is chief engineer of the company whose interesting work he describes.

have stood for years without repair. The longest span is of No. 1, hard-drawn copper, supported by half-inch plow-steel cable, both being carried by the same insulators. The deflection is approximately 35 feet, on a slope of 31 degrees. Another is of three-eighths-inch soft-iron cable, 1,120 feet long, and has been in service five years. A third, 660 feet long, is of hard-drawn copper only, having 25 feet deflection. The strain insulators in all cases are a series of the usual line insulators and pins, upon a longitudinal arm, hinged to permit adjustment to span motion. They are simple, inexpensive and entirely successful.

A 10,000-volt underground transmission was put in operation at the Gold King mine in 1896. Power was carried through an unused tunnel, 1,300 feet long, upon bare copper conductors, 12 inches apart, on standard line insulators, to a deep mining hoist equipped for electric power. The tunnel was always dripping with water, but no trouble was experienced during the several years of operation, although slight brush discharge or halo was at times observed.

An interesting installation to which power is furnished is that of the well-known Camp Bird, Limited, near Ouray. Nineteen motors and rotaries, in sizes up to 150 kilowatts, drive crushers, Huntingtons, concentrators, compressors, pumps and hoists, aggregating in all about 1,000 kilowatts. Two underground transmissions, each a mile in extent, are in operation. Continuous current at 550 volts from two rotaries and a 650-ampere-hour storage battery operate three deep-mine hoists of 150 horsepower, and an installation designed by Mr. C. S. Ruffner, now engineer of the Utah department, makes use of the alternating current transmitted at 10,000 volts through paper-insulated, lead-covered cable, for the purpose of operating two 50-horsepower pumps.

The success of the original plant prompted the manager of the company, Mr. L. L. Nunn, to institute a search for other waterpowers in the West, finding as a result that such powers were very remote from available markets, requiring much longer transmissions than theretofore used. Voltages higher than from 10,000 to 15,000 were not in commercial use, and were regarded as merely problematical; but two important water rights, already acquired in Utah and Montana, would have been worthless at such pressures. Mr. Nunn therefore determined, in 1895, to undertake at Telluride an experimental transmission at higher voltages, to be installed and operated as a practical test for power purposes, and to determine if possible the problems peculiar to long distances and high pressures.

Two identical 75-kilowatt, oil-insulated transformers were installed in the autumn of 1895, one at the Ames station and the other at the Gold King mill. They were designed for pressures varying from 15,000 to 60,000 volts, by convenient steps. A separate pole line was equipped with three circuits of different characteristics, upon three types of insulators.

Measurements with many special instruments were made, embracing the different voltages, styles of insulators, conductors and distances between them, and the conditions peculiar to the various phenomena met at every step. Observations upon a wide range of atmospheric conditions were made by means of United States Weather Bureau apparatus at either end of the line. The commercial feasibility of high pressures was demonstrated by the successful operation of the Gold King mill during a great part of the year at pressures from 30,000 to nearly 60,000 volts, as well as by continuous electrification for nearly a month during dry weather of a three-mile telephone circuit, upon telegraph insulators, at pressures rising from 10,000 to 40,000 volts.

The change of the system from single to polyphase terminated actual transmission experiments. The reducing transformer was moved to the station, and another equipment designed for polyphase tests was ordered. The remaining time was devoted to open-circuit losses, and to the verification of measurements previously made. This work continued until August, 1897, when construction was begun upon the Provo plant.

Much of the data obtained from these experiments was incomplete, requiring caution in its use, due largely to the time and study required in solving, step by step, the problems and difficulties met at every stage of the work. However, that much of value was obtained is shown by the subsequent successes at Provo. Sufficient had been learned to warrant the commercial adoption for the first time of 40,000 volts, nearly thrice the voltage of any previous plant; to lead to the manufacture of transformers which, after seven years' continuous operation, are still in daily service; to determine the design of the Provo-type insulator, the method of line construction, distance between wires, and the importance of wave-form, and to make possible this great advance in long-distance, high-voltage transmission.

This experimental work, as clearly appears from the foregoing facts, was begun, carried on and finally utilized by the Telluride company in the regular and necessary course of its growing business; yet it must be added that important services were rendered by Mr. V. G. Converse, under whose direction the transformers had been designed and constructed, and who participated throughout the greater part of the work during all the experiments with actual high-pressure transmission, and subsequently by Mr. Ralph D. Mershon, in the elaborate instrumentation and laboratory practice, including a notably ingenious method of reading high-tension losses upon low-tension circuits, devised by him and used in substantiating the accuracy of the earlier measurements; also that different types of insulators were contributed by the General Electric and the Westinghouse companies and by Mr. Fred D. Locke, on account of their friendly interest in the work.[1]

The original plant at Provo contained two 750-kilowatt, 60-cycle, 800-volt, three-phase, General Electric generators, direct-connected at 300 revolutions per minute to twin horizontal turbines under 125 feet head, a six-panel Wagner switchboard, two banks of oil transformers and two outgoing circuits. All contents thus in duplicate were assembled in two complete, independent units, designed for operation independently or paralleled at both high and low pressure. Prior to the power-factor indicator, a device which answered a somewhat similar purpose was installed, consisting of a wattmeter on the low-pressure paralleling bus, with current coil in one bus and shunt across the other two. This indicated cross current, and was used in the adjustment of field charges. Transformers were each 250 kilowatts, 800 to 40,000 volts, star-connected at both high and low pressure, with neutrals grounded.

Triple-pole air switches and four-foot fuses formerly connected each bank of transformers with its transmission line. One form of air switch, opening six feet, contained no metal except conductors, and was composed entirely of paraffined wood and rawhide, without porcelain, glass or other insulator. Others were sliding frames, carrying line insulators.

During the first year of operation the transmission comprised a single 32-mile line to one receiving point at Mercur, where the arrangement was similar to that at the power house, save that two reducing transformers were connected two-phase three-phase, grounded neutral, for 220-volt, two-phase induction motors. The Provo-Eureka line, 42 miles long, carries seven-strand aluminum cable equivalent to No. 4 copper. The Eureka-Mercur cross line, 28 miles long, equivalent to No. 5 copper, was added to complete the triangle thus formed and permit cutting out either of the three sides without interrupting service.

The Logan plant was completed in 1901, containing two 1,000-kilowatt, revolving-field alternators, direct connected at 400 revolutions to double-discharge twin turbines under 212 feet head. This plant is connected with the Provo system by duplicate lines over 100 miles long, passing the cities of Ogden and Salt Lake. The Provo and Logan plants are thus operated in unison through nearly 200 miles of transmission. Distdibuting points at Mercur, Eureka, Bingham, Salt Lake and Provo are also junction points of the duplicate lines, equipped with switches in each incoming line, as well as in circuit with the transformers, so that in case of threatened trouble the patrolman can without delay have his section cut off for immediate repair without interrupting service.

The three conductors of each transmission form an equilateral triangle 76 inches between wires, carried by a seven-foot cross-arm and the top of the pole. Extra long pins raise the insulators from six to 12 inches above cross-arms, are of selected locust, kiln-dried and immersed from six to 12 hours in hard paraffin at 150° C. Cross-arms are of Oregon fir, kiln-dried and soaked in boiling bitumen. Those upon the first line were attached in the usual manner with metal braces. The burning of cross-arms and poles on account of broken insulators, during prolonged wet weather, occurred most frequently at these braces. When the next lines were built in 1899 treated wooden braces were substituted, with results so favorable that all metal braces were soon replaced. It was still observed, however, that even light leakage seemed to concentrate around the lag bolts, carbonizing the wood and finally loosening the bolts. For the Logan lines of 1900 and all later lines, therefore, the cross-arms were mortised through the poles and wedged and pinned with hardwood—thus discarding all metal except conductors. This construction was originated by Mr. A. L. Woodhouse, who, upon the close of the high-pressure experimental work in Colorado, of which he had charge, became and still is superintendent of the Utah department. It has proved amply strong, not expensive, and during the four years' operation of the 400 miles thus constructed very few poles have been burned.

Provo-type glass insulators, designed by Mr. V. G. Converse, have been used throughout. Many have broken, but these have usually shown the effects of guns or stones. In fact, there has not been a single breakage, except in one lot, improperly annealed, clearly due to either internal or dielectric stresses. It is difficult to see wherein any other insulators could have done better, unless bullet-proof. College laboratory tests to the contrary notwithstanding, leakage losses are inappreciable, except during severest storms, and then not serious where insulators are unbroken. It is a mistake to suppose that Utah climate is favorable. During the rainy season it is as wet as any, and the alkali dust of the so-called saltstorms is as trying as seacoast spray. At time dense volumes of this impalpable dust from the Great Desert are accompanied by clouds or fog. In this damp, sticky state the dust completely covers to a considerable depth the under as well as the upper surfaces of insulators, as well as poles, cross-arms and pins. Over these surfaces streamers gradually creep, until, meeting at the pole, they break into an arc, like that which was photographed by Mr. C. E. Baker, the line patrolman at Mercur, and which has several times been published. A quick turn of the generator rheostat at the critical instant breaks the arc, without interrupting service of induction motors.

The arrangement of power houses and transmissions already described is such that the opening of paralleling switches may resolve the system into a single transmission from 100 to nearly 400 miles in length, with a generator at each end, yet side by side. If one generator be reversed, synchronized as a motor with the other and loaded by its waterwheel, any length of transmission may, by manipulation of a paralleling switch, be alternately cut in and out between them. Since switchboards and instruments are connected, measurements made are immediately comparable. In this manner losses and power factor may be measured, and the corrective effect of charging current observed.

Solid aluminum wire, first used in 1898, was slightly alloyed to increase strength, but proved worthless, breaking repeatedly with square, glass-like fractures. It was at once replaced with commercially pure, seven-strand cable, still in use. Similar cables have generally been employed for subsequent lines, while spans have been successfully increased to 180 and 200 feet, with less deflection than usual with copper.

The experience with oil transformers for 10,000 volts at Telluride, and the refusal of manufacturers to give any guarantees whatever for other transformers for higher pressures, led the Telluride company, when undertaking this 40,000-volt transmission, to manufacture its own. The first equipment was made at the Wagner company's works under designs and supervision of Mr. Converse. The later ones were made by the Converse Transformer Company. When erected, the oil in the tank and the transformer in an oven were slowly raised to and then maintained during 24 hours at a temperature of 125° C. The transformer was then immersed in the oil, and both continued at the same temperature for a further 24 hours. As bearing upon the question of fire risk due to oil transformers, it may be of interest to note that of the large number of these high-pressure transformers used during the last seven years, chiefly in isolated sub-stations containing much wood and seldom visited, all but four are still in operation; that these four were destroyed by fire of doubtful origin, and that only one transformer has required repair other than change of oil.

The plant at Norris, Mont., designed and constructed in 1901 by Mr. O. B. Suhr, superintendent (now resident engineer of the Ontario Power Company), contains at present two low-speed, 1,000-kilowatt units. A duplicate transmission of 60 miles conveys power to the city of Butte. These lines, as well as both raising and reducing transformers, were designed for the use of 40,000, 60,000, or 80,000 volts. Longer pins are used than in Utah, and conductors form a triangle of 108 inches. While producing the present limited amount of power, and awaiting a suitable insulator, the lower voltage has been used.

In conclusion, it may be said that the Provo plant—the first transmission at more than 16,000 volts—while undertaken materially in advance of the art, and not exempt from its share of troubles, has, nevertheless, been fully successful as a financial venture, and not without value in the progress of the science. Long periods of perfect operation, monotonous in their uneventfulness, have proved beyond question the success of high pressures for long distances. The new and larger power house at Olmsted, at the mouth of Provo Canyon, completed this season, is modern in every detail. It contains three 3,600-horsepower generators, operating under 340 feet head. Air switches and fuses are everywhere giving place to oil switches with time-limit automatics, and constant reconstruction to meet its increasing demands keeps the system as a whole abreast of present practice. Thus the Telluride Power Company, while again and again a pioneer in power transmission, must not be associated alone with the experimental methods of early days, but may in the future be found still engaged in progressive, practical pioneer work.

1. An interesting account of this work and some of the technical results may be found in Mr. Mershon's report quoted in Mr. Scott's paper before the American Institute of Electrical Engineers, at the Omaha meeting, in July, 1898.

Electrification of Erie Lines in New Jersey Contemplated.

The Erie Railroad company has under contemplation a number of plans for improving its property in the vicinity of New York. One of these is the "electrification" of the suburban service throughout New Jersey. The new plans call for an expenditure of about $30,000,000. To electrify the suburban lines a central power station is to be erected at Paterson, which will bring the remotest point of the power delivery within a radius of 20 miles from the central station. Fifty-one miles of road in all will be electrified if the plans are followed out.

The Chickasha Light and Power Company of Chickasha, I. T., has been absorbed by the Chickasha Light, Heat and Power Company.

Single-phase Alternating-current Motors.

By Herbert P. Andrews.

Early prejudice against the single-phase motor was partially due to several unsuccessful types of machines being put upon the market, in response to the demand for motors adapted to run on single-phase circuits, and partially to the reasoning of several prominent electrical writers, who taught that such motors were necessarily inferior in efficiency and output to multiphase motors. Now, that this prejudice has been largely overcome, doubtless the theory will soon catch up with the practice in this line.

So far as the efficiency or output of these two types is concerned, there is practically no difference, in a frame of given size and correct design, whether wound for single-phase or multiphase currents. In fact, the reactions are equal in both types of machine, the rotary field being induced in the primary element in the multiphase motor directly from the line and reacting on the secondary, while in the single-phase type this rotary field is the resultant of the single-phase primary winding and the induced currents of the secondary. While in normal operation the distribution of flux is practically equal whichever way the rotary field is generated.

Prominently connected with the development of this type of motor we find the name of E. S. Pillsbury of St. Louis, and it is my purpose in this article to describe his latest product in this line, together with some of the earlier types that lead up to it. In Fig. 1 is given a longitudinal elevation of one of the earliest types of single-phase motors designed by Mr. Pillsbury in 1897. The special features in this motor consisted in combining a progressively wound armature with a slot-wound field, in such a manner that it started as a series motor, and after the machine had acquired the proper speed, in providing a means for moving the brushes away from the commutator, connecting them together and simultaneously short-circuiting the winding on the armature, after which the motor ran purely as an induction motor. These motors were also provided with a short-circuited winding on the rotor, to prevent it from going above synchronism in case the operator failed to throw the lever at the proper time. The field windings were applied in such a manner that the magnetic lines of force were more intense at the center of the pole than at either side, they decreasing in strength as they approached the ends, which points were practically neutral. In this manner a symmetrical field was attained, making the magnetism of the poles intense at the proper point. The slot into which the winding was laid served the double purpose of enabling the distribution of flux, as described, to be attained, and in preventing the distortion of the field caused by the reaction of the rotor on the stator, which tended to drag the flux to one horn of the pole-piece.

In March, 1899, patents were granted to E. S. Pillsbury and F. Schwedtmann on an improved type, a longitudinal section of which is shown in Fig. 2. The improved features of this motor consisted in the construction and arrangement of the centrifugal device and its associated parts, for electrically connecting the brushes, short-circuiting the commutator and removing the brushes from the commutator, in the construction and arrangement of the field-core supports and the mechanism employed for adjusting the latter. In this motor the windings were practically the same as those employed in the machine previously described, except that the closed coils on the armature, being unnecessary, were abandoned, the winding being a plain multipolar progressive one. On throwing the main-line switch the motor started as a series motor as described above, and after attaining the proper speed the two weights (G') move outwardly by centrifugal force, thereby moving the fingers (G") forward and simultaneously short-circuiting the commutator, throwing the brushes away from the latter, and electrically connecting the brushes, after which the machine operates as an induction motor. It was during this period, while Mr. Pillsbury was engineer for the Wagner Electric Manufacturing Company, that this company was awarded the Edward Longstreth medal by the Franklin Institute for the proficiency attained in the manufacture of this type of motor. It was also during this time that the machine shown in Fig. 3 was developed, patents being granted to Mr. Pillsbury for it in January, 1903. This machine was an improvement on the machine shown in Fig. 2, the new features consisting in a superior design of frame and method of adjusting the field core; in the novel form of governor weights (19), bell crank (23), and rods (24), whereby motion was transmitted for throwing of the brushes, short-circuiting commutators, etc; in the brushes being in electrical connection at all times; in the bearings forming part of the end plate, and in a new method for adjusting spring (26) which determines the speed necessary to operate the governor weights or the synchronous speed, all of which are evident from inspection.

At the present time Mr. Pillsbury is associated with the Century Electric Company of St. Louis. During his connection with this company he has developed his latest type of motor, shown in Fig. 4, patents on which were granted him in September, 1904. The principal object in this design is to secure a more efficient machine. With this point in view, it is so constructed that, in starting, instead of the secondary current induced in the armature or secondary member being commutated, the current supplied to the field or primary member is commutated. This makes it possible to employ larger and heavier conductors in the armature or secondary member in place of the fine-wire conductors heretofore employed, whereby the armature is rendered more substantial, is rendered of low resistance and small self-induction, and will carry a greater load than an armature provided with the fine-wire windings; thus, the present armature is less susceptible to changes in frequency and capable of withstanding a greater overload. The general principles of the field and armature windings in this machine are similar to the ones described above, except in the size of conductors as noted. In the previous types of four-pole machines the brushes served to connect the armature windings at four points 90 degrees apart; in this machine the same conditions are brought about by permanent connections to the windings. After this motor has attained the proper speed the governor weights (50) operate a substantially designed cam (55) which transmits motion for throwing off the brushes and short-circuiting the commutator on the armature, and at the same time making four connections in field coils diametrically opposite.

Fig. 5 shows the general appearance of this motor as it is being made at the present time, and in Fig. 6 are curves plotted for a five-horsepower machine, showing the efficiency and power factor; also the current consumption, speed and slip.

In the development of this motor Mr. Pillsbury has kept in mind the fact that, in addition to a high efficiency, there is also a growing demand for machines simple and substantial in mechanical construction. It is with this point in view that this company has already departed somewhat from the details in letters patent No. 770,924, as shown in Fig. 4.

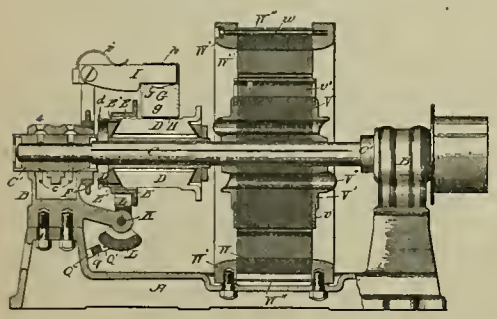


Fig. 1. Type of 1897.

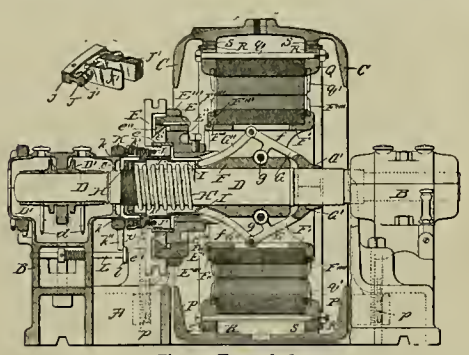


Fig. 2. Type of 1899.

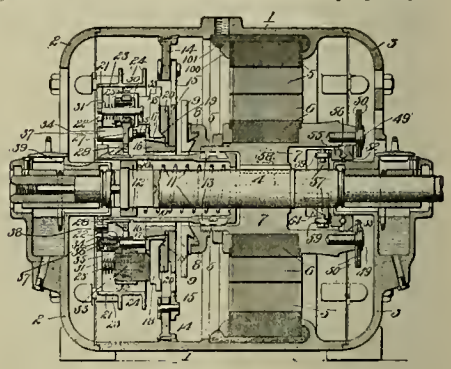


Fig. 4. Type of 1904.

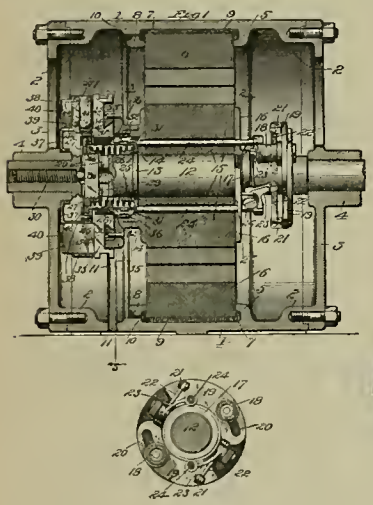


Fig. 3. Type of 1903.

Fig. 5. General View of 1904 Type.

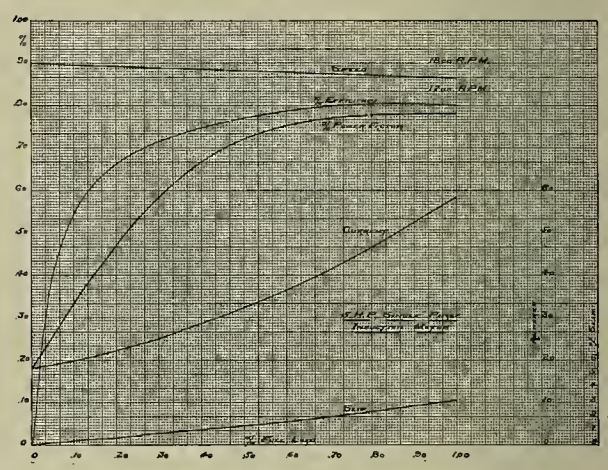


Fig. 6. Efficiency and Power-factor Curves for Five Horsepower Motor.

SINGLE-PHASE ALTERNATING-CURRENT MOTORS.

The corporation counsel of Washington, D. C., acting on the suggestion of District Electrical Engineer Allen, is about to pass upon the advisability of amending the regulations, so that fees will be required for all permits for electrical work, including illuminated signs. Previous to last September, it was customary for the building inspector to issue permits without fees for all signs, whether they were illuminated by electric lights or not, while a fee of $1 was required under the regulations for light in front of buildings. In many cases these lights were placed around signs previously erected, practically making them illuminated signs. The electrical engineer believes these cases should be uniformly treated.

Lundell-Lozier Department of National Electric Company.

The National Electric Company of Milwaukee has entered into an important arrangement with Robert Lundell and Robert T. Lozier by which the National company will manufacture and market the new motors and generators and systems of operation and control that are covered by the latest inventions of Mr. Lundell, the commercial direction of the undertaking being placed in the hands of Mr. Lozier, who will also act as general manager of the electrical sales department of the National company. Under this arrangement Mr. Lundell assumes the direct supervision of the engineering involved under the license that he grants the National company. It might be said that this license covers all of Mr. Lundell's inventions not already under license to other companies and all inventions that he may hereafter make during the life of this license.

These inventions of Mr. Lundell are of particular interest, in that they cover important developments in direct-current apparatus. Some of these patents are for a new type of motor and dynamo frame construction as well as a new method of commutation by which a material gain is obtained in the space occupied by the apparatus, its efficiency and the flexibility of its speed control and regulation.

This form of construction represents an important departure in standard motors of fixed speed and is particularly advantageous in variable-speed motors for direct application to machinery, both from point of construction and flexibility of control. These Lundell inventions are equally valuable in systems of regenerative operation and series-parallel control and to the numerous other uses to which electric motors are now so generally applied. The whole group of patents is comprehensive in its scope; it covers a new type of machine construction, new principles of commutation and new methods of operation based upon the inventor's long and varied experience in the direct-current field, in which Mr. Lundell has won both fame and distinction, his apparatus being now largely used not only in this country but throughout the other countries of the world. It might be said that the Johnson-Lundell Traction Company of England has been organized to manufacture under these patents in Great Britain and elsewhere abroad.

The field to which Mr. Lundell's inventions particularly apply is one with which Mr. Lozier has been associated from the earliest commercial development of the electric motor, he having been placed in the testing department of the Sprague factory when it was started in West Thirtieth Street, New York, in 1887, when the first commercial electric motors were developed, and has since followed the development of the business in all its phases. It was in this shop that Mr. Lozier first met Mr. Lundell and formed a friendship that has developed into the alliance consummated by the arrangement with the National company. In the 17 years that have followed each has had the opportunity of maturing in his experience in his own special line, and now their conjunction with the National company's fine manufacturing facilities and high commercial standing is an event of considerable significance to the trade and to the art.

The National Electric Company of Milwaukee, formerly operating under the style of Christensen Engineering Company has in the last seven years equipped the majority of the electric cars using air brakes. Four years ago it built its present plant, equipped with modern tools and labor-saving machinery; also a foundry having open-hearth and crucible furnaces for making steel castings as well as cupolas for gray cast iron and a complete brass foundry. This plant has all the other features necessary to make it one of the most comprehensive and up-to-date plants to be found in the electrical-manufacturing business.

The success met with in the air-brake business encouraged those financially back of the National company to enter into the general field of elcctrical machinery, and two years ago a competent engineering corps under the able direction of Mr. W. L. Waters, chief engineer of the National Electric Company and an active sales organization were put into operation, and the results of this work have in turn been so successful that the National company has now decided to follow up the material gain already made with a view to developing this branch of their business to its fullest capacity and to this end have established a separate electrical department.

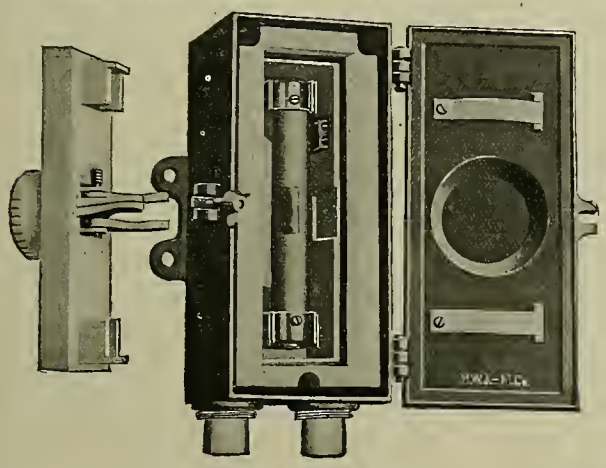
Mr. Lozier will be aided in directing the work of that department by his long experience in the electrical field. Beginning with Edison early in 1883 and running down through the engineering and commercial branches of the business for 13 years with the General Electric Company, for the last eight years he has devoted his time to marketing the apparatus of the Bullock Electric Manufacturing Company.

Mr. Samuel Watkins is the president of the National company. He organized it and under his able direction the company has reached its present prominence.

Mr. Bernard T. Becker, who represents the interests of those financially back of the company and who is himself a large stockholder and a director in the company, will act in an executive capacity in connection with the operation of the company.

The first vice-president and general manager of the National Electric Company, Mr. Frank C. Randall, is widely known throughout the street-railway field, and the air-brake sales will continue, as in the past, under his direct charge.

Of the operative force Mr. R. P. Tell is the secretary and treasurer. Mr. J. H. Denton, well known to all those who come in contact with the air-brake business, is the general superintendent.



NEW POLE-LINE FUSE BOX.

New Pole-line Fuse Box.

The H. W. Johns-Manville Company of New York is placing on the market a new pole-line fuse box known as the Sachs Noark fuse box, which is shown in the accompanying picture. The box is designed for 2,500 volts and will protect the insulation of the current-carrying parts from the weather and also allow of the maximum amount of insulation to be used. The external casing consists of a cast-iron box having a hinged cover, opening sideways. The cover is provided with a rubber gasket, which forms a weather seal between the box proper and the cover, which latter is firmly held in position by the thumb-nut hasp. Inside of the iron box is a porcelain box provided with a porcelain cover and fuse holder. When in place the cover is flush with the top surface of the porcelain box and finds a seat on a rubber gasket placed in a ledge around the inside of the outer walls of the porcelain box. After the wire once enters the porcelain bushing on the bottom of the box it is entirely surrounded by porcelain and is perfectly protected from leakage or contact with the non-current-carrying parts of the box.

The fuse is held to the cover by means of a "lobster-claw" device, which consists of a pair of tongs made of a specially treated insulating material, manipulated so as to clamp or release the fuse by means of a nut embedded in the porcelain handle, on the exterior of the cover. This nut works on a stud projecting from the clevis to which the claws are attached. Turning the nut in one direction causes the claws to be brought together to clamp the fuse, so that it is firmly held to the blocks on the porcelain cover. Movement in the opposite direction permits the spring to open the claws and release the fuse. When clamped to the cover, the fuse and cover are manipulated as one device and form practically a plug, co-acting with the contacts attached to the base portion of the porcelain box. The fuses are fitted with contacts, which consist of flat blades on each side of the fuse tube, forming a knife-blade switch contact. The receiving clips on the base of the porcelain box are made of spring metal of ample conductivity, and the insertion of the fuse into them is readily accomplished; not only due to the rounded corners of the clips, but also because the cover telescopes onto the block until it finds its seat on the rubber gasket.

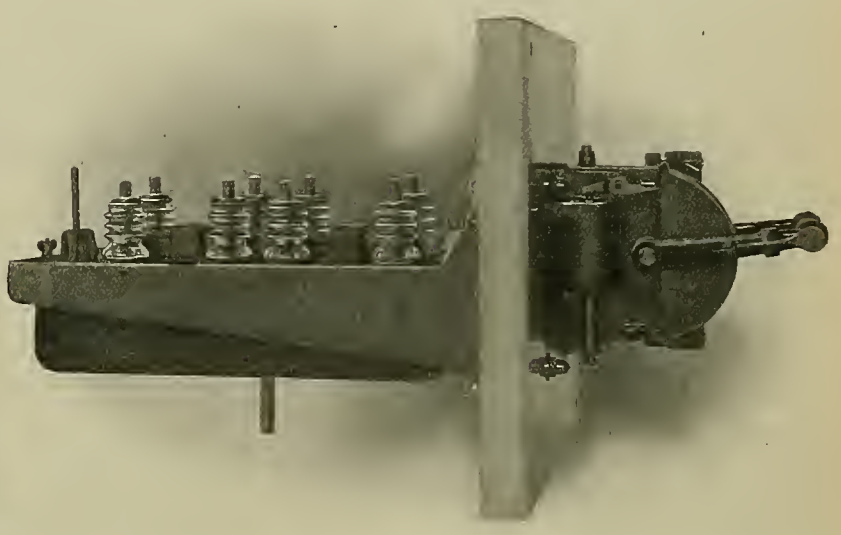
The arrangement is such that the box is practically closed just before the fuse reaches the contact clips. The fuse may, therefore, blow while being inserted into the clips without injury to the person who may be handling the porcelain knob on the outside of the cover.

Oil Switch for High Voltages.

The accompanying illustration shows a form of oil switch which has been developed by the Stanley Electric Manufacturing Company. It is of the horizontal-break type, and the arc when drawn is carried upward by the generated gases, increasing in length and breaking just below the surface of the oil.

The switch is furnished complete with oil and tank. The breaking distance corresponds to the company's standard practice at the lower voltages. For the higher voltages, however, the breaking distance is increased by multiplying the number of breaks, thus distributing the arc.

Both fixed and moving contacts are disk-shaped, with rounding edges, and are interchangeable. When the switch is opened, arcing takes place between these rounded edges rather than from the flat portions which form the contact surfaces. By thus providing arcing points, good contact services are maintained at all times.



OIL SWITCH FOR HIGH VOLTAGES.

From the back of each disk extends a threaded projection, which, in the case of the fixed contacts, screws directly into the ends of hollow studs. In the moving contacts, however, two nuts secure each to a connection strip. This construction facilitates removal, and the expense of replacing the disks is trifling.

The rounded edges after long use become damaged by the arc, and perfect edges can be easily brought into play by giving the disks a partial turn. As the disks may be turned to six or seven different points before requiring renewal, the life of the switch is increased several times, and the cost of repairs decreased accordingly.

The fixed contact disks are held against the lower ends of the insulators by hollow studs into which they screw. The lead wires are soldered into the top of these studs, insuring good connection.

By means of ball joints, the moving-contact disks are mounted upon the carriers, which are rigidly attached to the driving rod. These disks are self-aligning in regard to the fixed disks against which, when the switch is closed, they are pressed by strong coil springs, eliminating all possibility of poor surface contact.

These switches are made for pressures of 2,500 and 6,600 volts and may be used in connection with overload time-limit or reverse-current relays.

Electric Lighting in the City of Mexico.

The Mexican Light and Power Tramway Company, which is controlled by Toronto and Montreal capitalists, announces that a contract has been made with the federal government of Mexico by which the company secures the contract for the entire lighting of the City of Mexico and suburbs till 1917. The contract is made on a basis that will give a substantial profit to the company. The government, through President Diaz, also awarded to the company contracts for the lighting of the postoffices and government buildings in the City of Mexico. The contracts were arranged by Mr. C. H. Cahan of the law firm of Harris & Cahan of Halifax, N. S., the attorney for the company.

The Telephone Problem in Large Cities.[1]

By F. J. Dommerque.

It has been the general rule, up to the present time, to divide a large city into a number of districts; to locate a central office in each district and to connect these offices by trunk lines. When economy only is taken into consideration, this method of handling the telephone business is probably correct, as in large cities the actual minimum of annual expenditure will be obtained with more than one office district, because the expense for the wire plant, which is the principal item of annual expense, decreases with increasing number of office districts, while the other items that contribute to the annual expense increase up to a certain point where the sum of all items gives a true minimum.

Paying, however, due respect to the quality of service, it is a plain fact that with the introduction of trunking the service must become less efficient, because, to begin with, it takes more time to put through a trunk call than a local call. As all trunk calls must be handled by at least two operators, a greater liability to human errors is introduced; trunking also increases the apparatus and cable in the office, tending thereby to deteriorate the quality of transmission; and, finally, no matter how good the discipline of the operating room may be, it generally happens that in the busiest hours of the day, when the service should be most rapid, all the trunk lines are in use and subscribers are forced to wait for connections. The trunking troubles are still more aggravated by the necessary evil of order wires. It is a wonder how in large cities, where the percentage of trunking is very high, the operators are at all able in the busy hours to distinguish between orders. Anyone who ever listened in on an order-wire circuit in a busy exchange will be convinced of the difficulties in that respect.

If, therefore, money was no object, the ideal way of giving telephone service would be to bring all subscribers' lines into one switchboard. Looking at the problem from a physical standpoint, there is a limit to the size of the switchboard. To begin with, it may be conceded that as a result of many years' experience the multiple form of switchboard has shown itself as most adapted to satisfactory service. As a multiple board demands all subscribers to be in reach of every operator, it is absolutely necessary to decrease the size of the multiple jacks with increasing number of subscribers. The greatest number of lines that can be accommodated in a multiple section with the smallest jacks at present in commercial service (jacks with three-tenths-inch centers) is 20,000 in an A section (a section upon which only local and outgoing trunk work is done), and 25,000 in a B section (a section used for incoming trunk work only). The capacity of a B section is greater on account of the gain in space by the absence of the answering jacks and signals and outgoing trunk jacks. However, 20,000 lines do not necessarily mean 20,000 subscribers, since by the aid of party lines and private-branch exchanges the number of subscribers may be greatly increased. Party lines being mostly used in residence districts, where the lines are of considerable length, effect a great saving in line expense and consequently permit of lower rates, which circumstance increases the number of residence subscribers; party-line service naturally tends to increase the size of an office district.

There exists the possibility of extending the use of a single office to a larger city than of 200,000 population by the aid of so-called "division systems," sometimes termed group systems. Such systems subdivide a multiple board into two or more divisions, so that only one-half or one-third or one-fourth the number of lines (according to the number of divisions) are multipled in each division, while each division contains answering jacks and signals for all the lines. A two-division board thus would contain 20,000 multiple jacks of the three-tenths-inch type in each section of each division, giving a total of 40,000 lines. There would have to be a total of 80,000 answering jacks and signals, as each line would have to appear in each of the two divisions. This doubling of answering jacks can signals, however, does not mean doubling of space, as in a two-division system the answering jacks can be spaced close together (20 per strip), while in a straight multiple board they are spaced 10 per strip for good service; because in a two-division board there are twice as many jacks for the same number of originating calls as in a straight multiple system.

Seven years' experience with division boards has established the fact that more than two divisions will not give both good and economical service; four divisions can give good service, but the service is not economical, principally on account of the practical impossibility of using an intermediate distributing board, since the cross-connecting wires become unwieldy; hence, the possibility of distributing the load evenly over the operators, or, rather, the possibility of loading each and every operator to the limit is excluded. With two divisions, the use of an intermediate distributing board is practical, as not more than a three-pair cross-connecting wire is required. Therefore, with a two-division system, 20,000 single-line and 60,000 party-line and private-branch exchange subscribers can be accommodated on 40,000 lines in the switchboard, whence the use of a single exchange may be extended to cities with a population of 400,000.

Many telephone engineers are unfavorably disposed toward anything that involves labor on the part of the subscriber, and in a two-division system the subscriber would have to press one of two buttons upon his instrument, according to the division upon which the desired subscriber is located; and this operation, though involving only a minimum of attention on the part of the subscriber, is not quite as simple as just lifting the receiver off the hook to signal the operator. Where a two-division system would not find favor, the city must be divided into districts and trunk lines must be used. In such a case the number of districts should be kept small, in order to keep the trunking in narrow limits. In fact, the trunking should be kept below 50 per cent. —in other words, of all the originating calls, not more than one-half should be trunked. This can best be accomplished by establishing one office with a 20,000-line board in the center of the densest telephone population, then selecting clusters of less dense telephone population and providing each of them with an office and trunk between them. In this arrangement all boards would be multiple boards, as there would be sufficient local business to require a multiple on the A sections. As soon as the district of dense telephone population becomes too great for one office, and must, therefore, be subdivided into more districts, the percentage of trunking will naturally arise; and from experience it is known that in New York and Chicago, for instance, the percentage of trunking exceeds 60 per cent. and has been considerably higher at the time when the offices, or, rather, the switchboards, were smaller. When the percentage of trunking is high, the multiple in the A boards is not used much, and the question is raised if it would not be better under the circumstances to trunk all the calls, so that the A board would be a receiving board only, while the B board would contain a large multiple. Doing this should offer an opportunity to simplify operation, as the A operator's circuit could be made very simple. Time also should be saved in the average duration of a call, on account of simpler and more uniform manipulations; in other words, when all calls are trunked, it should take less time to put up a connection on a trunk line than where only part of the calls are trunked.

From the above considerations it follows that in an exchange without trunking, the best service can be rendered, and that the quality of service deteriorates with increasing percentage of trunking. It also is a fact that with large office districts the annual expense is greater than with small office districts. The question arises, Which of the two, better service with greater expense, or inferior service with minimum of expense, should be selected; or is there a compromise?

Where competition exists, as is now the case in all large cities of the United States with the exception of New York and a very few others, that company which gives the best service is most apt to find the greatest favor with the public. Where the telephone service is in the hands of the government, like in all principal European countries, the government certainly desires to give the best service if it can only raise the money. It seems, therefore, reasonable to say that the best service should be made the rule, and that every effort should be made to render this best service with the least expenditure.

The principal item of expense entering into this problem is the line expense. Any reduction therein will be in favor of larger office districts, the term "district" being here relative, meaning a district containing a great number of subscribers and not necessarily covering a large area, though the larger the area the more marked the difference in expense will appear.

With large office districts more lines can be concentrated into heavy underground runs, which will reduce the relative cost of the conduit system. Larger cables can be used, and larger cables are cheaper per conductor than small ones. The demand for larger cables has prompted the cable manufacturer to build cables with 400 and more pairs. Of course the conductors in these cables have to be of a finer gauge than had previously been the custom; but the development in transmitter design kept pace with the progress in cable manufacture, so that these cables with finer wire do not deteriorate the transmission so long as the capacity is kept within reasonable limits. All these briefly mentioned items are in favor of large as against small office districts.

The introduction of party-line service in the residence district has made the proposition of large offices still more favorable. With small office districts, the management often was doubtful whether party lines would really be money savers, because the parties as a rule were located so far apart that the common line from the exchange to the point or points of connection with the party lines, plus these party lines, did not cost much more than individual lines direct from the exchange to each of the parties; the saving in the line expense in that case did not seem to be in accordance with the decreased revenue per party line. With large office districts the common line from the exchange to the connecting points is most likely long in comparison to the party lines, and, therefore, a real saving results.

On the other hand, improvements have been and are constantly made in the design of trunk circuits, the principal step in advance being the introduction of automatic features like automatic or machine ringing, which secure simpler operation and reduction of time, but necessarily involve complication in the apparatus.

In the Strowger automatic telephone system, now so largely exploited, trunking is carried on entirely automatically, the subscriber being made to perform what little is left of operating. This is a case of going to the other extreme where all calls, as far as large exchanges are concerned, involve trunking, and where all the trunking is done automatically in the exchange with, at present, very complicated apparatus. It is not the purpose of this paper to enter into a discussion of automatic vs. manual exchanges; it may only be assumed that the automatic exchange can be made practical and it may further be expressed as a personal opinion that the vertical and rotating movement as applied in the Strowger switch is the keynote of automatic working. With this in mind, the exchange problem in large cities becomes entirely different. The trunking no more affects the service, and, therefore, the choice between large and small offices or office districts resolves itself into a problem of economy pure and simple. In this case the engineer must find the true minimum of annual expense and be guided thereby in the selection of the number and location of the offices.

The sum total of automatic apparatus will be the same, whether all concentrated in one building or scattered over many. The length of the trunk lines, however, varies, being shortest with all the switches in one building and increases with the increasing number of and distances between offices. The reverse is the case with the subscribers' lines, and there can be found a balance where, ceteris paribus, the expenditure on trunk lines plus the expenditure on subscribers' lines gives a minimum.

So far the term "service" has been used to designate the more or less satisfactory arrangement and working of the apparatus either by operators or automatically. Another phase of service is represented by the quality of the transmission of speech. Not much need be said in relation to this, as there are obtainable the most efficiency transmitters and receivers, and it is only a matter of dollars and cents to obtain same; it is, furthermore, simply a question of finances to build the lines so that they will present sufficiently high insulation, low enough resistance and balanced induction and capacity.

Stress is here laid upon a good talking circuit for the reason that with the introduction of automatic exchanges this most essential requirement in any telephone enterprise has been sadly neglected. The advent of the Strowger automatic exchange has also caused a return to the local battery at the subscriber's station for talking, which is contrary to the trend of the present moment toward centralization in all manually operated exchanges. However, the necessity of a ground connection at the subscriber's premises for signaling purposes is against modern practice.

After having disposed of the local exchange requirements for large cities, a few words may be added with regard to the toll and long-distance facilities that should be provided. Both the toll business and the long-distance business being of the same nature and closely allied, one switchboard seems to be preferable for both kinds of service. The switching apparatus for this purpose should be so located that either no cable at all or only a minimum amount would enter between the toll and long-distance lines and the point where the same are switched to the local subscriber's lines.

As the toll and long-distance lines are very costly, they ought to be loaded to the fullest extent. To do this effectively the operator should be enabled to keep the lines busy all the time, and, therefore, only a few lines should be assigned to one operator (in Germany they assign only two lines to one operator), while provision should be made to make the connections with the utmost speed. For outgoing calls for such subscribers as frequently use the toll and long-distance lines, provision can be made to call the toll board direct without going first through the local board, by providing a double signaling device, one being the regular signal upon the local board, operated by the subscriber taking the receiver off the hook, and the other a second signal terminating in a distributing operator's section of the toll boards, this signal being arranged similar to the second signal in a two-division signaling system operated by the subscribers pressing a button.

For incoming toll and long-distance work the same subscribers may have their lines multipled through the toll board, so that every operator can connect to them direct.

All toll boards in large cities should be provided with ticket carriers somewhat along the line of the cash system in large department stores, which are operated by compressed air or belts.

By the use of composite circuits much time can be saved, as the calls may be ordered up by telegraph, leaving the lines ready for actual conversations.

1. Abstract of a paper presented before Section G of the International Electrical Congress of St. Louis, September 12, 1904. Mr. Dommerque is secretary of the Kellogg Switchboard and Supply Company of Chicago.

Telephones on Railroad Train.

Members of the Merchants' and Manufacturers' Association were recently touring Western Pennsylvania and Ohio in a special train composed of eight Pullmans. The Central District and Printing Telegraph Company, which is the Pittsburg local Bell telephone company, made the innovation of placing a telephone in each car, so that members of the association could converse from car to car without leaving their seats. These telephones were also arranged to be connected to the long-distance lines at places where the train stopped for more than half an hour. This arrangement of telephone service proved to be very useful and has been highly complimented by the members of the association.

Arrangements were duly made in all of the towns where stops were to be made to have a direct wire run from the central exchange of the town to the siding where the train was to pull in. Before the train left Pittsburg an entire telephonic system was installed in the nine cars of the special. In the stateroom of the newspaper men's car a long-distance telephone was installed, the batteries being stored from view, and a neat little talking instrument set up on the wall of the stateroom. As soon as Steubenville, the first stop, was made, all that remained for the linemen to do was to attach the plugs from the train and the one on a pole near the station, about 25 yards of wire being used to make the connection. This wire was run under the tracks, the entire connections being made in a few moments. Then President Lloyd of the association called up Mayor Hays of Pittsburg and had quite a long chat with him. The telephone connection was instantly made at the office of Steubenville central, Steubenville called Pittsburg, and Pittsburg in turn gave the special train connection with the mayor's office.

After this experiment the chain of telephones in the various cars was connected up and it was made possible to talk from one end of the train to the other while the cars were bowling along at a speed of 60 miles an hour. The rumbling of the train did not seem to affect the hearing over the telephones in the least.

It is thought that this experiment may be the forerunner of the equipment of all Pullman cars with telephones in this manner. The equipment was planned by Mr. S. P. Grace, chief engineer of the Central District Company.

TELEPHONE MEN.

L. E. Corrigan has resigned his position as manager of the west office of the Detroit Michigan State Telephone Company's exchange. He was presented a signet ring by the operators of the exchange.

Mr. John M. Humiston, for the last eight years connected with the engineering and construction departments of the Chicago Telephone Company, has arranged to engage in similar work in the employment of the firm of McMeen & Miller (Kempster B. Miller and S. G. McMeen) of Chicago. Mr. Humiston studied at Lake Forest University, near Chicago, and Armour Institute of Technology, Chicago. In vacations, during his college work, he acquired practical knowledge of engineering, construction and operation in the service of the Metropolitan West Side Elevated Railway of Chicago and of the Bankers' Electric Protective Company of Chicago. Mr. Humiston engaged with the Chicago Telephone Company in 1896, spending four years in the engineering department as assistant to the chief engineer. One of the most important pieces of work on which he was engaged during this engineering connection was a complete development study, which resulted in a forecast of the character and extent of future work on the particular sizes, locations and arrangements of the various central offices and their districts. Later Mr. Humiston became connected with the actual application of engineering to construction, being assistant superintendent of construction until January 1st of this year. At that time he took charge of the increase and maintenance of the great outdoor plant of the Chicago Telephone Company in the intense downtown districts of Chicago, and of the shops in which the heavy materials, fittings and fixtures for this construction are made ready. Although it is not ordinarily apparent at first thought, the amount of additional installation and of rearrangement and changes necessary in this congested area really makes a very large total each year, and this thorough experience in handling large things has done much to develop foresight and energy in Mr. Humiston's makeup.

JOHN M. HUMISTON.

A case was tried by telephone in Salem County, N. J., when William Perrine was arrested by a game warden for shooting a bird protected by law. Justice Harris Smith called Perrine up by telephone, and Perrine entered his plea immediately. The justice then fined Perrine $26 over the telephone.

Telephone News from the Northwest.

A telephone line is under way between Pierre, S. D., and the Cheyenne River Indian Reservation.

The Steninger Telephone Company of Parker, S. D., has been formed with $50,000 capital to cover the county. The company already controls about 85 miles of rural lines.

The Iroquois (S. D.) Telephone Company has sold its lines to the Dakota Central Telephone Company.

The Cannon Falls (Minn.) Telephone Company has made extensions and improvements to its system during the summer. The local exchange is to be fitted with a new switchboard of the self-restoring type, 200 drops.

Paul H. Jeardeau of Denhoff, N. D., contemplates building a telephone line from Denhoff to Washburn, with branches to Harvey and Goodrich.

The Wisconsin Telephone Company will establish a new exchange for Ashland, Wis., costing $40,000. A new board was installed only two years ago, but it is to be replaced.

It is rumored that the Tri-state Telephone Company will seek a local franchise at Breckenridge, Minn., in addition to the present one for long-distance service.

The Rocky Mountain Bell Telephone Company has again been denied a franchise at Red Lodge, Mont.

The Sunset Telephone Company proposes to erect a new exchange building at Bellingham, Wash.

The Cascade County Rural Telephone Company has begun work on its new line near Great Falls, Mont.

The new telephone lines from Perham, Minn., to Dent and Richville have been completed.

The Hudson (S. D.) Telephone Company is building lines to Ireton and Rock Valley, Iowa.

Rapid progress is being made in the extension of the Rocky Mountain Bell Telephone Company's lines to Thunder Mountain, Idaho. The plan is to complete the line before snow flies. R.

Bell Telephone Output for September.

The September exhibit of the instrument output of the American Telephone and Telegraph Company is indicative of improved business conditions in the mercantile world, as well as a broader scope in the company's service. Shipments were abnormally heavy, compared with 1903 and 1902 for the corresponding period, and the percentage of returned instruments was smaller, so that the net output makes an excellent relative showing. The comparative figures follow:

September:	1904.	1903.	1902.
Shipments	106,305	79,406	75,011
Returned	38,353	33,438	43,334
Net output	67,952	45,968	31,677
Since January 1st:			
Shipments	876,609	812,229	808,334
Returned	374,925	358,831	346,689
Net output	501,684	453,398	461,645
Total outstanding	4,281,201	3,693,718	2,987,251

COMMUNICATION.

Telephone Status in New England.

To the Editor of the Western Electrician:

In your issue of October 15th, under the heading of "New England Telephone News," we find your reference to the Westerly Automatic Telephone Company, in which you say that the Boston corporation will retire from the field. If that means that the Bell company will retire from the field, it is quite correct. The Westerly Automatic Telephone Company remains a licensee of the Eastern Automatic Telephone Company and will remain an Independent company. It has simply entered into a contract with the Bell company for long-distance connections.

VINTON A. SEARS,
Vice-president Eastern Automatic Telephone Company.

Boston, October 17, 1904.

GENERAL TELEPHONE NEWS.

The Lyons Telephone Company has been incorporated at Ellsworth, Kan., with a capital stock of $12,000.

The Kansas Telephone Construction Company of Kansas City, Mo., has been incorporated with a capital stock of $75,000.

The Rocky Mountain Bell Telephone Company has commenced the construction of a new telephone building at Missoula, Mont., the structure to be erected at a cost of approximately $30,000. The building, as planned, will have a frontage of 25 and a depth of 75 feet.

Quincy, Ill., is to have an Independent telephone system, a franchise giving broad privileges having been passed by the City Council, the conception and fostering of the project being due to Mr. Charles Wheat. The well-known telephone engineers, Samuel G. McMeen and Kempster B. Miller of Chicago have been secured as consulting engineers, having entire charge of the construction of the system, and they have opened a branch office in Quincy, which will be maintained throughout the work.

Awards to Three Great Electrical Companies.

It is interesting to note that the 5,000-horsepower engine of the Allis-Chalmers Company at the St. Louis World's Fair, popularly known as the "big reliable," and the huge generator built by that company's electrical department, otherwise known as the Bullock Electric Manufacturing Company, each won a grand prize. These two machines, forming the unit which supplies decorative lighting of the Exposition buildings and grounds, and which have never failed under the most frequent and most unexpected emergency loads, are well known. In the Department of Mines and Metallurgy the Allis-Chalmers exhibit was also awarded a grand prize, the highest honor given by the international jurors. Among other features of this mining exhibit contributing to its success are the famous style K gates, gyratory rock and ore breakers, the Overstrom concentrating table, the Allis-Chalmers style A and B crushing rolls, the Gates ball and tube mills, and the heavy six-foot Huntington mill. The Bullock Electric Manufacturing Company's grand prize also covered all its alternators, synchronous motors, direct-current generators and motors and rotary converters. In addition, the Bullock system of multiple-voltage control of motors received a gold medal.

The General Electric Company announces an interesting list of awards received at the St. Louis Exposition. These include five grand prizes, 10 gold medals, five silver medals and two bronze medals. The list in detail is as follows: Grand prizes—(1) Curtis steam turbine; (2) alternating-current turbo-generator installation, alternating-current generator and motors, static transformers and rotary converters; (3) direct-current generator and motors; (4) electric-railway motors and the control systems for single and multiple-unit operation and for mining and industrial locomotives; (5) arc and incandescent-lamp and arc-lighting systems. Gold medals—(1) Complete switchboard and controlling apparatus and application of electric motors for mechanical purposes; (2) mercury arc rectifier; (3) wires and cables for lighting and power; (4) electric measuring instruments; (5) electric laboratory apparatus; (6) warship turret-handling and controlling apparatus; (7) sewing-machine motors; (8) best exhibit in electrical department; (9) mining locomotives; (10) social betterment of employes. Silver medals—(1) Sockets, switches and wiring appliances; (2) balance light-distributing concentric-diffuser steel ceiling; (3) electric searchlights; (4) sockets, switches and wiring appliances; (5) Lemp irreversible automobile steering check. Bronze medals—(1) lumichromoscope; (2) porcelain wares.

The group of Westinghouse and allied companies reports one special award, 12 grand prizes, eight gold medals, four silver medals and one bronze medal. The special award was in the Department of Machinery for "the best, most complete and most attractive installation." The 12 grand prizes were awarded as follows: To the Westinghouse Electric and Manufacturing Company for "alternating-current generators and motors, alternating-current turbo-generator installation, static transformers and rotary converters;" to the same for "direct-current generators and motors;" to the same for "electric-railway motors, alternating-current and direct-current and control systems for single and multiple-unit operation and for mining and industrial locomotives;" to the Westinghouse Machine Company for "horizontal gas engines and steam turbines;" to the Westinghouse Air Brake Company for "air brakes and friction-draft gears;" to the Westinghouse Traction Brake Company for "brakes for electric cars;" to the American Brake Company for "driver brakes;" to the Westinghouse Automatic Air and Steam Coupler Company for "air and steam couplers;" to the Westinghouse Brake Company, Limited, London, England, for "air brakes and accessories; to the Westinghouse Company, Limited, of St. Petersburg, Russia, for "air brakes and accessories;" to the Union Switch and Signal Company for "signal system;" to the Cooper Hewitt Electric Company for "the development of the mercury-vapor arc lamp." Gold medals—To the Westinghouse Electric and Manufacturing Company for "complete switchboards and controlling apparatus, and the application of electric motors for mechanical purposes;" to the same for "alternating-current, direct-current and Bremer arc lamps and arc-lighting systems;" to the same for "electric measuring instruments;" to the Nernst Lamp Company for "Nernst lamps;" to the Cooper Hewitt Electric Company for "vapor lamps for photo-engraving;" to the Pittsburg Meter Company for "water and gas meters;" to the Westinghouse Electric and Manufacturing Company for "industrial betterment work;" to the Westinghouse Air Brake Company for "the housing the working classes." Silver medals—To the Westinghouse Electric and Manufacturing Company for "switches, fuses and wiring appliances;" to the Sawyer-Man Electric Company for "incandescent lamps;" to the Bryant Electric Company for "electric-light fittings;" to the Societe Anonyme Westinghouse, Havre, France, for "gasoline automobiles." Bronze medal—To the Perkins Electric Switch Manufacturing Company for "electric switches."

Testing Guy Anchors with a Rhiele Machine.

A rather interesting method of testing the holding power of guy anchors is by the use of a Rhiele machine, and the accompanying illustrations show the method of performing the tests which were made upon the American bull-tongue anchor which is being placed upon the market by I. A. Bennett of Chicago.

Fig. 1 shows the machine as set up ready for the test. The connecting rod of the anchor, which was embedded in the earth, was attached to the middle of a beam of heavy construction, as shown in the picture. One end of the beam was supported by a solid foundation, the other end resting upon the upper surface of the movable member of the machine, which was then operated as in making a tension test, the movement of the machine pulling up on the anchor, and the maximum resistance being measured upon the scale of the machine; a necessary correction was, of course, made for the leverage of the beam.

Fig. 2 shows the anchor as it looks in the earth before and after opening. The tests referred to were made with the anchor buried four feet under the surface. The following stresses were necessary to start anchors of various sizes from the ground: Three-inch, 8,713 pounds; four-inch, 10,521 pounds; five-inch, 15,412 pounds; six-inch, 16,645 pounds; seven-inch, 19,380 pounds; eight-inch, 21,600 pounds; 10-inch, 33,537 pounds; 12-inch, 45,210 pounds. The operation of the testing machine is shown in Fig. 3.

These figures indicate the pulling power at four feet under earth, which practically means that a four-foot crust of earth has a maximum resistance as shown above, as the anchor holds until the earth breaks, as is well illustrated by the fact that the Rev. Carl Ackerman, professor of mathematics of Lima College, Lima, Ohio, who superintended the installation of a 12-inch anchor five feet in the ground, found that it stood a strain of 60,000 pounds without moving the anchor an inch. Arrangements were then made for increasing the stress, and additional stress was then put on until the connecting rod broke, and the anchor remained unmoved. Therefore, it is safe to say that, with an anchor buried 10 feet under the ground, providing the connecting rods and anchors are sufficiently strong, it would be next to impossible to remove the anchor except by digging it up.

In the use of this anchor it is necessary to dig a hole of six inches in diameter for a six-inch anchor, drop the anchor into the hole, pack back the earth, and the maximum resistance varies according to the depth buried; for a six-inch anchor from 16,625 pounds buried in four feet of soil to 92,000 pounds buried in 8½ feet of soil. The entire strain on this kind of anchor is upon the solid earth, and at the series of tests there was no means readily accessible for testing the maximum resistance of the earth.

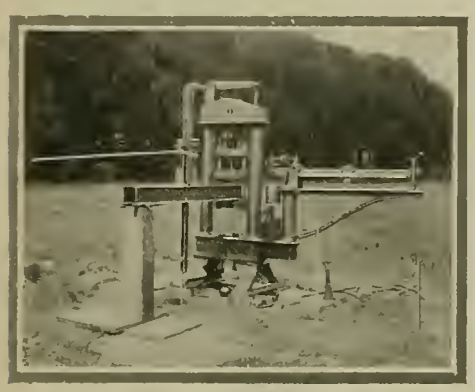


Fig. 1. Machine Ready for Testing Anchor.

Fig. 2. Position of Anchor in the Ground.

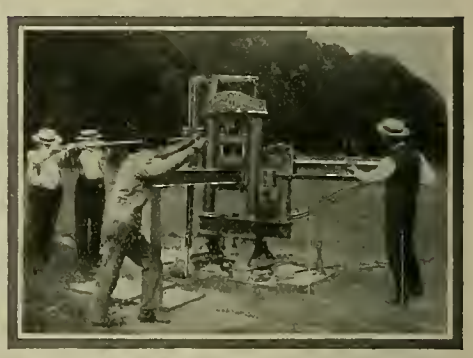


Fig. 3. Method of Conducting Test.

TESTING GUY ANCHORS WITH RHIELE MACHINE.

BOOK TABLE.

Interborough Rapid Transit (The New York Subway: Its Construction and Equipment). New York: Interborough Rapid Transit Company. 1903. Pp. (10 by 13½ inches) 154, with 122 illustrations.

Widespread interest has been attracted by the great subway of the Interborough Rapid Transit Company in New York, and the new souvenir book which has just been issued by the company gives probably the greatest amount of information on the subject that has ever been published. The book is large, well bound and finely printed and tells all about the subway, beginning with the construction work. The power house, sub-stations, cars, roadbed, distributing system, in fact all the many parts of the system, are taken up separately and described in detail, numerous fine halftone illustrations being a feature of the book. A historical sketch of the things which led up to the formation and development of the great scheme is contained in an introductory chapter. A map of all the lines of the Interborough Rapid Transit Company is helpful in locating the parts of the system which are underground and those which are elevated. Altogether, the book is of much interest and will be appreciated as a valuable source of reference concerning matters pertaining to the subway.

The Prussian System of Electric Train Lighting.[1]

By Carl Roderbourg.

On November 8, 1900, there occurred an event which brought forward the question of electric train lighting in its application to the Prussian state railways. In a train collision at Offenbach, near Frankfort-on-the-Main, a number of cars were set on fire, and the conflagration spread with such rapidity that many lives were lost. The public and the press attributed the main cause of the rapid spread of the fire to the escape of gas from the tanks under the cars, a fact which was, however, contradicted by the railroad administration. The motor was also officially discussed in the Prussian House of Representatives, and while it did not appear that the danger from the gas tanks had been clearly proven, it was decided by the administration of the Prussian state railways, as a result of this accident, to proceed energetically with experiments in the introduction of electric train lighting.

Privy Councilor Wittfeld, in the Prussian Ministry of Railroads, laid down the following fundamental principle to be followed in the experiment: "No automatic switches or regulating apparatus shall be used in electric train lighting." Although the Prussian state-railway administration made no objection in exceptional cases to the conduct of tests with lighting systems which did not comply with this general principle, it was generally adhered to.

Next to Mr. Wittfeld, credit is due Dr. Büttner of the Accumulatoren Fabrik Aktiengesellschaft that it was made possible to light railroad trains and single cars by electricity without the use of automatic regulators and switch apparatus and without handling an excessive weight of storage batteries. With this system electric current for the incandescent lamps is produced by the well-known method of having one or more dynamos on the train itself. Connected in parallel with them are storage batteries hung under the cars, which, in case of need, supply current for the lamps, and which may be recharged by the dynamos.

Following a suggestion of Mr. Wittfeld, Dr. Büttner has succeeded by the use of special apparatus in avoiding variations in illumination noticeable to travelers, notwithstanding the difference in electromotive force of the storage batteries during charge and discharge, and securing constancy of pressure at the lamp terminals without special regulation, notwithstanding the variable speed of the dynamos.

Although there is a loss of energy inherent in the system, it offers the advantage of complete reliability in operation and simplicity in handling; and the Prussian railway administration is of the opinion that more importance should be attached to this reliability in operation than to the increased energy consumption, which is small relatively to the whole train. The principle of the constant electromotive force at the lamps with variable electromotive force of the source of energy is attained by the insertion of very small iron wire in the circuit of each incandescent lamp. The wire is in small glass pear-shaped globes, like incandescent lamps, containing hydrogen gas. By varying the pressure of these gases, as well as by the adoption of a special spiral form of wire, the temperature of the wire when current is passing is brought to the proper point. If an iron wire is heated by electric current to a point at which it barely becomes visible in the dark, its electrical resistance increases with extraordinary rapidity with further increase of temperature. If the electromotive force increases, the temperature of the wire increases instantly and consequently its resistance, so that within considerably wide limits of electromotive force little more current is allowed to pass than in the case of low electromotive force.

If such a wire is connected in series with an incandescent lamp, the electromotive force at the terminals can be considerably increased without subjecting the lamps to an excessive current. Such an iron-wire resistance had been previously in use by the Allgemeine Elektricitäts Gesellschaft to steady the Nernst lamps in the ordinary lighting circuits. To Dr. Büttner belongs the merit of having applied the method to incandescent lamps and for much greater variations in pressure.

The variations in current which result from the insertion of iron wire in series with incandescent lamps is shown in the following table for various electromotive forces:

Variation of Current with E. M. F.

Line E. M. F.		Current.	
56	Volts	8.0	Amp.
58	"	8.1	"
60	"	8.2	"
61.6	"	8.3	"
63.6	"	8.4	"
65	"	8.4	"
70	"	8.41	"
72.5	"	8.43	"
76	"	8.46	"
82	"	8.5	"
83.5	"	8.55	"
84.0	"	8.6	"
86	"	8.7	"

Owing to the fact that the variation of pressure due to the use of storage batteries in train lighting is very much less than indicated in the above table, and, moreover, takes place slowly, the variations in the illumination of the cars are not perceptible to the eye under such conditions.

Two through trains connecting Berlin and Hamburg on the Prussian railway system, and subsequently two additional trains on the same line, and finally two trains between Berlin and Stettin, were similarly equipped. The trains are always operated as a unit, and each train is equipped with only one shunt dynamo, which is mounted on the boiler of the locomotive and driven by a 20-horsepower De Laval steam turbine.

The dynamo is coupled to the reduction shaft of the turbine, the turbine disk making 20,000 revolutions per minute, while the dynamo runs at 2,000 revolutions. The dynamo develops 180 amperes at 68 volts, but can develop continuously a greater output and at a higher electromotive force in order to charge the storage batteries. The storage batteries of the Accumulatoren Fabrik Aktiengesellschaft, Berlin, are connected in parallel with this dynamo; a battery of 32 cells with a capacity of 76 ampere-hours at a three-hour discharge rate, is hung under each car. The storage batteries act mainly as a reserve; they become operative only when the locomotive becomes separated from the train or the dynamo should fail for any cause.

The maintenance of the whole equipment is very simple. The engine driver starts his turbine at a certain hour, connects the circuits and gives no further attention except in case he desires to charge the storage battery, when he cuts out the resistance in the field circuit of the dynamo. The switching on of the lamps is done generally by the porters, partly also by the passengers. This arrangement has operated satisfactorily from the start. In the meantime the Prussian railroad administration has gone a step further, and for the following reasons:

The system under consideration, if adopted on all through trains, would necessitate the equipment of all the locomotives of freight trains. The number of these locomotives is much greater than the number of trains, owing to the fact that the locomotives are often changed on long hauls. On the contrary, the baggage car at least accompanies the train on the whole run. It appeared desirable on this account not to install the dynamo on the locomotive but in the baggage car, and in this way the number of dynamos required could be materially reduced. To drive the dynamo by any form of engine power, a benzine engine, for instance, appeared too complicated. The most convenient form of drive is no doubt that from the car axle. This requires that the dynamo be operated at not even approximately constant speed.

Furthermore, there are a number of through cars, which in transit are transferred from one express train to another, in order to avoid change of cars to the passengers between main points having no direct express connections. These through cars often run beyond the jurisdiction of the Prussian state railways, into Saxony, Bavaria, Switzerland, Italy, etc.

1. A paper (somewhat abbridged) presented before Section E of the International Electrical Congress at St. Louis, September 13, 1904.

If it is desired to furnish these with electric lighting, it can be done only if they are equipped each with its own dynamo, which must be adapted to the various lighting systems in use on the different express trains to which they may be coupled. In this case the only possible method of driving the dynamos is from the car axle.

All similar systems hitherto used are equipped with a circuit-breaker, which interrupts the current if the speed of the dynamo falls below a certain limit, in order that the storage battery, whose electromotive force is greater than that of the dynamo at low speeds, may not discharge into the dynamo. This circuit-breaker is automatic and is liable to derangement on account of shock, and it does not therefore conform to the Wittfeld principle, above cited. Dr. Büttner, therefore, substituted for it a so-called unipolar or electrolytic rectifying cell. The electrodes of such a cell consist on one side of aluminum, and on the other of any metal not soluble in the electrolyte of the cell. It is well known that aluminum has the remarkable property of cutting off a current, even of several hundred volts, if sent through the aluminum into the electrolyte in a positive direction, but allows the current to pass almost without diminution if the direction is reversed. The selection of the electrolyte is important, most of them in the course of time attacking the aluminum and destroying the electrode. Others have the peculiarity that the effect of the aluminum plate ceases when the temperature exceeds 40 to 50° C. Dr. Büttner has succeeded, after experimenting with many different solutions, in finding a mixture which does not attack the aluminum plate nor diminish its efficiency even should the temperature rise above 70 to 80° C.

As a second electrode he uses iron plates in his cells, and these aluminum cells, which act as a check valve in his train-lighting system, are inserted in place of the automatic circuit-breakers. While the electromotive force of the dynamo preponderates, it sends current through the aluminum cell into the line. The drop in the aluminum cell may then reach as high as three volts. If the speed of the dynamo diminishes and its electromotive force falls below the terminal voltage of the battery, the aluminum cell cuts off the current and the dynamo may come to rest, or even have its rotation reversed, without permitting current from the battery being sent into the dynamo and wasted.

An arrangement is in addition applied to the dynamo to provide for the case of a car going in the opposite direction, the commutator brushes being carried forward until a point is reached at which the dynamo generates current in the same direction as before. This arrangement can be avoided if, in accordance with the suggestion made to Dr. Büttner by Mr. Liebenow, four aluminum cells are used instead of one in the conversion of alternating into direct current. In this case, however, the drop may reach six volts. Another arrangement is in preparation by which this also is avoided. The dynamo, which in general is designed as a shunt machine, is supplied with the supplementary main circuit working on the fields which lowers the electromotive force if the current becomes excessive. In this way the excessive charging of the storage battery at very high speeds is prevented; otherwise the arrangement is as above described. At the present time two trains are being operated between Berlin and Cologne, on which the dynamo is installed in the baggage car, driven from the car axles by belts. Several through cars are now in construction in which the armature of the dynamo is mounted directly on the car axle.

The following instructions are given for the maintenance of the equipment:

(1) The ball bearings should be inspected every two weeks at first, and then every four weeks, to insure that there is a sufficient supply of vaseline. The ball bearings should be cleaned and supplied with fresh vaseline every six months.

(2) The pole-changer on the armature shaft must allow of easy motion in both directions by turning the armature.

(3) The commutator should be kept round and smooth.

(4) The carbon brushes should be held firmly by the brush holders and impinge on the commutator with a gentle pressure.

(5) The belt should be tested particularly at the joint to confirm its satisfactory operating condition.

(6) The wood driving pulley should be inspected as regards tightness on the shaft.

(7) The screw shaft of the belt tightener should be properly oiled and after tightening of the belt should be secured.

(8) The dynamo bearings must not heat so as to be uncomfortable to the touch. If a bearing heats, the belt should be slackened until the dynamo no longer rotates. The storage batteries should be handled in accordance with the specific instructions. The specific gravity of the solution should be measured every eight days, in order to ascertain if the batteries have received sufficient charge while en route. If the specific gravity of the solution is too low, the electromotive force of the dynamo should be increased. If the car follows a new route, it is recommended that a measurement be made at the end of each trip.

As the illumination of the cars is very abundant, and as special reading lamps, which can be switched on or off by the passenger, are attached to the backs of the division between every two seats, the electric lighting of the trains is very popular with the public.

CORRESPONDENCE.

Great Britain.

London, October 15.—The near approach of the completion of the several tube railways in the hands of Mr. Yerkes, and of the electrified District Railway, may be judged by the fact that a general manager to the Underground Electric Railways Company of London has just been appointed. The gentleman selected, as no doubt the cable has informed the American press, is Mr. John Young, atpresent general manager of the huge system of municipal tramways in Glasgow, and who, for organization and management, is probably the most accomplished man in the kingdom at the present time. The post was filled privately, and was not advertised, and it appears that the offer was made to Mr. Young in such a way that, despite his advancing years—he is over 60 years of age—he found himself unable to refuse it at a time when he was not seeking any new field of operation.

We hear little nowadays of any government experiments with space telegraphy. Some time ago communication was established between the naval depot at Portsmouth and the army at Aldershot, a distance of some 60 miles, but no information was published as to the apparatus employed. It is now stated, however, that a party of the Royal Engineers Telegraph Battalion is about to conduct some experiments in North Wales with a view to effecting communication across the Snowden range of mountains. The apparatus which will be used is the portable outfit invented by Dr. Alexander Muirhead, in conjunction with Sir Oliver Lodge.

After much discussion in council, the Bournemouth corporation has at last decided to apply to the postmaster-general for a license to erect a municipal telephone exchange.

The vexed question of how the horse tramways in the northern suburbs of London shall be converted to electric traction is still causing much uneasiness to the various parties concerned. As I have before pointed out, the lines are leased to a company, and the lease does not expire until 1911. If the lines are to be converted to electric traction, naturally the company will have a say as to the system to be adopted, and, on the score of expense, it insists that that system shall be the overhead trolley. Against this the various borough councils, as the road authorities, are demanding that the underground-conduit system shall be adopted. A third party interested is the London County Council, which, as the tramway authority leasing the lines, is inclined to give way to the company, but at the same time it favors the conduit system. This has been the condition of affairs for a year or two now, and although a number of conferences have been held between the parties a definite decision has not yet been come to. Another such conference has now been announced, but if the attitude taken by the municipal representatives is that adopted on previous occasions, it would appear most likely that North London will have to wait until the lines fall into the hands of the London County Council in 1911 before any decisive movement can be made in the matter.

Apropos of this, it is interesting to know the opinions of the responsible officers of the London County Council's tramway department on the question of conduit versus trolley tramways. It has always been hurled at the heads of the council that the conduit system should only be adopted in the central area and that the overhead trolley should be employed a few miles out, on the score of expense—a policy which has not been adopted hitherto. The tramway manager of the council, however, in a paper recently read before the Municipal Tramways Association of Great Britain, expressed the opinion that the conduit system was the only successful solution of the problem for London, and that the council would always adopt it where a return could be anticipated, irrespective of the nature of the locality.

The progress of the various large electric power companies in Great Britain is happily more rapid nowadays than it was a year or two ago. Quite a number of schemes which have been sanctioned by Parliament were not put in hand at once, but a very general movement is noticeable now. Both the Lancashire and Yorkshire companies have their first large power stations nearly completed, while two or three others have been supplying from temporary plants. The Fife Company in Scotland will be giving a supply in December, while another Scotch undertaking, the Scottish Central Electric Power Company, has just placed the contract for its first generating station. The value of the first portion of the tender is some $76,000, and it includes one 1,200-horsepower set, two 600-horsepower sets and two 150-kilowatt sets.

In the session of Parliament before last a large sum of money was voted in order to enable the Admiralty to put into progress a huge electric power and lighting scheme in connection with the various naval dockyards and depots. The undertaking has been commenced at one or two dockyards simultaneously, and a feature of all contracts in connection with it is that all workmen shall be British and that all the material shall be of British manufacture. Very few technical details are available at present.

Another instance of promoters obtaining parliamentary powers for work of an electrical character and then making little effort to put them into force has occurred in the North of England. Some four or five years ago a company was granted statutory powers to build a tube railway under the River Tyne from South Shields to North Shields on the ground that there was a pressing public need for such a means of communication. Since then, however, the public has heard little of the promoters until the last few days, when the consent of the South Shields corporation has been granted to the testing of the strata by means of boring artesian wells.

The great drawback to the extension of electric tramways into the more rural districts of England is that the traffic will not pay for the expense involved in building the lines. Many efforts have been made to overcome this difficulty, and as a possible solution several municipalities have been granted powers to run motor omnibuses in such localities. Up to the present such a system of locomotion has not been extensively employed. The matter has been revived again recently, however, and developments may be looked for. The Bath Electric Tramways Company is considering the matter, and the London County Council, although the suggestion was not acted upon, was advised the other day to stop the expenditure on tramways and go in for motor buses. G.

New York.

New York, October 22.—The Rapid Transit Commission has decided to return $2,000,000 of the cash deposit handed over by the Interborough company as a guaranty of the proper construction of the tunnel. A large amount of the original deposit will still remain as a guaranty with respect to the rest of the subway.

Experimental electric cars are now running over the new Williamsburg Bridge. Hundreds of people on the plaza watched the running of the cars across the structure today. Three cars were hooked together and run over all switches to find out how the switches worked. Everything was discovered to be in first-rate running order. The first car contained officers of the company and the other two cars a number of employes. An officer of the company said that although November 1st was the time set for the running of cars over the bridge, the Brooklyn Rapid Transit Company was prepared to begin the service for the public at once. As at present arranged, however, cars for passengers will begin operation at 5 a. m. on November 1st. The bridge tracks will be available for eight of the Brooklyn lines, and a few weeks later it is expected that shuttle cars at a three-cent fare will be operated on the bridge.

On Monday night a motorman, Irving Lamphere, on the Third Avenue Elevated railroad was burned to death when he allowed his car to collide with a train ahead .The accident took place at One-hundred-and-twelfth Street and there ensued a dangerous fire. By some mishap the employes of the elevated turned on the current in the exposed third rail while a score of firemen were fighting the blaze, and this of course greatly increased their difficulties and dangers. The entire road was blocked until 6:22 the next morning, when the wreckage crew got the southbound tracks clear. Motorman Martin E. Dexter, who was in charge of the southbound train which came near running into the smash-up, was congratulated on all sides for stopping his train in 30 feet when the danger was signaled to him. C. R. Barnes, electrical expert for the State Railroad Commission, began at once an investigation into the cause of the wreck.

The Brooklyn Rapid Transit Company has started to build a handsome new edifice 11 stories in height, to be fitted up entirely for the offices of the company. The site is at the northeast corner of Clinton and Remsen Streets. The building will be of skeleton fireproof construction and the interior appointments will be in the best style of modern office buildings.

The recently incorporated New York and Manhattan Telegraph Company, which claims to have a franchise from the state of New York, has met with great difficulty in erecting lines in the vicinity of Oyster Bay, L. I. The company is placing poles and stringing wires on the north side of Long Island for the purpose of connecting with New York and in opposition to the Western Union Company. Last Tuesday week six poles on the property of Frank Loyd, near Syosset, were cut down, and no effort has as yet been made to replace them. On Saturday last 12 more poles were removed during the night. The property owners along the new line claim that they have not been consulted, and it is feared that more poles will be removed. The representatives of the company on their side claim to have the right to erect the telegraph lines and to lay a cable across the Sound west of Oyster Bay to Stamford, Conn.

Last Monday there was incorporated at Albany, N. Y., the Sylvan Electric Bath Company of New York city. The company has a capital of $500,000 and its directors are J. H. Lancaster, L. T. Jones and Franklin Barritt. D. W. W.

New England.

Boston, October 22.—The Massachusetts branch of the American Federation of Labor has appointed a committee on the subject of an eight-hour workday for the electric-railway employes in this state. On the Boston Elevated Railway Company's system the present arrangement calls for the performance of

10 hours' work within a time limit of 12 hours. Some of the other lines have similar agreements with their men, but the employes are showing signs of unrest after a long period of immunity from strikes and labor disturbances, as the proposition to agitate for an eight-hour day indicates, and the outcome of the inquiry will be awaited with considerable interest.

The Boston and Northern Street Railway Company, in pursuance of its plans for its new power plants, has recently placed orders with the General Electric Company for five 500-kilowatt direct-current Curtis turbines. At the new station in Quincy, Mass., two 2,000-kilowatt alternating-current Curtis turbines are being installed, and provision has been made for a prospective installation of four such turbines in all.

The United Electric Light Company of Springfield, Mass., started its new 1,500-horsepower turbine engine October 15th. Extensive changes in the plant have been under way for some time, but are now practically completed, adding considerably to the power and efficiency of the service.

The Worcester Consolidated Street Railway Company's excise tax for the current year has been fixed by the Worcester assessors at $14,500.52. The city of Springfield has fixed the excise tax upon the Springfield Street Railway Company for 1904 at $11,353.

The receivers of the Middleboro, Wareham and Buzzard's Bay Street Railway Company ask for a Circuit Court decree authorizing the sale of the road, subject to its mortgage, at public auction.

Installation of the boilers and electrical outfit for the power plant which is to operate the new machine shop at the Boston Navy Yard is in progress. Foundations have just been completed for the stack and work began October 20th on the brick superstructure. The electric power house is 115 by 110 feet and the adjoining shop builldings are 340 by 60 feet. Four of the furnaces and boilers are already in place and ready for use, with connections to the engine and pumping outfit completed. The engine room, however, is as yet in the rough and will require a large amount of work to bring it up to the proper condition for occupancy. B.

Dominion of Canada.

Ottawa, Ont., October 22.—A. J. Bemis of Boston, Mass., has taken control of the Cape Breton Electric Company of Sydney, Nova Scotia, as general manager, in succession to Mr. E. S. Dimmock.

Charles D. Haines, ex-congressman, of Kinderhook, N. Y., recently appeared before the City Council of Hamilton, Ont., and asked for favorable consideration of a scheme to construct an electric railway between that city and Brantford, Ont. The proposed line to Brantford would cost upward of $300,000.

The latest monthly report of the civic lighting committee of the city of Woodstock, Ont., is considered as demonstrating, in a practical manner, the wisdom of the city in taking over the electric-lighting plant. The number of incandescent lights now in use is 4,100, showing an increase of 3,500 in less than three years. From the present time until the first of the new year the demand for electrical power for lighting purposes is expected to tax the capacity of the municipal plant to its utmost.

The conference of the partners in the all-British Pacific cable, which was to have assembled in London, England, about the 15th of October, was postponed owing to the fact that Sir William Mulock, postmaster-general of Canada, was unable to attend the meeting until after the impending Dominion elections. The Pacific cable has not given the results that were expected, financially, and Canada's share in the deficit on the first year's operations, amounted to $120,000. The chief object in calling the London conference is to ascertain by what means this annual deficit may be overcome, and, if possible, to bring about an annulment of the concessions made by New South Wales to the Eastern Extension Cable Company. This company is a direct competitor with the government-owned British cable to Australia, and its agreement with the New South Wales government gives it advantages which most seriously prejudice the business prospects of the British cable.

Mr. H. M. Shea, formerly of the Montreal Street Railway Company, but who has been the superintendent of the West India Electric Company of Jamaica, since its organization, says that Montreal capitalists, in organizing this electric railway, have accomplished a great work for the island, and that the railway has greatly benefited the trade of Jamaica, by establishing freight lines to different points in the country. Further progress would largely depend on the extensions made to different freight lines to enable the company to carry exports to the steamers. Much difficulty was experienced in getting men to work permanently. After a couple of months' labor, the natives did not care whether they worked any more during the rest of the year. They consequently became very independent, and large numbers would quit work.

Winnipeg, Man., October 22.—Superintendent Blair of the Montreal Street Railway Company was hanqueted and presented with a fine cut-glass center piece on the eve of his wedding to a Quebec lady recently.

An interesting case has been fought out by the Toronto Street Railway Company on the question as to how its property shall be assessed by the city for taxes; it has been carried through every court in Ontario and the city won; then the company carried it, on appeal, to the Privy Council of the House of Lords in England, the highest legal body in the British dominions, whose decision is final. The decision of the lower courts was reversed. This is a case of great interest to all street railways throughout the Dominion of Canada, as it was a test case fought out by the Toronto Electric Railway Company on its own behalf and on behalf of all the other electric railways in Canada

Earnings of the Toronto electric street railway for the week ended September 24th were $46,419, an increase of $4,165 over the corresponding week of last year.

The city solicitor of Toronto has been instructed by the council to take action against the Toronto electric railway for criminal neglect in not equipping its cars with power brakes and compelling it to equip its cars with power brakes and to keep its tracks and roadbed in good condition and proper repair; also to prefer an indictment against the president, directors and other officers of the company, as circumstances may warrant.

The Winnipeg Street Railway Company is building some new cars for its new St. Charles line, and they are being fitted up with all the latest devices known to street-railway service. They are to be 48 feet long over all by eight feet 4½ inches wide, and will be geared much higher than the other cars in service. They are to seat 36 people, and to have a baggage compartment at the end. The seats are to be covered in rattan. They will be electrically lighted and heated throughout. Residents of St. Charles and Silver Heights will be benefited. The cars will also carry the mail to St. Charles, and give a more frequent service.

Negotiations which have been carried on between the council of Kildonan and the Winnipeg Street Railway Company for an extension of the railway through the municipality of the village of Birds Hill on the east side of the Red River, are now completed, and the road will run across the Norwood Bridge and through the town of St. Boniface. It will pass through Elmwood, close to Louise Bridge and will run down the Birds Hill road past the Elmwood Cemetery, through the municipality of Kildonan, keeping close to the river, and reaching as its present terminus the village of Birds Hill.

E. P. Fairburn, the government engineer of electric railways, has suggested to the government the appointment of a commission to investigate the report on the best class of car fenders. The Toronto Street Railway Company has asked for the report, and it is suggested that the principal street-railway companies should themselves appoint a commission of experts, who shall make a thorough investigation of fenders in use in American cities, and those which are to be tested at the St. Louis Exposition, and that the fender or fenders so recommended be ordered to be adopted under the act regulating electric street railways.

The gross receipts of the Toronto Street Railway Company for the month of September and the percentage paid to the city are as follows compared with the corresponding period of last year: September, 1904, $248,748 gross receipts, and city's percentage, $19,899; 1903, gross receipts, $237,548.23, and city's percentage, $19,803.85.

Ohio.

Cleveland, October 22.—The Circuit Court has refused to dissolve the injunction granted by Judge Dissette of Cleveland to prevent Attorney Probasco from taking depositions in the Miami and Erie Canal case. The court suggested that Mr. Probasco might carry the injunction proceedings up and secure a decision instead of applying for a writ.

An attempt will be made to have cars running over the Toledo and Indiana line as far as Bryan by February 1st, and the construction company has an extraordinarily large force of men on the work with that end in view.

The hearing on the motion to remove the receiver of the Cleveland, Painesville and Ashtabula Electric Railway Company has been deferred till next Tuesday at the request of the plaintiffs. The defendants claim there is no cause for the appointment of a receiver, and will fight the case.

The Cincinnati Chamber of Commerce has awarded the contract for furnishing generators for the new electric plant to the Bullock Electric Manufacturing Company. It is estimated that there will be a saving of $3,000 a year by having a private plant. Current is now costing $6,000 a year.

Judge Lawrence of Cleveland, in a case before him a few days ago, decided that it is not a part of a street-car conductor's duty to aid passengers in getting on and off cars, unless they are ill or crippled or for some other special reason of the kind. Nor is the company compelled to keep the street free from ice. The decision was the result of suit brought against the Cleveland Electric Railway Company by a woman who claims she was permanently injured by falling on the icy pavement.

Labor unions of Cleveland have asked that the ordinance requiring all heavy cars to be equipped with modern brakes and other appliances be enforced against the Cleveland Electric Railway Company.

A franchise has been asked through Ottawa by the Lima City Railway Company for a line that is to extend to Toledo. The franchise will probably be granted at once.

A building to be used as a depot and waiting rooms will be built by the Cleveland Electric Railway Company beside its tracks at the Union Depot. This is one of the coldest places in the city, and people who must wait for cars in the winter suffer a great deal. The building will be 50 feet long and 12 feet wide.

Arrangements are said to have been completed for building an electric line from Toledo to Bono, on the lakeshore east of the city, for the accommodation of the market gardeners. The territory is thickly populated.

A skeleton ordinance for the Toledo Railways and Light Company was presented to the council committee on railroads and telegraphs of Toledo by City Solicitor Denman. It is void of either time limit or rates of fare, but the company on Wednesday night offered to accept the franchise with a sliding scale of fares, depending upon the car-mile earnings of the road the year before. Six tickets for 25 cents will be sold to begin with. Seven will be sold for the same when the car-mile earnings reach 25 cents, and eight when they reach 30 cents. Children are to be carried on a two-cent fare. The company is to provide a universal-transfer system, so that a passenger may ride to any point on the line, even if he has to walk from one point to another to take a car to which he is transferred. Transfers must be made on parallel lines if necessary to accomplish this purpose. But in no case is the company required to return the passenger to the point of starting on one fare. The plan will probably necessitate transfers on transfers. Many other clauses are appended to the new ordinance.

Connections have been made between the tracks of the Scioto Valley Traction Company and the Central Market line at Columbus, so that the Scioto Valley cars will shortly enter the city and go around the loop. O. M. C.

Michigan.

Detroit, October 22.—The new Hackley Hospital at Muskegon is to have what is believed to be the largest and finest static X-ray machine in the country. It was originally built for exhibit at the World's Fair, but was not completed in time. It will be used for the treatment of surgical cases, and it is capable of producing a current of 50,000,000 volts, practically without amperage. An idea of the size of the machine may be given from the number of plates, which is 24, the stationary plates being 44 inches in diameter and 12 revolving plates 30 inches in diameter.

The Pontiac Common Council is considering the granting of a franchise to the Detroit and Bay City Traction Company. It is anticipated that the company will find plenty of opposition from some of the aldermen. Part of the right-of-way is to be over private grounds and it is claimed that great damage will be done to the property in these wards.

The Sturgis branch of the Michigan Central Railroad Company will probably be changed to an electric line. This branch runs from Battle Creek to Sturgis and Goshen and has never been a paying line. A company has been organized to build an electric line from Battle Creek to Coldwater, and it is expected that this is a move on the part of the Michigan Central railroad to head off the proposed interurban line.

The 82d regular meeting of the Detroit Engineering Society was held last evening in the parlors of the Hotel St. Clair. S. C. Root of the American Blower Company read a paper on "The Test of an Indirect Steam-heating Coil." Dinner was served to members and friends at six o'clock.

C. E. Cheney, J. A. Forrester and C. W. Taylor of this city are the incorporators of the Shore Line Telephone Company and have filed articles of association with the county clerk. The capital stock is $50,000, of which $10,000 has been paid in cash.

C. A. Ward of Ann Arbor has petitioned the council of Pontiac that he be allowed to install a hydraulic power plant for the purpose of lighting with electricity the entire county, also part of Wayne County.

The jury in the case of the township of West Bloomfield against the Detroit United railway concluded from the evidence furnished that the northwestern division of the Rapid railway system has not been furnishing its cars with modern conveniences to provide comfort to its passengers; also that the franchise granted by the township did not contemplate the raising of fares. The court will now listen to arguments as to whether a mandamus shall issue compelling the United railway to live up to the terms of the franchise the township claims it has violated.

Ann Arbor people have incorporated a new electric line, known as the Ann Arbor Interurban Electric Railway Company, capitalized at $500,000, to build a railway from Ann Arbor south 50 miles to the state line.

The city of Benton Harbor has granted J. B. McMichael a franchise for the independent entry and terminal facilities for his interurban line, which is to connect that city with Eau Claire, Niles and Dowagiac. Operations will be commenced at once, and it is expected that grading will be completed before spring. The original plan for this line contemplated the coming into the city over the tracks

of the Benton Harbor and St. Joseph Electric Railway Company, but Colonel Bean, president of the road, refuses to accept the franchise drawn up for him which provides for universal transfers.

It is rumored that the St. Johns electric line will build an extension from St. Johns to St. Louis. If this extension goes through Bay City will make a strong effort to have the road extended to that city.

Officers of the Cincinnati, Dayton and Fort Wayne (electric) road recently paid a visit to Saugatuck with a view of putting in an electric line between South Haven and that point. It is understood that they were favorably impressed with the route.

J. C. Mock of Detroit has been re-elected president of the Railway Signal Engineers' Association, which held its last annual meeting in St. Louis. Mr. Mock is signal engineer of the Michigan Central Railroad Company.

The Port Huron council has passed a resolution demanding that the street-railway company provide its cars with power brakes within 60 days from the date of the ordinance. C. G. W.

Northwestern States.

Minneapolis, October 22.—Hartig & Hellier of Minneapolis were granted a 25-year franchise to install an electric-light and power plant at Waverly, Iowa.

The Sauntry-Cain Lumber Company will sell its electric-light plant to the village of Moose Lake, Minn.

A new electric-light plant at Central City, Iowa, will be voted.

An electric-light system will be installed at Arlington, S. D., by the Arlington Mill Company.

The Oshkosh and Western Electric Railway Company of Berlin, Wis., has incorporated with a capital of $10,000. J. H. Porter heads the list of stockholders. The company proposes to build a trolley line from Berlin to Oshkosh.

The Interurban Electric Railway Company has installed an electric-light system at North Liberty, Iowa.

The right-of-way has been secured for the proposed electric road from Waterloo, Iowa, to Cedar Rapids.

Charles E. Boogren has sued the Twin City Rapid Transit Company for $10,350 damages for being ejected from one of the company's St. Paul cars.

The Omaha (Neb.), Lincoln and Beatrice Interurban Company has secured a site at Papillion for its new power plant.

The Snohomish and Cherry Valley (Wash.) Electric Railway Company has been organized, with J. W. Hall, president, and E. L. Colburn, secretary.

The Ashland (Wis.) Street Railway Company is contemplating the extension of its line to Washburn next spring.

E. E. Downs has resigned his position as president and general manager of the Winnebago Traction Company of Oshkosh, Wis. He will leave that city as soon as his successor is appointed.

Work has been commenced on the new dam and station for the Manistique (Mich.) Light and Power Company.

E. V. Hauser has sold the electric-light and telephone plants at Havre, Mont., to H. W. Turner of Butte, at $36,000.

The tidelands at Olympia, Wash., are being purchased in large blocks, and it is rumored that the Olympia and Tacoma Interurban Railway Company will utilize them for terminal facilities.

The new power company which will put in a plant at Rollingstone, Minn., has been granted a franchise at Winona and will furnish that city with street lights.

The Nebraska Electrical Company was the lowest bidder for the electric-light plant at Lincoln, Neb., $33,260 for the outside construction. Another company bid $28,286 for the engines, boilers and other machinery.

Rocky Mountain States.

Salt Lake City, October 20.—The electric-light plant at Grangeville, Idaho, has been partially burned, and as a result the city is in darkness. The damage amounts to several thousands of dollars, and it will require several weeks before the machinery is repaired.

A consolidation of the Gallatin Light and Power Company and the People's Electric Light Company of Bozeman, Mont., has been effected, the negotiations involving an interchange of stock.

E. H. Dewey of Nampa, Idaho, is at the head of an enterprise which involves the construction of the Settlers' electric railway, and citizens of Boise and Nampa have displayed their interest in a financial way in the project. Committees have been appointed to take charge of different departments of the work, and surveys for the road have already been made.

B. Mahler of Cleveland, Ohio, and associates have before the council of Salt Lake City, Utah, a petition for a franchise for an interurban railway. The project is for the construction of an electric-railway system connecting Provo with Brigham City, Utah. While the franchise has not yet been granted, it is considered practically certain that the petitioners will be given the concessions asked for.

Capitalists of Hood River, Ore., of whom Leslie Butler, H. F. Davidson and John L. Henderson are the most heavily interested, have decided to erect a 50-foot dam on the Hood River, to be utilized by the Oregon Lumber Company, and to construct a power plant which will supply the city with electric light.

The City Council of Spanish Fork, Utah, is considering a petition of Mr. Lewis and others of that city, for a franchise for the installation and operation of an electric-light plant, the power to be secured from the Spanish Fork River. The cost of the enterprise, on which favorable action will probably be taken by the City Council, is estimated at $60,000. It is the intention of the promoters to supply Payson and Spanish Fork.

A. E. Wilder of Chicago has arrived in Salt Lake, where he will assume the management of the local offices of the Postal Telegraph Company. G.

Pacific Slope.

San Francisco, October 21.—The Bureau of Supplies and Accounts, Navy Department, Washington, D. C., is advertising for bids to furnish at the navy yards, Mare Island, Cal., and Puget Sound, Wash., and the Naval Training Station, San Francisco, Cal., a quantity of incandescent lamps, telephone switchboards, Weston ammeters, bracket fans and accessories, transformers, rubber-covered wire, lamp cord, miscellaneous electrical supplies, etc. Blank proposals will be furnished upon application to the Navy Pay Offices, San Francisco, Cal., and Seattle, Wash.

Application has been made to the Board of Supervisors of Santa Barbara County, Cal., by Hugh T. Huff, for a franchise to construct and operate an electric railway between Santa Maria and Guadalupe, this state.

The trustees of Suisun, Cal., have granted a franchise to Leonard Prioe to maintain an electric-lighting and power system in Suisun for 25 years, for $25.

The Humboldt Lumber Company is to install a new electric plant at Korbel, Cal., of 600-light capacity.

The Oceanside Electric and Gas Company has been incorporated at San Diego, Cal., by E. V. Griffes, C. J. Walker, P. E. Hatch and others of Long Beach, Cal., and M. J. Shaul of Oceanside, Cal. The capital stock is $25,000. The company has been formed for the purpose of supplying the city with light and power.

The electrical engineer of the Southern Pacific Company has just submitted to General Manager H. C. Markham, at San Francisco, plans to convert the ferry steam roads and the South Pacific Coast Narrow Gauge as far south as San Jose, Cal., into electric roads, together with estimates of cost for construction and cost of obtaining electric power from the Bay Counties Power and the Standard Electric Companies, controlled by John Martin, Eugene de Sabla and their associates.

Bids will be received by the Board of Supervisors of Contra Costa County, Cal., up to November 14th, for a franchise to construct poles and wires along the roads and streets in Contra Costa County, for the purpose of transmitting electric current for all purposes, as applied for by William Angus. J. E. Rodgers of Point Richmond is the county clerk.

J. F. Parkinson of Palo Alto, Cal., has asked the trustees of that town for a franchise for an electric car line on the San Francisco and San Jose road through the town of Mayfield.

The United Railroads of San Francisco is arranging to use electricity to move the machinery that operates the Hayes Street cable west of Larkin Street. The plan is to abandon steam as a motive power and apply electric power to the driving drums that turn the cable rope. Electricity will be generated at the North Beach power house and carried along feed wires to the power station at Hayes Street and Central Avenue. Should the plan prove successful, the company will probably use electricity in moving the McAllister Street engines.

The Mount Diablo Light and Power Company has filed articles of incorporation at Oakland, Cal. The capital stock is $50,000. C. A. Jeffery, L. B. Smith and others of Oakland, and J. W. Burge of Haywards are the incorporators.

Architect Arthur B. Benton is preparing the plans for the Telephone Exchange Building to be erected at Redlands, Cal., for the Home Telephone Company.

A concession has been granted to Liconciado Felipe Seijas and associates for the establishment of an electric-light plant in Ciudad Juarez, Mexico, opposite El Paso, on the Rio Grande border.

Articles of incorporation have been filed at Santa Rosa, Cal., by the Guerneville Light Company. The incorporators are W. P. Turner, O. O. Cobb, W. A. Turner and others. The capital stock is $25,000. The object is to construct and maintain a lighting plant in Guerneville, Cal.

An ordinance has been adopted by the Board of Supervisors of Napa County, Cal., granting to the San Franscisco and Napa Railway Company a franchise for constructing and operating electric railways and telephone and telegraph lines along certain public highways in Napa County. N. W. Collins is the county clerk.

The chairman of the Board of Trustees of Riverside, Cal., has been instructed to sign a contract with the Westinghouse Electric and Manufacturing Company for the purchase of transformers and other electrical machinery to cost $4,150.

The Edison Electric Company, through its agent at Whittier, Cal., has made a proposition to the town of Whittier to install an arc-light service for the two main streets of the town. If the lights are installed, it will require extensive changes in the company's plant at Whittier.

Before another year passes, the city of Redlands, Cal., expects to have an extension of the Pacific electric-railway system, via Santa Ana, Orange, Riverside and Lona Linda, connecting at Redlands with the Traction Company's lines and going to San Bernardino.

Chief Engineer T. C. Archer of the Willamette Valley Electric Railroad Company has completed the preliminary survey for the proposed electric roads in the vicinity of Eugene, Ore.

The county commissioners of Multnomah County, Ore., have granted a franchise for an electric road from Montavilla east to Troutdale. The terms are such that immediate work must begin and the line be completed 18 months from date, or the franchise must be forfeited.

J. M. Stark, D. Galbreath and C. L. Fitchard have organized the Independence and Salem Electric Railway Company of Independence, Ore. The capital stock is $100,000. The company will construct and operate a railway from Independence to Salem, Ore. A.

PERSONAL.

George Stanley, purchasing agent of the Cleveland Electric Railway Company, is confined to his home with typhoid fever.

Mr. James F. Smith, president of the Leather Preserver Manufacturing Company of Chicago, died at his place of business on October 26th. Death took place while Mr. Smith was in his office attending to his daily affairs, and heart disease is given as the cause. Mr. Smith was a business man of experience, and his sudden demise was a shock to many friends.

Walter Ross, who has served several years for the Detroit United Railway Company as claim agent, has resigned his position for the reason that he preferred the practice of law. President J. C. Hutchins of the Detroit United Railway has appointed F. E. Rankin of the Harrison-Geer office as his successor. Mr. Rankin formerly had charge of the claim department of the Grand Trunk railway system, and is well qualified for the position.

H. M. Smith has resigned as train dispatcher of the Lake Shore electric railway, with offices at Fremont, Ohio, to accept the position of general manager of the Rockford and Interurban Railway Company of Rockford, Ill. Mr. Smith has occupied the position of train dispatcher on the Lake Shore since 1899, and this comes in the nature of a promotion for faithful services. He will be succeeded at Fremont by W. N. Conklin, who has been night dispatcher for some time.

Mr. Walter Craig Kerr's thoughtful address to young engineers, delivered to the graduating class of Stevens Institute last June, has been reprinted from the edition privately issued for distribution to the members of the class. It is entitled, "The Point of View." Mr. Kerr is of Westinghouse, Church, Kerr & Co., and President Humphreys of Stevens speaks of him as "a man who, as engineer, educator, and man of affairs has demonstrated his qualifications for wisely advising engineer graduates about to begin the practice of their profession."

Mr. B. E. Sunny of Chicago, who is a public-spirited citizen as well as an electrical man of wide reputation, is greatly interested, as the president of the Civic Federation, in the adoption of the constitutional amendment to be presented to the voters at the election of November 8th by which Chicago may have the new charter so urgently needed. He hopes that electrical men in all parts of the state will do their utmost to help their Chicago coworkers and other good citizens in securing the voters' approval of this proposed amendment, which is favored by all the great political parties.

Desmond G. FitzGerald died at his residence in Clare, Suffolk, England, on October 9th in his seventy-first year. He was much interested in scientific investigation, and in 1861, according to the Electrical Engineer of London, he devoted "his whole attention to the production of a weekly paper devoted to electrical subjects, and thus the Electrician [of London] started. The task he undertook was herculean, and, although the paper was conducted with the greatest ability and energy, the time was not ripe for so big a venture, and after a few years it ceased to exist." Mr. FitzGerald was a large contributor to the technical press for many years. He made many inventions relating to electrochemical products, telegraph apparatus and accumulators, and "failed but by a hair's breadth to become one of the greatest of British inventors." For some time in the '60's and '70's Mr. FitzGerald, who was a man of great energy, was the principal teacher in a school of telegraphy. He was a member of the Institution of Electrical Engineers.

ELECTRIC LIGHTING.

The Oceanside (Cal.) Electric and Gas Company has been incorporated with a capital of $25,000 by E. V. Griffes, C. J. Walker and others, all of Oceanside.

The Bellaire (Ohio) Light and Power Company has completed improvements at a cost of about $75,000, and the additional equipment is now in operation.

Work will soon be started on the erection of the Allegheny City (Pa.) light plant on Braddock Street. The contract for it has been let to C. F. Knapp at a bid of $33,472.

The Suburban Power Company of Buffalo, N. Y., was incorporated recently with a capital stock of $10,000, to conduct a lighting business, supplying the towns in the vicinity with electricity for lights.

The Borough Council of West Chester, Pa., has renewed the contract with the Edison Electric Illuminating Company for the lighting of the streets of the town for a period of five years at $10,055 per year.

The committee of the City Council of Topeka, Kan., to which was referred the ordinance asking for a new 30-year franchise for the Edison Electric Illuminating Company, has referred the ordinance back to the council, with the recommendation that it be not passed. The committee decided to ask the company to prepare another franchise, and it adopted a number of suggestions concerning new features to be introduced.

In the reorganization of the Oklahoma Gas and Electric Company, which took place on October 20th, the following-named officers and directors were elected: President, C. B. Ames, Oklahoma City; vice-president, H. M. Byllesby, Chicago; secretary, D. T. Flynn, Oklahoma City; treasurer, A. H. Grimes, Guthrie; directors, Rufus C. Dawes of Chicago, Samuel Insull of Chicago, and H. M. Newton of Sparta, Wis. R. J. Graf of Chicago was appointed assistant secretary and treasurer. H. M. Byllesby & Co. were retained as engineers for the property.

ELECTRIC RAILWAYS.

H. M. Byllesby & Co. of Chicago, who are at present constructing the gas plant at Muskogee, I. T., have been retained as engineers by the Muskogee Electric Traction Company to design and construct a railway in the town of Muskogee, with an approximate trackage of 4.7 miles.

Surveying is in progress several miles east of Green Bay, Wis., for a proposed electric railroad running from Manitowoc to Shawano by way of Green Bay. It is understood that the survey is being made for the Chicago and Northwestern Railway Company, but no official statement can be secured.

C. C. Smith of Fond du Lac, Wis., who is well known in connection with the Oshkosh and Fond du Lac Interurban, was in Milwaukee recently endeavoring to interest capitalists in a proposed electric railway between Milwaukee and Fond du Lac, to be known as the Milwaukee and Fond du Lac Rapid Transit Company.

The new Metropolitan railway in Paris was opened October 19th in the afternoon, when a train leaving the station at Père la Chaise made the journey to the Avenue Villiers. The trains are composed of five cars, three of which are motor cars. Great precautions have been taken to protect the lighting apparatus and insure easy exit in case of fire.

The new interurban electric line between Joliet and Aurora, Ill., was officially opened October 21st with appropriate exercises. The cars will go into Aurora over the tracks of the Southern Traction Company there. Aurora officials attempted to interfere with this arrangement, but Judge Willis of Geneva granted a temporary injunction prohibiting interference.

AUTOMOBILES.

An international automobile exposition is to be held December 9 to 24, 1904, in the city of Paris. Applications for space for exhibits will be received up to December 4th by the commisariat général, 6 Place de la Concorde.

A strong public sentiment is being aroused in England against what is called the motor-car peril. Every day the newspapers print letters describing accidents and calling attention in emphatic terms to the encroachment upon the rights of the public by motor-car and motor-cycle owners and drivers. Some days these letters occupy a column or more of space, and their tone indicates that a profound feeling of indignation exists among the writers.

SOCIETIES AND SCHOOLS.

The annual meeting of the electrical committee of the Underwriters' National Electric Association will be held at the rooms of the New York Board of Fire Underwriters, 32 Nassau Street, New York city, on December 7, 1904, at 10 a. m. As in the past, the meetings will be open to all interested in the matter of rules for the installation of electric wiring and apparatus, as contained in the National Electrical Code. Reports of committees and all suggestions for changes in the code to be acted upon at this meeting, should be in the hands of Secretary C. M. Goddard by November 5th, in order that they may be put into print for the meeting. The secretary's office is at 55 Kilby Street, Boston.

The National Electric Light Association is about starting an active campaign for new members, and the appointment of Mr. Henry L. Doherty as committee on membership promises well for the success of the campaign. The great increase in membership in the last two or three years was largely due to Mr. Doherty's personal efforts and methods suggested by him, and now that he has taken the matter up officially large results may be looked for. At the last meeting there were three new classes of membership created, and it is in these classes particularly that the increase is expected. Officers and employes of member companies are to be received as members, with the written consent of the member company with whom connected. The entrance fee for such members will be $5 and the annual dues $5. They will of course receive the various publications issued by the association throughout the year, so this is a very low rate for dues. College professors and teachers of electrical engineering may become members at a rate of dues of $4 per year, with no entrance fee.

PUBLICATIONS.

Fairbanks, Morse & Co. of Chicago are distributing a little folder concerning one of their types of gasoline engines which they call the Jack-of-all-trades.

Bulletin No. 142 of the Stanley Electric Manufacturing Company of Pittsfield, Mass., is devoted to single-phase induction motors of small sizes, repulsion motors and condenser motors.

A loose-leaf "flyer" sent out by the Dwyer Machine Company of Lynn, Mass., is descriptive of a portable photometer for the special use of lamp salesmen. Another describes a standard station photometer.

A folder with detachable post-card comes from the H. T. Paiste Company of Philadelphia. It makes a "Plain Proposition" why those who are fitting up show windows for the coming holidays should use Paiste receptacles.

The Crocker-Wheeler Company of Ampere, N. J., in order better to dispose of its railway generators exhibited at the Exposition, has issued a booklet describing the six machines which are for sale, with delivery after January 1st.

Names and addresses of reliable manufacturers of and dealers in machinery, equipment, supplies, instruments, tools, etc., used in the mining and milling industries have been issued by Mines and Minerals of Scranton, Pa. The directory is classified, the contents being also arranged alphabetically.

A handsome catalogue of hydraulic turbines and governors has been issued by the Allis-Chalmers Company. The catalogue is capitally illustrated with many striking pictures. It contains much information about this class of machinery, and, what is valuable to prospective buyers, a page of data necessary for working out plans and estimates. The turbines of the well-known house of Escher Wyss & Co. of Zurich are the ones described, as the Allis-Chalmers Company has the rights for North America for this machinery.

SPACE TELEGRAPHY.

It is asserted that within 60 days apparatus for wireless telegraphic communication between Boston, Providence, New Haven and New York will be in operation. The De Forest company is the projector. G. H. Barbour, its executive engineer, was in Boston recently and closed a contract for the erection of the station. Ocean messages also will be sent and received.

Stephen Dudley Field has, it is said, recorded successfully the Morse alphabet on paper tape by means of space telegraphy. Mr. Field calls the instrument an amplifier. By means of it a land line may be joined directly to a wireless one, and by this means a message might, perhaps, be sent through ether waves from London across the ocean to New York and there turned onto a wire and carried without interruption to San Francisco.

The report addressed by Admiral Manney, chief of the Bureau of Equipment of the Navy Department, to the secretary of the navy shows that the bureau already has established 22 space-telegraph stations along the coast for naval and general maritime use. It contains a list of 60 additional points where the wireless system is to be installed. These latter include not only the North American continent, but all of the insular possessions of the United States. The Isthmus of Panama is included.

The contract has been let for the erection of a new Marconi station near Port Morien, about four miles from Glace Bay, Nova Scotia. The contract calls for the dismantling of the present towers at Table Head and the erection of a new one of the same height, 215 feet, and the removal of the operating room and power house to the new location. The Marconi company has purchased 400 acres of land, where the new station is to be erected. The station will be in the center of the property. The towers will be built on a similar plan as the present ones, but will be situated four miles inland. It will be the most powerful station yet constructed by the Marconi company. The construction work will be completed by the first of the year.

MISCELLANEOUS.

Prolonged experimenting with the X-rays is said to have been the indirect cause of an operation which was performed in the City Hospital at Rochester, N. Y., recently on Dr. Louis W. Weigel, as a result of which the physician lost his right hand and the three middle fingers of his left hand.

It is said that the Southern Pacific Railroad Company will build an internal-combustion locomotive on the principle of the Diesel engine. It is to weigh 100 tons, and will carry, it is said, sufficient oil to run a train without stop from New York to San Francisco. The General Electric Company is reported to be building the electrical parts.

Electrical devices for increasing the secretion of milk in various domestic animals are said to be used in Switzerland and Holland. The apparatus used in applying the current is the same as the one in ordinary use by physicians, while the manual operation is very simple and is practically identical with the procedure which has been in use in medicine for many years. Two sponges soaked in salt water are placed alternatively on each side of the mammary gland, close up to the ventral wall, the sponges being moved over the surface of the gland. The gland is traversed in every direction, but the current employed is very weak, because of the fact that the subjacent muscle must not be contracted, a condition which would not only be painful, but which would retard the secretion of the fluid. It is declared that the milk of the animals subjected to the "faradization" of the mammary gland does not present any differences from milk which is normally secreted.

TRADE NEWS.

E. M. Cox of Seattle, Wash., has succeeded to the electric and gas-fixture business of Cox & Calderwood.

The General Incandescent Arc Light Company has removed what was its Cleveland branch office to 61 Perin Building, Cincinnati, Ohio.

An electric elevator is required in the Brooklyn police headquarters, 269 State Street. Sealed bids will be received by Police Commissioner McAdoo until 2 p. m. on November 3d.

The Chicago Stage Lighting Company of Chicago was incorporated recently with a capital of $2,500 for the purpose of manufacturing electrical apparatus. The incorporators are J. J. Fanning, G. E. Stevenson and W. J. Stevenson.

The Moline Incandescent Lamp Company has opened a branch office at 105 Chambers Street, New York, with E. E. Anderson as manager; also a branch office at New Orleans, with S. J. Stewart as manager. Other offices will be opened as rapidly as proper representatives can be secured.

It is believed that the new Electrical Securities Corporation, mentioned in the Western Electrician last week, will take over some of the securities owned by the General Electric Company. Its plan of operation will probably be very much like that of the United Electric Securities Company of Boston. The Boston company has issued five-per cent. 30-year bonds, secured by the bonds of electric illuminating, power and street-railway companies. The General Electric Company owns stocks and bonds valued at over $14,000,000.

A number of opportunities to those interested in the installation of electrical plants are offered by a number of foreign countries, as follows: The municipality of Chivilcoy, province of Buenos Aires, Argentina, is open for proposals to build an electric-lighting plant for the town; the municipality of Philippopolis, Bulgaria, will receive proposals for erecting an electric plant for lighting the city and furnishing power for running a railway line; the city of Wellington, New Zealand, will extend its electric-railway system to Island Bay, Ohiro, and Kilbirnie; the government of Roumania has decided to supply an electric-lighting plant to the town of Caracol; the Electrical Owtschar and Kablar in Tschatschak, kingdom of Servia, is open for bids to furnish turbines and generators, with requisite hydroelectrical material and cables for transmitting power to a distance of about 44 miles.

BUSINESS.

Mr. Kuhlman of the Kuhlman Electric Company, Elkhart, Ind., was in Chicago last week looking after the interests of his company.

The Electric Appliance Company, Chicago and San Francisco, is still advocating the contract method of buying lamps. The lamp season is now at its height, and an unusually heavy fall business, the company says, is being handled with ease and

promptness, owing to the large number of customers who are taking advantage of the contract system.

The American Electric Fuse Company of Chicago was awarded first prize on its exhibit of protectors at the World's Fair, St. Louis. The American Electric Fuse Company's exhibit was a handsome one, including protectors of all types for telephone exchanges. The American Electric Fuse Company is very proud of its record in taking the first prize, and announces that its protectors which received the highest award were taken from its regular stock. Since the first of October the company has received orders for over 10,000 pairs of Kaisling protectors, including two orders from abroad. Over 500 sample protectors have already been distributed, and requests have been received for as many more, which are being made up and sent out as rapidly as possible.

The Independent Telephone Manufacturing Company of Madison, Wis., has just issued a new bulletin which is made on the loose-leaf plan, each leaf containing a description and illustration of a separate article. In order to change the reading matter or illustration concerning any one article all that is necessary is to insert a new leaf. The Independent Telephone Manufacturing Company was organized by L. W. Burch of the Electric Supply Company and H. E. Beister, who was formerly an employe of the Standard Telephone Company of Milwaukee. Mr. Burch is the general manager.

Delegates and visitors to the recent street-railway convention in St. Louis greatly appreciated the complimentary luncheon given by the Gould Storage Battery Company at its booth in the Palace of Electricity on October 13th. The booth was shut off from the rest of the building by draperies, and the luncheon was pronounced a decided success. The visitors were particularly interested in the working exhibit of booster-battery regulation.

ILLUSTRATED ELECTRICAL PATENT RECORD.

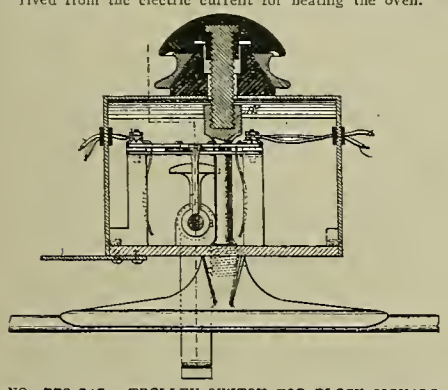
Issued (United States Patent Office) October 18, 1904.

772,350. Electrical Conduit. Alfred Fellheimer, Chicago, Ill. Application filed October 19, 1901.

A building wall is comprised of tiles or blocks having openings forming a continuous conduit or conduits and removable covers of tile associated with the tiles or blocks.

772,354. Electric Furnace. Henri Harmet, St. Etienne, France. Application filed March 20, 1902.

At the base of the furnace is an enlarged crucible chamber. A series of electrodes penetrate the chamber and form the poles for an electric current. Means are provided for conveying gas under pressure from the mouth of the furnace into the crucible chamber adjacent to the electrodes together with a refining oven and means derived from the electric current for heating the oven.



NO. 772,547.—TROLLEY SWITCH FOR BLOCK SIGNALS.

772,368. Electrical Time Cut-out for Controlling Railway Barriers or the Like. Franz Neugebauer, Goldschmieden, near Deutsch Lissa, Germany. Application filed May 26, 1904.

The cut-out is returned to its normal position by the closing of a local circuit, a current interrupter being arranged in the local circuit. Electromagnets control the interrupter and separate electric circuits are adapted to energize the magnets. Rail switches are arranged in the magnet circuits and are placed in front of and behind the barrier, one of the switches being adapted to be operated by a train before arriving at the barrier to complete the circuit of one magnet and thus break the local circuit, and the other switch being adapted to complete the circuit of the other magnet and thereby the local circuit.

772,396. Quadruplex Telegraphy. John C. Barclay, New York, N. Y. Application filed February 1, 1904.

The system constitutes a line conductor, two transmitters and separate generators for the transmitters arranged to supply to one of the transmitters a current of different direction from that supplied to the other, a polar relay having its armature connected to the line and having opposed contact stops therefor, one connected to the one transmitter and the other to the other transmitter, and means for operating the polar relay.

772,400. Electrical Machine. Ole S. Bragstad and Jens L. La Cour, Karlsruhe, Germany. Application filed June 13, 1902.

A combined alternating and continuous-current machine has two mechanically connected rotor windings revolving in fields energized respectively by an alternating supply current of certain frequency and a continuous current, the rotor windings being connected in parallel and supplying currents to a direct-current circuit through a commutator and brushes carried by one of the machines and to an alternating-current circuit through slip rings.

772,401. Portable Light. George M. Brill, Philadelphia, Pa. Application filed April 29, 1903.

A portable electric lamp comprises a handle, a plate attached to the handle, fingers on the plate, a bulb and a guard attached to the plate having means for engaging with the fingers on the plate.

772,415. Battery Holder. Frank Jackson, Denver, Colo. Application filed March 4, 1904.

A battery holder comprises a number of compartments, a metal battery-surrounding jacket being secured within each compartment. A conductor extends from the jacket of one compartment into the top of the adjoining compartment and a spring-pressed contact plate is connected to the conductor.

772,446. Weighing Apparatus. Thomas R. Weyant, Brooklyn, N. Y. Application filed September 30, 1903.

Electromagnets control the feed members of the weighing apparatus.

772,456. Electrical Conductor for Electric Railways. Theophilus P. Chandler, Philadelphia, Pa. Application filed April 18, 1904.

A coupling joint for electric conductors consists of the two ends of the conductors, each screw threaded, combined with a coupling formed of two cylindrical tubular parts respectively screwed over the ends of the conductors and united by a swivel joint, the tubular parts having their abutting ends made flat and their outer ends tapering toward the conductors.

772,459. Counter for Registering Calls for Automatic Telephone Exchanges. John Erickson, Chicago, Ill., assignor to the Strowger Automatic Telephone Exchange. Application filed November 15, 1902.

Registration of calls for an automatic telephone exchange is accomplished by a counter, and a motor connection between the exchange and the counter adapted to operate the latter several times in registering one call. Means are adapted to return the counter to the number of the previous call.

772,465. Alternating-current Motor. Waldo A. Layman, St. Louis, Mo. Application filed March 9, 1903.

One member of the motor has a circuit commuted at starting, the circuit being locally closed and operative both at starting and at speed. A second circuit, inoperative at starting, is supplied, and means for rendering the second circuit operative after the motor has started.

772,522. Time Alarm for Electric Logs. Carl G. O. H. von Köhler, Stockholm, Sweden. Application filed June 23, 1903.

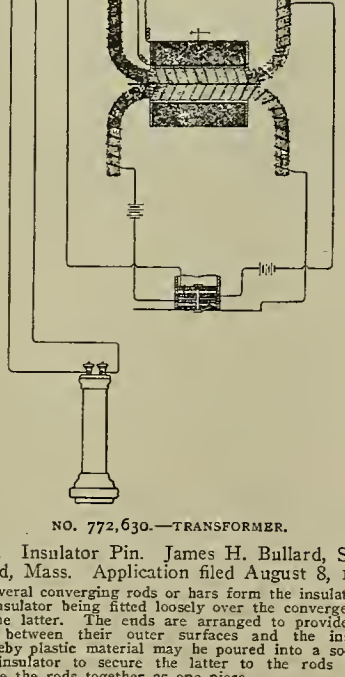
An electromagnet adapted to oscillate a lever is arranged in a circuit intermittently closed by the movable part of the apparatus. A pivoted lever, one end of which is located between a rack and the end of the oscillating lever, is supplied with a stop pivoting on the shaft of the gear-wheel of the log.

772,547. Trolley Switch for Block-signal Systems. Joseph Weatherby, Jr., New Cumberland, Pa., assignor to the Weatherby Electric and Manufacturing Company, New Cumberland, Pa. Application filed December 7, 1903.

In a circuit-controlling switch for block-signal systems are a hanger-ear and a guy-wire insulator, the ear and insulator having engaging portions for direct normal connection. A coupling is adapted to engage the engaging portions of the ear and insulator and hold them spaced apart or extended from direct connection. A switchbox occupies the space between the spaced-apart or extended ear and insulator and is connected by the coupling thereto. (See cut.)

772,548. Signal Mechanism for Block-signal Systems. Joseph Weatherby, Jr., New Cumberland, Pa., assignor to the Weatherby Electric and Manufacturing Company, New Cumberland, Pa. Application filed December 10, 1903.

A number of incandescent lamps are placed in a special form of reflector to be used for signaling purposes.



NO. 772,630.—TRANSFORMER.

772,553. Insulator Pin. James H. Bullard, Springfield, Mass. Application filed August 8, 1903.

Several converging rods or bars form the insulator pin, an insulator being fitted loosely over the converged ends of the latter. The ends are arranged to provide channels between their outer surfaces and the insulator, whereby plastic material may be poured into a socket in the insulator to secure the latter to the rods and to secure the rods together as one piece.

772,571. Electric Motor Vehicle. Hiram P. Maxim, Harry M. Pope and Herbert W. Alden, Hartford, Conn., assignors to the Morton Trust Company, New York, N. Y. Application filed September 24, 1897.

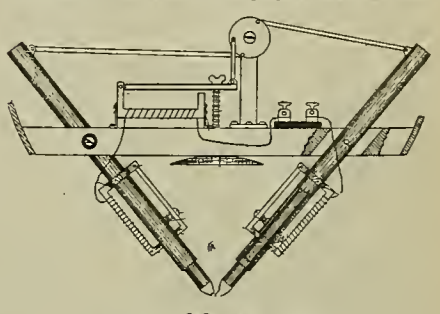
An electric automobile is described.

772,590. Induction Coil. Richard Varley, Providence, R. I., assignor to the Varley Duplex Magnet Company, Providence, R. I. Application filed July 12, 1904.

The casing and vibrator are the principal features of the invention. A flexible cover fits upon the casing and completely incloses the vibrator.

772,591. Induction Coil. Richard Varley, Providence, R. I., assignor to the Varley Duplex Magnet Company, Providence, R. I. Application filed July 12, 1904.

Combined with a box or housing is an induction coil adapted to fit therein, a group of contact plugs on one of the parts, and a similar group of hollow contacts or terminals on the other part, the hollow contacts being arranged to receive all of the plugs at the same time.



NO. 772,658.—ARC LAMP.

772,592. Induction Coil. Richard Varley, Providence, R. I., assignor to the Varley Duplex Company, Providence, R. I. Application filed July 18, 1904.

In an induction coil are arranged a vibratile circuit controller, means for creating a pressure of the contacts and means for relieving the pressure during the periods of energization of the coil.

772,604. Electric Interlocking Switch and Signal System. Gustave Bleynie and Théophile Duconsso, Paris, France. Application filed April 29, 1904.

A combinator is divided into as many sectors as it is desired to group itineraries under the command of the single member. Contacts are arranged on the generating lines of each of these sectors to coact with corresponding springs and effect the necessary connections for simultaneously grouping, on the source of energy, the transmission circuits controlling the distribution of energy to the motor apparatus of the switches and signals which it is a question of operating, and for grouping in series with the motor a control pawl and the circuits for controlling the position of these apparatus.

772,630. Method of Transforming Electrical Currents. Albert L. Parcelle, Boston, Mass. Application filed April 10, 1903.

Transforming an electric current may be accomplished by superimposing a rising current onto a waning or falling current in a secondary coil by simultaneously and synchronously increasing a current in one primary coil and core acting on the secondary coil and decreasing a current in a secondary primary coil and core acting on the secondary coil. (See cut.)

772,638. Trolley Head for Electric Tram Cars. Wilhelm Willenbücher, Manchester, England. Application filed January 7, 1904.

A bracket is fastened on the end of the pole to carry the wheel, and prongs extend out from the bracket to direct the wheel upon the trolley line.

772,644. Fire-alarm System. William L. Denio, Rochester, N. Y., assignor of one-half to Hobart F. Atkinson, Rochester, N. Y. Application filed May 9, 1904.

A main circuit connects the central station and an alarm box containing also an audible box-number receiving device. A ground branch from the main circuit at the central station contains a telephone and a second ground branch is located at the alarm signal box with a telephone therein.

772,649. Sparking Igniter. Ernst Eisemann, Stuttgart, Germany. Application filed April 12, 1902.

Details are described.

772,658. Electric Arc Lamp. George F. Grove, Dayton, Ohio. Application filed January 11, 1904.

In an arc lamp are combined an electromagnetic arc controller, two converging carbon holders, connections between the arc controller and the carbon holders by which the positions of the holders are controlled, and electromagnetic carbon clutches electrically connected with the arc controller in series, whereby the carbons in the holders feed together so that the arc is maintained in permanent position. (See cut.)

772,661. Electrically Controlled Trap-door for Mines or Tunnels. Joseph Krzyzanowski and Stanislaus Wysocki, Juzowka, Russia. Application filed February 25, 1904.

The trap door is arranged to be opened and closed by an electric motor which can be controlled from a distance.

772,665. Block Signal. Charles H. Morse and Charles F. Hopewell, Cambridge, Mass. Application filed March 21, 1904.

In a block-signal system having a danger signal and a safety signal at each end of the block is a signal-controlling switch at each end of the block, a lighting magnet and a put-out magnet at each end of the block for operating the signal-controlling switch, and a blocking magnet at each end of the block, operated by one of the signal circuits, for holding the adjacent signal-controlling switch in its normal position.

772,666. Roentgen Tube. Carl H. F. Müller, Hamburg, Germany. Application filed November 22, 1902.

A vacuum tube having an anticathode and a number of cathodes located therein is associated with focusing reflectors mounted upon the cathode and of different focal distances and located at different distances from the reflecting surface of the anticathode so as to produce rays of different penetrative power.

772,667. X-ray Tube. Carl H. F. Müller, Hamburg, Germany. Application filed March 23, 1904.

A vacuum tube having anode and cathode terminals contains a primary regulator for varying the intensity of the cathode rays, and a secondary regulator for controlling the degree of vacuum of the tube.

772,676. Sound Indicator for Vessels. Josef Schiessler, Vienna, Austria-Hungary. Application filed December 26, 1903.

A sound-receiving device is adapted to be inserted into water and an indicating device arranged above the water; a connecting tube is placed between the two devices. The sound-receiving device has steel cylinders arranged radially therein and adapted to be influenced by the sounds propagated by the water. Yielding electrical contacts are closed by the cylinders, and electromagnets are excited by the current passing through the circuits.

772,679. Electric-railway System. Elmer A. Sperry, Cleveland, Ohio, assignor to the Morgan Electric Machine Company of West Virginia, Chicago, Ill. Application filed November 12, 1902.

Features pertaining to the roadbed and track are described.

772,717. Apparatus for Removing Water from Peat. Bernhard Kittler, Memel, Germany. Application filed March 19, 1904.

The essential parts of the apparatus are a casing, an inclosed sieve to form an intervening annular space, means for exhausting the air from the space, a hollow rotary shaft within the casing, perforated hollow arms communicating therewith and electric connections on the shaft and sieve.

772,730. Electric-railway System. Edmund C. Morgan, Chicago, Ill., assignor to the Morgan Electric Machine Company of West Virginia, Chicago, Ill. Application filed August 27, 1902.

The driving wheels of a motor-car truck are driven by the motor through the agency of intermediate gearing.

772,732. Switching System for Combined Third and Traction Rails for Electric Railways. Edmund C. Morgan and John H. Morgan, Chicago, Ill., assignors to the Morgan Electric Machine Company, East Chicago, Ind. Application filed August 8, 1904.

Switching mechanism to move simultaneously the track and third rails is described.

772,735. Throw-rail for Combined Third and Traction Rail-switching Systems. John H. Morgan, Chicago, Ill. Application filed April 16, 1904.

A throw-rail for track and conductor rails is described in the patent specifications.

772,745. Arc-light Distributer. Henry J. Palmer, New York, N. Y., assignor of one-half to Chester Robinson, New York, N. Y. Application filed February 15, 1904.

Reflecting apparatus for distributing the rays of arc lights is described.

772,772. Thermoelectric Fire Alarm. Herman Barditzky, Memphis, Tenn., assignor of one-half to Frank Sybilla, Chattanooga, Tenn. Application filed May 14, 1904.

A bar having a low coefficient of expansibility has three brackets projecting therefrom in line with each other, one having a threaded opening and the other two smooth openings in line therewith. A metal needle having a high coefficient of expansibility engages in the threaded opening and is slidably mounted in one of the smooth openings. A contact plug is yieldingly mounted in the other smooth opening.

772,773. Combined Receiver and Transmitter Bracket for Telephones. Harry A. Barnes and Nelson E. Showacre, Baltimore, Md. Application filed May 6, 1904.

Mechanical parts of a combined receiver and transmitter bracket are described.

772,782. Signaling Device for Telephone Systems. Henrik T. Cedergren, Stockholm, Sweden. Application filed January 28, 1902.

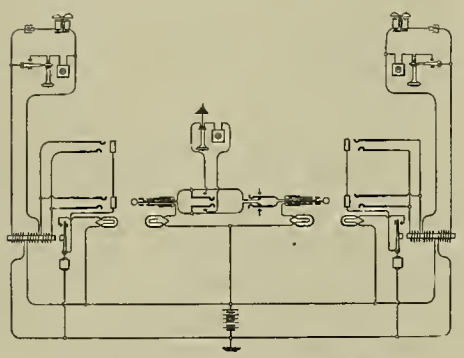
The relay in the cord circuit of the system is so connected that the insertion of the plug of the cord in its corresponding jack connects the relay in series with the test line relay and the armature of the subscribers' line relay.

772,833. Telephone-exchange System. Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Company, Chicago, Ill. Application filed October 21, 1899.

Some of the important points in the invention are a signal-controlling magnet having a winding in the circuit, the signal being responsive to the movements of the sub-station-telephone switch, a second winding for the electromagnet in inductive relation to the first-mentioned winding, a telephone circuit and a switch for bringing the circuit in connection with the second winding of the magnet, whereby the circuits are united inductively. (See cut.)

772,856. Sparking Plug for Combustion Engines. Charles H. Wisner, Flint, Mich., assignor to Peter P. G. Hull, Jr. Application filed July 24, 1902.

Details are described.



NO. 772,833.—TELEPHONE EXCHANGE SYSTEM.

772,871. Telephone-exchange Trunk Circuit Apparatus. Charles A. Crapo, Denver, Colo., assignor to the Western Electric Company, Chicago, Ill. Application filed December 29, 1902.

Combined with a telephone trunk line and connection switches at each terminal for uniting the trunk line with other lines is an electromagnetic ringing key for the trunk line at one end. A local circuit for the ringing key, and means controlled through the joint action of the connection switches at both ends of the trunk line for closing the local circuit, whereby the ringing key is automatically actuated when connection is made at both ends of the trunk line is also a feature of the invention.

772,877. Electric Lamp. George F. Fischer, New York, N. Y., assignor to Thomas J. Bull and Henry D. Schaad, New York, N. Y. Application filed July 9, 1902.

In a medical lamp are a support adapted to be secured to the head of an operator and a lamp socket movably mounted directly on the support and electrically connected therewith. A contact piece carried by and insulated from the lamp socket is adapted to make contact at one end with one pole of a lamp and a yieldingly mounted contact member carried by and insulated from the support, being arranged to engage the opposite end of the contact piece whereby the lamp socket may be moved without breaking the circuit.

772,878. Magnetic Detector. Lee De Forest, New York, N. Y. Application filed June 20, 1903.

A magnetic detector comprising a magnetizable shell and a number of demagnetizing coils is adapted for connection with the antenna and earth in parallel.

772,879. Art of Duplex Wireless Telegraphy. Lee De Forest, New York, N. Y. Original application filed June 4, 1903. Divided and this application filed September 21, 1903.

Simultaneously transmitting and receiving a message at the same station is accomplished by employing different spark frequencies for the transmitting and the receiving waves, and by isolating the indicating device of the receiving apparatus from the effects of waves produced by the associated transmitter during the time of duration of each spark and in submitting the indicating device to such influences between each spark.

772,896. Apparatus for Telephone Switchboards. Frank R. McBerty, Evanston, Ill., assignor to the Western Electric Company, Chicago, Ill. Application filed December 26, 1899.

A subsidiary signaling circuit including a source of current is divided into two parallel branches, a line signal and the switch contacts of the relay being included in one of the branches, a subsidiary signal included in the other branch, and switch contacts closed in the act of making connection with the line to form a cross conductor between the branches intermediate of the switch contacts and the line signal in one of the branches to shunt the line signal and to bring the supervisory signal into shunt with the relay contacts.

772,897. Busy Signal for Telephone Trunk Lines. Frank R. McBerty, Evanston, Ill., assignor to the Western Electric Company, Chicago, Ill. Application filed January 14, 1901.

772,898. Trunk Line for Telephone Exchanges. Frank R. McBerty, Evanston, Ill., assignor to the Western Electric Company, Chicago, Ill. Application filed January 26, 1901.

Improvements to trunk-line equipments are described in these two patents.

772,899. Supervisory Signal for Telephone Switchboards. Frank R. McBerty, Evanston, Ill., assignor to the Western Electric Company, Chicago, Ill. Application filed February 12, 1902.

The apparatus comprises a circuit containing a resistance and a signal device and leading-through relay contacts controlling its continuity. A shunt of the signal device contains one winding of a differential magnet and a switch for closing the shunt. A branch circuit or second shunt includes both windings of the differential magnet and shunts the resistance and relay contacts. An independent signal device is connected in the second shunt and controlled by the differential magnet.

772,900. Telephone-exchange System. James L. McQuarrie, Chicago, Ill., assignor to the Western Electric Company, Chicago, Ill. Application filed January 14, 1901.

The apparatus contains an electromagnetic switch adapted when actuated to disconnect the local source of current, and a local circuit for the electromagnetic switch closed in connecting the link conductors to the trunk line, whereby current for the local line is supplied from the distant trunk-line battery during the connection of the local line with the trunk line.

772,908. Flashing Device for Incandescent Electric Lamps. Corneil Ridderhof and Greyson E. Miles, Grand Rapids, Mich., assignors to the Wilmarth & Morman Company, Grand Rapids, Mich. Application filed December 9, 1903.

A T-shaped rocking lever actuated by electromagnet plungers in its travel throws in and out various lamp circuits.

EXPIRING PATENTS.

Following is a list of electrical patents (issued by the United States Patent Office) that expired on October 25, 1904:

371,915. Governor for Incandescent Lights on Arc Circuits. C. D. Baker, Chicago, Ill.
371,936. Electric Railway. J. Hartman, Jr., Philadelphia, Pa.
371,937. Rheostat. J. Hartman, Jr., Philadelphia, Pa.
371,940. Electrical Communicating System. A. G. Holcombe, New York, N. Y.
371,958. Electric Current Indicator. W. H. Markland, Altoona, Pa.
371,980. Automatic and Autographic Telegraphy. C. Selden, Baltimore, Md.
372,012. Electrical Resistance Board. I. W. Colburn, Fitchburg, Mass.
372,026. Electrical Safe Lock. C. J. Kintner, Philadelphia, Pa.
372,027. Electromagnetic Safe Lock. C. J. Kintner, Philadelphia, Pa.
372,028. Electrical Safe Lock. C. J. Kintner, Philadelphia, Pa.
372,029. Electrical Combination Lock. C. J. Kintner, Philadelphia, Pa.
372,046. Electrical Primer. G. Stuart, Elswick Works, Newcastle-upon-Tyne, England.
372,078. Underground Electric Conductor. H. Metzger, Pittsburg, Pa.
372,155. Telegraph Key and Sounder. G. M. Lane, Asbury Park, N. J.
372,168. Coin-operated Induction Coil. W. Oliver, London, England.
372,193. Galvanic Battery. J. T. Armstrong, London, England.
372,201. Regulator for Dynamo Electric Machines. C. E. L. Brown, Zurich, Switzerland.
372,208. Electric Valve Controller. S. W. Dermitt and W. V. Dermitt, Pittsburg, Pa.
372,231. Regulator for Electric Motors. A. W. Meston, St. Louis, Mo.
372,245. Autographic Telegraphy. J. E. Watson, Louisville, Ky.
372,247. Call Register for Telephones. A. F. Adams, Little Rock, Ark.

SPECIAL MENTION.

For Indianapolis, Louisville, Columbus, Cincinnati and all points south take Pennsylvania Lines. Purchase tickets at city office, 248 Clark Street, Chicago.

The General Incandescent Arc Light Company, New York, has closed a contract with Westerly, R. I. (Mr. Kinglesmith, superintendent), for its new street-lighting system, which embraces a 50-light circuit, in the face of severe competition.

The Standard Varnish Works of New York city have two products which they wish especially to bring to the notice of the public. One is Voltalac, an insulation varnish to keep off moisture and prevent burnouts. The other is G. P. black finishing varnish, for dynamo armatures and fields. Voltalac drys in two hours and always remains plastic.

The General Electric Company has commenced two suits against August Talmont and George D. Roedelsperger, doing business under the name of Talmont Electric Engineering Company, for alleged infringement of patents belonging to it, issued on inventions of Thomas A. Edison and Mark H. Branin for improvements in methods of manufacturing incandescent lamps.

The Teter-Heany Developing Company of York, Pa., is meeting with success in the sales of its indestructible fireproof asbestos-covered magnet wire. This wire is peculiarly adapted to the arduous services encountered in street-railway motors that are so constantly subjected to abnormal current "rush" and the consequent temperature rise. This wire is being used in large quantities by the Carnegie Steel Company, Cutler-Hammer Manufacturing Company, Chicago City Railway Company, Interborough Rapid Transit Company of New York and by the Westinghouse Electric and Manufacturing Company, and it is also being adopted by many other leading street-railway and lighting companies throughout the United States. The insulation of this wire is said not to be impaired even when subjected to a red heat. This wire is finding many friends, too, in the coal-mining regions, where it is used in electric coal-cutting machinery. The Teter-Heany Company says that the United States Navy has adopted this wire, after very exhaustive test, and it is to be used on all electrical apparatus in the magazines of the United States battleships. This service requires a wire that will not carbonize or smoke and to be practically safe at all temperatures. The company is placing also a high-grade fireproof line of flexible cords and house wires upon the market. The company's general selling representative, F. P. DeWilde, has introduced the article to the trade, and has made arrangements whereby the W. R. Garton Company of Chicago will assume the western selling agency for the product. This last-named concern is now in a position to supply armature-field coils of this wire for all standard railway apparatus.

WESTERN ELECTRICIAN

EVERY SATURDAY

Vol. XXXV. CHICAGO, NOVEMBER 5, 1904 No. 19

Electric Coal-handling Apparatus on Dock at Superior, Wis.

An interesting illustration of the application of electricity to coal-handling apparatus may be found at one of the coal docks of the Northwestern Fuel Company. The dock in question is located at Superior, Wis., and is known as "Superior Dock No. 1." This is one of the Northwestern Fuel Company's principal distributing centers for coal throughout the Northwest, the coal being shipped by lake steamers from Lake Erie points, a distance of from 800 to 1,000 miles to Superior, at the western end of Lake Superior, where it is unloaded at the docks and reshipped by rail to various points.

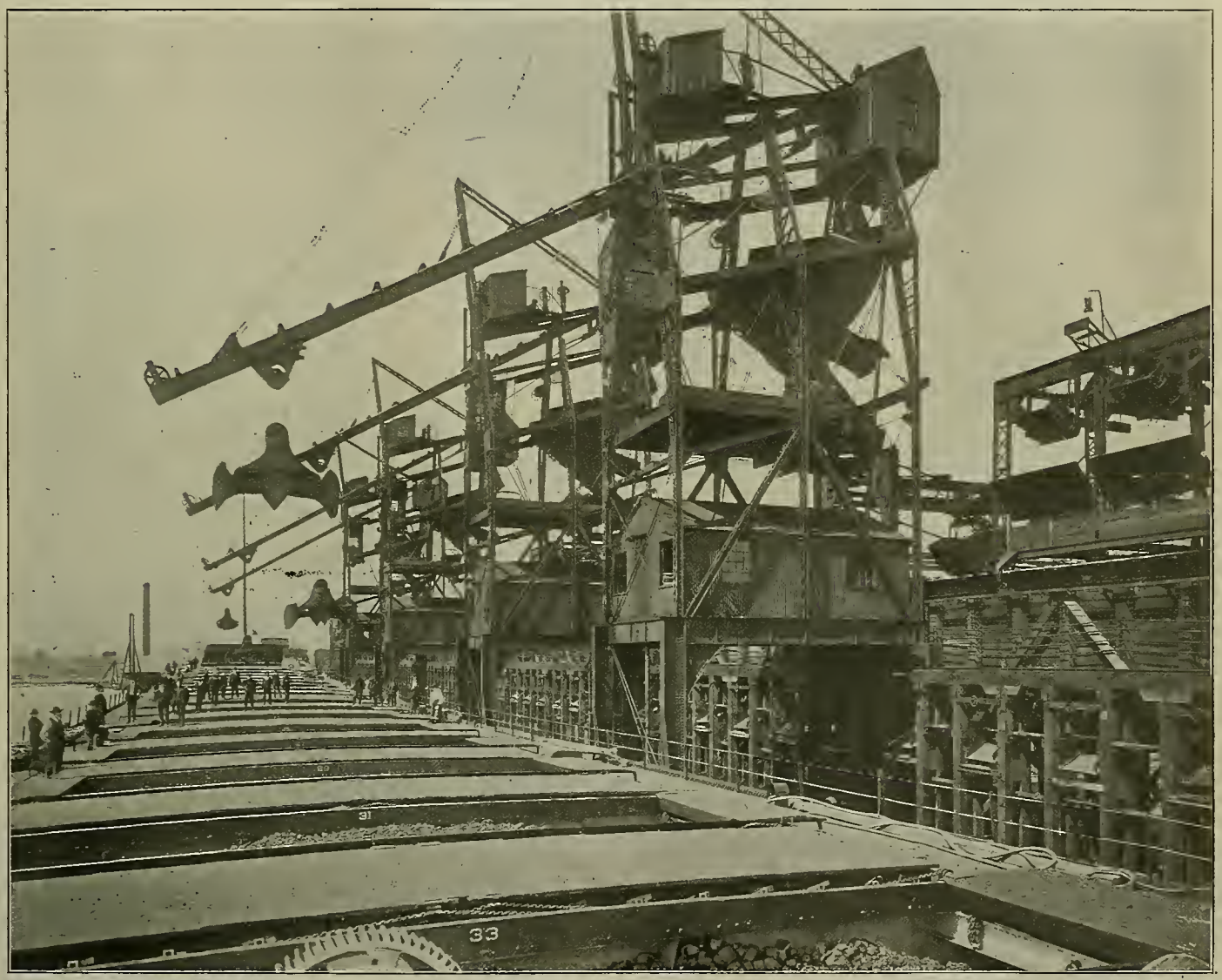


FIG. 1. ELECTRIC COAL-HANDLING APPARATUS ON DOCK AT SUPERIOR, WIS.

Method of Handling Coal.

The coal-handling apparatus, all of which is motor-driven, comprises a complete unloading, distributing and reloading plant for bituminous and anthracite coal, and consists of hoisting towers, transfer cars, bridges, stocking and shovel trolleys, box-car loaders, elevators and conveyors.

Coal steamers are made fast to the dock, where they are parallel with and immediately contiguous to a runway on which are operated four hoisting towers, it being thus possible to locate any tower opposite any hatch on the steamer. The coal is hoisted from the hold of the vessel by clamshell buckets and deposited in hoppers within the towers, from which it is dumped into trolleys resting on the transfer cars, the transfer cars operating parallel to the line of the towers so that they can take their coal from any tower. The trolleys, when thus loaded, are run from the transfer car on to any of four bridges which extend across the dock. As these bridges are movable the coal may be finally deposited anywhere on the dock where it is desired for storage.

The reloading of the coal is done by means of trolleys operated on the bridges above referred to, these trolleys being equipped with shovel and clamshell buckets. In reloading, coal is mechanically trimmed in box cars by means of electrically operated portable box-car loaders. Screenings are disposed of by means of elevators and conveyors. It should be noted that separate systems are provided for unloading, stocking and reloading, thus permitting the three processes to be performed simultaneously and independently, and assuring great rapidity in handling the coal.

Figs. 1 and 2 are reproductions of photographs showing a vessel unloading coal at the dock. The former gives a view over the hatchways of the great boat, while on the dock are clearly shown the four hoisting towers with their clamshell buckets and the transfer cars. The housings for the electric motors with which the various operations are performed are clearly shown. Fig. 2 (next page) gives a more distant view of the same boat, giving an idea of its length and cargo-carrying capacity. These photographs were taken while the steamer Augustus B. Wolvin was being unloaded. Her cargo consisted of 10,300 net tons of soft coal, this being the biggest cargo ever carried on the Great Lakes. Her maximum capacity is estimated at 12,000 tons of coal. The Wolvin is probably the largest boat in the world devoted exclusively to freight carrying, having a length of 560 feet, with a beam of 56 feet.

Power Plant.

The power house is located on the dock and 250 volts is maintained at the bus bars, the distance of transmission being short. Separate circuits are run from the power house to the hoisting towers, transfer cars and bridges.

The power-house equipment consists of six 150-horsepower return tubular boilers, with foundations and floor space for the installation of two additional boilers when required. The generating plant (Fig. 3) consists of three 200-kilowatt direct-current 250-volt General Electric machines, each driven by a 300-horsepower Buckeye engine, and a storage battery of Chloride accumulators (Fig. 4), consisting of 120 type G-35 elements in G-45 tanks, with regulating shunt booster. The rating of the battery is 1,360 amperes for one hour, the tanks being of sufficient size to permit of increasing the capacity of the battery at any time to 1,760 amperes for one hour by the addition of five pairs of plates.

Load Conditions.

This plant was first installed without the storage battery and was operated during one season in this manner. In the fall of 1903 a test was made of the plant, which developed the fact that the load fluctuated through a range of from 0 to 4,500 amperes, the average being 1,050 amperes. These conditions were exceedingly severe on the engines and generators, as the maximum load was nearly 90 per cent. overload for the generators. Aside from this fact, the small average load made an extremely low-load factor for the station. Even under these conditions it was obvious that an increase in station capacity

should be provided, the question being whether to install more generators or a storage battery. A contemplated increase in load made this additional apparatus necessary.

The conditions existing at the power house were exactly similar to those met with on a small street-railway system—that is to say, the load fluctuated from zero to a maximum with an average extremely low when compared to the maximum. It differed, however, from a small railway load in the fact that the motors were stopped and started far more frequently. As the acceleration of the motors was also more rapid the fluctuations on the station were frequent and of short duration.

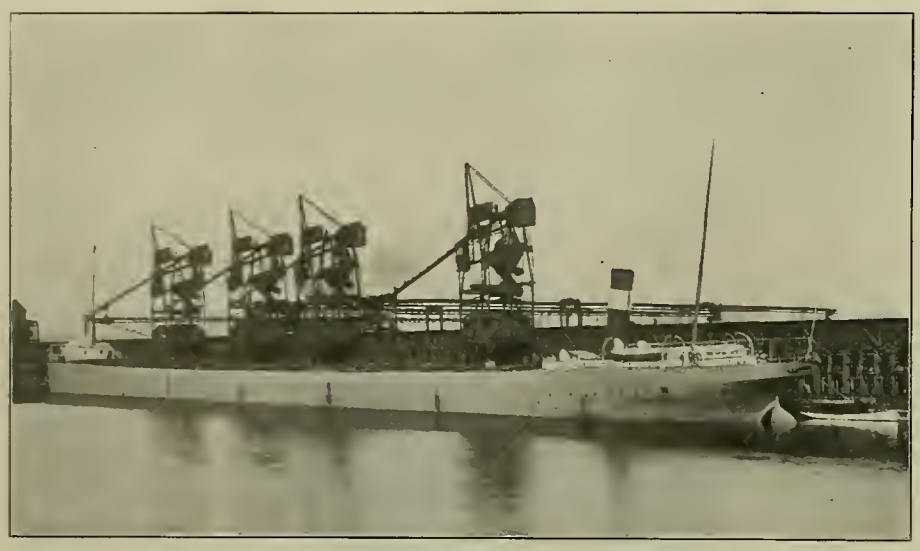


FIG. 2. COAL-HANDLING APPARATUS AT SUPERIOR, WIS.—FREIGHTER UNLOADING AT DOCK

The installation of a battery was decided upon, the battery, booster and other auxiliary apparatus being identical with that of a railway plant. The booster installed was of the regulating shunt type, made by the Western Electric Company. The battery and booster are in series, the combination being connected in parallel with the generators. The battery is used solely to relieve the generators of the heavy-current fluctuations, automatically discharging when the load is in excess of the average and charging when the load is below the average, thus maintaining on the generators a load closely approximating the average station output.

The station is now operated with a heavier load than existed at the time the above-mentioned test was made. The average load at present, while heavier than at that time, is still within the capacity of the three generators, and, as the battery cares for the fluctuations, the plant is now operated with the same number of generators as were originally installed. It is obvious from this that the load factor has been greatly improved and the generators and engines relieved of the severe strain incident to the wide fluctuations that they were originally subjected to.

The battery is also used for night lighting on the dock, which service was formerly supplied by the local lighting company.

It is of the greatest importance that a maximum speed be attained in unloading the steamers in order to avoid holding them at Superior any longer than is absolutely necessary. An idea of the facilities of this dock for unloading may be gained from the fact that the clamshell grab on each of the four hoisting towers has a capacity of two tons, the towers being designed to operate at two cycles a minute. When operating at this rate each tower has an unloading capacity of four tons a minute, or 16 tons a minute for the four towers.

Opening of The New York Subway.

[From the New York correspondent of the Western Electrician.]

The completed portion of the New York subway, the construction of which was commenced on March 25, 1900, was officially opened on Thursday, October 27th, at 1 p. m., when there was a gathering in the City Hall presided over by Charles V. Fornes, president of the Board of Aldermen. Those assembled included Mayor G. B. McClellan, Bishop Greer, Archbishop Farley, ex-Mayor Van Wyck, under whose administration the subway was initiated; Alexander E. Orr, president of the Rapid Transit Commission; August Belmont, president of the Interborough Rapid Transit Company, the lessee; John B. McDonald, the subway contractor; Chief Engineer William Barclay Parsons, Vice-president E. P. Bryan, General Manager Frank Hedley (formerly of Chicago), and a large number of representative men and engineers.

After prayer by Bishop Greer, Mayor McClellan spoke.

Chief Engineer Parsons then announced amid applause that he had the honor to report that the subway was ready for operation from City Hall to One-hundred-and-forty-fifth Street on the West Side.

A speech followed from Mr. Orr, who warmly complimented Mr. Parsons. He said that it is expected in a very few weeks the eastern division will be ready for operation as far as the station at Lenox Avenue and One-hundred-and-forty-fifth Street. It is too early yet to estimate when the subway will be completed to its northern terminal points. He also said that it was expected to have the portion of the Brooklyn division situated between the City Hall Park and the South Ferry, ready for operation some time during the coming summer.

Mr. McDonald also spoke. He said in part: "The study of the problem from an engineering as well as a commercial standpoint consumed many years and was a herculean task, presenting difficulties and conditions not met elsewhere in all the world. The narrow island of Manhattan, bisected by streets filled with water, gas and heating mains, electric ducts, pneumatic tubes, sewers, surface and elevated railways, and with its buildings constructed on foundations varying from shifting sand below the tide line to hard and seamy rock rising to high altitudes, and with the Harlem River interposing on its north line—all these were obstacles which the engineer had to meet and conquer. It has been done."

Mr. August Belmont made a long speech. He referred to the financial side of the undertaking, to the obstacles surmounted in this connection, to the safeguarding of the city's interests, and added that he and his associates contemplated still further rapid-transit facilities.

After the pronouncement of the benediction by Archbishop Farley, the mayor, in the name of the people, declared the subway open.

Leaving the building Mayor McClellan and the company proceeded to the City Hall terminal. The mayor, under Mr. Hedley's instruction, took his place as motorman of the first train and fitted a silver handle to the controller. The train was filled with official guests and started precisely at 2:35½ p. m. The mayor held the controller until One-hundred-and-third Street, when Mr. Hedley took charge, and the train continued to One-hundred-and-forty-fifth Street. The whole journey of nine miles was accomplished in exactly 26 minutes.

Immediately after the starting of the first train, specially invited visitors to the number of 15,000 were allowed to ride through the subway. At seven o'clock the general public was admitted on payment of a five-cent fare. Up to midnight no less than 111,811 paying passengers traveled over various portions of the route, the greater number going uptown by the express cars. By the desire of Mr. Belmont the proceeds of the first evening's traffic, amounting to $5,594.05, is to be handed over to the city hospitals.

At Sherry's restaurant in the evening the directors of the Interborough company gave a dinner in honor of Mr. August Belmont, during which Walter G. Oakman, a vice-president of the company, presented an elaborate silver loving cup to Mr. Belmont. A feature of the banqueting table was a model of the subway system with a reproduction of the Seventy-second Street station.

It may be interesting to recall that the subway is owned by the city, which has loaned $35,000,000 to the Interborough company, the company to repay this amount with 3½ per cent. interest in installments during the next 50 years, when the operating lease expires. The construction of the tunnel has involved great difficulties. About 3,000,000 cubic yards of excavation were made, one-third of which was in stone.

The entire work up to date has cost about 120

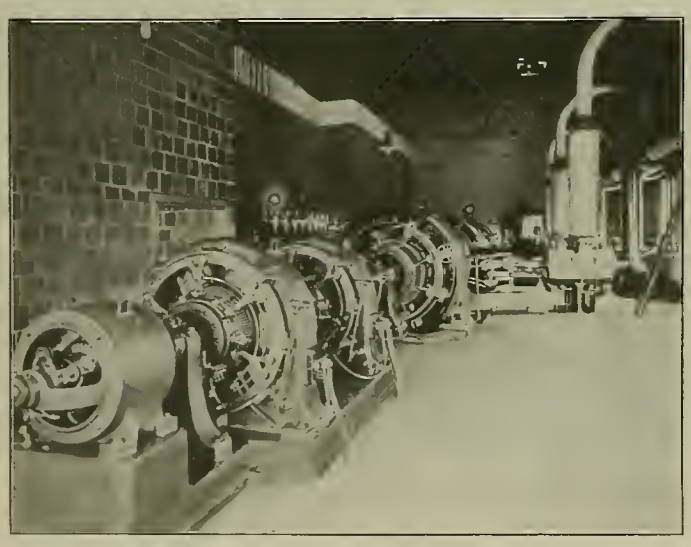


Fig. 3. Generators and Booster.

Fig. 4. Storage Battery.

VIEWS OF PLANT FURNISHING POWER FOR ELECTRIC COAL-HANDLING APPARATUS AT SUPERIOR, WIS.

lives. The stations are commodious and brilliantly lighted and the finishings are all of bronze, brass and other metal, woodwork being eliminated as far as possible. The system is electrical, one great power house developing the required energy.

The Proposed Chicago Subway.

Before April, 1906, active work may be commenced upon a comprehensive subway system for the congested downtown district of Chicago, according to a statement made by Alderman Milton J. Foreman at a banquet recently given by the Real Estate Board in Chicago. Mr. Foreman is chairman of the local transportation committee of the City Council, and he gave an interesting talk upon the much-needed improvement to the city's transportation facilities.

The system will extend as far south as Twelfth Street, as far north as Chicago Avenue, and as far west as Halsted Street. The subway will accommodate through traffic. Surface cars will continue to carry local traffic. The tunnel, if the present plans are carried out, will be divided into four compartments. Two of these will be for railways, the others for such public utilities as heating and refrigerating plants, high-pressure water pipes, and electric wiring The present river tunnels will be utilized in the new system, Alderman Foreman explained, while the cars after leaving the subways will be run either on elevated structures or through alleys.

A fund of $2,000,000 is on hand for the beginning of the work. This sum is sufficient to keep con-

FIG. 2. WORK OF THE TELLURIDE POWER COMPANY.—LONG SPAN AT CAMP BIRD DIVIDE.

struction work going for two years. After that time the fund at present devoted to bridge and intercepting-sewer construction will be at the disposal of the subway board. Such is the subway plan at present.

"No solution for transporting passengers in Chicago presents itself," said Mr. Foreman, "without the consideration of a subway. The city is growing perpendicularly, not horizontally. We propose to duplicate the surface of the downtown thoroughfares underground. There must be room for sidewalks as well as rails.

"We should construct the subway gradually. With the funds on hand we can begin immediately. As soon as the drain on the water and bridge fund has been lessened we shall have sufficient funds to continue the system.

"The question is to be submitted to you whether it is practical to take the street cars off the surface. The local and through traffic should not be mixed. If we force the traction companies off the streets, how do we know that some future city council will not grant a franchise to another company?

"With the perfection of the subway system, the sewer problem will no longer confront us. The present catch basins in the downtown district would not be tolerated in such a city as Havana, which was once notorious for its uncleanliness.

"It is appropriate that just as the New York subway goes into operation the definite announcement of what Chicago intends to do should be made."

The next annual meeting of the Southern Hardware Jobbers' Association will be held at Virginia Hot Springs on June 6th to 9th next. This will be the fifteenth convention. The headquarters will be at the New Homestead Hotel. C. B. Carter of Knoxville, Tenn., is secretary.

Work of the Telluride Power Company.

In last week's issue of the Western Electrician (pp. 352 and 353) was presented Mr. P. N. Nunn's valuable paper on "Pioneer Work of the Telluride Power Company." This paper was read in Section D of the International Electrical Congress. The accompanying pictures were received too late to

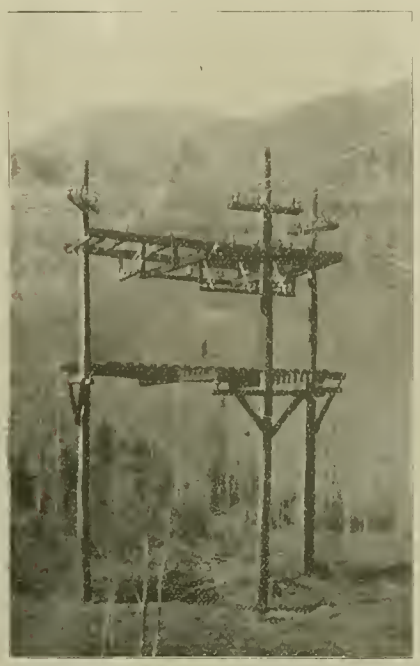


FIG. 1. WORK OF THE TELLURIDE POWER COMPANY.—OPEN-AIR SWITCHING JUNCTION.

be used when the paper was printed, but they are so intrinsically interesting that they are presented herewith.

Fig. 1 is a view of one of the open-air switches that are placed at all junctions in the transmission lines other than generating or distributing points. These switches are mounted on standard line insulators and are operated from platforms similarly insulated.

An interesting picture is that in Fig. 2, which

FIG. 3. WORK OF THE TELLURUDE POWER COMPANY.—SUPPORTS AND STRAIN INSULATORS AT CAMP BIRD DIVIDE.

shows a long span at Camp Bird divide. There are a number of these long spans crossing canyons and divides near Savage Basin. The divides are bare ridges at an altitude of 13,000 feet and swept by frequent snowslides. They are inaccessible in winter and even in the summer the difficulty and danger encountered in constructing a transmission line in such localities may be readily imagined by studying the picture. Spans of this kind up to 1,100 feet are used, the longest being of No. 1 hard-drawn copper supported by half-inch plow-steel cable, both carried by the same insulators. The deflection is approximately 35 feet on a slope of 31 degrees. The strain insulators for the long spans are a series of the usual line insulators and pins upon a longitudinal arm. These arms are hinged to permit adjustment to span motion.

The stress upon the supports located upon the tops of the ridges and carrying the weight of these long spans is enormous, and very strong construction is necessary. Fig. 3 is a view of the tower on the summit of Camp Bird divide. The support, though simple and inexpensive, is exceedingly durable and has stood the test of years without repair. In this picture also may be seen the strain insulators referred to above.

Fig. 5 is an exterior view of the power house, located at Logan, Utah. This plant was completed in 1901 and contains two 1,000-kilowatt revolving-field alternators direct connected at 400 revolutions to double-discharge turbines operating at a head of 212 feet. Duplicate lines over 100 miles in length connect this plant with the Provo (Utah) system. Distributing points are at Mercur, Eureka, Bingham, Salt Lake and Provo.

At present all-wood pole construction is used on the Logan lines. Fig. 4 is a good illustration of this type of pole. The three conductors of the line form an equilateral triangle 76 inches between wires, carried by a seven-foot cross-arm and the top of the pole. The cross-arms are mortised through the

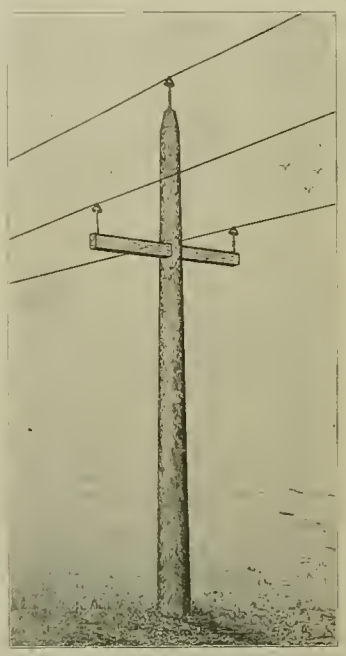


FIG. 4. WORK OF THE TELLURIDE POWER COMPANY.—SAMPLE OF ALL-WOOD CONSTRUCTION.

pole and wedged and pinned in place, thus doing away with all metal except conductors. This construction was original with Mr. A. L. Woodhouse. Extra long pins raise the insulators well above the cross-arms, and they are made of selected locust soaked from six to 12 hours in paraffin at 150° C. The cross-arms are of Oregon fir, kiln-dried and soaked in boiling bitumen. During the four years' operation of the 400 miles of line thus constructed very few poles have burned down.

Insulators of the Provo type have been used

FIG. 5. WORK OF THE TELLURIOE POWER COMPANY.—LOGAN POWER HOUSE.

throughout, and of the many which have been broken the cause has generally been gun practice or stones. Leakage losses are inappreciable, except during the severest storms.

The Carnegie Technical Schools of Pittsburg will, it is said, be placed on a site covering 32 acres and will represent an expenditure of $5,000,000. Palmer & Hornbostel of New York are the architects, and work on the buildings will be begun as soon as working plans can be prepared.

Protection of Life in the New York Subway.

By Sydney W. Ashe.

How could an underground railroad, equipped with express trains, traveling at a schedule speed of 38 miles per hour, be operated in a city like New York so as to obtain the greatest possible safety for its public patrons? This was the problem which the engineers of the Interborough Rapid Transit Company had to solve before trains could be placed in service, and well have they met the conditions.

As an experienced engineer passes through the subway, from station to station, examining the construction of the tunnel, looking over the signal systems, investigating the construction and equipment of the cars, he realizes how great has been the task for these engineers and how well they have solved it. From the elaborate signal systems, down to the most trifling detail, you see everywhere innumerable safety devices. As we observe these devices a feeling of pride arises at the evidence that the protection of life has been of paramount importance in this great undertaking.

In the construction and equipment of this extensive railway underground it has been imperative to provide against three great factors of danger—water, fire and accidents.

Means Provided to Prevent Leakage of Water.

Let us consider the danger from water. Suppose that water were to accumulate in the subway and

FIG. 1. NEW YORK FIREPROOF SUBWAY CAR.

weaken the substructure, depressing the tracks, the resulting calamity is obvious, or imagine sufficient water collecting to form a circuit between the third rail and the ground rail, the automatic switches in the sub-stations would open, and there would be no power to operate the cars in that section of the road.

Every precaution has been taken to make the tunnel waterproof. It is built in a substantial manner and covered with many layers of waterproof felt. Also the bed of the tunnel is of concrete, varying in thickness up to two feet. In some places, such as Battery Park, the thickness is greater than two feet. A complete system of drainage has been provided, and electric pumps have been installed at low points to remove water in case of excessive rainstorms.

Precautions Against Fire.

The danger from fire has been equally well considered. The tunnel is built entirely of fireproof materials, concrete and iron being freely used. Even the paint with which the tunnel is coated is fireproof, being asbestine fireproof paint. In fact, the only exposed combustible materials are the railroad ties, which are almost submerged in broken trap rock, and the small ticket-office boxes. The stations are constructed of iron, concrete and tiling. All of the feeder wires supplying the third rail with power are enclosed in fireproof earthenware ducts and embedded in the side walls of the tunnel. Where these feeders enter the upright manholes at the end of the stations, they are separated from the tunnel by metal doors. Should a heavy short-circuit or an excessive load come upon them, resulting in their destruction, it would be impossible for the burning feeders to send flame into the tunnel proper. Such an occurrence might happen if the circuit-breakers in the sub-stations were not in proper adjustment.

The current sent into the motors of the cars is limited by safety devices, making it practically impossible in ordinary service to burn out the coils in the motor body. It is asserted by the manufacturers of these motors—the General Electric and Westinghouse companies—that the coils are semi-fireproof.

Latest Subway Cars Absolutely Fireproof.

The first lot of subway cars delivered were constructed as fireproof as possible compatible with building a handsome passenger coach. They were sheathed with copper to the base of the window frames, which made them quite novel and conspicuous. Trains are arranged with pantograph gates from car to car, to prevent passengers from falling between them. Cars are also equipped with both automatic and hand brakes, in addition to Van Dorn couplers and heavy safety chains. These cars have a triple floor, there being sheets of asbestos fire felt between succeeding layers of flooring. A great many of these cars were supplied by the St. Louis Car Company.

The latest type of car designed by Mr. George W. Gibbs of the Interborough is considered to be completely fireproof. Its general construction is evident from Fig. 1, while Fig. 2 shows the all-metal framing complete. The problem of constructing a fireproof car with a low-tunnel clearance, which would not exceed in weight a wooden car of the same dimensions and which would operate noiselessly and be comfortable in all kinds of weather, was a difficult proposition. Mr. Gibbs has ably solved it and succeeded in designing a car which fulfills these conditions in every detail. A small amount of wood, about 685 pounds, has been used in their construction, but this wood has been fireproofed, resulting in a complete fire-resisting structure. The total weight of one of the car bodies is about 34,000 pounds, the motor truck weighing 12,240 pounds and the trailer truck, 8,400 pounds. The car flooring is built up in three parts, the lower layer consisting of galvanized corrugated sheet iron. This is covered with fireproof flooring of "monolith," a composition. This flooring is covered with ash strips to form a good wearing surface. The lining to the floors and side walls is such as will resist transmission of heat and will deaden all sound; in fact, the cars in general appearance and construction are as wide a departure from a wooden car as seems possible to obtain. This in case of accident will undoubtedly have a very good moral effect upon passengers. Another good feature is the moldings which enclose the electric-light wires, they being composed of aluminum. The car is very strongly built, as is evidenced by the illustration. With all of the subway cars asbestos has been freely used in their construction wherever there was a possibility for fire to originate. All switches through which pass heavy-train circuits are provided with automatic blow-out coils, which extinguish arcs forming when the switches are opened by the motorman's controller mechanism.

Automatic Electric Control.

When piloting a train a motorman has the lives of the passengers in his care. No matter how many safety devices a train may be equipped with it is possible for the motorman through negligence to cause accidents. Electric railways would be almost absolutely safe if the personal equation of the motorman could only be eliminated. It is possible, however, to provide against sickness or death of the motorman and this has been accomplished in the subway equip-

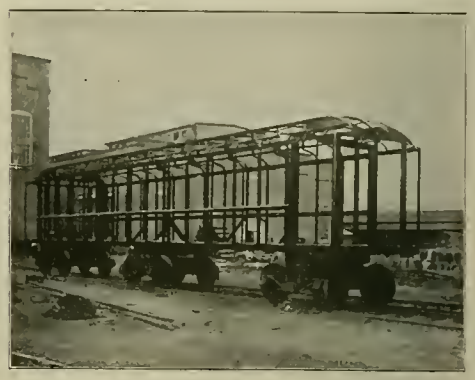


FIG. 2. METALLIC FRAMEWORK OF FIREPROOF CAR FOR NEW YORK SUBWAY.

ment by constructing the master controller, operated by the motorman, with an automatic attachment.

Referring to Fig. 3, which is an illustration of this controller, (1) is a button on the master controller handle which must be held down at all times except when the car is at rest. A slight pressure is necessary to push down this button, but when once down it is caught by a latch and may be held down by the weight of the handle. As this button is pressed down it closes the contact fingers (2) on the controller drum. Should the motorman for any reason remove his hand from this button the contact (2) flies back, opening the controlling mechanism which cuts off the supply of power for the cars. In addition, when this contactor flies back the emergency air-brake valve (4) operates in conjunction with the pilot valve (3) and allows the compressed air to escape from the brake apparatus, and the

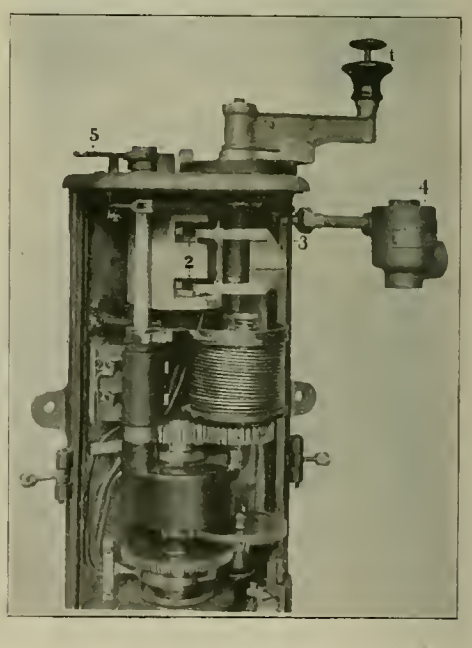


FIG. 3. AUTOMATIC CONTROLLER FOR NEW YORK SUBWAY CARS.

brakes are applied instantly to the wheels, bringing the train to rest.

This is accomplished in the following manner: A small pipe connects from the upper part of the emergency valve with the pilot valve in the controller. The projection on the right-hand side of the emergency valve is connected directly to the train line of the air-brake system. The valve opens at the bottom to atmosphere. At the same time that the button is released and the auxiliary contacts at (2) cut off current from the controller, a cam bears against the stem of the pilot valve at (3) and allows air to escape from the upper part of the emergency

valve. The train-line pressure forces up the piston in the emergency valve and allows the air in the train line to escape to atmosphere, immediately applying the brakes. Consequently if the motorman for any reason takes his hand from the controller handle while the train is moving, current is cut off from the motors throughout the train and the brakes are immediately applied.

The electrically set circuit-breaker is held closed by a retaining coil energized from the control-circuit switch in the car from which the motorman is operating. If for any reason the train breaks apart the circuit-breakers on the rear part of the train open immediately, due to the fact that the retaining coil is no longer energized.

The removal of the motorman's hand from the controller handle, therefore, not only cuts off the power but applies the brakes. If for any reason the cars composing a train should become separated the power will be immediately cut off and the brakes applied in the detached cars. The controller was designed especially by the General Electric Company for the subway equipments.

Emergency Brakes.

A vital point in the equipment of an electric car

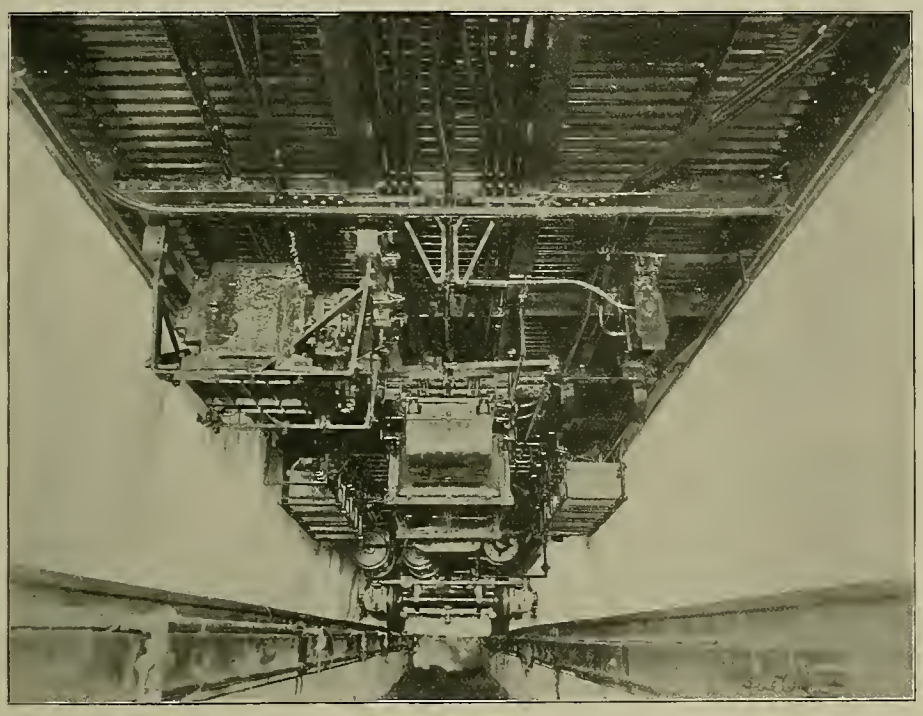


FIG. 4. BOTTOM OF NEW YORK SUBWAY CAR.

lies in its brake equipment, the failure of which in express service would undoubtedly cause a serious calamity. With the modern system of brakes, such as the subway cars are equipped with, compressed air is used to move the braking apparatus. The normal position of the brake-shoes is against the wheels, and to start a train in motion it is first necessary to obtain a supply of compressed air, which, when applied to the brake mechanism through piping, compresses springs and allows the brake-shoes to release their pressure upon the car wheels. It is obvious that should the supply of air for any reason become exhausted that the brake-shoes will be immediately forced against the car wheels by their springs. Extending throughout the train is a piping system termed the train line. Between cars the train line is joined by a hose called a jumper. Through this train line the air pressure is applied to the braking apparatus. Should the cars become detached accidentally, resulting in the rupture of this connecting hose, the compressed air will escape and immediately be followed by the automatic application of the brake-shoes bringing the car to rest. The supply of compressed air is obtained by electric pumps located under the floor of the car. The air pressure is maintained constant to within 10 pounds in the air reservoirs by an automatic governor. Formerly when one pump motor on one car started to compress air it took some time before the other motors on the remaining motor cars followed, but the National Electric Company and the Westinghouse Traction Brake Company have designed for the subway cars automatic governors so that when the motorman throws his pump switch and starts one of the pump motors the others follow almost immediately. Fig. 4 shows the bottom of one of the fireproof cars, showing the mechanism employed.

Safeguards—Provision Against Accidents.

Most serious of all the dangerous factors to be contended with is the danger from accident. The possible accidents which could occur are too many to enumerate. The motorman might run his train into the preceding one if the tunnel were not sufficiently illuminated, if he were unable to detect signals, or if he were incompetent. The train might be derailed by being run too rapidly around a curve, such as the one at Forty-second Street and Fourth Avenue.

These conditions have been considered and met by constructing the cars with a large vestibule at each end. The forward vestibule is at the disposal of the motorman when operating his car. He may therefore seclude himself from the annoyance of passengers by closing the doors and pulling down shades on the windows on both sides of him and in his rear. He is then in almost total darkness, the illumination being just sufficient to permit him to see his operating handles. Being alone, he devotes all his attention to the piloting of his train. The tunnel is dimly illuminated with electric lights placed behind the pillars so as to be invisible from the motorman's cab and of sufficient intensity to permit of the tracks being readily seen. By this system the motorman is not blinded by the glare of the lights and all signals stand forth boldly so as to be readily detected.

Elaborate Signal Systems for High-speed Express Trains.

There is one safety device in the subway equipment whose importance cannot be overestimated. This device is hardly noticeable to the casual visitor in the subway, as it is situated between the express tracks and occupies a small space. It is directly opposite the signal posts and is called the automatic safety stop. Its function is to stop automatically an express train as it tends to rush past a danger signal. Suppose for some unknown reason the motorman did not observe the danger signal. As the train, moving rapidly, passes the danger post a small upright projection on the side of the track rail (see arrow in Fig. 5) comes into contact with a tripping mechanism on the side of the car and opens a stop in the train-line, allowing the compressed air to escape and the brakes to be applied.

This automatic stop is upright only when the signal is set. If it is desirable to pass this signal a guard must descend from the train and insert a key in the device, which will allow of its being moved. The automatic stop is operated by compressed air from the signal post.

The express tracks are provided with signals at regular intervals, their location depending upon the traffic conditions. A maximum speed of 45 miles an hour has been considered as possible for express trains and the signals have been located accordingly. The distance between signals is equal to the braking distance of the car plus one-half the braking distance. The tracks are equipped with pneumatic switches with interlocking mechanism.

An additional safety feature is a device developed

FIG. 5. SIGNAL POST AND AUTOMATIC TRAIN STOP IN NEW YORK SUBWAY.

by Mr. George W. Gibbs, consulting engineer for the Interborough, by means of which the station attendant may instantly set the danger signals by running to a box (see Fig. 6) and throwing the various handles. In fact, the various safety devices are so numerous that they are almost indescribable.

In concluding I wish to emphasize the magnitude of this great undertaking, the completeness of the work to the merest detail and the skill which has been displayed by those called upon to participate in its development. It is with pride that we feel that to the American electrical engineer is largely due the credit for this wonderful development of the twentieth century.

[Other recent articles in the Western Electrician on the New York Subway are: "The New York Rapid Transit Railway," by Mr. Ashe, January 2, 1904; "Power Equipment of the Rapid Transit Company," September 17, 1904, and "The New York Subway Ready for Use," October 29, 1904.—Ed. W. E.]

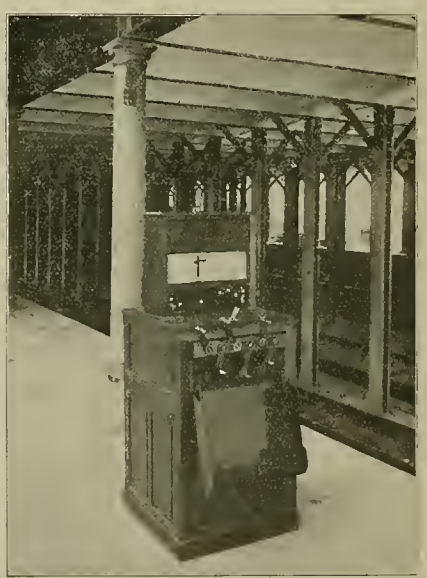


FIG. 6. SWITCH FOR SIGNALS AND INTERLOCKING IN NEW YORK SUBWAY.

Trade in Russia.

Electrical apparatus is said to be in increased demand in Russia, despite the war. New lighting systems, street-railway lines, etc., are being introduced. Germany is said to export almost 80 per cent. of the entire amount of electrical apparatus shipped to Russia. The sale of automobiles is growing rapidly, in spite of the rather poor condition of the roads. Only strongly built machines are wanted. French and German firms control most of the market, though a few English and Russian automobiles are seen. It is said to be advisable to ship the framework of the automobile in a separate casing from the other parts, in order to save duty.

WESTERN ELECTRICIAN

EVERY SATURDAY.

PUBLICATION OFFICES:
510 Marquette Building, • CHICAGO.
TELEPHONE, MAIN 1746.

Eastern Office, 193 Times Building, New York.
Telephone, 3806J Cortlandt.

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted. This paper is entered at the Chicago postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the **old address** as well as the new should be given.

CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—**the only general electrical paper published in the West**—thoroughly covers a territory *exclusively its own.* THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be furnished on application.

REMITTANCES.—All checks, drafts and other remittances should be made payable to the order of the publishers, the **Electrician Publishing Company**, and addressed to the offices of publication, Suite 510, Marquette Building (204 Dearborn Street), Chicago, Illinois, U. S. A.

CONTENTS OF THIS NUMBER.

Electric Coal-handling Apparatus on Dock at Superior, Wis. Illustrated 365, 366
Opening of the New York Subway 366, 367
The Proposed Chicago Subway 367
Work of the Telluride Power Company. Illustrated 367
Protection of Life in the New York Subway. By Sydney W. Ashe. Illustrated 368, 369
Trade in Russia 369
Editorial 370
Fuel Cost of Operating Steam Locomotives and Electric Railway Motors (White) 371
Successful Test of New York Central Electric Locomotive 371
American Institute of Electrical Engineers 371
Electrical Exports for September 371
Proposed Electric Railway Up Mt. Popocatepetl 371
New Oregon Power Company 371
The Telautograph. By James Dixon. Illustrated. With discussion. (American Institute of Electrical Engineers) 372, 373
Electric Motor on Swing Saw. Illustrated 373
Underground Railways. By William Barclay Parsons. (International Engineering Congress) 374
Copper Market 374
American Conduit Company's Booth at St. Louis Exposition. Illustrated 374
Shall the Trans-Siberian Railroad Be "Electrified"? 374, 375
Direct-connected Gas-engine Unit. Illustrated 375
Lamp-socket Ring. Illustrated 375
Advisability of Substituting Electric for Steam Traction. By J. G. White. (International Engineering Congress) 375, 376
Book Table 376
National Electric Light Association (Proceedings) 376
Raymond's "Alternating-current Engineering" 376
Ohio Telephone Notes 376
Telephone News from the Northwest 376
Southeastern Telephone Developments 376
Long-distance Telephone Line from Chicago to New York for Railroad Service 376
Telephone Development in Kansas and Oklahoma 377
Telephone Companies in New Brunswick 377
Extensive Telephone Merger in Texas 377
Extensions in New Mexico 377
New Companies 377
General Telephone News 377
Double-carbon Arc Lamp. Illustrated 377
St. Louis Street-railway Affairs 377
World's Fair Visitors of Last Week 377
Storage Batteries as an Adjunct to Central-station Equipment. By Gerhard Goettling. Illustrated. (International Electrical Congress) 378, 379

DEPARTMENTS.

Correspondence 379, 380, 381
Great Britain 379, 380
New York 380
New England 380
Texas and Mexico 380
Southeastern States 380
Michigan 380
Ohio 380, 381
Pacific Slope 381
Personal 381
Electric Lighting 381
Electric Railways 381
Societies and Schools 381
Publications 381, 382
Miscellaneous 382
Trade News 382
Business 382
Illustrated Electrical Patent Record 382, 383, 384

DATES AHEAD.

Electrical committee of the Underwriters' National Electric Association (annual meeting), 32 Nassau Street, New York city, December 7th.

Interstate Independent Telephone Association of America (annual convention), Auditorium Hotel, Chicago, December 13th, 14th and 15th.

VISITORS to the Louisiana Purchase Exposition at St. Louis who are interested in electricity or electrical literature are cordially invited to call at the booth of the Western Electrician, which is in Block 1 (Section 13) of the Palace of Electricity, just west of the main northern entrance to the building. Here will be found copies of the current issue of the paper, bound volumes of the Western Electrician from the first number, a careful selection of electrical books exhibited by the Electrician Publishing Company, and other objects of electrical interest. Chairs are provided for weary sight-seers, and an attendant will extend a hearty welcome to all readers or friends of the paper.

ELECTRICAL men throughout the state of Illinois are once more respectfully requested by their fellow workers in the city of Chicago to favor with their influence and their votes the proposed constitutional amendment to enable Chicago to get the new charter so urgently needed. This amendment is to be submitted to the voters of the state at the general election of November 8th. If this were a measure identified in any way with partisan politics, the Western Electrician, a technical journal, would have nothing to do with it. But it is not. All the great political parties are in favor of the proposed amendment, which is designed to give the second city in the United States a more scientific, modern and sensible system of self-government than the outgrown patchwork under which the city is now administered. Chicago simply seeks the opportunity of using municipal tools and methods adequate to its needs. There is no opposition to the proposed amendment, so far as we know, anywhere in the state. However, the proposition must receive the affirmative vote of a majority of all those voting at the election in all parts of Illinois or it will fail. The person who casts a ballot for a candidate for president and fails to vote on the charter proposition practically votes against it. It is for this reason that the friends of good government in Chicago—among whom, we take it, are all electrical men—are so anxious that the voters throughout the state, who are benevolently and patriotically, rather than directly, interested, should not overlook the charter amendment.

AFTER a quiescent period of several years, the telautograph is beginning once more to attract attention, and there are not wanting those who now observe it in operation for the first time and who believe that a new invention has sprung into prominence. At the Chicago World's Fair in 1893 the telautograph was exhibited in practicable form and attracted no little attention, and it was as early as 1886 that Cowper and Robertson brought the writing telegraph into fairly operative form. But the early telautograph, although in many ways useful and a really wonderful piece of mechanism, was too complicated and delicate for general use. During recent years it has been greatly simplified, and it is now attracting renewed attention. There are many uses to which the telautograph may be put where it has a real advantage over the telephone or the telegraph. A written message sent by telautograph may be read by anyone, while that sent by the telegraph can only be interpreted by one familiar with the Morse code. It has an advantage over the telephone in many instances where it is wished to preserve the messages, and this has been made use of in department stores to some extent within the last year or two.

An interesting paper appearing elsewhere in this issue describes the present-day telautograph. It was written by Mr. James Dixon and presented before last week's meeting of the American Institute of Electrical Engineers. One of the principal applications of the telautograph is in the United States coast-defense service for sending ballistic data, such as range and azimuth of target or character of projectile from position-finding stations to the gunners. The instruments designed for this service are made with water-tight cases, and it is said that the concussion of the heaviest discharges has no effect on the delicate parts of the instrument. The distance to which messages may be sent seems to be purely a matter of electrical resistance. The greatest resistance so far operated through has been 1,600 ohms and the longest line in operation is seven miles of submarine cable at Portland, Maine. Seven receivers in series relation may be worked from one set of rheostats, which makes possible the sending of seven messages simultaneously from a single station.

NEW YORK is patting itself on the back with great heartiness on the completion of its rapid-transit subway, and it certainly has a right to look pleased and to expect congratulations. The designing and building of the subway, so far as it is completed, has been a great work worthily performed. "The subway," by the way, is not quite accurate as a name, for a small part of the new rapid-transit railway is elevated on viaducts, while an extension from South Ferry goes in a tunnel under the East River to Brooklyn. However, the major portion of the route is traversed in an actual subway and the name is sufficiently distinctive for all practical purposes. The portion now complete and in operation is almost entirely in the actual subway. It extends from City Hall station to the station on the west side of the Borough of Manhattan at Broadway and One-hundred-and-forty-fifth Street. It is expected that the eastern division, which branches off at Onehundred-and-third Street, will be ready for operation as far as the station at Lenox Avenue and One-hundred-and-forty-fifth Street within a few weeks. Next summer, it is hoped, the portion of the Brooklyn division situated between City Hall Park and South Ferry in Manhattan will be ready for operation. No time is set for the completion of the subway to its northern terminal points. Work is thus in progress on the northern ends of the route and on the southern end, the latter constituting a part of the Brooklyn extension.

Now that a large portion of the subway is in use there is no need to repeat descriptions of the scope and execution of the work, which have formed the subject of a number of articles in this journal. It is certainly an undertaking of great magnitude, carried out at the initiative and under the direction of the Rapid Transit Commission of the city of New York, whose chief engineer, William Barclay Parsons, is entitled to the highest praise for the technical ability, energy and patience which he has displayed in designing and supervising the work. John B. McDonald is the contractor who did the work, and in a recent address, speaking of the engineering problems, he said that they constituted a herculean task, presenting difficulties and conditions not met elsewhere in all the world. "The narrow island of Manhattan, bisected by its streets, filled with water pipes, gas pipes and heating mains, electric ducts, pneumatic tubes, sewers, surface and elevated railways, and with its buildings constructed on foundations varying from shifting sand below the tide line to hard and seamy rock rising to high altitudes, and with the Harlem River interposing on its north line—all these were obstacles which the engineer had to meet and conquer."

The road, which is four-track for a considerable portion of its extent, is operated by electricity, of course, and is especially noteworthy for the number of protective devices in service. An article on this feature is presented in this issue of the Western Electrician. Current is supplied from a power house 694 feet long, 201 feet wide and 123 feet high, containing 11,000-volt three-phase alternating-current units. These units are of 7,500 kilowatts ultimate capacity each, and nine are in place or under contract. There are three turbo-generators for lighting. In an interesting paper on "Underground Railways," prepared for the recent International Engineering Congress and presented in abstract on another page, Mr. Parsons says of this station that "the total energy produced when the engines are worked to their full capacity, including the substitute engines, is 132,000 horsepower. This represents the largest steam-driven power installation hitherto constructed, and, as such, is interesting."

To New York the final completion of this rapid-transit system means much, not only in actual relief of the congestion of existing methods of transportation, but in the overcoming, in large measure, of the natural bonds which, owing to peculiar topographical conditions, have hitherto limited and impeded its growth. The city will receive the hearty good wishes of its sister municipalities and the country on the creditable public spirit, enterprise, financial strength and engineering ability shown in the rapid-transit subway.

Fuel Cost of Operating Steam Locomotives and Electric Railway Motors.

What follows is an extract from Mr. J. G. White's paper on "The Substitution of Electricity for Steam as a Motive Power," which was presented before Section F of the International Electrical Congress at St. Louis on October 4th.

Fuel account, under average conditions, should show little difference between steam and electric operation. A steam locomotive will ordinarily consume from 30 to 80 pounds of steam, and burn 3.5 to 10 pounds of coal per brake-horsepower-hour.

The electrical central station will produce power with a much smaller fuel consumption per indicated horsepower, but the losses in transmission and conversion are so great that this saving may largely disappear.

Below are given the probable efficiencies of transmission and distribution of power from the indicated horsepower of the engine to the brake horsepower of the motor for full rated and average loads, the latter being, say, about 70 per cent. of rated loads.

	Full-load Efficiency.	Average Load Efficiency.
Mechanical efficiency of engine	92	90
Generator	92	90
High-pressure transmission lines	95	98
Sub-station transformers	97	95
Rotary transformers	92	90
Low-tension distribution	85	92½
Motors	80	75
Total efficiency	48¾	47

Something less than half the indicated horsepower of the station engines is thus likely to be available at the motor-driving wheels to propel the train, while locomotives have a total average efficiency of about 65 or 70 per cent. (ratio of indicated horsepower to draw-bar pull).

While a large high-grade central station should show a fuel consumption of perhaps two to 2½ pounds per indicated horsepower-hour, the above average efficiencies would require about 4½ to five pounds of coal per effective horsepower at the driving wheels. These results are easily attainable with large and economical stations, and very large units of both turbines and reciprocating engines can now be purchased with guarantees that they will produce power, under test conditions, with a consumption of not more than nine to 10 pounds of steam per indicated horsepower-hour, or, say, 1¼ pounds of coal per indicated horsepower-hour.

Messrs. Arnold and Potter give partial results of test made with suburban locomotive making four trips daily between Grand Central Station and White Plains, N. Y. This locomotive spends approximately four hours per day in actual running, one hour per day in shifting, and is idle 19 hours per day. Coal burned during the whole 24 hours is charged, and it was shown that the total fuel consumption was the apparently high figure of 15.6 pounds of coal per effective horsepower-hour at the drawbar of the locomotive.

These gentlemen assume that the central station can generate power with a fuel consumption of 2½ pounds coal per indicated horsepower and a total efficiency (ratio of indicated horsepower to effective horsepower at drivers) of 50 per cent.; resulting in a total fuel consumption by electric motors of five pounds of coal per effective horsepower at the driving wheels of the motor cars. They, however, estimated that the total cost of power, including interest and depreciation on electric station and transmission system, would be about the same for either system.

From considerable data at hand, it is safe to assume that power can be produced in large high-grade stations and delivered at switchboard at a total manufacturing cost in the United States of 0.4 cent to 0.7 cent per kilowatt-hour, and a total cost, including interest and depreciation, of 0.75 cent to 1.25 cents per kilowatt-hour.

It is said that Manhattan Elevated power costs about one-half cent per kilowatt-hour at the station switchboard and two-thirds cent per kilowatt-hour at the train shoes, excluding fixed charges.

Successful Test of New York Central Electric Locomotive.

One of the electric locomotives built for the New York Central terminal service in New York city was tested at Hoffman's Ferry, near Schenectady, on October 27th. As far as it went the test was successful. In the cab of the locomotive when it left its shed were W. K. Vanderbilt, Jr., W. J. Wilgus, E. B. Katte, Hinsdill Parsons, president of the Schenectady Railway Company; W. B. Potter, superintendent of the railway department of the General Electric Company; E. D. Priest of the General Electric Company, A. F. Batchelder of the General Electric Company, and F. F. Eisenmenger, mayor of Schenectady.

A short run was made down the track at about 40 miles an hour, and then the private car which brought the New York Central officials to the scene was coupled on, and, with Mr. Vanderbilt at the controller, the full four miles of track was traversed. With his hand on the controller, Mr. Vanderbilt, like Mayor McClellan, appeared to be in his element, and he threw back the lever another notch, letting the engine forge ahead at 60 miles an hour.

The machinery worked well. The only cause for delay was insufficient current at the sub-station to start up the rotary converter for half an hour. The test was a preliminary one and more complete tests, including electrical measurements, will be made later.

American Institute of Electrical Engineers.

First of the season's gatherings and the first regular meeting under the presidency of John W. Lieb, Jr., the New York meeting of the American Institute of Electrical Engineers on October 28th was of much interest. Mr. Pope, the secretary, announced the deaths of Max Osterberg of New York and Prof. B. S. Lanphear of Ames, Iowa. He also stated that the chapter room in Carnegie Hall had been leased for the meetings of the remainder of the season. President Lieb made an introductory address, in which he called attention to the constantly broadening scope of the Institute. He felt that the work of the committees seldom received the appreciation which was due. He spoke of the International Electrical Congress and the visiting foreign electrical engineers and said that in the case of the Boston, New York, Philadelphia and Niagara Falls handbooks, distributed during the "circular tour," arrangements have been completed whereby these books will be put on sale. "While at St. Louis," continued Mr. Lieb, "where the Institute had its convention and a joint meeting with the Institution of Electrical Engineers, we were presented by the Institution of Electrical Engineers a very fine painting representing Sir William Gilbert before Queen Elizabeth, which will no doubt be a permanent ornament of our quarters when we shall occupy them in the new Union Engineering Building."

As chairman of the committee consisting of himself, B. J. Arnold and Dr. S. S. Wheeler, Charles F. Scott gave some details of the Union Engineering Building. He said that the plans of Architect Robert D. Hale—a son of Dr. Edward Everett Hale—of Boston had been chosen, to be modified, however, to meet the desires of the committee and its architectural adviser. Mr. Scott went on:

"The architect is meeting with the committee from time to time, and the plans are progressing. The sub-committee on building has had several meetings with him this week and everything is going nicely. We hope to be able to have the plans in a fairly matured shape so that they may be taken up with the board of directors for final suggestions and issued to the general membership before very long.

"A general outline of the building may be given at this time. It is to be on Thirty-ninth Street, midway between Fifth and Sixth Avenues, facing south. The entrance floor will have a large central corridor, with offices for administration, and the like, and in general it is to be a large assembling place for audiences coming in to find their way upstairs, and audiences upon being dismissed will not be crowded in a small corridor, but will have a large circulating place for leaving the building. There will be a carriage-drive around the whole building, covered on one side. The building itself will be practically free and open on all sides. At the east side Mr. Carnegie has generously purchased a lot and put a building restriction on it, so that there will be no house on the lot higher than four stories. That will give us light and air to the east above that perpetually. On the west there is planned a 10-foot space left vacant on our own property, so that will never be built upon, and on the rear there is a little space for the driveway at the back, so that, with the exception of a small area on one side, we will have air and light on all sides of the building.

"On the second floor there will be a large auditorium, seating somewhere from 1,200 to 1,500 persons. The plan is to have ample corridors around the meeting room, for circulation of visitors and for those who want to talk, who can then step outside the meeting room and talk there, rather than inside the meeting room. Above will be some smaller lecture halls. One of these will be in amphitheater style, so that any experiments or demonstrations can be readily seen. There will be some smaller halls also, for smaller meetings. The upper floors will be set aside for the various societies, for the use of secretaries, board rooms, etc. And, if it is pleasing to the societies, there will be some facilities for one or two rooms fitted up in club style, which will make them a comfortable place to sit and talk, with a writing and reading room.

"There will be ample room for the other societies which desire quarters in the building. There are a number of branches of engineering societies in existence now which will undoubtedly desire quarters in the building, such as railway clubs, chemical societies, societies of gas engineers, societies of municipal engineers, and the like. There are some dozen or more that were communicated with last year, and they were found to be acceptable to the idea of their coming in and sharing the building. At the top there will be a large library, with overhead light over the reading room on the upper floor, with stack room just below. At the suggestion of the general building committee the several societies have appointed a general committee on library, the idea being to bring the libraries of the various societies together and make them the nucleus for a great engineering library. That work is under way and something notable can be hoped for in that direction.

"One other line of work which received a great deal of attention is that of organization—a way in which these three societies shall be united to hold their property which is coming to them and purchasing the lots and holding title to the lots and the building. The plan determined upon is the formation of a separate organization, under the title of the United Engineering Society, which has been authorized by a law passed by the New York Legislature at the last session. This United Engineering Society is to be composed of three representatives from each of the so-called founder societies. By-laws for the government of this society have been drafted, and these by-laws have been submitted to the several societies and have in general received their indorsement. There are a few particulars which are being looked after, but there is a substantial agreement on the matter, and the consummation of the plan may be looked for in the near future; so that the building in its plans and the building in its organization is progressing nicely."

President Lieb found it necessary to depart to represent the Institute at the dinner of the Department of Electrical Engineering at Columbia University. Vice-president Calvin W. Rice occupied the chair for the remainder of the evening. Two papers were read, one on "The Telautograph," by James E. Dixon, engineer of the Gray Telautograph Company, and the other on "The Transposition of Electrical Conductors," by Frank F. Fowle of the American Telephone and Telegraph Company. Both were discussed. The telautograph paper, with an abstract of the discussion, is given elsewhere in this issue.

Electrical Exports for September.

Electrical exports from the United States for the month of September amounted to a total value of $841,836. Of this amount, $349,421 represents goods classified as electrical appliances, including telegraph and telephone instruments, and $492,415 represents the value of electrical machinery exported during the month. The total amount shows an increase of $150,416 over September, 1903, and the increase is due to the large amount of electrical machinery exported last month. A comparison of the figures is as follows: Electrical appliances—September, 1903, $369,642; September, 1904, $349,421. Electrical machinery—September, 1903, $321,778; September, 1904, $492,415. Thus it is seen that appliances fell off $20,221, while machinery increased $170,637.

Classified according to destination, the following countries were the principal foreign buyers of American electrical machinery in September last: British North America, $99,352; United Kingdom, $97,159; Mexico, $61,747; British Australasia, $58,116; Japan, $24,519; Germany, $17,419; British Africa, $16,717; France, $16,054; British East Indies, $15,592; Brazil, $12,143; Central American States and British Honduras, $11,961; Cuba, $5,114; Argentina, $4,400; Philippine Islands, $1,480.

Proposed Electric Railway Up Mt. Popocatepetl.

Captain Charles Holt of New York, who, as the representative of a syndicate of New York capitalists, recently purchased Popocatepetl volcano from General Sanchez Ochoa of the City of Mexico for $300,000 gold, says that the same syndicate will build an electric railway from the City of Mexico to Puebla. He says that Domingo Barrios, who recently obtained a concession from the government for the construction and operation of the proposed railway, was acting on behalf of the New York syndicate. It is planned, according to Captain Holt's statement, to not only build an electric line to Puebla but to build a branch line up Mount Popocatepetl to its summit, and to health and pleasure resorts which the syndicate proposes to establish in the vicinity of the mountain. The company which will undertake these extensive improvements and operations is now being organized in New York. It will have a capital of $5,000,000 gold.

New Oregon Power Company.

Local capitalists have filed articles of incorporation at San Francisco of the Southern Oregon Power Company. The capital stock is $500,000, fully paid up by the incorporators. Jesse W. Churchill of Yreka is president and Alexander J. Rosborough of Oakland is secretary of the company. Frank H. Ray of New York is among the directors. The company will do business in the Rogue River Valley in Southern Oregon. The dam and power house at Gold Roy on Rogue River are finished and the power line is already built to Medford, Ore. The company is a sister company of the Siskiyou Power Company of Northern California, and both companies are under the same management. The company expects to complete the entire project in six months and expects to find an active market for its output in the mines, lumber districts and for irrigation. It will also light the town of Jacksonville.

The Telautograph.[1]

By James Dixon.

Electrical transmission of handwriting has engaged a certain amount of attention ever since telegraphic transmission of printed characters was successfully carried out.

As early as 1886 Cowper and Robertson brought the writing telegraph into a fairly operative form. This instrument was adapted to operate several receivers in series in "reporting" service, where the regular news-ticker service was unobtainable or too expensive. The system was put to some use, chiefly in Pittsburg and vicinity.

The writing was received on a paper tape, advanced at constant speed by clockwork. No pen-lifting device was provided and the words were connected together by a mark of the pen, making figure-work poor. As the characters were formed by the combination of the pen motion and the tape motion, a certain amount of practice and skill was required to produce a legible message.

The electrical features were as follows: Two independent variable currents were obtained from the transmitter; these passed over lines to the receiver, where they traversed two electromagnets set at right angles to each other, and so influenced their effect upon a common armature as to cause the receiver-pen rod to reproduce the motion of the transmitter pencil.

It will be noted that this principle is nearly identical with that of Grüllu's telechipograph, recently described in the technical press, the main differences being that the telechipograph writes upon a larger field and uses a beam of light and photographic record instead of a pen with ink record.

Following the writing telegraph, Prof. Elisha Gray constructed, at his Chicago laboratory, an instrument which wrote upon stationary paper, and which he called a teleautograph. It required four line wires and operated as follows: By means of cords and drums the motions of the transmitting stylus were resolved into two component rotary motions which were used to operate two mechanical interrupters in the primary circuits of two induction coils. The relations of the parts were such that a motion of the transmitting stylus amounting to one-fortieth of an inch caused a complete make-and-break at one or both of the interrupters.

The line currents were the impulses produced in the secondary circuits of the induction coils. These impulses passed over lines to two electromechanical escapements in the receiver. By means of cords and drums their motions were combined and caused to act upon the receiver pen. By the use of relays and condensers and a local battery at each receiver the paper was advanced when necessary and the pen lifted from and lowered to the paper. The mechanical difficulties met with in perfecting this instrument were very great, and in the apparatus exhibited at the World's Fair in Chicago in 1893 the escapement mechanism was brought to a perfection thought impossible of attainment only a short time before. The writing showed a saw-tooth or step-by-step character, due to the action of the escapements. The instrument was abandoned on account of the number of line wires required, limited speed, numerous fine adjustments, and cost and difficulty of manufacture.

In 1893, while still working at the escapement device, Professor Gray patented a variable-current instrument, using two line wires, which worked, in a general way, like the present telautograph. The motions of the transmitter pencil were resolved into two components, which were used to vary two line currents, the variable resistances being carbon rods dipping into tubes of mercury. The receiver contained two d'Arsonval movements to the moving elements of which the pen-arms were attached. Professor Gray never developed this instrument much beyond the laboratory stage, probably on account of his firm belief in the escapement type.

Foster Ritchie, at that time an assistant to Professor Gray, gave considerable attention to this patent and perfected an instrument based on it. He obtained a patent for improvements and has produced an instrument that operates in a fairly satisfactory manner under certain favorable conditions.

The telautograph has been brought to its present state chiefly through experimental work done by, or under the personal direction of, Mr. George L. Tiffany, to whom several patents for improvements have been granted. Mr. Tiffany's instrument operates upon the variable-current principle, and includes a number of interesting features, among them what may be called a straight-line d'Arsonval movement, which is used to operate the receiver.

The operation may be briefly described thus: At the transmitter a pencil is attached by rods to two lever arms which carry contact rollers at their ends. These rollers bear against the surfaces of two current-carrying rheostats, connected to a constant-pressure source of direct current. The writing currents pass from the rheostats to the rollers and from them to the line wires. When the pencil is moved, as in writing, the positions of the rollers upon the rheostats are changed and currents of varying strength go out upon the line wires. At the receiver these currents pass through two vertically movable coils, suspended by springs in magnetic fields, and the coils move up or down, according to the strengths of the line currents. The motions of the coils are communicated to levers similar to those at the transmitter, and on these levers is mounted the receiver pen, which, by the motions of the coils, is caused to duplicate the motions of the sending pencil. Fig. 1 shows the circuits of the instrument.

Many of the principles and devices in the instruments are of considerable interest. The method by which the variable currents are obtained is the laboratory arrangement for securing a variable pressure from a direct-current, constant-pressure circuit; that

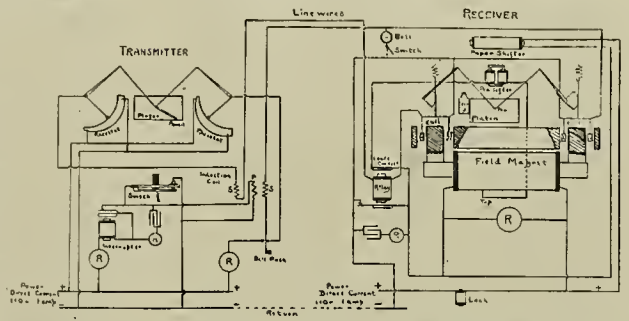


FIG. 1. OPERATING CIRCUITS OF THE TELAUTOGRAPH.

is, the line circuit (of constant resistance) is connected as a shunt around that part of the rheostat between the moving roller and the ground or return. Motion of the roller varies the amount of resistance in series with the line and also the amount in parallel with it and fine gradations are easily obtained, giving smooth motion of the receiver pen. In this way a variable pressure is impressed on the line circuit, giving a variable current. In all the other variable-current instruments, a constant pressure was impressed on the line and a resistance in series with the line varied to give the desired variations in current. One result of the shunting method is a better form of rheostat, more easy of construction and handling, in which, also, the heating is better distributed.

The rheostats are wound upon castings of I cross-section, with the turns of wire lying close together on the inner or contact face. After winding, the insulation on this face is saturated with glue, which is allowed to harden and is then scraped off, taking the insulation with it, and giving a surface where contact is possible on every turn of the wire. This gives a rheostat of a large number of small steps, of good mechanical construction, and of low cost.

The receiver operates with what may be called a straight-line d'Arsonval movement. The moving element or coil is wound upon a copper shell for damping effect. The magnetic circuit is so arranged that one pole surrounds the other, forming an annular air gap of short length and large cross-section in which the direction of the flux is radial. The field is electromagnetic and is highly excited, to secure uniformity. The coil, suspended in the annular space, moves up or down with little friction, as it touches the sides of the space of the core very lightly, if at all. The principle is the well-known one that a current-carrying coil in a magnetic field tends to place itself with respect to the field so that the flux enclosed by the coil shall be a maximum.

The current for operating is taken from the ordinary lighting mains, preferably at about 115 volts. Satisfactory operation has resulted with pressures from 80 up to 250. At 115 volts, receiver and transmitter each require about one ampere while in operation. Fairly steady pressure is necessary, as the receiver, being in effect a voltmeter, is rather sensitive to sudden changes, the effect being slight distortion of the message.

A master switch at the transmitter is provided to do all necessary switching of line and power circuits, to make needed changes in connections and to cut off current when not writing. A relay in one of the lines closes the power circuit of the receiver whenever the transmitter at the distant station is switched on, and serves to prevent waste of current when not in operation.

Attached to the master switch is a mechanical device, which shifts the transmitter paper the space of one line of ordinary writing for each stroke of the switch. The relay mentioned controls the electrical receiver paper shifter, and, as each stroke of the switch causes a stroke of the relay, the receiver paper is shifted an amount equal to that at the transmitter. The writing space is about two inches long and five inches wide, allowing for three or four lines of writing. When filled by messages a few strokes of the switch serve to bring fresh paper into position at both receiver and transmitter.

To prevent switching on of the transmitter while its home receiver is receiving a message from the distant station, an electromagnetic lock is connected in the receiver power circuit, controlled by the relay, and locks the home transmitter in the "off" position until the distant transmitter is switched off. If both transmitters were switched on at once neither station would receive any message; the lock is provided to render this condition impossible.

The ink supply is most important, and is arranged for as follows: At the left of the receiver platen is a bottle with a hole in the front near the bottom. When filled with ink and tightly corked the ink does not run out of this hole, because of the pressure of the atmosphere. The ink is accessible for the pen at the hole, and the surface of ink exposed to evaporation is small.

The pen is made of a piece of german silver bent double, after the manner of a ruling pen, and makes a uniform line in any direction over the paper. It takes up its supply by capillary attraction, from the hole in the front of the bottle. When the receiver is switched off, retractile springs draw the pen-arms to stops so arranged as to bring the pen exactly in front of the hole in the bottle, and when the pen-lifter armature is released the pen is caused to insert its tip in the opening. Thus a fresh filling of ink is obtained each time the paper is shifted. When not in use the pen rests in the ink, always ready to write.

For the prevention of mechanical shocks to the necessarily light-moving system of the receiver, it has been necessary to supply means to prevent the switching on or off of the transmitter, and by that action of the receiver, when the transmitter pencil is "out in the field;" that is, at a position other than that corresponding to the opening in the receiver ink bottle, as in that case the receiver pen would instantly jump to a similar position. This position is called the "unison point," a term having its origin in the days of the "self-propeller" escapement, telautograph. By placing a catch, released only by pressure of the pencil point upon it at the transmitter unison point the desired result is accomplished and the transmitter master switch cannot be switched either "off" or "on" unless the pencil be placed at the unison point and held there until the stroke of the switch is completed. In this case, as everywhere, the apparatus is made strong enough to stand any possible shocks, and then every precaution is taken to prevent their occurrence. Aside from shock to the moving system, these jumps might shake the ink supply out of the pen and prevent the recording of the message.

The pen-lifter is a magnet placed back of the receiver writing platen, and carrying upon its armature a rod adapted to engage with the pen-arm rods and raise the pen clear of the paper when the magnet is energized. This magnet is controlled from the transmitter as follows: Beneath the transmitter platen is a spring contact, opened by pressure of the pencil upon the paper, and closed by a spring when the pencil is raised. An induction coil having an interrupter in its primary circuit is so connected to this spring contact that when the pencil is raised the primary winding is short-circuited. The induction coil has two independent secondary windings through which the two variable line currents pass before leaving the transmitter. The effect of the induction coil and its interrupted primary current is to induce in the two line currents superimposed vibrations or "ripples" when the pencil is pressed down on the paper and the spring contact is open. When the contact is closed by its spring and the primary winding is cut out no vibrations are produced in the line currents. In one of the line wires, at the receiver, is placed a relay upon whose sheet-iron diaphragm armature is mounted a loose contact, consisting of two platinum-silver contacts in series, sealed in a glass tube, to prevent oxidation. A local circuit contains the winding of the pen-lifter magnet and this loose contact.

When the vibrations are present in the line current, due to the pressure of the pencil upon the paper and consequent opening of short-circuit of the primary of the induction coil, the diaphragm of the relay is shaken, the loose contact opened, and the pen-lifter is de-energized, its armature is drawn back by a spring and the pen is allowed to rest against the paper. When there are no vibrations in the line currents due to the raising of the pencil from the paper, the relay diaphragm is at rest and the pen-lifter is energized and the pen is lifted clear of the paper.

The superimposed vibrations used for operating the pen-lifter have another minor effect. The suspended coils, and through them the entire moving system of the receiver, are kept in a state of very slight mechanical vibration while the pen is on the paper. This aids the flow of ink from the pen point, assists the pen in passing over any roughness or irregularity in the surface of the paper, and materially reduces friction in the joints or pivots of the moving system, and results in better writing. In some of the later instruments the two relays—that for pen lifting and that for paper shifting and power switching—are combined in a single piece of apparatus.

For signaling, a push-button is placed upon the transmitter, and a call-bell or buzzer is mounted on the receiver. This circuit is disconnected by the master switch while a message is being written. Spring reels are attached when needed to roll up the received messages for preservation and future reference.

The ordinary arrangements for operation are as follows: The instruments may be operated singly, upon a private line having an instrument at each end, or on an exchange system where a switchboard provides for connection. Working in this way, sat-

1. A paper presented at the meeting of the American Institute of Electrical Engineers, New York, October 28, 1904.

isfactory writing has been obtained with a resistance in each line wire of 1,600 ohms and an operating pressure of 110. Multiple operation can be carried out to a limited extent, three receivers being at present the maximum number that can be operated at once, in multiple, using 110 volts. This allows of placing a supervisory machine upon a line.

When no response to messages, beyond a bell signal, is required, and the same message is to be sent to a number of stations, a series arrangement of receivers is used. With a transmitting pressure of 110 volts a maximum of seven receivers can be operated from a single pair of transmitting rheostats and rollers. This number may be increased by increasing the pressure or by adding additional rheostats and rollers, operated by the same pencil. Using both these methods, a maximum of 50 or more receivers may be operated at once.

Instances in actual commercial use of the arrangements of instruments mentioned are: Private lines; the transmission of mail and other orders from office to factory or yards; investigation of checks over lines between paying tellers and bookkeepers in banking concerns, and transmission of messages, usually in cipher, between brokerage firms and cable or telegraph offices. A few moments' thought will bring to mind many places where a telautograph private line could be used to save time and trouble, especially where accurate transmission of figures is essential.

Multiple operation may be resorted to when a third station upon a line desires a record accessible at any time, of what is being sent, as, for instance, when one of the officers of a bank desires to know what passes between his bookkeepers and paying tellers. On such a line the third station receives all messages and can write to either or both of the other stations, should the necessity arise.

Series operation may be used when several stations are to receive the same message and no response except a bell signal is required, as in sending orders in a hotel or club from dining room to kitchen, pantry and wineroom; in "reporting" or news service, or for bulletin work, such as the announcement of arrival and departure of trains to a number of stations in a large railway station or freight depot. Fig. 2 shows the standard commercial instrument.

One of the most important uses for series systems

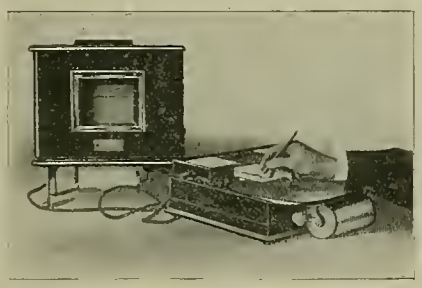


FIG. 2. THE TELAUTOGRAPH.—TRANSMITTING AND RECEIVING INSTRUMENTS.

has been found in the United States Coast Defense Service, in sending ballistic data, such as range and azimuth of target, or character of projectile from position-finding stations to the gunners. This is called "fire-control communication," and is installed in the forts by the United States Signal Corps. In a paper presented [before the Institute] by Col. Samuel Reber on "Electricity in the Signal Corps" [see Western Electrician of June 21 and June 28, 1902] will be found a description of the position-finding systems and the desired characteristics of a system of communication for sending this data to the guns are stated as follows: "The system that will successfully solve this problem must be simple in construction, mechanically strong, so as not to be affected by the blast, as the receivers are placed close to the guns, rapid in operation, and give a character of record that can be read without liability of error." Since that paper was prepared it has been decided that the receivers must be mounted directly on the gun carriage and can have no shelter other than that afforded by their own cases. Add to these requirements the fact that the instruments must be cared for by post electricians, and operated by enlisted artillerymen, messages must be visible at night; and the operation must be independent of rain, salt mists, cold, heat, or tropical insects, and it is apparent that no easy problem is presented.

A special type of telautograph has been designed for this service and has been adopted by the United States Signal Corps for fire-control communication.

In this service "telautograph" the rather delicate pen-lifter relay is eliminated and the receiving pen-lifters are operated over a third line wire by the transmitter platen switch directly.

Each gun receiver is enclosed in a watertight brass case, suspended by springs from the gun carriage directly in front of the gunner. The parts are, as far as possible, made "brutally strong," and the construction is as simple as possible.

The desired rapidity of operation is inherent to the telautograph, and accuracy of record is insured by careful writing and by the use of a "home" receiver, mounted at the transmitter, where the operator can see it plainly, which is connected in series with the gun receivers and records the messages as actually sent over the line.

Freezing of ink is prevented by the addition of alcohol; and rain, mists and insects, as well as the effects of the blast, are shut out by the metal case. A heavy glass window is placed in the case, so that messages can be read without opening the case.

A small incandescent lamp inside the case lights automatically when the receiver is writing and may be lighted by pressing a button at other times, thus providing for visibility at night. Fig. 3 shows the army type of receiver mounting.

On warships there is a somewhat similar service to be rendered, and the performance of this should fall to the army type of telautograph.

Commercial service has given opportunity for the installation of a considerable number of private-line telautographs in actual use, and at least three of each of the other typical installations are in operation at the present time.

Much of the improvement in details of construction and reliability in operation has resulted from ex-

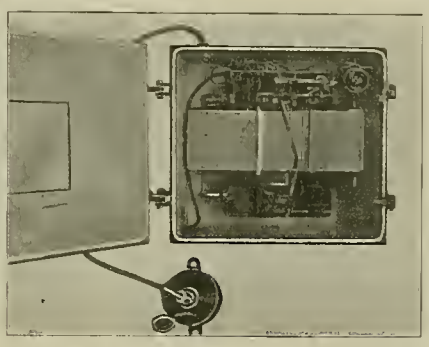


FIG. 3. THE TELAUTOGRAPH.—ARMY TYPE OF RECEIVER MOUNTING.

perience gained in efforts to perfect the service of these commercial plants. The experience leading up to the special army type of telautograph has extended over a period of about five years, and in the present instrument all the requirements, unusually severe as they are, have been successfully fulfilled.

DISCUSSION.

C. O. Mailloux, New York: I ask what is the longest distance which has been attained and what are the prospects of longer distances?

Mr. Dixon: The distance is apparently purely a matter of resistance, and the most we have worked with so far is 1,600 ohms on each line working. The longest line in actual operation was seven miles, submarine cable, at Portland, Maine, for the army. The army instruments are somewhat specially made, as they have to work outdoors without any protection at all, so we put them in a brass case. They have to be visible at night, and there is a lamp which lights at the time the machine is writing.

E. B. Fahnestock, Brooklyn: How does a variation in the insulation of a line affect the work?

Mr. Dixon: It will affect the shape of the fields to some extent. If it is uniform on both lines, it can be provided for with a line adjuster fastened to the transmitter. In the army work there is a receiver mounted before the eyes of the sender, and he can see what is going to the line. If he finds the field is getting out of shape he can adjust the lines, and take care of that. In commercial work we have not had any difficulty with these things, as yet, as the insulation has been good on all the lines we have worked.

Mr. Bates: Will Mr. Dixon tell us if it is possible to send a message to several different stations at the same time?

Mr. Dixon: This set consists of seven receivers. There are only two here represented in the experiment. We can manage seven receivers with one pair of rheostats. Where there are a larger number than seven to be operated, we double up the rheostats and have a couple of transmitters; but we can take care of seven receivers from each pair of rheostats. We also, within certain limits, operate on multiple—that is, we can handle four receivers in multiple by using high resistance in the suspended coils instead of the low-resistance ones that we use generally. There is a limit to the amount of wire we can get on, and the weight we can permit in the coils to carry the weight back and forth.

A. C. Crehore, Yonkers, N. Y.: I ask whether it is an error in the paper, stating that one ampere is required?

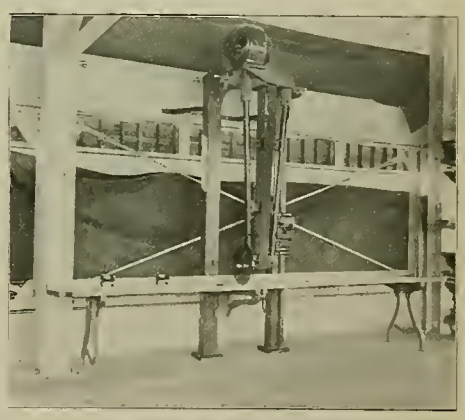
Mr. Dixon: No, sir; that is correct. The rheostats have about a quarter of an ampere, the induction-coil circuit about one-eighth, and the variable line currents may get as high as one-quarter each, which will make it one ampere. In the receivers the field-magnet winding, excited from the direct-current circuit, has 180 ohms, and the resistance of the paper shifter has about 500, and it takes about an ampere there. The maximum current on the line in an ordinary set is about one-third of an ampere, an average of about two-tenths on each wire.

Townsend Wolcott, New York: These army instruments were designed especially for the Signal Corps, and, as Mr. Dixon said, one of the principal requirements is that they should be able to withstand the concussion of the guns. We had some doubt at first whether the instrument would stand it, but so far it has withstood any explosion we have had. We have not had any real warfare since we have used the instruments, but in all the experiments we have made they have come out all right. The explosion of the guns does not interfere with the writing. It did at first spatter the ink, but that has been remedied. The springs take care of a good deal of the jar. A year ago last summer, at Portland, during the maneuvers, they fired at a scow. The rangefinders look at the vessel and take the range. At the end of a certain interval of time, say a minute or so, they observe the position again, and after two or three observations, the position where the vessel will be at the end of the next 30 seconds is predicted by calculation, and that information is sent to the gunners. That is the use of the telautograph, to send the information to the gunners. The gunners aim the guns to the position indicated, and then, when the signal to fire comes, they discharge without seeing the object at all. Somebody made a mistake and wrote a 3, which looked like a 5, and the gunner saw it, and came near making a real hit, but that was not the fault of the instrument; it was the fault of the man that did the writing. He should have written so that the gunner knew what he meant.

Mr. Dixon: In regard to the shock to these particular instruments (the instruments used in the demonstration), I will say that they were on the battleship Alabama for several weeks, and the men tried to use them up. They put them as near the middle as they could get them of a 13-inch gun, and trained the gun parallel to the instrument, but they did not seem to discover any faults in the instrument at all.

Electric Motor on Swing Saw.

A desirable location for an electric driving motor was secured in the swing-saw outfit shown in the accompanying illustration by slightly modifying the yoke casting of a standard swing saw built by M. B. Tidey of Newark, N. J. The motor, as shown, is mounted above and attached to the frame, with which



ELECTRIC MOTOR ON SWING SAW.

it swings. It is of the semi-enclosed, shunt-wound type manufactured by the Crocker-Wheeler Company, Ampere, N. J. When run at full speed (1,170 revolutions per minute) four horsepower is developed by the motor, which drives the 18-inch circular saw, through a belt connection, at approximately 2,500 revolutions per minute. The motor is mounted so that its center of gravity is one inch forward of the center line of the trunnions on which the frame swings. The result is that when not in use the saw swings back out of the way, thus eliminating the use of the customary counterweight.

In the picture the frame is shown held in working position so as to give full view of the saw, but ordinarily, when not in use, it swings back, clear of the table, against a stop. The bench is of hardwood, supported at the ends by cast-iron legs and at the center by a bracket, as shown in the cut. It is graduated in inches and has two adjustable stops to facilitate the cutting of lengths in duplicate. The equipment, controlled by a starter, shown mounted on the right-hand upright, at the operator's constant command, makes a very compact and convenient unit.

Considerable progress has been made in the work of utilizing the water of the Tequixquiapam springs, in the state of Queretaro, Mexico, for power purposes. The water of these springs will be conveyed through a canal to the agricultural regions of San Juan del Rio after it has first been used to generate electric power. The power generated at Tequisquiapam will be conveyed to the city of Queretaro by transmission lines and will be used to light that city and to operate factories and other industries. Engineer H. Alcocer is in charge of the construction of the works.

Underground Railways.[1]

By William Barclay Parsons.

In the United States there have been constructed or put under construction only three underground railways for local transit. While it is difficult to establish rules of practice from three examples, nevertheless, as these lines differ in many respects, in feature of design and construction, from similar lines in Europe, these different characteristics can be set down as determining the tendency of American practice. The three railways referred to, in order of their construction, are as follows:

	Miles Constructed.	Miles Under Construction.	Total.
Boston	3.1	1.2	4.3
New York	15.5	3.5	19.0
Philadelphia	....	2.0	....

In addition to the above mileage, which is exclusive of elevated or viaduct extensions, very extensive additions are being considered for New York, and some additions in both Boston and Philadelphia. These extensions will be constructed in accordance with the same standards as the lines already in operation.

The characteristic features of these railways, and in which they differ from European practice in similar railways, are:

1. Near approach to the street surface.
2. The use of steel beams in walls as well as in roofs.
3. Simplicity of design in steel structure.
4. The use of concrete instead of brick or stone masonry.
5. The use of reinforced concrete.
6. The addition of extra tracks for express or special service.
7. A freedom in design whereby the general type of structure is changed to meet local requirements.

The three lines under consideration have each, for a portion of the route, more than two tracks. In Boston the additional tracks made a four-track line, all four tracks being intended for (and were for several years used for) trolley cars which became surface cars after passing the limits of the subway. At present two of the four tracks are used temporarily by trains running over elevated structures in the outlying districts, but, as soon as a new neighboring parallel subway can be built, the "elevated" trains will be placed in it and all the tracks of the old subway will be restored to their original use. The arrangement in Philadelphia is similar to the present arrangement in Boston.

In New York the additional tracks are provided to furnish express facilities, so that in the same railway two kinds of service are provided, one for local needs, that is, trains stopping at intervals of about one-fourth mile, and the other for a longer distance travel, with stops averaging 1½ miles. The local trains make an average speed of about 15 miles per hour, the express trains, owing to the fewer stations, a speed of about 30 miles per hour, time lost in stops included in both cases. For the seven miles traversing the portion of the city where there is the densest traffic, this four-track arrangement permits the running of express trains in both directions. Beyond this section three tracks on two diverging lines are provided, enabling an express service to be furnished in the direction of major traffic; that is, southward to the commercial district in the morning, northward to the suburban residential district in the evening. In order that full advantage may be taken of this opportunity for fast service, the trains in New York are equipped with a greater amount of power than has hitherto been realized in actual practice. The trains are to be self-contained as to power, that is, propelled by motor cars and not by locomotives. The motor cars have each two 200-horsepower motors, and the train make-up is so adapted that an express train will consist of five motor cars and three trailers. Each motor car weighs when loaded with passengers 43½ tons, and the trailers 33 tons, or, say, 316½ tons for the train complete. The nominal horsepower per ton of trains is therefore 0.32. This power, however, can be increased greatly during the period of acceleration, when there will be available about 10 horsepower per ton of train.

The American underground railways have been designed to accommodate two kinds of traffic, either train and individual surface cars, or express and local trains, and therein they present distinctly different characteristics from underground railways of other countries. This basal feature in design inevitably involves varying designs in structure, in order that the two services may be accommodated satisfactorily and mutually. Stations of different types are at once involved; depressed tracks to make junctions with the central tracks and avoid rail crossings of the upper ones are necessitated. When once the uniformity of design has been broken, other variations will always follow. Therefore, although the general type of American underground railway can be said to be a structure with a flat roof supported by rows of columns between the tracks, the designers of the subway have not hesitated to depart from this standard whenever local conditions gave proper warrant for so doing, and in considering American practice this freedom of variation or departure is a characteristic to be borne in mind. Thus, in Boston, of a total mileage of 4.3 miles, 45 per cent. is in two-track standard or reinforced concrete, flat-top section; 15 per cent. is in four-track standard section; 18 per cent. is in two-track arch section, some built in cut and cover and some by a half-shield, and 22 per cent. is in sub-aqueous arched work under compressed air. Similarly, in New York, the total length of subway constructed or under construction is divided among the following types:

	Miles.
Single-track, Arched	0.14
Double-track, Standard	4.17
Double-track, Arched	3.95
Double-track, In single tubes	1.36
Three-track, Standard	2.20
Three-track, Arched	0.17
Four-track, Standard	5.64
Four-track, In two-track arches	0.38
Five-track, Standard	0.74
Eight-track, Standard	0.25
Total	19.00

The last two types cover yards and sidings. Of all the above 14.22 miles are in cut and cover, 3.42 miles in ordinary tunnel, counting the four-track work in double tunnels as the equivalent length of actual tunnel, and 1.36 miles in tubular tunnel, for the most part under compressed air. In the case of both Boston and New York, in addition to the above variations in type of structure, there are many minor variations, all requiring special treatment, such as cross-overs, tracks passing beneath other tracks, loops, etc.

The permanent way consists of wooden ties, not preserved except as protected by tie-plates, laid in fine broken-stone ballast and carrying heavy rails, the heaviest section being used in New York, where the weight is 100 pounds per yard. In order to maintain a fast-running service at the minimum interval, automatic home and distance signals are adopted, and, in addition, an automatic device whereby if a motorman overruns a signal, power is at once cut off the train and the brake is applied.

In operation usual American practice is followed. There are no classes, and a uniform fare of five cents, regardless of distance is charged, while the cars are of the ordinary type with end doors. Both end and middle doors are used in Boston. In order to reduce to the minimum the chance of fire the cars for the New York subway were designed with a metal underframe, and the floor is covered on the underside with a special asbestos product. All wiring is carefully done; parts subject to short-circuit are separated, and all points of electrical connections are isolated in asbestos fireproof cases. Work, however, has been begun on an all-metal car of which there is every promise of ultimate success, and, at a cost and of a weight no greater than a well-built composite car as described above.

Power is universally electric, and furnished to the trolley cars by the usual overhead wire and to the trains by a third rail. On the trains the power is utilized on motor cars, the motor cars being under a multiple-unit control. The power is carried through the subways, in the case of New York and Philadelphia, by cables drawn through terra-cotta ducts built in the side walls, and thus protected fully against damage by train derailment. The cables are led to the ducts through manholes from the street surface directly. The power itself is produced in large central stations by alternating-current dynamos of the ordinary type, sending out the current at high voltage (11,000 volts), transformed and reduced in sub-stations to direct current at 550 volts, at which pressure it is fed to the line. In size such central stations attain large proportions. In order to supply the necessary power for the rapid-transit service in New York, on 68.6 miles of running track, partly underground and partly elevated, the main power house is 693 feet long and 210 feet eight inches wide, and 123 feet high. It contains, as the basis of the main plant, 11 generating units rated nominally at 5,000 kilowatts, and capable of delivering, at the time of maximum load, 7,500 kilowatts each. Each is operated by a separate engine with a capacity of from 7,500 to 11,000 horsepower. These generators are of the three-phase, alternating-current type, 25 cycles per second, and operating at 11,000 volts. The total energy produced when the engines are worked to their full capacity, including the substitute engines, is 132,000 horsepower. This represents the largest steam-driven power installation hitherto constructed, and, as such, is interesting.

[1] An abridgement of a paper presented before Section C of the International Engineering Congress at St. Louis on October 5, 1904. The author is chief engineer of the Rapid Transit Commission of New York city.

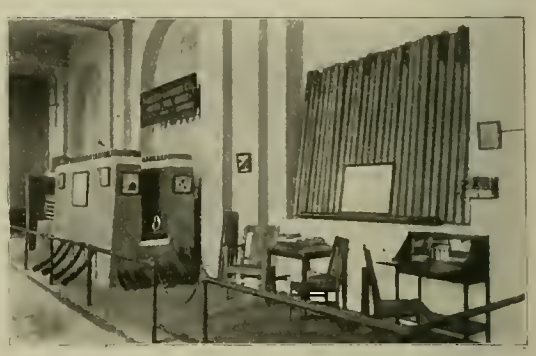
Copper Market.

Copper for weeks has gradually been improving, and prices during the latter part of October were the highest since the month of May, being 13¾ cents a pound for electrolytic wire bars and 13¾ to 13⅜ for Lake. A month before electrolytic was 12.65 to 12.75 cents and Lake 12⅝ cents a pound. Unusually large exports kept stocks down in this country to a safe limit, and the position of copper from the sellers' point of view is very satisfactory. It is fair to expect an increased domestic demand eventually, but thus far the spirit of conservatism appears to have a pretty strong hold on the home buyer. The trade seems more or less a unit in keeping its purchases down to a restricted plane, and is not disposed greatly to exceed its actual requirements when providing itself with new supplies of raw material.

American Conduit Company's Booth at St. Louis Exposition

The accompanying cut illustrates the conduit display made at the St. Louis Exposition by the American Conduit Company. This view of the booth shows the "office end." At the other extremity is to be seen the example of construction. The exhibit demonstrates the high class of underground construction obtained by the use of the American bituminized fiber conduit. It consists of a portion of a manhole, showing the neatness of work possible with this conduit at the entrance of the manhole. There is also a portion of the underground system, with the street, the earth and the concrete filling removed to expose the ducts themselves. This portion brings out one of the advantages of long lengths, namely, few joints in the system; and it also shows the perfect and permanent alignment secured and the sealed joints—a feature invented and introduced by this company.

Another portion of the exhibit shows the open trench with the various layers of ducts as they appear in the course of actual progress of the construction work. There are also some bends of various radii and diameter and some lengths of conduit; also some interesting photographs showing construction work in various cities where bituminized fiber conduit has been used. An attractively furnished office or reception room is provided for the convenience and comfort of those who are directly or indirectly interested in electrical conduits.



AMERICAN CONDUIT COMPANY'S BOOTH AT ST. LOUIS EXPOSITION.

The company hopes shortly to give some interesting demonstrations in the way of tests, showing the high insulating qualities of its conduit.

Shall the Trans-Siberian Railroad Be "Electrified"?

A recent issue of Engineering (London) states that two rather ambitious schemes for electric traction on a large scale have recently been brought before the Electrotechnical Association of St. Petersburg. The first is no less than the electrification of the trans-Siberian railroad, a project considered by Count A. F. Lubienski as not only desirable but necessary. The transportation of passengers and goods on this railway, apart from the traffic due to the war, has developed to such an extent that it will soon become necessary to increase the number of trains. Owing to several circumstances, particularly the lightness of the rails and the insufficiency of water, the existing trains are said to have reached their practical limit of speed; and though the water difficulty might be met by canalization or other means, the relaying of the track would entail an enormous expenditure of money and time. The count maintains that the most rational and economical way of meeting the case is by the introduction of electric traction on some parts of the line at least. The existing track would be made use of and the many sharp curves and heavy gradients would not limit the speed of a multiple-unit electric train to the same extent as in the case of a train drawn by a steam locomotive. It is proposed to make use of the rivers and waterfalls along the course of the line for the supply of electric energy, which would be generated at power stations from 100 kilometers to 200 kilometers apart and distributed in both directions to transformer sub-stations at a pressure of perhaps 100,000 volts.

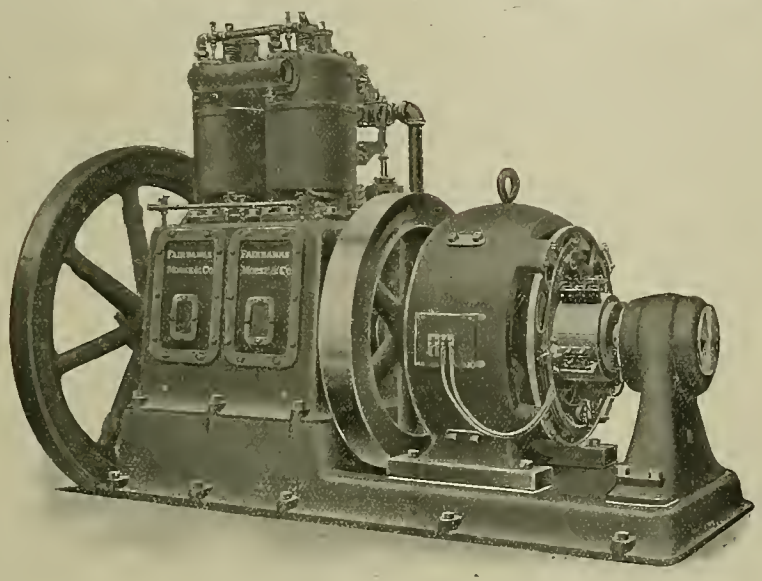
The second project was brought forward by Mr. G. O. Graftis. He proposes the electrification of the Caucasian railways on the grounds that electric traction is particularly adapted to a mountainous country and that abundance of power is at hand in the waterfalls of the Caucasus. The large number of rivers and mountain torrents watering the district through which the railway runs, and supplying up to 80 cubic meters of water per second, constitute an ideal source of power, which could be turned to account with little difficulty. As to the expense of constructing a line along the rocky coast of the Black Sea, the speaker adduced figures showing the cost of the Italian Lecco-Sondrio-Chiavenna electric railway and the Vladikavkase steam railway. He estimated that the establishment of central stations and sub-stations equipped with plant for producing three-phase current at 30,000 volts would entail an expense of £1,000,000 above the cost of a steam service. On the other hand, the working expenses of the electric service with the same amount of passen-

gers and freight carried would show an annual saving of £800 per mile as compared with steam. It is also claimed that, as the electric service would admit of heavier gradients, the construction of the permanent way would be cheapened.

After the meeting, in consequence of the importance of schemes of this nature to a district well supplied with waterpower, the Electrotechnical Association appointed a committee to make an exhaustive investigation of the subject.

Direct-connected Gas-engine Unit.

The illustration presented herewith is one of the modern designs of a direct-connected gas engine and dynamo as built by Fairbanks, Morse & Co. of Chicago, showing the simplicity of the engine and the small floor space which an outfit of this kind occupies. Engines of this type can be had in sizes ranging from two horsepower to 300 horsepower. It will be seen that the engine is out of the vertical order, with the cylinder placed on top of an oil-tight crank case This arrangement not only affords lubrication for the bearing but at the same time prevents any throwing of oil about the premises or the possibility of any objectionable odor being emitted from burnt lubricating oil which would pass into the engine room. The engines are fitted with a volume governor, which regulates the amount of fuel supplied to the engine in direct proportion to the load applied to the generator. The generator being direct-connected to the shaft of the engine, the same conditions are afforded as when using the most approved type of



DIRECT-CONNECTED GAS-ENGINE UNIT.

direct-connected steam set. The generators used with these sets are also manufactured by the company and are of the ordinary direct-current type to correspond to the capacity of the engine.

In localities where natural gas is available the cost of fuel would be very much less than when using gasoline or illuminating gas, the average price being about one-quarter of that of illuminating gas. At such prices for fuel the cost of electric light produced by using an engine such as has been described would be comparatively trifling. Considering the economy in another light, it is said that the cost of electric light produced as above would be about one-tenth the cost of the same amount of light when produced by burning gas direct in an open flame. Current from the gas-engine unit is also available for power for electric fans and the like.

Lamp-socket Ring.

A new device which is exploited by the H. W. Johns-Manville Company of New York city is illustrated herewith and is termed the Electrobestos incandescent lamp-socket ring. Electrobestos is an asbestos product, and the rings made from it are fireproof and practically non-breakable, thus being especially adapted to street-railway and steamship service. These socket rings will not melt like rubber, neither will they break through vibration or because of atmospheric changes as do the porcelain rings. These features alone make them worthy of attention. Their non-conducting properties have been established in a breakdown test of 2,000 volts.

The committee on state legislation recently recommended to the City Council of Chicago that a bill be presented to the Legislature giving the city the right to own and operate gas and electric-light plants, as the Mueller act confers the right to municipal ownership of street railways. The first step was also taken toward securing for Chicago the right to regulate the price of gas. The committee on state legislation recommended to the council that it memorialize the general assembly to pass a bill giving the city the necessary authority.

Advisability of Substituting Electric for Steam Traction.[1]

By J. G. White.

1. There should always be a substantial, and, under favorable circumstances, a very large increase in gross receipts, due to specific advantages of electric traction, among which are:

(a) Increased general comfort of passengers, contributed to by greater cleanliness, better ventilation, more brilliant and better distributed lighting and more equable heating of cars.

(b) Higher speeds, due largely to increased accelerations rather than to higher maximum speeds. Such accelerations are attainable because of increased traction coefficient, due to uniform torque, use of powerful motors and to greater weight on driving wheels.

(c) More frequent service, either with single cars, which can be operated at a cost justified by their earnings, or by trains operated by multiple-unit control, of such length as will accommodate the changing volume of traffic.

2. There will be a considerable increase in capital invested, with proportionate increase in fixed charges.

The total cost of rights-of-way, roadbed, tracks, stations, signaling systems and similar minor items should, although differing in detail, be substantially the same.

The cost of rolling stock should be nearly the same, although electric motors and tracks, with accessories, usually cost slightly more than locomotives of the same aggregate capacity.

The cost of central power station and of distributing and contact systems is a large item, against which steam equipment has ordinarily no counter charge.

In exceptional cases increased capacity of lines and terminals may be secured by electric equipment with less investment than in any other way. Such increased capacity will be due principally to the higher average speeds, making it possible to run more trains; more rapid operating of trains into and out of terminals, increasing their capacity by as much as 100 per cent., or use of electric locomotives more powerful than any steam locomotive which can be constructed under existing limitations.

3. Operating costs on exceptional roads will be somewhat decreased under electric traction. On other lines, still favorable to electric traction, operating costs will increase, but the gross earnings will be increased by a larger amount.

More in detail, general expenses should not be substantially altered; maintenance-of-way and buildings should be slightly less with electric traction, owing to absence of pounding of reciprocating parts of locomotives, better distribution of weights and absence of deleterious gases.

Owing to absence of smoke and gases, maintenance of cars, etc., should be moderately less, while the maintenance of motor equipments will probably be less than 50 per cent. of the cost of maintaining locomotives for equal service, partially offset by repairs to stations and distributing systems.

Wages should be somewhat less, due partly to the possibility of securing men at lower rates per hour, but more especially to increased mileage attained, partly because there is no necessity of waiting about in terminal yards with steam up until called for.

Ordinarily fuel costs will not greatly differ, although substantially less with electric traction in favorable cases.

Fuel cost may, in exceptional cases, be slightly reduced by return of current to line on down grades, and during certain periods of retardation, but ordinarily this is not justified. In special cases power costs may be reduced by the use of waterpower, or in other ways, such as sale of current for light and power in territory occupied by lines electrically operated.

On the whole, total operating costs will not greatly differ, but whether they will be increased or decreased can be determined only by a careful study of each special case. Rarely, if ever, will operating costs be reduced sufficiently to cover interests on additional investment required, the expected gain from conversion being from increased receipts.

The relative importance of the different items entering into operating costs may be better appreciated by some specific figures.

For the year 1903 the total expenses of the Pennsylvania division of the Pennsylvania railroad were $47,722,082, of which

Locomotive repairs amounted to	$3,886,860
Locomotive fuel	4,716,485
Locomotive labor	4,154,057

It is thus clear that each of these three items approximates 10 per cent. of the total operating expenses, so that they are about equally important. For reasons given in the body of the paper it seems probable that saving in locomotive repairs and locomotive wages are each likely at times to exceed savings in fuel, although the latter has frequently received nearly all the attention in discussions.

4. Reliability and Safety.— With thoroughly good equipment there should be little difference between the two systems; but with inferior installations, electrical equipment will suffer by comparison from somewhat greater chance of interruption to service and increased fire risks, which will, however, be offset, partially at least, by there being no steam or smoke to obscure signals.

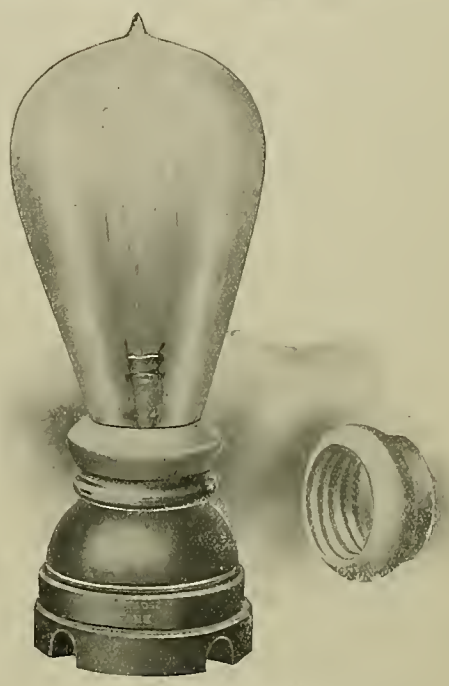
Illustrations.—In 1895 the Manhattan Elevated railway made gross earnings of $9,731,213 and net earnings of $3,524,939. In 1901 the gross earnings were $10,253,271, and net earnings $4,132,016. In no one of the intervening six years were net earnings so large, the average being about $3,100,000. For the year ended June 30, 1904, gross receipts are reported to have been $14,529,188, and net earnings $7,811,462. For the seven years before the commencement of electrical operation the net earnings were largest in the first of these seven years (1895), and during this whole period the average annual gross earnings were practically constant. The large increase in both gross and net earnings must consequently be due almost entirely to electrical equipment. The increase in net earnings approximates 23 per cent. on the cost of the electrical equipment.

5. Available Systems of Electrical Equipment.—In nearly all cases where electrical conversion is justified, direct-current motors alone deserve serious consideration. These should be supplied from direct-current generators, for compact systems operating within a radius of perhaps six miles from the generating station. With greater distances current should be supplied from alternating generators through rotary transformers.

If single-phase motors are as well developed as the manufacturing companies claim, they merit consideration where an infrequent service is operated, especially if at considerable distances from the power station. Assuming that accounts of the present development of the single-phase system are not too optimistic, three-phase or other systems will have practically no status in future conversion studies.

6. Probable Developments.—Within a few years the New York Central and Pennsylvania railroads

1. Concluding portion of a paper presented in Section F of the International Engineering Congress at St. Louis on October 4, 1904. Mr. White is an electrical engineer of New York city.



LAMP-SOCKET RING.

will have useful data from their New York installations. It seems probable that their suburban service will be gradually extended, as likewise the suburban service of the New York, New Haven and Hartford railroad. Having tunnels in Washington, Baltimore and Philadelphia and crowded terminals in the latter cities, it seems reasonably probable that the electric service of the Pennsylvania railroad will ultimately be extended to Washington and be made to include its suburban business from Philadelphia. Before that time, however, other suburban steam roads will probably be electrically equipped from such cities at Chicago, Philadelphia and New York.

Within a few years a considerable number of suburban lines in and about London, Paris, Berlin and the smaller European cities should be converted to electrical operation. Some interurban steam roads are also likely to undergo conversion, even where traffic is now light, provided a considerable increase in gross percentage earnings is likely to result.

Other than as above, the cases of electrical conversion are likely to be rare, justified only by exceptional circumstances.

The conversion of main trunk lines and freight roads does not deserve serious consideration, except in rare instances, where increased capacity is urgently needed and not otherwise attainable at reasonable cost, or if operating through frequent or long tunnels.

BOOK TABLE.

National Electric Light Association. (Proceedings of the twenty-seventh convention, held in Boston, May 24-26, 1904.) In two volumes. New York: Published by order of the executive committee of the association. 1904. Pp. (6¼ by nine inches). Vol. I., xlvi., 577, with three appendixes; Vol. II., 582. With 302 illustrations in the two volumes.

So voluminous were the proceedings of the National Electric Light Association at the Boston convention last May that the transactions this year have been bound in two volumes. Volume I. contains all the papers, reports and discussions of the convention. The second volume contains the "Question Box" and "Wrinkles" and is nearly as large as the first. Volume I contains besides the things mentioned above, all of which are carefully indexed, lists of the conventions of the association, the past presidents, honorary, active and associate members, present officers and executive committee and the committees which reported to the last (27th) convention. An excellent picture of President Charles L. Edgar appears as the frontispiece of the book. Illustrations and diagrams which were presented with the various papers are printed in the transactions. The "Question Box" in Volume II. was edited by Mr. H. T. Hartman of Philadelphia and is given in full in the book. This part alone takes up 433 pages and is indexed by contributors, each contributor being given a number, and, following the name, the numbers of questions answered: by topics, each topic having a designated letter, and by questions, each question being given in the index, together with its number. This system of indexing is rather complicated and might be improved. The "Wrinkles," department, edited by Mr. Charles H. Williams of Madison, Wis., contains a great many valuable hints to central-station men.

Alternating-current Engineering. By E. B. Raymond. New York: D. Van Nostrand Company. 1904. Pp. (5¼ by 7½ inches), 232, with 102 illustrations. Price, $2.50.

The study of alternating currents, although now prominent in electrical engineering schools, did not attract widespread interest until after direct-current practice had become well developed. Consequently there are many men employed in the various branches of electrical industry without complete technical training in this branch of the work—men who may be thoroughly at home in direct-current work. The author of the book under consideration for many years has had to do with men who have felt the need of a more thorough groundwork in alternating currents, and to meet their requirement he has written this book in a practical way without complex methods of explanation and without the use of calculus. The first part of the book is devoted to making clear the general laws of magnetism and alternating currents. The latter part deals directly with modern alternating-current apparatus, and the details of operation and methods of testing are taken up extensively. The book is well abreast of the times, and the single-phase induction motor and the repulsion motor are thoroughly discussed. The work contains five chapters in all and under each chapter are articles complete in themselves but having a relative bearing upon the rest of the articles in the chapter. There is an excellent article upon "Polyphase Transmission and Relative Weights of Copper with Different Systems," and another upon "Surges in Transmission Circuits." As a whole the book is one which will appeal to the practical man. But it is not one to be taken and glanced through for mere pastime. It will require some study to master its contents, but when this is done the reader will possess a good working knowledge of alternating currents.

Ohio Telephone Notes.

E. W. Moore of the Everett-Moore syndicate, in an interview, said that Independent telephone bonds stand now just where electric-railway bonds stood a few years ago, as far as the market is concerned. They will sell well in cities where the plants are located, but there is not much demand outside. However, within a few years sentiment will change in that respect and there will be a good market for Independent bonds.

Work has been begun on the new system of the Oil Belt Telephone Company at Cygnet. A complete exchange will be installed and free service will be given to subscribers in Bowling Green and a number of surrounding towns.

A report comes from Ashtabula to the effect that the Central Union Telephone Company will equip all its principal offices with telegraph instruments, to be used on the telephone wires for the transmission of official business. It is stated that the business of the company has become so heavy on the long-distance lines that official business could not be taken up, and, as a result, large amounts of tolls have been paid to the telegraph companies. Managers and inspectors will be expected to learn the use of the telegraph instruments, and business may thus be transacted over the lines at the same time they are being used for telephone purposes. It is stated that the offices at Ashtabula, Painesville and Conneaut are now being fitted up for this purpose.

The Citizens' Telephone Company of Columbus is building an exchange at Dublin, in order to give better accommodation to its patrons in that section of Franklin County.

Wires are now being strung between Dayton and Richmond, Ind., by the United States Telephone Company of Cleveland.

It is announced that the Bell telephone company will build an exchange in Lorain to cost $15,000, adjoining the Hotel Franklin. This is a new move in the fight between the Bell interests and the Independent company.

Reports of officers of the Jefferson and Warren Telephone Company of Orangeville for the year ended October 1st show gross earnings of $16,049.41. The operating expenses were $9,051.01, leaving net receipts of $6,998.40. The capital stock authorized is only $80,000, and not all of this has been issued.

The exchange of the City and Suburban Telephone Association at the corner of Canal and Race Streets, Cincinnati, will be opened for business on November 12th.

Frank L. Beam, manager of the Citizens' Telephone Company of Columbus, has been chosen a director of the Home Telephone Company of Charleston, W. Va., and Cyrus Huling was re-elected to the board. At the meeting a fews days ago provision was made for the issue of $100,000 additional preferred stock. Proceeds from the sale of this stock will be used to retire $75,000 bonds and the remainder for extensions. The company now has 200 miles of toll lines.

The Barlow and Watertown Telephone Company of Watertown has been incorporated with a capital stock of $10,000. S. W. Harvey, R. Wolcott and others are interested. C.

Telephone News from the Northwest.

The Robinson telephone interests in Southwestern Minnesota, managed by "Telephone Robinson" of Pipestone, Minn., seek a local franchise at Westbrook, Minn.

The Tri-state Telephone Company attempted to build a line through Owatonna, Minn., for long-distance work, following the right-of-way of the Rock Island railroad, after being refused admission by the council and defeated in an attempt to secure admission by mandamus. The company was required by the court to cease operations pending the outcome of the suit.

The Chippewa Telephone Company was granted admission to Eau Claire, Wis., by the council of the latter city.

D. M. Neill, who has been granted a franchise for an exchange at Red Wing, Minn., has received some materials for the conduit work, and will have materials and work rushed as rapidly as possible.

The Tomah Telephone Company has extended its lines near Sparta, Wis., into the Bear Creek neighborhood.

The council of Superior, Wis., has amended the franchise of the People's Telephone Company, allowing a new scale of rental.

The Wisconsin Telephone Company has disconnected its long-distance service with the local exchange at Durand, Wis., and has established a toll station there instead. The local company is arranging to connect with the Consolidated Telephone Company's lines.

The Wisconsin Telephone Company has received the new switchboard for the exchange at Fond du Lac, Wis., and will install it as soon as possible. It will be in working order about December 1st.

The Rocky Mountain Bell Telephone Company has asked for a franchise for 50 years at Helena, Mont., before putting its lines underground. The council may amend the proposed ordinance, allowing the city to terminate the franchise at the end of 25 years, if it sees fit.

The Iowa Telephone Company will erect a new exchange building at once at Keokuk, Iowa. It will be 38 by 50 feet in size, three stories high. The company is also installing conduits for its wires.

The Blakeville Farmers' Mutual Telephone Company has incorporated at Dunkerton, Iowa. C. W. Smith is president and William Rodgers, secretary. Authorized capital is $5,000. R.

Southeastern Telephone Developments.

An Independent telephone system has been established at Lumber City, Ga., with long-distance connections. F. P. Morse is manager of the system.

The Citizens' Telephone Company of Lexington, S. C., has been commissioned with $1,000 capital by J. E. Coughman and A. J. Fox.

The railroad commissioners of South Carolina, under whose control the telephone lines of the state were placed by a recent act of the state Legislature, after making several investigations under the provisions of the law, are disposed to regard the law a failure and it is likely that changes will be made, the law being considered too general.

The Southern Bell Telephone Company has a force at Batesburg, S. C., ready to begin the work of installing a telephone system.

Subscriptions are being raised to build an independent telegraph line from Dillon, S. C., to Gibson, N. C., to connect with the Postal company.

A telephone line is being built from the Morgan Falls Electric Works to Chamblee, Ga., connecting also with the line to Dunwoody, Ga. L.

Long-distance Telephone Line from Chicago to New York for Railroad Service.

In order to augment its present telegraph service the Lake Shore and Michigan Southern Railroad Company has erected a long-distance telephone line which reaches from Chicago to Buffalo over the Lake Shore line. The line has also been further extended by the New York Central railroad from Buffalo across New York state to Weehawken, N. J., just across the Hudson River from New York city. Ultimately it will be extended to the terminal of the New York Central in New York city through a special two-stranded cable passing under the Hudson, giving through telephone connections from Chicago to New York for the use of the two railroad systems named.

That part of the work extending over the Lake Shore lines is now completed and in working order. The system is for the use of the railroad only and is used only for the convenience of talking from office to office, no train dispatching being done by telephone. Starting with Chicago, there are five stations along the line which are fitted with switchboard facilities, namely, Chicago, Toledo, Ohio, Cleveland, Ohio, Ashtabula, Ohio, and Buffalo, N. Y. At all these cities a private branch exchange switchboard is installed in the railroad station. These boards, through an agreement with the Bell telephone companies in the several cities, are connected to the switchboards of these companies. By means of the switchboards it is possible to break the line up into sections and carry on conversations between several stations simultaneously, for instance, between Chicago and Cleveland and between Cleveland and Buffalo. Through talking, however, when necessary, can be carried on, and the service is said to be excellent.

Elkhart, Ind., though having no switchboard, has connections to the line and as it is at that city the master mechanic has his office the telephone is especially valuable to the station at that point.

The line is built of No. 8 copper wire, according to specifications similar to any long-distance line. The wires are strung on the telegraph poles and the apparatus throughout is of the Bell manufacture. As stated above, the Bell companies at the various points have connections to the line, but this is by special arrangement, for the line is owned entirely by the railroad company.

From Buffalo to New York the line extends along the West Shore right-of-way. The reason for this is that the pole line there is in better condition.

Mr. A. G. Francis, manager of the railway department of the Chicago Telephone Company, took particular interest in the installation of the system at the Chicago end and was of much assistance to the railroad company in completing that part of the work.

Persons, firms or corporations receiving award medals at the Louisiana Purchase Exposition may reproduce the same by photograph or drawings. If they desire to reproduce them in metal the coinage must be done at the United States mint. This is the gist of a decision made by Acting Secretary of the Treasury Taylor, in reply to an inquiry from J. G. Pangborn, president of the United Exhibitors' Association.

Telephone Development in Kansas and Oklahoma.

The Southwestern Telephone Company (Independent), whose general office is in Anthony, Kan., is evidently in a prosperous condition. A new exchange has just been built at Enid, Okla., costing over $60,000, and the company is now rebuilding its exchange at Anthony. The Southwestern company owns seven exchanges in Kansas and Oklahoma, as follows: Anthony, Kan., 300 subscribers; Harper, Kan., 150 subscribers; Attica, Kan., 50 subscribers: Carmen, Okla., 125 subscribers; Cherokee, Okla., 100 subscribers; Alva, Okla., 250 subscribers, and Enid, Okla., 800 subscribers. This makes a total of 1,775 subscribers now connected to the system. In addition, the company owns and operates 350 miles of toll lines which connect with all the Independent companies in Southwestern Kansas and Northwestern Oklahoma. The gross annual income of the company is over $50,000, dividends having always been paid during the eight years of its existence. P. G. Walton is president of the company, F. R. Zacharias, vice-president, and Fred Washbon, secretary and treasurer.

Telephone Companies in New Brunswick.

There are now three telephone companies in the Province of New Brunswick, according to a recent consular report, and all are extending their lines. The oldest, the New Brunswick Telephone Company, is spreading out in the upriver counties, where the Union company, with headquarters at Florenceville, is doing the same. The Central company has its headquarters at Bellisle, in Kings County, and there is a rumor of an amalgamation of the Union and Central. If this occurs, there will be two strong rival companies in the province. The St. John City Council has approved a proposition either to install a system of its own or negotiate with another company to enter this field and compete with the New Brunswick company, whose rates have been increased and are declared to be excessive. The question has been discussed, estimates have been procured, and pledges of support have been received. The question is now under further consideration looking toward final action.

Extensive Telephone Merger in Texas.

Arrangements have almost been completed for the merging of the local telephone exchanges at Brownwood, Goldthwaite, Coleman and Ballinger, Texas, together with about 320 miles of long-distance lines. These long-distance lines run from Lampasas to San Angelo and from Brownwood to Glen Cove, Burkett, Brady and intermediate points, and from Brownwood to Richland Springs and intermediate points. The new company which is about to take over these local exchanges and long-distance lines is headed by J. G. Watkins of Fort Worth. Extensive improvements will be made, among which will be the installing of the central-energy system in each of the towns. The company will also begin work at once constructing new long-distance lines and replacing the existing lines with new copper wires.

Extensions in New Mexico.

It is announced that the Colorado Telephone Company, which now operates a long-distance telephone line into Las Vegas, New Mexico, from the north, has decided to extend that line as far south as Socorro, touching Santa Fe, Albuquerque, Cerillos, Belen and other towns along the route. From Belen the company will extend the line to Las Cruces, New Mexico, where it will connect with the telephone line from El Paso, thereby giving El Paso a new long-distance telephone outlet to the north. It is stated that the company recently made the appropriation for extending the long-distance line in question and that the work of constructing it is now in progress.

NEW COMPANIES.

The Thornberg Telephone Company of Thornberg, Kan., has been incorporated with a capital stock of $1,000.

The Derby and Rose Hill (Kan.) Telephone Company has been incorporated, to construct a line between the two towns named.

It is reported from Harrisburg, Pa., that the Sullivan County Telephone Company has been incorporated with a capital stock of $5,000 by J. E. Bird, Fred Newell and others.

The Sunset Telephone Company has begun active work on the establishment of a system at Reno, Nevada. The system will be thoroughly modern, and will be established at an estimated cost of $35,000.

Frank M. Fish, John K. Fish and G. W. Whitehead have incorporated the Badger Telephone and Telegraph Company, with a capital stock of $1,000,000. The principal place of business is Phœnix, Ariz.

GENERAL TELEPHONE NEWS.

The Afton Telephone Company has sold out its business in Afton, I. T.

It is said that the switchboards of the Bell telephone companies are worth over $20,000,000.

E. J. Hall of the American Telephone and Telegraph Company, New York city, has been in Kansas City visiting his brother, S. R. Hall.

The New England Telephone and Telegraph Company's Chelsea (Mass.) exchange has been removed to the corner of Fourth and Division streets, where it has more modern quarters and all appliances brought up to date.

The Waitsburg Rural Telephone Company of Waitsburg, Wash., intends to incorporate with J. W. Morgan as president; Gustave Volmer, vice-president; W. B. Brooke, secretary, and A. W. Phillips, treasurer.

The Bell Telephone Company has put in a complete new telephone system at Ottawa, Kan., and is giving a free service for three months. The Independent telephone company will have its line completed from Ottawa to Kansas City by November 10th.

Plans have been completed by the Meadville Telephone Company of Meadville, Pa., for a line from that city to Cochranton, giving a through and direct service to Pittsburg, Franklin, Oil City and Titusburg. If possible, the line will be completed early in December.

The Association of Telephone Subscribers in Paris, which was recently organized to protect subscribers' rights against a too haughty administration, held a meeting recently, at which President Marquis de Montebello announced highly successful results of the campaign inaugurated. The administration promised not to suspend subscribers without good reason hereafter.

A new telephone system is being installed for the Champion mining plant at Houghton, Mich. The Western Electric apparatus will be used. Thirty telephones will be installed and more can be added when needed. All the residences of the officials, engine and shaft house and the library building will be connected. It is expected that the system will be in operation within a week.

The committee on gas, oil and electricity of the Chicago City Council has reported, recommending that a special committee be appointed to deal with the various phases of the telephone situation in Chicago and to hear all disputes concerning the telephone companies, their rates, toll charges, franchise-extension claims, etc. The report is to be taken up at the council meeting on November 21st.

The Mexican government is using the telephone with great success in its campaign against the hostile Yaqui Indians. A complete telephone system has been constructed in the turbulent territory of the state of Sonora under direction of the secretary of war, and the movements of the warring bands of Indians are promptly reported to the military authorities. In this manner many Indians have been captured and their plans for raids frustrated.

The Bell Telephone Company has leased the ground on the northeast corner of Tenth and Pine Streets, St. Louis, and will erect thereon for its own use an office building to be 10 or 12 stories high. The company has executed a bond of $100,000 to erect within five years a building to cost from $350,000 to $500,000. The Bell company's Olive Street building will be refitted and used exclusively for exchange purposes when the proposed structure is completed.

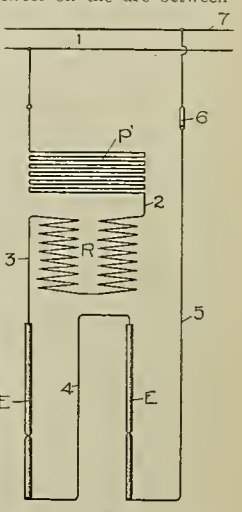
A newspaper story is to the effect that experiments have recently been made by the superintendent of a local telephone company in Sherborne, N. Y., whereby a telephone system will be installed in church, so that the deaf members of the society can hear the preaching and the singing as easily as their more fortunate brethren. A specially constructed transmitter is to be placed near the pulpit and the choir loft and connected by wires with the pews which are occupied by the deaf members. There small receivers will be placed.

An unusual marriage took place recently in the municipal hospital of Philadelphia when Mrs. Eva H. Lyons was married to Frederick E. Mehren, who lay dangerously sick with smallpox in one of the wards. The lady risked her life to go to the ward, and the telephone was the medium through which the ceremony was performed, the magistrate being in his office several miles away. The sickroom was fitted up for the ceremony and telephone communications made directly to the bed, the magistrate being able to hear the answers to his questions clearly. Seven hours after the ceremony, however, the sick man died.

The Wellington and Cowley County (Kan.) Traction Company has been chartered with a capital stock of $500,000, for the purpose of building an electric railroad and to maintain telephone and telegraph lines throughout these counties. The directors include George H. Hunter and C. A. Gambrill of Wellington, Kan.

Double-carbon Arc Lamp.

When a double-carbon arc lamp is mentioned one is apt to think of the lamps of this type which were devised and used in the palmy days of the open arc, when it became necessary to supply a lamp to last all night for street lighting. But a Lynn inventor, Charles E. Harthan of the General Electric Company, has secured a patent for a direct-current, constant-potential twin arc lamp adapted for modern conditions. The diagram shows the general arrangement of the electrodes and wiring. The construction of the lamp permits the two pairs of carbons to be placed near together, preferably about two inches apart, so as to prevent the arcs from being too near the inner surface of the globe. It is found that by bringing the carbons near each other the current traversing one pair has a steadying effect on the arc between the other pair; but this effect is lost if they are so near as to exert a blow-out action.



DOUBLE-CARBON ARC LAMP.

The positive line (1) is connected with the resistance coil (P'), from which a lead (2) runs to one terminal of the magnet (R), whose other terminal is connected by lead (3) with that one of the carbon tubes whose lower carbon is supported by a leg of the lamp. The binding post at the upper end of this leg is connected by lead (4) with the other carbon tube, and the circuit therefrom is by way of the other leg of the lamp, a gas-cap lead (5) and switch (6) to the negative side of the line (7).

Certain details of the construction of the lamp are described by Mr. Harthan, among which are particulars relating to the frame of the lamp and the method of supporting the inner globe. In order to permit the use of inclosing globes of different lengths an improved supporting device is provided, consisting of a wire bail suspended by springs and having at its lower end a ring to receive the lower end of the globe and a depending loop serving as a finger-hold in pulling down the bail to release the globe. The ring may be either of sheet metal or integral with the bail and loop. Each spring is supported by an eyelet on the under side of the base-plate. The upper end of the inclosing globe fits in an annular groove in the gas-cap and the hot gases escape through tortuous passages in the cap to the outer air.

St. Louis Street-railway Affairs.

A mortgage deed of $10,000,000 on the property of the United Railways Company of St. Louis has been filed with the recorder of deeds by James Adkins, treasurer of the company. It covers all the company's property in the city and county. The document also indicates that it was given to secure the United Railways Company, on bonds issued by the St. Louis Transit Company, dated October 1, 1904, and aggregating $10,000,000. The Mercantile Trust Company is named as trustee for the bondholders. Following this announcement it is reported that a temporary injunction restraining Brown Bros. & Co. of New York from establishing an alleged "blind pool" of St. Louis Transit Company and United Railways Company assets has been granted in the Circuit Court in St. Louis on application of the attorney for Louis A. Cella, S. W. Adler and C. A. Tilles, who assert ownership of 11,000 shares of St. Louis Transit Company stock.

World's Fair Visitors of Last Week.

Among those registered at the booth of the Western Electrician in Electricity Building at the St. Louis Exposition last week were the following-named: F. Windt, M. E., Prague, Bohemia; J. B. Mueller, St. Louis, Mo.; D. R. McDonald, Lisbon, Ark.; Arthur Ramsey, Springfield, Ill.; Bert Fuller, Newberg, Mo.; Fred Trasdae, Newberg, Mo.; Henry Meyers, Republic, Ohio; Samuel Celler, Brooklyn, N. Y.; C. James McFarland, St. Louis; Harry S. Larze, Bristol, Pa.; R. O. Klass, Avoca, Iowa; W. P. Coles, Chatham, Va.; Chester A. Hammill, Maywood, Ill.; Gilbert Gaum, Ensley, Ala.; George W. Cummings, Sioux City, Iowa; J. W. Slaughter, Garrett, Ind.; F. Bain, Chicago; Ray C. Landes, State College, Pa.; George Carson, Carthage, Mo.; R. S. Gibson, Auburn, Ill.; John R. Miller, Newtown, Ind.; J. C. Hinde, Madison, Ill.

Storage Batteries as an Adjunct to Central-station Equipment.[1]

By Gerhard Goettling.

In presenting this paper on storage batteries, I shall attempt to give a brief outline of the present methods of installation and operation of storage batteries as practiced by the Edison companies in the United States.

Development.

Only a few years ago, most of the station managers knew storage batteries only by name, and were strongly averse to their use as being unnecessary and complicated; but gradually they found that the complication brought into their plants by the new element was far outweighed by the advantages and the reliability which the use of batteries offers.

I might say that the present opinion is that any direct-current system, and also alternating-current systems operating with converting sub-stations, cannot give reliable service without the aid of batteries.

This fact is best shown by the marvelous growth of the application of batteries to central-station distribution in the last 10 years. Following the installation of a comparatively small battery of English manufacture in the Fifty-third Street station of the New York Edison Company, the Boston Edison Company made the first decided step in advance, by installing, in 1894, a battery of German manufacture of much larger capacity. Since then the use of batteries has increased greatly, so that, at the present time, there are some 98 batteries installed—30 being located in generating stations, having a capacity of 23,036 kilowatt-hours and 68 in sub-stations, with a capacity of 101,206 kilowatt-hours.

The following table shows the yearly increase in number and capacity:

Table I.—Kilowatt-hour Capacity of Central-station Batteries.

Year.	Generating Stations.		Sub-stations.		Exciter Batteries.		Total.	
	No.	Capacity Kw.-H.	No.	Capacity Kw.-H.	No.	Capacity Kw.-H.	No.	Capacity Kw.-H.
1894...	2	938	....	.....	....	.....	2	938
1895...	4	1,233	1	2,778	....	.....	5	3,971
1896...	5	2,668	6	9,575	....	.....	11	12,343
1897...	7	6,406	10	14,043	....	.....	17	20,449
1898...	8	7,360	15	22,175	1	309	24	30,044
1899...	12	12,342	23	35,212	1	309	36	47,863
1900...	13	12,392	36	59,513	1	309	50	72,214
1901...	15	13,891	42	67,296	2	390	59	81,586
1902...	19	19,398	47	75,117	2	390	68	94,914
1903...	22	21,695	63	94,475	5	730	90	116,900
1904...	22	21,695	68	101,206	8	1,341	98	124,242

The table shows during the last three years very little increase in the generating-station batteries. This is due to the modern tendency of companies to concentrate their generating plants in very few, but large, generating stations for alternating current, where batteries are used only for the excitation, as indicated by the increase in exciter batteries. This concentration necessitates numerous sub-stations for distribution, and these sub-stations are generally equipped with batteries, as is also indicated by the increase of sub-station batteries.

That the combination of large high-tension alternating-current generating plants and direct-current sub-stations is not found to be reliable without the aid of batteries, is shown by the practice of most of the large companies. For instance, in New York, Chicago, Boston, Brooklyn and San Francisco, where about 75 per cent. of the total output of 170,000 kilowatts is generated as alternating current, 60 batteries are in operation, with a total capacity of 84,000 kilowatt-hours; that is, two-thirds of the total given in Table I.

It is also worthy of note that practically all of the batteries in use in America in central-station service have been furnished by one manufacturing concern. A careful investigation shows that over 95 per cent. of the total storage-battery capacity in this service has been furnished by this one concern.

Construction of Batteries and Battery Rooms.

The battery room should be located as near the switchboard room as possible. This is especially advisable, so that the connections between battery and switchboard may be short, and the loss in voltage reduced to a minimum. It also facilitates the inspection of the batteries.

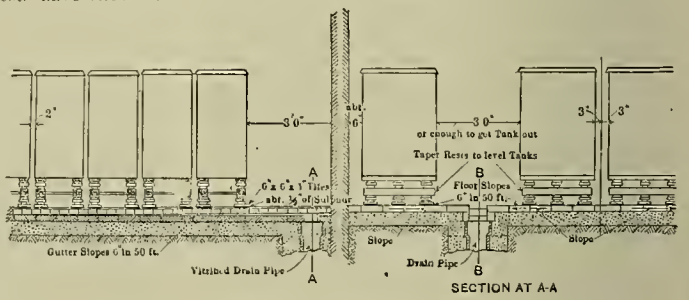
The battery room must be large enough to receive the battery without crowding the cells too much together. Taking the base area covered by a single tank as a basis, the space occupied by the tanks should not be greater than one-half the floor area. There are some battery rooms where the tanks cover more than 50 per cent. of the floor space, but the results show that the distance between the tanks is too small, and the aisles between the different rows of cells are so narrow that any repair work on the battery is rendered difficult and expensive, besides making it very inconvenient to keep the battery room clean and dry.

The floor of the battery room must, first, be strong enough to support the battery with the tanks completely filled with plates, and, second, it must be acid-proof, especially in modern fireproof buildings of brick and iron construction.

To protect the flooring from acid, two kinds of covering—brick and concrete—have been in use. The former has been found most satisfactory, and is now considered as standard construction. This covering has, as a base, a layer of six inches of concrete. On top of the concrete is put a thin layer of sand, about one-eighth inch, in which the bricks are laid. The common vitrified brick, nine inches by four inches by 2½ inches, or a special size 10 inches square by two inches thick, is in use for this purpose. The bricks are laid one-fourth inch to three-eighths inch apart, leaving some space for grouting them with hot pitch. If the pitch becomes brittle when cooled, a small amount of tallow should be mixed with it before use. In pouring the pitch between the bricks care must be taken to fill the space entirely, but at the same time not to cover the surface of the bricks. If too much sand or pitch is used, there is danger of settling, throwing the tanks out of alignment.

The second construction consists of several layers of tar paper or other waterproof material. On top of this waterproofing are laid six inches of concrete, and the surface of this concrete made level and smooth. In some cases the base of the flooring is first covered with three inches of concrete and then waterproofing put on, and on top of this another layer of three-inch concrete. Both methods have given satisfactory results. In any case it is necessary to carry the tar paper next to the walls eight to 12 inches above the level of the floor, to avoid the danger of acid leaking through the cracks between the concrete and walls. Sheet lead is also successfully used

On top of the concrete floor is sometimes put a thin layer of cement. The cement makes a smoother finish, but has the disadvantage of being more easily attacked by the acid. Experience has shown that, contrary to the general opinion, the concrete is very slightly affected by the acid, due to the fact that the acid coming in contact with the concrete is neutralized in a short time. Actual tests have shown that one pound of concrete of the usual mixture, having a specific gravity of about 4.2, neutralized 0.48 pound of H_2SO_4. When we apply these figures to actual conditions, we find that the amount of acid which is lost per year by spray can corrode less than one-eighth inch of the surface of the concrete. This theoretical result agrees fairly well with experience, which shows that a long term of years is necessary before the thickness of the concrete is diminished to any appreciable amount.



ARRANGEMENT OF BATTERY ROOM.

The vitrified-brick floor has the advantage that it will withstand the action of the acid far better than the concrete floor. But if sufficient care is taken to keep the battery room clean at all times, as ought to be done in all cases, especially when the floor is washed at regular intervals with a weak solution of carbonate of soda, the concrete floor will give fairly satisfactory results.

Every battery room ought to be provided with proper drainage of the floor, so that it can from time to time be flushed with water. The best method is to give the floor from the center of each row of cells a slope toward the aisles, so that there will be no possibility of any acid or water remaining underneath the tanks.

Iron columns and pipes in battery rooms are best protected by encasing them with expanded-metal work, upon which a coating of plaster is placed. This if kept well coated with a good lead paint, will prove a satisfactory way of protecting all ironwork. As a further precaution, the iron columns must be protected at their base against attack by the acid. Satisfactory results have been obtained by covering the column at the base with sheet lead to a height of one foot above the level of the floor, soldering the sheet lead at the seams together, so that it forms a uniform cover, and filling the spaces between the iron and lead with hot pitch. Smaller portions of ironwork can be treated only with a good acid-proof paint, and inspected often enough to make sure that no iron sulphate is forming and liable to drop into the cells.

The copper bars can be protected either by a coating of lead or by painting. The lead coating is accomplished by a process similar to galvanizing iron, and has proved fairly satisfactory, but it has the disadvantage that, if once attacked by the acid, it cannot be repaired without dismantling, and painting must then be resorted to. Therefore, there is some question whether it is necessary to go to the expense of lead-coating the copperwork, if paint can produce a satisfactory result.

Special attention must be given to the connection between the copper bars. The nuts of the bolts at these points are very seldom sufficiently protected by simply painting them, so, as an extra precaution against corrosion, the paint should be coated with vaseline, or, better still, a special type of bolts should be used, these being so constructed that on each end a lead cap can be screwed on. This lead cap is filled with vaseline, and, when in place, it covers the nut entirely and prevents any acid getting in contact with the nut.

The question of securing a good acid-proof paint has received special attention in the last few years, since the amount of copper in battery rooms to be kept in good order is very considerable. Today, probably the best paint which can be used has carbon for a base. This, however, cannot be used in all cases, as it takes some days to dry. For protecting metalwork in battery rooms, it is very good. A special quality of black asphaltum paint is one of the best wood protectors, which dries quickly, and is found to be very satisfactory. A word of warning might be said about some kinds of metal-oxide paints. It is claimed that the oxides in these paints will not be attacked by the fumes, but experience shows that they are transformed in a short time to sulphates, and the paint thus made valueless.

All battery rooms must be well ventilated. The best way is to provide a steady circulation of air through the same, by having an inlet for fresh air at one end of the battery room, generally located near the floor, and an outlet for the acid fumes at the farther end, near the ceiling. Too much draft must be avoided, as it tends to increase the evaporation from the cells.

When it is found impossible with natural draft to change the air in the battery room in reasonable time, an exhaust or blower-fan may be used. The former secures good ventilation, better than the latter, it having but the minor disadvantages that the fumes pass over the fan blades, which, however, if made of phosphor-bronze or brass, are but slightly attacked. The motor for driving the fan is best located outside of the battery room, and connected with the fan by a rubber belt.

The outlet for the air must be so far away from the end-cell copper bars that the acid fumes do not have to pass between them. The copper bars rest on porcelain insulators, the insulators being mounted on wooden stringers, which are supported either by iron hangers from the ceiling or by iron pillars from the ground.

The end-cell switches are either outside the battery room, or, when it is necessary to have them inside, a special partition is built around them, so that the acid fumes have no access to them. As a rule, they are motor-controlled from the main switchboard.

It is best to install all cells in one tier, as a double-tier installation makes it difficult to inspect and fill the cells in the upper tier, and also the wooden tanks in the upper tiers are easily damaged by the acid fumes rising from the lower cells, so that in the end the expenses for repairs are much higher than the saving gained eventually by this double-tier installation. Metal stands particularly, which, of course, would have to be used with large-size cells, are very hard to protect, so that the metal sulphate formed on them will not get into the electrolyte.

The next point we have to consider is the insulation of the tanks. The former practice of installing with single insulation proved unsatisfactory. When a battery with this insulation has been in service for more than three or four years, troubles with leaky tanks have not been uncommon, so that at the present time double insulation is the standard.

This double insulation (see cut) has been found to give most satisfactory results, as the upper insulator is far enough away from the floor to enable it to be kept perfectly clean and dry, and the additional height of the tanks from the floor gives a better circulation of air underneath them, which maintains a drier floor.

The wooden stringers between the porcelain insulators can run either lengthwise with the row of cells, or crosswise. The former arrangement is generally used with small-sized tanks, using one set of stringers for five to six cells. For large sizes of tanks, it is found advisable to have one set of stringers for each cell separately, with the stringer running crosswise to the row. This arrangement, besides giving a better circulation of air, and facilitating the inspecton underneath the cells, makes also each cell independent from the other—a very important point in case of repairs.

In the construction of tanks, there are many points which should be considered to render the life of the tank as long as possible. The most acid-proof kind of lumber should be used; that is, wood which contains a large amount of resin, like Georgia or yellow pine. Of course, this kind of wood is hard to work on, as the tools become sticky by the resin, and must be often cleaned and sharpened, but the slight overexpense in manufacturing is well paid by the longer life that is gotten from these tanks.

Means should also be provided to keep the woodwork of the tank as dry as possible. This is done

1. A paper presented before Section E of the International Electrical Congress at St. Louis, September 16, 1904. Mr. Goettling was a delegate to the Congress from the Association of Edison Illuminating Companies.

by giving the upper edge a slight slope to the inside of not more than one to five. If the slope is made steeper, the edge will be too weak and easily break off when the tank is in service. The lead lining of the tank generally overlaps the upper edge on the outside for about two inches. By putting small wooden strips underneath this overlapping, the lower edge of the lead is kept about one-half inch away from the woodwork of the tank, so that any acid dripping from the edge does not run down along the wood. The former kind of plain tanks has been abandoned in favor of the paneled form, the latter being more rigid and giving better insurance against breakage on account of the warping of the wood. Between the cells in each row are put small porcelain insulators, which insure uniform distance between the cells, and also prevent the walls of the tanks from bulging out. For the latter reason, also, the outside wall of the tanks at the end of each row is reinforced by lead-coated iron rods.

The battery plates, both positive and negative, as now furnished, show great improvements over those of previous years. Those most generally installed by the leading company are of the "Manchester" type for the positives, and of what is known as the "box" plate for the negatives.

The positive consists of a rigid conducting support, holding in place soft lead formed into small buttons of coiled ribbon, with corrugated surfaces, these buttons extending slightly beyond the surface of the hard-metal support, or grid, as it is technically called. These plates have been found to stand very satisfactorily the excessive demands that the storage battery is called upon to meet. The development in the negative plate has kept pace with that of the positive plate. The negative plate now consists of a hard-metal supporting grid, in which the various sections of active material are securely held in place by means of a thin covering of perforated sheet lead. The advantage of this plate over all other types lies in its strong mechanical construction, in its greatly increased life, and its ability to maintain its capacity throughout a long period of use.

A still further development, and a most important one, is the substitution of thin wooden diaphragms between the plates as separators, in place of the glass tubes heretofore generally used. This new type of separator is superior, in that it effectively prevents any possibility of short-circuits forming between the plates, thus keeping the cells in uniform condition, so that the amount of work in operating the battery is reduced materially, and the proper relation of charge to discharge maintained more economically—all of these features combining to effect a very considerable increase in the life of the plates.

Operation.

Among the numerous functions performed by the storage battery in modern lighting and power distribution systems are:

(1) Supplying current for the peak of the load, both at the generating station and the sub-stations, current so furnished being regained at the time of light loads, so that the load factor is placed on a most economical basis.

(2) Regulating or equalizing the pressure due to sudden fluctuations in the load.

(3) Carrying the whole load when there is interruption in the service from the generating station, or locally, when the translating or transmitting service in the sub-station is in trouble.

(4) Carrying the entire load, when it is so light that it is uneconomical to run the generating apparatus.

(5) As a reserve for preventing interruptions in the exciter circuit in alternating generating systems and for quickly starting up alternating-current motor-driven exciters.

All these features, except (5), are well known, so that it is necessary only to add a few words about the exciter batteries, their introduction being a comparatively new one, but of the utmost importance for alternating-current generating stations.

In former times, where each alternating-current generator had its own exciter, a trouble in the exciter affected only its own generator, leaving the rest of the system intact, but with the present practice of uniting all exciters on one common bus, which in turn feeds the fields of all generators, it will readily be seen that trouble in the exciter system will affect the whole station, with serious results. Therefore, it is necessary to keep the exciter bus at all times, and under all circumstances, alive, and at the proper voltage. The present sources of supply for the exciter bus are a set of motor-driven generators, with one or more steam-driven exciters as reserve. The steam-driven exciters need some time for starting, and are, therefore, not able to replace a motor exciter immediately, as is essential in case of emergency.

It is therefore important to have an additional supply of current to the exciter bus, which will work instantaneously. A feeder run from some other direct-current station to the exciter bus may accomplish this, but in such a case it is either connected ready for service at all times, which makes complications in operating at the exciter bus, as well as at the direct-current station; or, it is simply ready for connection in case of trouble, and then much valuable time is lost by telephoning from the alternating to the direct-current station, and, therefore, the advantage of an instantaneous reserve is lost. There is, with such a feeder, always also the serious danger of its burning out at a critical moment.

All these troubles are avoided when there is a storage battery in the station connected to the exciter bus. The discharge current of this battery, at the one-hour rate, ought to be equal to the maximum excitation necessary at the exciter bus, with 1.6 volts per cell pressure at the end of discharge.

When an accident happens the battery will give immediately enough current to keep the excitation up, although the voltage may drop somewhat. Actual tests in New York have shown that the exciter-bus voltage can drop 11 per cent. without giving trouble in the system. Allowing that the whole motor-exciter system breaks down, that the battery is suddenly called upon for the one-hour rate of discharge, and that the operator has no time to adjust the end-cell switch, the drop from floating voltage will be well within the above limit. The end-cell switch must, of course, be motor-driven and controlled by push buttons; so it is the practice to have several push buttons at different convenient places in the station, in order that the operator can work the end-cell slider, from any place wherever he may happen to be, at the time of the breakdown.

In order to keep the capacity at the highest point, an exciter battery should be fully discharged once a week, and then immediately charged at the three-hour rate.

This high charging rate is advisable only for exciter batteries, where it is necessary to have the battery ready for service after a discharge as soon as possible. For lighting batteries, it is better to charge them at not higher than the five-hour rate.

The discharge rate of a battery naturally varies according to the service, and, under normal conditions, the rates prescribed by the manufacturer of the battery should not be exceeded. But in case of emergencies, it can be called upon for service at any high rate, without hesitation, provided care is exercised to restore it to normal condition with the least possible delay. The danger of harmful overdischarging does not exist in the case of Edison service, as the discharge is limited by the voltage on the main bus, which is not allowed to drop below certain limits.

In a very large degree the obtaining of successful results from a battery is dependent both upon the quality and the specific gravity of the electrolyte in the cell, and also upon the manner in which its changes in specific gravity, in the course of regular operation, are observed.

The presence of impurities, except within certain extremely small quantities, affects not only the immediate service of the battery, but also acts materially in reducing its life, so that it is most important that every possible precaution be observed in obtaining suitably pure electrolyte and maintaining it so.

The electrolyte must at all times be maintained at the proper level, so that the plates will not be exposed to the air. There is a gradual lowering of the level, due to evaporation, especially during charge, and this should be regained by the addition of the purest water obtainable, preferably distilled water. In order to keep the evaporation down to a minimum, and also for the sake of protecting the exposed metal work about the battery from the effect of the acid fumes, which come off when the battery is being charged, some batteries are equipped with a covering over the cells, either in the form of a thin rubber sheet or a glass plate. This is not always to be recommended, on account of the difficulty of inspecting the cells; but the introduction of the wooden diaphragm separators has materially reduced the amount of inspection required and, therefore, the chief objection to covers.

As a medium for following the work that the battery is doing, and the condition of the various cells through the observation of its variations in specific gravity, the electrolyte is one of the most important factors in the routine of battery operation. It is, therefore, advisable to take, at certain periods, generally once a week, specific-gravity readings of each cell in the battery. Any cell which is not in normal condition will indicate it by abnormal specific gravity, and can thus be easily detected and promptly repaired. In my practice, in Boston, I have found it very convenient to plot the results of the weekly acid readings graphically, and, following my example, the Edison companies in New York and Chicago are using now the same method, with splendid results.

Further, it is essential that not only proper care be given to the individual cells in the battery, but also that the proper relation betwen the amount of charge and discharge shall be maintained. To accomplish this, recording voltmeters are now used extensively, and the curves drawn by these instruments have been found to be a valuable guide for the operator when using the battery, especially during the charge. In a very short time there will be on the market a recording hydrometer which will record the drop and rise of the specific gravity in a specially selected pilot cell, and I hope that this instrument will also be a great help for the proper operation of batteries.

As an additional check on the condition of the battery, it is advisable occasionally to make discharge tests, comparing the battery with a pilot cell.

In conclusion, I might say that too much care cannot be exercised in giving a battery regular attention, as in any piece of machinery it is the better practice to anticipate trouble, and exercise every care to prevent its occurring, rather than to wait until it develops and then attempt to remedy it.

CORRESPONDENCE.

Great Britain.

London, October 22.—The preliminary of a draft set of regulations in connection with the use of electricity in factories and workshops has just been issued by the home secretary. As a matter of fact, certain requirements have been imposed in factories by the Board of Trade for some years past, where higher voltages than 250 volts have been adopted. Some thousands of factories have been ostensibly working under the Board of Trade regulations, but instances have been brought to the notice of the home secretary in which they have not been observed, and as a result, serious, and sometimes fatal, accidents have occurred in the premises of such persons. As a consequence it has been thought desirable that certain of the Board of Trade regulations should be given the force of rules under the Factory and Workshops' Acts. Therefore, under the regulations now issued, the employer is made responsible for any damage to human life. The present regulations are based on the old Board of Trade regulations without any addition except by way of relaxation. Moreover, they do not contain all the regulations which, if deemed necessary, will be imposed later on. Therefore, the question of the generation and transformation of the electrical energy upon factory premises has not been taken up, the regulations above referred to merely stipulating that where the normal working pressure is between 250 and 650 volts, the wiring shall be enclosed in a strong metal casing and so arranged that there shall be no danger from shock or fire. All main and branch circuits are to be protected by fuses or automatic cut-outs, and all such fuses or cut-outs shall be so enclosed that similarly no danger from fire or shock can result.

The remarkable arbitration to determine the price to be paid by the Bournemouth corporation for the small undertaking of the Poole Electric Traction Company has now been concluded, although no award has yet been made. The facts of the case are that the Poole company has a small system of 3½ miles, running from the western boundary of Bournemouth to Poole, actually in operation, and certain lines not yet running on the east, with running powers over the intermediate municipal tramways. The tenure of the Poole line was 35 years, after which the undertaking could only be bought up by the local authority as a going concern. The usual conditions for the purchase of tramways in this country are that a lease of 21 years is granted and then to be bought out at the market value of the undertaking without anything for good will. It will thus be seen that the Poole company, though small, exists under very favorable conditions. In 1901, the Bournemouth corporation, knowing these circumstances, wished to buy the company out, the basis for determining the purchase price being the profit shown in the company's accounts for 1901. Considering the period which the company has still to run, and that it can then only be acquired as a going concern, it is not surprising that its claim amounted to over $2,000,000, a large amount on the face of it for so small a system. On the other hand, the corporation said that $300,000 was the utmost value of the undertaking, and that is the problem which the arbitrators still have to solve. Locally, the case is of small interest, comparatively, but to the electric-traction industry the decision of the arbitrator will be of vast importance, as during the last few years many tramway rights have been granted to companies under similar conditions, and no precedent yet exists for the price paid by a municipality in purchasing such lines before their lease has expired.

Municipal telephony has not "caught on" to any great extent in Great Britain, and perhaps it is well that this is so, until further experience has been gained. It is true that in all those towns where a municipal exchange has been in operation for over a year a profit has been shown in the accounts, but the amount of controversy which the methods of making up the accounts has evoked will probably be instrumental in suggesting to other local authorities that municipal telephony is not the remunerative business many would have us believe. Quite apart from the larger items of sinking fund and depreciation, it is the practice of some local authorities to charge the expenses of canvassers to capital account instead of revenue, thus tending to produce a fallacious balance sheet. This is merely one item, for it would take too much space to deal fully with the matter here. But it serves to show the soundness or otherwise of the methods adopted.

A light-railway and tramway exhibition is to be held in London next year. The last show of this character was held in 1902.

An association has been formed to support the present system of weights and measures in Great Britain, and to combat the increasing favor with which the metric system is now viewed. This latter for some years has had a strong ally in the shape of the Decimal Association.

But little has been done on a large scale in Great Britain hitherto in the matter of forming electric clubs, and especially so when compared with the United States. A proposal is now being made to organize an electric club for Birmingham and district, and, if successful, the idea could well be applied to other large centers.

Last week Mr. J. W. Benn, chairman of the London County Council, gave his annual address and

dealt at some length with the tramway problem. The council now works 40 miles of lines, about one-third of the total tramways of London, and last year 133,000,000 passengers were carried on these 40 miles, which is worked partly by horses and largely by electric traction. Two million five hundred thousand dollars was received in fares, and 50,000,000 passengers were carried at one-cent fares. The huge power station at Greenwich is being rapidly pushed forward, but that vexed question of the northern lines still remains undecided.

In pursuance of the scheme for equipping the dockyards of the Admiralty with an electric-lighting and power installation, a tender has just been placed for the complete electrical equipment of Sheerness dockyard, one of the largest, and quite close to London.

An interesting development of the increasing practice of local authorities to trade outside their areas has arisen at Halifax. The Halifax corporation is building tramways in Sowerby, a separate adjoining district, and in return the Sowerby council promises to exempt the Halifax corporation from rates in respect of such tramways. But the Lancashire and Yorkshire Railway Company, with which the new tramways will compete, is a ratepayer of Sowerby, and quite naturally resents the arrangement above referred to. Furthermore, under the Public Health Acts, there is a big doubt as to whether it is legal, and the railway company intends to test the point.

G.

New York.

New York, October 29.—The event of the week has been the opening of the rapid-transit subway, as recorded in another part of this issue. The actual public operation of the subway dates from midnight on Thursday, since when the regular schedule of express and local trains has been followed with more or less regularity. There have been a few minor accidents, attributable to the breakdown of mechanical appliances, and one or two slight injuries to passengers, due to unmanageable crowds. On Friday evening during the rush hour, there was very great trouble in dealing with the crowds at City Hall. The service of the surface and elevated cars from this point northward was neglected, to the extent of perhaps as much as 75 per cent. of the usual business, but it is expected that within a very short time there will be a readjustment of traffic and that each line will find its own peculiar patrons. General Manager Frank Hedley of the Interborough company estimates that the number of subway passengers carried between midnight and midnight on Friday was 350,000. The maximum total capacity of the line as at present equipped is 25,000 an hour.

Cars were expected to be running over Williamsburg Bridge by November 1st, but an altogether unexpected cause of delay has been encountered in the issuance of a Supreme Court writ restraining the operation of cars pending a hearing, on account of alleged attempts to charge an additional fare for a trip over the bridge. There is no doubt that the contract between the city and the bridge-operating company has been loosely drawn; but public sympathy is generally with the officials of the Brooklyn Rapid Transit Company, whose cars are ready to run across the bridge. The wires, tracks and switches on the bridge have been officially inspected and pronounced satisfactory.

The New York Fire Department proposes to separate the fire-alarm telegraph system from the chief bureau of the department, of which it is now a branch, and to place the alarm systems of all the boroughs in charge of a competent electrician, with the title "superintendent of fire-alarm telegraph." This official is to be directly responsible to the fire commissioner for the proper care and efficiency of the service. The estimates for the electrical work in the maintenance and extension of the fire alarm in the Borough of Queens next year amounts to $10,725. An amount of $1,325 is to be spent for fire-alarm signal boxes.

The Western Electric Company has received a contract for furnishing telegraph supplies in the Fire Department of New York city.

The Educational Department of New York city has presented its estimates for the special school fund of 1905. The total includes the sum of $24,140 for electric work in the public schools. The highest sum mentioned in the estimates for electric work is $3,520 for School No. 22. School No. 18 is scheduled for an expenditure for the same purpose of $2,500. Another estimate is for maintaining and repairing the telephones in the schools of Greater New York to the amount of $16,800.

The proprietors of the National Bridge Works of Long Island City intend to use electricity for all power purposes in the new plant now being erected.

Cooper Hewitt vapor lamps have been put up along the Panama Steamship Company's pier No. 57, North River. The improved illumination facilitates loading operations at night.

The new Broadway Tabernacle at Fifty-sixth Street is to have an installation of 1,670 incandescent lamps and motors of 102 horsepower.

Among the incorporations reported this week from Albany is that of the Empire State Dry Battery Company, capitalized at $50,000. The head office is in New York city and the directors are R. K. Walcott, Oliver Williams and H. G. Sanders.

D. W. W.

New England.

Boston, October 29.—The Boston Elevated Railway Company's car barns at Forest Hills Station were destroyed by fire last Tuesday morning, and Thomas B. Dunn, a young medical student from the University of Vermont, who had been in the company's employment through the summer, was burned to death. Fifty cars were destroyed, and the loss entailed amounts to about $175,000.

As a result of the inquest relative to the Melrose dynamite explosion which wrecked a crowded trolley car about a month ago, Percy C. Hawkins, the foreman, and Roy C. Fenton, driver, for Eastman's Express Company, are held in bonds of $1,000 each to answer to the charge of manslaughter. Their case will come up in December.

The Boston and Northern Street Railway Company has opened this week a new line between Saugus Center and Cliftondale, about a mile in length, which serves as a feeder from Saugus to the road between Malden and Lynn.

A new trolley-road project is under consideration in Southeastern Massachusetts, to provide connections from the inland towns to the South Shore summer resorts, with Scituate Harbor particularly in mind.

The Boston Transit Commission received bids on Thursday for the construction of Section 1 of the proposed new tunnel under Washington Street, 10 contractors submitting figures, ranging from $152,000 down to $82,858, the latter winning the award.

The Lowell Electric Light Company has asked the Massachusetts Gas and Electric Light Commission for authority to issue 600 additional shares of stock. The present capital is $600,000. The proceeds will be devoted to extensions of the system.

The section of the new Groton and Stonington railway in Connecticut which covers the stretch from Groton to Mystic is approaching completion, and will be opened to travel early in November.

Col. William A. Gaston of Boston, former president of the Boston Elevated Railway Company, is financially interested in the Willimantic Street Railway Company, and has been on a tour of inspection of the route of the proposed extension to South Coventry, Conn. The Willimantic Board of Trade and the Business Men's Association of that city favor the project.

B.

Texas and Mexico.

Austin, Texas, October 27.—The contract which was recently entered into by Governor Miguel Ahumada of the state of Jalisco, Mexico, and I. N. Zermeno and Ernesto Mora, the latter being the assistant manager of the Bank of Jalisco at Guadalajara, for the construction of the first division of the Guadalajara-Morelia electric railway, has just been ratified by the Legislature of the state of Jalisco.

Compania Anonima del Alumbrado Electrico de Puebla will make improvements to its plant at Puebla, Mexico, to cost about $30,000 gold. Arc lamps are to be used in place of the incandescent lamps which are now in use for lighting the streets of the city.

Hon. Ramon Corral, vice-president of Mexico, who owns the electric-light plants at Guaymas, Mexico, and in the city of Hermosillo, has given orders for extensive improvements to these two plants to be made. The proposed improvements will cost about $50,000.

A number of capitalists of Saltillo, Mexico, are organizing a company for the purpose of installing an electric-light and power plant for that city, to be operated in opposition to the plant already established there. The electric power will be generated from a mountain stream near Saltillo.

The Tezuitlan Copper Company has completed and placed in successful operation its electric railway, which runs from its smelting works at Aurora, Mexico, to the town of Tezuitlan. The power plant for the road is situated on the Atexcaco River.

It is announced that extensive improvements are to be made to the street railway of the Ferrocarril Urbano Company of Colima, Mexico., which property was recently purchased by D. G. C. MacNeill of Colorado Springs, Colo., who is also extensively interested in mines in the Guanajuato district of Mexico. The road is to be operated by electric power as soon as the plant can be installed.

An electric-light plant is to be installed at Lagos de Moreno, Mexico. The state Legislature has passed a bill exempting the proposed plant from all state taxation for a term of years.

The Mexican Light and Power Company, which is building a great electric-generating plant at Necaxa, Mexico, has let the contract for the construction of its transmission line to the City of Mexico. It is stated that the transmission line will be completed and the company will be ready to deliver electric power into the City of Mexico some time next year. The initial power of the Necaxa plant will be 40,000 horsepower.

The Mexican Incandescent Lamp Manufacturing Company has obtained a contract to furnish the electric-light plant of the city of Vera Cruz with 20,000 lamps to be delivered this year.

Steps have been taken by a number of the leading rice growers of the section around Gano, Texas, to combine their irrigation interests and establish a large central electric power plant for the purpose of furnishing power for operating their irrigation plants.

The Northern Texas Traction Company of Fort Worth has begun work on a number of important improvements, the cost of which will be about $50,000. These include several short extensions of existing lines in Fort Worth and North Fort Worth.

H.

Southeastern States.

Charlotte, N. C., October 29.—The plant of the Whitney Reduction Company, which is harnessing the narrows of the Yadkin River near Salisbury, N. C., is now on a firm financial basis and the work is steadily progressing. The canal from which the power will be derived will be over four miles long and 26,000 horsepower is to be developed. The river has a fall of 300 feet in 10 miles.

The Washington (D. C.) Railway and Electric Company is at work on plans to improve its service. Much new machinery has been ordered, part of the new equipment being bought at the St. Louis Exposition.

The Alamance Street Railway Company of Graham, N. C., has been incorporated, with $25,000 authorized capital, to build an electric-railway system. J. L. Williamson, J. L. Cates and others are interested.

The franchise and right-of-way of the Asheville and Weaverville (N. C.) electric railway have been transferred to John D. Miles of Warsaw, Ind., and it is said the work will begin shortly on the 10-mile line.

A party of New York men recently investigated the waterpower on the Savannah River near McCormick, S. C., and surveys are being made. In the party were D. M. Mackay and Dr. F. A. C. Perrine of New York, C. M. Knight of Brooklyn and L. F. Dorn of Parksville.

The Piedmont Electric Company of Asheville, N. C., has the contract for a 300-light system at Mineral Bluff, Ga., for the Blue Ridge Tannery; also for a 650-light plant to be run in connection with a new cotton mill at Marshall, N. C., to light the town.

The town of Camilla, Ga., has voted $25,000 for acquiring a water and lighting plant.

Work on the new electric-light plant at Hartwell, Ga., for municipal lighting, will soon be started, and the material is being received.

It is rumored that the Carolina Land and Development Company has bought a fine waterpower on Broad River, near Chester, S. C., the stockholders of the company being mostly Charleston capitalists, and that ample financial backing is available.

L.

Michigan.

Detroit, October 29.—The control of the Detroit, Flint and Saginaw interurban road has passed to Chicago capitalists represented by John M. Duffy, they having secured the control of the $1,000,000 stock. It is understood that this sale is in conjunction with the Nester interests. The line from Saginaw out to Bridgeport is in operation, making in all 16 miles of completed road reaching out toward Frankenmuth, and the balance of the construction of over 50 miles of track will be pushed through to Flint. The bonded indebtedness of the road is $1,000,000. It is expected that the new owners will make important changes in the business policy of the road, and that a bid will be made for freight business. It is probable that the new power house will be built at Bridgeport.

A new electric line is being planned by P. B. De Lisle of Delray, to run from Delray through the village of Woodmere to Detroit. Cheap rates will be given, with workingmen's tickets at the hours that are given by the Detroit United Railway.

G. A. Mullins, who is interested in the new Kalamazoo and Lake Shore Traction Company, which is to connect Kalamazoo with Benton Harbor, states that the road is entirely financed, and that work will be resumed on the west end of the line early in the spring.

The officials of the Detroit street railway state that 80 per cent. of all their cars have now been equipped with air brakes, as called for under the Hillger ordinance, and the remainder of the cars will be equipped by January 1st. The new fenders ordered by the Common Council have been applied to about 10 per cent. of the cars, and the balance of the cars are being supplied.

The Detroit United Railway has suffered another loss by fire, five cars being destroyed by fire supposed to have originated from a defective motor.

The Battle Creek and Kalamazoo interurban electric line has constructed one of the largest bridges in Michigan (for an electric road) over the Michigan Central railroad at Galesburg. It is 780 feet long, with a span over the track of 126 feet, being 22 feet and two inches above the railroad track.

C. G. W.

Ohio.

Cleveland, October 31.—Dennison, Prior & Co. of this city have purchased $1,000,000 bonds of the Ontario Power Company of Niagara Falls. Already contracts have been made for all the current that

can be produced. It is believed that a transmission company will take the current and dispose of it over the state, and it is further possible that the Vanderbilt interests will secure their power for the electric cars along the line of the New York Central.

A new storage-battery station will be built at Newburg by the Cleveland Electric Railway Company. Dan R. Hanna, son of the late Senator Hanna, has been chosen a member of the board of directors to succeed George G. Mulhern, former superintendent.

A new building, 120 by 64 feet, is being erected at the corner of St. Clair and Perry Streets in Toledo by the Nagel Electric Company. It is to be completed by May 1st.

The Interurban and Terminal Company of Cincinnati will connect its power house with that of the Rapid Transit Company, so that in event of necessity one may use the other's power.

The Galion Southern Railway Company of Galion has been incorporated to build a line from Galion to Fredericktown through Morrow, Richland, Crawford and Knox Counties. W. L. Ball, O. Wise and others are interested.

Last Thursday night space-telegraph communication was established between Cleveland, Ohio, and St. Louis, a distance estimated to be about 750 miles, by the DeForest system. The message on Thursday was clear and distinct, repeated back over the telegraph lines it was found to be correctly understood in every detail. The stations in the Schofield Building and at Nottingham, near Cleveland, will shortly be combined and many improvements made on the instruments. This will enable the operators to do much better work. As rapidly as possible the DeForest company is pushing its work. Stations will shortly be built at Toledo, Detroit, Port Clinton and Duluth by a subsidiary company.

The Postal Telegraph Company has arranged to move its office at Columbus from North High and Gay Streets to the Ruggery Building on Gay Street, where excellent quarters will be fitted up.

O. M. C.

Pacific Slope.

San Francisco, October 28.—Allan Pollock, formerly general manager of the San Francisco Gas and Electric Company, which position he left to assume the management of the new Hotel St. Francis, has severed his connection with the hotel and is back to his old position with the lighting concern. General Manager Lawless resigned some time ago and Mr. Pollock decided to accept the position.

The City Council of Corvallis, Ore., has granted a franchise to the Willamette Valley Electric Railway Company to operate a line in Corvallis.

The Snohomish-Cherry Valley Trolley Company has been organized at Snohomish, Wash., by J. W. Hall, Fred S. Anderson, E. Lloyd Colburn and W. M. Snyder. This is part of the large system to be operated between Mount Vernon and Seattle, Wash.

G. R. Aldrin is planning to establish an electric power plant in Greenhorn City, Ore., early in the spring. The plant will have a capacity of 800 horsepower.

Attorney Sayre of Seattle, Wash., states that the town of Edmonds is being wired for electric lighting. A party of capitalists is planning to build a plant in that town.

The Columbia Electric Company has been incorporated in San Francisco by S. Sprout, J. P. O'Brien and others. The capital stock is $5,000,000.

The War Department has notified the Pacific Division and the Department of California that the Alaska telegraph system is completed and ready for service.

The Pacific Postal Telegraph-cable Company has commenced work on a new line from San Francisco to Ogden, Utah. This will tap a vast territory in which the Western Union at present has no competition.

The electric-lighting plant in the Rialto Building is to be enlarged at once. Arrangements have been made for laying conduit for wires to the Crossley Building, just across the street from the Rialto, and to the new nine-story office building to be erected soon by one of the Law Brothers at the corner of Market and Anna Streets.

The Central Light and Power Company, with offices and plant in the Parrott Building, will soon erect a building for storage purposes at Stevenson and Fourth Streets.

J. J. Simons of San Diego is projecting an electric road from San Diego to Riverside, Cal., via Escondido.

The trustees of Vacaville, Cal., have adopted a resolution calling for an election to be held for the purpose of submitting the proposition to the voters of bonding the town for $40,000 for the construction of a water and light plant.

The council of Lemoore, Cal., is advertising for sealed proposals for furnishing one 100-horsepower, high-speed engine, one alternating-current three-phase 75-kilowatt dynamo and switchboard, complete, new or second-hand.

The Ukiah Redwood Lumber Company has been incorporated at Ukiah, Cal., by C. A. McComber, S. C. Golden and others, for the purpose of establishing and maintaining an electric-light system at Ukiah.

The San Jose and Los Gatos interurban road has asked the supervisors of Santa Clara County, Cal., for an electric-road franchise from the town of Mayfield to the San Mateo County line, along the San Francisco road.

A.

PERSONAL.

The appointment of E. U. Harlan as manager of the Monterey Electric Street Railway, Light and Power Company of Monterey, Mexico, is officially announced.

Sales Manager L. P. Sawyer of the Buckeye Electric Company, Cleveland, passed through Chicago last week en route for the Southwest on an extended business trip.

Cornelius Shields, general manager of the Lake Superior Corporation, died at Sault Ste. Marie on October 29th. Mr. Shields was 49 years of age. He began his career as a telegraph operator. He had much to do with the reorganization of the company controlling the great hydro-electric plant at the "Soo."

E. Henry Barnes, age 66, died suddenly on October 25th in New Haven, Conn., where he was rated as one of the city's prominent business men. He was one of the directors of the Edison Electric Illuminating Company of Boston, and had been a director of the Boston Electric Light Company before it was absorbed by the Edison.

President C. C. Warren of the Warren Electric Manufacturing Company, Sandusky, Ohio, visited Chicago last week. Mr. Warren was entertained at a number of dinners by friends during his stay. As ex-commodore of the Interlake Yachting Association, also, Mr. Warren is compelled to assume many pleasant social duties in addition to those of a business nature.

Prof. B. S. Lanphear, assistant professor of electrical engineering at Iowa State College, Ames, Iowa, died recently at his old home in New York state. He was a graduate of Cornell. He was a valued member of the American Institute of Electrical Engineers and secretary of the local branch at his college. The student meetings of the Institute at Ames under his direction had become important and profitable, and through his efforts a large number of students were enrolled in the organization.

Max Osterberg, E. E., A. M., consulting engineer and electrical expert, died in New York on October 16th. He was taken suddenly and seriously ill about August 1st of cerebral apoplexy, and from the first his condition was very serious. Mr. Osterberg was well known from his connection with electrical work in New York. He was a member of the American Institute of Electrical Engineers, and some of his earliest work in the electrical field was in editing the Proceedings of the International Electrical Congress held at Chicago in 1893.

The American Institute of Electrical Engineers wants to know the addresses of the following-named foreigners who visited the United States during the summer in connection with the International Electrical Congress: Wilhelm Durnkranz, Baron Wolfgang Ferstel, C. F. Milliken, H. L. Riseley, E. Ziehl. Considerable mail addressed to the above-named persons has accumulated at the secretary's office, 95 Liberty Street, New York, and should be forwarded to the addressees without further delay. Secretary Pope will be grateful for any information regarding the whereabouts of these men.

ELECTRIC LIGHTING.

Chicago Edison stock recently made an advance from 145 to 160.

The Trinidad (Colo.) Light and Power Company has increased its capital stock to $70,000.

The Shenandoah (Iowa) Electric Light and Power Company has published a notice of dissolution.

The municipality of Heidelberg, South Africa, contemplates installing an electric-lighting plant and establishing waterworks.

The proposition of bonding the city of Troy, Mo., for $10,000 to erect an electric-lighting plant was carried at a recent election.

The Commonwealth Light and Heat Company of Augusta, Me., has been incorporated with a capital of $15,000. I. L. Fairbanks is president.

A special election will be held on November 14th at Monroe, Mich., to submit to the taxpayers a proposition to bond the city for $25,000 to build a municipal electric-light plant.

The municipality of Reichenberg, Bohemia, intends to erect a large electric plant to supply light for neighboring small towns and industrial establishments and another plant to furnish electric light to the suburbs of the city.

Ownership of the Southwest Missouri Light Company of Joplin, Mo., has passed into the hands of local people. The officers are: President, George W. Moore; vice-president and secretary, David D. Hoag; treasurer and general manager, A. M. Barron. Substantial improvements are to be made, including the installation of turbine waterwheels of 1,000 horsepower, a 250-horsepower boiler and a 500-horsepower generator. The betterments will cost about $30,000. It is the intention of the company to combine eventually with the Missouri Ice and Cold Storage Company under the name of the Jasper County Light, Power and Ice Company.

Electric lights and telephone service in Hegewisch, Indiana Harbor, Whiting, Roby and Robertsdale, were put out of service October 26th, when a dredge of the Great Lakes Towing Company, in operation in the Calumet River at One-hundred-and-twenty-second Street, severed the service cable from the electric plant in South Chicago. The communication between the suburbs and Chicago was cut off during the night, and the towns were in almost complete darkness.

ELECTRIC RAILWAYS.

The city of Ottawa, Kan., has granted a franchise for a street railway to Hugh Holmes of Kansas City, who agrees to have a line from Kansas City completed in 18 months.

The Hummelstown and Campbelltown Electric Street Railway Company has begun the operation of its line from Hummelstown to Palmyra, Pa., a distance of eight miles. M. S. Hershey, the chocolate manufacturer, is president and principal stockholder in the company.

A. B. Cleveland has been discharged as receiver of the Cleveland, Painesville and Eastern Traction Company and the property is again in the hands of the owners. J. G. Mitchell of Toledo, who filed the application for receiver, withdrew it and said that he had acted on wrong information.

Public indignation was aroused to such a pitch at Toledo, Ohio, a few nights ago when the City Council granted 25-year extensions on all street-railway franchises that the services of 40 policemen were required to protect the aldermen from violence at the hands of the public. The franchises are owned by the Everett-Moore syndicate, which controls the traction and lighting systems of the city.

A movement looking to the reorganization of the Chicago General Railway Company in Chicago was announced recently. William C. Wood has offered, it is said, to purchase the bonds of the Twenty-second Street line and of the West and South Towns company, one of the constituent corporations of the Chicago General, which has been in the hands of a receiver for years. Mr. Wood says he controls the Southern Railway Company, a corporation formed some time ago to build suburban lines in the south division of the city.

E. O. Sessions, chief engineer for the St. Joseph, Albany and Des Moines railway, is receiving bids for grading and for materials for the construction of the entire road. The St. Joseph line will be operated by steam from St. Joseph, Mo., to Des Moines, and by the third-rail electric system on the divisions between Albany, Mo., and St. Joseph and between Winterset, Iowa, and Des Moines. The construction will include 19 depots, power and freight houses, machine shops and roundhouses, the entire expenditures being estimated at $8,500,000.

SOCIETIES AND SCHOOLS.

At the meeting of the American Institute of Electrical Engineers on October 28th 42 associates were elected.

The next meeting of the Electrical Section of the Western Society of Engineers will be held in the society's rooms in the Monadnock Building on November 11th. Mr. Samuel G. McMeen will present a paper, illustrated by lantern slides, upon "A Few Interesting Phases of Long-distance Telephony." The paper will take up the methods, usefulness and difficulties of simultaneous telegraphy and telephony. Some recent progress in bettering long circuits is to be discussed, and the limits of speech on the longest lines. Other points of interest to be brought out by the paper are commercial interrelations of local and long-distance lines, "ring-through," "booster-battery" and "ticket-tube" systems.

PUBLICATIONS.

The latest discount sheet of the General Incandescent Arc Light Company of New York is intended both as a discount sheet and as advertising matter. The company gets out a series of catalogues, each made up of a number of bulletins. The discount sheet contains the numbers of these various bulletins and the classification under which they belong.

Information upon producer gas, its manufacture and uses, is contained in section one of Catalogue A of the Wile Power Gas Company of Rochester, N. Y. Comparisons are made between producer gas and other forms of power. The efficiency of producer gas as a fuel is further shown, compared with coal fires, illuminating gas and natural gas. The bulletin contains good illustrations of the suction type of gas producer and of the automatic type.

A leaflet comes from the Pittsburg Transformer Company setting forth some facts about the company's business for last month, in which the statement is made that the business for that period was greater than for any other single month in its history. The monthly calendar for November has also

appeared, and the portrait of the young lady which adorns the front of the calendar is the best of the series, all the members of which have thus far been calculated to uphold the prestige of the company.

"A pleased customer pleases us" say Pass & Seymour of Solvay, N. Y., and so, to accomplish this mutual satisfaction, they have issued a folder devoted to P. & S. porcelain sockets which they think will bring pleasure to prospective buyers. Angle sockets, pendant sockets and fixture sockets are held up to the notice of the reader, together with special inducements to those in the electrical trade.

Emerson enclosed motors and motor-driven friction and bench drills are described in two recent bulletins from the Emerson Electric Manufacturing Company of St. Louis. The enclosed motors are of a new spherical type and are shown in detail in the bulletin devoted to them. These sizes are self-contained and need no starting box and can be furnished for operation in an inverted position. Dimensional drawings are given on one page, together with specifications. On another page are data and list prices for making out orders, arranged in two tables, one for shunt-wound and one for series-wound motors. The motor-driven drills described in the other bulletin are small pieces of machinery, the motors ranging from one-twentieth to one-half-horsepower capacity. Some are belted and others direct-driven; in the latter case the motor is mounted with its shaft vertical.

The Western Electric Company's latest bulletin upon knife switches is deserving of more than passing attention not merely from the fact that its appearance is pleasing but because of the arrangement of the data which it contains. Unusual pains have evidently been taken in the preparation of this bulletin to make it of real value to the prospective buyer. For instance, on pages 18 and 19 and 26 and 27 are to be found drilling plans, tables of dimensions, dimension drawings of switches giving sufficient information for designing bus work, and in fact all the necessary data for laying out a switchboard as far as switches are concerned. The bulletin will be found to be of much practical assistance to engineers and contractors. All the company's various types of knife switches are illustrated and described in detail. The last pages are devoted to a description of a knife-contact instrument switch and a new style of ground detector, the latter having been but lately placed on the market. Altogether the bulletin is a credit to those who have had the care of its preparation.

MISCELLANEOUS.

The new electric-light and power plant at the Yak tunnel, Leadville, Colo., has been placed in operation. Electric motors now take the place of mules in moving the cars.

The Arrow, Captain Thomas S. Baldwin's airship, traveled a distance of 10 miles over the Exposition grounds and the city of St. Louis on October 25th, alighting safely at its starting point. During the flight the airship was under the complete control of the navigator, flying part of the time in the teeth of the wind. The balloon part is cigar shaped, of Japanese silk, 54 feet in length and 17 feet in diameter and requires 8,000 cubic feet of gas to inflate it. The frame attachment is 30 feet in length. It carries a double cylinder, seven-horsepower gasoline engine, making 2,000 revolutions a minute to drive the propellers. One of the chief new features is an arrangement whereby the ship is pulled through air instead of being pushed.

It is a very unusual thing to have the Republican, Democratic and Prohibition parties of a state adopt the same plank in each of their platforms. This has occurred in Illinois this year. The plank is one endorsing the pending constitutional amendment, which applies only to the city of Chicago, and, it ratified by the voters in November, will open the way for a new charter for the city.

TRADE NEWS.

The imports of electrical apparatus into Egypt during the years 1901, 1902 and 1903 were valued at about $210,000, $276,000 and $338,900, respectively. In this trade Great Britain led with the lion's share each year. In 1903 the figures were: Great Britain, $155,145; Germany, $72,065; France, $41,170; Switzerland, $30,890; Austria-Hungary, $17,220; Sweden, $9,280; Italy, $5,430; Belgium, $5,100; United States, $2,585.

The Safety-Armorite Conduit Company of Pittsburg has entered suit against Cortlandt D. Richmondt and the Mark Manufacturing Company of Chicago, Ill., doing business at Evanston, Ill., and Zanesville, Ohio, in the United States Circuit Court for the Northern District of Illinois, asking for an injunction restraining the defendants from engaging or co-operating in the manufacture or sale of Electric iron-armored conduit.

Sealed proposals will be received at the office of the supervising architect of the United States Treasury Department, in Washington, D. C., until November 30th, for the construction (including plumbing, heating apparatus, electric wiring and conduits) of the United States postoffice at Anderson, Ind., in accordance with the drawings and specifications, copies of which may be had at the office mentioned or at the office of the postmaster in Anderson.

In Lynn, Mass., it is reported that there are indications that before another year passes there will be material increases at the Lynn plant of the General Electric Company, arrangements now being under consideration for removing more of the work from the Schenectady plant to the Lynn works. To accomplish this, additional factory buildings on the bank of the Saugus River are under consideration. Eventually, it is asserted, all steam-turbine work will be done at the Lynn factories.

The Northern Wire and Cable Company of South Milwaukee, Wis., has opened a Chicago office at 1201 and 1202 Marquette Building, with Mr. J. B. Wallace, one of the best known and most popular of Chicago's electrical men, as sales agent. The company has lately purchased the magnet-wire department of the Miller-Knoblock Electrical Manufacturing Company, South Bend, Ind., and has remodeled all of the machines, furnishing them with several improvements. This makes an addition of 30 machines to the Northern company's former capacity, which enables it to take care of a large proportion of both the cotton and silk magnet-wire trade. The company is now installing machinery for the manufacture of jack cable.

Daily papers report that the Westinghouse Electric and Manufacturing Company has authorized the sale of $15,000,000 five per cent. 20-year debenture bonds at such times and in such amounts as the board shall decide. It is pointed out that the issuance of these debentures is a temporary expedient to furnish the company at once with working capital, which, in the judgment of the directors, can easily be taken out of the current earnings of the immediate future. Since its organization the company has followed the policy of increasing the value of its plants out of current earnings rather than by means of capital increase, so that the value of its fixed and working assets, as stated by the directors, is double the amount of the share capital, this in spite of the fact that in 1903 $4,500,000 additional common stock was issued at 160. The stock pays quarterly dividends of 2½ per cent. each. There are outstanding $2,000,000 of five per cent. debentures due in 1913 and $850,000 six per cent. first-mortgage bonds of a subsidiary company due in 1916. The retirement of the existing debentures is provided for by sinking fund. The directors anticipate a large increase in the company's business, resulting from the introduction of the single-phase system in the operation of interurban railways and the conversion of steam into electric roads, in addition to the natural growth of all other divisions of the electrical field.

BUSINESS.

The address of the Cincinnati branch office of the General Incandescent Arc Light Company is 62 Perin Building, not 61 Perin Building, as first announced.

The blotters now issuing from the Chicago Mica Company are full of good points relative to "Micabond" and the other high-class products of the Chicago Mica Company. The merits of this company's insulating material have enabled the company to build up an enviable reputation and a large trade, and no little credit is due to Secretary Heilstedt for his ingenuity in producing novel sorts of advertising.

The new government laboratory at Manila is being fitted with eight Bossert distributing panelboards and one switchboard. The Bossert Electrical Construction Company of Utica, N. Y., has made decided advancement in the construction of panelboards, switchboards and junction boxes, especially the last named, and, the company points out, the government experts are making good use of the increased economy and efficiency effected by these improvements.

The International Telephone Manufacturing Company of Chicago is making its central-energy, as well as its generator-call, wall and desk telephones, so as to completely avoid the use of any of the exposed metal parts as a part of the circuit, absolutely preventing the user from receiving an electrical shock when using the telephone. It is said that the International company, in designing its apparatus, considered these points as one of the most essential in the telephone system, especially for large cities or even rural exchanges, where there is considerable danger from lightning.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued (United States Patent Office) October 25, 1904.

772,914. Switch. Charles C. Badeau, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed September 16, 1901.

The switch is provided with a switch blade, a handle pivoted separately from the switch blade, a double-link toggle connecting the handle and switch blade, means for arresting the toggle when overset, and means for tripping the toggle independently of motion of the handle.

772,921. Current-limiting Switch for Electric Lights. Harry W. Brown, Winchester, Mass., assignor to the General Electric Company, Schenectady, N. Y. Application filed December 3, 1901.

Combined with a translating circuit are a current-limiting switch to open the circuit on definite current flow, coin-operated means for closing the circuit irrespectively of the current flow, and timing mechanism for opening the coin-operated closure.

772,923. Time Cut-out for Electric Circuits. Edwin F. Callender, Galesburg, Ill. Application filed December 10, 1900.

A rod is attached to the alarm arbor of the clock and rotates with it. The rod is connected to the handle of a switch, which is opened through the turning of the arbor and consequent movement of the arm.

772,927. Apparatus for Through Ringing on Telephone Trunk Lines. Henry M. Crane, New York, N. Y., assignor to the Western Electric Company, Chicago, Ill. Application filed February 17, 1902.

Two telephone switchboards with telephone lines centering at each board have a trunk line extending between the boards. A relay at one of the boards controls a source of calling current and applies it to the telephone line which is connected with the trunk line at that board. Differential windings for the relay are connected respectively with the limbs of the trunk line, means for producing a flow of current in both limbs of the trunk line are supplied and a switch at the distant end of the trunk line diverts current from one of the differential windings of the relay.

772,936. Cut-out Switch for Telephones. James R. Harris and Charles A. Harris, Trenton, Mo. Application filed June 23, 1904.

An audible electromagnetic signal separate from the telephone has a ground-wire connection. A conducting lever is normally in electric contact with one of the conductors, and another conducting lever is normally in contact with the other main-line conductor. A conductor is placed between the first-named lever and the telephone, a conductor between the last-named lever and the signal, and a ground-wire connection contiguous to the main-line conductors.

772,944. Electrical Testing Apparatus. William J. Kyle, Philadelphia, Pa., assignor to the Keystone Telephone Company, Philadelphia, Pa. Application filed November 19, 1902.

A portable device constructed and arranged for testing electric circuits consists of an inclosing casing, two pairs of terminals mounted upon the casing and respectively arranged to detachably connect with circuits to be tested, a generator within the casing and circuit connections between the generator and both pairs of terminals.

772,950. Alternating-current Motor. Maurice Milch, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed February 10, 1904.

In an alternating-current motor are a polyphase primary member, a rotatable secondary member provided with a commutator, and short-circuiting brushes bearing on the commutator and displaced from the lines of magnetization of the several phases of the primary member.

(See cut on next page.)

772,959. Medical Battery. Leon W. Pullen, Philadelphia, Pa., assignor to the Wireless Railway Company. Application filed February 18, 1904.

A medical battery consists of a core of insulating material combined with an induction-coil mechanism, a battery and two inclosing metallic cases respectively in circuit with the terminals of the secondary coil. These are adapted to be grasped by the hands. One incloses and directly supports the battery and the other, adjustable longitudinally, incloses the induction-coil mechanism.

772,963. Electric Cigar Lighter. William Roche, Jersey City, N. J. Application filed January 29, 1904.

Two converging conducting members are made to break an electric circuit and light a torch by the spark thereby produced.

772,967. Safety Fuse. Edward L. Simons, Alden, Pa. Application filed June 24, 1903. Renewed August 4, 1904.

An inclosing shell has removable caps, closing the ends of the shell. Carriers are secured to or form part of the caps. Means separate from the carriers and operative from without the shell allow of removably securing a fusible wire or strip to the carriers.

772,985. Insulated Rail Joint. George A. Weber, New York, N. Y., assignor to the Weber Railway Joint Manufacturing Company, New York, N. Y. Application filed June 8, 1904.

The rail rests upon an insulating support and is insulated also from the bolts holding it to the support.

772,987. Contact for Trolleys. Thomas F. Wetton, Newark, Ohio. Application filed February 4, 1904.

A contact shoe is pivoted to the trolley pole and engages the trolley wheel. An integral weight maintains the contact shoe in engagement with the trolley wheel.

773,007. Telephone System. Richard M. Eaton, Philadelphia, Pa. Application filed December 31, 1901.

A special station is connected directly with one of the subscribers' stations, and means, including a movable member located at the subscribers' station whereby communication may be had selectively either with the central station and the other subscribers' stations, are connected therewith or with the special station.

773,024. Signaling. John Millar, Kearney, N. J. Application filed October 22, 1902.

The signal is moved to the various positions by an electric motor, which, in turn, is controlled by the signal operator.

773,025. Signaling. John Millar, Kearney, N. J. Application filed October 22, 1902.

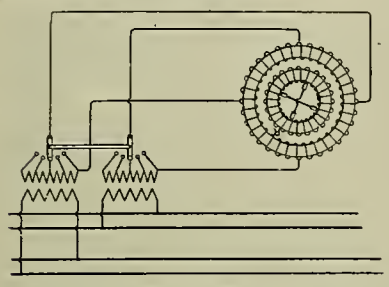
A restoring device for the signal is operated by a motor.

773,026. Automatic Gas Regulator. John L. Murphy, New York, N. Y. Application filed May 5, 1904.

A thermostat located in proximity to the burner is operated by the flame. Electromagnetic means comprising a magnet and a source of electricity automatically cut off the supply of gas when the flame is extinguished.

773,039. Signaling System. Howell W. Souder, Tamaqua, Pa., assignor of one-half to W. D. Zehner, Lansford, Pa. Application filed October 22, 1902.

Connected in series with a main signaling conductor are incandescent electric lamps spaced at approximately equal distances. Resistances are also connected in series with the main conductor so as to form shunts around the lamps. Ground connections are located at each end of the main conductor, also a lamp without a resistance shunt in each ground connection, the lamps in the ground connections being of a different color from those in the main circuit.



NO. 772,950.—ALTERNATING-CURRENT MOTOR.

773,048. Trolley Wheel. Ray E. Briggs, Chicago, Ill. Application filed June 15, 1904.

Three wheels are mounted in tandem on the trolley barp.

773,062. Electric Igniter for Gas Engines. Robert Cooper and John Cooper, Saltsburg, Pa. Application filed February 14, 1902.

A ratchet wheel is mounted on a hollow shaft carrying an insulated disk electrode. A solid shaft carries a second electrode, both electrode shafts passing inside the combustion chamber of the engine.

773,065. Electrical Railway Signal. James L. Dickey, Atlanta, Ga. Application filed August 29, 1902.

The line of railway is divided into sections, a main circuit extending along each of the sections. Signals are placed at intervals along each of the sections and adapted to be operated by a current passing over the main circuit.

773,069. Apparatus for Utilizing Electrical Oscillations for Signaling Purposes. Clarence E. Freeman, Chicago, Ill. Application filed January 14, 1901.

Apparatus for utilizing electrical oscillations for signaling or similar purposes consists of a radiating conductor, spark terminals therefor, and means for successively raising the spark terminals to unifom difference of potential at the instant the spark is discharged, whereby the maximum amplitude of the electrical oscillations is substantially the same in the successive oscillations generated.

773,079. Marine Engine Governor. Andrew Kerr, New Brighton, England. Application filed February 23, 1904.

An electric circuit controls the supply valves of the engines, the circuit being in turn operated by contacts moved by a piston which operates in a cylinder below the water level in the tunnel of the ship.

773,080. Electric Signal for Railways. Wilbur C. Lamphier, Worcester, Mass. Application filed June 17, 1903.

Combined with a signaling device forming part of an electric circuit is a fixed contact plate included in the circuit. A sliding bar provided with a lug is arranged to be carried under a blade spring and bring the plates into contact.

773,089. Ear for Carrying Overhead Trolley Wires. Francis Morris, Govanhill, Glasgow, Scotland. Application filed June 13, 1904.

An improved ear or support for carrying trolley wires comprises a bar of conducting material having a channel to hold the trolley wire, a socket piece for suspending the support and devices for securing the socket piece in position so as to press the wire within the channel.

773,091. Cash Register. William H. Muzzy, Dayton, Ohio, assignor to the National Cash Register Company, Jersey City, N. J. Application filed April 9, 1904.

The cash register has several receptacles and within the register are a number of incandescent lamps with different colored globes, each corresponding to a different receptable. These lamps are thrown into circuit according to the receptable which is opened.

773,119. Circuit-Breaker. Adolph F. Christmas, Pittsburg, Pa., assignor of two-thirds to Frank R. McFeatters, Wilkinsburg, Pa. Application filed June 22, 1903.

The circuit-breaker comprises a movable contact arranged to close by gravity, a co-operating contact, a solenoid in the circuit, a hollow core for the solenoid and a stem connected to the movable contact and extending through the hollow core, the arrangement being such that the solenoid core has a certain amount of free or idle movement on the stem.

773,120. Electric-motor System. Adolph F. Christmas, Pittsburg, Pa., assignor of two-thirds to Frank R. McFeatters, Wilkinsburg, Pa. Application filed December 2, 1903.

Combined with a reciprocating motor having a number of coils are circuits leading to the coils, and a circuit interrupter and changer arranged to break the circuits and make them alternately through the coils, the circuit interrupter and changer being arranged to allow a long time interval between the breaking of the circuit and the succeeding making. (See cut.)

773,121. Rotary Mercury Circuit-Breaker. Adolph F. Christmas, Pittsburg, Pa., assignor of two-thirds to Frank R. McFeatters, Wilkinsburg, Pa. Application filed December 2, 1903.

A body provided with a chamber has three circuit terminals exposed in the chamber, one at least of which is of mercury. A positive pole is in constant electrical connection with the mercury terminal, negative poles are connected to the other two terminals and means are supplied for moving the body to bring the two negative terminals alternately into electrical connection with the positive terminal.

773,122. Electric Hammer. Adolph F. Christmas, Pittsburg, Pa., assignor of two-thirds to Frank R. McFeatters, Wilkinsburg, Pa. Application filed December 2, 1903.

In an electric reciprocating tool are a sleeve or bobbin closed at one end, two coils thereon, a partition separating them, a reciprocating core in the sleeve and closely fitting it, and an air-duct through the partition and entering the sleeve at such a point that it will be uncovered when the core approaches the limit of its outward movement.

773,123. Rotary Mercury Circuit-Breaker. Adolph F. Christmas, Pittsburg, Pa., assignor of two-thirds to Frank R. McFeatters, Wilkinsburg, Pa. Application filed December 4, 1903.

A rotatable body, a partition of insulating material dividing it into two chambers, a body of mercury in each chamber, but only partially filling it, metallic connections extending through the partition and exposed in both chambers, an annular circuit terminal exposed in each chamber with which the mercury is in constant contact, and means for rotating the body are the features of most importance in the device.

773,124. Electric Hammer. Adolph F. Christmas, Pittsburg, Pa., assignor of two-thirds to Frank R. McFeatters, Wilkinsburg, Pa. Application filed December 4, 1903.

In an electric reciprocating tool are a coil and core, a tube inclosing the core and having an internal shoulder at one end, two end pieces, one having an external shoulder, which is engaged by the internal shoulder on the tube and the other having external screw threads, and a coupling sleeve having internal screw threads engaging the external screw threads on one end piece and also having means engaging the end of the inclosing tube.

773,125. Electric-motor System. Adolph F. Christmas, Pittsburg, Pa., assignor of two-thirds to Frank R. McFeatters, Wilkinsburg, Pa. Application filed December 4, 1903.

A hammer is driven by a reciprocating motor having a single coil. There is a time-interval circuit-breaker in the circuit arranged to automatically break and make the circuit, the circuit-breaker being arranged to maintain the circuit to the coil only momentarily.

773,129. Dynamo. Isidor Deutsch, Montreal, Canada, assignor to the Electric and Train Lighting Syndicate, Montreal, Canada. Application filed May 14, 1903.

The essential parts are a rheostat, a disk suitably journaled and designed to carry the rheostat finger, a row of teeth having a beveled rearward portion and circularly arranged on the face of the disk, a second row of teeth of similar construction arranged inwardly of the row, and a pawl. A solenoid is designed to govern the position of the pawl on the face of the disk, and means for imparting to the pawl a reciprocatory motion are also supplied.

773,166. Electric Signal System. Howell W. Souder, Tamaqua, and John Early, Lansford, Pa. Application filed December 7, 1903.

A signal conductor extends along the block, and circuit-controlling devices for the conductor are located near each end of the block. A resetting conductor extends along the block, and has a break in its main line. A circuit-closer is provided for the break and an electromagnet is included in circuit with the signal conductor and controls the circuit-closer to close the break in the resetting circuit when there is current passing through the signal conductor. (See cut on next page.)

773,168. Sparking Plug. Charles F. Splitdorf, New York, N. Y., assignor to the Electric Vehicle Company, Jersey City, N. J. Application filed March 13, 1903.

Details are described.

773,171. Method of Receiving Electrical Impulses. Daniel W. Troy, New York, N. Y. Application filed April 8, 1904.

A method of receiving electrical impulses consists in displacing electrical discharges in vacuum by means of the energy of received impulses.

773,182. Automatic Electric Switch. James I. Ayer, Cambridge, Mass., assignor to the Simplex Electric Heating Company, Boston, Mass. Application filed June 27, 1904.

An electric circuit contains a translating device and a switch for opening and closing the circuit, a pair of magnets for respectively causing the opening and closing movements of the switch and a regulating device controlled by the condition of the translating device and operating under predetermined conditions to effect the energization of one or the other of the magnets.

773,187. Telephone Signaling Device. Donald M. Bliss, Brookline, Mass., assignor to the Holtzer-Cabot Electric Company, Brookline, Mass. Application filed September 19, 1902.

Circuit-interrupters are mounted on rotatable shafts and speed-changing gears connect the shafts. A frame is provided with bearings for the shafts and there are means for coupling one of the shafts to a motor.

773,195. Relay. Thomas A. Casey, Jersey City, N. J., assignor to the Manhattan Electrical Supply Company. Application filed March 16, 1904.

The relay consists of movably supported magnets, an arm secured to the magnets, a slot in the base through which the arm projects, an adjusting screw threaded in the arm, an abutment for the screw and a spring connection between the arm and the base.

773,198. Telegraph System. Albert C. Crehore, Yonkers, N. Y. Application filed August 12, 1903.

Several receiving relays are embodied in the system with means for successively energizing the relays in groups, each group containing less than the full number of relays. A series of magnets greater in number than the relays and a local circuit for each magnet containing circuit-closers corresponding in number to the relays comprise the apparatus.

773,201. Fuse. Louis W. Downes, Providence, R. I., assignor to the D. & W. Fuse Company, Providence, R. I. Application filed April 29, 1904.

In an inclosed electric fuse is a shell, a band fitting closely within the open end of the shell, a cap fitting over and closing the open end of the shell, and securing means passing from the cap through the wall of the shell into engagement with the band and securing the latter against the inner surface of the shell.

773,213. Electrical-controller Attachment. Albert H. Mathewson, Thompsonville, Conn. Application filed April 7, 1904.

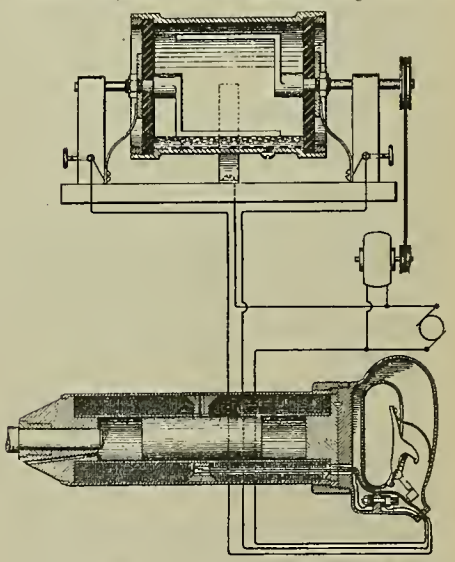
An attachment for an electric controller contains a frame, pawls supported by the frame, a handle with a part adapted to be successively engaged by the pawls, a part adapted to cause the disengagement of the pawls and a movable hand grip for turning the handle and for moving the pawl-disengaging part.

773,246. Magnetic Separator. John W. Carnoghan, Silvercreek, N. Y., assignor of one-half to Albert B. Chapman, Silvercreek, N. Y. Application filed November 27, 1903.

The magnetic separator comprises a downwardly tapering funnel, and two pairs of magnets arranged in an annular series around the outlet of the funnel and inclined to form a downwardly tapering skeleton throat. The magnets of one pair are arranged on diametrically opposite sides of the throat, while the magnets of the other pair are also arranged on diametrically opposite sides of the throat, but at right angles and in a lower plane relatively to the first-mentioned pair of magnets. (See cut on next page.)

773,263. Electric Train Signal. Ernest M. Quittmeyer, Bridgeport, Conn. Application filed December 23, 1903.

An electric generator, a reversing switch, warning and final signal rails, a tower indicator, an electric circuit through the parts and a cab indicator having connections



NO. 773,120.—RECIPROCATING MOTOR SYSTEM FOR TOOLS.

adapted to engage the signal rails whereby the circuit may be completed through the cab indicator are the most essential parts of the system.

773,280. Trolley Harp. Thomas Egan, Muscatine, Iowa, assignor of one-half to J. G. Dermedy, Muscatine, Iowa. Application filed April 14, 1904.

Details are described.

773,314. Trolley Catcher. Charles F. Davy, Mohawk, N. Y. Application filed June 20, 1904.

A drum mechanism for taking up the slack in the trolley rope is described.

773,323. Circuit-operating Device. Charles F. Hopewell, Cambridge, Mass. Application filed August 17, 1904.

A conductor has two insulated sections adapted to be engaged by a traveling contact device of a moving vehicle. Circuits for two solenoids are connected respectively with the insulated section and with the main trolley wire and a circuit-closing device is operated by the successive action of the solenoids.

773,324. Track-switch Operating Mechanism. Charles F. Hopewell, Cambridge, Mass. Application filed August 17, 1904.

Electromagnetically controlled means move a pivoted switch plate.

773,326. Electrical Signaling Apparatus. Charles A. Junken and William B. Tredwell, Hampton, Va.; said Tredwell assignor to William H. Boyenton, Hampton, Va. Application filed February 17, 1904.

In a range finder there are a pair of solenoids, an armature common to the solenoids, an indicator con-

nected to and movable by the armature, and means for proportionately increasing or decreasing the volume of current passing to one of the solenoids as it is decreased or increased in the other.

773,331. Electric Battery. Charles F. Mackey, Philadelphia, Pa., assignor of two-thirds to William H. Tomer and Harry N. Carter, Philadelphia, Pa. Application filed December 11, 1903.

A zinc positive element forms a casing with a perforated wall. Flanges at its upper end forming supporting hooks, a carbon negative element in the casing, a receptacle to which the casing is fitted, the flanges of the casing engaging the edge of the receptacle and an electrolyte in the receptacle are the other parts.

773,334. Trolley Signal. Charles H. Morse, Cambridge, Mass. Application filed September 21, 1903.

A trolley-operated lever operates the signal and a locking device for the trolley-operated lever is provided with means for disengaging the trolley wheel from the wire whenever the lever is locked.

773,340. Telegraphic Receiving System by Means of Hertzian Waves. Octave Rochefort, Paris, France, assignor of one-half to La Société Anonyme d'Electricité et d'Automobiles Mors, Paris, France. Application filed August 26, 1903.

A coherer containing two electrodes and a third element between them is described.

773,369. Electrical Block Signal. Howard Brooks, Wheaton, Ill., assignor of one-half to J. W. Porter and M. A. Berg, Chicago, Ill. Application filed December 21, 1903.

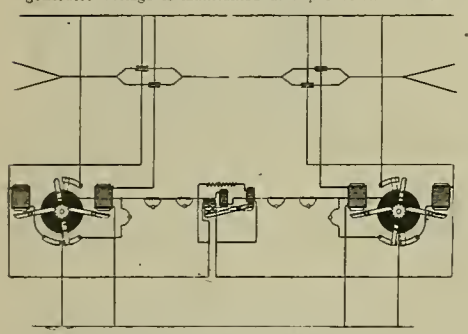
An electromagnet is provided with three coils, forming independent circuits. An electric signal is adapted to be operated by the electromagnets and there are means for breaking one of the circuits by the action of one of the two remaining circuits.

773,372. Electric Circuit. George A. Campbell, Newton, Mass., assignor to the American Bell Telephone Company, Boston, Mass. Application filed March 5, 1900.

The circuit coosists of an electric conductor provided with self-induction coils of low resistance and high inductance inserted in the conductor in series at short intervals, and a further series of self-induction coils of gradually varying inductance, at either or both ends of the conductor.

773,398. Apparatus for Regulating Voltage. Maurice Leblanc, Paris, France. Application filed January 5, 1903.

A source of voltage having a predetermined value acts against a source of an opposing voltage varying with that supplied by the generator. A circuit containing a field winding of the exciter develops current in accordance with the resultant of the opposing voltages, whereby the generator voltage is maintained at a predetermined value.



NO. 773,166.—SIGNAL SYSTEM.

773,399. Regulating Apparatus for Constant-current Generators. Maurice Leblanc, Paris, France. Application filed February 26, 1903.

A current generator, an exciter and means controlled by the current supplied by the generator, to feed to the exciter field a current which changes its direction under a variation of strength of the main-line current are the main parts.

773,400. Method of Regulating Constant-current Dynamos. Maurice Leblanc, Paris, France. Application filed February 26, 1903.

A compound dynamo is proportioned to develop a constant voltage and an opposing dynamo has a field winding in the generator circuit, the opposed dynamos determining a current supplied to the exciter field so as to keep the generator-current strength constant.

773,407. Apparatus for the Electrical Treatment of Air. John E. Mitchell and Dennis Parks, St. Louis, Mo. Application filed July 9, 1904.

In combination with inclosed relatively movable electrodes are a pump and means for synchronously operating the electrodes and pump.

773,410. Automatic Gas Igniter. Harry B. McNulty, Washington, D. C., assignor to the McNulty Incandescent Gas Lighter Company. Application filed October 22, 1903.

Details are described.

773,411. Electric Igniter. Harry B. McNulty, Washington, D. C., assignor to the McNulty Incandescent Gas Lighter Company. Application filed October 22, 1903.

An igniting resistance is carried within the hood of the burner.

773,416. Electric Dispatch Box for Overhead Lines. Roberto T. Piscicelli, Naples, Italy. Application filed July 3, 1903.

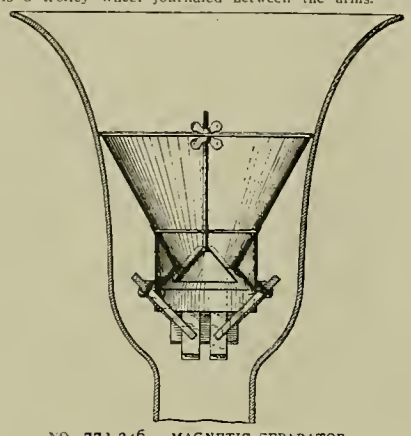
A despatch box with two or more motors arranged the one behind the other is provided with a general casing having the same width as the motors and wedge shaped at both ends.

773,438. Electric Railway. George H. Thomas and Martyn J. Stone, Scranton, Pa. Application filed October 14, 1903.

A hinged cover for third rails is described.

773,459. Trolley. Martin L. Beistle, Ingram, Pa. Application filed August 15, 1904.

Combined with a trolley pole is a harp swiveled thereon, the harp comprising a curved bar. Pivoted to the bar is a trolley wheel journaled between the arms.



NO. 773,246.—MAGNETIC SEPARATOR.

773,464. Electric Switch. Albert G. Bodine, Baldwin Township, Allegheny County, Pa. Application filed February 2, 1904.

Two independent electromagnets operate the switch.

773,467. Electric Switch. Walter L. Bradshaw, Cambridge, Mass., assignor to Keough Bros. & Co., Boston, Mass. Application filed February 24, 1904.

A circuit-controlling member is carried by a gravity bar to make or break connection with a clip forming one of the terminals of an electric circuit, the clip being adapted to releasably grasp or retain the circuit-controlling member when made to engage therewith.

773,472. Electric Circuit. George A. Campbell, Newton, Mass., assignor to the American Bell Telephone Company, Boston, Mass. Original application filed March 5, 1900. Divided and this application filed July 7, 1904.

An electric circuit is made up of a conductor provided with self-induction coils of low resistance and high self-induction in series, several within a wave-length, for overcoming reflection losses.

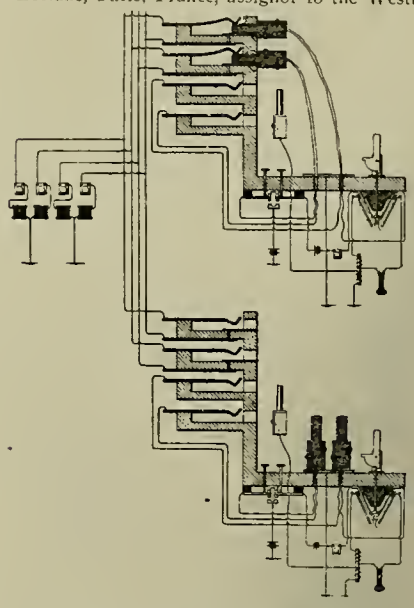
773,485. Electric Time-switch. Benjamin Dubinski, San Antonio, Texas. Application filed March 26, 1904.

Details are described.

773,506. Multiple Switchboard for Telephone Exchanges. Milo G. Kellogg, Chicago, Ill., assignor to the Kellogg Switchboard and Supply Company, Chicago, Ill. Application filed February 28, 1891.

Two telephone lines connected together for conversation have their calling annunciators permanently grounded. A clearing-out annunciator is connected in the direct circuit of two connected lines, the calling annunciators being adapted not to respond to clearing-out currents. (See cut.)

773,508. Process of Regulating Voltage. Maurice Leblanc, Paris, France, assignor to the Westinghouse Electric and Manufacturing Company. Application filed February 5, 1904.



NO. 773,506.—MULTIPLE SWITCHBOARD.

Exciting a generator is done by varyiog the electrical energy furnished by the exciter to keep the voltage of the current fed by the generator to the main line at a predetermined value. The exciter field is supplied hy a current which changes its direction under a variation of the main-line voltage.

REISSUE.

12,281. Electric Motor. Albert B. Holson, Chicago, Ill., assignor to the Holson Motor Patents Company, Ltd., Grand Rapids, Mich. Application filed May 31, 1904. Original application dated June 3, 1902.

In a motor is provided an annular duplex rack, a shaft being arranged within the rotary member and carries pinions fixed upon its ends and engaging with the rack at opposite sides.

EXPIRING PATENTS.

Following is a list of electrical patents (issued by the United States Patent Office) that expired on November 1, 1904:

372,313. Incandescent Electric-light Bulb. R. Haines, Corning, N. Y.
372,330. System of Electrical Distribution. E. W. Rice, Jr., Lynn, Mass.
372,334. Lamp Post and Lamp. F. A. Sawyer, Portland, Me.
372,358. Electric Dynamometer. J. Cauderay, Paris, France.
372,361. Electric Regulator for Hydraulic Elevator Systems. L. Daft, Plainfield, N. J.
372,363. Steam and Electric Connection for Railway Cars. B. R. Deacon, Montreal, Quebec, Canada.
372,378. Automatic Telephone Exchange. T. D. Lockwood, Melrose, Mass.
372,404. Apparatus for Transmitting and Receiving Electrical Signals. M. Deprez and B. Abdank-Abankanowicz, Paris, France.
372,441. Coin-operated Induction Coil. P. G. Williams and A. W. Roovers, Brooklyn, N. Y.
372,447. Dynamo Electric Machine. C. Batchelor, New York, N. Y.
372,468. Secondary Battery. C. Hering, Philadelphia, Pa.
372,475. Automatic Telegraphy. W. A. Leggo, Montreal, Quebec, Canada.
372,501. System of Electric Distribution and Alternating Currents. E. Thomson, Lynn, Mass.
372,550. Apparatus for Covering Insulated Electrical Conductors. E. McKnight, Philadelphia, Pa.
372,598. Circuit System for Electric Brakes. G. F. Card, Covington, Ky.
372,599. Coupling for Electric Brakes. G. F. Card, Covington, Ky.
372,637. Coupling for Electric or Other Wires. F. S. Pond, Woonsocket, R. I.

SPECIAL MENTION.

Sir William Crookes, "one of the leading figures of the scientific world," is the subject of the Bullock Electric Manufacturing Company's biographical calendar for November.

The new isolated plant installed in the Twenty-third Regiment Armory, Brooklyn, N. Y., will contain two 75-kilowatt generators built by the Northern Electrical Manufacturing Company of Madison, Wis., direct connected to Harrisburg engines operating at 275 revolutions per minute. There will also be a 35-kilowatt 600-revolutions-per-minute Northern generator belted to a Nash gas engine.

F. G. Jones, president of the American Electric Fuse Company, Chicago, recently returned from a trip to the eastern office of the company at New York city. Mr. Jones reports that the company's eastern office has recently concluded contracts for over 20,000 pairs of Kaisling protectors and that the eastern business is more than double what it was last year, largely due to the energetic work of W. B. McCurdy, eastern manager. Mr. Jones also reports the American Electric Fuse Company's sales of protectors during the month of October at all its offices has been in excess of 35,000 pairs.

The Manhattan Limited, via Pennsylvania Lines, leaves Chicago daily at 1 p. m.; arrives New York three o'clock next afternoon. Compartment observation car through without change. Get tickets and full information at city office, 248 Clark Street, Chicago. Five other trains from Chicago to New York.

A. A. Carlisle of the Wesco Supply Company, St. Louis, has sold a complete electrical installation for the electric-light plant in Amory, Miss., consisting of a 150-kilowatt Triumph generator, Hardie-Rymes Corliss engine and boilers, Adams-Bagnall arc lamps, Peerless incandescent lamps and the necessary material for installing the plant.

Signaloid is a solution chemically prepared by the Signaloid Chemical Works of New York for the purpose of coloring incandescent lamps and globes. The process is simple and instantaneous. By merely dipping the lamp in the solution of Signaloid and withdrawing it immediately, a brilliant and durable transparency is produced, giving the lamp the appearance of being made of colored glass. It is said that the coloring will not crack, peel or rub off.

The Jury of Awards of the Louisiana Purchase Exposition has awarded a gold medal for rail fastenings to the Continuous Rail Joint Company of America, for its display of rail-joint products, made in the Transportation Building. The exhibit shows various types of rail joints produced by patented machinery controlled by the company in this country. Careful manufacture and perfect fit, giving three points of contact in one piece of metal, thus forming a rail joint of two symmetrical pieces, obtained as a result of these patents, has secured both from steam and electric railroads appreciation of the value of this device. Further acknowledgment of the merits of the continuous rail joint is shown in the fact that over 20,000 miles of railroad track has been equipped within the last 10 years. This company is now bringing out a new type of insulated rail joint, and also an electric bonding joint to be placed upon the market. The offices of the company are at Newark, N. J.

WESTERN ELECTRICIAN

EVERY SATURDAY

Vol. XXXV. CHICAGO, NOVEMBER 12, 1904 No. 20

High-power Gas Engines in Electric Stations in Spain and Holland.

By Frank C. Perkins.

Among the important electric power plants recently installed in Spain using high-power gas engines should be mentioned that of the Sociedad de Gasification Industrial at Madrid. This plant is supplied with gas producers supplying 1,100 cubic meters of Mond gas to six Nuremberg gas engines, each having a capacity of from 1,800 to 2,000 horsepower. These engines are directly coupled to three-phase alternating-current electrical generators without utilizing an additional flywheel, the speed being 94 revolutions per minute. The polyphase alternators supply a current of 3,000 volts pressure to a power-transmission line and also for lighting service. This station, which has recently been installed by the Vereinigte Maschinenfabrik Augsburg und Maschinenbaugesellschaft Nuremberg Actiengesellschaft, has a total capacity of 12,000 horsepower, all of the engines being of the double-acting, four-cycle Nuremberg type. Fig. 2, on the next page, is a plan of this station, showing the location of the six units.

Five direct-connected, double-acting Nuremberg engines of the same construction were installed in May, 1904, at Scheveningen at the electric power station of the Exploitatie Maatscheppij. The engines in this electric station in Holland each have a capacity of 350 horsepower and operate at a speed of 150 revolutions per minute. They are directly coupled to direct-current dynamos with large flywheels for aiding in the speed regulation, the current being generated at a pressure of 450 volts and utilized for lighting and power purposes.

Fig. 1 is a picture of one of the direct-connected units, such as are used in the Scheveningen station. The unit is here shown mounted on a trial stand.

The Nuremberg producer-gas equipment supplying fuel to these high-power gas engines includes six gas generators, three washers and six purifying machines. For starting the high-power Nuremberg gas engines in some cases electrically operated gearing is employed, transmitting the power to the rim of the gas-engine flywheel, while in other cases compressed air is utilized in the gas-engine cylinders. Fig. 3 shows the method of starting the engine with an electrically operated gearing, the teeth of the gear fitting into corresponding teeth cut in the face of the flywheel. Fig. 4 is a section through the Scheveningen station from which the arrangement of the gas producers and the method of piping to the engines may be seen.

There is no question but that there is a great field for the high-power gas engine in electric power stations of the future, not only on account of the very high thermal efficiency of this prime mover, but also from the fact that the waste gases may be utilized to better advantage from coke ovens and blast furnaces than by employing boilers and steam engines. The highest efficiency of the modern steam engine does not exceed 25 per cent., while the best thermal efficiency of the high-power gas engine is said to reach nearly 32 per cent., with a consumption of 8,000 British thermal units per brake horsepower.

Comparing the simple non-condensing steam engine, as well as the compound condensing steam engine with the high-power internal-combustion engine operating with producer gases as well as with waste gases from a blast furnace or coke retort, the following data, given by American engineers constructing the Nuremberg gas engine in the United States are of especial interest.

With the simple, non-condensing steam engine taking the steam pressure at 100 pounds a square inch, gauge, and a steam consumption of 28 pounds per indicated horsepower per hour with a mechanical efficiency for the engine of 92 per cent. and losses in the steam pipes of five per cent., the thermal efficiency of the plant is said to be 5.5 per cent. This takes the feed-water temperature at 212° F. and the evaporative efficiency of the boilers at 70 per cent. with the total heat in one pound of steam 1,217 British thermal units. The heat added to the water to generate one pound of steam is 1,007 British thermal units, the heat consumption of the plant being 46,000 British thermal units per brake horsepower.

Now with the high-power gas engine operating with producer gases, the thermal efficiency of the plant is 20.3 per cent., or nearly four times as great, the heat consumption per brake horsepower per hour being 10,000 British thermal units and the heat consumption of plant being 12,500 British thermal units per brake horsepower, taking the efficiency of the gas producer at 80 per cent. The saving in coal by using the gas engine instead of the simple non-condensing steam engine is 8,200 pounds per brake horsepower per year, or 73 per cent. The gas-engine plant with producer gas consumes 3,050 pounds of coal per brake horsepower per year, while the steam-engine plant with simple non-condensing engine consumes 11,250 pounds of coal per brake horsepower per year. This assumes that the coal has a heat value of 13,500 British thermal units per pound, the plant operates 3,000 hours per year and

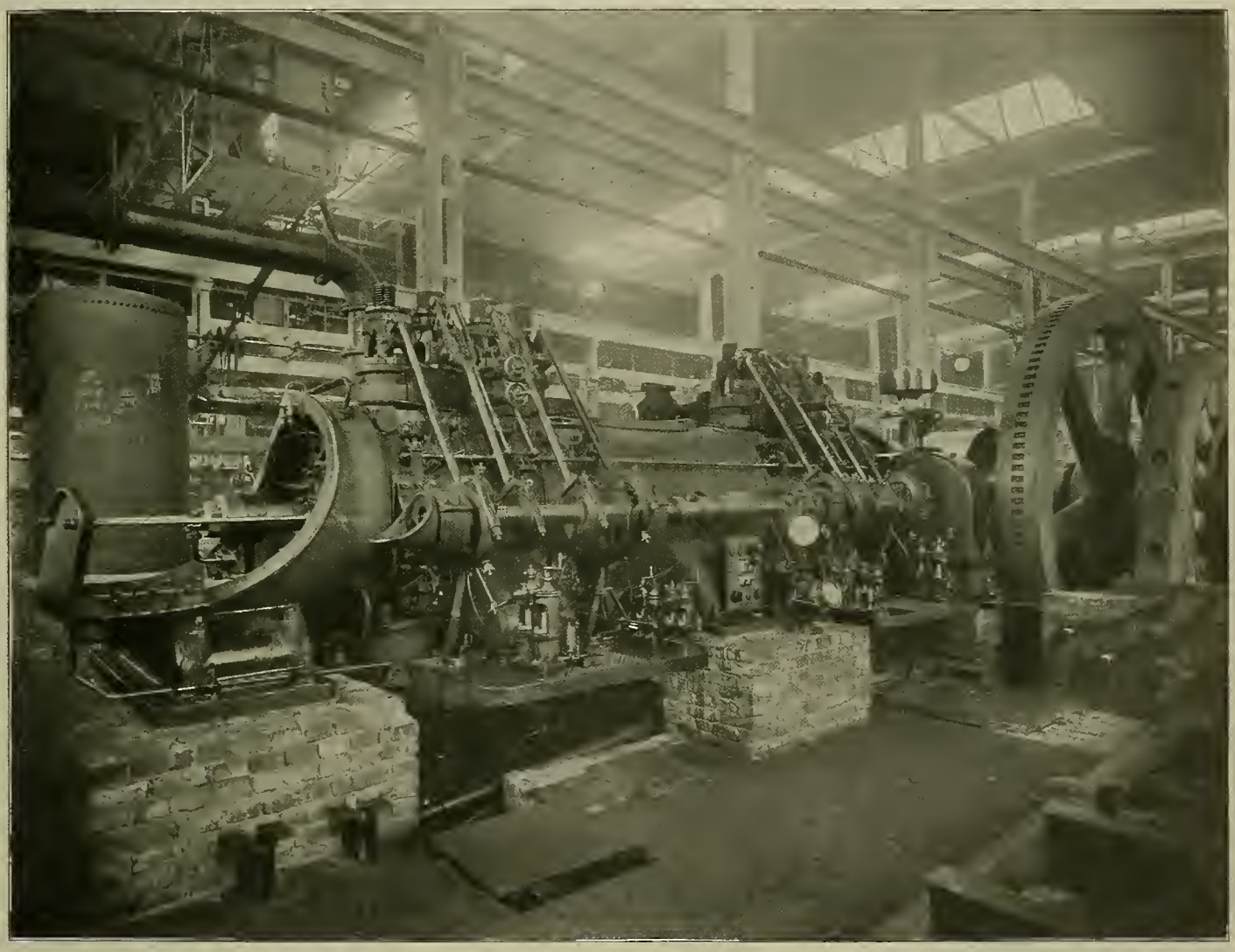


FIG. 1. HIGH-POWER GAS ENGINE FOR SCHEVENINGEN (HOLLAND) ELECTRIC STATION ON TRIAL STAND.

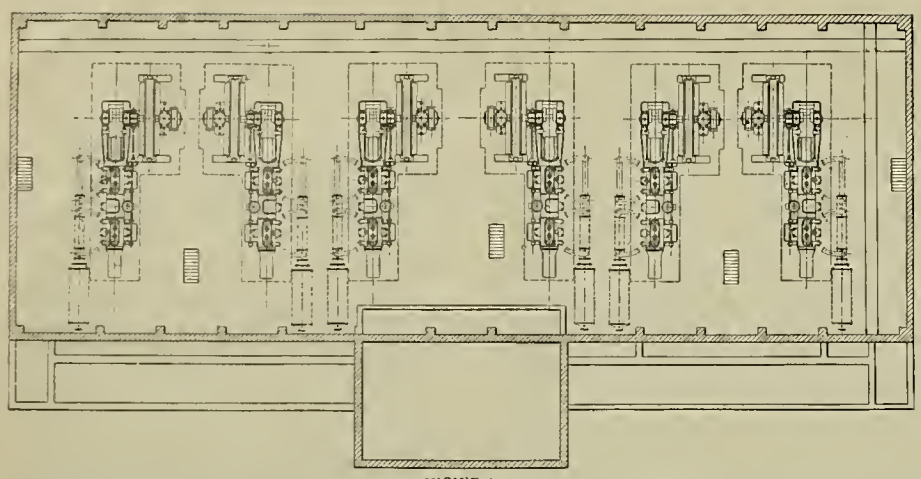


FIG. 2. PLAN OF GAS-ENGINE POWER PLANT AT MADRID.

that there is a consumption of 10 per cent. additional coal for banking.

Considering the compound condensing steam engine with a steam consumption of 15 pounds per indicated horsepower per hour at a steam pressure of 150 pounds per square inch, gauge, and a mechanical efficiency of 90 per cent. for the engine with condensing outfit, together with five per cent. losses in the steam pipe, the thermal efficiency of this steam-engine plant is given as 9.7 per cent. The evaporative efficiency of the boilers is given as 70 per cent., the feed-water temperature 180° F. and the total heat in one pound of steam 1,225 British thermal units, while the heat added to the water to generate one pound of steam is 1,045 British thermal units and the heat consumption of the plant 26,200 British thermal units per brake horsepower.

With a high-power gas engine operating with waste gases from coke retorts or from blast furnaces, the thermal efficiency of the plant is 23.5 per cent., or 2½ times that of the compound condensing steam engine. The heat consumption for the blast-

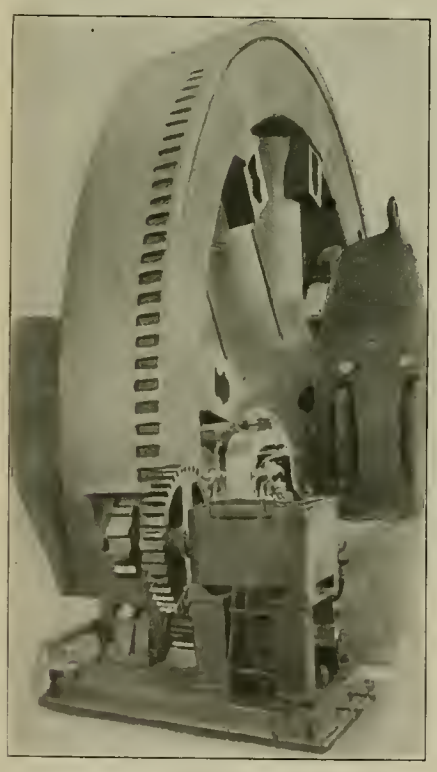


FIG. 3. AUXILIARY STARTING MOTOR FOR HIGH-POWER GAS ENGINE.

furnace gas engines is 10,000 British thermal units per brake horsepower per hour, while the heat consumption of the plant complete is 10,850 British thermal units per brake horsepower per hour, allowing eight per cent. for the losses in gas cleaning.

In blast-furnace plants, where more power is required than it is possible to develop by burning the entire waste gases under boilers, it becomes necessary to use coal for the development of the excess power. In cases where coal is used, the coal consumption per effective horsepower would naturally be, for the same class of coal, in direct proportion to the heat consumption of the plant. As in the above comparison of the gas-engine plant with the steam-engine plant using the simple non-condensing engine, taking the heat value of the coal at 13,500 British thermal units per pound, the plant operating 3,000 hours per annum, with the addition of 10 per cent. additional coal for banking, the gas-engine plant with producer gas burns 3,050 pounds of coal per brake horsepower per year. The steam-engine plant with compound condensing engine burns 6,400 pounds of coal per brake horsepower per year, so that the saving in coal by using the gas engine instead of the compound condensing steam engine is more than 50 per cent., or 3,350 pounds per brake horsepower per year.

As is well known, the high-power gas engine has made wonderful progress on the continent of Europe during the last decade and is now employed extensively, not only in iron and steel plants and in mines where waste blast-furnace gases, as well as the waste gases from coke ovens are available, but also in many electric central stations distributing current for light and power where producer gas must be employed and a complete gas-generating plant must be installed. In America the high-power gas engine is being employed in electric stations with economy, not only where gas-producing plants have been found necessary, but where natural gas is available, giving extremely low cost for electric power generation.

Fires Due to Carelessness with Electrical Apparatus.

The quarterly fire report of the electrical bureau of the National Board of Fire Underwriters, giving accounts of fires due to electrical causes, shows that in most cases the fires have either been due to carelessness in handling apparatus or in improper installation, and not to inherent fault in the apparatus itself. For instance, there were three fires caused by open fuses blowing and setting fire to nearby inflammable material. Open fuses are no longer countenanced in good electrical construction, and in these instances the fault was due to improper installation. Two cases were due to electric pressing irons being left with the current turned on. Four others originated from incandescent bulbs being left lighted in inflammable material. One peculiar instance is recorded where a barrel of paint was being hoisted to an upper floor of a building when the grip broke and the paint was precipitated onto a generator which was in operation below. The paint was ignited and a considerable fire was the result.

Electricity to Replace Steam on Long Island Railroad.

The Pennsylvania Railroad Company has let the contract to equip the entire Long Island railway system with electric motors. The initial contract, on which work has been begun by the Westinghouse Electric and Manufacturing Company at East Pittsburg, is for 122 motor cars. Each car will be equipped with four motors of 125 horsepower each. These will be placed under the traction car, which will haul a train of passenger cars of the customary length. Many of the present baggage cars will be transformed into motor cars.

The motors ordered are of the same type as was intended for use in the tunnel between Long Island and New York. The new cars will be running in the spring and will be used exclusively on the excursion trains next summer to Rockaway Beach and other points along the shore for the rapid handling of crowds.

Work upon the large power house at Long Island City, which will supply the power for the operation of the Long Island end of the tunnel as well as for the suburban lines of the Long Island railroad, is rapidly nearing completion, and it will be ready soon for the installation of the generators and other machinery. It is the intention at the present time to install only about 20,000 horsepower for the operation of such portions of the Long Island system as are now being "electrified." Sub-stations are being erected at various points.

President A. J. Cassatt of the Pennsylvania railroad, has appointed an advisory committee of five

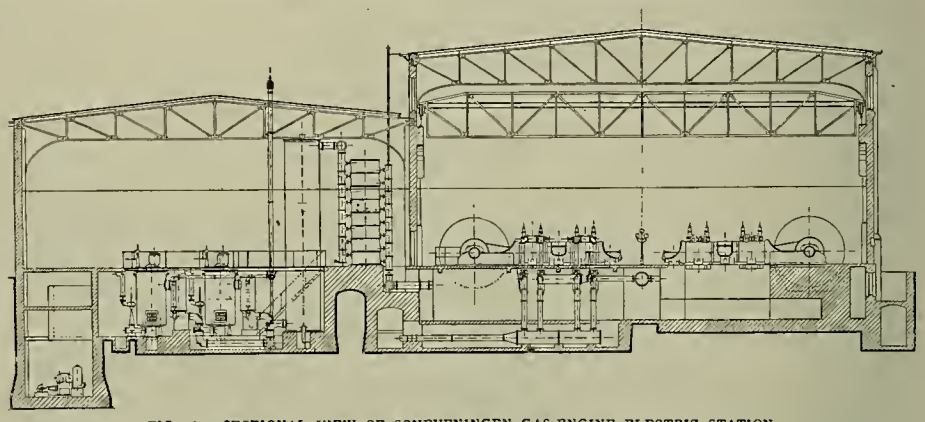


FIG. 4. SECTIONAL VIEW OF SCHEVENINGEN GAS-ENGINE ELECTRIC STATION.

to assist in the large electrical and mechanical improvements connected with the company's terminal plans for New York city and Long Island. The committee is composed of Theodore N. Ely, chief of motive power, chairman; W. H. Baldwin, president of Long Island Railroad Company; A. W. Gibbs, general superintendent of motive power; D. S. Newhall, purchasing agent, and A. S. Voght, mechanical engineer, all of the Pennsylvania railroad.

Changes in Lighting System in Evansville, Ind.

The city of Evansville, Ind., is looking for extensive improvements to be made in the near future to its lighting system. Specifications have been adopted by the city board providing for electric-light or gas illumination, or both.

The specifications provide for bids for a minimum of 500 enclosed-arc electric lights, or 285 electric arcs and 500 incandescent gas lanterns, the number to be increased at the option of the board but not to be decreased. Bidders may bid for either electric lights or gas lanterns or both. The present contract with the gas and electric company is on practically the same specifications as to the character of both the electric and gas lamps. The present contract price is $18 a year for gas lanterns and $60 a year for enclosed-arc lights.

The electric lights are to be of the latest improved enclosed-arc pattern and of 2,000 candlepower. For each defective lamp 50 cents per day is to be deducted and where the candlepower is not up to the standard there is to be a corresponding reduction in the price paid for the service. The successful bidder is to keep all lights, posts, mast arms and the like in good repair. The contract for lighting all the city buildings, including police station, city hall and hose houses, is to be let on the same day, November 26th.

The Territorial Engineering Company of Oklahoma City, Okla., has been incorporated with a capital of $25,000 to operate street railways, electric-light and gas plants. The incorporators are G. W. Burke, F. H. Peckham and M. L. Cunningham of Oklahoma City.

Underground Electrical Construction.[1]

By Louis A. Ferguson.

It is generally conceded that where the business will warrant the investment electrical lines are much better underground than overhead. The cost of underground work is several times that of overhead, and it is only in districts of fairly dense load, and in the case of important transmission lines, that the expense of underground lines is justified. In almost all cities of 50,000 inhabitants or over there is a business section, and possibly in addition a small portion of the residence section, where it will be found desirable to install underground lines. Local conditions will govern each case, and it is hardly possible to lay down general rules in regard to the comparative desirability of overhead and underground lines.

Electric companies in the United States are practically committed to the drawing-in system of cables and conduit, and it is to such a system that this paper refers particularly. What is commonly known as the Edison tube system has been used in the past extensively for low-tension work, and is still used to a limited extent, but on account of the relatively short life of the tube and the higher cost of repairs, its use in late years has greatly diminished.

Various forms of ducts are on the market for underground work, vitrified-clay tile being used much more than all other kinds of conduit. There seems to be no good reason for using pump-log or ducts made of any inflammable material, particularly for electric-light or power work. Cement-lined iron pipe has been used to a certain extent, but there has been some trouble with cables in these pipes, due to the lead on the cables being in contact with the iron ferrule at the ends of the lengths of pipe. Cement pipe is also used to a limited extent. Vitrified-clay pipe is furnished in both single and multiple construction.

There are two objections to the use of multiple duct as compared with single duct. First, between any two cables in one piece of multiple duct there

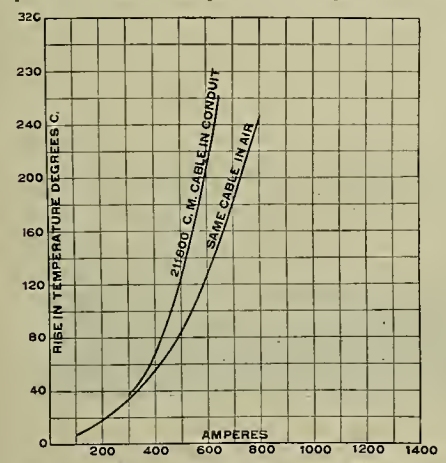


FIG. 1. UNDERGROUND ELECTRICAL CONSTRUCTION.—CURVES OF CARRYING CAPACITY.

is only one wall; second, it is not possible to break joints as with single-duct conduit. These two things increase the liability of a fire in one duct reaching cables in adjoining ducts. In single-duct construction there are always two walls between adjacent cables and all joints are broken, so that there is a very slight possibility of a burnout in one cable reaching any adjoining cable. Single-duct construction is unquestionably the best, particularly for large companies, where a burnout on a cable is liable to be severe, on account of the large amount of power concentrated at that point.

The first cost of single and multiple tile is approximately the same. The cost of installing multiple duct should be approximately 15 per cent. less per duct-foot than for single duct. The weight of single-duct tile is about 20 per cent. more per duct-foot than for four and six-duct multiples. The lower cost of installing multiple duct is due to the lower freight charges, on account of the lesser weight, and also to the smaller cost for labor. It is usually necessary to employ a bricklayer for installing single-duct conduit, and multiple duct may generally be installed with the better class of laborers.

Conduit should always be bought according to specifications, and if a large amount is to be purchased it will pay to detail an inspector at the factory, to make sure that nothing but good tile is loaded. There is always a certain amount of bad tile in every kiln, and your own inspector will naturally be more careful in sorting this than the manufacturer.

A good arrangement of ducts is secured by laying them not more than four wide and as high as necessary to obtain the required number of ducts. These ducts should be separated into two vertical rows where they enter the manhole, the separation being about eight inches. The separating of the ducts should begin about five or six feet back from the manhole. This arrangement gives two vertical rows of cables on each side of the manhole, and leaves them much easier to support and protect than would be the case with three or more vertical rows. With an arrangement of ducts not more than four wide no cable can have more than one other duct between it and the surrounding earth, thus permitting good radiation of heat.

Nearly all cables for underground work are insulated with either paper or rubber and are lead-covered. For some purposes, such as the grounded side of street-railway circuits, or the neutral of

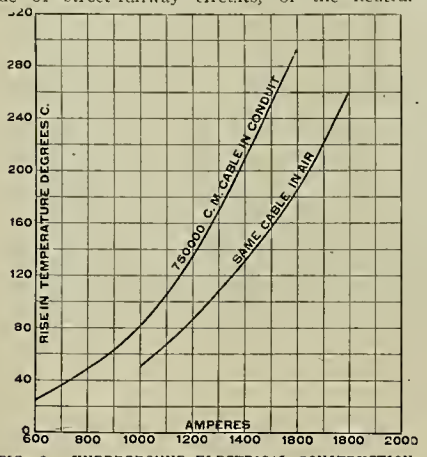


FIG. 2. UNDERGROUND ELECTRICAL CONSTRUCTION.—CURVES OF CARRYING CAPACITY.

Edison three-wire systems, bare copper is satisfactory. Bare copper should not, however, be installed in the same duct with lead-covered cables. Paper-insulated cable is more generally used than rubber, on account of its lower first cost and also on account of its greater carrying capacity. Rubber cable will stand rougher use and may be more easily handled in extremely cold weather than paper cable. It is easier to protect the ends of rubber cables than those of paper, and for this reason rubber cable is sometimes used for mains and services on account of the large number of connections necessary for this work. It is not difficult, however, safely to install paper-insulated cable for this class of work, and it is much more satisfactory to do this, and thus carry only one kind of cable in stock. Paper-insulated cable is particularly suitable for feeders, on account of its high carrying capacity. Within the last two years cable with varnished cambric insulation has been used for high-voltage work inside stations, and, to a limited extent, for underground work.

For low-tension work, up to 700 volts, the thickness of insulation on cables is determined largely by mechanical considerations. For street-railway feeders, single-conductor cable is used, while for lighting and power lines either single, two or three-conductor cable is used for distributing mains, but it is more difficult to make satisfactory joins for service taps on three-conductor cables than on single-conductor ones, particularly if this has to be done in small service handholes. Single-conductor cable makes a safer installation for this class of work. Single-conductor cable is commonly used for low-tension feeders in sizes ranging from 350,000 to 1,000,000 circular mils. Considerable saving in feeders may be made by using two-conductor concentric cable with pressure wires laid up with the outer conductor. Concentric cables for feeders are used mostly in the

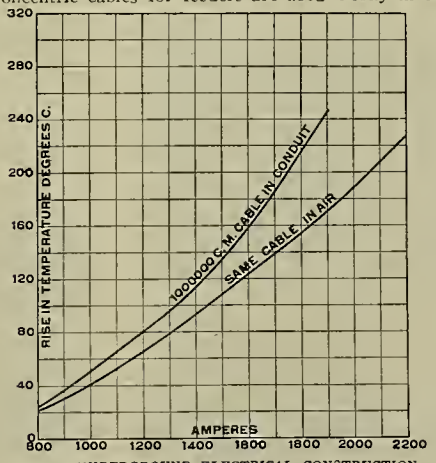


FIG. 3 UNDERGROUND ELECTRICAL CONSTRUCTION.—CURVES OF CARRYING CAPACITY.

1,000,000-circular-mil size. Its carrying capacity is less than that of two-conductor cables of the same size, and the cost is about the same. The saving is made in duct and manhole space and in the cost of installation.

Figs. 1, 2 and 3 show the carrying capacity of lead-covered paper-insulated cable in air and in conduit. These tests were made in a laboratory, the conduit consisting of a single duct of vitrified-clay pipe, surrounded with approximately six inches of sand on all sides.

Transmission lines for carrying large amounts of power from stations to sub-stations are nearly always three-conductor and made with the split type of insulation. Cables are in use in the United States and Canada carrying current at pressures as high as 25,000 volts, although a large part of cables in this class of work are operating at pressures between 5,000 and 15,000 volts. The following table shows the thickness of insulation used by the different companies on cables of this kind. It will be seen that for paper cables the thickness of insulation between conductors ranges from 17 to 67 mils per 1,000 volts, and from 15 to 52 mils per 1,000 volts between conductors and ground. In other words, some companies are using a factor of safety three or four times that used by others.

Company.	Line Voltage.	Kinds of Insulation.	Thickness of Insulation in Thousandths of an Inch.			
			Between Conductors.	Between Conductors and Ground.	Per 1,000 Volts Between Conductors.	Per 1,000 Volts Between Conductors and Ground.
New York Edison	6,600	Paper	312	312	47	47
New York Metropolitan.	6,600	Paper	436	343	67	52
New York Subway Co..	11,000	Paper	436	468	40	43
New York Manhattan ..	11,000	Paper	436	436	40	40
Buffalo-Niagara L.....	11,000	Paper	406	406	37	37
Buffalo-Niagara L.....	11,000	Rubber	562	281	51	25
Chicago-Edison.....	9,000	Paper	406	383	44	38
Milwaukee.....	15,000	Paper	500	437	33	29
St. Paul.....	25,000	Paper	562	484	22	19
St. Paul.....	25,000	Rubber	436	374	17	15
Providence.....	12,500	Rubber	562	281	45	22
Montreal.....	25,000	Paper	562	406	22	16

As a rule, more trouble will develop on underground cables due to poor work on installation, rather than to faults in the cables themselves. This is particularly true of the first few years the cables are in service. It will generally be found more satisfactory for a small company to have its cables

FIG. 4. METHOD OF PROTECTING CABLES IN MANHOLES WITH SPLIT TILES.

installed by the manufacturing company which furnishes them; a large company, however, can install its own cables cheaper than the manufacturing company. All cables, excepting possibly those of small size, as well as those of a moderate size, where a large amount is used, should be ordered in exact lengths, making the proper allowance for training in manholes and waste cable. Manholes should be located so that it will not be necessary to pull longer than 500-feet lengths of cable, although in special cases this distance may be extended slightly. Short lengths of small-sized cable may be easily pulled in by hand, but longer lengths or large cable will require a capstan, or some similar device, operated ordinarily either by men or by horse. Within the last two years electric trucks with a motor-driven winch, have been used for drawing in cables, and satisfactory reports from several companies using them have been received. It is claimed that there is a very decided saving in using the truck as compared with a capstan for drawing in cables. This method should be more satisfactory in a crowded street than the use of the capstan, as there would be less time lost, owing to being interfered with by passing vehicles.

The ends of the cable should be examined as soon as the cable is pulled in, to determine if any moisture is present; if so, the cable should be cut back far enough to remove the moisture and the ends carefully taped. If any great length of time is to elapse before joining, the lead should be wiped over the end of the cable. If manholes with square corners are used, care should be exercised to avoid bending the cable too short in order to make a good-looking installation. For work where a great deal of room is not required in manholes it is best to build them with the corners cut on the diagonal, so that the cables, on leaving the end of the duct, will follow the manhole wall easily without necessitating short bends.

Iron racks are used ordinarily for supporting cables, and while this is the easiest way of doing it, there is the danger of stray currents crossing from one cable to another where iron brackets are used. This may be avoided, however, by putting small

1. Abstract of a paper presented at Section E of the International Electrical Congress at St. Louis, September 13, 1904. Mr. Ferguson is second vice-president of the Chicago Edison Company and was a delegate to the Congress from the Association of Edison Illuminating Companies.

pieces of sheet rubber on top of the iron brackets. Manholes are sometimes built with chases in the side wall to provide support for the cables. This also serves the purpose of protecting the cables from fire due to adjoining cables. The third method of supporting cables, and also at the same time fireproofing them, is the use of split-clay tile for covering the cables, the tile being supported on one or two light angle irons extending longitudinally through the manhole. At the ends of the manhole

FIG. 5. UNDERGROUND CONSTRUCTION.—9,000-VOLT CABLES PROTECTED WITH TERMINAL BELLS.

45-degree curves are laid in reverse, so that cables are completely covered with tile through the manhole. This method is the safest one of the three, and the most expensive. Its use is, however, warranted in protecting the important lines, such as high-tension transmission cables. Fig. 4 shows a manhole where split tile has been used for covering the cables. Cables may also be fireproofed by covering them with a double wrapping of asbestos paper or tape, and binding this by means of brass or iron tape. This fireproofing is more easily installed than the split-clay tile, particularly in crowded manholes.

Special attention should be given the taking care of station ends of cable, particularly three-conductor transmission cables. Fig. 5 shows the ends of four

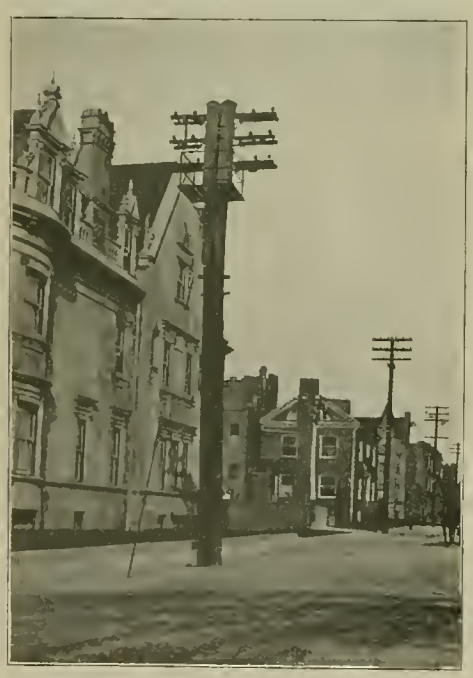


FIG. 6. POLE JUNCTION FOR OVERHEAD AND UNDERGROUND WIRES.

9,000-volt three-conductor cables protected with the necessary terminal bells.

In an alternating-current system operating both overhead and underground lines, one of the most difficult places to protect is the connections between the two. This is ordinarily done by carrying a lead-covered cable up the pole in an iron pipe to within a few feet of the cross-arms. The end of the lead cable should be protected with a suitable pothead and the connections made from the lead cable to the weatherproof wire by means of a short piece of wire with high-grade insulation. Varnished-cambric insulated wire with an additional protection against the weather of two or three layers of friction tape, well painted, has been used for this purpose. It is well also to box in the lead-covered cables above the top of the iron pipe, taking the insulated wires out through bushings in the sides of the box. The boxing in of the lead cable and potheads is done both to protect them from the weather and from damage by linemen, and also to protect the linemen from coming in contact with the grounded lead while working on live wires. A cable pole with the connections made in this manner is shown in Fig. 6. Underground cables should be protected against lightning discharge by means of arresters placed within one or two poles of the cable pole.

On large underground systems it is desirable to ventilate the manholes for the purpose of allowing heat given off by the cables to escape. The amount of heat given off by a large number of loaded cables is very considerable, and while this heat is given off to the surrounding earth to a great extent, more of it can also be gotten rid of by ventilating the manholes. This is done ordinarily by leaving a sufficient number of openings in the cast-iron covers of the manholes.

One of the most essential things in connection with an underground system is a satisfactory system of records. Suitable forms should be provided, so that it will be an easy matter for the foreman on the work to make the necessary notes, and these foreman's reports should be sent to the drafting room for transferral to the permanent records. The number of records necessary will depend on the size of the company and the nature of the work. A good system of records will be found of great value in locating and taking care of trouble and in laying out new work. They will also be of assistance to the contract department in looking up new business. It frequently happens, where complete records are not kept, that the company depends to a certain extent upon the memory of some of the employes, and if these employes leave the company, the information is lost. For a comparatively small expense records can be made which will be always accessible.

Patent Office Statistics.

The report of Commissioner of Patents F. I. Allen for the year 1903 contains some interesting information concerning the department. A comparative statement of the business of the office from 1837 to 1903 shows that in 1837, '38 and '39 there were no applications made. In 1840 the number was 765 and in 1903 50,213.

Statistics for 1903 show that the people of Connecticut are the most inventive, there being one patent issued to every 996 inhabitants. Mississippi is at the other extreme with one to every 22,161. Of the foreign countries to citizens of which patents have been granted England leads with 1,065.

The total expenditures of the patent office for the year 1903 were 1,448,645.81, and the receipts from all sources $1,642,201.81, leaving a surplus of $193,556.

The increase of the appropriation for the scientific library of the office from $2,000 to $2,500, made by the appropriation bill of last year, was a step in the right direction, and if this sum can be further increased so as to furnish $4,000 per annum for the purpose of the library and for the transportation of publications of patents to foreign governments, the library can be maintained in a condition of efficiency.

Production of Aluminum in 1903.

Although exact figures upon the production of aluminum cannot be obtained, estimates of the probable production in 1903 have been made by Mr. Joseph Struthers of the United States Geological Survey, which are near the real figures. He estimates the production of aluminum in the United States during 1903 at 7,500,000 pounds, as compared with 7,300,000 pounds in 1902, and 7,150,000 pounds in 1901. Mr. Struthers bases this assumption on the fact that the uses of the metal and its alloys have recently been greatly extended. Bauxite, the crude mineral from which aluminum is extracted, has been consumed during the last few years in successively larger and larger quantities, and this also would seem to indicate that the production of aluminum is steadily increasing.

The chief point of interest affecting the aluminum industry in the United States during the year 1903 was the final adjudication of the may lawsuits and counter lawsuits which have been instituted from time to time in behalf of the Electric Smelting and Aluminum Company of Cleveland, Ohio, and the Pittsburg Reduction Company of Pittsburg, Pa.

Electrically Operated Paper Mill at Grand Rapids, Wisconsin.

Paper-making is an industry of magnitude in the state of Wisconsin, some of the largest mills of this kind in the world being in operation there. Grand Rapids, the geographical center of the state, is located upon the Wisconsin River and one of its foremost industrial concerns is the Consolidated Water Power and Paper Company. This company is operating a new electrically driven plant and has secured such satisfactory results from its machinery that paper makers will find the plant interesting and will profit by its inspection. The company employs electricity in this line of work perhaps to a greater extent than has ever been undertaken before. There are of course a number of operations performed by machines direct-connected to turbine shafts and belted to line shafting, but the operations are largely performed by electrically driven machinery.

The river at Grand Rapids, Fig. 1, necessitates a dam 1,707 feet wide. An average head of 40 feet is secured with about 10,000 horsepower available. There are installed eight 48-inch Samson turbines, two of which are used to drive dynamo units, five to drive the grinding machinery and one to operate a line shaft driving beaters and Jordan engines.

Two Samson turbines in the dynamo room develop 1,000 horsepower each and are equipped with Lombard governors. Each turbine operates two generators, one being an alternator and the other a

FIG. 1. ELECTRICALLY OPERATED PAPER MILL.—DAM IN WISCONSIN RIVER.

300-kilowatt direct-current generator. The alternating-current machines provide current for lighting service and for long-distance transmission. All of the current supplied by the direct-current generators is employed in the plant and the dynamos carry a practically constant overload. There are two 40-kilowatt direct-current exciters, each driven by individual turbines, as well as a motor-generator exciter set. The switchboard consists of 21 panels of blue Vermont marble, of which nine are direct-current with one blank for extensions of the direct-current service, and 11 panels for alternating-current work. Mr. V. D. Simons, electrician of the company, designed the board and is also responsible for the excellent transmission system throughout the plant as well as the admirable application of motor drive.

Waterpower is used exclusively for generating energy in the plant, and the only use for steam is for heating, cooking and for fire protection. The boiler room disposes of the wood refuse from the mill, but the demand for steam requires considerable coal in addition. Induced draught is used.

The arrangement of the mill makes a minimum handling of raw and work material. The pulp-wood enters the mill at its upper end and works its way through the plant until it emerges at the shipping platform in the shape of paper ready to be taken to the printing presses. The pulp wood is shipped in by rail as the timber resources of the valley of the Wisconsin River have been exhausted. A large storage pond (Fig. 2) is provided for pulp wood and wood is floated down to a conveyor at the farther end as required. The log conveyor is driven by a back-geared motor and lifted into the wood room. The pulp wood is taken to a 48-inch saw direct-coupled to a spherical motor. A conveyor takes the pulp wood to a line of six barking machines located in the wood room. There are five 48-inch machines and one 60-inch machine, each direct-coupled to a

motor. The barking machines denude the pulp log and when the wood leaves the room it is entirely free from all surface imperfections as well as bark, etc. The output of the wood room as electrically equipped is 60 cords per day of 10 hours.

From the wood room a conveyor driven by a back-geared motor carries the pulp wood across the forebay on a bridge to the grinding room. This conveyor and the motor are to be seen in Fig. 3, the 48-inch saw being also shown. The grinders are arranged in tandem, being coupled to the turbine shaft. Their purpose is to reduce the logs to pulp. From the grinders the pulp is put through a refining process and circulated through a course of beater engines and Jordan engines (Fig. 4), and thence to the stuff chests preliminary to being put through the paper machines or carried to the wet room, where the refined pulp is worked up into heavy sheets and stored in this shape for future use. The wet room contains four 84-inch wet machines, each driven by a back-geared motor. The sheets of pulp paper are stored until required and enter the pulp system again through the beater engines, where they are reduced to pulp of the proper consistency for the paper machines.

If the pulp as ultimately refined is intended for immediate delivery to the paper machines it goes through a series of stuff chests on the first floor and is subsequently lifted by motor-driven pumps to the machine room and delivered to one of the two paper machines used.

Interest in the motor drive of the plant of the Consolidated Water Power and Paper Company centers in the variable-speed motors installed for operating paper machines. Each paper machine is driven by an individual variable-speed motor located midway on a line shaft on the first floor (Fig. 5). The motor affords variations of 300 to 500 revolutions per minute, equivalent to a speed of from 50 feet to 500 feet per minute in the paper machines. The lowest speed is employed for the movement of the paper machines for repairs or other work. The high speed used in actual production is from 450 to 480 feet per minute. The paper machines are rated at 30 tons of print each per day, but the average total output is 65 tons and the increase is due in no small measure to the electric-transmission machinery used for driving the paper machines. The Beloit Iron Works, Beloit, Wis., built the paper machines and terms them 130 inches, although the output trims to 121 inches. The machine room is thoroughly ventilated by means of two 72-inch fans, each driven by a motor, and the ventilating system enables a complete change of air in four minutes, freeing the machine room entirely from steam and condensation.

The finishing machinery (Fig. 6) consists of several splitters and a Holyoke cutter, all belted to a motor located on the floor below.

In addition to the motor drive for the paper machinery, pumps, wet machines, conveyors, saw, barker, etc., there are several freight elevators driven by belted motors.

Visitors to the plant are impressed by the absence of the great wilderness of belting usually associated with paper machinery as well as the utter absence of noise caused by belt and line-shaft drive. The cleanliness of the plant is especially noticeable as well as freedom from suction drafts, belting, dust carried by belting, etc. The operation of the mill is characterized by a hearty co-operation which renders the attainment of maximum output with minimum trouble.

The product of the Consolidated Water Power and Paper Company is confined to print paper like that employed by the daily newspapers, and the company has attained a high standard of quality by the use of its electrically driven machinery.

The motors for the entire plant were built by the Northern Electrical Manufacturing Company of Madison, Wis., as were also the 300-kilowatt direct-current generators.

Fig. 3. Motor-driven Log Conveyor.

Fig. 5. Variable-speed Motor Driving Line Shaft.

ELECTRICALLY OPERATED PAPER MILL.

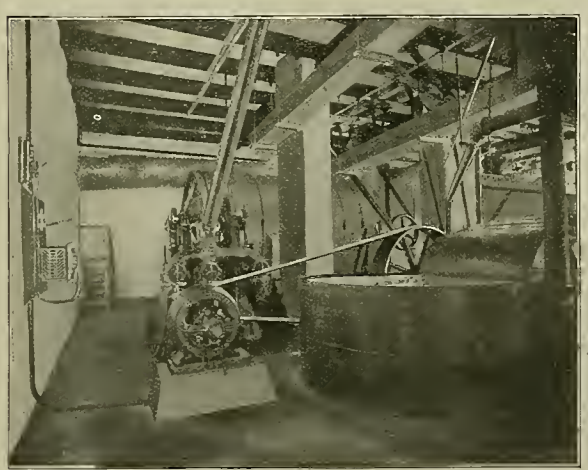


Fig. 4. Motor-driven Beaters.

Fig. 2. Storage Pond.

Fig. 6. Motor-driven Finishing Machines.

ELECTRICALLY OPERATED PAPER MILL.

International Tramway Conference.

The annual conference of the International Tramway and Light Railway Association was held in Vienna in September. Two papers were read at the conference, one by Mr. Petit of Brussels, upon protective devices against the falling upon trolley wires of wires used for other purposes, and another by Mr. Vellguth, general secretary of the German Tramways and Light Railway Administrations, upon transfer tickets.

Mr. Petit in his paper arrived at the conclusion that a complete guarantee of safety was not afforded by any of the existing methods. In his opinion, if it were not possible to entirely obviate crossings by the laying underground of conductors conveying weak currents, a reduction in the number of crossings should be effected by the combination of these conductors in bunches or bundles.

In regard to transfers, Mr. Vellguth stated it was impossible to propose a solution which could be of general application. It could only be said that the effect of an alteration in the tariff, or the control could only be predicted on rare occasions, and that even insignificant changes might have totally unexpected results.

Questions of importance to tramway operation were brought up and discussed and also a report by Mr. Klitzing of the Magdeburg tramways upon economy in the consumption of current.

Chicago Street-railway Situation.

Except for another wrangle between the Chicago Union Traction Company and its underlying companies concerning the proposed payment of $300,000 interest on the bonds of the Consolidated Traction Company, which lines are considered necessary to the Union Traction Company, the Chicago traction situation has taken on no new phases recently. A recent conference between a receiver of the Union Traction Company, who is also the representative of Judge Grosscup, and the corporation counsel is believed to indicate that negotiations for a Union Traction franchise will soon be taken up between the city and Judge Grosscup, now that the election is over. Negotiations of this nature, it is said, have been delayed by the Union Traction interests in the hope of coming into control of the Chicago City Railway system, but the possibility of such a deal is now considered remote. Corporation Counsel Tolman has warned the traction receiver that further delay might make it impossible to pass an ordinance in the face of the opposition of municipal-ownership people, and he therefore suggests an ordinance along the lines of the Chicago City Railway ordinance.

The real war over the Chicago City Railway ordinance is expected when the referendum petition for the submission of the ordinance to the voters is submitted to the election commissioners on November 15th. It is probable that the Municipal Voters' League or the Civic Federation will undertake the task of investigating the names on the paper, and if the number remaining after striking off those which cannot be verified is not sufficient, the petition of the immediate municipal-ownership advocates will be disregarded by the City Council.

Plans for Chicago's prospective subway system may be adopted this winter. To do this it is thought advisable to study the New York scheme before anything definite is done. To do this Chairman Foreman is preparing plans to have the local transportation committee of the City Council, accompanied by the mayor and other city officials, go to New York this month to inspect the new subway system there.

WESTERN ELECTRICIAN

EVERY SATURDAY.

PUBLICATION OFFICES:
510 Marquette Building, · CHICAGO.
TELEPHONE, MAIN 1746.

Eastern Office, 193 Times Building, New York.
Telephone, 3806J Cortlandt.

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted. This paper is entered at the Chicago postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the **old address** as well as the new should be given.

CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—**the only general electrical paper published in the West**—thoroughly covers a territory *exclusively its own.* THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be furnished on application.

REMITTANCES.—All checks, drafts and other remittances should be made payable to the order of the publishers, the **Electrician Publishing Company,** and addressed to the offices of publication, Suite 510, Marquette Building (204 Dearborn Street), Chicago, Illinois, U. S. A.

CONTENTS OF THIS NUMBER.

High-power Gas Engines in Electric Stations in Spain and Holland. By Frank C. Perkins. Illustrated..385, 386
Fires Due to Carelessness with Electrical Apparatus... 386
Electricity to Replace Steam on Long Island Railroad.. 386
Changes in Lighting System in Evansville, Ind..... 386
Underground Electrical Construction. By Louis A. Ferguson. Illustrated. (International Electrical Congress.) 387, 388
Patent Office Statistics 388
Production of Aluminum in 1903 388
Electrically Operated Paper Mill at Grand Rapids, Wis. Illustrated 388, 389
International Tramway Conference 389
Chicago Street-railway Situation 389
Editorial 390
Recent Development of the Gas Engine. By George E. Walsh 391
American Society of Mechanical Engineers..... 391
Ohio Interurban Railway Association 391
Some Notes on the Edison Nickel-iron Storage Battery. By F. M. Davis. (Western Society of Engineers).392, 393
New Members of the Institute 393
International Automobile Exposition 393
Wireless Station at Kansas City. Illustrated..... 394
Secrecy and Invention 394
Cost of Hydro-electric Plants..... 394
Book Table.—Tesla's "Experiments with Alternate Currents"..... 394
Electric Heaters in New York Subway. Illustrated..... 394
Elevated-railway Traffic in Chicago 394
Single-phase Railway System for Interurban Service. Illustrated 395
World's Fair Visitors of Last Week..... 395
Ohio Telephone Notes 396
Telephone News from the Northwest..... 396
Southeastern Telephone Developments..... 396
General Telephone News 396
The Trouble Shooter 396, 397
Automatic Telephone Exhibit at the World's Fair. Illustrated 397
Infringement Litigation on Scribner-McBerty Patent.... 397
Neutralizing Winding for Transformers. Illustrated.397, 398
Electrical Generating Stations and Transmission. By L. B. Stillwell. (International Engineering Congress) 398, 399

DEPARTMENTS.

Correspondence 399, 400, 401
Great Britain 399
New York 399
New England 399, 400
Southeastern States 400
Ohio 400
Michigan 400
Northwestern States 400
Pacific Slope 400, 401
Dominion of Canada 401
Personal 401
Electric Lighting 401
Electric Railways 401, 402
Societies and Schools 402
Publications 402
Space Telegraphy 402
Power Transmission 402
Miscellaneous 402, 403
Trade News 403
Business 403
Illustrated Electrical Patent Record.....403, 404

DATES AHEAD.

Electrical committee of the Underwriters' National Electric Association (annual meeting), 32 Nassau Street, New York city, December 7th.

Interstate Independent Telephone Association of America (annual convention), Auditorium Hotel, Chicago, December 13th, 14th and 15th.

VISITORS to the Louisiana Purchase Exposition at St. Louis who are interested in electricity or electrical literature are cordially invited to call at the booth of the Western Electrician, which is in Block 1 (Section 13) of the Palace of Electricity, just west of the main northern entrance to the building. Here will be found copies of the current issue of the paper, bound volumes of the Western Electrician from the first number, a careful selection of electrical books exhibited by the Electrician Publishing Company, and other objects of electrical interest. Chairs are provided for weary sight-seers, and an attendant will extend a hearty welcome to all readers or friends of the paper.

A FREQUENT topic for discussion in the daily press, particularly in the sensational papers of New York city, relates to precautions which should be taken against accidents due to the "deadly" third rail. As a matter of fact, danger to life from the third rail, with the voltages at present used, is not as great as many suppose, and passengers on roads using it need feel no apprehension, with the most ordinary precaution. Nevertheless, the companies should exercise all needful care to protect workmen or others who find it necessary to walk on the tracks from coming in contact with the rail. A recent suggestion is to paint the third rail, all except the top, red—a bright, eye-arresting red. Carelessness in crossing the tracks or excitement at moments of impending danger are responsible for a large share of the accidents of this sort, and if the rail were to be painted a color so bright as to impress the sight at all times, the danger—slight as it already is—would be lessened. This precautionary measure has the merit of comparatively slight expense, and while it would be less efficacious at night than in the daytime, the suggestion may be worthy of attention. By adopting it one more danger signal would be hung out for the benefit of the foolish and unwary.

MR. LIEB has entered upon his duties as president of the American Institute of Electrical Engineers at a time when the organization is in the full tide of its usefulness. With a membership of 3,200, with the stimulus of a year's work especially full and varied, including such events as the Transmission convention in Chicago and the "circular tour" of foreign visitors to the International Electrical Congress, and with the prospect of before long occupying its share of the fine Union Engineering Building in New York, the Institute is certainly advancing with flying colors—a worthy representative of the profession for which it stands. Mr. Arnold may well look back with satisfaction on the record of his administration, for it does credit to his alert interest and tireless zeal. The work of Mr. Pope as secretary is always intelligent and thorough, and it deserves a word of praise. The new president is a man of energy and tact who has been a member of the Institute for the last 17 years. His home is in New York, and, differing from Steinmetz, Scott and Arnold, it will not be necessary for him to make a long journey to attend meetings at headquarters. We wish his administration every success.

EARTHQUAKES may have an electrical origin. Several persons have indulged in speculation of this sort, and Mr. Guarini, who is well known to the readers of the technical press of Europe and the United States, has lately made an address on the subject before the Belgian Society of Astronomy. Of course, if everything is electricity, if electricity is the "it" of the universe, earthquakes, like deal tables and the substance of the brain, are included. But the electrical theories of earthquakes proceed on more old-fashioned lines. Two are those of Mr. Dary and Mr. Plante. Mr. Dary supposes that the terrestrial strata, by their different degrees of electric conductivity, form natural condensers which are charged by telluric currents. When the dielectric is pierced there is produced an earthquake or subterranean storm, analagous to an atmospheric storm. Mr. Plante considers that the earth is attracted by electrified cloud masses, while Mr. Guarini considers: (1) That heat is produced in the terrestrial crust under the effect of telluric currents heating slightly conductive beds. When aqueous infiltrations meet these beds the water is vaporized and the pressure of the vapor may produce subterranean explosions. (2) There is produced in the watercharged layers phenomena of electrolysis under the effect of the telluric currents. The masses of gas in this case may explode under the effect of a spark or heat. To these hypotheses Mr. Tokiansky adds another. Being given the fact that the earth includes all necessary chemicals for the production of carbide of calcium, it is possible that there exist in certain portions of the earth natural deposits of carbide of calcium. If aqueous infiltrations meet these beds there is produced acetylene, which, under certain conditions, may explode. The last guess is not, of course, an electrical one. The principal importance of these theories lies in the fact that if earthquakes are of electrical origin there is some slight hope—very slight, we fear—of preventing them by providing artificial conductors for the currents that produce the phenomena.

WHILE the outlook for the "electrification" of many railroads, or branches or terminals of railroads, now using steam, is bright, it is premature to declare, as the New York Times does, that "the locomotive has rendered an invaluable service to civilization, but it is nearing the end of its usefulness, and every year finds its sphere of effective operation restricted." The steam locomotive is a highly finished machinery product, although, as compared with the electric motor, it labors under the disadvantage of reciprocating rather than rotary motion; it is probably far from its end, not near to it. The daily papers can gain a summary of the situation, as viewed by recognized authority, by reading the recent presidential address of Mr. Bion J. Arnold, retiring president of the American Institute of Electrical Engineers: "I do not anticipate that all roads will soon adopt electricity," says Mr. Arnold, "for the steam locomotive will hold its field in this country for many years to come, but I do expect, judging somewhat from 'positive knowledge,' a remarkable development soon to begin in the electrical equipment of favorably located steam roads." Electricity supplies a better illuminant than gas, but it has not superseded gas lighting for economic reasons. Similarly, it is probable that the steam locomotive will not be superseded, at least for a long time to come. But many a locality that now knows, all too sorrowfully, its smoke, cinders and noise will happily know it no more. One such locality should be, and we are sure will be, that adjacent to the suburban lines of the Illinois Central railroad in Chicago.

AN ENGLISH electrical contemporary makes the interesting comment that, the flagship of Admiral Rojdestvensky (we hope that is the official spelling) being equipped for space telegraphy, his fleet should have been, and doubtless was, in communication with the Russian Admiralty very soon after the recent naval fight in the North Sea, when the Russian ships, as all the world knows, repulsed the English fishing fleet, although the latter was apparently superior in number, after a brilliant engagement. Inasmuch as the Russian fleet was about a thousand miles from St. Petersburg, in an air line, at the time the trawlers became mixed up with it, the likelihood of practicable wireless communication at that distance with the apparatus in use on the Czar's warships is rather remote. Marconi says that the Atlantic liners receive messages through space at a distance of 1,500 miles from shore, but we are not aware that it is asserted that the "marconigrams" are transmitted from ships for anything like that distance. It is obviously impracticable to install counterparts of the powerful land sending stations on shipboard, and we believe that Captain James' performance of 240 miles from the London Times' dispatch boat in the Far Eastern war is about the record for legible wireless transmission from a ship at sea. Possibly Admiral Rojdestvensky could have sent a space-telegraph message to some receiving station on the coast of the North Sea or the English Channel, whence it could have been telegraphed to St. Petersburg by ordinary means. Here, however, difficulties of cipher code and of differing systems of space telegraphy are to be considered. But the fact that the point is raised shows the extent to which "wireless" figures in the transmission of naval intelligence.

Recent Development of the Gas Engine.

By George E. Walsh.

It is well known that the development of the large-unit gas engine has not reached the same high standard of usefulness and efficiency in this country that it has in either Germany or France, and those engineers familiar with what has been accomplished abroad in this direction were disappointed in the failure of the promised exhibition of the gas engines of large design from Europe at the St. Louis Exhibition. Nevertheless, the display of gas engines at St. Louis was of sufficiently broad character to indicate even to the most casual visitor that this form of prime mover has entered in an energetic manner into the field of development of our industrial life. The installation of these gas engines, and their operation at the exhibition, showed the progress that manufacturers have made in the last few years in thus utilizing gas for power purposes. The effect of this must have far-reaching results, especially among electrical engineers, who are considering the gas engine for power-station work in certain parts of the country.

It seems scarcely more than five years since the gas engine of 1,000 horsepower was considered a brilliant dream, with little possibility of realization. Small gas engines were in use for a long time before anyone actually predicted the construction of a prime mover of this type sufficiently large to do all the work of a large electrical station. But so rapid has been the development of the gas engine abroad that engines of 3,000 and 5,000 horsepower are now in use. Continental builders have even constructed gas engines of 6,000 to 8,000 horsepower, and their working has proved as efficient and economical as the smaller units. The ultimate limit of the gas engine thus appears as great as that of the steam engine.

European engineers have made more remarkable strides in this direction than Americans for a variety of reasons, the chief probably being that the cost of ordinary fuel made it imperative upon every industry to utilize every particle of waste heat. In the electrical industries the supply and distribution of waterpower are also more restricted than in this country, and electrical engineers saw the advantages in the development of the gas engine.

In developing the gas engines of 5,000 to 8,000 horsepower, the continental builders are preparing to invade fields with this prime mover heretofore considered alien to its use. For instance, the installation on a marine vessel of a gas engine appears somewhat beyond the realm of the possible from an economical standpoint, but several German builders are making the experiment. The purpose of this is to secure economy of fuel and space. On a vessel space for coal storage and engine room is most important. Usually it occupies altogether too much of the vessel's room, leaving so little proportionally for cargo and passengers that it is always an intricate problem with the marine architects how to solve the question. The adoption of liquid fuel on many steamers has to some extent economized storage space for fuel.

The gas engine of the self-containing type can, in the minds of continental builders, prove an efficient prime mover on certain classes of ships because of this same quality of space saving. The self-contained gas engine consists of producer, washer, reservoir and engine complete as one unit. The plant is a model of modern condensation of space and energy. This indicates something of a new line of departure that continental engineers are studying.

It may be said that their experiments and tests are following three lines of development: First, the improvement of extremely large gas engines to utilize blast furnace or some other form of producer gas; second, the construction of better types of gas producers for particular lines of work, and, third, the development of self-contained gas engines in which the producer and engine, with all necessary equipments, are made into a complete unit.

Nowhere in this country have these three lines of development attracted so much general attention as in Germany and France. In the first field we are still far behind the engineers of continental Europe in developing and utilizing the extremely large gas-engine units. The smaller gas engines are in general use all over this country, and they have been ingeniously applied to unique lines of industry that are worthy of special attention; but the extremely large units have not yet reached a point where they can compare with the best German and French engines.

The question of what will be the ultimate limit of the gas engine is important, and it has a bearing upon our commercial and manufacturing industries of far-reaching effect. The gas engine of 1,000 horsepower is utilized for central-station work in parts of this country with entire success, and others of even much larger power are installed for general work. The 500 to 600-horsepower gas engine is one of the most economical and satisfactory prime movers now in use anywhere. It is rapidly making its way into numerous trades and industries. In the cities where gas is furnished at reasonable rates the small gas engines are popular. Since the manufacturers of the gas engines guarantee an effective horsepower by the consumption of 18 cubic feet of gas of 135 calories (the usual quality of city gas), the use of the engines has multiplied rapidly. In German cities from 15 to 25 per cent. of the total output of the gas works is supplied for operating gas engines, while in Paris something like five per cent. of the total output is utilized in this way. There are few, if any, American cities, where even one per cent. of the gas output is used for operating gas engines. However, the steady development of the industry indicates that changes in this respect may be expected, and that in cities where gas is supplied at $1 or less per 1,000 the gas engine will become an important factor in the industrial life of the near future.

The second line of development which engineers are pursuing abroad in their experiments and tests with gas engines is at present more important than the first. There are no fundamental problems to solve in the development of larger types of gas engines, but in the improvement of the producer there is a wide latitude offered to the inventor and engineer. The large types of gas engines are usually operated by blast-furnace gas, but the problem of the smaller one is to utilize gas manufactured economically for it. The question of using bituminous as well as anthracite coal for fuel is also important. When the producer can use soft coal as efficiently as it does anthracite, then the gas engine will enter upon another phase of its development. At present the producers are nearly all limited to anthracite coal, and as a result the range of usefulness of the gas engine is greatly restricted.

The continental engineers of Europe are more interested in this line of development than Americans, for the simple fact that anthracite coal is a far less common fuel in Europe than here, and its cost and supply are every year growing more problematical. Even in this country the question is rapidly reaching the acute stage. Few mills and factories could today be operated profitably upon anthracite. Consequently the question of saving the waste heat of furnaces for use in the gas engine depends a good deal upon the nature of the fuel used. The producer must be improved so that all grades of coal can be used with satisfactory efficiency. This problem is both difficult and intricate, and it is not likely that it will be easily solved in the near future; but every year we make a few strides toward greater efficiency in the burning of all grades of coal.

The German engineers in their efforts to extend the field of the gas engine by developing the efficiency of the producer have made extensive tests with briquettes of different compositions. These have been composed of anthracite coal dust and the lignite or brown coals of central Europe. From these compositions fair success has been attained, especially when used under improved conditions, such as modern gas generators supply today.

The progress of the gas motor is naturally associated with corresponding improvements in gas generators. At first the quality of the gas that could be used in the gas engine was so high that only the choicest selected anthracite coal could be burnt. It had to be carefully screened and of exceptionally high grade. In recent years the gas generators have been improved, and the engines have been developed to such a point of efficiency that relatively low-priced, common grades of anthracite suffice. As a direct result of this improvement in the gas-generating plants, the engines have multiplied in use.

In fact, a gas generator using a $5-a-ton grade of anthracite coal gives more effective horsepower, when the gas is burnt in a modern 100-horsepower engine, than could be obtained from a good steam engine burning coal at $4 a ton. The energy of the average generator gas ranges from 30 to 40 calories per cubic foot. Gas generators are constructed to use coke, but the high price of this fuel does not in any way help solve the problem. The Riché type of generator that has been used in France for burning wood produces a relatively high quality of gas, but its usefulness for operating gas engines must be confined to districts where wood is plentiful as a fuel. There are places in this country where such a gas generator might find a profitable field, especially in the great northwestern lumber regions or in the southern pine districts.

In England an experiment was made by the chemical works of Brunner, Mond & Co., which seemed to indicate a partial solution of the subject for special purposes. A gas generator was installed that would use fine grades of bituminous coal, but this was made remunerative only by the formation of chemical sub-products. After a few small tests the plant was fully installed with the new form of generator. It was found that the cost per kilowatt-hour was only 0.8 cent, using 25-horsepower Crossley gas engines.

The use of water gas for motors has not proved very successful, owing to the necessity of using coke, but in Germany some success has been attained in this direction with improved Delwick generators.

The third and last line of improvement in the development of gas engines for industrial purposes is to perfect the single-unit or self-contained gas engine. This is vastly the most intricate problem confronting engineers. It combines all the other questions in one. To make such a single unit effective and economical, weight, space, horsepower effectiveness and economy of fuel must be considered in the installation. Such a self-contained unit must consist of producer, washer, reservoir and engine complete. To accomplish this so that weight and space will be reduced is a problem of a good deal of intricacy.

Nevertheless, so persistently have German engineers pushed their experiments and tests that plans are made for the complete installation of a vessel with such a single gas plant that will reduce the amount of space and weight demanded by an ordinary steam engine, and at the same time show a considerable economy in fuel. This probably represents the high-water mark of recent developments of the gas engine as an adaptable prime mover. Should it enter the field of marine motive power it might achieve a success that would make it of widespread value on certain types of boats that are today undergoing evolutionary changes.

American Society of Mechanical Engineers.

The forthcoming annual meeting of the American Society of Mechanical Engineers will, as usual, be held in New York city, the date of the opening session being December 6th. President Ambrose Swasey will deliver the annual address, the subject being "The Achievements of the Engineer, with Respect to Exact Measurements." The second session will occur on December 7th at the hall of Mendelssohn Union, 113 West Fortieth Street, at 9:30 o'clock. This will be the business session of the convention, and the following professional papers will also be presented: "A New Hydraulic Experiment," by A. F. Nagle; "A Twist-drill Dynamometer," by W. W. Bird and H. P. Fairfield; "Diamond Tools," by Gus C. Henning.

The third and fourth sessions will take place at Mendelssohn Union, December 8th. At the morning session the following papers will be considered: "Centrifugal Fans," by A. J. Bowie, Jr.; "Computation of Values of Waterpowers and Damage Caused by Diversion of Water Used for Power," by Charles T. Main; "An Indicating Steam Meter," by Charles E. Sargent; "Stay Bolts, Braces and Flat Surfaces: Rules and Formulæ," by Robert S. Hale; "Condensers for Steam Turbines," by George I. Rockwood; "Bursting of Four-foot Flywheel," by Charles H. Benjamin; "Influence of the Connecting Rod Upon Engine Forces," by Sanford A. Moss; "Losses in Non-conducting Engines," by James B. Stanwood; "Power Plant of Tall Office Buildings," by Stirling H. Bunnell, and "Pressures and Temperatures in Free Expansion," by A. Bordody and R. C. Cairncross.

Ohio Interurban Railway Association.

The next meeting of the Ohio Interurban Railway Association will be held at the Boody House, Toledo, on Monday, November 17th. The principal question to be discussed is the handling of freight, and all managers who are operating such a service are requested to either send to the secretary or take to the meeting with them samples of the rate sheets and other documents on the subject. The idea is to get as much information on the topic as possible through the experience of those present. Indiana and Michigan traction men are invited to be present at this meeting and take an interest in the subjects considered. The matter of getting as many roads as possible to use the mileage coupon book may also receive some consideration, although that is not mentioned in the notices sent out.

Edward D. Steger, owner of the Denison, Bonham and New Orleans railroad in Texas, and one of the promoters of the Kansas City-Duluth road, which, it is said, is planned as an electric line, has returned from Paris and announces that French capitalists have promised all the money to construct the line and ultimately to extend it to Galveston.

Some Notes on the Edison Nickel-iron Storage Battery.[1]

By F. M. Davis.

Although the two types of accumulator, nickel-iron and lead, have many points in common and to about the same degree, still there are prominent characteristics peculiar to each which determine any particular adaptability and superiority in certain given fields of service.

It is at once obvious that the lead cell must find its chief natural usefulness in connection with large power stations where the requirements call for a large capacity and where the battery is subject to very little or no mechanical influences beyond that incident to its fundamental activities in charging and discharging. Automobile work introduces serious mechanical disturbances that a lead cell cannot endure without serious deterioration. Here the nickel-oxide cell finds its field of usefulness, because of its indestructibility and flexibility of operation.

Intermediate between these extremes are to be found a great variety of applications for storage batteries where local conditions and first cost may largely determine the selection of battery, as, for example, in common-battery telephone service.

To facilitate comparison a table may be compiled showing the relation between the two types of battery, as shown herewith. Two supplementary tables are first shown, in which specific cases are investigated for the purpose of deriving a part of the data for the general table which follows thereafter.

Table Showing Ratio of Plan Areas and Volume for Batteries of Similar Voltages (24 Volts)—Data Based on Specific Cases.

Descriptive.	Lead Cell.	Edison Cell.
Size Cell.	"E-7."	"E-18."
Ampere-hour rating	120	110
Watt-hours, per cell	240	135·3
Number of cells	11	17
Cell length	9⅛	2⅝
Cell width	6¾	5⅛
Cell height	11⅝	13¼
Space between cells	½ inch.	¼ inch.
Total plan space	712 square inches.	241 sq're inches.
Connected for 110 ampere-hours	653 square inches.	241 sq're inches.
Ratio of space (110 ampere-hours)	100 per cent.	37 per cent.
Ratio of volume (110 ampere-hours)	100 per cent.	52 per cent.

Watt-hours per Pound of Cell at Normal Rates.

Descriptive.	Lead Cell.	Edison Cell.
Size Cell.	"E-7."	"E-18."
Mean discharge volts	2.0	1.23
Discharge current	15.0	30.00
Discharge hours	8.0	3.66
Ampere-hours	120.0	110.00
Watt-hours	240.0	135·30
Pounds, per cell	60.25	13.00
Watt-hours, per pound	4.00	10.41

General Comparison Table (Lead vs. Edison Cells).

Descriptive.	Lead Cell.	Edison Cell.
Receptacle.	Glass or Lead.	Steel.
Plates	Lead.	Steel.
Positive material	Lead oxide.	Nickel oxide.
Negative material	Lead sponge.	Iron oxide.
Material retained by	Adhesion.	Perforated walls
Electrolyte	Dilute acid.	Caustic potash.
Corrosiveness	Strong.	Weak.
Specific gravity electrolyte	1.20	1.18
Int. res. per ampere-hour capacity	100 per cent.	133 per cent.
Gassing on charge	Mild.	Violent.
Product of gassing	Explosive.	Explosive.
Product of gassing	Corrosive.	Harmless.
Polarization	Inappreciable.	Inappreciable.
Life approximate	10 years.	Assumed 20 yrs.
Maximum cell voltage	2.55	1.90
Minimum cell voitage	1.80	1.10
Normal charge voltage	2.4	1.75
Normal discharge voltage	2.0	1.23
Ratio of discharge voltage	100 per cent.	60 per cent.
Normal time of charge	8 hours.	3¼ hours.
Normal time of discharge	8 hours.	3⅔ hours.
Minimum time of charge	3 hours.	1 hour.
Minimum time of discharge	3 hours.	1 hour.
Ampere-hour over charge required	10 per cent.	10 per cent.
Ampere-hour efficiency	85 to 92 per cent.	80 per cent.
Watt-hour efficiency	70 to 75 per cent.	55 per cent.
Watt-hour per pound of cell	4.00	10.41
Bulk per watt-hour output	100 per cent.	48 per cent.
Battery plan space ratio	100 per cent.	37 per cent.
Initial costs	100 per cent.	120 per cent.
Renewal costs	100 per cent.	40 per cent.
Attendance costs	100 per cent.	50 per cent.
Internal-resistance ratio	100 per cent.	68 per cent.

There are several characteristics of the Edison cell that commend its application in telephone service. Its durability, small demands for attention and general operating flexibility are much in its favor. On the other hand its normal voltage is low and is subject to a large per cent. of variation. Its first cost is high and its actual life has not yet been determined. These qualities may be listed as follows:

The Edison Cell and its Qualifications for Telephone Service.

Superior Qualities.	Inferior Qualities.
Construction durable.	Voltage low.
Attendance small.	Voltage variation great.
Maintenance slight.	First cost high.
Internal resistance low.	Electrical efficiency low.
Corrosiveness slight.	
Volume small.	

As the lead cells and the nickel-iron, or Edison cells, constitute the only storage batteries of any considerable importance, only these two types will be compared.

Owing to the very thorough construction and special processes involved in its manufacture, the present cost of the Edison cell is high. In fact the present prices prohibit the general adoption of this cell for the great majority of storage-battery applications. It may reasonably be expected, however, that the cost of the nickel-iron type of cell will soon be reduced to figures comparing favorably with the cost of lead cells as methods of manufacture become more developed and improved.

The relative approximate costs may be compared by reference to the following table:

Commercial Data on Lead vs. Edison Cells.

Descriptive.	Lead Cell.	Edison Cell
Size.	"E-7."	"E-18."
Ampere-hour capacity	120	110
List price per cell	$14.00	$10.00
Relative price for 110 ampere-hour cell	$12.83	$10.00
Watt-hour capacity 110 ampere-hour cell.	220.00	143.0
Kilowatt hour capacity 110 ampere-hour cell	.22	.143
Cost per kilowatt-hour capacity	$58.32	$69.93
Ratio of costs per kilowatt-hour capacity.	100 per cent	120 per cent

The Edison battery equipment, on account of its greater voltage range, must include certain accessories, including counter electromotive-force cells, with suitable switching and wiring equipment for regulating purposes. It may be noted that the initial cost of the Edison battery equipment is about twice as great as for a similar lead battery. It does not necessarily follow from this, however, that the lead battery is any cheaper for maintaining service an indefinitely long time, as its maintenance expense is relatively high.

The continued maintenance of a battery for a long period of time involves two factors—personal attendance and renewal of parts. The former may be said to comprise general care and repair and would be covered by the payroll, while the latter relates to the renewal of worn-out or defective parts such as would be covered by bills for material.

As indicated in the general comparison table of lead and alkaline cells, the lead cells must require a greater amount of attention in their normal working than the Edison cells, for there are more points demanding attention. Moreover, the danger from neglect is much less for the Edison cell than the lead cell. This means less expense for attendance in favor of the Edison cell.

Storage-battery practice in the past has pretty thoroughly demonstrated that the average life of an ordinary lead battery, under usual conditions, is from five to 15 years, or say 10 years. There are many obvious and well-known reasons why the life of a lead cell is thus limited, e. g., gradual loss of the active material, sulphating, etc. On the other hand, there appears to be practically no chance for deterioration in the Edison cell so long as pure water is used to replace evaporation and gasing and so long as the electrolyte is kept well above the plates. The question of renewals, therefore, is also evidently in favor of the Edison cell.

The results of this investigation may be briefly summarized as follows:

First.—The Edison cell is entirely practical in its three chief physical aspects—mechanical, chemical and electrical.

Second.—Owing to its low ampere-hour and watt-hour efficiencies, its power consumption is large for a given output. This considerably increases its operating expense where the power rates are high.

Third.—Its present relatively high initial cost must limit its general adoption only to uses for which it is especially adapted.

Fourth.—Its application in telephone service would appear to be advantageous in small common-battery exchanges because of its small demands for attention and maintenance, doubtless more than sufficient to offset the difference in initial cost.

Fifth.—It is especially adapted to the requirements for automobile service.

Discussion (Abstract).

Chairman W. B. Hale: The subject we are about to discuss—the new Edison storage battery—is an attractive one. The Edison cell has aroused much interest of late, partly due to its intrinsic merits and partly on account of the eminence of its inventor. This battery has many good points, among which may be mentioned durability, a fairly good efficiency and the ability to withstand rough usage, while its lightness makes it valuable for automobile work. It may be described as an oxygen-lift cell, in which oxygen is electrolytically conveyed from the negative or iron plate to the positive or nickel plate during charge, the caustic electrolyte remaining unchanged. During discharge the nickel oxide of the positive element is reduced to a lower form.

H. M. Beck (Electric Storage Battery Company): I would like to ask Mr. Davis a few questions, as I am not familiar with the subject from this standpoint, and I expect there are others here tonight who are in the same position. I will ask, first, how he determines the end of a charge; when is a cell charged, or when is the time to cut off the current? I notice in a great many of the curves he shows that he starts with a given voltage and ends with a lower voltage than that with which he started. Of course, the voltage is one of our most important methods of determining the proper amount of charge in a lead battery, and this, especially in the lead type, is very important. I do not suppose it is so important in this cell, except from an efficiency standpoint, but there must be some means besides voltage for determining when the cell is full and when the current is to be cut off.

Mr. Davis: The most reliable means of determining when a cell is fully charged is by a few experiments to determine what amount of charge is sufficient to get the rated ampere-hour output. There seems to be no fixed voltage to be attained on full charge. For the most part, the voltage appears to rise gradually as the charge is continued, with possibly one or two exceptions shown on the curves, where it was slightly less, but as a rule it is the other way. I know of no way except experimental charges to determine when a sufficient charge has been instilled.

Mr. Beck: For instance, in telephone or automobile service you use a certain amount of the charge, it may be only a small fraction. Is there no way, then, of telling how much to put back when you do not know what has been taken out?

Mr. Davis: That is my understanding. When the state of charge is not known approximately, the battery should be recharged. When the voltage falls below about 1.23, the battery will run for a short time on the secondary discharge. It is better practice, however, from an efficiency standpoint, not to run on this secondary part of the discharge. Better results are to be obtained by recharging as soon as the primary part of the discharge is exhausted.

Mr. Beck: Then the only safe method would be (no matter how much the discharge) to put in the complete charge in order to be sure the cell was full?

Mr. Davis: For an automobile run it would be desirable to put in a full charge to make sure that there had been instilled a sufficient charge to depend upon. Of course, this question would depend somewhat upon the nature of the service.

Mr. Beck: Have any tests been made to show how the cell holds its capacity? Suppose it is charged up to its full capacity and is allowed to stand charged for two or three days and is then discharged. Have you any figures on the percentage of loss?

Mr. Davis: No test was conducted for allowing the cell to stand, fully charged, except in one case when the electrolyte was removed during the time in question in order to determine if there would be any injury resulting from leaving the electrolyte out. Of course it is well known that if an ordinary lead cell is taken apart, fully charged, and allowed to stand, it will heat and the negative plate will oxidize and be ruined. In a telephone exchange, where there is a small plant, and the attendant, possibly, may not know much about a battery, he will doubtless at some time have occasion to take out one or more plates, and seeing that they get hot after standing a short time he will wait for them to get cool, and at the end of that time the plates will be ruined. In this test it was desired to see what would be the result of such treatment of the Edison cell.

Mr. Beck: In regard to the lead plates being ruined on being allowed to dry when taken out, I might make a few remarks on that subject, because it is something I am a little more in touch with. The fact is, we do not consider it the best thing for a lead cell to permit it to dry out; but, on the other hand, I will say that we have more than once made use of just such treatment, and it actually greatly improves the capacity of the battery. I know of a case where the electrolyte was taken out and the cells were allowed to stand for about one-half day and allowed to heat. The electrolyte was then put back and the cells charged up, and the capacity of the battery was brought up to the full amount, or 100 per cent., although it was previously only about two-thirds. This is a treatment we have used a number of times in just such a way in order to get the capacity up; so that such treatment is not always ruinous to the lead battery.

Mr. Libby: There is one point I would like to bring out. At the time Mr. Davis started on his tests I was curious to know, first, if some of the claims made for the cell were actually true; but while inspecting these claims, practically the main point was concerning its adaptability to telephone work. There are one or two things in connection with the cell that would seem to indicate that it was adaptable for telephone work; one of these is the internal resistance. One requirement in telephone work is to have a battery of very low internal resistance, so as to cut down the danger of cross-talk. You will recall that in the curves shown the internal resistance starts at about 0.0017 ohm. In a lead battery of the same rating the internal resistance was found to be very nearly double the amount just mentioned. You can easily see that this is because in the Edison battery the plates are close together—not more than one-sixteenth inch space between the plates. At the end of the discharge the internal resistance is about the same as for the lead battery at the begin-

1. This is the concluding portion, with abstract of discussion, of a paper read before the Electrical Section of the Western Society of Engineers, on October 14, 1904. Mr. Davis is connected with the engineering department of the Kellogg Switchboard and Supply Company, and his paper is valuable as an account of impartial tests made in the laboratory of that company.

ning of the discharge, so that this particular point seems to be in favor of the Edison cell.

On the other hand, there is a disadvantage with this cell in connection with telephone work. For example, on our system (the Kellogg) we use two sets of 11 cells of battery, giving about 22 volts. The minimum voltage would be, with the lead battery, about 20, and the highest about 27. You can see whereby the initial voltage of the Edison cell, being only 1.23 volts, it necessitates a larger number of cells. Moreover, the maximum and minimum voltages run in wider ranges than on a lead cell; consequently, in order to prevent burning out supervisory and line lamps at full charge, it would be necessary to cut in counter electromotive-force cells. Mr. Davis neglected to state how he built up counter electromotive-force cells with an ordinary nickel plate and an iron plate—two plates fastened about one-sixteenth inch apart, which gave a counter electromotive force of about two volts. This would be very inexpensive, and probably would not cost more than $3 a cell, so this counter-electromotive-force cell-cost is not very large and is easily gotten around.

Again, a disadvantage with the cell would be in the low ampere and watt-hour capacities. The cell would be a good one to use in some towns, as Mr. Davis cited, where the attendant knew practically nothing about the storage battery. I should prefer giving an attendant in such a place a cell of this kind, because it is covered over and the chances for evaporation are not nearly so great as with the lead cell, and there would not be as much danger of ruining it.

Some of you may wonder why, in some of the tests referred to, the electrolyte was left out of the cell for nine days. The reason for that was this: I have been in a great many telephone exchanges. In some I have actually seen one or two cells standing in the corner. On asking what the cell was there for, I was told that there was something wrong with it, and the attendant, not knowing what was the matter, had taken the cell out. When he came to put it back the cell did not work satisfactorily, and to his evident surprise it did not recuperate. With this test of nine days we desired to see if it was possible, after that length of time, to put the cell back into normal condition, and as Mr. Davis has shown you by the curves, he was able to get about 50 per cent. of the watt-hour capacity out of the cell, even after that bad treatment.

Mr. Blumenthal: I would like to ask Mr. Davis if he can tell us the formula for the nickel oxide and also for the iron oxide? He spoke of the relative weights of these batteries; now perhaps he can tell us about the relative space required for the use of the Edison battery. I have an idea that a special automobile or an attachment would have to be built to accommodate the extra cells. In regard to the weight you give for the watt-hour efficiency of a lead battery, was that for automobile or stationary type?

Mr. Davis: The stationary type was considered—i. e., the type ordinarily used for power-station work. An Edison battery will occupy less space than this station type, but will take more space than the special automobile type of lead battery. Mr. Edison has advanced the chemical equation, $NiO_2 + Fe = NiO + FeO$, as representing the chief chemical reaction associated with the discharge of the cell. Mr. A. L. Marsh, however, who has made a considerable investigation of the electrochemical theory of storage batteries, has maintained that the equation $Ni_2O_4 + Fe = Ni_2O_3 + FeO$ most nearly represents the change that accompanies the discharge.

Mr. Scheible: Are all of those oxides used in the cell, or is there a preponderance of certain kinds?

Mr. Davis: This list of oxides is presented merely to illustrate the nature of the two metals. The actual oxides which are contained in the pockets are of a complicated nature, and they are not generally known. I was unable to get the exact formulæ for them, as they are kept secret. But there are theories which give certain formulæ which are rather complicated, and I did not attempt to remember or present them. The process of preparing them is also rather complicated. In this case, after the tests, I noticed that there were to be seen particles of mercury, indicating that mercury entered into the construction or formation of those oxides. Samples of oxides submitted to the speaker for examination showed the iron oxide as a fine black powder, while the nickel oxide appeared to be a hard green amorphous substance of a granular or lumpy texture.

Mr. Libby: In justice to Mr. Beck, I would like to modify a statement I made. I said that the internal resistance of a simple Edison cell was about half that of the lead cell, which is true; but taking a set of 11 lead cells, one would have to use 17 of the Edison cells to get the same voltage. Hence, the over-all internal resistance of the 17-cell Edison battery would be only slightly lower than the over-all internal resistance of the 11-cell lead battery.

Mr. Smoot: I would like to ask if that over-all internal resistance is the resistance which would produce the difference of potential between the discharge and subsequent charge with 1½-minute cycles at very high rates? Do you find the behavior of the Edison cell similar to that of the lead battery of the same size in this respect?

Mr. Davis: I would state, in this connection, that many of these charges were at rather high rates. The advised charging rate is 40 amperes, but there are many experimental charges at 60 amperes. The idea is, that these oxides are not good conductors of electricity. However, they are contained in pockets which are of metal and hence are in immediate contact with good conductors of electricity; therefore, the current in passing from one plate to the other does not all pass through the oxide particles, but a part of it will go direct through the steel plates themselves, and at the surface of the steel plates water will be broken up into oxygen and hydrogen. I ascribe the difference in voltage to be due partly to this polarization effect. A variation of current causes a corresponding small variation of voltage, the latter being due chiefly to the internal resistance.

A. L. Marsh: I would like to ask a question regarding the different voltages of the Edison cell. Is there a rapid fall of electromotive force at any point, or is the drop gradual?

Mr. Davis: In charging the battery under a normal charging rate of 40 amperes, the voltage at all times comes up to about 1.75 volts, and then, on discharging, it drops away to about 1.23 volts. While there is a slight, gradual decrease, it is approximately about 1.23 throughout—that is, so long as the current remains constant.

Mr. Marsh: Does the working electromotive force fall lower than 1.23 volts at any stage?

Mr. Davis: Yes; first we have the so-called primary discharge. Beyond this point it falls to about 0.7 or 0.8 volt and continues for a comparatively short time on what is known as the secondary discharge. This secondary discharge is evidently conducted on a different kind of oxide; that is, a lower oxide, and the chemical action is evidently somewhat different. It is not advisable to run on this secondary discharge because, after such usage, a much prolonged charging is necessary to get the cell back to its normal primary condition again. This is not generally advisable as it causes low efficiency, although it will stand charging at a very high rate and the time required will not be very great. For instance, no injury comes from charging or discharging at 100 amperes or even at a higher rate for the "E-18" cell which has a normal rating of 40 amperes.

Mr. Marsh: Then there is a marked drop in voltage between the primary and secondary discharges?

Mr. Davis: Yes; there is an abrupt fall between the primary and secondary discharges. In charging there is no distinction between the primary and secondary. When the charging is begun the voltage comes right up to very nearly the highest voltage.

Mr. Lunn: A comparison of cells used in automobiles might be of interest. Take a type of cell one size larger than the one we have heard described—the "E-27" Edison—and a cell of the "Exide 13 M.V." Express type, of the same ampere-hour capacity—168 ampere-hours. The number of cells generally used in an automobile battery ranges from 20 to 40. Take, for instance, a 40-cell battery of the "Exide" type, giving a pressure across the terminals of about 80 volts. A battery of 64 cells of the Edison type is required to give the same terminal pressure. The average voltage of an Edison cell during discharge is about 1.23; the average voltage of an "Exide" cell is about 1.98. The weight of the "Exide" battery would be 1,560 pounds; of the Edison type, 1,120 pounds, the Edison battery weighing about 32 per cent. less than the "Exide." The cost of the Edison battery would be about $960; of the "Exide" battery, between $550 and $600, or the cost of the Edison battery is almost double that of the "Exide." The watt-hours per pound of complete cell are about 11.8 for the Edison type and about 8.5 for the "Exide" cell. The watt-hour efficiency is the most important point in comparison, that of the Edison cell being about 46 per cent., while the watt-hour efficiency of the "Exide" cell is about 70 per cent. To be sure, these figures are derived from laboratory tests, but the same factors which would cause these figures to change in practice in one case would likewise affect the other, so we could expect the same difference in efficiencies to hold. Take, for instance, a machine like the Montgomery Ward trucks. The actual monthly cost for charging current at 10 cents per kilowatt-hour would be in the neighborhood of $60. The charging current for an Edison battery of the same kilowatt-hour capacity would be about $90, a difference of $30. This $30 a month for a year and a half (about the life of a lead battery) would more than pay for a new lead battery. So I do not see where the great saving is going to be made in using the Edison battery in place of the lead battery for automobile work, especially when one costs $960 and the other about half that.

Mr. Beck: There was one point brought out in regard to the action of the Edison cell which in practical work would make that efficiency still lower than Mr. Lunn has made it—that is, with the lead cell you are able to tell when the battery is charged and when it is time to discontinue the charge. With this Edison cell you have no means of telling just how much electromotive force you have taken out of the battery, but you want to know before starting out the next time that you have a full charge. Under these conditions the only way I see that you can do is to give it a full charge each time, and in this way the actual efficiency would in practice be very much lower than the relative efficiency of the two types of cells under laboratory conditions.

Mr. Lunn: In that connection I might say that it is usually the practice to figure on how far you want to go before charging the battery, and charge accordingly. In some cases a practice is made of giving the battery a full charge after every partial or full discharge. This, of course, might bring down the efficiency of the battery very considerably. Another point in connection with the Edison cell is its mechanical strength. The sealing on of the cover, however, has given the Edison people a great deal of trouble. They now make a practice of fusing instead of soldering the cover on to the cell proper, so as to keep the solution from eating its way out. Some of the earlier batteries gave considerable trouble on account of leakage of the electrolyte around the cover, due to imperfect soldering.

Mr. Smoot: In regard to the lead battery for automobile work, the difficulty has not been to make a good lead battery, but to teach the drivers how to handle their battery. For instance, batteries in the hands of the skilled operators will give marvelous results as compared with the operation of batteries in general use, while the battery in the hands of those unfamiliar with it will give entirely different results. It appears that the Edison battery has not had this inexperienced treatment as yet, and it seems to me a little unfair to compare it with practical tests on the lead battery.

Mr. Davis: I have read of two or three automobile tests where the Edison cell has been used in automobile work sufficient to demonstrate quite thoroughly that it will stand up in actual tests. Not that I have made that sort of test myself, but I feel well satisfied that such test has been properly made. I wish to acknowledge Mr. Libby's valued assistance in connection with the tests just conducted.

Mr. Libby: The tests made by Mr. Davis were not made for the purpose of finding out whether this was a good automobile battery, but the primary object was to find out whether the battery was a good one for telephone work. It has been previously mentioned by me that in certain cases it might be advisable to use the Edison battery for telephone work, but the tests as a whole indicate that practically the only field for this cell, as now built, is in automobile work.

New Members of the Institute.

At the directors' meeting of the American Institute of Electrical Engineers, held in New York on October 28th, 42 applicants were admitted to associate membership in the Institute. The following-named are among the number:

Austin, A. O., California Gas and Electric Corporation, Stockton, Cal.
Barton, E. J. M., Panama Railroad and Electric Light Company, Panama, Republic of Panama.
Bell, U. S., Southeastern Tariff Association, Atlanta, Ga.
Brosius, F. R., Columbus Railway and Light Company, Columbus, Ohio.
Clay, J. A., Hecla Mining Company, Burke, Idaho.
Crane, A. S., Sanitary District of Chicago, Chicago, Ill.
Davis, C. W., Southwestern Electrical Engineering and Construction Company, Dallas, Texas.
Enslen, E. F., Jr., Ford, Bacon & Davis, Birmingham, Ala.
Ferguson, W. A., Mexican Light and Power Company, Mexico City, Mexico.
Gould, F. S., Asheville, N. C.
Gunter, Emil, General Electric Company, Pierson, Fla.
Harper, R. H., Harper Electric Company, Fort Wayne, Ind.
Hild, F. W., General Electric Company, Chicago, Ill.
Iyer, T. K. A., Cauvery Power Electric Scheme, Mysore, South India.
Kidder, L. H., Compagnie Explotadora de Las Furzas Hidro Electricitas, Mexico City, Mexico.
McGeorge, Harold, Electric Controller and Supply Company, Cleveland, Ohio.
Milford, G. R., Northern California Power Company, Whitmore, Cal.
Milmow, Albert, Grant & Co., Manila, P. I.
Nordstrum, L. D., Purdue University, West Lafayette, Ind.
Osborn, Harold, Department of Machinery, World's Fair, St. Louis, Mo.
Petersen, O. G., Stearns Laboratory Company, Stearns, Ky.
Raymond, Francis, III., General Incandescent Arc Light Company, Chicago, Ill.
Reynolds, H. H., Kilburn & Co., Calcutta, British India.
Towle, G. C., McCulloch Company, Mattoon, Ill.
Waters, H. B., Missouri River Power Company, Canyon Ferry, Mont.

International Automobile Exposition.

Announcement is made that the international automobile exposition at Berlin will be held at Landes Austellung Park on February 4th to 19th, 1905. The exhibition will be under the joint control and management of the German Automobile Club of Berlin and the Association of German Motor Vehicle Manufacturers at Cannstatt. This will afford an opportunity for American manufacturers to bring their work before the German public. It is said that while the fame of the Mercedes and other German-made racing and touring vehicles is world-wide, there is a distinct impression in Germany that in respect to electric carriages for city use and the smaller vehicles of moderate price for business and recreation American makers are still quite in advance. Some of the leading types of American-made "runabouts" are already sold and are highly appreciated. The exposition of next February will be far more extensive and complete than either of its predecessors. Applications for space and all further information should be addressed to the managing director, Freiherr von Brandenstein, No. 4 a Sommer-Strasse, Berlin, N. W.

Wireless Station at Kansas City.

Operations of the De Forest Wireless Telegraph Company toward the establishment of a practical system of overland commercial space telegraphy are being energetically pushed. Radiating from the large station on the Fair grounds at St. Louis, regular communication is now maintained with Kansas City, Mo., and Springfield, Ill., and it is stated at the Chicago office of the company that commercial messages to the number of about 30 a day are accepted and transmitted between each of the points named. While messages have been successfully sent to Chicago from St. Louis by the wireless method, no attempt has yet been made to establish a commercial business over the 300 miles for the reason that the permanent station now in course of erection in Chicago is not yet completed. Within three weeks, it

WIRELESS STATION AT KANSAS CITY.

is stated, the Chicago station will be prepared to do a commercial business.

The most recent station to be completed is the one at Kansas City, a picture of which is shown herewith. The station consists of a simple square building with a mast of wood and steel rising to a height of 250 feet. The mast carries the usual rigging of wires. This station will ultimately link the principal city on the Missouri River with the Great Lakes system and also the stations on the Atlantic coast. Eventually, it is stated, the station at Seattle, Wash., may be connected across the Rocky Mountains with the Missouri Valley system.

De Forest apparatus has been installed at Sedalia, Mo., but has not yet been put in commercial operation. Within a short time, it is said, a large station of 50 horsepower will be erected at Fort Worth, Texas. The horsepower of the apparatus at the other stations is: St. Louis, 20; Kansas City, 20; Springfield, three; Chicago (temporary station), two; new station, 20. When the large new system is completed in Chicago the old station will be used as a part of the proposed lake system.

The rates charged by the company for commercial messages between the cities now provided with the long-distance apparatus have thus far been the same as those of the regular telegraph companies.

Secrecy and Invention.

A decision has been rendered by the United States commissioner of patents to the effect that an inventor who has completed the inventive act by reduction of his invention to practice may lose his right to obtain a patent, in favor of a subsequent inventor, by concealment and delay in applying for a patent. A person who refuses to instruct the workers in the art and seeks to protect himself in the use of the invention by keeping it secret, thus apparently leaving the field of invention vacant to stimulate the activity of other inventors, cannot secure a patent in the face of the claims of a later inventor who has given the invention to the public. So far as he is concerned the field is truly as vacant as he wished it to appear, and he forfeits his rights in favor of his rival, whether or no that rival has already secured a patent.

Cost of Hydro-electric Plants.

An important factor bearing on the cost of hydro-electric plants is the character of the waterfall itself. With a given head of water, the cheapest fall to develop is one where the drop is vertical, then the length of the penstock need be little more than the height. In the Scientific American are given some of the most important factors to be considered in the planning of a hydro-electric installation.

Perhaps the most important single factor bearing on the cost of waterpower development is the available head. As a rule, the cost of the development per unit of power will increase as the head decreases, other factors remaining the same. The lower the head, the greater must usually be the mass of the dam, the larger must be the canal, penstocks and power house, and the heavier must be the waterwheels and electric generators, per horsepower developed. For wheels and generators the weight per unit of output decreases as the speed of revolution increases, and this speed goes up with the head of water. The mass of the dam, and the sizes of the canal and penstocks, increase with the volume of water to be handled, and this volume grows larger as the head decreases per horsepower of capacity.

If the bed of the stream has only a moderate descent of five or 10 feet per mile, it will probably be cheaper to build a comparatively high dam and set the water back a few miles, than to dig a canal or lay a pipe line to carry the discharge of the stream over the same distance. Near the foot of such a dam at one end, a power house may be located and supplied with water through short penstocks much as in the case of a natural, vertical fall.

With heads that range from as low as 10 up to nearly 2,000 feet, created in some cases by natural falls, in others by canals or pipe lines miles in length, and in still others entirely by dams, the cost of hydro-electric plants is subject to wide variations. In a very general way it may be said that a complete waterpower development with its electric generating station will cost anywhere from $50 to more than $300 per kilowatt of capacity. Somewhere about midway between these extremes the cost of the majority of hydro-electric plants will be found. The figures just named have nothing to do with the cost of transmission on distribution lines, which depends on factors that are but little influenced by the type of waterpower development.

In one case a head of 14 feet was created almost entirely by the erection of a stone-masonry dam across a small river. From one end of this dam a short canal several hundred feet long conveys the water to the electric generating station on the river bank below. The station building is constructed of stone, concrete, brick and steel, with a floor area sufficient for two direct-connected generators of 800 kilowatts total capacity, and with a traveling crane overhead. For the real estate, the construction of the dam, canal and power house, and the complete equipment of the latter to develop 800 kilowatts, the approximate cost was $190 per kilowatt of generator capacity. On another small river a head of 23 feet was created in part by a natural fall in the bedrock of the stream, and in part by a masonry dam. From one end of this dam a steel penstock was carried to a brick power house near by. This power house was equipped with direct-connected waterwheels and generators, and with transformers for an output of 1,500 kilowatts. For this complete hydraulic and electric plant the approximate cost was $160 per kilowatt of generator capacity.

BOOK TABLE.

EXPERIMENTS WITH ALTERNATE CURRENTS OF HIGH POTENTIAL AND HIGH FREQUENCY. By Nikola Tesla. New York: McGraw Publishing Company. 1904. Pp. (five by seven inches), ix., 162, with a new portrait of the author and 40 illustrations in the text. Price, $1.

Tesla's is a name to conjure by, and this little book will not lack for readers, although it is but a reprint of a lecture delivered several years ago before the Institution of Electrical Engineers in London and of an article on "The Transmission of Electric Energy Without Wires," published in the Electrical World and Engineer last spring. There is a fascination about the personality and work of Tesla, due partly to his fame as an inventor, but largely to his daring conceptions and prodigal predictions. An example of the latter and of the writer's fervid style is the very last paragraph of the book:

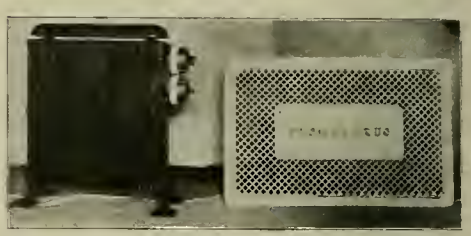
"When the great truth, accidentally revealed and experimentally confirmed, is fully recognized, that this planet, with all its appalling immensity, is to electric currents virtually no more than a small metal ball and that by this fact many possibilities, each baffling imagination and of incalculable consequence, are rendered absolutely sure of accomplishment; when the first plant is inaugurated and it is shown that a telegraphic message, almost as secret and non-interferable as a thought, can be transmitted to any terrestrial distance, the sound of the human voice, with all its intonations and inflections faithfully and instantly reproduced at any other point of the globe, the energy of a waterfall made available for supplying light, heat or motive power anywhere—on sea or land, or high in the air—humanity will be like an ant heap stirred up with a stick. See the excitement coming!"

An interesting biographical sketch forms the introduction to the lecture. In this it is said that Mr. Tesla is "tall and spare, with a clean-cut, thin, refined face and eyes that recall all the stories one has read of keenness of vision and phenomenal ability to see through things."

Electric Heaters in New York Subway.

For the heating of the ticket offices and toilet rooms of the New York subway the engineers of the Interborough Rapid Transit Company decided to adopt the special heaters submitted for their consideration by the Prometheus Electric Company of New York, which are shown in the accompanying illustration.

The office heater, shown at the left, consists essentially of a cast-iron box supported on two sets of legs, the box being 16 inches wide, 17 inches high and 4½ inches deep. Air is admitted through the bottom of the heater, which contains a number of openings, and escapes, after being heated, through



ELECTRIC HEATERS IN NEW YORK SUBWAY.

an opening at the top of the heater, which is covered by an iron canopy, leaving an air space of one inch between the box and the canopy. To prevent any possible overheating of the box, which might cause scorching of clothing, a number of slots are provided on the back of the heater to facilitate the escape of heated air.

Two 500-volt, 10-ampere switches are mounted on a special support at one end of the heater, and by means of these switches one-half of the full heater equipment of each heater may be used. A ribbed plate is attached to the front by means of screws, and by simply taking off this plate the interior of the heater may be inspected.

The electric equipment proper consists of eight ironclad Prometheus heating units, supported on blocks of procelain, which are attached by means of studs to the back of the box.

The main circuit wires leading to the heater are passed through a special porcelain bushing and a porcelain tube at one end of the heater, where they are connected to copper lugs. So simple is the construction that the entire electrical equipment can be taken apart and replaced in 10 minutes.

Prometheus units each have a capacity of 100 watts, so that the total capacity of the heater is 800 watts. Each unit is 1¼ inches wide, 12 inches long and one-eighth inch thick.

The heater which has been adopted for use in the toilet rooms is shown at the right in the picture, the front of the heater being seen. The wall plates, which measure 14 inches by 28 inches, and which are finished in dull nickel, are to be attached to cast-iron boxes, which are built into the wall in such a manner that after the heater is in place the front of it is flush with the slate covering of the walls.

The electrical construction of these heaters is similar to that of the ticket-office heaters, the same parts being used for both types of heaters. A number of these wall heaters are equipped with six ironclad units, giving a total capacity of 600 watts, and another set of plates is equipped with four units, making a capacity of 400 watts. There are four of these heaters in each toilet room, and they are controlled by switches in such a manner that the heaters may be turned on and off in sets of two, or one half of each heater may be used at any one time, in conjunction with one half of any other heater. The plate being of the grid pattern permits of a thorough circulation of the air, preventing overheating of the plate.

Elevated Railway Traffic in Chicago.

Traffic on the elevated railroads of Chicago for the month of October was in general a disappointment as compared with October, 1903. The Northwestern Elevated is the only one to show an increase, having gained 2.4 per cent. over October, 1903. The daily average of the Metropolitan was 2.815 below 1903, while the South Side Elevated shows a decrease of 2.9 per cent. for October compared with last year. The daily average of passengers carried by the several roads for October, 1903 and 1904, is as follows: Northwestern—1903, 71,617; 1904, 73,385. Metropolitan—1903, 117,387; 1904, 114,572. South Side—1903, 85,788; 1904, 83,291.

The Chicago and Oak Park Elevated Railway also shows a decrease in the daily average of passengers carried of from 44,725 in October, 1903, to 43,269 last month.

Single-phase Railway System for Interurban Service.

The alternating-current railway motor is not a new and untried experiment. Previous to 1902, when Mr. B. G. Lamme publicly advocated the use of single-phase alternating current for railways, a long series of tests at the Westinghouse shops had demonstrated the value of the series alternating-current motor.

To the merits of the direct-current railway system, which the alternating system retains, are added others peculiar to the use of the alternating current. Prominent among them are the removal of the voltage limit, which lessens the cost of transmission and also simplifies the problem of collecting large amounts of power through moving contacts for the operation of heavy trains; the higher efficiency of transformers as compared with direct-current rotary converters in sub-stations, and an increased car efficiency by the elimination of rheostatic losses, thus lessening the amount of power required to operate the system. Added to these are the wide range of speed control and the disappearance of electrolysis. There is also a material saving, both in initial expense and the cost of operation and maintenance. The cost of the alternating-current car equipment is considerably more than that of the direct-current, but the saving in transmission circuits and the omission of the rotary converters in the alternating-current system, and the saving in other respects appear to leave a balance in its favor.

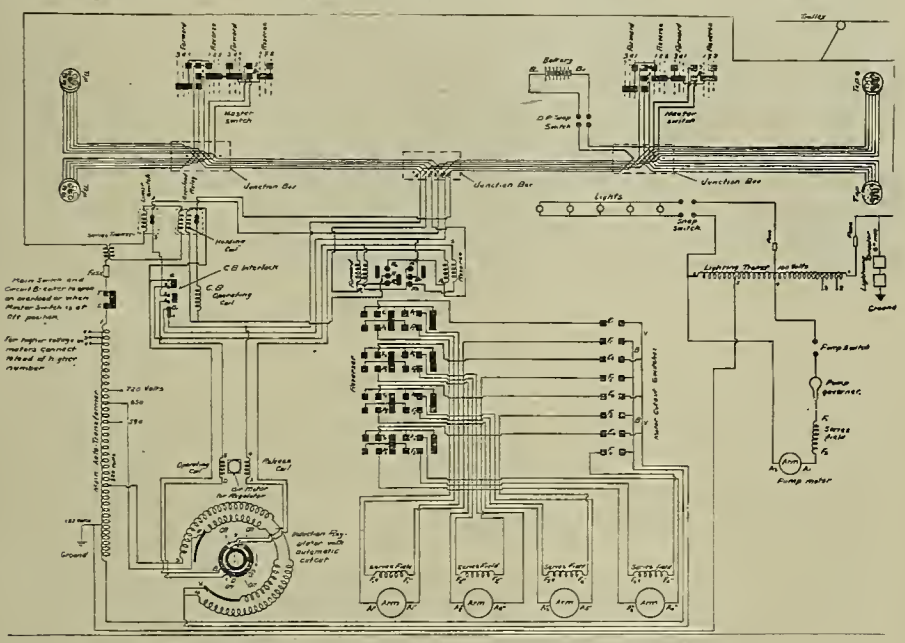


FIG. 1. DIAGRAM OF CAR CIRCUITS OF SINGLE-PHASE RAILWAY SYSTEM.

In the Westinghouse system there are three electric circuits upon each car, as shown by the accompanying diagram, Fig. 1. They are the motor circuit, the auxiliary-control circuit and the lighting and heating circuit. In the motor circuit there are placed the circuit-breaker, main transformer, inductor regulator, reverser, motor cut-out switches and motors.

In the auxiliary-control circuit an electropneumatic system of control is used, the various parts being operated by compressed air controlled by magnet valves. Current for the magnet valves is obtained from a 14-volt storage battery placed under the seat of the car. The use of a separate low-voltage circuit for this service is a valuable factor of safety.

The lighting and heating circuit contains the necessary apparatus for lighting and heating the car and operating the air-compressor motor with its governor.

The motor circuit (Fig. 2) begins with an auto-transformer of special design connected between the trolley wire and the ground. This transformer is so arranged that the current of air created by the motion of the car circulates through it, thus keeping it cool. At a point approximately 230 volts from the ground a circuit is led from this auto-transformer through the secondary of the induction regulator, and another tap, approximately 650 volts from the ground is led through the primary of the regulator.

Between the auto-transformer and the trolley is placed the circuit-breaker, which also acts as a main switch, and not only automatically opens the circuit when an overload occurs, but also whenever it is desired to cut off the current from the car. This circuit-breaker is held in place by a compressed-air cylinder working against a powerful spring.

The voltage applied to the motors, and consequently the speed of the car, is governed by the induction regulator. The circuit connections of the regulator are shown in Fig. 3. This is in effect a transformer with its primary core and winding movable with respect to the secondary. It is operated by means of a small pneumatic motor controlled by electromagnetic valves and may be turned so that its voltage either opposes or aids that of the auto-transformer any amount within the capacity of the regulator. In the "off" position the full voltage of the regulator is opposed to the 230-volt circuit of the auto-transformer, thus giving a low voltage for starting the motors. At the "full-on" position the entire voltage of the regulator is added to that of the 230-volt circuit of the auto-transformer, giving the proper voltage for full-speed running. The regulator can be left indefinitely in either of these or in any intermediate position, and thus the car can be run at any desired speed.

The operation of the various magnet valves which regulate the movement of each of the above pieces of apparatus is controlled by means of a master switch, located on the platform of the car. There are but three positions for the handle of the master switch for operating the car in a forward direction, and three corresponding positions for backing. When the handle is turned to the first notch on either side connection is made with the magnet valves governing the reverse switch. Air is admitted to the proper cylinder and the reverser thrown to the proper position. When the reverse switch has been operated air is then admitted to the pneumatic cylinder of the circuit-breaker, and the circuit-breaker is then closed. This applies current to the motors, and the car starts.

To secure a higher speed the handle is thrown to the third notch which closes the circuit of the magnet valves controlling the pneumatic motor, which drives the induction regulator, and air is thus admitted to the air motor. The regulator is then turned, gradually raising the voltage at the terminals of the motors. If the handle of the master switch is left on the third position the regulator will advance to the "full-on" position, where it will be automatically stopped. If it is desired to operate the car at anything less than full speed, the handle of the master switch may be brought back to the second position, and the regulator will at once stop and remain stationary. Under such circumstances, if the handle is again moved to the third position, the regulator will advance and increase the voltage at the motors and consequently the speed of the car. If the handle is moved back to the first position, the regulator will return toward the minimum position, lowering the voltage on the motors, thus lowering the speed of the car. If at any time it is desired to cut off the current, the handle of the master switch may be returned to the "off" position, in which case the circuit-breaker will open at once, thus cutting off the current immediately.

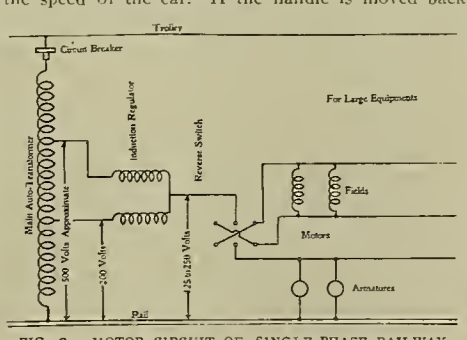


FIG. 2. MOTOR CIRCUIT OF SINGLE-PHASE RAILWAY SYSTEM.

The lighting and heating circuit is operated from a small auto-transformer, similar in design to the one in the motor circuit. From this transformer are supplied the lights in the car, the heating circuits, if any, and the small motor for operating the air compressor. The latter may be controlled by an automatic governor or by the hand switches, which are conveniently located.

Where the voltage of the line is 1,000 or less, connection between the car and the trolley wire is established by means of a trolley of the ordinary type. For higher voltages, a trolley of the bow type, especially designed for the purpose, is used. This is raised and lowered by compressed air under the control of the motorman, and any danger from shock in handling is thus avoided. The chief advantages given by the trolley are the substitution of pneumatic for hand control, with the consequent elimination of all danger from grounding through the hand ropes, a continuous contact with the trolley wire and the impossibility of the trolley slipping off the wire and damaging the overhead structure.

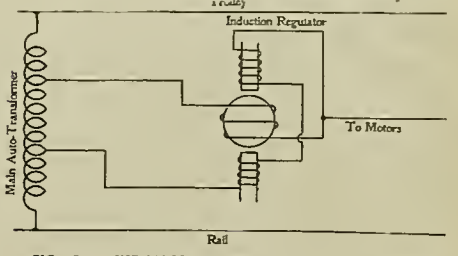


FIG. 3. INDUCTION REGULATOR CONNECTIONS IN SINGLE-PHASE SYSTEM.

At each support, the trolley wire is attached at a point alternately 12 inches to right and left of the center of the track, so that it is staggered, and the contact between it and the trolley varies from one side to the other, and thus undue wear at any point is prevented.

The overhead structure, which is of the catenary type, is indicated in Fig. 4, showing spans upon the Inter-works railway. The trolley wire is suspended from a messenger cable by hangers of different lengths, so graduated that the wire is at all points parallel with the track, presenting the best possible condition for continuous contact under high speeds. This construction also gives a greater rigidity, with the absence of up-and-down or sidewise motion and an increased strength and consequent ability to support loads of ice in winter storms. This catenary structure can be suspended from side brackets, as shown, or the ordinary span construction can be adopted. Grooved trolley wire is used, and since it is supported at frequent intervals, great rigidity can be obtained with a small size of wire. Suitable details of construction for use upon curves of different radii, of anchors, steady strains, section breaks, turn-outs, etc., have also been carefully designed.

FIG. 4. CATENARY TROLLEY WIRE FOR SINGLE-PHASE SYSTEM.

World's Fair Visitors of Last Week.

Among those registered last week at the booth of the Western Electrician in Electricity Building at the St. Louis Exposition are the following-named: F. J. Whybrew, Richmond, Va.; C. S. Gault, Cooperdale, Ohio; W. E. Boilean, Dubuque, Iowa; Stanley Purcell, Trenton, Mo.; John Van Skiver, Davenport, Neb.; O. B. Riley, Fort Worth, Texas; John L. O'Donnell, Chicago; O. B. Code, Madison, Wis.; R. H. Ford, Madison, Wis.; Richard Stoecker, Fishers Isle, N. Y.; Fred Jlcellarius, Dayton, Ohio; R. A. Hart, Battle Creek, Mich.; A. H. Appleby, Watts Flats, N. Y.; L. H. Vankirk, Gaieton, Pa.; William Canze, Owosso, Mich.; Felin Miller, New York; Mr. and Mrs. C. W. Forbrich, Chicago; H. P. Dennis, Electricity Building, World's Fair; William McIntyre, Fayette, N. D.; T. M. Meyer and wife, Milwaukee, Wis.; J. D. Davenport, Valleyhead, Ala.; Henry F. Scott, Dennison Manufacturing Company, South Framingham, Mass.; T. V. Field, C. M. Telephone Company, Indianapolis, Ind.; Henry Whitumb, Hudson, Mass.; Harold Macdonald, Auburn, N. Y.; W. O. Grady, Brooklyn, N. Y.; I. J. Wallon, Brooklyn, N. Y.; J. Donovan, Chicago; J. J. McKinstry, Chalybeate, Miss.; Otto G. Morgan, Corvallis, Ore.; A. B. Wood, Cottage Grove, Ore.; A. R. Champlin, Newton, Kan.; W. T. Tolch, Suttersville, Pa.; W. E. Oakley, Millbury, Mass.; Richard Tobson, Fahm, Sweden; H. De Gehepper, Chicago.

Ohio Telephone Notes.

According to the figures given out a few days ago the Cuyahoga Telephone Company of Cleveland has added 3,000 subscribers since the new switchboard was cut in last March.

Reports from Toledo show that the Toledo Home Telephone Company has 9,000 subscribers in its territory. Toledo seems to be good soil for anything that has Independence about it.

The New Lyme Telephone Company, New Lyme, has been incorporated with a capital stock of $600. M. A. Smith and others are interested in it.

S. W. Harvey has purchased the telephone interests of the L. C. Hayes estate, the property being located in Washington and Morgan Counties. A company called the Barlow and Watertown Telephone Company has been incorporated with a capital stock of $10,000 to take charge of the Hayes-Harvey and the Hayes, Harvey and Fisher lines, including a half interest in the Beverly-Waterford exchange, and the McConnellsville, Stockport, Lowell, Marietta and Fisher and Wolcott lines. Construction work on the trunk lines will be pushed along as fast as possible. All the lines will be connected with the Watertown exchange and the business will be looked after from that point. A large part of the stock of the new company was sold at once.

Through President John Kilgour, the Cincinnati and Suburban Bell Telephone Company has offered a reward of $1,000 for the apprehension and conviction of the murderer or murderers of Alma Steinway, an operator at the Park exchange, who met death on the night of November 2d while on her way home from work. She is the third victim of a supposedly insane or degenerate person who lies in wait about Winton Road and Spring Grove Avenue for girls whom he picks out while on the street or riding on cars.

A new exchange has been opened in a temporary building at Lakewood by the Cleveland Telephone Company and at first has 300 subscribers. A handsome building will be erected on the front of the lot that has been purchased. The need of additional facilities caused the company to put an exchange in temporary quarters until the building can be erected.

Federal telephone matters have been quiet for some time, but negotiations are still in progress for the settlement of all the claims against the company. It is believed that will be done before the expiration of the time limit next April if the creditors maintain a broad view of the situation. All the companies are now doing well and it is believed that everything will be done to bring about a settlement that will be satisfactory to all.

An attachment has been issued for Sol Kineon and George Kineon of Cincinnati by the courts at Covington, Ky., on the ground that they are guilty of contempt of court in stretching wire through the city after an injunction had been granted restraining them. The Kineons are claimed to be the principal owners of the Merchants' Police and District Telegraph Company, against which the injunction was directed. C.

Telephone News from the Northwest.

The Morrison County Telephone Company has arranged to secure long-distance service at Swanville and Grey Eagle, Minn., over the lines of the Minnesota Central Telephone Company.

The Tri-state Telephone Company expects to have its long-distance line from the Twin Cities connected with Grand Forks, N. D., by November 15th.

T. A. Jack has been placed in charge of the Minnesota Central Telephone Company at Park Rapids, Minn.

The Northwestern Telephone Exchange Company is about to make extensive changes in its pole system at Anoka, Minn., removing many of the lines to the alleys and clearing the streets as much as possible.

A telephone line is to be built from Dunbar, Mich., to Girard Junction by the Girard Lumber Company.

The Union Telephone Company has completed a local exchange for Finley, N. D.

The Dassel and Cottonwood Telephone Exchange Company has its new exchange at Dassel, Minn., in operation. It connects with the long-distance line of the Tri-state Telephone Company.

Representatives of 30 Independent telephone companies met at Janesville, Wis., last week and declared against any alliance with the Bell organization or any connections for toll service.

Fourteen Independent telephone companies of central Nebraska have organized the Central Nebraska Toll Association. The meeting was held at Shelton.

The Kiron (Iowa) Telephone Company has built a line to Boyn.

The Homdahl Telephone Company of Forest City, Iowa, has its line completed.

A new telephone line is being constructed from Wauko, Iowa, to Hanover.

The Midland Telephone Company of Milford, Iowa, is building a line to Lake Park and Spirit Lake.

The Citizens' Telephone Company will erect a modern exchange building at Racine, Wis., at a cost of $30,000.

The annual report of the Twin City Telephone Company shows that the gross earnings of the company for the last year are $434,570. Dividends on the $1,500,000 stock amounted to $85,000, and the net surplus was $101,244. R.

Southeastern Telephone Developments.

F. C. Toepleman, general manager of the Home Telephone and Telegraph Company, has cut in the system at New Bern, N. C. The local system has a modern exchange with an ultimate capacity of 800 subscribers.

The Southern Bell Telephone Company and the citizens of Greensboro, N. C., have about settled all differences as to rates. A committee of five will be selected to hear all complaints against the telephone company hereafter.

A 25-mile telephone line has been completed by the city of Lynchburg, Va., to connect with the city water-supply plant being built on Pedlar River. L.

GENERAL TELEPHONE NEWS.

The Citizens' Telephone Company has sold its plant in Trinidad, Colo.

The Filmore County Telephone Company has sustained a considerable fire loss at Geneva, Neb.

The Alvin and Angleton Telephone Company of Alvin, Texas, is extending its line to Friendswood.

The Whitewater Telephone Company has been incorporated in Whitewater, Kan., with a capital stock of $15,000.

The coast south of Monterey, Cal., is included in the plans of the Vantana Power Company for a telephone line.

The Pekin Co-operative Telephone Association of Pekin, Kan., has been incorporated, with a capital stock of $4,500.

The Home Telephone and Telegraph Company of Santa Monica and Ocean Park, Cal., has been incorporated with a capital stock of $250,000.

J. Sutton of Pasadena, Cal., acting on behalf of W. D. Porterfield, has applied to the trustees of Santa Monica, Cal., for a telephone franchise.

A. F. Stearns, C. L. Beckley and E. M. Brooks have been appointed by the Oakland Development League of Oakland, Ore., to solicit subscriptions toward installing a telephone system at that place.

The supervisors of Los Angeles County, Cal., have granted to Louis Blankenhorn a permit for a telephone and telegraph line in Cahuenga Valley, Ballona, Centinela and Santa Monica Road districts.

The lines of the Home Telephone Company of Kansas City, Mo., are being cut by strikers and considerable damage has already been done. The company has offered a reward for the arrest of persons cutting the line.

The Board of County Commissioners of Lincoln County, N. M., has granted a franchise to O. P. Pierson for a right-of-way to construct telephone lines in Lincoln County. A line between Capitan and Lincoln is to be in operation within 90 days.

A merger has been effected of the Telephone and Telegraph Company of New Jersey with the American Telephone and Telegraph Company of New Jersey under the corporate name of the latter company. The companies are identified with the Bell telephone system.

The trustees of Mill Valley, Cal., will receive sealed bids up to 8 p. m., December 20th, for a franchise to erect telegraph and telephone poles and wires and to transmit telegraph and telephone messages and electricity for light and power along some of the streets of Mill Valley, as applied for by the Mill Valley and Mt. Tamalpis Scenic Railway. S. H. Roberts is the town clerk.

The Michigan State Telephone Company has a gang of men in Marshall, Mich., fixing up the city line and also putting up poles for the farmers' line. When the Marshall Telephone Company (Independent) started in the Bell company lost nearly all of its business, but now that the exchange has passed into the hands of the Citizens' Telephone Company of Grand Rapids, the Bell is making a bid for business again. It will put in long-distance instruments in all business places, and is making contracts for free service until such time when it will have an exchange numbering 300 telephones.

A peculiar accident was reported in the daily newspapers of October 28th, in which a man by the name of Adams received a severe shock while conversing over a telephone at Indianapolis, Ind. He was talking over one telephone line when he came in contact with a telephone of another system, thereby receiving the shock. A prominent official of the Indianapolis Telephone Company asserts that the instrument belonging to his company was in perfect working order at the time of the accident and was found to be so early the next morning and that there was no possibility of the man having received the shock from the set of his company.

The Trouble Shooter.

Stories by the score—stories more wonderful than many adventures recounted by writers of fiction—might be told of the deeds of the telephone trouble shooters. Years ago there was a telephone pole line in the Mosquito Pass, far up the Rocky Mountains. The name of the place is singularly inappropriate in winter when the snow is often 20 feet deep. The pole line was frequently broken by storms and snowslides, although the stout poles were placed at distances of only 100 feet. To reach the pass over the snow when the winds howled and the thermometer was below the zero point, while at any moment tons of snow and earth mingled with great boulders might come tearing down the mountain side, was a task which called for the skill and the daring of the trained mountaineer. Men were always ready for the work. Perhaps they were not the most expert when it came to making electrical connections, but again and again they braved the perils of the pass and restored communication. A cable now stretches through that narrow defile. It is laid on the mountain rock and kept in place by piles of stone. It works as well when covered by 20 feet of snow in winter as when the hardy mountain grasses and flowers grow around it in summer; but men in the service of the Bell companies still tell of the days when the trouble shooters made their winter visits to the forbidding pass with the inappropriate name.

Even in the heart of great cities, during the storms of winter, the skill and ingenuity of the trouble shooters are often taxed to repair the damage done. There is a case on record where in the city of New York employes of the Bell Telephone Company strung their wires along the fences of residence streets, carried them over the roofs of ice-covered buildings, and when they encountered a church belfry took the line in through the window on one side and out through the window on the other. It was in the work of the trouble shooters, after a severe storm in Massachusetts, that, so far as known, fence wires were first used as part of a telephone line. The pole lines were down for a long distance, and to bridge the gap a cable was used, but it was not quite long enough, and then connection was made through the wires of a nearby fence to the point where the pole line was still standing.

Whether he wages his war with the elements in the snowdrifts of a northern winter, or the rush of swollen rivers in the season of freshets, the trouble shooter shows himself quick to adapt the means at hand to his purposes. During the floods at Kansas City, in the summer of 1903, the Missouri and Kansas Telephone Company of the Bell system was the only public-service corporation which continued business. Electric lights ceased to illuminate streets and buildings; as locomotives could not swim, railroad men gave up the attempt to run their trains; and boats took the place of the street cars. But the telephone managers, with the assistance of the trouble shooters, kept their lines working. When the wires were broken at one point they were promptly strung at another. Men in boats strung cables along a bridge, one span of which had disappeared. They had no sooner finished the work than the rest of the bridge went down with a crash, taking the telephone wires with it. Thereupon spars were erected, one on each side of the river, and wires were stretched between them. Service over these wires was maintained until cables could be strung across the piling of one of the ruined bridges.

The task of keeping up communication from bank to bank of the river was not the only one which kept the trouble shooters busy day and night. When the man whose office on the first floor of his establishment was under water began to do business in the second story, the telephone employes came in boats to put a telephone where it could be used without the necessity of diving. The young women who sat before the switchboards in one of the central offices of the company were carried to and from their work in rowboats. The company stood back of the force of trouble shooters and supplied the means to do the work required in the emergency. Its efforts were crowned with success, and the operation was pertinently described by the man who said, "In order to enable people to talk by telephone during the flood the company spent money like water."

The life of the trouble shooter offers a variety of experiences lacking in the ordinary occupations of life, and it possesses a fascination to some men which keeps them at the work so long as they are physically able to do it. Even the uncertainty of what he is to meet when he reaches the seat of the trouble adds interest to the work of the trouble shooter. Aroused from sleep in the middle of the night, perhaps with a snowstorm raging without, he dresses with the speed of a fireman, gets his kit and plunges into the darkness. Supported by a strap over his shoulder, the trouble man has on his back a set of telephone instruments which enable him to talk with the office when he has reached a point where he finds that the wires are broken. He carries a small coil of wire and another of rope. He has a pair of "come-alongs," an expressive name, because with these appliances he forces the ends of a broken wire to come together. The "come-alongs" consist of two small vices attached to each other with rope and tackle. He also has a supply of small copper tubes used in holding the wires in place while he is splicing

them, plyers for twisting and cutting the wires, a clamp used in the same operation, a hatchet, a screwdriver, a number of short pieces of copper wire, and several glass insulators. Most of these, with several other small articles, are fastened to a broad leather belt. To rings in the belt the trouble shooter fastens a strap long enough to go around the largest pole, so that when he reaches the top his hands may be free. The strap also prevents his making a quick return to the ground in case his spurs pull out of the wood, and for this reason it is called the safety. To this collection of glass, leather, and hardware are added the spurs which the trouble shooter straps to his feet to enable him to climb poles. He carries a weight almost equal to that of the kit of a soldier in heavy-marching order.

When he starts out to locate a break in the line the trouble shooter knows about where he will find it, for in every telephone office there is apparatus which will indicate pretty nearly where the trouble exists. To reach the place he may walk several miles through the snow or perhaps he goes on horseback. Often he is obliged to climb a number of poles before he finally locates and remedies the trouble. He cannot make his way skyward when encumbered by a heavy overcoat, and so he leaves it on the ground, although the temperature may be below zero. And very likely when he has retraced his way to the telephone office the trouble shooter finds that more trouble has been detected, and he immediately sets out on another trip.

All the troubles for which the trouble shooter goes on his hunting expeditions are not by any means due to the elements. There are places in the West where the frolicsome cow-puncher riding gaily to town seldom resists the opportunity to shoot up a few of the insulators on the telephone poles. The energetic small boy, when he finds that, by attaching it to a string and whirling it around his head he can lodge a tin can among the telephone wires, regards that as a pleasing diversion. It incidentally makes work for the trouble shooter, but the small boy very likely does not know that, and, possibly, if he does, would regard the sport as even more amusing.

Telephone cable lines make work for the trouble shooter. The lead sheath which encloses the cable must be perfectly airtight. An opening the size of a pinhole will make a section of cable worthless. To examine a cable suspended from poles, the troubleman travels along the line on a cable car—not the kind of a cable car which formerly ran in the streets of large cities, but a small seat suspended by rods from two grooved wheels. The wheels run on the wire rope to which the cable is attached, and, sitting in this car, the trouble shooter hauls himself from pole to pole, scanning the surface of the lead sheath. When he reaches a pole he lifts his car around it and resumes the journey he is making through the air.

Even the cables buried in conduits under the city streets often help to keep the trouble shooter busy. Many curious accidents have happened to these cable lines. Once in the city of Denver it was found that an underground line was not working. The instruments at the central office located the trouble in a section of the cable which extended beneath an alley. The troubleman went there, but could see nothing wrong. It was evident that the pavements had not been disturbed for a long time, and there was nothing above ground which indicated that anything was wrong. Repeated tests showed that the trouble was in that locality, and finally a trench was dug, and it was then found that an iron pipe had been driven through the conduit. The owner of a building on one side of the alley had made a contract to heat a building on the other, and the soil being soft, the steam pipe had been driven through it, smashing the conduit and destroying communication through the cable.

Without the trouble shooter and his works the telephone service would be frequently interrupted. With his assistance the Bell telephone companies wage a never-ending war against destructive elements. Often he repairs the broken line before the subscriber, whose telephone is at the end of it, has occasion to use the instrument. In the case of a conflagration, such as that which swept away a large portion of the business section of the city of Baltimore, the trouble shooters are at work before the ruins have cooled, so that the business men who are burned out may have telephone service as soon as they have found temporary quarters.—From a booklet distributed at the Bell telephone booth at the St. Louis Exposition.

The Wellington and Cowley County Traction Line has been incorporated with a capital of $500,000, to construct lines centering in Wellington, Kan.

Automatic Telephone Exhibit at the World's Fair.

The Automatic Electric Company of Chicago announces that the jury of awards of the Louisiana Purchase Exposition has awarded the grand prize to its exhibit of automatic telephones and switchboards. This award is for general excellence in group 70, which includes all forms of telephone switchboards, telephones, telephone apparatus, appliances, appurtenances and supplies.

The Automatic Electric Company is the only Independent telephone manufacturer to receive the grand prize, which is the highest award in the power of the Exposition officials to make.

The company's exhibit is one of the most interesting and noteworthy in Electricity Building. It occupies a conspicuous position in Section 24 and is housed in a finely appointed pavilion of its own. An interior view of the pavilion is shown in the accompanying picture. The exhibit proper consists of a complete automatic telephone exchange of the 10,000 type, divided into two switchboards and having power equipment and all other accessories. To this exchange is connected a large number of telephones scattered throughout the exhibit and Electricity Building. The automatic service has been in constant use by the officials of the electrical building since the opening of the Fair. The exhibit is in charge of Harry S. Durant of the sales department of the Automatic Electric Company, assisted by James Strasburg of the mechanical department.

AUTOMATIC TELEPHONE EXHIBIT AT THE WORLD'S FAIR.

Infringement Litigation on Scribner-McBerty Patent.

Judge D. J. Hazel of the United States Circuit Court, Western District of New York, in a lengthy opinion sustains the Rochester Telephone Company as defendant in the suit brought by the Western Electric Company to establish infringement by the defendant of certain claims of United States patent, No. 559,411, granted in 1896 to Charles E. Scribner and Frank R. McBerty and subsequently assigned to the complainant.

The invention relates to improvements in signaling apparatus for telephone switchboards, and, as the specification states, particularly concerns "a mode of operating the signals for connection and disconnection upon a switchboard in which the signals are controlled by relays in the line circuit actuated in the use of the telephones at the sub-stations." Its object is "to provide means for operating the signals for disconnection and to prevent the waste of current through these signals while they are not in use.

After reviewing the evidence in the case and the merits of the invention at length, Judge Hazel concludes: "Steps forward in the art of telephony are but natural results of the persevering experimenting of the many skilled electricians constantly engaged in adjusting and adapting familiar principles to new objects and uses. Every advance is not entitled to patentable distinction. Careful consideration has been given all the evidence and especially that of Professor Jackson, Mr. Dunbar and Mr. Dean, upon the questions of anticipation and want of invention. These defenses are established by preponderating evidence. The substitution by the complainant as a supervisory signal organization of the familiar line-signal organization, for the foregoing reasons, has not sufficient merit to entitle it to the protection of the patent law. The presumption of validity to which the patent is entitled by virtue of its issuance is outweighed, and the Scribner and McBerty patent, though of superior utility, is, nevertheless, devoid of invention. My conclusion is that the application of the principle of the O'Connell patent to the subscriber's line was a mere improvement without involving the exercise of inventive faculty. Other questions presented on argument need not be considered. The bill should be dismissed with costs."

Neutralizing Winding for Transformers

In transformers so designed that the current flows into or out of the middle or other intermediate point of a winding it is necessary that the current flowing in one portion of the winding toward or from the middle point should neutralize in its magnetic effects the current flowing to or from the middle point in the other portion of the winding. This neutralization is ordinarily sufficiently complete in the case of the shell-type transformer if the point at which the current enters is central in the winding space. In the core-type transformer, however, one-half of the winding is placed on one leg of the core and the other half on the other leg. This means that the reactance between the two halves of the winding is very high and that the magnetic effect of the currents in the two halves of the winding would to no great extent be neutralized when the currents in the two halves differ appreciably in value. The desired result may be secured by making use of multiple-connected windings co-operating with the first-mentioned windings, these windings consisting of two coils on each leg of a transformer, the coils on one leg connected, respectively, in series with the coils on the other leg. The two pairs of sets of coils are then connected in multiple with each other, due to which arrangement any inequality of current between the two halves or portions of the first-mentioned winding has its magnetic effect distributed equally to each of the legs of the transformer core through the close inductive relation of the multiple-connected coils, which may act as either secondaries or primaries with respect to the winding.

These features form the basis of a patent recently issued to Walter S. Moody of Schenectady and assigned by him to the General Electric Company.

Fig. 1 is an illustration of one of the various embodiments of which the principle is capable, while Fig. 2 is a simplified diagram of circuits.

In the particular system of phase transformation shown in the diagram a primary, or, it may be, a

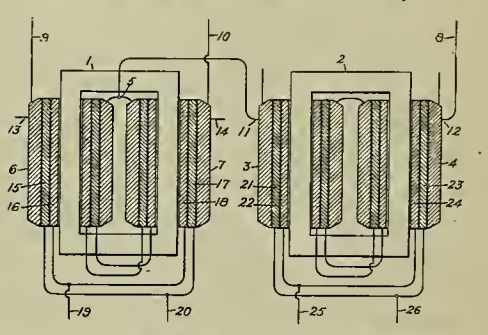


FIG. 1. NEUTRALIZING WINDING FOR TRANSFORMERS.—SECTION OF WINDING.

secondary, of one transformer has one of its terminals connected into the middle point of a corresponding primary or secondary on another transformer. The three remaining terminals are connected to leads, which form a vehicle for three-phase currents. The remaining windings on the two transformers carry quarter-phase currents. The transformer which has one of its windings connected into the middle point of a winding on the other transformer has received the name of "teaser," the other transformer being called the "main" transformer. For purposes of interchangeability these transformers are made identical in construction; but each is provided with taps in its windings, so that it may serve either as a teaser or as a main traansformer.

In Fig. 1 the main transformer has its core indicated at (1), and the teaser has its core indicated at (2). The teaser winding consists of two coils (3 4) on the respective legs of the core (2), these coils being connected in series with each other, with one terminal leading to the junction (5) between two coils (6) and (7), similarly arranged on the core (1) of the main transformer, and the other terminal to one of the three-phase mains or leads (8). The remaining three-phase leads are connected to or constitute continuations of the terminals of the windings, as indicated. The teaser winding requires to be of less voltage than the voltage of the winding (6 7) of the main transformer, for which reason the terminals of its coils when the latter are used together as a teaser winding are brought out from the winding at short distances from the ends, as indicated at (11) (12). The windings of the main transformer are provided with similar taps, so that less than the whole winding may be utilized in case the transformer is used as a teaser.

On each leg of the core of the main transformer are provided two secondary windings. The inside coil on the one leg is connected in series with the

outside coil on the other leg of the core, the remaining coils, which are respectively outside and inside coils, being also connected in series with each other. The two sets of coils thus cross-connected are joined in multiple with each other across two of the quarter-phase mains (19) (20). The four secondary coils (21) to (24) inclusive on the core of the teaser transformer are similarly connected to the remaining two-phase mains.

The relations of the windings, which are shown in cross-section in Fig. 1, may perhaps be rendered a little clearer by reference to Fig. 2, in which the teaser and main windings are represented at (3 4) and (6 7), respectively. The corresponding secondary windings on the main transformer are indicated at (15) to (18), inclusive, while the secondary windings on the teaser transformer are similarly indicated at (21) to (24), inclusive.

By reference to Fig. 2 it will be evident that idle current flowing in the main winding on either side

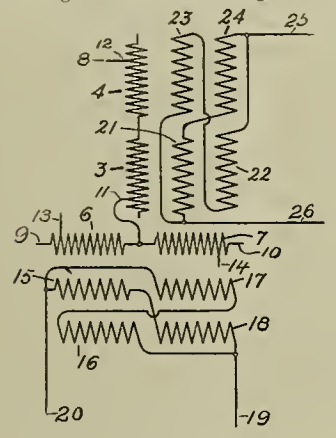


FIG. 2. NEUTRALIZING WINDING FOR TRANSFORMERS.—DIAGRAM OF CONNECTIONS.

of the junction must operate inductively upon the adjacent secondary windings, thereby giving rise to a corresponding flow of idle current in these windings. The idle current thus generated in the windings on one leg of the transformer necessarily flows in the corresponding secondary windings upon the other leg of the core, the secondary windings on one core leg being respectively in series with the corresponding windings on the other leg of the core. The equalization of the magnetizing effects of the primary windings (6) and (7) thus prevents the flow of lagging current in them from raising the voltage in one winding and lowering it in the other, as would otherwise take place without the use of the means indicated for neutralizing the effects of the currents of the two windings. The connections between the windings (21) to (24) of the teaser transformer are not necessary when the transformer is used as a teaser.

Electrical Generating Stations and Transmission.[1]

By L. B. Stillwell.

* * * * The substitution of a trolley potential of not less than 2,000 volts for the normal, continuous-current trolley potential of 550 volts, which becomes possible by adopting the alternating-current motor, practically avoids the difficulty which the converter system of supply encounters in dealing with conditions of congested traffic. In the case of the converter system, such congestion as frequently occurs in railway traffic implies load upon adjacent sub-stations, which, in extreme cases, may amount to several times the normal load upon these stations, and provision for such congestion involves, therefore, the installation of sub-station apparatus and of distributing circuits to and from the sub-stations greatly in excess of the apparatus required for conditions of normal operation. The use of alternating-current distribution at 2,000 volts (or more) from the transformer sub-stations provides naturally and automatically for temporary concentration of the power supply normally distributed over a considerable section of the line.

Should experience demonstrate that it is practicable to use in regular operation trolley potentials as high as 12,000 volts, which was the potential used in the trials at Zossen, a railway of some length, e. g., 30 or 40 miles, could be supplied economically without the use of either step-up transformers at the power house or step-down transformers along the line, the only transformers required being those carried upon the locomotive or motor car and used for the purpose of reducing the trolley voltage to a potential suitable for motor operation, and it is even possible that these transformers also may be dispensed with. On the other hand, if the simple, efficient and comparatively cheap transformer be used in power house and sub-stations, there appears to be no reason in general why 50,000 or 60,000 volts should not be used in the transmission circuits, and the adoption of a higher transmitting potential implies at least corresponding increase in the economical radius of transmission, and, therefore, in the length of track that can be supplied with power from a single generating station. It is not transcending the limits of conservative engineering statement to say, that today the art of generating and transmitting electricity and the art of utilizing energy thus transmitted for traction purposes are such that sections of trunk-line railways, 300 miles in length, can be supplied economically, and operated from a single power house located midway between the ends of the section.

* * * *

During the last decade the accepted principles of plant organization in the case of continuous-current apparatus have not materially changed. The average size of the generating unit has increased, and the size of the largest available generating units has about doubled, i. e., the largest continuous-current units today approximate 2,700-kilowatt output, while the largest in commercial use 10 years ago were about half that rating. The average size of continuous-current installations also has grown materially, installations aggregating 10,000 kilowatts being not uncommon. The largest installations of this class, however, up to the present time, do not exceed about 15,000 kilowatts.

Practically every installation of this class operates its dynamos in parallel, as has been the custom from the earliest days of the electric-lighting and power industry. In the organization of alternating-current plants, parallel operation is now recognized as correct practice, and is almost invariably adopted in important installations. Ten years ago, while it was recognized as theoretically the correct method of operation, it had not been adopted generally, owing to practical difficulties encountered in obtaining sufficiently uniform rotation, in cases where reciprocating engines were used as the prime movers, and in adjustment of governors to secure proper division of the load. This latter difficulty was encountered not only in the case where alternators were driven by steam engines, but also in cases where hydraulic turbines were used to supply power. The plant installed by Ganz & Co., in Rome, was operated in parallel from the start, but, at least for a time, the governors of engines, driving the alternators which operated in parallel, were mechanically connected, and in synchronizing one dynamo with another, banks of lamps were used to adjust the load and consequent speed.

In America the first alternating-current plant operated in parallel was that at Greensburg, Pa., and it was so operated for a time as early as 1887. The results, however, were not very satisfactory, owing to difficulty in securing a proper division of the load, and this method of operation was not adopted in America in any important plant until the installation of the Niagara Falls Power Company began commercial operation in 1895. The 7,500-kilowatt alternating-current plant used to light the Chicago Exposition comprised 10 two-phase machines operating at 60 cycles per second. They were not operated in parallel, and a very elaborate and complicated switchboard was used to permit the use of any one of the alternating units in supplying any one of the numerous distributing feeder circuits.

The frequency used by Ganz & Co., in Rome and elsewhere, was 42 cycles per second. That used in the case of the Greensburg plant and many other American plants prior to 1890 was 133 cycles per second. That used by the Niagara plant was 25 cycles per second.

Reduction in frequency, as is well known, facilitates parallel operation particularly in respect to the act of synchronizing, i. e., connecting in parallel, with one or more alternators already in operation, another alternator which it is desired to put into service.

Nearly all important alternating-current plants installed during the last decade operate their dynamos in parallel. The ease and certainty with which this highly important method of operation is now utilized are direct results of the painstaking and scientific work of the designers and builders of the many excellent steam engines now available. * * * *

Any extended reference to the relative use of steam turbines and reciprocating engines would be outside of the intended scope of the subject, but it is difficult to discuss the comparative features of dynamos driven by turbines and those driven by reciprocating engines without including a few general statements relative to these respective prime movers. In the popular mind, and apparently also in the minds of some engineers, the great advantage which may be expected to result from the substitution of steam turbines for reciprocating engines is reduction of space occupied. In marine work the reduction in dimensions and weight is of the utmost value. On land it is far less important. That the substitution of turbines for reciprocating engines will, in general, result in some economy of space occupied is to be expected, but it is pertinent to remark that, up to the present time, comparison of the areas covered by some of the most important plants recently designed and using, respectively, these two classes of engines, does not support the view that the turbine effects any very material economy in this direction. In engineering matters generalizations are almost invariably liable to exception, but it will be admitted probably that, in so far as this comparison is concerned, vertical space is not very expensive; the difference in height of the turbine-driven unit and the unit driven by the reciprocating engine affects only the height of the engine room, and this difference involves no material difference in cost. The essential question, so far as space occupied is concerned, therefore, appears to be the relative area occupied by plants of the two classes comparable in output and in the number of decks and boilers. A comparison may be made, for example, between the plant of the Manhattan division of the Interborough Rapid Transit Company in New York city and the plant now under construction in Chelsea, London, for the London Metropolitan Underground Railway Company, the alternators for both of these plants having been supplied by the same manufacturer. In both of these plants two decks of boiler are used. The power house of the London company covers an area of 84,960 square feet. It is designed to contain 10 turbine-driven units rated 5,500 kilowatts each and two units rated 2,000 kilowatts each. The ground space occupied, therefore, is 1.44 square feet per rated kilowatt.

The power house of the New York company covers an area of 85,072 square feet, and contains eight alternators driven by reciprocating engines. The corresponding rating of the alternator unit of each type is 5,500 kilowatts, and the writer believes it safe to say that the generating unit used by the New York company is able to take care of any overload to which the turbine-driven unit is adequate. The area covered by the New York power house is 85,072 square feet, and the area per rated kilowatt output, therefore, is 1.93 square feet.

To make the comparison more fair the two units of 2,000 kilowatts each, included in the design of the London station, should be excluded, for it would have been possible to install in the New York plant units of similar output, similarly located and driven by reciprocating engines, had the use of auxiliary units of relatively small output appeared desirable to the engineers who designed that plant. Making the deduction of 4,000 kilowatts of the Chelsea plant, the areas per rated kilowatt output become for the London plant 1.55 square feet and for the New York plant 1.93 square feet per kilowatt.

The most conspicuous examples of power houses using but one deck of boilers are those recently erected, respectively, by the Chicago Edison Company and the Interborough Rapid Transit Company, New York city, the latter being located on the North River, between Fifty-eighth and Fifty-ninth Streets. The ground space covered by the Chicago plant, including switch rooms, is 171,000 square feet, and its ultimate equipment will comprise 14 5,000-kilowatt turbines. The space occupied is, therefore, equivalent to 2.44 square feet per rated kilowatt. The ground space occupied by the plant of the Interborough Rapid Transit Company is 692 feet long by 200 feet wide, and it is designed to contain 12 units driven by reciprocating engines. These units were purchased under specifications calling for 5,000-kilowatt machines, but they are rated by the manufacturer 5,500 kilowatts. If the former rating is taken, the space occupied per kilowatt output is 2.30 square feet, or, if the manufacturer's rating is accepted, it is 2.09 square feet. It appears, therefore, prima facie, that the use of the turbine does not imply material economy in dimensions of the site requisite for a large electric power plant, and it is probable that an accurate comparison, having reference, not to rated output of the generating units, but to actual safe output under operating conditions, would show results even less favorable to the steam turbine. Accurate data regarding ability of the turbine units to carry overloads with good economy and without excessive temperature, however, are lacking, since no large turbine-driven plant hitherto has been operated under commercial conditions adequate to determine satisfactorily its limitations in respect to overload.

In connection with this subject, it should be noted further that the importance of increasing the ratio of output to ground space occupied has been apparently largely exaggerated in the minds of many who have written upon the subject. Exceptional cases have arisen and will occasionally arise where power houses must be located upon extremely expensive sites. With alternating-current transmission, however, such cases are extremely rare. Instances in which a price higher than $6 per square foot has been paid for land used as a site for a large alternating-current plant are infrequent, and a moment's consideration will show that at this price no material crowding of expensive machinery is justified. At $6 per square foot the saving effected by reducing the area per kilowatt from 1.93 square feet to 1.55 square feet per kilowatt—the respective figures for the New York and London plants previously referred to—is $2.28 per kilowatt. This difference, be it remembered, is invested in land and at four per cent. per annum represents nine cents per rated kilowatt per annum. Something should be added for taxes, but no allowance need be made for depreciation. On the contrary, the value of land in cities is almost uniformly increasing from year to year. Making every reasonable allowance, it appears safe to say that the saving effected will not amount to more than 10 cents per rated kilowatt per annum, and for a 40,000-kilowatt station, like the Manhattan, the

1. Extracts from a paper presented in Section F of the International Engineering Congress at St. Louis, October 5, 1904. The author is a consulting electrical engineer in New York city. The paper is a review of progress during the last decade.

limit of the saving that might be effected by a reduction of 20 per cent. in ground space occupied is $4,000 per annum. This is less than one-half of one per cent. of the cost of operating the Manhattan power house. Special cases will arise where ground space occupied must be rigidly economized, and this can be done when necessary, whether engines or turbines be used: e. g., the Thirty-eighth Street plant of the New York Edison Company, which is designed for a rated ultimate output of 56,000 kilowatts, occupies less than 54,000 square feet, i. e., less than one square foot per kilowatt.

That the turbine possesses no very material advantage over the vertical reciprocating engine in respect to ratio of output to area of power houses is due, of course, to the fact that the vertical reciprocating engine occupies but a small fraction of the total area of the plant; general features of plant organization being similar, the spacing of the boilers usually fixes the proper centers for the engines or turbines, and such advantage of the turbines as it possesses in respect to floor dimensions is partially, if not wholly, offset by the increased size of the condensers.

If the steam turbine ultimately supplants the reciprocating engine in electric power plants, the change will be made not because there is any controlling difference in the ground space occupied, but by reason chiefly of other and more important advantages. Among these may be mentioned the fact that the turbine is comparatively a very simple mechanism without reciprocating parts. It is comparatively small and light, and in due time will be relatively cheap. Its high speed also tends to reduce materially the cost of the direct-connected dynamo, as has been shown in this paper. The advocates of the turbine also claim important fuel economy, particularly under variable loads, but this claim has not been effectively substantiated in commercial service. The foundations required for turbines are much less expensive than those called for by reciprocating engines.

As regards transmission of continuous current used for lighting and general power purposes, underground circuits in large cities of the United States and in many important towns of less size have, in very large degree, displaced overhead circuits. Improvement in quality and reduction in cost of insulated lead-sheathed cables have resulted from the competitive efforts of many manufacturers in America and Europe, and these improvements, in connection with the development of higher esthetic standards in urban communities have resulted in a gratifying reduction of the amount of overhead construction in this class of service. In connection with continuous-current distribution for the operation of electric street-car service, relatively less progress in substituting underground for overhead construction has been made, but in some of the most important cities, notably in Washington and in the Borough of Manhattan, city of New York, the greater part or all of the street-car service is supplied without any overhead construction whatever. In a number of cities, while the overhead-trolley wire is used, the feeder circuits in whole or in part have been placed underground.

Transmission by alternating currents has undergone remarkable development in the last 10 years. Power to the amount of 10,000 kilowatts, developed by mountain streams, is transmitted to cities and towns in California located at distances ranging from 154 to 218 miles from the generating stations. These plants use 40,000 volts for the transmitting circuits. Buffalo is supplied with more than 18,000 kilowatts from Niagara Falls. Montreal is receiving power from the Shawinigan Falls over circuits 85 miles in length, operating at 50,000 volts, and the plant of the Guanajuato Power Company in Mexico is successfully delivering power over circuits 101 miles in length, and operating at 60,000 volts.

Transmission plants which 10 years ago would have been regarded as remarkable now attract little or no attention, as they are successively placed in commercial operation. Lists of alternating-current transmission plants recently furnished by the three leading American companies manufacturing this class of apparatus, show that they have installed in the United States, Canada and Mexico, 447 plants, aggregating 734,123 kilowatts output. The potentials range from 125 to 60,000 volts, and the distances of transmission vary from a few feet to 218 miles. The limits of this paper forbid even brief reference to very many points of interest; only a few of the more salient and important facts can be mentioned.

The highest potential in commercial use is 60,000 volts; the longest distance over which power is electrically transmitted is 218 miles. The largest copper conductors used in America for overhead transmission at a potential exceeding 20,000 volts are of 350,000-circular-mil section, and the largest aluminum conductors similarly used are of 500,000-circular-mil section.

An idea of the range and efficiency of electric transmission, using potentials now in commercial use, conductors of sizes now in commercial use and transmitting power to the maximum distance thus far attained in commercial operation, may be conveyed by the statement that at 60,000 volts a three-conductor circuit comprising three copper conductors of 350,000 circular mils each will transmit 7,500 kilowatts (10,000 electrical horsepower) a distance of 218 miles with a loss in the transmitting circuits which, making due allowance for the wattless component of the current, will not exceed 10 per cent.

CORRESPONDENCE.

Great Britain.

London, October 26.—Just as Dublin is at present probabaly the most conspicuous town in the United Kingdom by reason of its municipal electric-light works, so a few years ago all eyes were more or less turned toward Salford, where bad management had brought the undertaking to the verge of bankruptcy. Things reached such a pitch that a special inquiry was held by Judge Parry, with the result that certain reputations were more or less damaged and a determined effort made by a new staff to put the works in a sound financial position. All this happened about two years ago, and since then remarkable progress has been made. The accounts of the electricity supply business in Salford for the last 12 months showed that there was a gross profit of nearly $215,000, and after extinguishing a deficiency of $12,500 on the previous year's accounts and also providing for interest and redemption of loans $40,000 has been placed to depreciation account and $7,500 to the relief of the rates.

On the other hand, considerable excitement still exists in Dublin over the municipal electric-supply business. The offer by the consulting engineer to take over the works and run them for the corporation under certain conditions has been rejected by the lighting committee and a sort of compromise patched up between the resident engineer and the consulting engineer. Things had remained in this condition for a few weeks, when the excited feelings of the anti-municipalists found another opportunity for an outburst when it was announced that a further loan was to be applied for in order to carry out certain necessary works which, it is contended, were provided for in the original estimates. At the inquiry concerning the details of the loan the anti-municipal taxpayers were legally represented, and the line of cross-examination of the corporation officials was to show that at present, for some reason or another, the undertaking was selling at an average price per unit less than the cost of generation. It was admitted that the rates in Dublin had increased by five pence on the pound, owing to the loss on the electrical undertaking. At the close of the inquiry the inspector of the sanctioning authority reserved his decision.

The question of the evolution of a gas turbine is only of indirect interest to electrical engineers, especially in view of the comparative youth of the steam turbine as applied to driving dynamos. That efforts are being made to go a step further, however, is interesting, as no doubt the possibilities are great. At present no one on this side has attempted to make an actual gas turbine, but a paper read last week by Mr. R. M. Neilson before the Institution of Mechanical Engineers indicated the difficulties which had to be overcome and some efforts made to surmount them. From this it would appear that the first obstacle has proved to be the compression of the mixture of gas and air to form the charge; another the shape of the nozzle through which to apply it, and thirdly, the method of applying the charge to the turbine. More than this cannot be gone into here, but the paper in question should be undoubtedly interesting to those studying in this direction.

For many years the London County Council has sought powers to build an electric tramway along the Thames embankment, a fine highway running parallel with the River Thames for about two miles. In many people's minds a tramway along here would relieve the considerable pedestrian congestion which exists along the Strand, while on the other hand there is a large number of persons against the proposal for æsthetic reasons. On every occasion when the council has applied to Parliament for powers to build this tramway it has been rejected by but a few votes, and once by only one vote. It is now announced that yet another effort is to be made in the next session of Parliament, and although the council's efforts to improve locomotion are to be applauded, yet the bill of parliamentary costs incurred upon abortive schemes yearly gives one something to think about.

On several occasions in these notes reference has been made to the large development in the application of electricity in mining operations. As a consequence many English firms have devoted their energies to this class of plant and orders are now being received not only for British but also for foreign mines. The manufacturing firms interesting themselves in this class of work are for the most part situated in the mining centers, and one of the largest Tyneside firms has just received a contract for the electrical equipment of the Alquife mines in the south of Spain. Pelton waterwheels and three-phase generators will be installed, the current being transformed from 500 volts to 5,500 volts for transmission to the mines, a few miles away.

One or two matters of detail respecting tramway systems in this country may be interesting. In the larger municipal services the use of covered-in top decks to the double-deck cars is now quite the fashion, and a large number of smaller authorities are only awaiting the results of the experiments in the larger cities to make up their minds one way or another. In Bradford, too, the use of chilled iron wheels is being discarded in favor of steel wheels, the reason being a possibility of a saving in maintenance and repairs.

The annual meeting of the Underground Electric Railways Company of London, of which Mr. C. T. Yerkes is chairman, was held a few days ago. As might be expected, the chief topic of his address was the condition of the huge generating station at Lot's Road, Chelsea, which is to supply the District railway as well as the four-tube railways with which the Underground company is also associated. It is expected that trains will be running by January 1, 1905. The generating station is consequently in a forward condition. Provision has been made for 10 batteries of eight boilers, but at present eight batteries only are being erected. Westinghouse-Parsons steam turbines coupled to 5,500-kilowatt three-phase generators are also being installed. Delay has been created by manufacturers of the generating plant and also by the car builders, and by the difficulties encountered in converting the District railway steam lines, which has to be carried out during the few hours between the last train at night and the first in the morning. G.

New York.

New York, November 5.—The New York subway has now been in operation for nine completed days, and for the most part the handling of the traffic has been extremely satisfactory. During the first complete week it is announced that no less than 2,000,000 passengers were carried. On Sunday there was an exceptionally large crowd of curious sightseers. The few delays and mishaps that have occurred have been mainly due to the difficulty of handling the crowds. One or two motors have broken down, leading to temporary stoppages on either the express or the local lines, but never on both at the same time. Two or three workmen have also been killed or injured. A strong suggestion is made to open an additional express station at Times Square on Forty-second Street and Broadway. The first few days traffic was, of course, abnormal, but there are signs that the regular up and downtown passengers are redistributing themselves on the surface and elevated lines, and it is probable that after a few weeks there will be no actual falling off of receipts on the older lines.

It is promised that the line between One-hundred-and-forty-fifth Street and One-hundred-and-fifty-seventh Street will be opened for regular traffic in the coming week, the official inspection of this section having been completed. It is also expected that the lower Broadway section from City Hall to the Battery will be ready about March, 1905.

The advantages and disadvantages of the subway are being thoroughly well discussed. There seems to be good ground for the criticism that the ventilation is defective, and Dr. August Seibert has published the results of careful analyses of the subway atmosphere at various points, showing that it is deficient in oxygen.

The opening of the subway has made the crush at Brooklyn Bridge worse than ever during certain hours, due to the greater number of passengers arriving at City Hall. The solution of this problem is farther off than ever, and it will not be properly solved until Brooklyn Bridge is rebuilt. The various schemes under way for enlarging the Manhattan terminal are only palliative.

Trolley cars for passengers began running over the Williamsburg Bridge on Thursday morning without previous public announcement. This service, however, was only tentative, and the regular service was commenced for 13 lines of Brooklyn cars on Friday morning, on which day rather more than 1,000 cars crossed over. A few technical difficulties have been encountered in dealing with this traffic. The schedule time for crossing the bridge is 4½ minutes, but up to yesterday this time had not been made.

One of the railroad tunnels under the Hudson River is now completed and ready for the laying of the rails. It is anticipated that the second tunnel will be completed in June, 1905, and that electrical-railroad intercommunication between New York and Jersey City will be an accomplished fact before the end of next year.

Following some representations of the electrical expert of the Merchants' Association, the Brooklyn Rapid Transit Company will put on six additional trains on the Kings County elevated line.

New York electrical workers to the number of 1,600 have formed an association—among other purposes for the averting of strikes in their industry.

Rupert Hughes, a Yale graduate, well known in New York and London as a poet, playwright and novelist, has been appointed editor of the Marconigram. Hitherto this publication has been issued in the interests of the Marconi company, but in future it will appear as a popular monthly magazine devoted mainly to the newer phases of electricity.

The New York Telephone Company has made complete and practically perfect plans for its election-news service. A temporary telephone exchange has been installed in Gold Street, connecting with 100 stations. Election results will be supplied to the general public on payment of the ordinary charge for calls. D. W. W.

New England.

Boston, November 5.—In accordance with a decree of the Massachusetts Supreme Court in the suit of the Massachusetts Construction Company against the New Hampshire Traction Company $:70,000 first-

lien 4½-per cent. bonds and 2,363 shares of stock of the Traction company were sold at auction recently. The purchaser was W. D. Drummond of New York, representing the New York Security and Trust Company, and his bid was $100,000.

The directors of the Edison Electric Illuminating Company of Boston met on Thursday and voted to issue 10,450 shares of new stock at $200 each on the basis of one share of new for every 10 shares held, and a meeting of stockholders is called for November 18th to act on the increase. I. Tucker Burr has been elected a director in place of C. Henry Barnes, deceased, and George A. Silsbee becomes a member of the executive committee.

Alderman Quigley of the Boston board is after the Edison Electric Illuminating Company for a reduction of rates. At this week's meeting of the aldermen he introduced an order requesting the mayor to petition the Massachusetts electric-light commissioners to order the lighting company to reduce the price of electricity to the city 50 per cent. and to other consumers 25 per cent. The order was tabled and is regarded as an election move by most of the people interested.

The Boston Elevated railway is making preparations for the running of five-car trains by lengthening the platforms of the stations. The changes in the subway stations involve difficult problems for the engineers and the extension of the platforms will be very narrow at best. The changes are not in the nature of permanent improvements, as the platforms will have to be rearranged again when the elevated trains are removed to the Washington Street subway, probably about three years hence. B.

Southeastern States.

Charlotte, N. C., November 5.—The Durham (N. C.) Traction Company has made a proposition to build a 12-mile electric line to Chapel Hill, N. C., if the citizens of the latter place will petition the Legislature to abolish the present steam line. The proposition is said to be favored by the town of Chapel Mill.

The power house for the new water and electric-light plant at Batesburg, S. C., has been completed.

The town of Tennile, Ga., has voted a bond issue to raise funds to improve the waterworks system and to buy an electric-light plant.

The Broad River Light and Power Company, with $1,000,000 capital, has been commissioned, with headquarters at Union, S. C., where it is proposed to develop a fine waterpower on Broad River. The incorporators are mostly from Charleston, S. C., and include J. H. Dingle, F. K. Myers, M. V. Haselden and others.

At Newman, Ga., an election has been carried in favor of bonds for the purchase of the Newman Light and Power Company's plant to be operated by the city of Newman. L.

Ohio.

Cleveland, November 5.—Connection was made between the Lake Shore Electric and the Detroit, Monroe and Toledo Short Line at Toledo a few days ago, and now it is possible to make the trip from Cleveland to Detroit, with change of cars at Toledo. From Erie, Pa., to Port Huron, Mich., the distance is 325 miles. It will possibly be but a short time until arrangements are made so that a through trip can be made by electric car.

It is said that over four-fifths of the claims against the Miami and Erie Canal Transportation Company have been bought in by members of the committee appointed for that purpose. It is thought that the remainder of the claims will be settled within two weeks, and the matter will then be straightened out.

For the second time, Fred Greene, receiver of the Springfield and Xenia Traction Company, failed to sell the property at auction. It is said he will ask the court for a lower appraisement, when it is thought representatives of the Bushnell syndicate will buy it in.

A mortgage for $2,500,000 in favor of the Mercantile Trust Company of New York has been filed by the Columbus, Delaware and Marion Railway Company, and a second mortgage is given to the Standard Trust Company to secure $300,000 of bonds payable in 1934. The Columbus Railway, Power and Equipment Company has also given a mortgage to the Standard Trust Company to secure an issue of $300,000 of bonds. This is an auxiliary of the railroad company, and the money will be used in improvements.

The earnings of the Columbus, Buckeye Lake and Newark Traction Company for September show an increase of nearly $4,000 over the same month last year.

Receiver Bishop of the Eastern Ohio Traction Company is quoted as saying that the plan of securing funds by an assessment is not progressing as rapidly as could be desired.

The Detroit, Monroe and Toledo Short Line has put through cars in operation between Toledo and Detroit. Within a short time a schedule of two hours and a half will be put on. Later it is expected that limited cars will be operated to make the trip in two hours. The distance is 58 miles. The road is built on private right-of-way and has standard steam-road construction.

The Cleveland and Southwestern Traction Company now has in operation an automobile repair wagon. It is operated with gasoline motors and weighs between 700 and 800 pounds, so that two men can remove it from the track when necessary. It is built for a standard-gauge track and will carry enough water and gasoline to run 100 miles. It will be used for hurry runs where repairs are needed.

Officers of the Cincinnati, Georgetown and Portsmouth Railway Company were elected a few days ago, W. A. Comstock being chosen president. An extension is now being built to Russellville, and the road will be extended to West Union.

Estimates show that the daily car mileage of the suburban roads entering Cleveland is 33,000. The Lake Shore Electric has the largest car mileage of any exclusively suburban road, 9,000 miles. The Northern Ohio Traction and Light, including the Akron business, has a daily mileage of 11,650 through the summer season. The Cleveland and Southwestern has 7,500 miles; the Cleveland, Painesville and Eastern, 2,600, and the Eastern Ohio, 2,250.

E. E. Spring, superintendent of the Dayton and Piqua, delivered an address before the Commercial Club in Dayton on "Traction Lines as City Builders" a few days ago. He said the traction lines carry an average of 205,000 passengers a month in and out of Dayton. The talk was largely along the line of what the roads had done for the home town. O. M. C.

Michigan.

Detroit, November 5.—The Detroit, Ypsilanti, Ann Arbor and Jackson electric line, which has formed a consolidation with the Jackson Consolidated Traction Company, has now in operation the largest interurban line in the state—in fact, it might be termed the electric trunk line of the state. In addition to the doing away of possible competition between Detroit and Jackson, the merging of these lines has brought within the range of possibility a further consolidation of interurban lines throughout the state and their extensions. The policy of development of this system is to be controlled by an executive committee of the directors of the two lines and a representative of Coler & Co., New York bankers. It is stated that the line from Ypsilanti to Saline will be extended to Adrian and the Jackson line built on on to Lansing. The Jackson-Kalamazoo line has changed its schedule so as to connect with the cars of the Detroit, Ypsilanti, Ann Arbor and Jackson, thus making practically a continuous journey between Detroit and Kalamazoo possible with a change of cars at Jackson. The general offices of this system will be moved to Ypsilanti, where a large building is being added to and improved.

After a long discussion by the Pontiac council it failed to take any action in granting a franchise to the Detroit-Bay City Traction Company. It is stated that the Traction company threatens to put is road through some other town and leave Pontiac out. The new line proposes to do a general freight and passenger business.

The C. H. Blomstron Motor Company has filed articles of incorporation, capital stock $100,000. Samuel R. Kaufman and Nathan M. Kaufman of Marquette are the stockholders.

The Iona Electric Company has increased its capital from $25,000 to $60,000.

The Buick Motor Company of Flint has been reorganized and increased its capital stock from $75,000 to $300,000 preparatory to engaging in the manufacture of automobiles on a large scale. The parts entering into the construction of the machines will be made in Flint, but the assembling plant will be located at Jackson. This company has had its machine on the market for a year. The officers of the reorganized company are: President, C. M. Begole; secretary, W. S. Ballenger; manager, D. D. Buick.

According to the report of the state labor bureau in regard to the development of electric railways, there are upward of 1,000 miles of electric railway in the state, of which the Detroit United Railway has 385 miles of single-track road. This company employs 2,844 men at an average wage of $2 per day. In the year 1903 it carried over 104,000,000 passengers.

It is expected that the last rail of the new Detroit, Monroe and Toledo Short Line electric railway is laid and that tomorrow the cars of the company will begin running through from the Union Station, Toledo, to the Detroit City Hall. The line has been operating cars all summer between Toledo and Sibley, a short distance from Trenton, where passengers were transferred to the Detroit United Railway. In the meantime the work of building overhead crossings of the Michigan Central and the Wabash railroads and a double-track steel bridge over the River Rouge has been pushed to completion. It is planned to make the opening of the road an event of importance. C. G. W.

Northwestern States.

Minneapolis, November 5.—A franchise for an electric-light plant at Arlington, S. D., may be voted at the general election.

Negotiations between the Backus-Brooks Company of Minneapolis and the Canadian government have been completed and work has been resumed on the dam for the new power plant at International Falls, Minn.

The Cass Lake (Minn.) Water, Light and Power Company has completed the installation of new machinery in its plant and has increased the capacity fourfold.

The Interurban Railway Company is securing rights-of-way for extensions of its lines from Des Moines, Iowa, to Newton and Indianola.

The Twin City Rapid Transit Company has been granted a franchise for a line from Stillwater to South Stillwater, Minn.

The new dam at Jordan, Wis., for the purpose of furnishing power at Stevens Point has been completed.

Judge Lochren of the United States District Court has filed his decision in favor of the Twin City Rapid Transit Company in its suit with the city of St. Paul, Minn. The company sued to have the city enjoined from interfering with extending its lines, contending this was granted under the old horse-car franchise. The company's position is upheld by the court, but the city attorney will appeal to the United States Circuit Court of Appeals or to the United States Supreme Court. It is possible that a compromise may be reached.

The City Council of Monroe, Wis., has refused a street-car franchise for the second time.

The Hutchinson and Western Railway Company has been incorporated with a capital of $50,000 to build a trolley line from Hutchinson, Minn., to Lake Lillian. E. L. McGregory of Minneapolis heads the list of stockholders.

The Wausau Electric Company of Wausau, Wis., has started the machinery in its new power house.

The Kaukauna (Wis.) Electric Light Company is letting contracts for extensive improvements of its power plant.

The contract for two electric pumps for the waterworks plant at DePere, Wis., was let to W. H. Cook & Co. of Chicago. The Northern Electrical Manufacturing Company of Madison, Wis., received the contract for two 40-horsepower electric motors.

D. J. Shore of Minneapolis has succeeded O. F. Fobes as manager of the Pipestone (Minn.) Electric Light, Heat and Power Company.

The Mille Lacs and Minneapolis Electric Railway Company has incorporated with $150,000 capital. C. S. Kathan of Mora, Minn., heads the list of incorporators. It is proposed to build a trolley line from Mille Lacs Lake to Minneapolis.

The United States Gypsum Company is said to be arranging to build an electric road from Fort Dodge, Iowa, through Webster City to Iowa Falls.

It is reported that the light plant at Osceola, Iowa, has been sold to Mr. Sigler of Indianola for $30,000. R.

Pacific Slope.

San Francisco, November 4.—The North Shore railroad, which operates an electric railroad between Sausalito and San Rafael and between Sausalito and Mill Valley, Cal., has failed to pay its semi-annual installment of interest on its bonded indebtedness, which was due November 1st. The road has recently passed to the control of A. W. Foster, president of the California Northwestern.

The Mount Whitney Power Company has purchased the rights and interests of the Bursell & Henley Power Company on Middle Tule River and also the stock of the Globe Light and Power Company in Tulare County, Cal. As soon as the right-of-way is finally settled the Mount Whitney Company will install a power plant on Middle Tule River.

F. D. Farwell, manager of the Ice and Power Company at Los Gatos, Cal., states that the company is preparing to enlarge its facilities for power at that place by replacing all its generators with larger ones. The light and power lines are to be extended to Saratoga on the west and to the foothill regions on the east.

The Los Angeles Interurban Railway Company of Los Angeles, Cal., has purchased of the Southern Pacific Company the right-of-way, trackage and all property interests of the San Gabriel Rapid Transit railway. The Huntington interests have purchased and are negotiating for the purchase of large tracts of land in the vicinity of Brooklyn Heights. The company has a force of men on the extension of the Brooklyn Avenue line, which, it is understood, is to be extended to Eastlake Park.

The Edison Power Company is signing up contracts for teams to commence work on the Kern River power project the first of the year. The company has just completed power house No. 2 in Santa Ana Canyon, northeast of San Bernardino, Cal., and is building a bunk house for a large crew to be worked this winter at the head of the canyon, preparing for a power house on the Clark place.

The executive committee of the Sierra and Yuba Electric Railway and Power Company has a plan on foot, originating in Downieville, Cal., to promote an electric railway from Marysville to Downieville via Browns Valley, Challenge and the North Yuba River. Roughly speaking, there will be 65 miles of road to be built. A power house will also have to be erected. W. J. Belcher is chairman of the committee, with headquarters at Downieville, Cal.

The Seattle-Tacoma Power Company is making preparations for the installation of a waterwheel

generator unit at Snoqualmie Falls, Wash., which will nearly double the capacity of the plant. It will be 9,500 horsepower and will drive a 5,000-kilowatt generator. Charles H. Baker is chief engineer of the company.

The Edison Electric Company is making a number of improvements in its power house on Lower Castillo Street, Santa Barbara, Cal. New boilers and engines have been set up and a brick addition is being made to the building, which will contain the new machinery.

General Manager G. F. Chapman of the United Railroads of San Francisco states that the company is planning to change the 11-mile steam road of the company into an electric line during next summer.

The Seattle Electric Company has applied to the council of Seattle, Wash., for a franchise to construct and operate an electric railroad over certain streets of Seattle.

A survey for an electric railway to Lick Observatory on Mount Hamilton is now being made. K. P. Fisher has been chosen engineer of the road. Two routes will be surveyed, one by way of Alum Rock Park and the other by way of Evergreen. The road is estimated to cost $500,000. A.

Dominion of Canada.

Winnipeg, Man., November 5.—Notice is given of the approval by the government of the Victoria Power Company. The company has power to take 7,000 miner's inches from the Shawinigan Lake, V. I., being augmented as part of the undertaking by the withdrawal of 5,000 miner's inches from the Yoksilah River and the emptying of the same into Shawinigan Lake. The company is a subsidiary one of the British Columbia Electric Company. It has to subscribe a capital of $10,000 before commencing operations and has power to issue first-mortgage bonds to the extent of $750,000 to complete the work, to be done in 4½ years.

John M. Smith, comptroller of the Toronto street railway, has returned from Sao Paulo and reports that the Sao Paulo company is now producing about 20,000 horsepower and is a wonderful waterpower, which can be doubled or triplicated by building dams farther down the river. The company has secured a contract from the government to pump the water supply over the hills into the city reservoir. The traction company has now 100 miles of railway line and is steadily increasing its mileage.

The taxpayers of Waterloo have carried a by-law for $20,000; of this $11,000 will be used to purchase the present gas plant and $9,000 for extensions of the same.

The City Council of Winnipeg has granted permission to the Winnipeg electric railway to extend its street-car service by building new lines on Sherbrooke Street from Notre Dame Avenue to Cornish Street, and for tracks on Sherbrooke, Ida, Maryland and Cornish streets. Large additions are to be made to the machinery of this company, and the power house has been extended. The cost of the proposed improvements will run into many thousands of dollars.

A peculiar case has arisen in connection with the prosecution of the Kingston Electric Street Railway Company by the Lord's Day Alliance for running cars on Sundays. On the other hand, it is compulsory for the company to run Sunday cars, owing to the terms of its charter, which reads that the company is in duty bound to operate daily.

At the meeting of the directors of the British Columbia Electric Railway Company recently held in London, England, a total dividend of six per cent. was declared for the year ended June 30th.

The suburban electric railway of the Winnipeg Rapid Transit Company has commenced operating its line to St. Charles and will maintain a 50-minute service through from the Canadian Pacific depot in Winnipeg to St. Charles, a distance of seven miles. The street-railway subway at St. James is also completed. H.

PERSONAL.

Herbert Laws Webb, the English telephone engineer, has just returned to London from a tour of inspection of a number of the large telephone systems of northern and eastern Europe.

George L. Colgate, eastern and export agent for the Kuhlman Electric Company of Elkhart, Ind., is in the West from New York on a business trip. Mr. Colgate spent Friday of last week in Chicago.

Edward U. Roth, E. E., with the Société Alsacienne of Belfort, France, is in the United States inspecting some of the most interesting electrical installations. He is in Chicago at the present time.

Secretary A. M. Buchanan of the American Conduit Company, who has been at the company's Chicago office for some time, has left for Los Angeles, Cal. Mr. Buchanan may remain in California until spring.

Lee De Forest, while on his recent trip abroad, was given a dinner at the Hotel Cecil in London on the eve of his departure for home. Many prominent men were present, among whom were Sir William H. Preece, Prof. W. E. Ayrton, James Swinburne and A. A. Campbell-Swinton. Mr. De Forest gave a short review of the progress space telegraphy has made, especially in America. The dinner was an informal affair and was highly satisfactory to all concerned.

W. E. Truesdale has resigned his position with the Postal Telegraph-cable Company at St. Louis to become manager of the Columbus Dental Supply Company at Columbus, Ohio. Mr. Truesdale was at one time manager of the Columbus office of the Postal company.

William I. Leggett, who for a number of years was with the Western Electric Company and who has had large experience in the electrical-supply business in Chicago and New York, is one of the organizers of the Compiling Bureau of New York, which is engaged in making catalogues for the electrical trade.

Mrs. Helen E. Blitz, president of the Bishop Gutta-percha Company, died at her home in Westfield, N. J., on October 22d. She had been president of the Bishop Gutta-percha Company since 1894. Apoplexy caused her death while she was inspecting decorations in her beautiful new residence at Westfield.

Mr. Samuel Insull, president of the Chicago Edison Company, entertained Sir Henry Mortimer Durand, British ambassador to the United States, at luncheon at the Chicago Club last Saturday and in the afternoon took him out to the Chicago-Texas football game at Marshall Field. Sir Henry was keenly interested in the play, having played the English game for many years.

C. B. Fairchild, Jr., has resigned as eastern editor of the Street Railway Review to enter business for himself. In 1899 Mr. Fairchild became assistant editor of the Review and in 1901 assumed charge of the New York editorial office. Previous to this he was for six years on the editorial staff of the Street Railway Journal, devoting much of his time to work on the Red Book of American Street Railway Investments.

Frank C. Moffitt, who was recently selected to fill the position of manager of the Chicago office of the Western Union Telegraph Company, made vacant by the promotion of J. C. Smith to be a superintendent, has been employed by the Western Union continuously for 30 years. For the last two years he has creditably filled the position of manager at Milwaukee. Mr. Moffitt was born in Newark, N. J., in 1856. For his new position he is well fitted by long experience in executive work. He is practical and well read in the technicalities of his profession and stands equally high as a business man and a friend.

President T. F. Grover of the Northwestern Electrical Association was in Chicago a few days last week in the interest of the organization and incidentally transacted some business for the Eastern Wisconsin Railway and Light Company of Fond du Lac, of which he is vice-president and general manager. Thomas R. Mercein of Milwaukee, secretary of the association, was also in town at the same time. Strong efforts are being made for the success of the coming convention of the Northwestern association, and it is especially hoped that many street-railway companies will avail themselves of the opportunity of becoming members. Papers of special interest to them will no doubt be presented.

Much regret has been expressed at the news of the suicide of Henry E. Raymond, an assistant in the construction department of the General Electric Company at Schenectady, N. Y. His lifeless body was found on November 2d in a room at the Hotel Manhattan, New York, the evidence showing that he had hanged himself with the cord of a Venetian blind. Mr. Raymond was a trusted employe of the General Electric Company and recently made a business trip to Australia for the firm. No reason is apparent for the suicide. He was 33 years of age. His home was at Schenectady, where he had a wife and son. His brother, J. H. Raymond, is employed in the testing department of the same corporation.

W. A. Nelson, who was appointed superintendent of equipment of the Allis-Chalmers Company October 1, 1904, began his services with that company in August immediately after his resignation became effective as assistant superintendent of the Westinghouse Electric and Manufacturing Company. Mr. Nelson will have duties in connection with all of the works of the Allis-Chalmers Company and his experience admirably qualifies him for making a success in this new undertaking. R. C. Wright, for several years in charge of the design of special tools and fixtures used in the manufacture of steam turbines at the East Pittsburg works of the Westinghouse Machine Company, has resigned his position with that company to accept similar duties at the Milwaukee works of the Allis-Chalmers Company. Charles F. Barth has recently been appointed foreman of the steam turbine department at the West Allis works, and C. A. Derby has resigned his position as assistant manager of the Lyon Cypress Lumber Company to join the selling staff of the Allis-Chalmers Company in its sawmill department.

ELECTRIC LIGHTING.

The city of Madras, East India, is to erect stations for lighting purposes.

Crab Orchard, Neb., is considering the project of installing an electric-light plant.

The Delhart (Texas) Ice and Electric Company has been incorporated, with a capital stock of $100,000.

The Puget Sound Light and Heat Company, Seattle, Wash., has been incorporated with a capital stock of $100,000.

The towns of La Paz, Bolivia, and Fray Bentos, Uruguay, are projecting the erection of electric works for lighting purposes.

The Lenox (Iowa) Electric Light and Power Company has been incorporated with capital of $18,000 by T. W. Bennett and others.

The Thermopolis (Wyo.) Electric Light and Power Company has decided to rebuild its plant, which was destroyed by fire a few weeks ago.

Electric-lighting systems are to be introduced in the towns of Gubbio, Italy, and Espinar, Spain. The former will also install a system of waterworks.

J. T. Gibson, manager of the electric plant and railway company at Meridian, Miss., has announced that $100,000 will be spent in improving the service.

The Schoharie Light and Power Company has been organized at Tannersville, N. J., with a capital of $40,000. Francis and W. H. P. Bacon are interested in the project.

The Guthrie (Okla.) Electric Light and Power Company, which has just been incorporated, with a capital of $150,000, has asked for a 30-year franchise and will succeed the old company.

Work on the new power plant of the Muncie (Ind.) Electric Light Company, which will be built adjacent to the present plant on North Walnut Street, has been started. The plant is to cost $50,000, including equipments.

The McHenry Light, Heat and Power Company of McHenry, Ill., has been incorporated, with a capital of $20,000, to operate heat, light and power plants. Stephen Reynolds, DeWitt C. Doe and William D. Ball are interested.

Bids for supplying the new Capitol and all state departments and executive mansion at Harrisburg, Pa., with electric light and power for one year were opened recently. The Harrisburg Electric Company was the only real bidder, at $24,400. The award has not yet been made.

The Winter Park Electric and Fuel Company of Winter Park, Fla., has been incorporated, with a capital of $25,000, to construct and operate electric plants and to generate electricity for light and power purposes. J. M. Cheney, H. W. Greetham and H. H. Yowell are interested.

S. Davies Warfield, chairman of the executive committee of the United Electric Light and Power Company of Baltimore, Md., announces that plans had been consummated for the erection of one of the largest electric-light and power-generating stations in the United States. The company has purchased 22 acres of land immediately adjoining the city and having a water front of over 1,000 feet. The new generating station will provide for all needs of the city of Baltimore for electric light and power for many years to come.

Articles of incorporation of the Watsonville (Cal.) Electrical Company were filed recently in the office of the county clerk at Santa Cruz, Cal. The directors of the new company are W. A. White, J. A. Schanbacher, A. White, J. A. Linscott and W. D. Gulick. The capital stock is $25,000. The new company, which is a direct successor to the business of the Pajaro Electromechanical Company and the Watsonville Electric Company has also purchased the Redwood Electrical Company of Santa Cruz, and will operate the plant in the future.

The Waterloo and Cedar Rapids (Iowa) Gas and Electric Company has secured a temporary injunction restraining the Waterloo Produce Company from impairing the water of the Cedar River. It is averred by the plaintiff that the defendant disposes of feathers and other refuse by throwing it into the river; the feathers are sucked up by the electric company's intake pipe and thus interfere with the operation of the machinery. In the suit brought by Austin Burt, general manager of the company, it is stated that the plaintiff has suffered loss of time to the extent of $1,000 on account of the feathers.

ELECTRIC RAILWAYS.

An electric railway is projected in Lisbon, Portugal.

The official test of the New York Central electric locomotive which was to have taken place last Thursday, was postponed until today.

Mayor Bird of Wilmington, Del., recently informed the Republican workers of that city that the stringing of banners on trolley poles along Market Street would be a violation of a city ordinance. The

Republicans had secured permission from a local trolley company to use its poles, and, it is said, disregarded the mayor's warning.

The Sedalia (Mo.) Transit Company has been incorporated with a capital stock of $60,000, to put in electric railways.

Under the direction of Prof. August Yenn the formation of an "interurban orchestra" is being completed at Laporte, Ind. Arrangements are being made for a concert in the near future.

The Joliet, Plainfield and Aurora electric railway, a portion of which between Joliet and Plainfield, Ill., has been in operation for over a year, has now been opened for the entire distance to Aurora.

The contract for the construction of the Rochester, Syracuse and Eastern trolley road from Palmyra to Lyons, N. Y., has been let to J. G. White & Co. of New York. Work on this section of the road will begin this fall.

Articles of incorporation of the Indianapolis, Logansport and South Bend Traction Railway Company have been filed. It designs to construct a line from South Bend to Logansport, there to connect with other lines to Indianapolis.

The Columbus (Ohio), Delaware and Marion Railway Company has been incorporated to take the place of the Columbus, Delaware and Marion Electric Railway Company, the name under which the road from Columbus to Marion was built. The new company has a capital stock of $2,500,000 instead of $1,500,000 which the old company had.

F. A. Blackwell, president of the Coeur d'Alene and Spokane electric line, states that financial backing has been secured in the East for the proposed electric line from Spokane to Colfax, Wash. Work will be undertaken at once if the people are willing to subscribe a reasonable amount of stock in the company to assure eastern people of good faith. The road will cost $3,000,000.

The Chicago, Kenosha and Milwaukee Railway Company has abandoned the right-of-way owned by it on the east side of Kenosha, Wis., and it is announced that the road will be built a quarter of a mile west of the city limits. The company is now purchasing a new right-of-way and will extend its tracks on a straight line from Zion City, the present northern terminus, to Milwaukee.

The St. Joseph River Electric Railway Company has posted a $1,000 deposit to guarantee the building of a new road to be completed next summer. The road will connect thousands of acres of fruit lands near Benton Harbor, Mich., and will also connect most of the best-known summer resorts along the river. This road has created general interest over the entire county and property has enhanced in value all along the line.

It is reported that the proposed interurban railway from Wichita to Hutchinson, Kan., is being backed by the Rock Island, Santa Fe and Frisco railroads. The Hutchinson electric line is being promoted by J. J. Burns of Chicago, and rumors have it that the three railroads mentioned are backing Mr. Burns and that the electric line will be used as a joint passenger and freight line for Wichita, Newton and Hutchinson business. Work on the new electric road will be begun in a few weeks, it is said.

It is announced that the Washington Water Power Company of Spokane, Wash., has agreed to have the electric line to Medical Lake in operation by June 1st if the people of the city on the lake will fulfill the requirements imposed by the company and subscribe for $50,000 worth of stock, which is to be secured not only by the road to be built, but by the street-car lines, waterpower, lighting and electric power plants in Spokane. This sum ($50,000) is about one-fourth of the cost of the road.

A trolley line between Denver, Colorado Springs and Pueblo, with a spur to Manitou, is contemplated by the Denver City Tramway Company and the preparations for the building of the road are well under way. The Denver Tramway Company has been fighting the encroachments of the Colorado and Southern road into the tramway territory between Denver, Golden and Boulder, and it is the intention of the company to push its lines south. The cost of construction and equipment is placed at $10,000,000.

Construction has been commenced on the new power house of New Orleans (La.) Railways Company, the ultimate capacity of which is to be 60,000 horsepower. This station will embrace what is now called the Annex Station, whose present equipment includes three vertical cross-compound condensing engines of a total of 10,000 horsepower, and the immediate additions are three turbine units of 1,500 kilowatts each. Five thousand-kilowatt turbine units will be added as fast as needed in the new station, the design being of a sectional character, which permits additions with the least trouble and expense.

All the different street-car companies in Barcelona, Spain, are now owned and controlled entirely by foreign capitalists, and the work of substituting electricity on those lines that have not already adopted it is almost completed. The Belgian syndicate which purchased the old railway which connects the city with the outlying suburb of Sarriá is actively engaged on the preliminaries for prolonging the line from Sarriá to the little village of Vallvidrera on the crest of the surrounding chain of hills. Unforeseen difficulties with the authorities are alone responsible for the old section of this line not having already been converted into an electric tramway, as has been the purpose of the company from the first.

SOCIETIES AND SCHOOLS.

The electrical engineering department of the University of Illinois is making rapid growth, and this year the registration in this one department of the university has reached 230, an increase of 100 per cent., as compared with three years ago. Prof. Morgan Brooks is head of the electrical department.

Very neat and appropriate souvenir booklets containing programme and menu were issued on the occasion of the dinner given by the electrical engineering department of Columbia University on October 28th, containing among other things a list of the graduates in electrical engineering since 1891.

The International Jury of Awards at the Exposition in Group III, higher education, technical schools, etc., has awarded a bronze medal to the Thomas S. Clarkson Memorial School. The exhibit was warmly commended by the members of the jury, and has been a source of interest to visitors throughout the summer.

During the international exposition at Liège, Belgium, next year—June 26th to July 1st—will be held a congress of mines, metallurgy, mechanics and applied geology. The section of applied mechanics will be subdivided as follows: Machine design, internal-combustion motors, mechanical applications of electricity, turbo engines, steam engines and boilers and auto trucks. Information may be obtained from Henri Dechamps, general secretary of the committee of organization, 16 Quai de l'Université, Liège.

The Directory of Membership No. 3 of the American Institute of Electrical Engineers is revised to August 1, 1904. It is a carefully printed little book of 96 pages, pocket size, and contains an alphabetical index, a summary by states and a geographical directory. The total membership on the date mentioned was 3,151, of which 439 is credited to foreign countries. New York has 981 members; Pennsylvania, 311; Massachusetts, 235; Illinois, 185, and Ohio, 169. The work is executed with great thoroughness and accuracy. Persons who appreciate the difficulties in preparing a list of this sort free from errors will congratulate Secretary Ralph W. Pope on his work.

PUBLICATIONS.

The Crocker-Wheeler Company of Ampere, N. J., is sending out a postal card showing a silhouette of the U. S. S. Connecticut, for which the company is supplying an electric-light and power plant.

The National Stamping and Electric Works of Chicago are extensive manufacturers of gasoline vapor-lighting devices, and they have recently issued a pamphlet on this type of apparatus describing the construction and advantages.

Another appropriate and handsome piece of advertising literature is being distributed by the Allis-Chalmers Company, this time upon the power of the New York subway. The pamphlet is richly colored and finely illustrated and is calculated to uphold the high standard of excellence in this line which the company has thus far set. The power plant of the new subway is described in detail and numerous views of the apparatus are shown. Those who desire to know more about this great engineering undertaking will do well to procure one of the booklets, as a good idea of the power end of the work may be derived from it, and coming at this time, just after the opening of the subway, it is especially appropriate.

SPACE TELEGRAPHY.

An instance of the value of the space-telegraph plant in the Brooklyn Navy Yard occurred recently, when word was received that the collier Ameranda was entering the harbor. There being no berth room at the yard, an order was flashed to the Topeka, which had been at the service of the wireless commission lately, and was lying at anchorage off Tompkinsville, to hold the Ameranda down the bay until further notice.

The British Admiralty is making extensive use of the Marconi system of space telegraphy. Mr. Marconi, who is in this country, is reported to have said that "If it should become necessary for the British government to send orders quickly to Gibraltar or to the British fleet in Italian waters they would go by wireless, because that method under our improved system is so much faster and surer than any other." There are now 80 British warships thus equipped.

Lieutenant Cherardi, in charge of the government space-telegraph station at the Newport (R. I.) torpedo station, states that the German system recently installed on the Nantucket Shoals lightship is now in successful operation. The shore end of the system is at the local torpedo station, 95 miles from the lightship, and messages between these points are now being sent at the rate of 10 or 12 words a minute. It is stated that passing steamers fitted with the system will be able to keep in communication with the lightship for four hours while sailing on their regular course.

Some misunderstanding has arisen between the United States government and the Marconi Space-telegraph Company as to the sending and receiving of messages. The new government station which was recently installed by the Navy Department on the Nantucket lightship is not of the Marconi system. The Marconi company is displeased at this because the system originally used on the lightship was theirs. The Marconi company, therefore, now refuses to recognize the government station, which action, it thinks, will greatly lessen the usefulness of the station, because many of the great transatlantic liners use the Marconi apparatus.

POWER TRANSMISSION.

The city of Simla, British India, will expend $225,000 on a hydro-electric plant to improve its water supply.

The American Falls Canal and Power Company of Ogden, Utah, has been incorporated with a capital stock of $500,000.

The Southern Oregon Power Company has been incorporated at San Francisco, Cal., with a capital stock of $500,000, by Harvey Yeaman and others.

The Snoqualmie Falls and White River Power Company of Seattle and Tacoma, Wash., by amended articles of incorporation, has changed its name to the Seattle-Tacoma Power Company and has increased its capitalization to $3,500,000.

The Quebec Electric Company of Quebec, Can., will soon be in the market for about 6,000 horsepower of hydraulic electric generating machines and the necessary appurtenances. The plant is to be located at St. Anne and Seven Falls.

In less than a year it is said that every street car in Toronto will be propelled by power from Niagara Falls. The Toronto Railway Company has a contract with the Niagara and Toronto Power Company for all the power it may require for the operation of its lines, and a large force of men is now engaged in building the transmission line via St. Catharines and Hamilton.

MISCELLANEOUS.

The United States battleship Connecticut, launched a few weeks ago, contains, it is said, the largest electric-light and power plant ever installed on a battleship. The plant, which has a capacity of 800 kilowatts, consists of eight Crocker-Wheeler generators direct connected to Forbes marine-type engines.

The inside of a large standpipe at Paducah, Ky., was painted recently, the painters doing their work from a raft which floated upon the water within the pipe. In all previous times staging had been used within the pipe, but this time the staging was done away with and telephonic connection was established between the men in the standpipe and the engineer in the pump room. When the men had painted as high as they could, they signaled the engineer, who raised the level of the water in the pipe to the required height, and the men proceeded with the work.

Newspaper men of St. Louis were entertained a few nights ago at an "electric" dinner given by Messrs. H. J. Pain and J. F. Graham in the New York State Building on the Fair grounds. The feature of the occasion was that all the viands for the banquet table were cooked by electricity on an electric range invented by M. Bayno. After dinner, for the amusement of the guests, the chef broiled a quail in five minutes and toasted bread in one minute.

A cablegram from London says that Lord Raleigh has made a radium clock which will go for 2,000 years without winding up. In this clock, according to report, "a small piece of gold leaf is electrified by means of an exceedingly small quantity of radium salt. It bends away upon the metal substance and keeps on moving under this influence until it touches the side of the vessel. At the moment of contact it loses its electrical charge, upon which it springs back and is electrified again. The repetition of this process over and over again is the whole secret, and Sir William Ramsay considers that the clock might be expected to go on, barring accidents for a couple of thousand years."

A demonstration was recently given in the school of education of Chicago University of a method of brazing cast iron. The test was made by Burt Springer of Des Moines, Iowa, the inventor, in the presence of a number of iron-working experts. Two pieces of cast iron were fastened together and heated to a brazing temperature, after which they were treated with a powder which Mr. Springer had com-

pounded, having the same effect as a flux in the process of brazing malleable iron. It served the purpose of cleaning the iron and preparing it for the second part of the process. When the first part had been completed the inventor treated the iron pieces with a second preparation and brass spelter. The action of the former permits the spelter to flow into the iron on both side of the break, welding the two pieces together.

Observations upon the change in state of aluminum alloys were made by Professor Ernest Wilson. During three years' exposure to London atmosphere copper-aluminum alloys have gradually diminished in total conductivity, the extent being greater the higher the percentage of copper. Nickel-copper aluminum alloys, which show such a remarkably greater tensile strength than good commercial aluminum, during the last year also diminished considerably in conductivity. On the other hand, manganese-copper aluminum alloys have undergone comparatively little reduction in total conductivity, and one of them has a comparatively high tensile strength.

TRADE NEWS.

The Standard Storage Battery Company of Jersey City, N. J., has been incorporated at Trenton, with a capital stock of $500,000. The incorporators are Lewis B. Dailey, H. C. Coughlan and B. S. Mantz.

The Mexican Mining and Development Company of the City of Mexico announces that it is ready to place contracts for considerable electrical equipment to be installed on its properties in the state of Durango, Mexico. Among other machinery 100 electric drills and several mining hoists will be ordered to be operated with electric power.

A petition in bankruptcy has been filed against the Rosemont Electric Transmitter Company of New York city by creditors. The liabilities are $13,000 and assets consist of accounts, $3,500; some stock unfinished of little value, and patents. The bankruptcy was precipitated by dissensions in the board of directors, which was divided into two parties. Herman Schwarz is president and Arthur H. Schwarz, secretary. It was incorporated on December 15, 1902, with a capital stock of $250,000, to make an electric transmitter for sewing machines.

An unusual incident in the copper industry is the report that United States copper is being shipped to Japan. The United Metals Selling Company of New York, it is said, has recently taken contracts for the delivery of 10,000,000 pounds of copper in Japan and has already begun shipment. The Russian-Japanese war has cut down the output of the Japanese mines, and American copper is filling the void.

David Eccles is figuring on a proposition to build an electric street-car line at Logan, Utah. It is understood that he will make an offer to the citizens to build a line from the Agricultural College to the depot and along Main Street and down to the sugar factory, provided the city will furnish power temporarily at a fair price and that the business men subscribe about $30,000 in stock. The plans also contemplate the building of a line from the sugar factory south through Providence, Millville and Hyrum to Wellsville, with a branch to Paradise, all in Utah.

Comparatively few travelers for commercial purposes are visiting Russia during the current season, says Consul Slocum at Warsaw, Russia, and this is to be regarded as caused by the present financial situation. Word comes from travelers of experience that credits in general, not only in Russia proper, but in the south of Russia, have been very disappointing, and this in conjunction with the hesitancy natural to the condition of war and the uncertainty of the immediate future, have rendered the sound buyers more conservative and very careful in increasing their liabilities. This does not apply to the electrical industry especially but to trade in general.

The Compiling Bureau, 56 Pine Street, New York, is engaged in the preparation of catalogues and circulars exclusively for the electrical trade. The gentlemen composing the bureau are William I. Leggett, who was for a number of years with the Western Electric Company in Chicago and New York and who compiled all of its recent catalogues, and A. G. Brown, who has been with the General Electric Company and other important concerns. The record of each guarantees their success in a new field. Not only do they compile catalogues for their clients, but contracts they have entered into for paper, printing and plate work will reduce the normal expense incident to issuing new books.

Exports of all kinds from the United States to Russia, Japan, China, Hongkong and Korea show a marked increase in 1904 as compared with earlier years. To each of the countries named the exports for the nine months ended with September are larger than those of the corresponding months of 1903. The total exports to the countries named are shown by the Department of Commerce and Labor through its Bureau of Statistics as $56,448,225 in the nine months ended with September, 1904, against $44,807,366 in the corresponding months of 1903, and $47,663,031 in the corresponding months of 1902. The total imports into the United States from the countries named amounted to $65,389,022 in the nine months ended with September, 1904, against $60,375,925 in the corresponding months of 1903, and $49,540,259 in the corresponding months of 1902. Electrical machinery exported to Japan shows a marked increase in 1904, being $755,955 during the nine months ended with September, against $214,255 in the corresponding months of 1903 and $131,108 in the corresponding months of 1902.

BUSINESS.

The General Electric Company, among the 20 other awards which it received from the Louisiana Purchase Exposition, has received a gold medal for electric flatirons.

The F. Bissell Company of Toledo, Ohio, reports a large business in switchboards and tablet boards, and the factory is running with a full complement of men. The company recently published some new bulletins on this apparatus which it will mail upon request.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued (United States Patent Office) November 1, 1904.

773,550. Frame for Electric Machines. Carl Dihlmann, Berlin, Germany. Application filed November 23, 1901.

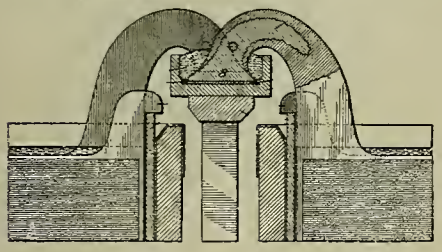
In an alternating-current machine are a substantially circular core, a girder frame surrounding the core and connections between the core and girder frame whereby the core may be adjusted with relation to the girder frame.

773,575. Automobile. Alvaro S. Krotz, Springfield, Ohio, assignor of one-half to Paul A. Staley, Springfield, Ohio. Application filed February 21, 1903.

The method of propulsion is by an electric motor through a differential gear.

773,621. Combined Trolley-wire Splice and Support. Alonzo B. Allison, Canton, Ohio. Application filed February 15, 1904.

An ear plate is provided with a curved flange, the flange formed of yielding or spring material. A cap is secured to the ear plate and the trolley wire is located upon the convexed side of the curved flange.



NO. 773,686.—STORAGE BATTERY.

773,626. Knife Switch. William F. Bossert, Utica, N. Y., assignor to the Bossert Electric Construction Company, Utica, N. Y. Application filed March 7, 1904.

A switch post of resilient material has a foot on one side from which arises a hollow column closed upon three sides and open upon one side. These parallel faces approach each other at their upper ends and form a gap whose parallel sides are open at each end.

773,685. Storage-battery Electrode and Process of Making Same. Elmer A. Sperry, Cleveland, Ohio. Application filed January 28, 1904.

The process of producing storage-battery electrodes consists in precipitating a carbonate of lead from a solution of a lead salt, roasting the carbonate to expel the carbon dioxide and produce a highly porous oxide or oxides of lead, and applying the oxide or oxides to a grid or support.

773,686. Storage Battery. Elmer A. Sperry, Cleveland, Ohio. Application filed February 11, 1904.

The battery comprises a vessel and separate electrodes, each electrode having a terminal and a carrying lug near the middle of its upper edge and substantially over its center of gravity, the lugs on adjacent electrodes being out of alignment. (See cut.)

773,708. Trolley Wheel. John J. Bouchard, Bradford, Pa. Application filed August 28, 1903.

A lubricating device for the trolley wheel is described.

773,725. Receptacle. Philip H. Fielding, New York, N. Y. Application filed April 5, 1904.

The receptacle contains a socket composed of hollow insulating and conducting portions, the two portions having their adjacent ends abutting, and forming continuations of each other.

773,733. Insulator. Leon W. Greene, Brooklyn, Mich. Application filed November 10, 1903.

Circumferential grooves or seats are provided on the insulator and a clamping member formed of a single piece of metal is bent to form a pair of spring arms adapted to engage the seats. The clamping member is held in engagement with the seats by the inherent spring tendency of the arms. (See cut.)

773,774. Electric Arc Lamp. Lorens S. Andersson, Stockholm, Sweden. Application filed April 15, 1902.

Characteristic features of the lamp are two electrodes connected in series to the main circuit of the lamp, and a third electrode forming a bridge between the first-mentioned electrodes. Means are also provided for regulating the electrodes independently of each other.

773,805. Incandescent Electric Lamp. Albert W. W. Miller, South Orange, N. J. Application filed September 29, 1902.

A disk of insulating material is mounted at the end of the lamp anchored to the cement and having projecting from its outer face a boss of angular cross section. A correspondingly formed cup-shaped base contact fits over the boss and has the central part of its contact face projecting beyond its edges.

773,821. Electric Furnace. Charles P. Steinmetz, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed May 24, 1900.

The electric furnace contains walls formed of a pyroelectrolyte and fashioned to receive and retain the substance to be acted upon, means for initially heating the pyroelectrolyte, and means for thereafter heating the electrolyte by the direct passage of current.

773,827. Roentgen-ray Tube. Elihu Thomson, Swampscott, Mass., assignor to the General Electric Company, Schenectady, N. Y. Application filed February 14, 1898.

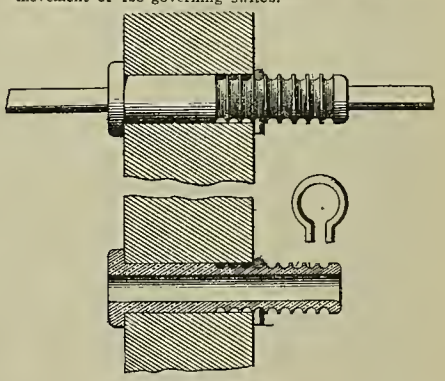
A method of regulating the degree of density of a vacuum tube consists in directing the rays generated in the tube toward a gas-yielding agent within the tube from such a distance that gas will be liberated from the agent only when the density decreases beyond a certain point.

773,832. Controlling System for Electric Motors. George Westinghouse, Pittsburg, Pa. Application filed March 18, 1903.

Combined with annularly disposed and independently actuated contact members are a centrally located air chamber, pneumatically actuated means for moving each member into its circuit-closing position, means for moving each of the members to open-circuit position when released from pneumatic pressure, electromagnetically actuated valves for applying and withdrawing pneumatic pressure and a governing switch for energizing and de-energizing the valve-actuating magnets in a predetermined order.

773,833. Controlling System for Electric Motors. George Westinghouse, Pittsburg, and Louis M. Aspinwall, Wilkinsburg, Pa.; said Aspinwall assignor to said Westinghouse. Application filed May 1, 1903.

In a controlling system for electric motors having resistance elements primarily in circuit are a manually operated governing switch and a series of power-operated motor-controlling switches. An independent governing circuit has its own source of current and means are included in the circuit for effecting progressive operation of a number of the motor-controlling switches without movement of the governing switch.



NO. 773,733.—INSULATOR.

773,836. Controlling Switch. Harold E. White, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed April 23, 1904.

Combined with an electric generator is an electric motor driven thereby, a separate source of excitation for both fields, a resistance, and a controlling switch arranged to connect the resistance in series with the generator field, then to gradually cut the resistance out of circuit, and then to gradually cut the resistance into circuit in series with the motor field.

773,837. Electric Meter. Eddy R. Whitney, Lynn, Mass., assignor to the General Electric Company, Schenectady, N. Y. Application filed February 29, 1904.

In an electric meter are combined a motor element, the torque of which is proportional to the square of the current measured, and a retarding device, the retarding effect of which is proportional to the first power of the speed of the meter. (See cut on next page.)

773,838. Thermo-electric Generator. Merle J. Wightman, New York, N. Y., assignor to the Pyro Electric Company, New York, N. Y. Application filed July 13, 1900. Renewed April 7, 1904.

In a thermo-electric battery is a series of couples, each provided with a water jacket in direct contact with the metal of the element, the jackets being connected to form a circulatory duct in which the fluid may flow in the general direction of the fall or rise of electromotive force. (See cut on next page.)

773,853. Electric Kiln. Frederick E. Dickinson, Kendallville, Ind. Application filed January 12, 1903.

Associated with a chamber are electric-heating means independent of the chamber but arranged in communication with it, and return flues from the chamber to the electric-heating means, all constructed to prevent the admission of air for the support of combustion and to effect a continuous circulation through the several elements of the same atmospheric air.

773,867. Portable Electric Winch. James Heywood, Philadelphia, Pa. Application filed March 14, 1904.

The winch which is carried upon a carriage is driven by an electric motor.

773,868. Automatic Electrical Signaling System. Franklin S. Holmes, New York, N. Y. Application filed April 16, 1903.

In an electric circuit are an automatic periodic-signaling mechanism and an electrical device for automatically measuring the interval between signals and announcing when the interval is exceeded.

773,869. Automatic Electrical Signaling System. Franklin S. Holmes, New York, N. Y. Application filed March 19, 1904.

An automatic periodic signaling mechanism is associated with a device controlled by the signals for automatically measuring the interval between signals and indicating when the normal interval is not equaled or is exceeded.

773,870. Automatic Electrical Signaling System. Franklin S. Holmes, New York, N. Y. Application filed March 25, 1904.

Combined with a main circuit leading through a pair of normally open contacts and from the contacts by two paths in multiple are a pair of contacts in each path, actuating means for intermittently closing the three pairs of contacts, a protection or analogous circuit, and a fourth pair of normally open contacts in one of the paths adapted to be closed by disturbance in the protection circuit.

773,880. Synchronizing Device for Dynamo-electric Machines. Louis C. Marburg, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed March 7, 1904.

Means for synchronizing alternating-current dynamo-electric machines comprise two transformers corresponding to the devices being synchronized, a ground connection from a middle point of the transformer secondaries and synchronizing switches connecting one section of each transformer with the synchronizing circuit.

773,881. Commutator. Maurice Milch, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed March 19, 1904.

Magnetite is placed in the spaces between the commutator segments.

773,893. Trolley Harp. Alson C. Ralph, Somerville, Mass. Application filed March 11, 1904.

A contact brush completes the circuit between the trolley wheel and the conductor in the pole.

773,917. System of Electrical Distribution. William L. Bliss, Brooklyn, N. Y., assignor to the Bliss Electric Car Lighting Company, New York, N. Y. Application filed February 3, 1902.

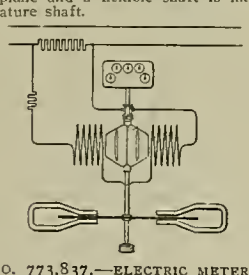
In a system of electrical distribution are a primary generator, a storage battery, means for automatically reducing the electrical energy which the generator supplies to the storage battery when the storage battery is fully charged, and means under the control of the generator-driving mechanism for restoring the generator to its normal operative condition.

773,918. Means for Exciting Dynamo-electric Generators. William L. Bliss, Brooklyn, N. Y., assignor to the Bliss Electric Car Lighting Company, New York, N. Y. Application filed February 26, 1902.

A normally open armature circuit of a dynamo has a shunt field and operates in conjunction with a storage battery for supplying current to the shunt field. A resistance is interposed between the shunt field and armature circuit.

773,930. Electric Motor. Frederick B. Duncan, Madison, Wis., assignor to the Northern Electrical Manufacturing Company, Madison, Wis. Application filed May 10, 1901.

The motor is carried upon a standard placed upon a portable platform. The motor is mounted to swing in a vertical plane and a flexible shaft is fixed to the end of the armature shaft.



NO. 773,837.—ELECTRIC METER.

773,937. Testing the Magnetic Qualities of Materials. Frank Holden, Rugby, England, assignor to the General Electric Company, Schenectady, N. Y. Application filed July 6, 1903.

An instrument for testing the magnetic qualities of a sample of iron or other metal consists of a closed conductor and means for generating in the conductor two electromotive forces, one due to variations of flux in the test sample and the other due to motion of the conductor.

773,950. Electric Turret Operating Mechanism. Osborn P. Loomis, Newport News, Va. Application filed December 16, 1903.

An electric turret-operating mechanism comprises an electric motor having a driving shaft, a driven shaft, a set of gears including a pinion fixed on the driving shaft, an electromagnetic clutch on the driven shaft in operative relation to the gear, and a motor controller having contacts for energizing the clutch.

773,961. Storage Battery. Charles B. Morgan, Cleveland, Ohio. Application filed April 18, 1904.

In storage batteries are an aluminium plate provided with pockets and pieces of aluminium and active material filling the pockets.

773,985. Apparatus for Recording and Reproducing Speech, etc. Elias E. Ries, New York, N. Y. Application filed February 26, 1903.

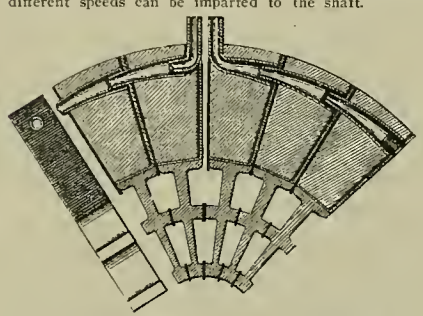
A magnetic phonograph or telephonograph apparatus has a substantially continuous record wire divided into consecutive sections or lengths, parts of the wire of each section being permanently exposed so as to render the several sections independently accessible for operation or reference.

774,012. Electrical Stop-motion Mechanism for Textile Machinery. Joseph B. Whitney, New York, N. Y. Application filed October 21, 1903.

In textile machinery having to do with the drawing of threads longitudinally are means for giving direction to the threads, an electric circuit, an indicator included in the circuit, circuit-closers controlled by individual threads and normally held thereby out of the circuit-closing position, and a circuit-breaking means consisting of a movable part engaging an appreciable number of threads and normally held by them out of the circuit-breaking position

774,018. Alternating-current Motor. Caspar Wüst-Kunz, Seebach, Switzerland. Application filed July 29, 1901.

A rotary induction motor consists of several elements forming a single machine having a casing, stator elements therein, each having a different number of poles, a rotor for each element, a shaft common to all the rotors, means to operate each element independently and means to operate one or more of the elements in parallel, whereby different speeds can be imparted to the shaft.



NO. 773,838.—THERMO-ELECTRIC GENERATOR.

774,019. Electric Time Switch. James E. Yates, Schenectady, N. Y. Application filed August 12, 1903.

Details are described.

774,029. Generating and Distributing Electricity on Railway or Other Vehicles. Frederick J. Beaumont, Stroud Green, England. Application filed September 30, 1901.

The generator is belted to the car axle with means for throwing the generator out of gear at a predetermined speed.

774,043. Trolley. William R. Cooper, East St. Louis, Ill. Application filed May 21, 1904.

In a trolley are two parts slidably fitted together, means for rendering the parts water-tight, and contact mechanism mounted upon one of the parts.

774,049. Process of Electrolytically Producing Lead Peroxide Layers Upon Positive Accumulator Plates. Julius Diamant, Raab, Austria-Hungary. Application filed January 4, 1904.

A process of electrolytically producing lead peroxid layers upon positive accumulator plates consists in adding to the electrolyte sulphonic acid derivatives of methane.

774,059. Electrical Alarm for Telephone Call Bells. John W. Fouche, Ryan, Va., assignor of two-thirds to Hugh B. Hutchison and Clarence A. Hutchison, Herndon, Va. Application filed May 2, 1904.

Details are described.

774,077. Motor Casing. Gustav E. Jacobson and Charls Anderson, Newark, N. J., assignors to the Essex Electrical Company. Application filed July 25, 1904.

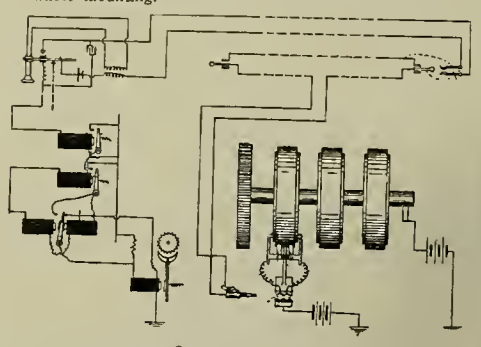
The motor casing is approximately spherical in form, divided into hemispherical sections.

774,082. Time Metering Charge for Telephone Services. Isidor Kitsee, Philadelphia, Pa. Application filed May 17, 1904.

Means are provided for indicating a number of units representing a certain value for the first unit of time, and for indicating a number of units representing certain values for units of time in excess of the first unit of time, the indicating means operating at a different rate per unit for the first unit of time from the rates of the excess time units. (See cut.)

774,085. Trolley-pole Contact. John J. Lacknor and Andrew J. Curtis, East Williamsón, N. Y. Application filed May 5, 1904.

Adjustable sleeves on the trolley pole carry the trolley-wheel mounting.



NO. 774,082.—TELEPHONE METER.

774,090. Alternating-current Selector. Hermann Lemp, Lynn, Mass., assignor to the General Electric Company, Schenectady, N. Y. Application filed December 1, 1897.

In an alternating-current rectifier or selector are a set of stationary contacts, a set of moving contacts, and an air gap that is constantly maintained between the two sets of contacts, the resistance of which varies with the movement of the contacts.

774,118. Roentgen-ray Tube. Elihu Thomson, Swampscott, Mass., assignor to the General Electric Company, Schenectady, N. Y. Original application filed February 14, 1898. Divided and this application filed April 26, 1902.

Combined with a tube adapted to generate X-rays are a gas-yielding agent within the tube, and means for causing rays generated in the tube to liberate gas.

EXPIRING PATENTS.

Following is a list of electrical patents (issued by the United States Patent Office) that expired on November 8, 1904:

372,657. Electrical Repeating Bell. H. B. Cox, Cincinnati, Ohio.
372,658. Galvanic Battery. H. B. Cox, Cincinnati, Ohio.
372,734. Carbon Battery. C. H. Wilder, Natick, Mass.
372,797, 372,798, 372,799. Electrical Distribution. J. W. Howell, New Brunswick, N. J.
372,805. Telegraphic Transmitter. G. Juengst, Croton Falls, N. Y.
372,808. Electrotherapeutic Apparatus. F. J. Kneuper, New York, N. Y.
372,822. Dynamo Electric Machine. F. J. Sprague, New York, N. Y.
372,823. Electric Motor. F. J. Sprague, New York, N. Y.
372,824. Electrical Pumping Apparatus. F. J. Sprague, New York, N. Y.
372,846. Telegraphic Transmitter. W. W. Evans, Washington, D. C.
372,851. Electrical Current Indicator. J. F. Kelly, Hoboken, N. J.
372,860. Resistance Regulator for Electric Currents. G. Montanus, Frankfort-on-the-Main, Germany.
372,910. Electric Motor. D. Higham, Philadelphia, Pa.
372,926. Electrical Cloth-cutting Machine. F. W. Novens, Minneapolis, Minn.
372,934. Method of and Apparatus for Connecting Alternate-current Generators. Oliver S. Shallenberger, Rochester, N. Y.
372,935. Apparatus for Connecting Alternate-current Electric Generators. Oliver S. Shallenberger, Rochester, N. Y.
372,936. Pressure-indicating Apparatus and Circuit for a System of Electric Distribution. Oliver S. Shallenberger, Rochester, N. Y.
372,940. Insulating Joint. F. H. Soden and J. H. Goehst, Chicago, Ill.
372,942. System of Electrical Regulation. W. Stanley, Jr., Great Barrington, Mass.
372,943. System of Electrical Distribution and Conversion. W. Stanley, Jr., Great Barrington, Mass.
372,944. Method of Electrical Distribution and Conversion. W. Stanley, Jr., Great Barrington, Mass.
372,945. Dynamo Electric Machine. W. Stanley, Jr., Great Barrington, Mass.
372,958. Electric Firing Mechanism for Guns and Shells. W. W. Bradley and J. R. Holroyd, Washington, D. C.
372,986. Regulator for Electric Lamps. S. Mathis, Norlanwelz, Belgium.
373,009. System of Electrical Distribution. H. M. Byllesby, Roselle, N. J.
373,010. Electric Meter. H. M. Byllesby, Pittsburg, Pa.
373,021. Galvanic Battery. J. W. Howell, New Brunswick, N. J.
373,029. Electric Converter. O. S. Shallenberger, Rochester, N. Y.
373,034. Dynamo Electric Machinery. H. E. Walters, Clifton, N. Y.
373,035. System of Electrical Distribution. George Westinghouse, Pittsburg, Pa.
373,036. Automatic Circuit-controlling Apparatus for Systems of Electrical Distribution. G. Westinghouse, Pittsburg, Pa.
373,037. System of Electrical Distribution. G. Westinghouse, Pittsburg, Pa.
373,038. Converter Box. G. Westinghouse, Jr., Allegheny, Pa.

SPECIAL MENTION.

All the comforts of club and home are to be found on the Pennsylvania Limited, which leaves Union Station, Chicago, daily at 6 p. m. Time to New York, 23 hours. Maid on this train to look after ladies and children traveling alone. Most perfect train running out of Chicago. Try it next time you go East. Tickets and full information at city office, 248 Clark Street, Chicago.

The International Telephone Manufacturing Company of Chicago, which is rebuilding the public-service telephone exchange for the municipality of Neepawa, Manitoba, Canada, has secured, in addition to its contract for central-office equipment, an order for subscribers' telephones, replacing those formerly in use. When the exchange is completed it will be fully equipped with International apparatus, replacing equipment made in France.

President Frank W. Boyer of the Chicago Mica Company, Valparaiso, Ind., visited Chicago last week. Mr. Boyer came West on a hurried business trip, touching at Valparaiso and Chicago, returning thence to Philadelphia. Mr. Boyer is with the Baeder-Adamson Company of Philadelphia and can only visit his interests at Valparaiso occasionally. The direct management of the Chicago Mica Company's plant is in the hands of Secretary E. H. Heilstedt, whose successful handling of the business and maintenance of President Boyer's liberal business policy, has brought the company to its present enviable position in the mica trade.

WESTERN ELECTRICIAN

EVERY SATURDAY

Vol. XXXV. CHICAGO, NOVEMBER 19, 1904 No. 21

Electric Locomotives in Use in Chicago Freight Tunnels.

Several articles have appeared in the Western Electrician concerning the tunnel system of the Illinois Tunnel Company in Chicago, the last one describing the system in general, being in the issue of February 13, 1904. This article gave a description of the system, including a map of the business portion of the city showing the streets then underlaid by tunnels. Reference was also made to an electric locomotive then being tested. Since that time work upon the system has proceeded. The tunnels are now being extended under the Chicago River to tap the active manufacturing portion of the West Side, and a large amount of the clay which is excavated in the erection of a number of the new office buildings now going up in the city is taken away to the dumps on the lake shore by the underground system.

There are two types of locomotive used at present in the tunnels, one operating with a rack and pinion, which serves at once as a current-collecting means and to furnish the necessary tractive power; the other type of locomotive operates with a trolley. The rack and pinion is used in those portions of the tunnel where there is any considerable grade.

Fig. 1 is a view taken at the mouth of the tunnel at Grant Park on the lake shore near Michigan Avenue. At this point the trestlework begins, which runs out to the fills which are being made on the shore. The grade of the track here as it ascends from the level of the tunnels under the streets is nine per cent. and the rack-and-pinion third rail is used. As seen in the picture, the locomotive is in the rear of a train of cars, these cars having just arrived loaded from the extension work under the river. Flat cars are used for this work, and along the tops of the flat cars are laid track rails upon which, in turn, are run the small cars, loaded with clay, as shown in the picture. The reason that this method is adopted is that the large cars cannot be used to advantage in the drift of the tunnel where the men are working. They are run up to within a short distance of the work, and from there the small cars are run over a temporary track to where the workmen may shovel directly into them.

The locomotive which is shown in Fig. 1 is manufactured by the Morgan Electric Machine Company of East Chicago, Ind., and is built along the lines of a gathering locomotive used in mines. Fig. 2 shows side and end elevations. One motor is used, of 75-horsepower capacity, and the locomotive complete weighs 6,000 pounds. The maximum height from the top of the rail is 3½ feet and the length over all seven feet. The voltage is 250. A substantial steel frame is mounted on suitable track wheels. Into this steel frame are mounted two steel sprockets or traction wheels, which are driven by means of suitable gearing. The sprocket wheels (A) which engage the third rail (C) serve the double purpose of driving the locomotive along the track and taking up the current from the third rail to feed the motor. The sprocket wheels are geared to always run in unison, avoiding all difficulty in crossing switches or other openings in the track.

The track rails are used as the return conductor. The third rail (C) consists of heavy iron bars, perforated at regular intervals throughout their entire length, and made into a continuous rail by means of fishplates, much after the manner of regular track rails. This continuous rail is enclosed and depressed in a specially prepared wood casing (D), which serves the double purpose of insulating the rail and protecting men and animals from the current. Fig. 3 is a diagram of connections.

The general arrangement of the operating devices may be seen in Fig. 1. As the motorman sits at the rear of the locomotive the controller is at his left hand. Turning the controller in one direction sends the locomotive ahead and in the reverse direction backs it. At the right hand is the brake wheel, which operates a friction clutch mounted on the armature shaft.

The locomotive shown in Fig. 1 is used for pushing loaded trains up the incline at Grant Park is already mentioned. Cars are brought to it, back in the level parts of the tunnel, by locomotives operating with a trolley. Fig. 4 is a picture showing the sub-basement of a new office building which is being erected at the corner of Madison Street and Wabash Avenue, and here a trolley type of locomotive is shown about to draw a load of side-dump cars which have been filled by excavations made under the building. This picture is of interest in that it shows a practical application of the tunnel cars. Years of time and millions of dollars in money have been expended in building the tunnels, and during all that time returns on the investment were, of course, not possible. Now, however, the tunnels are beginning to make some returns to the owners, and the picture just referred to shows one of the ways this is being done.

The sub-basement of the building, as seen in the picture, extends down nearly to a level with the tunnel under Madison Street. A lateral tunnel, which is seen in the picture, connects the basement with the main tunnel upon a slight grade. In the basement will be located the power plant of the building, and in all probability the coal for the operation of this will be brought in through the tunnel.

The locomotive shown in Fig. 4 was designed and built by the General Electric Company specially for the Chicago tunnel service, although it embodies a great many features which have been successful in mining fields. It weighs 9,000 pounds and has

FIG. 1. ELECTRIC LOCOMOTIVES IN USE IN CHICAGO FREIGHT TUNNELS.—RACK-AND-PINION (THIRD RAIL) TYPE ON LAKE FRONT INCLINE PUSHING FLAT CARS CARRYING LOADED DUMP CARS.

a rated drawbar pull of 1,200 pounds at six miles an hour. The frame of the locomotive consists of two heavy side castings and two end castings, carefully machined at the joints and held together by means of heavy bolts, giving the whole structure the rigidity of a solid casting. The side frames are cored out for axle boxes, axle springs, sand boxes and trolley pole.

The axle boxes are of the regular railway type with removable brass linings, and are lubricated from oil cellars filled with waste. The weight of the locomotive is supported from the axle boxes by means of heavy coiled springs. The brake consists of a vertical screw surmounted by a hand-wheel carrying a nut which is connected to the brake chains at each side of the locomotive by means of an equalizing bar. The pitch of the screw is such that a slight exertion will skid the wheels. The length of the threaded portion of the screw is sufficient automatically to compensate for the wear of the brake shoes, and no other adjustment is necessary. An important feature of this brake mechanism is that it is automatieally locked in any position in which it is left by the operator without the use of pawls or ratchets.

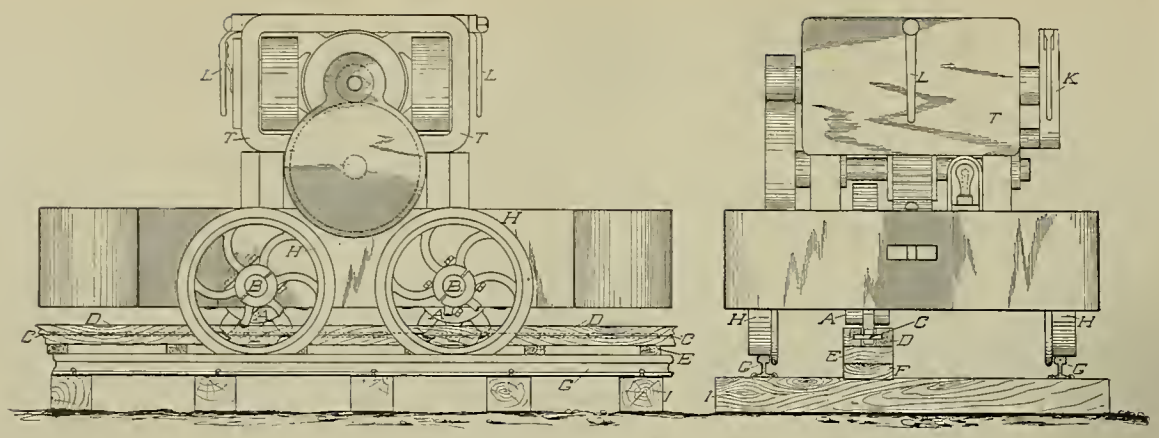


FIG. 2. ELEVATIONS OF THIRD-RAIL LOCOMOTIVE USED IN CHICAGO FREIGHT TUNNELS.

FIG. 4. ELECTRIC LOCOMOTIVES IN USE IN CHIGAGO FREIGHT TUNNELS.—TROLLEY TYPE.

The brake shoes are of a removable type. The shoe proper is made of cast steel, and by loosening a set-screw it may be moved from the periphery of the wheel and a new shoe dropped into place.

Four sand boxes are provided, operated in pairs. The valves are flat and are opened by levers located conveniently near the motor-runner, and closed by springs The locomotive is equipped with chilled-iron wheels pressed on and securely keyed to steel axles.

The controller is of the rheostatic magnetic-blow-out type, especially designed for mining locomotives. A commutating switch is incorporated in the reverse cylinder, the handle of which has four "on" positions, two for each direction of motion, one with the motors in series and the other with the motors in multiple. The main and reverse cylinders are interlocked in the usual manner and the controller provides for five speeds with the motors in series or multiple, four with resistance in circuit and one with full potential on the motors. The motors should be operated in multiple when starting a heavy load or hauling a loaded trip, and in series when running in with the empties or switching. This feature effects a considerable economy in the current and tends to eliminate trouble due to heating of the rheostats. An auxiliary contact is placed at the bottom of the main cylinder to equalize the fields of the motors when the controller is in the "off" position. This is done in order to prevent the motorman from retarding the train by "bucking" the motors, one acting as a generator and the other as a motor, a practice which is liable to cause trouble.

Fig. 5 is a diagram of the controller connections.

The locomotive equipments include a standard railway circuit-breaker, standard railway rheostats and an efficient headlight in which the reflector is protected from dirt and corrosion by a thick glass front, which is shielded by vertical bars, which do not materially cut off the light.

A new type of jack-knife trolley was especially designed for the Illinois Tunnel Company's system, in certain sections of which, particularly where the telephone cables are installed, the available space for turning a trolley is extremely limited.

The locomotive has two independent sets of driving wheels, and upon the axle of each is mounted a motor of the standard railway type. The motors are flexibly supported and arranged in tandem, that is, one motor between the axles and the other outside. The axles are driven by single-reduetion gearing, with machine-cut teeth, and the gear and pinions are enclosed in a malleable-iron dustproof case partially filled with oil.

The weights and wheel base of the locomotive are so proportioned that no trouble is experienced from rocking and no difficulty is met with in negotiating the curves, so that there has not in this service been a single case of derailment.

Government to Conduct Timber-seasoning Tests.

The Bureau of Forestry of the national Department of Agriculture has recently signed an agreement to make extensive timber-seasoning tests in two western states, in co-operation with two telegraph and telephone companies. Experimental stations will be located at Marinette, Wis., and Escanaba, Mich., and probably a third station will be established at Ashland, Wis. The expense of the experiments will be borne jointly by the bureau and the companies. Cedar and tamarack telephone and telegraph poles will be furnished by the state of Wisconsin free of cost, and two railroad companies have agreed to haul them to the experiment station without charge for freight.

The object of the experiments is to determine how many years can be added to the life of each pole by proper seasoning. Since millions upon millions of poles are used along telegraph and telephone lines, even one year's extra service for each pole will amount to a tremendous saving in expense. Unseasoned cedar poles last from 12 to 15 years. Seasoning experiments have shown how to increase this time by three or four years, and it is now expected to improve on this increase. Past methods of seasoning have effected a drying out of 20 per cent.

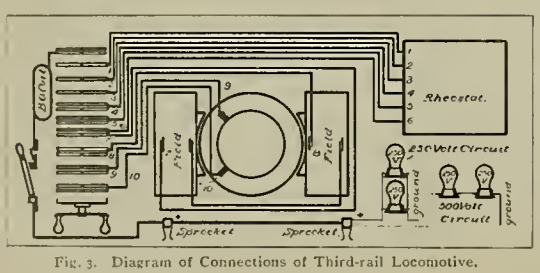


Fig. 3. Diagram of Connections of Third-rail Locomotive.

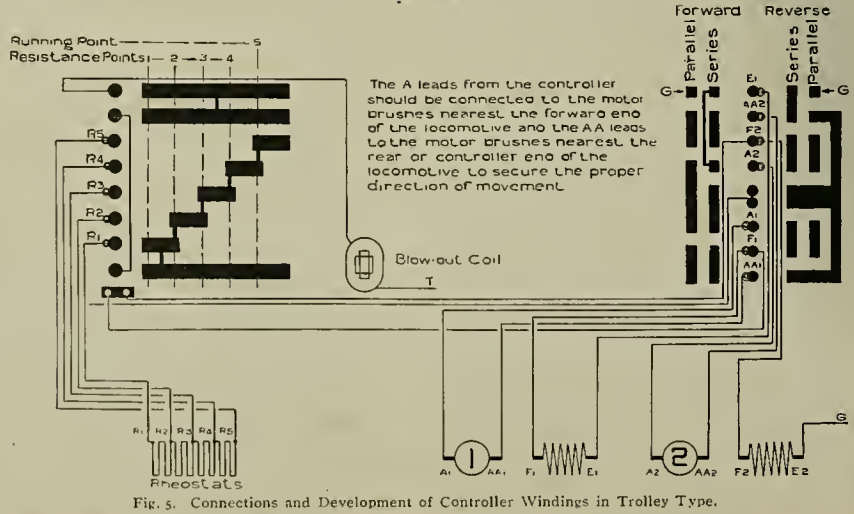


Fig. 5. Connections and Development of Controller Windings in Trolley Type.

ELECTRIC LOCOMOTIVES IN USE IN CHICAGO FREIGHT TUNNELS

of the original weight of the poles. The better seasoned the pole, the less chance there is for decay, which is promoted by moisture.

Such experiments are of large importance not only to telegraph and telephone companies, but to all users of heavy timbers which come in contact with the ground, at which line decay gets in its most deadly work. It is believed that still greater economies can be secured by the use of proper methods of preservative treatment. These experiments will undoubtedly be watched with great interest.

Death of James M. Thomas.

James M. Thomas, one of the staunch Independent telephone men of the country, died at his home at Irvington, N. Y., on November 8th from a complication of diseases of the stomach. While his end was not unexpected, his illness having been of such a nature as to make recovery almost impossible, the news of his death has been a great shock to all his friends and he will be mourned in all parts of the country, having been widely known through his untiring efforts in behalf of the Independent telephone movement.

James M. Thomas was born on a farm in Ross County, Ohio, April 24, 1858. He received his education in the common schools and in Ohio Wesleyan University of Delaware, Ohio, from which institution he graduated. After graduation he taught school, studied law and was admitted to the bar and practiced in Chillicothe, Ohio. He was elected probate judge of Ross County in 1892, which office he filled for six years. During his incumbency of the office of probate judge in 1894 he, with some others, became interested in the Home Telephone Company of Chillicothe, of which corporation he was elected president and in which capacity he served until his removal from the city. This company's exchange went into service in the spring of 1895, being one of the first Independent tele-

JAMES M. THOMAS.

phone plants in the Middle West. This institution is now doing a flourishing and prosperous business.

At the expiration of his term of office he moved to Cleveland, Ohio, where he became vice-president and general manager of the United States Telephone Company, the pioneer Independent long-distance telephone company of the United States. He served in this capacity for two years, removing to New York to become vice-president and general manager of the Telephone, Telegraph and Cable Company of America, an organization having for its object the installation of a complete telephone system in the city of New York and vicinity. He afterward resigned as vice-president and general manager of this organization and began the general practice of law in New York city, which he continued until his last illness, when he retired to his home at Irvington-on-the-Hudson, where he died November 8, 1904.

In 1897 at the organization of the Independent Telephone Association of the United States at Detroit he was elected its first president and was re-elected annually for five years thereafter, being succeeded by Hon. Hugh Dougherty of Indiana at the convention of the national association in June, 1903.

Judge Thomas was chairman of the litigation committee of the national association and as such took a leading part in the litigation begun by the American Bell Telephone Company, seeking to preserve the exclusive rights to all apparatus manufactured under the Berliner patents. This involved the right to use the so-called Berliner telephone transmitter, which litigation, if successful, would probably have been a fatal blow to the Independent telephone interests. The Bell Telephone Company failed in this litigation more largely as the result of the efforts of Judge Thomas in stimulating active defense than from any other cause or causes. His efforts for Independent telephony were persistent and consistent, and to them, especially during the earlier years of Independent telephony, is more largely due the success attained by the non-Bell companies than to any other one man.

He was a noble-hearted, generous, broad-minded man, one who made friends readily and held them tenaciously; lovable, tender, gentle, energetic and faithful; a man whose loss will be felt not only by a very large and wide circle of personal friends but by business associates and all interested in the welfare of Independent telephony.

Plans for Chicago Subway.

The local transportation committee of the Chicago City Council has received a detailed report from Engineer George W. Jackson together with plans and a general outline for a street-railway subway in the main business district of Chicago. According to the plans a 10-mile subway could be completed within 2½ years at a cost of $18,500,000.

Mr. Jackson proposes subway loops for the Wabash Avenue lines north of Twelfth Street, for the State Street lines north of Eldredge Place, for the Clark Street lines north of Eighteenth Street, for Van Buren Street east of Halsted, and for the Madison Street, Milwaukee Avenue and North Clark Street lines in the downtown district. The plans were ordered published by the committee, after which the subway proposition will be considered.

George Richardson, a Chicago inventor, also presented plans for a subway under the streets occupied by the elevated loop. He proposes to make the subway 60 feet wide, put four tracks in it and operate the surface cars on the same plan the elevated cars are run on the loop.

Control of Electrical Concessions in Chile.

A new law with reference to electrical concessions has recently been enacted in Chile and provides that the grant of concessions for electrical enterprises falls within the functions of the president of the republic, who is also to take measures for the inspection of electrical tramways and other enterprises from the point of view of public safety. Concessions for electrical undertakings with underground wires may be granted for 20 years, but the term of those with overhead wires is not to exceed 10 years. In Santiago, Valparaiso and other towns where electric tramways exist the electric telephone and lighting wires and other conductors for distributing electric power are to be placed underground, four years being allowed for the work.

Exhibition and Trial of New York Central Electric Locomotive.

Ever since the plans were first formulated for the electric locomotives which are to handle the terminal traffic in and near New York city of the New York Central and Hudson River Railroad Company, engineers and others have been looking forward anxiously to the time when one of the locomotives should be completed and actual tests made of the power. Such a test was made near Schenectady, N. Y., on November 12th, for the electric-traction commission of the railroad company and its guests. As readers of the Western Electrician are aware, these locomotives are being built by the General Electric Company and the American Locomotive Works.

FIG. 1. EXHIBITION AND TRIAL OF NEW YORK CENTRAL ELECTRIC LOCOMOTIVE.—LOCOMOTIVE ATTACHED TO SEVEN-CAR TRAIN.

The New York Central and Hudson River Railroad Company is now electrically equipping its New York terminal for a distance of 34 miles on the main line from the Grand Central Station to Croton and for 24 miles on the Harlem Division as far as White Plains. It is the intention to handle all the traffic within this district or zone electrically, and the locomotive just given trial is one of 30 to 50 which will be used in the haulage of the through passenger trains, the heaviest of which reach 875 tons in weight, and are to be hauled at maximum speed of 60 to 65 miles an hour.

By the use of the Sprague-General Electric multiple-unit system of control two or more locomotives can be coupled together and operated from the leading cab as a single unit. The motive power may, therefore, be easily adapted to the weight of the train with no complications in operation and with uniform make-up of the train crew. A single electric locomotive will be able to maintain the schedule with a 450-ton train, two locomotives being coupled together for heavier trains.

The locomotive developed remarkably easy riding qualities at high speeds and during acceleration, responding with ease and power to the will of the operator. Fig. 1 is a picture of the locomotive attached to a seven-car train.

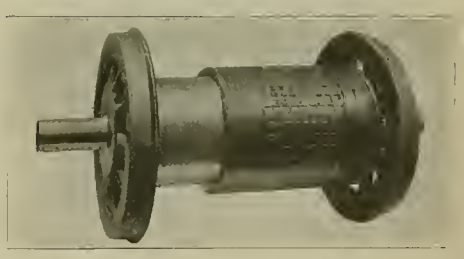


FIG. 2. ARMATURE MOUNTED ON AXLE OF NEW YORK CENTRAL ELECTRIC LOCOMOTIVE.

The locomotive consists of four driving axles, on each of which is mounted without intermediate gearing, as is shown in Fig. 2, the armature of an electric motor having a normal rating of 550 horsepower. The total rated capacity of the locomotive is 2,200 horsepower, although for short periods a considerably greater power may be developed, making it more powerful than the largest steam locomotive in existence.

Hitherto gearless locomotives have been built with the armatures of the electric motors mounted

on quills and spring-suspended from the driving wheels. In the new locomotive the use of spring-suspended quills is dispensed with, the armature being mounted rigidly upon the axle, thus reducing the bearings to those of the pony trucks and the main journals, all of which are outside of the driving wheels. The motor has two poles with flat faces so as to permit a large relative vertical movement between armature and poles as the latter move up and down with the riding of the frame upon the springs.

The main frame of the locomotive is of cast steel,

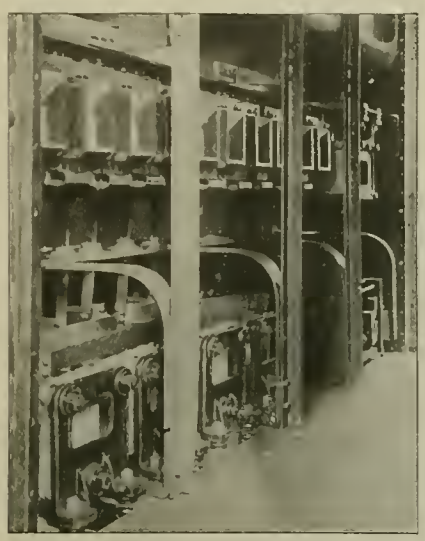


FIG. 3. RHEOSTATS AND CONTACTORS ON NEW YORK CENTRAL ELECTRIC LOCOMOTIVE.

and forms not only the mechanical frame of the locomotive, but also part of the magnetic circuit of the electric motors. The armatures are arranged in tandem, the end pole-pieces being cast as part of the end frames and the double pole-pieces between the armatures being carried by heavy steel transoms bolted to the side frame and forming part of the magnetic circuit, as well as cross-braces for the truck. The field coils are wound upon metal spools, which are bolted upon the pole-pieces. Proper distribution and division of the weight of the locomotive among the axles have been accom-

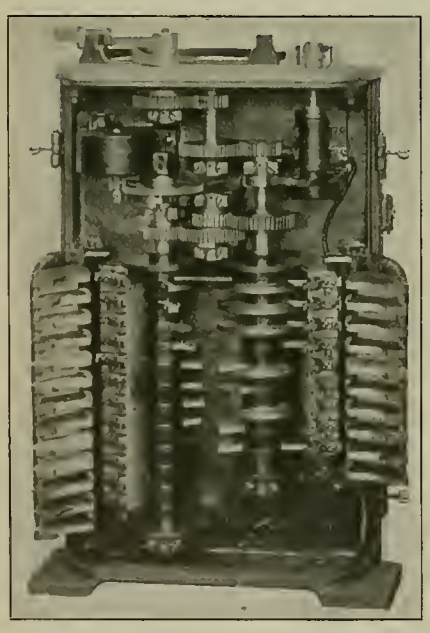


FIG. 4. CONTROLLER FOR NEW YORK CENTRAL LOCOMOTIVE FITTED WITH SPECIAL OPERATING LEVER.

plished by suspending the main frame and superstructure from a system of half elliptic springs and equalized levers of forged steel, the whole being so arranged as to cross-equalize the load and to furnish three points of support. The pony trucks are of the radial type and are pivoted by means of radius bars to the end frame of the main truck.

The brush holders are mounted on insulated supports attached to the spring saddle over the axle journal, thus maintaining a fixed position of the brush holder in relation to the commutator. These brush holders are made adjustable, so as to allow for wear of the commutator and journal bearings.

The superstructure consists of a central cab for the operator, containing master controllers, engineer's valves, and switches and valves required for operating sanding, whistling and bell-ringing devices. This apparatus is furnished in duplicate, one set on each side of the cab, and is arranged so as to be easily manipulated from the operator's seat, while at the same time a practically unobstructed view to front and rear may be obtained from the windows. The air gauge, meters, etc., are located so as to be easily read by the driver.

Extending through the cab is a central corridor arranged so as to permit access from the locomotive to the cars behind. The contactors, rheostats and reversers (Fig. 3) are arranged along the sides of the corridor in boxes of sheet steel, which are sheathed on the inside with fireproof insulating material. All of these appliances are therefore easily accessible for repairs or inspection.

The control system permits three running connections, namely, four motors in series, two groups of two in parallel-series, and all four motors in parallel. The motor reverser, contactors, rheostats and other controlling appliances are all of the Sprague-General Electric multiple-unit type. The master controller (Fig. 4), however, is fitted with a special operating lever about 24 inches long and capable of being moved through an angle of about 75 degrees. A current-limiting device is provided in the master controller and consists of a friction clutch operated by an electric magnet, which is energized by the current passing through one of the motors, the arrangement being such that when the current exceeds a predetermined amount the cylinder cannot be rotated further until the current has fallen sufficiently to allow the relay to drop. As long as the current does not exceed the desired limit the automatic feature is not in operation.

In the operator's cab there is placed a General Electric motor-driven air compressor having capacity of 75 cubic feet of free air per minute and consisting of a twin vertical-cylinder compressor driven by two 600-volt direct-current series motors. The compressor is controlled by a governor which automatically cuts the motors in and out of circuit when the air pressure falls below 125 pounds or rises about 135 pounds. A reduction in air pressure sufficient to

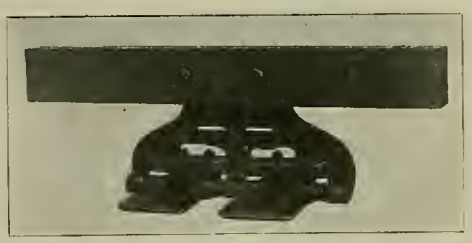


FIG. 5. CONTACT SHOE FOR NEW YORK CENTRAL ELECTRIC LOCOMOTIVE.

actuate any governor, simultaneously starts up the air compressors in both locomotives when running double-headed, and likewise when the air pressure has been raised and any one air compressor is closed down the other will be cut out of service.

Current is collected from the third rail by multiple-contact spring-actuated third-rail shoes (Fig. 5), whose supports are carried on channel irons attached to the journal box. There are four of these shoes on each side of the locomotive. In the yards at the terminal the large number of switches and crossings necessitates an overhead construction in places, and additional contacts are therefore mounted on the top of the locomotive for collecting current when the locomotive is passing over these points. These devices are plainly shown in Fig. 1. They may be raised and lowered by air pressure controlled from the engineer's cab. A magnetic ribbon fuse is placed in circuit with each shoe and overhead contact device so as to secure protection in case of accidental short-circuit.

It is the intention of the New York Central company and the General Electric Company to make complete preliminary tests and trials on these locomotives under all conditions likely to obtain in service operation. For this purpose the railroad company has set aside a six-mile stretch of track on its main line between Schenectady and Hoffmans, which has been equipped with standard third-rail construction. The track is practically straight and ballasted so as to permit a speed of 70 to 80 miles per hour being attained.

Power for operating the locomotive is furnished by the General Electric Company, and for this purpose there has been installed in the new power house at the Schenectady plant a 2,000-kilowatt three-phase 25-cycle Curtis turbo-generator (Fig. 6), delivering 11,000 volts to the line. A special high-tension transmission line has been constructed from the power station for a distance of five miles to the sub-station at Wyatts. This sub-station, which is shown in Fig. 7, contains a 1,500-kilowatt, 650-volt, 25-cycle General Electric rotary converter, with necessary static transformers for reducing the line potential from 11,000 to 460 volts, and a switchboard consisting of a 600-volt direct-current rotary-converter panel, an alternating-current starting panel and a high-tension panel with electrically operated oil switch. The rotary converter is self-starting from the alternating-current end, thus requiring no synchronizing or other complications when throwing machine into service. The step-down transformers are provided with taps giving one-third, two-thirds and full voltage for starting the rotary converter, these voltages being applied successively by means of double-throw lever switches. The machine starts freely and easily without sparking and without drawing more than full-load current from the line.

The apparatus in the sub-station, its location and arrangement and the dimensions are in general as proposed for the sub-stations to be built within the electric zone at the New York city terminal, so that

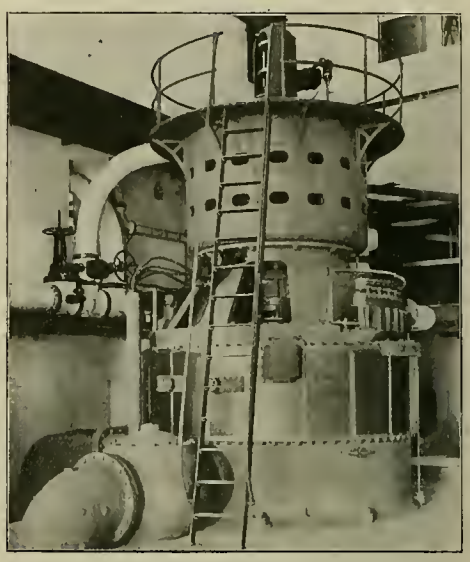


FIG. 6. CURTIS STEAM TURBINE FURNISHING POWER FOR ELECTRIC LOCOMOTIVE TESTS.

practical experience with the plant may be obtained while the locomotive tests are being made and in advance of construction. This power station, transmission line, sub-station equipment and six miles of track is probably the most complete testing plant ever provided for trial of electric-railroad motive power. Fig. 8 is a picture showing the exterior of the sub-station and nearby special overhead construction.

General dimensions and data applying to the locomotive are as follows:

Number of driving wheels	8
Number of pony trucks	2
Total weight of locomotive	95 tons
Weight on drivers	69 tons
Rigid wheel base	13 feet
Total wheel base	27 feet
Length over buffer platforms	37 feet

FIG. 8. SPECIAL OVERHEAD WORK AND SUB-STATION NEAR SCHENECTADY, FOR ELECTRIC LOCOMOTIVES.

Extreme width	10 feet
Height to top of cab	14 feet 4 inches
Diameter of drivers	44 inches
Diameter of pony truck wheels	36 inches
Diameter of driving axles	8.5 inches
Normal rated horsepower of locomotive	2,200
Maximum horsepower	3,000
Normal drawbar pull	20,400 pounds
Maximum starting drawbar pull	32,000 pounds
Speed with 500-ton train	60 m. p. h.
Voltage of current supply	600
Normal full-load current	3,050 amperes
Maximum full-load current	4,300 amperes
Number of motors	4
Type of motors	GE-84-A
Rating of each motor	550 horsepower

Owing to the fact that only a portion of the track to be used for testing is available as yet, no com-

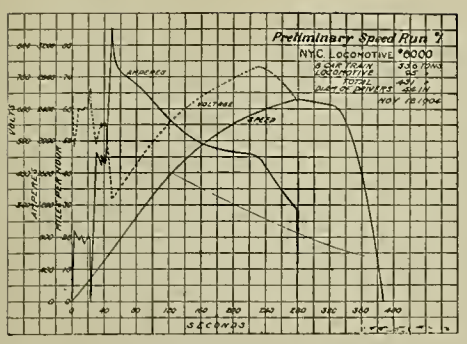


FIG. 9. CURVES OF PRELIMINARY SPEED RUN NO. 1 OF NEW YORK CENTRAL ELECTRIC LOCOMOTIVE.

plete locomotive tests have been made. There has been installed in the cab a full set of recording instruments, and records have been obtained of some of the preliminary runs made to test the bearings and running qualities of the locomotive. Although these records will be superseded by careful tests made on the full length of track, bonded and with sufficient feeders supplied to minimize the drop, they indicate in a general way what may be expected of the locomotive running in regular service. Curve sheets are here shown, giving speed, current input and voltage at the locomotive, all on a time basis, with an eight-car train weighing 336 tons and a four-car train weighing 170 tons, both exclusive of locomotive. The total weight of train, including locomotive and passengers, was 431 tons, and 265 tons for the eight-car and four-car trains, respectively.

Two sets of curves are shown, two running tests (Figs. 9 and 10) reaching as high a maximum speed as possible with the length of track available, and two sets of starting tests (Fig. 11) showing the more rapid rate of acceleration possible with the higher maintained voltage available near the substation. The maximum speeds reached were 63

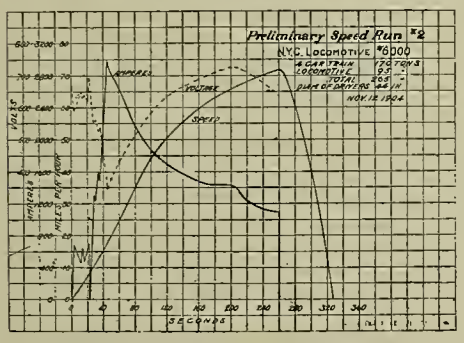


FIG. 10. CURVES OF PRELIMINARY SPEED RUN NO. 2 OF NEW YORK CENTRAL ELECTRIC LOCOMOTIVE.

miles per hour with an eight-car train and 72 miles per hour with a four-car train. It will be noted that the trains were still accelerating at these speeds, but the length of track so far equipped did not permit attaining higher speeds.

The New York Central locomotives are not designed for abnormally high speeds at intervals, but rather to obtain a high average schedule, due to their ability to accelerate more rapidly than is possible with the present steam locomotives.

In the starting tests a speed of 30 miles per hour was reached in 60 seconds with an eight-car train weighing, including the locomotive, 431 tons, corresponding to an acceleration of one-half mile per hour per second. During certain periods of the acceleration the increase in speed amounted to 0.6 miles per hour per second, calling for a tractive effort of approximately 27,000 pounds developed at the rim of the locomotive drivers. This value was somewhat exceeded with the four-car train, where a momentary input of 4,200 amperes developed a tractive effort of 31,000 pounds at the drivers with

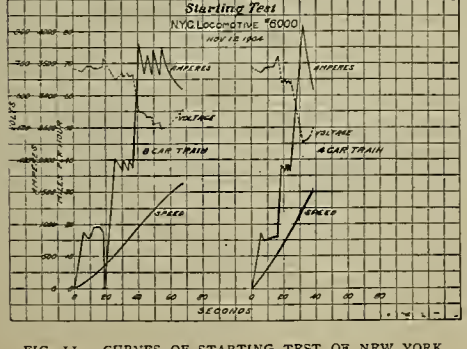


FIG. 11. CURVES OF STARTING TEST OF NEW YORK CENTRAL ELECTRIC LOCOMOTIVE.

a coefficient of traction of 22.5 per cent. of weight on drivers. The average rate of acceleration with the four-car train, weighing, including the locomotive, 265 tons, was 30 miles in 37½ seconds, or 0.8 miles per hour per second, calling for an average tractive effort of 22,000 pounds.

The maximum input recorded, 4,200 amperes at 460 volts, or 1,935 kilowatts, gives an output of the motors of 2,200 horsepower available at the wheel. With 4,200 amperes and a maintained potential of 600 volts there would have been an input to the locomotive of 2,520 kilowatts, corresponding to 2,870-horsepower output of the motors. This

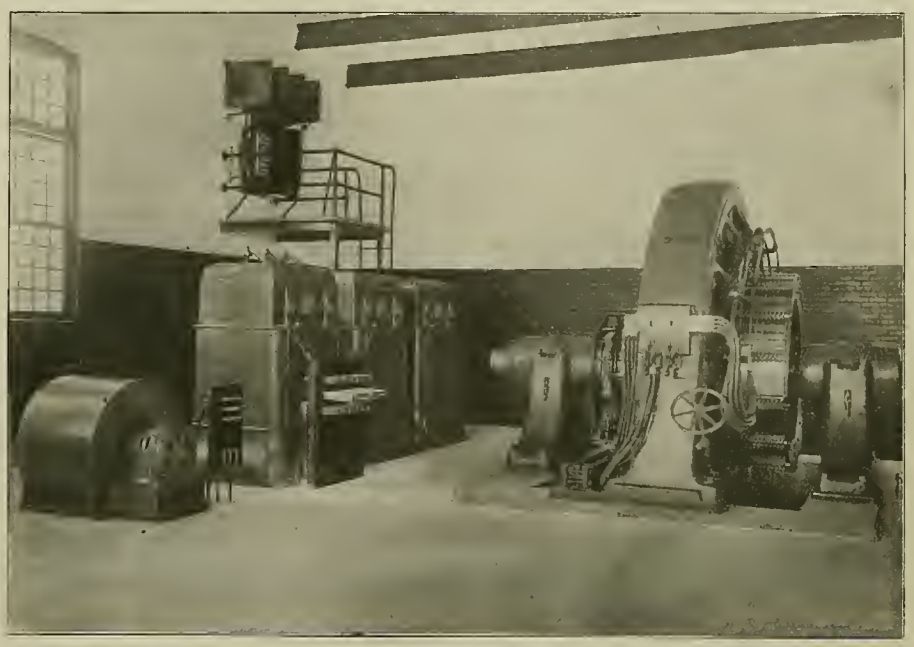


FIG. 7. INTERIOR OF SUB-STATION TO BE USED EXCLUSIVELY FOR TESTING NEW YORK CENTRAL ELECTRIC LOCOMOTIVES.

output is secured without in any way exceeding the safe commutation limit of the motors and with a coefficient of traction of only 22.5 per cent. of the weight upon the drivers, thus placing this electric locomotive in advance of any steam locomotive yet built. No service-capacity temperature runs have been made as yet, and the preliminary tests have not shown any appreciable warming up of the motors sufficiently to take thermometer readings. Throughout both the starting and running tests the

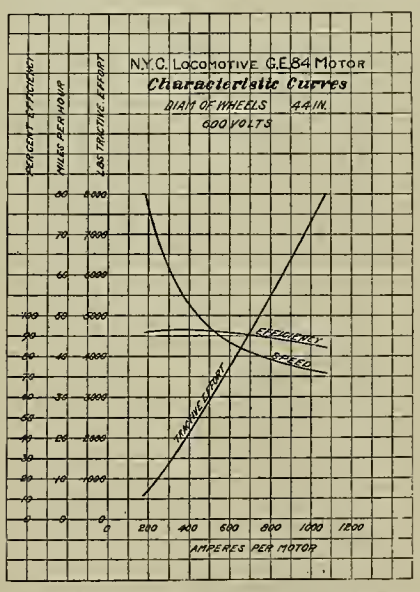


FIG. 12. CHARACTERISTIC CURVES FOR MOTOR OF NEW YORK CENTRAL ELECTRIC LOCOMOTIVE.

electric locomotive shows its remarkable steadiness in running, a distinct contrast in this respect to the steam locomotive, especially should the latter be forced to perform the work here shown to be accomplished by the electric locomotive.

The elimination of gear and bearing losses permits of a very high efficiency of the locomotive. Reference to the motor characteristics (Fig. 12) shows a maximum efficiency of approximately 93 per cent., this value being fully four per cent. better than possible with motors of the geared type. This gain is especially noticeable at the high speeds, the efficiency curve remaining above 90 per cent. even at the free-running speed of the locomotive alone in contrast to the 85 per cent. or less, which would be a good showing for a locomotive provided with geared motors. The simple construction and high efficiency made possible with this design of gearless motor together with the minimum cost of repairs attending such a construction makes the direct-current gearless-motor type of locomotive a distinct forward step in electric-locomotive construction.

Among those present at the test of November 12th were Messrs. W. J. Wilgus, John F. Deems, Bion J. Arnold, Frank J. Sprague and George Gibbs of the Electric Traction Commission of the New York Central, T. Voorhees of the Philadelphia and Reading, H. H. Vreeland of the Metropolitan street railway of New York, F. D. Underwood of the Erie railroad, M. B. Cutter of the Lehigh Valley, Samuel Rea of the Pennsylvania Railroad, W. H. Marshall of the Lake Shore, E. V. W. Rossiter of the New York Central, A. I. Culver of the Delaware and Hudson, C. A. Coffin, Eugene Griffin, E. W. Rice, W. B. Potter and J. R. Lovejoy of the General Electric Company, James McNaughton of the American Locomotive Company and George Westinghouse of the Westinghouse Electric and Manufacturing Company.

Electric Wires Prostrated by Storm in the East.

The worst wind and snow storm in the East since 1888 centered along the Atlantic Coast between New England and Virginia on November 13th. All direct wire communication between the East and Chicago was cut off and all news to the West was sent by cable to Newfoundland, then across Canada and into the United States. In New York city on the 14th business on the stock, grain and cable exchanges was paralyzed for hours and the city was cut off from telegraph communication with the country west of Baltimore and east of Boston. At Albany it is reported that all telegraph and telephone poles were down, the fire-alarm service was crippled and the city was in darkness. In Boston and other cities the storm was severe and the streets were made dangerous by live wires. The national capital depended on Chicago for its news from the East, as every one of the 88 wires to Baltimore were down. The first direct communication with Chicago from Baltimore was established by the Associated Press over a telephone wire. The great weight of the wet snow and the force of the wind brought down thousands of poles. In the 55 miles between Waterville and Bangor, Me., the Western Union Telegraph Company reports 564 poles down. The consequence of the storm was the greater when it is considered that the poles carrying the wires working from coast to coast were damaged. The work of repairing the lines was difficult, but is gradually being completed.

A Meteorological Explanation.

"What's all this stuff in the newspaper about an electric storm in your neighborhood?"

"There isn't anything in it. My wife has been missing things from our clothesline every washday, and I rigged up a pretty strong battery and charged the clothesline—it's a wire one—with a lively current; and some of the neighbors who got burnt appear to think it must have been an electric storm."
—Cleveland Plain Dealer.

WESTERN ELECTRICIAN

EVERY SATURDAY.

PUBLICATION OFFICES:
510 Marquette Building, - CHICAGO.
TELEPHONE, MAIN 1746.

Eastern Office, 193 Times Building, New York.
Telephone, 3806J Cortlandt.

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted. This paper is entered at the Chicago postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the **old address** as well as the new should be given.

CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—**the only general electrical paper published in the West**—thoroughly covers a territory *exclusively its own.* THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be furnished on application.

REMITTANCES.—All checks, drafts and other remittances should be made payable to the order of the publishers, the **Electrician Publishing Company,** and addressed to the offices of publication, Suite 510, Marquette Building (204 Dearborn Street), Chicago, Illinois, U. S. A.

CONTENTS OF THIS NUMBER.

Electric Locomotives in Use in Chicago Freight Tunnels. Illustrated 405, 406
Government to Conduct Timber-seasoning Tests.... 406, 407
Death of James M. Thomas. Portrait..... 407
Plans for Chicago Subway..... 407
Control of Electrical Concessions in Chile..... 407
Exhibition and Trial of New York Central Electric Locomotive. Illustrated 407, 408, 409
Electric Wires Prostrated by Storm in the East..... 409
The Private Trolley Car..... 409
Editorial 410
Use of Electricity in Spreading Election Returns..... 411
Proposed Changes in Philippine Tariff..... 411
World's Fair Visitors of Last Week..... 411
The Transposition of Electrical Conductors. By Frank F. Fowle. Illustrated. With discussion. (American Institute of Electrical Engineers)..... 412, 413
Small Electric Refrigerating Plant for the Household. Illustrated 413
Railroad Terminal Electrification..... 413
Telephone News from the Northwest..... 414
Ohio Telephone Notes 414
Electrical Section of Western Society Discusses the Telephone 414
Extensions and Improvements..... 414
Some Interesting Phases of Long-distance Telephony. By S. G. McMeen. With discussion. (Western Society of Engineers) 414, 415
Journey of a Telephone Message..... 415
Lineman's Testing Instrument. Illustrated..... 415
Adjustable Hangers for Lamp Cords. Illustrated..... 415
Printing Telegraphy. By Louis M. Potts. Illustrated. (International Electrical Congress)..... 416, 417
Book Table 417
Homan's "Self-propelled Vehicles" 417
Walmsley's "Modern Practical Electricity"..... 417

DEPARTMENTS.

Correspondence 418, 419, 420
Great Britain 418
New York 418
New England 418
Dominion of Canada 418, 419
Southeastern States 419
Ohio 419
Northwestern States 419
Michigan 419
Pacific Slope 419, 420
Personal 420
Electric Lighting 420
Electric Railways 420
Power Transmission 420
Societies and Schools..... 420, 421
Publications 421
Telegraph 421
Space Telegraphy 421
Miscellaneous 421
Trade News 421
Business 421
Illustrated Electrical Patent Record..... 421, 422

DATES AHEAD.

Electrical committee of the Underwriters' National Electric Association (annual meeting), 32 Nassau Street, New York city, December 7th.

American Society of Mechanical Engineers (annual meeting), New York City, December 6th, 7th and 8th.

Interstate Independent Telephone Association of America (annual convention), Auditorium Hotel, Chicago, December 13th, 14th and 15th.

VISITORS to the Louisiana Purchase Exposition at St. Louis who are interested in electricity or electrical literature are cordially invited to call at the booth of the Western Electrician, which is in Block 1 (Section 13) of the Palace of Electricity, just west of the main northern entrance to the building. Here will be found copies of the current issue of the paper, bound volumes of the Western Electrician from the first number, a careful selection of electrical books exhibited by the Electrician Publishing Company, and other objects of electrical interest. Chairs are provided for weary sight-seers, and an attendant will extend a hearty welcome to all readers or friends of the paper.

ELECTRIC LOCOMOTIVES to be used for widely varying purposes are described in this issue of the Western Electrician—those for operation in Chicago's underground system of freight tunnels and those for the terminal traffic of the New York Central and Hudson River Railroad Company. Though resembling each other in no detail except that each is driven by electricity, these two classes of locomotive represent applications of electric power which but a few years ago were not considered in the light of practicability. The small locomotives used by the Illinois Tunnel Company for hauling earth from the extension of the tunnel system and from building excavations are similar to those which will be used when the great work of the tunnel system begins—the handling of freight in the downtown district of Chicago. They are not far removed in construction and appearance from gathering locomotives now used in mines, but some details have been changed to make them better fitted for the particular service required in the tunnels. Two styles are used—one operating by the aid of a rack-and-pinion, the rack serving as a third rail for the current and at the same time furnishing the locomotive with means to exert the necessary tractive effort in climbing grades. The other style is fitted with a trolley pole and is used in the level portions of the tunnel. The weight of these locomotives is 6,000 and 9,000 pounds, respectively, and they readily draw a train of four or five cars at a speed of from seven to 10 miles an hour. In marked contrast are the monster locomotives weighing 95 tons each which are to handle the New York Central's terminal traffic in and near New York city. These locomotives, one of which has been exhibited and tested near Schenectady, weigh 95 tons, and one of them is capable of drawing a train weighing 875 tons at a speed of from 60 to 65 miles an hour. These locomotives and the "electrification" of the New York Central are a distinct advance in railroading and are expected to result in a marked improvement to New York city and in much added comfort to the patrons of the road. It is hoped that the roads in other large cities will not be long in following the good example.

WHEN one hears of the enormous amount of energy contained in a minute quantity of radium or its salts he wonders how the statement can be true. But the process by which the energy is measured is not so complicated after all when the methods are known. Sir William Ramsay in a recent article on the subject explains quite clearly how the energy of radium is measured. It has been found that when a quantity of a radium salt is dissolved in water a quantity of hydrogen and oxygen gases is liberated in about the proportions to form water and at the same time a luminous gas is given off. The radium salt therefore acts much as a current of electricity in decomposing the water. The mixed oxygen and hydrogen gases and the emanation are collected in a tube and cooled by liquid air. This causes the emanation to freeze and stick to the sides of the tube, but the oxygen and hydrogen remain in the gaseous form and are pumped away by the aid of an air pump. The liquid air is then allowed to boil away, and the emanation, as the tube warms up, goes back into the gaseous form. The amount of gas is, however, so small that it cannot be detected in a large tube, and therefore it is collected in a special narrow tube like the stem of a thermometer, where it may be discerned and measured. A tenth of a gram of radium bromide gives about one-thirty-thousandth part of a cubic centimeter of the emanation in a week. If water is now let into the tube the emanation decomposes the water into oxygen and hydrogen, the volume of these two gases which the emanation will decompose being 100,000 times the volume of the emanation itself. From this, knowing the amount of energy necessary to decompose the water, the energy contained in the emanation is directly determined. Further than this, it has been found that a grain of radium gives out continuously as much heat as would heat a grain of water from the freezing to the boiling point every hour; it is also asserted that about three-quarters of this heat is given off by the emanation, one-quarter being given off by the radium in changing into the emanation. The total energy evolved from the emanation can be calculated. During its comparatively short life of 28 days, one grain of the emanation gives off enough heat to heat 350,000 grains of water from freezing to boiling point. If this energy were all utilized in decomposing water it would yield about 3,500,000 times its volume of mixed oxygen and hydrogen gases. The density of the emanation is not accurately known, but it is probably about 100 times as heavy as hydrogen. Reckoned by weight, therefore, it is probable that one part of emanation would do as much work as 200,000 times its weight of mixed oxygen and hydrogen gases. Compared with dynamite, it is reckoned to be more than 400,000 times as powerful.

GAS TURBINES—practicable gas turbines—are regarded doubtfully by most thoughtful engineers as something hoped for but hardly expected. "What is meant by a gas turbine," said Elihu Thomson, writing early in 1903, "is a turbine driven by gas expanding from a chamber in which the gas is burned at high pressure and temperature with the requisite amount of air. Such a machine demands the pumping of the air and gas prior to their combustion. The waste gases are, of course, incapable of condensation in a condenser. The problems involved in a gas turbine are, then, altogether different from those of a steam-turbine engine, and they are necessarily more difficult of solution." Professor Thomson at that time expressed "serious doubts" whether a gas turbine would be developed. But the problem is a fascinating one and is attracting increasing attention. A notable contribution to the discussion was made no later than last month in a paper by Mr. R. M. Neilson entitled "A Scientific Investigation into the Possibilities of Gas Turbines," presented to the English Institution of Mechanical Engineers. Mr. Neilson speaks of the troubles to be encountered, and in his long paper he compares the advantages and disadvantages of gas turbines worked on different cycles, and the difficulties to be overcome to make these turbines a success. He arrives at no conclusions—no positive conclusions, at any rate; but his paper is of great value in stating the problem and in setting forth with exactness the obstacles to be encountered. More information is needed, he says, on three points: (1) Losses in pneumatic compression to high pressures (a) with reciprocating compressors, (b) with rotary compressors or (c) with a combination of reciprocating and rotary compressors; (2) expansion of hot gases in divergent nozzles, and (3) radiation losses and transference of heat from gases to metals at high temperatures. It would greatly aid the solving of the gas-turbine problem, says Mr. Neilson, if thorough experiments on these three points were available. But, while it is hardly of a constructive nature, Mr. Neilson's paper affords one paragraph that is of intelligible interest when separated from the context:

"The power of a gas turbine could be effectively varied with an insignificant variation of speed by cutting out one or more of the nozzles or admission ports which admit the fluid to the turbine buckets or first set of buckets when several are employed in series, the fluid being passed through the acting ports or nozzles at a uniform pressure and with a uniform velocity. To enable the acting nozzles or admission ports, no matter how many may be in use, to deliver the fluid always in the same uniform manner, it will be necessary, if one flame supplies all the nozzles or admission ports, to control the fuel and air supplies to the flame in conjunction with the mechanism which cuts off the nozzles or admission ports. It will, however, be usually advisable to supply the air and fuel to the flame at a constant velocity and, although this could be done when one flame supplied a varying number of nozzles, this would involve complications; and it may therefore be found expedient to have a separate flame and a separate combustion chamber for each nozzle. This will, however, involve the necessity of igniting or extinguishing a flame for each change of power, and although this could be done automatically, it is objectionable. Much careful consideration will be required to determine which is the least evil to put up with and which course had better be taken."

So that one has but to take a cursory view of the subject to get some idea of the "lions in the path." Whether these difficulties will yield to patient study and experiment, or whether the gas turbine, like the telephone relay and mechanical flight, will tantalizingly remain in the domain of "just beyond," only the future can determine.

Use of Electricity in Spreading Election Returns.

The use of electricity in announcing the results of the presidential election on November 8th was more extensive this year than ever before. Besides the excellent wire service given by the telegraph and telephone companies, and which will be mentioned later, several other means of informing the public of the general results were employed. For instance, the Chicago Daily News, as in former years, announced the result of election by an electric search-light signal. The projector, by which the signals were made, or rather the projectors, for there were two of them, one being held in reserve, was placed on the observation platform of the Masonic Temple, Chicago, and the highest point of the larger searchlight used was 362½ feet above the level of the street. The larger lamp, which was the one actually used to send out the beam of light that announced the election of Mr. Roosevelt, was secured from Charles F. Bogue of New York city. It is a 20-inch projector, and 45 amperes of current at 110 volts were used at the lamp terminals. Current was taken from the Chicago Edison substation in the Masonic Temple. The other lamp is 18 inches in diameter and is the one usually installed on the Goodrich Line steamship Christopher Columbus, being loaned for the occasion. The signal agreed upon in the event of Republican success, and announced in advance, was the sweeping of the beam of light in a horizontal plane in half circle. This signal was given out at 6.52 p. m. on November 8th and is said to constitute the earliest flash-light announcement of a presidential election ever made in the United States. The weather conditions were unfavorable, but the light is reported to have been seen as far distant as Lake Forest, 28 miles to the north. The searchlights were installed several days before the election and tests were made in advance of the actual signaling. In these tests both lamps were used.

Searchlights were also used in many other large cities throughout the country. The New York Times from the tower of its fine new building sent out a shaft of light to a prearranged code of signals which was visible within a radius of 30 miles from Times Square. The summit of the tower of the Times Building is 357 feet 10¾ inches above the curb, and Broadway at Forty-second Street is 54 feet 8¾ inches above tidewater. This makes the signal station 412 feet 7½ inches above tidewater. By reason of this great elevation the signals were visible in Paterson, Elizabeth, Newark and Intervening cities and towns in New Jersey. Suburban New Yorkers living in Yonkers, Tarrytown, White Plains, Mount Vernon and New Rochelle read them easily, and Staten Island also came within the signal radius.

Telegraphic Reports.

The main offices of the Western Union Telegraph Company and the Postal Telegraph-cable Company in Chicago were the scenes of unusual activity. In the operating rooms where reports were received special arrangements had been made for the quick handling of the latest returns, arranging them into bulletins and again sending them out to the thousands of offices throughout the country. A large number of extra operators were required in the Chicago offices and these were drawn from the staff of the Board of Trade. The arrangements were complete and the weather conditions were satisfactory, so that offices in the remotest parts of the country were given the latest returns within a few minutes after they were received.

The bulletins were handled by the Western Union at the Chicago office very much the same as on previous occasions. The cyclograph, a machine for making duplicate copies, was used. This machine turns out 300 copies a minute, typewritten on plain white paper, the time occupied in preparation being no longer than that of any ordinary message. The general system involved the telegraphing of the vote for principal candidates from every voting precinct in the United States to some central point in each state, where they were consolidated; from there they were sent to larger centers, between which there was an interchange, and from them a general distribution. At Chicago the whole mass was edited and condensed to fit the capacity of the wires, so that the latest returns were being sent all the time. These bulletins were characterized by brevity and completeness at all times.

Telephone Service in and Near Chicago.

The Chicago Telephone Company provided for a more general distribution of election news on the night of November 8th than ever before. Beginning as early as 12 years ago this company was the first to attempt any general distribution of news to subscribers. In the days of magneto exchanges where local batteries were used there was always more or less confusion because the listening subscribers would break in and talk, interrupting the reader and each other. This year all of the exchanges being operated on the common-battery plan, arrangements were made to cut the battery off entirely from the subscriber's side of the repeating coil so that the listeners could listen only and not talk or interfere with each other.

Several new plans were introduced and were thoroughly successful, the most novel one being an arrangement of 10 transmitters in each exchange office mounted closely together and having short rubber tubes extending to one mouthpiece, into which the reader talked. One reader was able, therefore, to operate the 10 transmitters simultaneously. To each instrument 20 lines were connected so that the one reader transmitted the bulletins to 200 people at one time. Observations made during the evening indicated that the transmission was excellent from these instruments. On the continuous-bulletin lines the operator called in about once in half an hour and asked if anyone wished to be disconnected from the group, so that a subscriber's line was not shut out from regular exchange service for a greater period.

The work of gathering the news for the bulletins was handled in the main office of the company, 203 Washington Street. Direct wires to the operating office of the long-distance company to the City Hall and to and from various local newspapers centered at this point. As fast as the news was received from any of these sources it was edited and brief bulletins were dictated, which were written in manifold and immediately passed to various readers for transmission to the branch exchanges, the toll department and to clubs, newspapers, public gatherings and subscribers in the downtown district.

Local returns from Chicago obtained from the manifold sheets of the compilers in the City Hall were instantly telephoned and were given out frequently with a delay of less than one minute. These were also transmitted direct to New York where in the office of the American Telephone and Telegraph Company news was received from all parts of the country, compiled into bulletins and again transmitted over the long-distance lines throughout the country. Chicago news would thus be passed to New York and in a short time would come back again in the shape of a long-distance bulletin. In one case it was noted that the returns received from Hammond, Ind., were transmitted to New York, edited, sent back and received in the Chicago office in less than four minutes.

The continuous-bulletin service began at 6 p. m. and ended at 11:15 p. m., and during that time 155 bulletins were sent out. At each half hour a general bulletin was prepared and transmitted to all exchanges, to be given out in response to inquiries from those who did not wish the continuous service but wished to get returns upon call. As rapidly as such calls were received the lines were gathered together in a group by an attending operator, and when a group of 20 was completed a reader would transmit the half-hourly bulletin, asking the subscribers to hang up their telephones and call again in half an hour. This service was availed of to a very wide extent. From records kept by the operating forces during the evening it was found that the bulletin service was transmitted to about 50,000 telephones in Chicago, and the system for handling the work, which had been developed and carried out by Mr. S. J. Larned, general superintendent of the company, was thoroughly successful.

In the suburban district, embracing 110 exchanges around Chicago, a great success was achieved for telephone bulletins. Subscribers' lines were arranged in groups of about 20 and operators read the bulletins as fast as they were received. In rural exchanges it was a great night for the farmers and no less than 5,000 of them remained at the telephone during almost the entire evening and received the latest news of the election. The farmer at home received news from districts a thousand miles away almost as quickly as that from his own county seat. Subscribers received not alone the local news, or Chicago news, but the news of the nation by telephone more quickly than they could have received it from any other possible source, thus illustrating the efficiency of a comprehensive long-distance telephone system.

The automatic telephone system of the Illinois Tunnel Company served its subscribers for the first time in a presidential election. As this company has no outside connections, no special arrangement had been made for distributing news to the general public. Special circuits, however, were arranged for the newspapers getting information from the Associated Press and this service was excellent.

Telephone Returns in Michigan.

The Michigan State Telephone Company inaugurated an innovation in the way of handling election returns in Detroit on election night. Returns from all over the state and country were received early in the evening and the outcome of various contests were known in the city at an early hour. From 6:30 p. m. until morning the company was in communication with every county in the state, and the figures were received within a very few minutes after they had been announced at the polling places. The returns were given to the public as soon as received by means of figures thrown by a stereopticon upon a large sheet opposite the general office building. President Jackson entertained many friends of the company in a large room on the fourth floor of the building, where the returns were read and afterward given to the public. The newspaper men were given the privilege of a pressroom and were given every opportunity to secure the earliest news. The presidential election was thoroughly covered as was the state and county. To aid the telephone system, some of the returns were telegraphed from some parts of the state over the telephone wires. A force of operators were kept at work until one o'clock receiving results that had been telephoned to the central stations of the various districts.

Telephone Bulletins in Cleveland.

The United States Telephone Company of Cleveland furnished a very thorough and effective bulletin service on the night of the election that was thoroughly appreciated. The reports were furnished through the local connections of the company in various towns, and bulletins were given to clubs, churches and political headquarters. At Cleveland the returns were bulletined on the Public Square and Grays' Armory with steriopticons, and at both places large crowds assembled to take advantage of the service. The returns were as thorough and complete as those furnished by the news agencies, and often in advance of them. Returns of local and state results were especially prompt and reliable. It can be said, without exaggeration, that the news service thus furnished was equal to anything else in the state.

Proposed Changes in Philippine Tariff.

The proposed changes in the Philippine tariff recommended by the Philippine Commission have been received at the War Department and published together with the existing tariff, and suggestions have been invited from manufacturers interested in the subject. Electrical manufacturers who are desirous of making suggestions in reference to the proposed rates should send them to the Bureau of Insular Affairs, War Department, Washington, D. C., not later than November 23d. For the information of the trade the following proposed changes are noted:

Item 248 to read as follows: Apparatus and appliances for the generation, distribution, testing, measuring and installation of electricity, dry and wet batteries, carbon brushes, arc lamps and their fittings, insulating materials, tapes and compounds used exclusively for electrical purposes; bells, annunciators, telephones and apparatus pertaining to the same; galvanometers, amperemeters, voltmeters and wattmeters, and all or any parts of apparatus specified, including insulators of glass or porcelain or of other material, 20 per cent. ad valorem.

Item 249. Storage batteries for lighting or power, net weight, $25 per 100 kilograms; proposed change, storage batteries, 20 per cent. ad valorem.

Item 250 to read as follows: Dynamos, generators, exciters and all other machinery for the generation of electricity for lighting or for power; transformers and electric motors, 20 per cent. ad valorem. (a) Incandescent lamps, mounted or not mounted, 20 per cent.

Item 261. Automobiles for passengers and for merchandise, $60 each. Proposed change, 20 per cent. ad valorem.

World's Fair Visitors of Last Week.

Among those registered at the booth of the Western Electrician in Electricity Building at the St. Louis Exposition last week were the following-named: Oscar Moore, Peoria, Ill.; Bert Davis, Peoria, Ill.; Ralph W. Richardson, Mason City, Iowa; O. C. Swanson, Mason City, Iowa; Robert E. Leve, New York city; Clifford Frost, Vandalia, Ill.; J. H. and C. W. Zinkhow, Peoria Gas and Electric Company, Peoria, Ill.; R. C. Clowry, New York city; J. B. Ven Enesy, New York city; Mr. and Mrs. H. D. Estabrook, New York city; J. C. Barclay, New York city; F. P. Cook, Chicago; T. J. Scheerer, New York city; A. W. McQueen, St. Louis; A. M. Williams, St. Louis; C. W. Furtney, New York city; S. Moser, Cincinnati, Ohio.

The Transposition of Electrical Conductors.[1]

By Frank F. Fowle.

The transmission of electromagnetic energy through the ether, by means of conducting wires whose function is that of directing and concentrating the energy flow, is accompanied by mutual interferences between transmission systems which employ in common any considerable portion of the ether. The extent to which the ether is energized in a direction transverse to the direction of energy flow is controlled by the design of the transmission circuit and the rate of energy flow. The energy storage-capacity of a transmission circuit is very

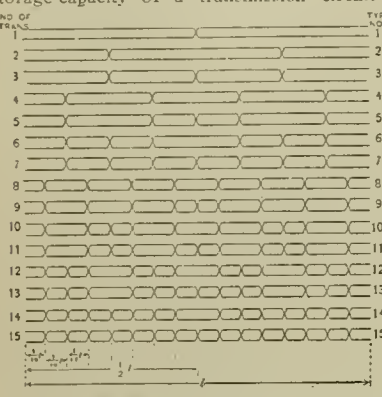


FIG. 1. TRANSPOSITION OF ELECTRICAL CONDUCTORS.—METHOD OF TRANSPOSITION WITH 15 CIRCUITS.

small in comparison with the transmitted energy but the great velocity of transmission renders possible the transmission of large energies. The conformations of the electric and the magnetic fields about a line circuit depend, in alternating-current systems, on the number of phases and on the number, size and separation of the wires. The field at a given point due to a single-phase circuit is constant in direction, but variable in intensity, from instant to instant throughout a cycle; the field due to a polyphase circuit varies both in direction and intensity.

Alternating-current transmission systems resolve themselves into two great classes, one for the transmission of power and the other for the transmission of intelligence. Power systems are characterized by: High pressure; large currents; low or moderate frequencies; only one fundamental frequency; relatively great reaction of terminal apparatus compared with line reactions; magnitude of inductive disturbances in the line usually small and important only as affecting regulation; line length less than a wave length, and the flow of energy usually in a given direction. Telephonic systems are characterized by: Low pressure; small currents; high frequencies, variable over a wide range; relatively small reaction of terminal apparatus compared with line reactions; magnitude of inductive disturbances in the line, usually large and rarely negligible; line lengths, usually greater than the wave lengths and often equal to many wave lengths, and the flow of energy alternating in direction and source.

As shown by Mr. J. J. Carty, in a paper before the Institute, on "Inductive Disturbances in Telephone Circuits," in April, 1891, the induced currents due to electric induction cannot be made to vanish entirely, as can those due to magnetic induction.

The treatment of induction between telephone circuits has been by empirical rule rather than theory. It has been determined by experiment, with receivers of a given sensitiveness and transmitters of a given power, how frequently two adjacent circuits should be transposed in order to eliminate the cross-talk. Using two-mile sections, transposed at the center, the cross-talk is distinguishable with transmission sufficiently powerful for 1,000-mile service. Half or quarter-mile sections, transposed at the center, are satisfactory; this results in a minimum transposition spacing of one-quarter mile. The existence of cable at each end of the line, in any considerable length, will reduce the cross-talk. It is necessary to devise different types of transposed circuits, no two transposed alike, in order to treat the cases occurring in practice. The manner of doing this is shown in Fig. 1.

The "exposure," as it is termed, of circuit 1 to circuit 2 is one-fourth; of 1 to 3 is one-fourth; of 2 to 3 is one-half; because a transposition at the junction of two sections, each transposed at its center, has almost no beneficial effect. The exposure of 1 to 5 is one-eighth; of 2 to 6 and 3 to 7, one-eighth; of 2 to 8 and 2 to 9, one-sixteenth, and so on. The derivation of the types is simple; the first three are obvious. The fourth is obtained by doubling the number of divisions of the transposition section from two to four. The fifth is obtained by superposing the first type on the fourth type, the sixth by superposing the second on the fourth, etc. [the principle followed is that shown in Fig. 2]. So far as the writer is aware, this synthetical system of deriving types of dissimilarly transposed circuits is due to Mr. John A. Barrett. The method may be extended as far as desired, but 15 types are usually sufficient.

The choice of a convenient length for (l) is an important matter. An eight-mile section has been extensively used, but is probably too cumbersome. A much more convenient section would be one four miles in length. If there are only a few circuits, a two-mile section may be used.

The procedure in applying the sections to a long line is as follows: Beginning at the first pole, of the open-wire line, apply the sections consecutively until the last section is approached. It is seldom the line length is a multiple of the section length, so the remainder should be a special section by itself, if over half the length of a standard section, or should be added to the last section, making a special section longer than the standard. The distances between transposition poles will be shortened or lengthened sufficiently to apply the standard section.

When there are several cross-arms it will simplify the construction if the transposition types are so chosen, in laying out a standard section, that there will be as few different types of transposition poles as possible. The junction of two lines which separate, or become joint, is a point which should be made the junction of the transposition sections, as well. The 15 types shown in Fig. 1 will be sufficient for a 40-wire line, because there will be certain diagonal exposures requiring transposition only at long intervals, and these extra transpositions may be located at the junction poles between sections.

Single-wire grounded lines cannot be transposed, and for this reason are not extensively used. They may be operated for short lengths of a mile or so, without interference from cross-talk, if very low-power receivers are used. For greater lengths there will be serious cross-talk; the low-power receiver is still necessary to remove extraneous inductive disturbances. Phantom circuits, built up from metallic circuits, are not in extensive use. The ordinary transposition is of no effect, and unless specially transposed such circuits will cross-talk and will be subject to extraneous induction.

When telephone lines are paralleled by power lines the transposition problem becomes more com-

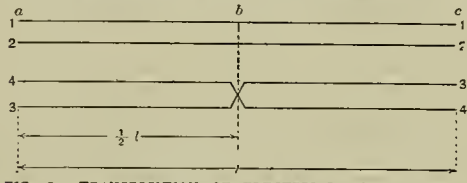


FIG. 2. TRANSPOSITION OF ELECTRICAL CONDUCTORS.—TRANSPOSITION OF TWO CIRCUITS.

plicated. It is necessary to recognize the manner in which the disturbing circuits alter the magnitude of their influence, by reason of abrupt changes in line pressure or line current, and changes in the wire spacings. If circuit (1-2), in Fig. 2, is the power circuit and (3-4) is the telephone circuit, there will be no mutual interferences if the distance (l) is not great. That is, the percentage pressure drop in (1-2) must be small enough so that the total induced charges on the portion (a b) are sensibly equal and opposite to those on (b c); likewise, the percentage current loss in (1-2) must be so small that the magnetically induced pressure in the portion (a b) is equal and opposite to that in (b c). The question as to whether electric or magnetic induction is the greater is complicated by the radical differences between the systems. In long telephone lines the electric induction may predominate; the impedance of an indefinitely long line is usually several hundred or a thousand ohms, and therefore the pressure is very much greater in magnitude than the current. In power circuits this ratio is dependent largely on the load, in any given case, but there are many instances where the ratio of pressure to current is small. The magnetic induction is usually predominant to a large degree in the latter cases. There have been instances of exposure to circuits giving 24-hour service, from which the induction was heavy only during the period of load.

If the circuit (1-2), in Fig. 2, has connected to it a transformer or a branch circuit within (a c), the effect of the transposition is no longer to neutralize the induction. If the transformer is at (b) the transposition will have the least effect. If (1-2) is a constant-current circuit and an arc lamp is cut in, the effect will be the same, as regards the efficiency of the transposition. A change in the spacing of the wires (1-2) will also decrease the effect of the transposition.

Therefore that portion of the disturbing line within which the conditions, affecting the phase or the magnitude of the induced currents and pressures, are constant should be treated as a section and all the telephone circuits should be transposed opposite its center. The regular cross-talk transpositions should be removed from the section. If the total external exposure to the power line involves several consecutive sections, the cross-talk transpositions should be opposite the junction of two sections, at the point where the disturbing current and pressure change in magnitude or phase.

The method [of transposition] (Fig. 3) works well until the character of the exposure becomes complicated, and then the transpositions become so frequent as to be impracticable, and, further, they frequently cannot be properly situated because of physical limitations. If the electric-light and power system is developing rapidly the exposures are changed frequently by new construction. Again, the telephone line may be separated from the power line by the width of a street; here the induction, while not excessive, is yet troublesome; and the theoretical transposition system to meet the conditions of exposure is just as elaborate as though one line were beneath the other. Twisted pairs or cable will meet this condition, although either remedy impairs the telephonic line efficiency. A prior consideration is whether the power wires are not separated, with respect to each other, farther than is necessary with the pressure employed and whether the separations are uniform.

Where telephone lines have paralleled transmission lines along highways, separated by 15 or 20 feet, or by the width of the highway, the following practice has been employed: All the telephone circuits are transposed at every tenth pole, the cross-talk trans-

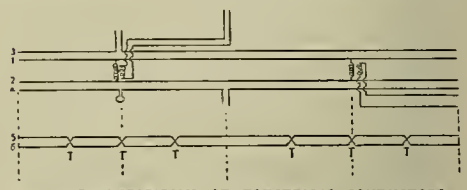


FIG. 3. TRANSPOSITION OF ELECTRICAL CONDUCTORS.—TELEPHONE LINE PARALLELING TRANSMISSION LINES.

positions occurring midway, so that transposition poles are five spans apart, the cross-talk and the induction transposition poles alternating. This practice, while it is somewhat uncertain of producing the best results, is probably best suited to certain requirements—where the method of sections would not produce any better results because of the physical unevenness and crookedness of the right-of-way.

Not infrequently high-pressure systems are transposed for their internal protection. When telephone circuits are on such pole lines, the transpositions in the power circuit may be availed of to reduce induction in the telephone circuits, but in the case of separate telephone circuits, on a parallel pole line of separate ownership, it seems wiser to treat such transpositions as neutral points—to be opposite the junction of two transposition sections of the telephone line. The question of where to locate telephone wires on high-pressure lines and how to protect them contains material for a paper by itself. In general, the induction from a three-phase line is slightly greater than from a single-phase line having the same wire spacing and current per wire and a pressure equal to the △ pressure. The separation between the wires should be as small as consistent with the length of span, and their plane suitably arranged with respect to the plane or planes of the power circuits.

A three-wire, three-phase line will have two transpositions within a section. It seems to be fairly general practice to transpose high-pressure systems, but it has been the writer's observation that the length of a section is usually three miles at least. On that account it is difficult to avail of the power-line transpositions in transposing the telephone line, and it is usually necessary to treat

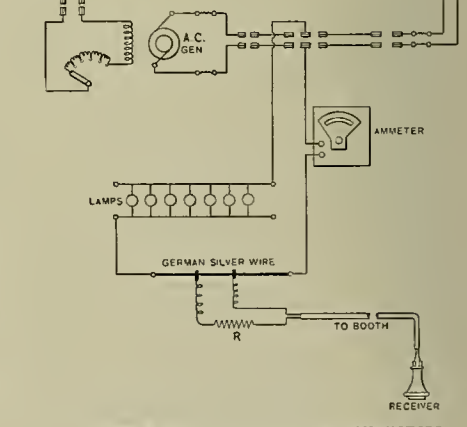


FIG. 4. TRANSPOSITION OF ELECTRICAL CONDUCTORS.—APPARATUS FOR DETERMINING PERMISSIBLE FREQUENCIES.

them at the junction points between adjacent sections.

On account of the very low frequency and the high ratio of pressure to current customary in high-pressure practice, there are usually no inductive interferences if the power and the telephone lines are separated by the width of a highway, or 30 to 40 feet, because the regular cross-talk transpositions are sufficient.

In the case of a single telephone circuit paralleling

1. Opening and closing portions of a paper presented to American Institute of Electrical Engineers, in New York, on October 28, 1904. Mr. Fowle is special agent of the railway department of the American Telephone and Telegraph Company in New York city.

a power circuit, the frequency of transpositions is a problem requiring calculation in any given case, because of the lack of standard practice in regard to wire spacing and circuit location. The writer made a series of listening tests with a bipolar receiver of 70 ohms resistance, to determine the permissible current at low frequencies which would not interfere with telephonic transmission over the longest lines—1,000 miles and upward. The circuit is shown in Fig. 4.

The method was that of deriving a very small known pressure from a non-inductive resistance and inserting a very large non-inductive resistance (R) (1,000 to 20,000 ohms) in series with the shunt circuit containing the receiver. The listening tests were made by four observers, who adjusted (R) to the minimum permissible value, in their estimation. The average results are plotted in Fig. 5.

Naturally, these results based on ear measurements are not highly precise, but they represent very small disturbances and are safe practice. In the case of short telephone circuits on power lines, used for private purposes, the receiver power may be much reduced and the permissible terminal current greatly increased.

There are two types of construction in use in making transpositions. One of these, the old-fashioned square transposition made by dead-ending both wires, each way, on two-piece insulators, and cross-connecting, is familiar to all. The other method requires two spans in which to complete the entire transposition. It is known as the "Murphy" and the "single-pin" transposition, and is coming into general use.

It has the comparative advantages of less first cost and simpler construction. It can be cut in at

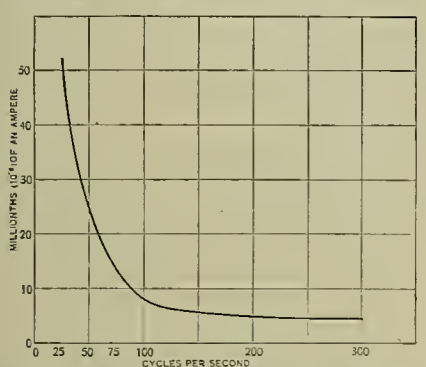


FIG. 5. TRANSPOSITION OF ELECTRICAL CONDUCTORS.—AVERAGE RESULTS OF LISTENING TESTS.

any time, cut out, or moved several poles, at less cost and with much less work than in the case of a square transposition. If transpositions occur frequently, every one-half or one-fourth mile, the line capacity is increased a few per cent. and the line inductance diminished, with a consequent slight increase in attenuation. The square transposition has the advantage of concentrating the entire transposition within a very short length and of not altering the plane or the separation of the wires. While the single-pin transposition changes the plane of the circuit, the wire separation is greatly reduced, and this is an advantage. Since it requires two spans in which to make this transposition, it is possible to transpose only at every other pole, as a maximum, in case of excessive induction, against every pole for the square transposition. For regular cross-talk transpositions the single-pin type is now preferred.

In conclusion, it seems evident that the recommendation of standards in the matter of wire separations, standard cross-arms and standard systems of transposition, would greatly facilitate the removal of inductive interferences and materially assist the builders of telephone circuits throughout the country. This matter is suggested for the consideration of the Institute.

Discussion.

Prof. W. S. Franklin, Bethlehem, Pa.: I am very greatly pleased to see laid before the American Institute of Electrical Engineers some of the great fund of engineering experience which has been accumulated in connection with the work of what we still call the Bell Telephone Company. I have been in the habit of thinking of Mr. J. J. Carty's paper as the only considerable contribution from among Bell telephone engineers to our Institute proceedings, but I have perhaps overlooked other important papers or forgotten them, inasmuch as my interest is always attracted chiefly by those Institute papers which are devoted to the physical problems rather than to problems of constructive or commercial adaptation. I am very much interested in Mr. Fowle's paper, especially the latter part of it, in which he gives very clear and specific statements as to how much inductive exposure is shown by experience to be permissible in telephone lines, and as to the bearing of line-drop, current loss, phase changers and branch points upon permissible exposure; how inductive disturbances may be in general eliminated by elaborate transposition schemes and how these schemes may be modified to meet special cases.

There are one or two questions I want to ask. Mr. Fowle mentions the fact that cable ends on a long telephone line serve to reduce cross talk, to increase the effectiveness of the transposition on the middle portions of the line. I ask whether he means to say that is because of the attenuation which takes place in the cable ends or because of the very complete transposition which is accomplished in a twisted cable. He makes the statement that cross talk and interference are greatly lessened by using cable ends on a line.

Mr. Fowle: I think that is due practically to the effect of the increased attenuation. The complete transposition in the cable itself practically eliminates all cross talk which arises there, and increased attenuation diminishes the power of the cross talk which may come in from other points.

W. N. Walmsley, Philadelphia: I ask what Mr. Fowle regards as the points of permissible distance—the ordinary minimum distance between telephone circuits and single-phase 2,000-volt power circuits?

Mr. Fowle: Do you mean that from the standpoint of the hazard of the circuit or the standpoint of induction?

Mr. Walmsley: Standpoint of induction.

Mr. Fowle: It depends not only on the voltage in the circuit but on the load, and in addition upon the distance between the two wires composing the power circuits and the spacing of the two wires composing the telephone circuit. I do not think it is possible to answer such a question generally. In a specific instance I can give an idea.

Mr. Walmsley: Take the pin distance between the wire.

Mr. Fowle: The pin distance on the 2,000-volt circuit is 30 inches.

Mr. Walmsley: Suppose the 2,000-volt wires are eight inches apart and your telephone wires are the same distance apart, how far away should the telephone wire be from the power wire, presumably on the same pole line?

Mr. Fowle: With the circuit for the electric-light current on pins eight inches apart and telephone circuit distant two or three feet on the same eight-inch spacing, with transpositions every 10 poles, certainly not more than a quarter of a mile apart; I do not think we would then have any difficulty. The size of the wires and the load on the alternating-current circuit would alter the situation and to a certain extent the frequency also. I think every 10 poles would be safe to work on. If they were on the same cross-arm, you would have a tendency to get more leakage. If on the same cross-arm you will obtain better results by using heavier insulators than is customary in telephone and telegraph work. If you use an insulator suitable for the electric-light work you will get better results.

Mr. Crehore, Yonkers, N. Y.: I wish to ask Mr. Fowle one more question, if he cares to answer it, in regard to the experiences which the telephone companies must have had with these transpositions. I know some years ago they adopted a system of transpositions, which, I believe, was used as a standard for some length of time, but I believe a new arrangement has been adopted. Of course, it is a difficult thing for a company to avoid making changes from one form to another. If he would care to tell us about the experience of the company it would be interesting for us to hear as to how many long-distance wires it is practicable to use on the same pole line, so that they are practically free from interference.

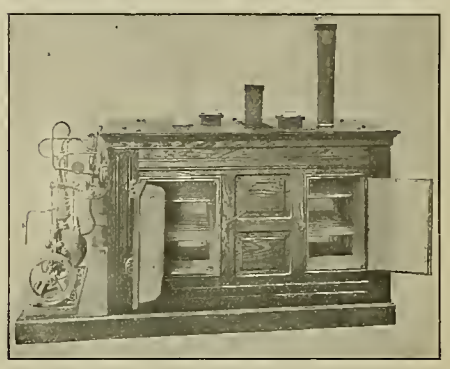
Mr. Fowle: Answering Dr. Crehore's question—so far as I am aware of the general experience, there has been no difficulty in obtaining perfect freedom from cross-talk, with as many circuits as it is possible to hold on the pole line from a mechanical standpoint. When you begin to use five or six cross-arms you can transpose the fifth arm like the top arm, the sixth arm like the second arm, and so on down, inducing transpositions perhaps over eight miles at the junction of two consecutive sections and take care of a very slight cross talk that will exist between the first and fifth, second and sixth arms, etc., due to their being transposed alike, but widely separated, so that I think it is safe to say that there is no difficulty in applying this system successfully to a line carrying as many circuits as is advisable or possible from a mechanical standpoint.

Professor Franklin: As I understand, the difficulty from leakage is partly balanced from the transposition. I ask Mr. Fowle if they depend on transposition at all for obviating bad insulation. Do you find it practicable?

Mr. Fowle: I do not know of any cases where they do depend on transpositions to obviate that. The plan there is to keep the balance and the insulation as high as possible. In telephone work it is highly essential to make insulation tests frequently to see that the two sides of the circuit are the same and the insulation high. I have seen a pair of wires—I made a measurement once on a circuit nearly 1,000 miles long in clear, cold, dry weather, and the insulation stood up between 40 and 50 megohms per mile for a circuit of 500 miles. An insulation resistance of every wire of more than 50 megohms a mile in good weather represents first-class construction, with the ordinary pony glass in use. In bad weather it may fall down to a megohm per mile or less, and even at a megohm per mile the attenuation is not much increased and the distortion slightly reduced.

Small Electric Refrigerating Plant for the Household.

Illustrated herewith is something of a novelty in the way of a small electrically operated refrigerating machine for the household which may be used for supplying a refrigerator box with dry cold air and also for the purpose of manufacturing ice from distilled or otherwise purified water. The machine has a refrigerating capacity equal to the melting or the use of 200 pounds of ice a day. It is automatic and is as free from complications as it is possible to make a machine of this character. It is installed on the same base as the refrigerator,



SMALL ELECTRIC REFRIGERATING PLANT FOR THE HOUSEHOLD.

becoming part of it, so that the entire plant is shipped as a unit, it being only necessary to connect the power and water when it is ready to operate.

The machine, though it may be operated by any available power, is especially adapted to motor drive and may be operated by a one-half-horsepower electric motor. When operated for 10 or 12 hours each day it will manufacture 20 pounds of ice besides refrigerating two storage compartments to a temperature of 35 to 38 degrees Fahrenheit. It is manufactured by the Brunswick Refrigerating Company of New Brunswick, N. J.

Railroad Terminal Electrification.

The railroads say that the people are always demanding something more from them in the way of improvements of one kind or another. This is true. It will continue to be true until the spirit of progress is succeeded by stagnation.

The railroads in Chicago have been required to elevate their tracks. At first they said it could not be done, except at prohibitive cost. But it has been done, or, rather, is being done, for the work is not yet completed. The railroad men themselves are greatly pleased with the results. Because of track elevation the trains can make fast time within the city limits. Besides benefiting through business and reducing damage-claim litigation, track elevation has enabled the steam railroads to do a much more profitable local and suburban business than formerly was possible.

The next great improvement will be electrification within urban limits of the steam-railroad terminals. The New York Central railroad is making an extensive move in this direction by electrifying its entire New York city terminal system. A Chicago engineer, Bion J. Arnold, who made the report for Chicago on the local transportation problem, helped to prepare the plans for the New York Central work and is now, with others, supervising their execution. All the trains of the New York Central are to be hauled out of and into New York by electric motors as soon as the work shall be completed. What this will mean to the life of a great city can easily be imagined. Smoke from trains will be entirely eliminated within the city limits.

When the New York Central plan shall be in successful operation the people of Chicago will be quick to demand the adoption of a similar system here. The presence on Michigan Avenue, overlooking the lake front and the Illinois Central tracks, of the new Railway Exchange Building may, curiously enough, do much to strengthen the demand for early electrification at least of the Illinois Central. The Railway Exchange Building is occupied largely by railway offices. Smoke from Illinois Central trains is proving very offensive to the occupants of this building who are railroad men, as well as to others along the lake front. The demand for the electrification of the Illinois Central will be extensively supported by railroad men.—Chicago Daily News.

In a suit brought by Jersey City against the Jersey City and Bergen street railway the Supreme Court last week sustained the demurrer of the company against payment to the city of unpaid car-license fees, amounting in all to nearly $100,000. This and a similar suit against the Consolidation company were won by an appeal to a New Jersey law under the statutes of limitation.

Telephone News from the Northwest.

Five rural telephone lines centering at Dodgeville, Wis., are arranging for a central office.

The Tri-state Telephone Company has opened a toll office at Murdock, Minn.

D. P. Mahony of Milwaukee has been made assistant to George N. Burke, manager of the office of the Wisconsin Telephone Company at Madison, Wis.

The Redwood County Rural Telephone Company has completed connection with Seaforth, Minn., from Wabasso.

The Red River Telephone Company now connects Moorhead, Minn., with Comstock, Wolverton, Kent, Hickson and Horace.

The St. Croix Valley Mutual Telephone Company of Swiss, Wis., has been incorporated. The company is completing a line between Grantsburg and Swiss.

The Interstate Telephone Company was formed recently at Marietta, Minn.

The news of the late election was distributed through the Northwest largely by long-distance telephone. The Twin Cities received news from the pivotal states by telephone, and the service was a great credit to the Bell system.

The Northwestern Telephone Exchange Company contemplates rebuilding the local exchange at Owatonna, Minn.

Two linemen working on a telephone pole in St. Cloud, Minn., were seriously injured by the breaking of the pole near the ground. They were attached to the pole by safety belts and could not free themselves. An inspection of all telephone poles in the city will result.

The Vincent Telephone Company will put in an exchange at Vincent, Iowa. The new company is controlled by the Martin Company of Webster City.

I. O. Isham was elected president and A. J. Sanders secretary of the new Emmet County Telephone Company, recently formed at Estherville, Iowa.

R.

Ohio Telephone Notes.

The probability that the Everett-Moore syndicate affairs may be fairly well cleared up between this time and next summer is encouraging to the Independent telephone interests of this state. It is thought that the affairs of the Federal Telephone Company will be in good shape within a short time, and President Dickson is giving his best work to that end.

The capital stock of the Marietta Telephone Company of Marietta has been increased from $50,000 to $100,000 for the purpose of enlarging the local plant and building extension to Sisterville, Newport and Matamoras.

Work on the line of the Caldwell-Marietta Telephone Company's line between Caldwell and Marietta will be commenced at once and pushed to completion.

The Chesterhill-Brown's Hill Telephone Company of Chesterhill has been incorporated with a capital stock of $3,000. E. Hopkins, H. G. Hopkins and others are interested in the enterprise.

The Franklin Telephone Company of Columbus is arranging to make important extensions in Franklin County, a good portion of the work being done this winter.

The capital stock of the Gratiot and Brownsville Telephone Company has been increased from $5,000 to $10,000.

C.

Electrical Section of Western Society Discusses the Telephone.

An unusually successful meeting of the Electrical Section of the Western Society of Engineers was held in the society rooms in the Monadnock Building, Chicago, on November 10th. Owing to the fact that the paper of the evening was upon a telephone subject, many prominent men in telephone work were present, the attendance in all being nearly 100. Chairman W. B. Hale called the meeting to order and introduced the speaker of the evening, Mr. Samuel G. McMeen of Chicago. Mr. McMeen's paper was upon "Some Interesting Phases of Long-distance Telephony," illustrated with numerous lantern slides, and his pleasing manner of delivery and the excellence of the paper itself were enjoyed by all. An abstract of the paper is given in succeeding columns.

EXTENSIONS AND IMPROVEMENTS.

The Sunset Telephone Company contemplates improving its entire system at Santa Clara, Cal.

The Home Telephone Company has filed at Riverside, Cal., a certificate of the creation of a bonded indebtedness of $500,000 in 1,000 bonds of $500 each, to run 30 years and bear five per cent. interest.

It is expected that action will soon be taken on the new plans for the telephone system at the City of Mexico, Mexico. As soon as authority is obtained from the government the Mexican Telephone Company will place orders for building the switchboard and will begin the construction of the conduit system.

Some Interesting Phases of Long-distance Telephony.[1]

By S. G. McMeen.

The cost of the path over which talking may be done between points widely separated is so great, for a variety of reasons, as to prevent a wholesale use of so valuable an aid. A principal reason why the investment cost reacts upon the consumer of the service is that the circuit is available for personal conversations during only such hours as the people furnish the work to be done, and a considerable reward always has awaited an arrangement which would utilize the idle time of these expensive circuits in any way allowing by-product values to be secured. The only way which has been found so far is that of utilizing the wires of the telephone circuit for the purpose of telegraphy, as well as for transmitting actual speech, and this has been accomplished by taking advantage of the very considerable difference in the frequency of telegraphic currents and actual voice currents.

Van Rysselberghe of Belgium has made the largest contribution to this art. It is a development of his system which utilizes each wire of a circuit for telegraphic purposes, whether it be or be not used for talking at the same time as well. A simple form of simultaneous working, quite rightly named "simplex," provides one telegraph circuit from each metallic-circuit telephone line. Broadly speaking, this circuit is not dependent upon a considerable difference in the frequencies of the telegraphic and speaking currents, but only upon the fact that the telegraphic current passes over both sides of the line in the same direction at the same time, while the speaking currents circulate in the metallic circuit as such. Simultaneous potentials on the two sides of the line naturally prevent any sounds from the telegraph appearing in the telephone circuit. The contribution of Van Rysslerberghe has led to the possibility of utilizing a metallic circuit not only for telephony, but for two independent telegraph circuits as well.

With so many telegraph wires on poles over the country, it has seemed a pity not to turn the thing around and provide for telephony as a by-product of telegraphy. This has been accomplished, although for the reason that the telegraph circuits are not in pairs, accurately matched one wire against another, and are far from being uniform as to material, it has not been possible to secure as good telephone circuits from the telegraph wires as telegraph circuits from the telephone wires.

The thing which has enabled practical results to be secured is an adaptation of the original principle of different frequencies. Over a composite circuit, the usual method of ringing from station to station over the telephone circuit by an alternating current of a frequency of about 16 is practically impossible. This is because of the heavy short-circuit provided by the two choke coils at each of the stations and the heavy shunt of the large condensers. If high-frequency speech currents can pass over these circuits with a very small loss, other high-frequency currents should find a good path. There are many easy ways of making such currents, but formerly none very simple for receiving them.

In telegraphy over land lines, that is, lines across country or in the air, the two things which particularly limit the distance over which communication is possible are the resistance of the wire and the insulation of that wire from others and the earth. In quadruplex and other multiplex systems of telegraphy aiming at the transmission of more than one telegraph message over a wire at the same time, the effects of the electrostatic capacity of the wire begin to be noticed. These capacity effects are most noticeable in very high-speed telegraphy, but not so greatly in the simplest forms of sending by hand.

In telephony, however, the effect of the capacity between the two wires of a circuit becomes marked as soon as the line attains a length of a few hundred miles. In telegraphy, repeaters can be used to start the signals on a new circuit, and thus, link by link, a very long stretch can be covered. No one has invented a practical telephone repeater, so that whatever is possible in the way of applying improvements must be done by making the transmitters more powerful, the receivers more sensitive, or the line better able to carry the current without loss.

In the laboratory one may build a line having a very considerable resistance, indeed, and talk over it successfully. In actual practice one may build a line and insulate it very thoroughly, but there is no way of building a line in the air, in the earth, or under the sea in which the dimensions and spacing of the parts of the circuit will be at all reasonable without the resulting capacity between the two wires being large enough to absorb a very considerable part of the transmitted current.

A line 1,000 miles long may have a capacity of seven microfarads, even if the two conductors are a foot apart. Any decrease of this distance of separation or any increase in the size of the wires increases the capacity; the shorter the poles the greater the capacity, and in underground or submarine cables, where the wires are very close together and are insulated with guttapercha or rubber, the capacity runs up enormously.

The most notable effort in the direction of improving long telephone lines as alternating-current transmission circuits, is found in the work of Dr. Pupin. His remedy is simply that of inserting inductances at regular intervals in series with the two wires of the line, the effect of these insertions being to neutralize the capacity between wire and wire. As the capacity is distributed uniformly throughout a line of uniform construction, the ideal method of cure would seem to be the insertion of just the right amount of counteracting inductance, also distributed throughout the wire. No one has shown just how inductance may be inserted in this distributed fashion, so that the close approach to the same result, accomplished by inserting inductances in lumps, is a very happy solution of the problem. The practical results of Dr. Pupin's method are a very striking improvement in the volume and quality of received speech. Because of a simple mechanical analogy, circuits so equipped with inductance coils are called "loaded" circuits. Loaded circuits in underground cables are a distinct success, and that method is the best-known one for improving long underground circuits, principally useful in trunk lines betwen the offices of a large city system. The improvement possible by inserting loading coils in long lines on poles is not so great as in the case of underground circuits. This difference in the respective improvements is due to the lower capacity and larger self-induction of the open-wire circuits. Under the best conditions, transmission over the latter is distinctly improved, but in seasons of wet or foggy weather covering most of the territory traversed by the line, a very large part, if not all, of the advantages of loading are offset. When a means has been found of distributing the inductance throughout an insulated conductor and of placing such a pair of telephone wires cheaply and easily in the earth, where insulation will remain constant, it is conceivable that much greater distances may be covered than are at present available.

Certain submarine telephone cables extending between Denmark and Sweden are provided with pairs in which each conductor is covered with a spiral wrapping of soft-iron wire, the object being a similar neutralization of the mutual capacity. It is reported of these cables that their success is marked, and that the manufacturers accepted specifications which called for quite a definite performance, the results bearing out the expectation in a large degree.

In all but the smallest communities there are enough lines of local subscribers to be switched together to require the service of more than one operator, and in such offices, unless they are very small, it is expedient to provide separate operators for the long-distance lines. In the largest communities, the lines of local subscribers are grouped in several offices, each serving its own district. Trunk lines connect these several offices for enabling any subscriber to talk to any other in the same city. One office suffices for all the long-distance lines entering such a city, and from that office trunk lines extend to the various subscribers of the local exchange proper.

These things being so, it is necessary that the subscribers have facilities for making their wants known to the long-distance office, and that the latter have facilities for calling up any subscriber wanted by a distant point. The former is accomplished by trunks leading direct from the local branch offices to special operators whose duty it is to write tickets of these calls. The latter is accomplished by means of trunks leading from the operators serving the long-distance lines to special operators in the branch offices, these having the duty of connecting those trunks with desired lines in the switchboard. It is the latter which are used for all actual conversations between long-distance lines and subscribers. The current to energize the subscriber's transmitter is furnished to him over his own line from his own office.

Carrying this last and important point further, it is instructive to note that the same feature is utilized in trunks from a long-distance office to a branch office. The called subscriber must receive current for his transmitter from the nearest possible central office, and naturally that is the office of his own district. It is further of advantage that, when he is called up over a special trunk line from the long-distance office, the operator who called him be able to ring his bell when she may choose to do so. She may need to repeat a call or may need to delay one until the distant subscriber is at his telephone. The mechanism which accomplishes the happy result of supplying transmitter current from the nearest office stands in the way of successful ringing over the line in the ordinary manner. The cycle of events [in the "ring-through" system] is the application of low-frequency ringing current, which controls the sending of direct current a short way, which controls the sending of low-frequency ringing current on to the called station. In actual practice the circuit is accompanied by many other elements having to do with local signals, busy test, etc., but, like many other circuits, the apparent complication is accompanied by a surprisingly simple and accurate operation.

When the principle of supplying current for transmitter purposes from the nearest office has been fulfilled, a highly satisfactory local transmission is

1. Abstract of a paper read before the Electrical Section of the Western Society of Engineers, in Chicago on November 11, 1904. Mr. McMeen is a well-known consulting telephone engineer in Chicago.

secured, even over lines of several miles length and several hundred ohms resistance. To enable the fullest advantage to be taken of transmission from these lines over the longest country circuits every minor assistance must be captured. With a given construction of transmitters, there is a critical maximum current which can be carried by the granular carbon of the instrument without excessive heating and consequent noises and permanent damage. The shortest lines and the longest lines being served by current from one source common to all, the potential of this source must be such as to give the longest lines current enough without giving the shortest lines too much. The very longest local lines, however, are in these systems prevented from getting enough current for the maximum efficiency when talking over long-distance lines, although they are getting enough for local conversations.

When only one operator is necessary in a town, all lines, both long-distance and local being switched by her, she may write her own tickets and execute them for all communication between long-distance and local circuits. As the community and its business grow, a condition is reached in which there may be many long-distance operators and many more local operators, and the former will need to be specialized as to their particular duties. In the largest offices, as I have indicated, the wants of the subscribers as to long-distance connections are sent in by telephone, written out on tickets, and these passed to operators who get the parties together. The problem of ticket passing so becomes important, and many ways have been practiced, culminating in the system which utilizes vacuum tubes carrying the ticket directly without any enclosing case. Suitable means maintain a vacuum in a large common tube, having a tap to a box-like valve at each such operator's position. The tickets are of uniform size and are so scored in making as to enable a flap to be bent up easily along the edge. The distributing operator has merely to insert the ticket, flap foremost, in the open end of the tube, whereupon the air pressure behind it will drive it through to its destination, which may be near by or far away, on the same or another floor of the same building or another. The speed maintained by the tickets in practice is 30 feet a second. The tubing is rectangular in section, and, by the exercise of much invention, it is possible to form the tubing as may be desired, the flat and edgewise bends being not long ago quite impossible to make from the straight stock.

Two springs in the receiving valve are normally in contact. The arrival of a ticket between them breaks a circuit, which removes a shunt from a relay. This relay in closing lights a lamp, which calls the operator's attention to the ticket's arrival.

DISCUSSION.

After the reading of the paper a general discussion took place and the first one to be called on to speak was Thomas D. Lockwood of Boston, whose name is familiar as one which has been allied with telephone development since the very beginning. Mr. Lockwood did not discuss the details of the paper, but preferred to speak in a general way upon the broader aspects of the subject. He said that one of the things which probably led Bell to study into the subject of transmitting sounds or signals to a distance was the fact that his father was the inventor of the sign language by which deaf mutes converse. This no doubt led him to try to devise some way by which people could be made to converse with one another when at a distance.

At best the telephone is but a poor imitation of the human voice, and the sounds which are heard coming from the receiver are very little like those spoken into the transmitter at the other end of the line. But it is known beforehand what to expect when listening into the telephone, and the drift of the meaning is caught, when it is easy to follow the conversation which is really far from the exact reproduction of the human voice.

Mr. Lockwood stated that there is as yet no practical telephone repeater made, many claims notwithstanding. Patent after patent has been issued for such devices, but as yet none has proved satisfactory; there are a plenty that will furnish the necessary volume, but the articulation is what is hard to preserve when a repeater is used. One thing that will always crop out is the production of a musical note which is multiplied in a repeater and will eventually spoil the transmission.

F. R. McBerty of Chicago was the next gentleman called upon, and he said a few words regarding the use of loading coils alluded to in the paper. One of the principal uses of these coils is to obviate losses in telephone lines, due to reflection, which may at times be as high as 50 per cent. It is known that the current of a telephone line or any line transmitting electrical energy will encounter losses due to reflection where the current passes from one section of the line to another, where the characteristics of the line—the induction or capacity—are different. This is in a way analogous to a reflection of a wave or undulation sent through a sectional rope, one section of which is light and the other heavy. Mr. McBerty then went on to explain how the loading coils are arranged in the form of terminal tapers to balance this effect of reflection.

Kempster B. Miller of Chicago said that one factor which will tend to check the growth of very long-distance service will be the fact that the working and resting hours of two widely separated sections of country do not correspond, due to the difference in time. This, for instance, would be a serious drawback to the profitable operation of transoceanic telephone lines if such were ever made possible. He then said a few words upon the repeater question. The thing in his mind now offering the most promise for a solution of the problem is the mercury-vapor lamp. By subjecting the arc of a mercury-vapor lamp to a varying magnetic influence the resistance of the gas is made to vary and there are the elements of a practical telephone repeater.

Journey of a Telephone Message.

"Just now," says the American Telephone and Telegraph Company in a booklet distributed at the St. Louis Exposition, "when thousands of people have spent several days on railroad trains to reach St. Louis from distant states, it is interesting to trace the route of a telephone message which has covered the same distance practically instantaneously. Suppose the message comes from a New York office building. From the transmitter on the desk of the person who is speaking, the sound is carried over wires, concealed perhaps behind the window casings, through the partition to the corridor. It flashes down the elevator shaft, and thence to a cable under the street. Here it journeys over a wire, one of 800 wrapped together in a lead-sheathed cable, and thus reaches the nearest central office, where it passes through the main and long-distance switchboards and their auxiliary apparatus. Then it flashes through a cable to the banks of the Hudson, where it dives under that river in another cable, and so reaches Jersey City. Here it goes to the pole lines on which it will make its journey westward. It crosses the meadows and pinelands of New Jersey, mounts the slopes of the Alleghanies in Eastern Pennsylvania, and descends to dart through farming lands and mining regions, past Pittsburg, with its foundries, and over a little strip of West Virginia. On the banks of the Ohio, it enters another cable, and emerges on the farther shore to travel through the pleasant farming lands of Ohio and Indiana, and over the undulating surface of the Prairie State, by roads which wind through great corn and wheat fields. Its journey is now nearly over, but the mighty Mississippi flows between it and its destination. Crossing on one of the great bridges, it makes the last stage of its journey through the conduits under the streets of St. Louis, thence in and out of the central office, back through conduits, and over aerial wires to the telephone of the person with whom the man in New York is speaking. And the sound has been carried between the two cities in a fraction of the time required for the conductor's warning cry of 'All aboard' to reach the people hurrying across the station platform to take the express train which spends 29 hours on the trip from New York to the city of the Exposition."

Lineman's Testing Instrument.

Though widely used for testing purposes, the ordinary magneto ringer has one serious drawback—there is no way of ascertaining the resistance of the circuit which is being tested out, and further-

LINEMAN'S TESTING INSTRUMENT.

more, the instrument will sometimes indicate a ground where none exists. The testing instrument illustrated herewith is manufactured by the Whitney Electrical Instrument Company and is sold by Machado & Roller of New York city. It is designed to possess the good features of the magneto without its drawbacks. The tester consists of a simple and strongly constructed voltmeter movement mounted together with two batteries, a small rheostat and a pair of terminals, in a small stout box of hardwood. The connections within the box are such that when the cord ends are touched together the batteries are applied direct to the voltmeter terminals, the rheostat being so adjusted that the voltmeter then shows a full scale.

Evidently if a resistance were interposed between the terminals it would be in series with the voltmeter, whose needle would then fail to reach full scale deflection by an amount proportionate to the value of the resistance.

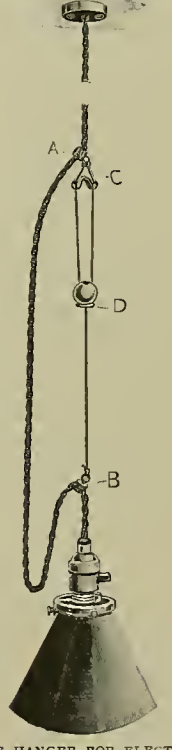
A table showing the number of scale divisions corresponding to different resistances is secured in the cover of the box, so that in taking a reading all that need be done is to touch the cord terminals to the circuit to be tested and then read the resistance by reference to the table.

As the maximum current that can be drawn from the batteries is the exceedingly small amount required by the voltmeter, these may be expected to last for long periods without requiring attention. The rheostat is made adjustable from the outside by means of a screwdriver, so that even after the battery voltage has fallen off, the instrument can still be made to give full deflection on a short-circuit.

The testers are made in two ranges, one giving a readable deflection through 5,000 ohms maximum and the other through 25,000 ohms maximum.

Adjustable Hanger for Lamp Cords.

The Innovate adjustable hanger, illustrated herewith, is designed instantly and automatically to adjust at any height electric lamps attached to hanging cords. The inventor, Mr. Fred L. Gregory of Chicago, has cleverly employed friction as the retaining power by bringing the cord of the hanger into contact with core (D) of ball. By loosening a screw and turning slightly to the left the lower portion of the core (which forms the bottom of the device), increased friction is produced and the heaviest lamp fixtures are as readily adjusted as the bulbs alone. The Innovates are complete and are so simple and practical that the most inexperienced person can attach them to



ADJUSTABLE HANGER FOR ELECTRIC LAMP.

any hanging lamp cord, wherever located, or transfer to another cord in a moment. By a pull or a push the lamp is instantly and automatically retained at just the height desired. Nothing can get out of order, as no springs, weights or coils are used; there is no wear on insulation and the device is practically everlasting. The ball shape is beautifully made and finished in nickel or oxidized copper. Another shape known as the watch shape is made in plain finish. This is a cheap but good automatic cord adjuster.

The manufacturers state that dealers and contractors are daily sending in orders from all portions of the country and many of the more progressive supply houses have already placed stock orders, arranged for listing the Innovates in their catalogues and are pushing the sale of these goods.

Plans are being formulated by the Erie railroad management for the electrification of its suburban service in New Jersey, involving 51 miles. The central power plant will be at Paterson, thus putting the remotest points of power delivery within a radius of 18 miles of the central station.

Printing Telegraphy.[1]

By Dr. Louis M. Potts.

In practically all of the printing telegraphs which have ever been proposed, the control of a number of operations over one wire has been accomplished by the employment of synchronism in one form or another, and a good and stable form of synchronism is a necessary foundation for its successful operation.

The simplest form of synchronism employed was that used by Royal E. House in his printing telegraph invented in 1846. This is the so-called step-by-step method. In this system at the receiving station a toothed wheel is driven by a motor. As this wheel rotates, the current sent over the line is made and broken as each tooth passes under a contact.

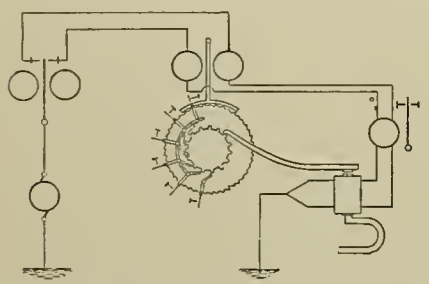


FIG. 1. PRINTING TELEGRAPHY.—BUCKINGHAM SYSTEM.

At the receiving station the apparatus is likewise driven by a motor. A toothed wheel is here employed, similar to the one at the sending station, but in this case it is an escapement wheel. This escapement oscillates under the control of an electromagnet operated by the pulses of current received.

To the class of step-by-step synchronous motions also belongs the Buckingham. However, this method represents a great improvement over the method previously mentioned, particularly in regard to speed. The necessary number of steps has here been reduced to six for any character, and always the same number. Each complete signal results in the advance of the receiving mechanism, six steps in every case, the difference in the signals being merely different combinations of long and short impulses. And, further, the synchronism is rendered more positive by being reset after each character by the so-called release impulse. This will be clear from Fig. 1.

Another phase of the development of the principle of synchronism is exemplified in the Hughes machine. Here we have the method of first regulating two machines; so that they naturally tend to run at as nearly the same speed as possible, and then, at frequent intervals, correcting the rate of one or both by the amount they have deviated the one from the other. This idea has been extensively used, and variously modified since. Even the Hughes machine itself has employed several different methods at different times.

In the Baudot multiplex system we have a system of synchronism very similar to the Hughes. But here we have a distinct improvement on the Hughes method, in that the synchronism is not corrected by the signals for the characters, but a separate impulse is transmitted over the line for the purpose of correcting the synchronism. The machine is kept in continuous motion by weight or a motor. The speed is locally kept very close to a definite speed, as in the Hughes, by a centrifugal governor, which, as the speed increases, causes the motor to do more

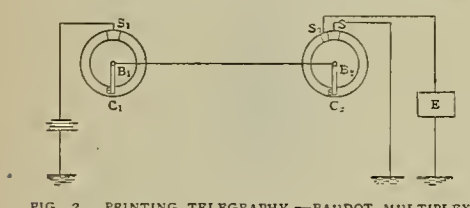


FIG. 2. PRINTING TELEGRAPHY.—BAUDOT MULTIPLEX SYSTEM.

work against friction, and thus keep its speed within a certain limit. The apparatus at one end is set to run slightly faster than at the other. Once in each revolution, or more frequently, the correcting impulse is sent out at the receiving station by means of a commutator and rotating-brush arm which connects the line to the battery at frequent intervals (Fig. 2). As will be seen on a part of the commutator (C_2), at the other terminal of the line, slightly in advance of that which sends out the correcting impulses, is a segment connected to the ground through an electromagnet. Assuming the brush (B_2) to travel faster than (B_1), it will arrive on the segment (S_2) before (B_1) leaves (S_1), and the magnet (E) will be energized. The magnet (E) operates a mechanical arrangement, which has the effect to set back the brush (B) a small amount, so that it again starts out in phase with (B), and thus at each revolution the magnet (E) corrects the rotation by the slight amount in has shifted during the previous revolution. We thus have two systems in synchronous operation within certain limits of variation.

We now pass to a somewhat different type of synchronous motion in which, when in proper adjustment, the two tend to run at synchronous speed, and, if disturbed from this position, will tend to return, i. e., they are in dynamic equilibrium. In the Murray page-printing telegraph we have an example of this form. As in the correcting systems, we have here at each station a vibrating reed, whose rates are made nearly equal by weights sliding along their length. These reeds vibrate against what are known as resilient stops, that is, stops which are not rigid but have a certain amount of elasticity. The effect of these stops is to allow a considerable variation in the period of the reed, according as it is actuated by a weak or strong periodic force. This periodic force is produced by an electromagnet operating on the reed as an armature. In series with the electromagnet are two sets of contacts; one set is operated by the reed itself, the other set is on a relay operated by the line relay. This line relay has both front and back contacts so connected that the circuit of the reed magnet is broken each time that the line current is made or broken. If the breaks at both contacts occur at the same time, the reed magnet will receive its maximum current.

If, however, the two breaks occur at different times, the reed magnet will receive less current, and, due to the effect of the resilient stops, as before mentioned, it will decrease its rate of vibration. If now the reed tends to go faster or slower, it will receive a less or greater amount of current, and will assume such a position that there is a balance between its tendency to go faster, and its tendency to receive less current due to its increasing rate.

The most perfect type of synchronism that has yet been devised is that used in the Rowland system of telegraphy. This is of the same general type as the Murray, but differs more particularly in that the Murray is merely a synchronism of vibration, while here we have the synchronous rotation of machines of considerable inertia, and consequently a much more stable system, and one subject to disturbances to a correspondingly less extent.

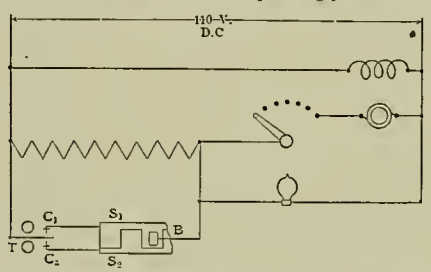


FIG. 3. PRINTING TELEGRAPHY.—ROWLAND SYSTEM.

A number of different methods have been used in this system, all having the same fundamental principles, but differing considerably in the methods of their attainment. In the first place a means is provided whereby two motors when rotating in synchronism are in dynamic equilibrium, and, secondly, a means of producing a frictional force when they are disturbed from this relation. This can be best understood by reference in detail to a particular form.

The simplest form, and that used on the latest type of the Rowland machine, is that in which the principle is applied to two direct-current motors. One motor drives the mechanism, by means of which an alternating telegraphic current is produced, in this case an alternating current of something over 100 complete periods per second. The second motor drives a commutator for synchronizing. Referring to Fig. 3, we have the polarized relay, which is kept in continuous vibration by the alternating current produced by the mechanism driven by the motor at the originating station. The commutator is kept in continuous rotation by the motor whose field and armature are shown. In series with the armature is a permanent resistance and a speed-regulating dial. The commutator is an ordinary crown commutator, having its alternate segments connected to the contacts of the relay. When the tongue (T) and the brush (B) are at the same time on the contact and segment, which are connected, the resistance is cut out of the armature circuit and it receives its maximum current. When they are at the same time on the contact and segment, which are not connected, the armature receives its minimum current. If now the relay is so vibrated and the commutator so rotated that as the tongue passes from (C_1) to (C_2) the brush (B) passes from (S_1) to (S_2), and as (T) passes from (C_2) to (C_1) the brush (B) passes from (S_2) to (S_1) and so on continuously, the resistance will be permanently cut out of circuit. If, however, the brush is shifted the distance of one segment ahead of this position, the resistance will be permanently in circuit. For any relation between these two extremes, the armature will receive at rapidly recurring intervals a larger and smaller amount of current.

The relation of the rotating brush and the vibrating tongue will determine the relative length of the interval of large current and of small current, and the integral effect will determine the speed of the motor, which it will be seen can have quite a large range. When the brush and tongue have such a relation that there are intervals both of large and small current, a tendency of the motor to increase its speed will call into action a tendency of the commutator to allow more or less current to flow through the armature, and the motor will assume a state of equilibrium where these two tendencies exactly balance. And, if the rate of this tongue increases, there is a corresponding increase in the current through the armature until a state of equilibrium is reached, and conversely. Such a system will remain in synchronism continuously for all ordinary variations, since such a state is a state of equilibrium, and, if disturbed from this state, it is acted upon by a force tending to return it. However, any freely moving system, if disturbed from a state of equilibrium, will not return directly to that state, but, when allowed to return, will go beyond this point, and possibly make a number of oscillations about it.

Under ordinary circumstances, due to various causes, such a system is almost certain to be subject to many such disturbances, and may even continuously oscillate about its position of equilibrium. In order that such oscillations may be removed, it is necessary that some frictional force shall be called into action whenever such oscillations arise, i. e., the system must be made aperiodic, or nearly so. In this case this result is very easily and quite effectively accomplished by having mounted on the motor shaft a light but strong flywheel having a large hollow rim filled with mercury. When the motor rotates steadily this acts practically as a solid flywheel. However, when the speed changes the mercury drags or pulls on the outer wheel and thus creates the frictional force necessary to dampen the oscillations when any disturbances occur. This also has the further effect to make the inertia of the system quite large, so that its period is so much slower than the alternations of the current that the separate pulses, or even a considerable number, have no separate distinguishable effect on the speed, but only the integral of a large number, so that the modifications of the current caused by the signals have no effect on the synchronism, except as they may effect differently large blocks of waves. Practically, it is found that about half the waves require to be altered to have any serious effect on the stability.

The basis of all electric telegraph systems is a succession of electric impulses sent to the point with which communication is desired. The character of these impulses has a most important bearing on the speed attainable by any system. In general, it is true that the speed will be determined by the number of impulses required for each signal, using as a unit the shortest signal, and counting each large unit in terms of the shortest. This is, however, very materially modified by other characteristics of the current. The principal effective consideration is the so-called trailing of the signals. This effect is not only produced by the electrical properties of the line, but is quite materially increased by the terminal main-line instruments. This effect is the duration of the action of a signal for a longer time than the length of the signal at the originating station. The line acting as a condenser, the other plate being the earth, takes up a certain charge, which, depending on its amount, prolongs the signal. This effect is still further increased by the fact that the iron core of the receiving relay holds its magnetism after the magnetizing force has been removed. This phenomenon exerts itself to a greater or less extent, depending upon the duration of the signal. A long impulse charges the line more fully, and also magnetizes the core of the receiving relay to a greater extent, so that a very short impulse will have a less effective value at the distant station when following a long impulse, than when it follows a short impulse. These facts very greatly modify the speeds of different systems, having apparently the same number of unit impulses per signal, but which have different limits to the upper and lower length of the impulses employed.

In the simple step-by-step systems the current consists simply of a succession of impulses of equal length which may alternate in direction or not. One long impulse for printing the signal is used; or the sending current is interrupted altogether, and the printing mechanism operated by purely local means. In this system we have a considerable number of impulses per signal, it being frequently necessary to rotate the wheel nearly a whole revolution. In addition, there is the length of time required for the actual printing, which, in many cases, requires even more time than the actual sending of the signal itself, since it requires the stopping and starting of parts having more or less inertia. For these reasons any system acting on such a principle is limited in speed by the rapidity with which the mechanical parts can move.

In the Buckingham system a decided step in advance has been made, and we have here a step-by-step system of remarkable speed. The speed has been increased by an extremely ingenious arrangement, by means of which six impulses are sufficient for any character. However, three of these impulses are short and three prolonged, so that the gain

1. Abstract of a paper presented before Section G of the International Electrical Congress at St. Louis, September 13, 1904. Mr. Potts is a consulting engineer of Baltimore and was a pupil and close adherent of the late Prof. H. A. Rowland.

from this reduction in the number of impulses is not as great as might at first appear. The length of the long impulses being equal to three short ones, we have in reality from 11 to 16 impulses for each letter, but, on account of the reversed polarity, and also on account of the fact that the longest impulses are equal to only three short ones, the current is well adapted for long-distance transmission. The speed limit has also been very ingeniously and materially increased by the small inertia of the moving parts.

In the Hughes system the current is extremely simple, being one impulse for each letter sent. However, a long interval ensues during which no impulse is sent over the line. We have here the fact that the wheel must in many cases be rotated nearly a complete revolution between successive letters, although, in certain cases, more than one character may be printed in one revolution. The speed of operation which has been possible with this machine, however, has not been such that the transmission of the line current enters seriously into consideration.

In the Baudot system, we have a much greater speed than that presented by the systems previously mentioned. The speed here has been greatly increased, due to the fact that the time element which enters into the step-by-step system, necessary for the actuating of the printing mechanism, has been entirely removed. The current at receiving station has merely to operate the light tongue of a relay. The printing is controlled by five relays and actuated by mechanical means, so that the time required to operate heavy mechanical parts is not added to the time necessary to transmit the signals, but takes place simultaneously and independent of them. However, a part of the time of the line is taken up to maintain synchronism, which must be subtracted from the effective use of the line for actual signals. The Baudot signals are made up of units of five short impulses, which may be all in one direction, or any combination of six impulses in opposite directions. On account of this feature it is possible to have very long impulses followed by very short ones in the opposite direction, thus bringing in the trailing effect mentioned above. We have two features which limit the speed of this system—the trailing of the waves, and the limit of the speed at which it is possible to maintain sufficiently stable synchronism.

In the Murray system we have an alphabet practically the same as the Baudot, except that current only in one direction is used, the alphabet being made by the use of the various possible combinations of any number of impulses up to five, the remaining impulses simply being omitted. The same troubles enter into the transmission of this current as in the case of the Baudot. However, we have no added time interval for the purpose of maintaining synchronism. This is accomplished by the signals themselves. A limit is here set upon the speed by the operation of the punching magnet. Although it is possible to make such a mechanism operate with great rapidity, yet it is most likely that the limit of speed in this system will be found to be limited by this operation, and not by the failure of the signals.

The basic current in the Rowland system is an alternating current, the ideal current for long-distance transmission. To transmit signals, it is necessary that the alternating current be modified. This is accomplished as follows: For each signal the base is a block of the alternating current, consisting of 11 half-waves; these 11 half-waves are modified by the reversal of any two. By this means the alternating current is modified to a smaller extent than if more waves are reversed. There is an extremely limited amount of trailing of signals here, due to greater equality in the duration of succeeding impulses. As in the Baudot, the time element of the local printing mechanism is completely removed, it being purely local and controlled by 11 relays. As in the Murray, the synchronism is maintained by the signals themselves, and no deduction is made for the effective value of the line for the maintenance of synchronism. The speed at which it is possible to send by the Rowland system is only limited by the frequency of alternating current; it is impossible to use, and still receive sufficient current at the receiving station to actuate the main-line relay positively, as no difficulty has been encountered in maintaining stable synchronism.

In the earliest printing telegraphs, also on the Hughes and Rowland, the messages are sent directly by a keyboard having a key for each character sent, and in the Baudot directly from a keyboard, but in this case having only five keys, and on this account requiring great skill for its operation. In many other systems, including the Murray and Buckingham, a punched paper strip, the invention of Bain, is employed. In both the Murray and Buckingham systems the preparation of the punched tape has been very much simplified by the use of a keyboard perforator, having a separate key for each character, the operation of which is very similar to the operation of an ordinary typewriter. This tape is prepared by one or more operators. The tape is then passed through a transmitter very similar to the Wheatstone. This method of transmitting presents the advantage of using the line to its fullest capacity.

In the Baudot and Rowland systems the fact that one sending operator cannot send as fast as a line is capable of transmitting, is met by having several operators use the line at rapidly recurring intervals. In the Baudot there are two or three operators at each end, while in the Rowland there are four. The great skill required for the Baudot is not required in the Rowland, due to the use of a keyboard having a key for each character. These keys are locked and unlocked, so that the operator can depress a key only at the proper intervals. The signals are transmitted at the proper interval by a commutator and rotating brush, in connection with a transmitting relay. The keyboard simply completes the circuit through the proper segments of the commutator for the signal to be sent.

In the matter of the reception of the signals there is as great diversity as in the sending. In the simple step-by-step system, the Hughes and Buckingham, the printing is accomplished by a prolonged impulse, which, by means of a relay sensitive only to long impulses, either sets in action a mechanical printing hammer, or operates an electrical one. In the Murray system we have at the receiving station, as well as at the sending station, a punched tape, which, after it has been prepared by the receiving apparatus, is passed through an attachment to an ordinary typewriter, which, by means of a set of 10 levers, controlled by the holes in the receiving tape, allows, by means of a combination of slots, the keys of the typewriter to be depressed by a series of cams actuated by a motor drive.

In considering the practical value of any system of printing telegraphy, there are many points which enter into the question. Of course, in the first place, it is necessary that the system, both mechanically and electrically, shall be sufficiently stable and certain in its operation to be operated continuously under the conditions of commercial work. It must also, for the greater and most important class of telegraphic business, be capable of sending the messages in such a manner that there shall be the shortest interval of time possible between the actual receipt of the message in the sending office and the delivery of the message at the receiving station. No matter how great advantages any system may have, if these conditions are not fulfilled the system cannot be even considered for the greater part of the telegraphic business handled today, although an exceedingly rapid system, which did not fulfill the second consideration, might be employed for a certain class of business which is today conducted by the mails. (There are a number of printing telegraphs which have recently been invented that show extreme rapidity, but are not adapted to much of the present telegraphic business but fill a new field, notably the Pollak-Virág and Siemens & Halske rapid systems.)

Aside from the two above necessary considerations, the usefulness of a system is dependent on the amount of business that can be transacted over one wire, and also upon the amount of business that can be transacted per operator, modified as may be necessary by the skill of the operator required. A very great point in favor of any system of telegraphy is simplicity, although this is not a necessity, provided that certain other conditions are fulfilled. If any system is shown to be reliable in its operation when supervised properly, the only point which really determines its usefulness is whether the cost of transmitting the message is reduced, as the determination of this cost per message should take into consideration any skilled employes who may be necessary to insure the continuous operation of the apparatus.

By considering the various printing telegraphs, with the above points in view, an idea of their comparative value may be obtained. The step-by-step telegraphs and the Hughes machine cannot seriously be considered for the transaction of any heavy business over long distances, since both the speed per operator and speed per wire are low.

In the Baudot machine we have a moderately high speed per wire, but not an exceptionally high speed per operator. The most serious objections to the Baudot are the great skill required for the operation of its keyboard, and the comparative difficulty of keeping it in stable and continuous operation, especially over many of the longer circuits.

The Murray system presents a high rate per operator, and also a comparatively high rate per wire. We have here, however, a serious objection from the fact that both the sending and receiving stations employ a perforated tape. It has been found in actual practice that a considerable delay is necessarily incident to the use of tape for this purpose, as it is necessary to perforate a considerable amount of tape before it can be actually used; this is likely to cause a delay of some minutes at both terminals. The greatest difficulty, however, is presented in the case of errors or damaged tape; in such cases it is always necessary to go back some little distance in the tape, and considerable delay is experienced in finding the error or disputed point on tape and to transmit it again over the wire.

In the Buckingham system we have also a high speed per operator, and a comparatively high speed per wire, although probably not as great as in the case of the Murray. However, the Buckingham system presents a decided advantage over the Murray, from the fact that the punched tape has been dispensed with at the receiving station, and is used only at the sending station. The use of tape at the sending station causes considerable delay, but not as much as in the case of its use at both stations, as the errors are detected much sooner. The Buckingham system would also in actual practice probably gain somewhat on the Murray, due to the fact that its operation would be more stable, as there are no reeds to tune at the terminals of the line, but the motion is a positive step-by-step action.

In the Rowland system there is a large speed per operator, possibly not as great as could actually be obtained on some other systems, such as the Murray and Buckingham, but it is to be expected that in practical work the sustained rate of the Rowland operator would be practically the same as that of the Murray or the Buckingham. The speed per wire is much greater than that of any other printing-telegraph system, and is greater than that of most other automatic systems, if we except the chemical. In the Rowland system, both sending and receiving are direct, and neither requires the services of a skilled operator. The time of delivery of the message has here been reduced to the minimum possible with an automatic system, and, by the aid of the several special contrivances, the correction of errors or inquiries in regard to messages has been reduced to the minimum. It is possible in this system to stop an operator in the middle of a message, and have the message duplicated, without the sending of a service message. The objections which have always been made to the printing telegraphs employing synchronous motion have been almost completely removed by the employment of stable synchronism, and also the furnishing of a means whereby synchronism can be established in less than one minute. On account of the direct method of operating the Rowland system, and also on account of its large capacity, a larger amount of mechanism is required than in the case of systems of smaller capacity. This feature has resulted not so much in great complication as in the multiplicity of parts.

BOOK TABLE.

MODERN PRACTICAL ELECTRICITY. (Vol. IV.) By R. Mullineux Walmsley, F. R. S. E. Chicago: W. T. Keener & Co. 1904. Pp. (seven by 9½ inches) 319, with 332 illustrations. Price, $3.

This volume completes the series of four, the other three were reviewed in the Western Electrician of October 24, 1903. "Electricity in the Service of Man" is dwelt upon more specifically in this volume, and while there is nothing essentially new in this work, still the primary object, which has evidently been to embody in the four volumes a little of the history and a fairly complete exposition of the methods and practices of modern electrical development, has been fulfilled in the series.

Volume IV. is in some ways the most valuable, inasmuch as it deals with the latest types of apparatus as used in England, at least. The two chapters on alternating currents and electrical measurements are, perhaps, deserving of the most consideration. In the former there are to be found good descriptions of the various kinds of induction motors, both single-phase and polyphase, and the single-phase alternating-current motor for traction purposes is also given its fair share of attention, thus bringing the book up to the latest which can be offered in this line.

SELF-PROPELLED VEHICLES. By James E. Homans, A. M. New York: Theo. Audel & Co. 1904. Pp. (5¼ by 8¼ inches) 652, with 460 illustrations. Price, $2.

This is the second edition of a valuable and complete book upon automobiles—valuable alike to the advocates of steam, gasoline or electric machines. The general principles of automobile construction and operation are given, including such vital points as the steering gear, tires, bearings, lubricants, etc. This is followed by quite an exhaustive account of the theory and operation of gas engines; as complete in this respect as is necessary for a good understanding and working knowledge of the gas engine for motor-vehicle work. The chapters on electric vehicles are sure to meet with the approbation of users of this class of automobile. For the owner or chauffeur who is unacquainted with the principles and phenomena of electricity a good many pages are given up to informing him, in a general way, of these principles, explaining the significance of the ohm, ampere, volt, etc., how they are derived and how used. The fundamental principles of electric circuits and batteries are then taken up, followed, successively, by discussions on the theory and operation of generators and motors, the laws of motor operation, the laws involved in the computation of speed and power and the variety of motors suited to automobile work. Electric meters are described and illustrated in a brief chapter and the principles underlying storage batteries, their construction and care are outlined.

Automobiling is more than a craze, a passing fancy, and the extent to which these machines have been developed renders necessary a skilled engineer for their design and a man of mechanical ability for their operation. For those men who have to do with the construction or operation of automobiles this book is intended, together with those of the other class, the owners, who take an active interest in the mechanical features of their machines.

CORRESPONDENCE.

Great Britain.

London, November 2.—The accounts of the municipal telephone system at Brighton for the first six months' working have just been submitted. They are interesting, in view of the poor competition that has been set up by the local authorities of Great Britain since municipal telephone exchanges were first inaugurated in 1899. The profit at Brighton is a little under $500, after paying interest and sinking fund. There are 1,488 instruments at work, and 27 public call offices. A rumor that has been current to the effect that an offer had been made by the National Telephone Company to purchase the undertaking, in a similar manner to Tunbridge Wells, is, it is stated, incorrect. At Glasgow, at present, there is such division of opinion as regards the present and future value of the telephone undertaking that a proposal was recently made to call in an expert to report as to the present state and value of the plant and probable depreciation that will require to be given effect in order to avoid loss when the undertaking will be sold to the government in 10 years time. This serves to indicate the feeling in a city like Glasgow, which is held up, in Great Britain, as a model of what a municipality embarking upon trading undertakings should be. Some discussion took place upon this proposition, which eventually was rejected, but during the discussion it was stated that although the undertaking had been in existence for three years, the depreciation fund only amounted to about $25,000 for a capital expenditure of nearly $1,700,000.

The Northeastern Railway Company, in carrying out the electrification of its local lines at Newcastle, left until the last the Goods line, upon which electric locomotives are to be used. The locomotives are now being delivered, and the following particulars are interesting: They are the largest ever built in this country, being of the double bogie type, with central cab and sloping ends, and weighing 50 tons each. One G.E.-55 motor is mounted upon each of the four axles, the gear ratio being 3.28. The Sprague-Thomson-Houston multiple-unit system of control is employed. A feature of these locomotives is that they are fitted with two shoes for contact with the third rail, and also an overhead bow collector, as some portion of the Goods lines will be dealt with in this latter manner. The locomotives are capable of hauling a 300-ton train on the level at a speed of 14 miles per hour.

A curious workmen's-compensation case was tried in the courts here a few days ago. A driver of an electric tram car sued his company under the workmen's-compensation acts for compensation, owing to his being incapacitated from work as a result of exposure to the elements, and as a consequence contracting chronic rheumatism. On the face of it, the claim appeared absurd, and legally, it was even more so, for, under the workmen's-compensation acts, compensation is only granted by virtue of contributory negligence on the part of the employer.

One of those periodical crusades against electric tramways which take place here, was started last week in the West of London, when a large number of local authorities met to discuss the noise created by the electric cars of the London United Tramways Company and to consider what means should be taken to secure an abatement of the nuisance. Nothing of a definite nature was arrived at.

The winter session of the Institution of Electrical Engineers commences next week, when Mr. Alexander Siemens, the new president, will deliver his inaugural address.

The question of the electrification of the tramways in the North of London is still causing great anxiety to the London authorities, who, in consequence of the delay which has occurred in inducing the local authorities to come to an agreement as to the system which shall be adopted, find themselves in imminent danger of losing authority to construct certain new lines which have been postponed pending a settlement of the larger question. In order, therefore, not to lose the powers to construct a line along an important thoroughfare, the council has agreed to adopt the conduit system, although it distinctly wishes it to be understood that this decision will not be taken to pledge them to this system for the whole of the northern lines. G.

New York.

New York, November 12.—The operation of the subway is proceeding smoothly. The trains are seldom inconveniently crowded and they run on very good time. The public is encouraged to travel on the express trains, although it is found that for shorter trips it is no advantage to change from the express to local to reach a station at which the expresses do not stop. There seems to be a demand for additional express stations, as for instance at Fifty-ninth Street.

The New York Central railroad is erecting two enormous power houses to supply current for the pending electrification of its suburban service. These buildings will be at Glenwood, near Yonkers, and at Port Morris. They will be of identical architectural design. Each structure will be 235 feet long, 167 feet wide and 125 feet high, with two smoke stacks of 290 feet each, and an internal minimum diameter of 17 feet. The coal bins, with a capacity of 6,000 tons, will be a feature. The main switchboards will be in an adjacent building, but can be controlled if needed from the engine room. The plant at each station will normally develop 30,000 kilowatts and the indicated horsepower of the 12 batteries of boilers is to be 24,000. There will be 16 steam turbines directly connected with the dynamos, and each turbo-generator, being supplied by its own boilers, will constitute an independent unit. The electric locomotives for use on the railway are being built by the General Electric Company at Schenectady, N. Y. They were officially tested today and are designed to haul a heavy passenger train at the rate of 70 miles an hour.

There is a persistent rumor that an amalgamation is pending between the New York and Brooklyn transit systems. Officials of the companies concerned do not encourage the public to believe these rumors, but they do not flatly contradict them.

Harry Alexander, electrical engineer of 20 West Thirty-fourth Street, Manhattan, has been awarded a substantial contract for a large amount of electrical work for a new amusement enterprise to be known as "Wonderland." The contract involves more than 100,000 incandescent lamps.

A sum of $30,000 is to be appropriated to improve the fire-alarm telegraph system in Manhattan. A large item is for cables, which are to be placed on the Sixth and Ninth Avenue structures, with the consent of the Interborough Rapid Transit Company.

The cost for the electrical equipment of the new Richmond Borough Hall will be $9,400. The contract has not yet been given out.

The Union Switch and Signal Company has installed a large interlocking electropneumatic signal and switch-control system of the Long Island City depot of the Long Island railroad. The contract price was $100,000. The system was timed to be placed in operation last Sunday morning, but at the last moment it was found that the supply of trained tower men was inadequate. The electrical connections with each switch were therefore disconnected as speedily as possible, and until further notice the switches will be thrown by hand. Everything was in readiness for the change and its non-adoption led to a great disorganization of the traffic on Sunday and the three following days. The Long Island railroad system of switches at Ozone Park, operated entirely by electricity and without pneumatic power, has given entire satisfaction since it was first used, three months ago.

At the Polytechnic Institute of Brooklyn a series of lectures has just been brought to a close on "Modern Views of Electricity," by Prof. E. R. von Nardoff, Ph. D., D. Sc., of Erasmus Hall High School. D. W. W.

New England.

Boston, November 12.—The new issue of 10,450 shares of stock of the Edison Electric Illuminating Company of Boston, to be acted upon by the stockholders at a meeting called for November 18th, is a part of the 20,000 shares authorized by the State Gas and Electric Light Commission in June of last year. The purpose of the $4,000,000 thus added to the capital (at $200 per share) is the meeting of the outlay for the numerous acquisitions of suburban companies which the Edison has accomplished during the last year or more. The total capitalization after the proposed new issue of 10,450 shares will be $11,485,500.

The Massachusetts railroad commissioners have authorized the Leominster, Shirley and Ayer Street Railway Company to issue 1,000 original shares of stock at $100 each for building and equipping the road.

The Boston and Worcester Street Railway Company has been authorized to issue $100,000 additional stock for payment of floating debt and purchase of additional property. Stockholders will get it at $100 per share.

The expected has happened in connection with the project for a trolley line from Lynn to Nahant, in which Senator Henry Cabot Lodge and other Nahant people were supposed to be interested. When they secured their charter certain other parties who had contemplated building such a line were cut out of the field. Now it appears that the project is to be abandoned. Negotiations with the Boston and Northern Street Railway Company and others who might have undertaken the work if an agreement on terms for operating could have been reached came to naught, and a recent report of a committee of the incorporators indicates that the deal is off.

The Northfield (Vt.) electric plant, owned by the town, was burned on November 3d, entailing a loss of $20,000, with insurance of $10,000.

Negotiations are pending for the absorption of the Haverhill and Georgetown and the Georgetown and Ipswich street-railway companies by the Boston and Northern Street Railway Company, which has been actively opposing all moves of the proposed new railway from Haverhill to Boston via Maplewood, which would parallel a good portion of the Boston and Northern company's service in Essex County.

The Templeton Street Railway Company, which has been trying to straighten out several tangles in its affairs for a number of months, will be sold on December 10th to satisfy a judgment in favor of ex-Congressman William E. Barrett of Boston, who owns the controlling interest.

The annual report of the Worcester Consolidated Street Railway Company shows 27,098,275 paying passengers carried during the last year and gross earnings of $1,333,440.86.

The Boston and Worcester Street Railway Company's annual report for the year ended September 30th has just been issued. This is the first complete fiscal year reported on, as the company began business May 12, 1903. For the period in 1903 between the opening and September 30th the company reported net earnings of $62,070 and a surplus applicable to dividends of $42,581. For the full fiscal year ended September 30, 1904, the company reports: Operating expenses, $220,532; net earnings, $179,489; surplus applicable to dividends, $91,296. A dividend of $46,944 was paid last July. The road has been a remarkable success from the start. B.

Dominion of Canada.

Winnipeg, Man., November 12.—The British Columbia Electric Railway Company has a big scheme on hand whereby electricity will be furnished the whole of the north side of Lulu Island, B. C., when it takes over the present Canadian Pacific railway line to operate it to Steveston, which it has agreed to do. Already the applications are out for the company's cheap light, and motors are being ordered for more than half the farms along the line. Manager Buntzen says that it is believed by the farmers that every threshing machine on the island will no doubt be operated by electricity when this scheme is completed, which will be January 1st next. Between New Westminster and Vancouver cheap electric light is being furnished the settlers along the line, and already 20 branch lines have been run for this service.

The City Council of the town of Westmount has passed a by-law calling for a loan of $225,000 for the purchase of a garbage destroyer and an electric-light plant to be run as a municipal plant. It is proposed to install 150 arc lights at a cost estimated at $73 a lamp a year. The capital cost of the light station is fixed at $118,076. The town is now being lighted by the Montreal Light, Heat and Power Company.

The Toronto Electric Street Railway Company is testing a large number of different makes of brakes. It now has 55 of its cars fitted with brakes made by the Momentum Brake Company. These are fitted to the heavy double-truck cars and work admirably. H.

Ottawa, Ont., November 12.—Owing to the lateness of the season it will not be possible to repair the cable between Belle Isle and Chateau Bay on the Labrador coast before next spring. The cable was destroyed by an iceberg a few weeks ago. The communication with Belle Isle, however, will not be materially affected, as the wireless system from the end of the government telegraph line in Labrador to Belle Isle is working.

The power development at Niagara Falls has already led to the erection of some very costly buildings on the Canadian side, and more are to be immediately placed under construction. The Electrical Development Company has just awarded contracts aggregating $120,000 for a new subsidiary power station to be proceeded with at once. Tenders will also be called for at once for the erection of a new power house to cost fully $300,000.

It is now stated that Toronto is not likely to receive Niagara power before the autumn of 1905. The cables of the Electric Development Company and the necessary apparatus for transmission will be completed some two years before the company is in a position to generate power at the falls. It is understood, however, that one of the other two power companies will be able to supply the Development company with power early next fall, and it is this power that will first reach the city of Toronto from Niagara. Pending definite information in the matter of this power-delivery question the York Radial Railway Company will not commence any vigorous construction work on extensions of the electric lines centering in the city.

An important amalgamation of electric-railway interests in the city of Toronto, Ont., has taken place and a new company has been organized under the name of the Toronto and York Radial Railway Company. This company is independent of the Toronto street railway. William MacKenzie is president and W. M. Moore general manager. The amalgamation includes the Metropolitan electric railway, the Mimico electric railway and the Scarboro electric railway. Big changes in the line of improvement are contemplated. Adequate station accommodation is to be provided along the entire route. A transfer service is to be provided for the Toronto terminals so that the traffic will be taken from the electric railways and distributed over all parts of the city. The system, which is to be operated by the new company, includes nearly 50 miles of railway.

It is probable that an electric smelter will soon be established at the city of Peterboro, Ont., near the Trent Canal. The present plan is to use the ore from the Belmont iron mines, located about 30 miles from Peterboro, close to the Trent River. The ore was for a number of years worked successfully and shipped to the United States, but the mode of shipment then being costly made the venture

non-productive. With the completion of the Trent Canal and the cheap and easily developed power at Peterboro the mines can be operated at a profit.

An important move has been made by the City Council of Ottawa looking to the purchase by the city of the Ottawa electric street railway. Messrs. Ahearn and Soper control the majority of the 10,000 shares of stock in the system. The company has still 20 years of its franchise in which to operate the system. W.

Southeastern States.

Charlotte, N. C., November 12.—The Georgia Railway and Electric Company has received a permit to erect a three-story building in Atlanta for office purposes, costing $90,000.

The Macon Railway and Light Company of Macon, Ga., has begun work on the additions to the city lines arranged for some time ago.

Work on the new electric-light plant at Washington, N. C., is being rapidly pushed to completion.

Navy experts have recently examined the power plants of the navy yards of the government at Charleston, Norfolk and northern ports, with a view to reporting upon the advisability of consolidating the plants at the various yards.

The town of Thomasville, Ga., has voted $35,000 for a muncipal electric-lighting plant. This action means a defeat of bonds and a victory for municipal ownership, the proposition being to assume the debt necessary to the city's owning the electric-light plant.

At Greensboro, Ga., the citizens have voted a bond issue for an electric-light plant. The bonds will soon be placed on the market.

The City and Suburban Electric Company of Charlotte, N. C., has begun preliminary work for the construction of lines to several neighboring towns, including Concord, 21 miles distant; Gastonia, 21 miles distant in an opposite direction from the first-named town, and other points. Mayor P. M. Brown, William C. Whitner, chief engineer, and others are interested. L.

Ohio.

Cleveland, November 12.—The local election in Toledo hinged almost altogether upon the franchise question, and most of the men who were in favor of giving the street railway the right to operate on the basis of the ordinance recently passed were defeated in their fight for members of the City Council. Just what the opponents of the franchise want and what crumb they are willing to concede to the company is not plain. It may be that good judgment would dictate seven tickets for 25 cents rather than have trouble. This is what Columbus has and the company has made a good profit. The mayor, it is said, has vetoed the franchise that was passed some time ago in Toledo.

Fifty new trailers have been ordered by the Cleveland Electric Railway Company for delivery next spring. They will be of the convertible type and have a smoking room. The lines are badly rushed at this time of the year, morning and evening, and are very uncomfortable. It will be absolutely necessary for the company to secure more cars, as the rapid growth of the city is constantly demanding additional service.

The public-service corporations of Cleveland have appealed to the state board of tax remission to abate the additions which Auditor Right of Cuyahoga County has added to the figures. The hearing will be held in Columbus on November 17th.

It is said that the Everett-Moore syndicate will probably get matters cleared up this winter until the business can be taken from the hands of the trustees. The members of the syndicate have been hampered by the tying-up of securities and are unable to develop their various properties as they would like. There is little doubt that as soon as all the matters are put into satisfactory shape the members of the syndicate will again become active in the railway and telephone business.

The Springfield and Xenia Traction property has been reappraised at $200,000, the former appraisement being $375,000. The property was offered for sale a short time ago, for the second time, and failed to sell. It is said a committee of bondholders will bid it in and will refinance it. Probably the Bushnell syndicate will take charge of the matter.

At the last election the people of the village of South Brooklyn voted to annex their town to Cleveland, and with the addition goes a small municipal light plant. If the annexation proceedings go through, it is said this will form the nucleus for a larger plant. The Board of Public Service has favored a municipal plant for some time, but did not care to have bonds issued for the purpose. Now they will probably vote to secure money for the extension of this plant.

The Eastern Ohio Traction Company, through Receiver Bishop, it is said, has effected a settlement of the floating indebtedness. Plans have been discussed regarding a reorganization of the company and of extensions costing $1,000,000. The road is doing very well at the present time and with connections reaching more good towns, it will be a good property.

The Citizens' Heat, Light and Power Company of Canton has been incorporated with a capital stock of $100,000. Anthony Howell and others are interested in the enterprise.

Some of the managers of Ohio roads are anxious to bring the question of affiliation with steam roads before the Ohio Interurban Railway Association, but others are fighting shy of committing themselves. Some of the roads have made favorable arrangements with steam roads and are doing very well in the way of originating business that pays both. Others have as yet had nothing to do with it. It is the general opinion that it is not yet time to take such a step. On special occasions the two have worked together well. Only a few days ago the Big Four and the Cleveland and Southwestern handled a football excursion to advantage.

O. M. C.

Northwestern States.

Minneapolis, November 12.—The new electric-light plant for the Wausau (Wis.) Electric Company has been completed.

The Brown-Corliss Engine Company will erect a waterworks, electric-light and power plant at Corliss, Wis., next spring at a cost of about $50,000.

The pending street-railway franchise has been voted at Moorhead, Minn.

P. Curtis of Norwalk, Ohio, and W. G. Mack and A. Huntington of Omaha, Neb., have purchased the electric-light plant at Sioux Falls, S. D.

Work has been started on a new dam and power house at St. Croix Falls, Wis. The total cost of the work is estimated at $4,000,000. A quarter of a million dollars was expended in securing sites and water rights.

H. Romunder of Newark, N. J., will start a factory at Milwaukee for the manufacture of electric cars. The plant will have a capacity of about three cars per day. A building has been secured and is already equipped for the work.

The Minnesota Light and Power Company of Winona, Minn., has been incorporated. H. M. Lamberton is at the head of the new company, which is capitalized at $75,000. It has accepted the franchise for lighting the streets at Winona.

An electric-light plant will be erected at Moose Lake, Minn. R.

Michigan.

Detroit, November 12.—A number of representatives of electrical concerns have been in Port Huron recently making estimates on the proposed conversion in motive power from steam to electricity for the tunnel. Three different systems are being considered. Third Vice-president Morse of the Grand Trunk, superintendent of motive power, has also made a visit recently to the New York subway and made an investigation of the system in use there. Definite steps are expected to be taken soon. This change is brought about by the calamity in the tunnel whereby the lives of several men were lost on account of being overcome by the coal gas.

In Jackson the work of removing the rails of the old Hawks-Angus electric line on Francis Street, just outside the city limits, was brought to a stop by Mrs. Vandercook, who refused to allow the men to tear up the right-of-way, owing to an agreement which had been entered into between her and the Hawks-Angus company stipulating that the rails were not to be removed without her consent. When this line was absorbed by the Jackson Consolidated road it was decided to take up the rails on the line past the Vandercook place.

Walter Westerman has been working quietly to obtain a franchise in Adrian for the Ohio Northern Traction Company, which company proposes to promote an electric line from Defiance, Ohio, to Ann Arbor, a distance of 90 miles. It is stated that most of the right-of-way has been secured and that condemnation proceedings have been started.

The Pontiac council has passed the franchise for the Detroit and Bay City electric railway, a provision of which is a rate of 1½ cents a mile for 30 miles each side of Pontiac. The line will enter the city at the northern limits and practically run parallel with the Detroit, Grand Haven and Milwaukee railroad to Wesson Avenue, where it will turn to the right and cross the Air Line tracks.

The Detroit and Bay City Traction Company, a new electric line which has been organized to construct a road from Detroit to Bay City, has closed a deal for terminal facilities at Bay City comprising 20 acres of land located in the southeastern part of the city, where the freight and other buildings will be placed.

The new cars of the Detroit, Monroe and Toledo Short Line which are now running into Detroit and Toledo have experienced some difficulty in operating through Detroit streets on account of the high flanges on the wheels. The grooves in the city rails are shallow and two derailing accidents have been narrowly averted.

The King Gas and Gasoline Engine Company of Battle Creek has been incorporated with a capital of $100,000.

A combination heating and lighting franchise has been granted by the village of Morenci to Dow & Fisher, who will heat residences and business houses with gas, steam or hot water and light these places with gas or electricity.

The Detroit, Monroe and Toledo Short Line electric railway was opened for business through to Detroit on Saturday last as planned. Heavy rails have been used; a stone-ballasted roadway and fine overhead equipment permitting high speed. The cars are strongly built and finely equipped. At Monroe a Toledo party headed by Mayor Finch met the Detroiters. The visitors were entertained at the Toledo Club, where dinner was served for them and a number of speeches were made. Cars will now be operated on the regular schedule, leaving Detroit every hour from 6 a. m. until 9 p. m. All of the bridges on the line have been constructed of steel and the culverts and abutments to the bridges are made of concrete, and iron pipes are used on drains under the tracks. The entire roadbed is rock-ballasted and there are no grade crossings. Each car is equipped with four 75-horsepower motors and they are geared for a high speed. Between Detroit and Wyandotte there is a double track, which will be continued for the entire distance. It is stated that the entire cost of the road is more than $2,000,000. One mile of right-of-way over the Wabash, Michigan Central and the River Rouge cost $150,000.

C. G. W.

Pacific Slope.

San Francisco, November 10.—The installation of electric lights and other electric apparatus in the residence of Isaac Owens in Pacific Avenue, has just been finished and is the finest of its kind in San Francisco. The work was planned by William Curlett and was executed by the electrical construction department of the Joshua Handy Machine Works. Each room has a flush push-button switch and intercommunicating telephone. The main stair-hall lights are controlled by the Sechrist switch system.

The Technical Society of the Pacific will hold its next meeting at the Mercantile Library Building on December 1st, 2d and 3d. Many interesting papers will be read by well-known experts. Some of the subjects to be covered are: Hydro-electric power development and transmission in California; engineering and the law; phenomena of machine operation; fuel oils, etc.

The Vallejo, Benicia and Napa Valley Electric Railway Company has finished the laying of rails between Vallejo and Napa, Cal., and will soon institute a half-hourly service.

The Monterey Gas and Electric Company is installing new machinery at Salinas and is also overhauling the old apparatus. A new engine has arrived and this will be used for generating power for the day circuit, which will be in operation by January 1st.

The switchboard at the big power house at Colgate, Wash., which was left unfinished after the fire there last spring, is now being put in shape, and this plant will soon be working at its full capacity. The De Sabla power house carries most of the load at present. At Electra two new waterwheels of 5,000 horsepower each are being installed.

Rights-of-way have been obtained for the completion of the Pacific electric railway's broad-gauge line into San Pedro, Cal.

A 3½-mile extension of the electric line from Cœur d'Alene City, Idaho, to Fernan Lake is one of the plans of the Cœur d'Alene and Spokane Railway Company proposed for next year.

A movement is on foot among the business men of Puyallup, Wash., to build an electric railway up the valley to Sumner, Orting and Tacoma.

Clarkson, Wash., is much agitated over the prospects for the electric line now being discussed in that section. F. J. Randolph of Clarkson, accompanied by Horace Bowker of Boston, Mass., who is closely in touch with the stockholders of the Lewiston-Clarkson Company, has been taking a trip through the Grangeville and Nez Perce sections in Idaho for the purpose of getting all information obtainable regarding the project.

It is reported in San Bernardino, Cal., that a company is being formed by Redlands and San Bernardino capitalists to enter the field as competitors of the Edison Electric Company.

The trustees of Modesto, Cal., have accepted the proposition made by C. T. Tulloch to furnish electric lights for the city. The contract is to go into effect December 1, 1904.

It is reported that the Northern Electric Railway and Navigation Company, recently organized at Colusa, Cal., and which plans to build an electric line on the west side of the Sacramento River from Colusa to St. Johns, will ultimately extend the line northward through Red Bluff to Redding.

The Oakland Traction Company has secured a franchise in Oakland, Cal., for an electric road along College Avenue. The franchise was purchased so that the company may build an electric road from Fortieth and Broadway to the Claremont Country Club grounds.

The Oxnard Light and Water Company has purchased a tract of land at Oxnard, Cal., on which it will build a large brick power house for a new and up-to-date lighting plant. A 200-horsepower heavy-duty engine has been ordered with boiler plant, dynamos, etc., and work will be commenced immediately.

The city of Azusa, Cal., has purchased the lighting plant of the Azusa Electric Lighting and Power Company for $2,300.

J. F. Parkinson has been granted a franchise by

the trustees of Mountain View, Cal., to construct and operate a standard-gauge electric railroad over certain streets and highways in Mountain View.

The New York-Grass Valley Mining Company of Grass Valley, Cal., will soon install a 100-light electric plant on its property. G. W. Root is manager.

The Kearsage Gold Mining Company of Independence, Cal., will build reduction works and install an electric-power plant and machine drills on its property. T. F. Murray is superintendent.

Superintendent Galliger of the Stockton Gold Mining Company has closed a contract for an electric-lighting plant to be used in lighting the mine and mill at Stockton, Utah. A.

PERSONAL.

E. W. Brown, for several years chief electrician of the Pueblo Traction and Lighting Company, died recently at Pueblo, Colo., from a stroke of paralysis.

Thomas Lowry of Minneapolis, president of the "Soo" railway and of the Twin City Rapid Transit Company, it is announced, will be a candidate for the United States Senate to succeed Moses C. Clapp.

Ex-Mayor F. B. Johnson of Lansing, Mich., has resigned as a member of the Lansing electric-light and water commission in view of his prospective removal to West Water, Utah. J. Edward Roe was appointed to succeed him.

The friends of W. L. Abbott, chief operating engineer of the Chicago Edison Company, will be pleased to note the election of Mr. Abbott as one of the state university trustees, and the further fact that he ran well ahead of other successful candidates.

F. A. Stratton of Mount Vernon, N. Y., has been elected to the presidency of the Westchester Lighting Company, which is capitalized for $22,500,000. He has served the company for six years as vice-president, during which time he extended its electric and other plants to 22 cities and towns in Westchester County and the Bronx, N. Y.

William Johnson, for many years consulting engineer for the North Chicago Street Railway Company, died at the home of a daughter in Norwich, N. Y., on November 14th. He was the inventor of many mechanical devices and frequently was called to Washington as expert in patent affairs. He resided at 4835 Forrestville Avenue, Chicago.

P. B. Yates has just been appointed district manager for the middle states for the Gould Storage Battery Company, succeeding E. L. Draffen, who has resigned to engage in other business. Mr. Yates took charge of the western office in Chicago on November 1st. Mr. Yates has not only won his spurs as a salesman, but is technically educated and thoroughly conversant with all matters pertaining to advanced storage-battery work.

John S. Peck, for 11 years a member of the engineering staff of the Westinghouse Electric and Manufacturing Company at Pittsburg, has severed his relation with the parent company to become acting chief electrical engineer of the British Westinghouse Company, with residence near Manchester. He was the guest of honor at a dinner given by his associates just before his departure. Mr. C. F. Scott and others made speeches, and a handsome silver stirrup cup was presented to Mr. Peck. Mr. Peck sailed for England last month.

Among recent appointments in connection with the reorganization of Sibley College, Cornell University, under the directorship of Prof. Albert W. Smith, are those of Vladimir Karapetoff, formerly with the Westinghouse Electric and Manufacturing Company, to be assistant professor of electrical engineering, with special reference to experimental engineering, and Robert Rankin, one of the assistants of Prof. H. H. Norris, on the electric-railway tests at the World's Fair, to be instructor in electrical engineering.

ELECTRIC LIGHTING.

The city of Colgate, I. T., has granted a 20-year franchise to the Colgate Company to erect and operate an electric-light plant.

The Union Light and Power Company of St. Louis, Mo., has purchased a convenient site on which it will erect a new transformer station.

The Americus Gas and Electric Company of Providence, R. I., has made application for a franchise to build and operate an electric-light plant at Americus, Ga.

The Farrell Light, Heat and Water Company of Brinkley, Ark., has been incorporated with J. J. Farrell as president and treasurer, H. W. Boyle, vice-president, and W. S. Kilpatrick, secretary. The capital is $50,000.

The Blackhawk Electric Company of Davenport, Iowa, through its president, W. A. Fuller, has secured a contract to install a complete municipal electric-lighting plant. The company will erect the buildings and install the machinery and dynamos, involving an outlay of about $20,000. The contract is to be completed by March 1st. The same company now has a similar contract under way at Ottumwa, Iowa.

Victor M. Garber of Shreveport, La., has been granted a franchise for the erection of an electric-light and power plant in the city of Plaquemine, La.

The Mansfield Electric Company, Mansfield, Ill., has been incorporated by E. E. Saylor, R. E. Howe and C. W. Fierke. The company will operate a light, heat and power plant. The capital is $10,000.

An election will be held in Martinsville, Va., on December 15th to decide on the proposition to issue $60,000 of bonds for the purpose of securing a system of electric lights and waterworks.

A private company will erect an electric-light plant and system of waterworks for service to the city of Brunswick, Mo. The plans have all been completed by W. K. Palmer of Kansas City, Mo.

The Guthrie Electric Light and Power Company of Guthrie, Okla., incorporated with $150,000 capital to succeed the local electric-light and gas company, has applied to the city for a 30-year franchise, and will rebuild the entire system if a franchise is secured.

The Oklahoma Gas and Electric Company of Oklahoma City has reorganized with C. B. Ames, president, and D. T. Flynn, secretary. The company was previously reported as having engaged H. M. Byllesby & Co. of Chicago as engineers in charge of extensive improvements to be made to electric and gas plants.

The Baltimore Electric Power Company, recently incorporated with a capital stock of $3,500,000 and $7,500,000 bonds is to build and own the proposed electric plant of the Maryland Telephone and Telegraph Company in Baltimore. A site of 6.4 acres on the water front has been purchased and preliminary preparations are being made to erect the necessary buildings. The main building will be of fireproof steel-frame construction and overhead coal bunkers will be built on steel and concrete. Turbine engines will be used and the entire plant will be installed on the unit system, including large battery equipment to store electricity for cases of emergency. Electricity will be furnished for lighting and power to manufacturing industries, stores, residences, etc., and the plant is expected to be completed within a year. The officers are: President, David E. Evans; vice-president and general manager, H. W. Webb; treasurer, R. F. Bonsall; secretary, William T. Spring.

ELECTRIC RAILWAYS.

Surveys are being made for an interurban railway from Springfield, Ill., via Petersburg to Beardstown.

The Sedalia Transit Company has been organized to build an electric railway in Sedalia, Mo. H. S. Rumsey of St. Louis is the president.

Thomas J. Wilcox, who promoted the interurban electric road from Clinton to Davenport, Iowa, states that the road is practically complete and ready for business. It is 36 miles long and has 11 stations aside from the terminal.

The first car operated on the trolley line in course of construction between Temple and Belton, Texas, has been run as far as Midway, five miles distant from Temple, which is as far as the track is laid. The line is being built by Pennsylvania men.

President O'Connell of the Oxford, Cochranville and Parkesburg (Pa.) electric railway has about concluded arrangements with a Philadelphia trust company to furnish bonds in $300,000 for the building of the electric line across country that is to connect Parkesburg with Oxford, a distance of 15 miles. The rights-of-way have been secured.

It is reported that the Michigan City (Ind.) street-car system, including the power house and electric-light plant, has been sold to the Chicago, Lake Shore and South Bend Railway Company, of which J. B. Hanna is president and F. B. Wagner is vice-president. It is given out that the new company will make many improvements in Michigan City and that grading for the proposed electric line to Chicago will begin next spring.

By a resolution introduced in the Common Council, Richmond, Va., has taken the first step toward the ownership of the electric lines on its streets, now the property of Frank Jay Gould of New York. The lines are in the hands of receivers, and if the mortgages are foreclosed the city is considering becoming the purchaser. A portion of the council favors the purchase of the roads with a view to giving the people the benefit of three-cent fares.

In connection with the proposed electrification of the Long Island railroad mentioned in last week's issue it may be said that Westinghouse multiple-unit control will be used in operating the 122 cars contracted for by the Pennsylvania company with the Westinghouse Electric and Manufacturing Company. These cars and 61 trailers will be used for suburban traffic and will be put into operation next spring. The motors will be of the latest type, embodying the most modern ideas in both electrical and mechanical design, and will possess an extremely liberal overload capacity. The machinery for the Long Island power plant, which is now being installed, is supplied by the Westinghouse company, and will include three turbo-generators, each having a capacity of 5,500 kilowatts, as a notable part of the plant. Westinghouse, Church, Kerr & Co., consulting engineers, are in charge of this installation.

The franchise ordinance authorizing the use of streets in Quincy, Ill., to the Illinois and Missouri Railroad Company for electric-railway purposes has been filed. This is for the building of an electric railroad between Hannibal and Quincy. Before commencing construction the company is required to file an approved bond of $10,000 contingent on the faithful performance of the agreement. The railroad will enter Quincy on Second Street and will be granted privileges in the business center.

POWER TRANSMISSION.

Henry Lewis, Edward Delahunt and Thomas MacDonald, all of Buffalo, N. Y., have incorporated the International Current Power Company at Buffalo with a capital of $100,000.

The Papoose Mining Company of Helena, Mont., which will operate in Kings Gulch, Choteau County, has been authorized to do a general mining business and build plants for the generation and transmission of electric power and to furnish power to mines, mills and smelters. The capital stock is $20,000. Charles Whitcomb and Ben. D. Phillips are interested.

SOCIETIES AND SCHOOLS.

Before the Jamestown (N. Y.) local branch of the National Association of Stationary Engineers recently, Messrs. J. E. Hanson and C. J. Salisbury gave instructive talks on problems of interest to engineers. Mr. Hanson explained the working of the rotary converter and Mr. Salisbury gave an illustrated description of the construction of steam turbines.

Homer E. Niesz, editor of the "question box" to be prepared for the next meeting of the National Electric Light Association, is about to send out a communication pertaining to the next annual issue of the "question box" and is desirous of obtaining the names of those able and willing to contribute either questions or answers, to whom he may send the communication.

Fifty-seven railroads in North America reported as being members of the International Railway Congress are entitled to 327 delegates to the session to be held in Washington in May. This with the eight delegates of the American Railway Association and the 16 of the United States government gives a total of 351 delegates from America, not including the official representatives from Canada and Mexico. The Department of State announces that 18 countries have signified their intention to be represented at the congress. They are the Argentine Republic, Belgium, British India, Cuba, Denmark, Dominican Republic, Great Britain, Greece, Guatemala, Honduras, Mexico, Netherlands, Paraguay, Peru, Roumania, Servia, Siam and the Transvaal.

The "Transactions of the International Electrical Congress," held at St. Louis, are now being prepared for the press and will contain 153 specially invited papers, together with the discussions and a report of the proceedings of the Chamber of Delegates. They will form three large octavo volumes, each of which will contain about 900 pages, and a frontispiece engraving. The membership roll of the Congress closed on the last day of the meeting, September 17th, but anyone desiring to obtain a copy of the Tranactions can do so by subscription. Subscriptions will be received until December 1st. The subscription price is $10, which includes the cost of delivery to the subscriber. As it is not intended to print a reserve stock, and only those for the Congress membership, or on order, are being at present printed, orders should be sent in promptly to the treasurer, Mr. W. D. Weaver, 114 Liberty Street, New York city.

The Westinghouse Electric and Manufacturing Company recently entertained at its works the members of the British Iron and Steel Institute, concluding with a banquet given in the largest aisle of the works, its length being one-third of a mile. The portion of the aisle set apart for the banquet was beautifully decorated by flags of the United States and Great Britain. The lighting effect was beautiful, the Bremer lamps being strung from the ceiling and Cooper Hewitt lamps suspended from the sides, the latter to make possible the taking of photographs. The tables were almost hidden beneath the chrysanthemums, roses and other flowers used for ornamentation. A lounging room was provided for the convenience of the guests, where writing materials and souvenir postal cards showing interior and exterior views of the works were provided. A most unique souvenir was given to each person present at the dinner, it being in the form of an induction motor and small enough in size to permit of its being carried in the pocket. There were over 600 persons invited and fully 600 joined in the festivities. Sir James Kitson, past president of the British Iron and Steel Institute,

thanked the city of Pittsburg on behalf of Andrew Carnegie for the unusual kindnesses shown to the distinguished visiting manufacturers, and Mr. Westinghouse indicated his great pleasure in being honored on this occasion by the presence of visiting friends from abroad.

The next meeting of the American Institute of Electrical Engineers in New York will be held in the chapter room, Carnegie Hall, on November 25th. Heavy electric traction will be discussed and two papers are announced: "Factors Influencing Subway-motor Specifications," by Lewis B. Stillwell, electrical director, Interborough Rapid Transit Company, New York, and "Problems on Electric Traction on the Long Island Railroad," by O. S. Lyford, Jr., electrical engineer for Westinghouse, Church, Kerr & Co., New York.

PUBLICATIONS.

"The Typical College Courses Dealing with the Professional and Theoretical Phases of Electrical Engineering," a paper which was read by Dugald C. Jackson, professor of electrical engineering in the University of Wisconsin, before a joint session of the American Institute of Electrical Engineers and the Society for the Promotion of Engineering Education, and which appeared in Science, has been reprinted by the author and is now to be had in pamphlet form. The paper treats of the intellectual assets of the average student entering an engineering course and the methods to be employed if he is to get the most out of his course.

TELEGRAPH.

The council of Seattle, Wash., has passed an ordinance for the purchase of a new 12-circuit repeater for the improvement of the fire-alarm system.

Frank Jaynes, general superintendent of the Western Union Telegraph Company at Prescott, Ariz., announces that during the coming year the company will build a line from Tombstone to Bisbee and Douglas.

The naval observatory will transmit telegraphic time signals at midnight and at one, two and three o'clock a. m. on January 1st, seventy-fifth meridian time, to indicate the beginning of the new year to each of the great standard-time belts of the United States. Last year these signals were heard in Alaska, at Panama, Valparaiso, Buenos Ayres, Honolulu, Guam and Manila.

SPACE TELEGRAPHY.

The Marconi space-telegraph station at Cape Race, N. F., has been completed, the Allan Line steamer Tunisian being the first ship to communicate with it. The vessel remained in communication with the station nine hours and obtained news of the result of the presidential election in the United States and other happenings.

Reports from St. Louis state that on November 11th a number of space-telegraph messages were accurately transmitted between the World's Fair tower and a balloon, which got messages at altitudes varying from 800 to 1,500 feet. A balloon having a capacity of 14,000 cubic feet of gas was fitted with apparatus for receiving wireless telegrams. This basket was suspended close to the basket proper of the balloon. In this were W. W. McQueen of Guthrie, Okla., and W. S. Forman of St. Louis. Aeronaut Paul Knabenshue of Toledo, Ohio, occupied a seat formed of ropes above the main basket. He is a brother of A. Roy Knabenshue, who successfully operated Captain Baldwin's airship, the California Arrow. The balloon was safely landed in the evening about 2½ miles southwest of the Fair grounds.

Acting upon a suggestion from the British government that Canada follow the example of the imperial authorities in bringing space telegraphy under government control because in time of war it is manifestly desirable that wireless communication should be under the same supervision as the mails and ordinary telegraphy, it is understood that measures will be taken in Canada to control space telegraphy. There is a clause in the Marconi charter which gives the right to the government to appropriate it in the course of time, and it is understood that no additional charter will be granted.

MISCELLANEOUS.

It is reported that the government of British India has sanctioned the expenditure of 50,000 rupees for the purchase of electric transporters for use at Shalimar.

The bureau of information of the Burned District Commission of Baltimore, Md., reports that the permits for new buildings in the burned district issued to November showed a total of 322 buildings, some of which cover five or six separate lots, the aggregate declared valuation being $7,780,145.

Blackwell's Island Bridge over the East River at New York city, the contract for which has been let, will be one of the largest ever constructed. It will be 10,270 feet long, containing 100,000,000 pounds of steel, and will be 135 feet high, the contract price aggregating $5,000,000. When finished it will have eight miles of trolley tracks and four miles of elevated railroad tracks. This is considered sufficient to carry 150,000,000 passengers per year. To cover these tracks would require 2,000 cars and to cover the entire bridge would take 1,000,000 people.

TRADE NEWS.

A company to be known as the Electrical Crystal Battery Company of Marionville, Mo., has been incorporated with a capital of $500,000. Among those interested are W. H. Bradford, G. W. Greener and C. D. Turner.

Sealed proposals will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until 3 o'clock p. m., December 8th, for the installation of two electric passenger elevators in the courthouse and postoffice at Salt Lake City, Utah., in accordance with the drawings and specification, copies of which may be obtained at the above address.

Professor Klingenberg, a director of the Allgemeine Electric Company of Berlin, Germany, who is now in the city of Mexico, has just completed the construction of an electric-light and power plant of about 3,000 horsepower in Havana, Cuba, the installation of the plant having been accomplished by the Allgemeine company. This company is represented in Mexico by Enrique Schoendube, who will shortly build the hydroelectrical plant that will furnish electrical energy to Queretaro from waterpower situated at a distance of 50 miles from that city. Professor Klingenberg says that the rapid development of Mexico of late has induced the Allgemeine company to investigate the republic as a field for investments. He will remain in the city for some time.

BUSINESS.

Hugo Reisinger of New York city, importer of electra high-grade Nuremberg carbons, reports that this product was given the grand prize by the international jury of awards of the Louisiana Purchase Exposition.

The Cooper Hewitt Electric Company of New York has been awarded by the Louisiana Purchase Exposition a gold medal for vapor lamps for photo-engraving, and also the grand prize for the development of mercury-vapor arc lamps.

The L. M. Ericsson Telephone Manufacturing Company of Tonawanda, N. Y., has been incorporated at Albany. The capital is $200,000 and the directors are Axel Bostrom of Stockholm, Sweden, and F. M. Parke and C. H. Smith of Buffalo, N. Y.

The General Electric Company has commenced, under date of November 3d, four suits against the Missouri-American Electric Company of St. Louis, Mo., for manufacturing incandescent electric lamps in infringement of United States patents Nos. 532,760, 537,493, 537,693 and 726,293. The Edison Electric Light Company commenced suit on November 2d, against the Goudey-McLean Company of New York city for dealing in or selling lamps manufactured by the Germania Electric Lamp Company of Harrison, N. J., in infringement of United States Patent No. 444,530.

The Eureka Electric Company of Chicago may take just pride in the new catalogue which it has just issued upon central-energy telephone apparatus. Nearly everything pertaining to central-energy systems is listed in this catalogue, and the descriptions of apparatus are helped out by the numerous fine illustrations. The systems described are constructed for the use of a 24-volt circuit. A pilot light is employed in conjunction with all the targets.

The Westinghouse Electric and Manufacturing Company has sold to J. E. Henry & Sons of Lincoln, N. H., two large induction motors for use in their pulp mill. The larger motor is a type F, rated at 600 horsepower, and will be supplied with three-phase current at 400 volts and 3,000 alternations. The smaller motor is of the type C, constant speed, and is rated at 300 horsepower. Both will be connected to pulp grinders. These motors are ordered in addition to a large number of machines, including 24 induction motors and four 350-kilowatt alternators, with exciters, switchboards, transformers and detail apparatus. Henry & Sons' mills have a capacity of about 60 tons per day of news, high-grade bag and manila paper. This is one of a large number of paper and pulp mills equipped by the Westinghouse company, whose experts have made a special study of this class of work. Another large sale of electrical apparatus by the Westinghouse company is to the Transit Development Company of Brooklyn for use in 10 substations, which will be installed by the company on its suburban lines. The order includes 13 three-phase rotary converters, each being of 1,000-kilowatt capacity with direct-current voltage of 550; 33 transformers of 400-kilowatt capacity and 12 of 200-kilowatt capacity. These transformers will be of the air-blast type. Complete switchboard installations will also be furnished for all these sub-stations. Power from generators of the Brooklyn Heights Railroad Company will be delivered to the sub-stations at 6,300 volts, 3,000 alternations, three-phase.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued (United States Patent Office) November 8, 1904

774,158. Protective Device for Electrical Circuits. Frank B. Cook, Chicago, Ill. Application filed November 13, 1903.

Protective apparatus for electrical circuits comprises a horizontal base, a tubular fuse, spring members adapted to mount the fuse horizontally upon the base, one of the spring members exerting a torsion on a portion of the fuse. Spring members are adapted to mount a thermal protector alongside the fuse.

774,160. Self-soldering Thermal Protector. Frank B. Cook, Chicago, Ill. Application filed March 26, 1904.

In a thermal protector for electric circuits are a piece of resistance material for inclusion in the circuit, means to which the resistance material is normally held in a fixed position by a heat-susceptible material, and means for turning the resistance material upon its support when the heat-susceptible material is softened.

774,163. Brush Holder for Electric Generators. Isidor Deutsch, Montreal, Canada, assignor to the Electric and Train Lighting Syndicate, Montreal, Canada. Application filed May 14, 1903. Renewed March 25, 1904.

Combined with the commutator are a pair of brush-holding arms at the side of the commutator and moving parallel to the commutating plane, a pivot-bearing for the arms disposed substantially at right angles to the axis of the commutator and means for holding a brush between the arms.

774,202. Electrical Connection. Frank J. Russell, New York, N. Y. Application filed January 7, 1904.

An electrical terminal receptacle has line-terminal contacts upon opposite sides of the plug opening or throat. An extension circuit plug carries pivoted contact levers. Yielding obstructions are adapted to be moved aside by the plug as it is inserted into the throat.

774,203. Drop-circuit Cut-out. Frank J. Russell, New York, N. Y. Application filed May 16, 1904.

The device consists of a base block, terminals in the form of spring hooks, a drop circuit cap formed with spring-jaw drop-circuit terminals, and with bearing surfaces opposed to the elastic terminals, and fuse cartridges interposed between the bearing surfaces and the spring terminals.

774,230. Electrolytic Apparatus. Arthur Brichaux, Brussels, Belgium, assignor to the Solvay Process Company, Syracuse, N. Y. Application filed October 4, 1898.

A furnace is provided with a muffle chamber and a flue and has a supporting ledge provided with an air passage. A muffle in the chamber is in communication with the flue and a muffle plug is supported on the ledge and constructed to close the muffle and opening when in a predetermined position.

774,265. Toll-collecting Appliance for Telephone Pay Stations. Frank R. McBerty, Evanston, Ill., assignor to the Western Electric Company, Chicago, Ill. Application filed February 10, 1900.

Combined with a toll device having a temporary coin receiver is an electromagnet and mechanism operated by a momentary excitation of the magnet for discharging the coin from the receiver. A channel receives the released coin and a deflector is arranged to be moved by the magnet, whereby a prolonged excitation of the magnet causes the coin to be diverted from the channel.

774,283. Apparatus for Telephone Trunk Lines. Edwin H. Smythe, Freeport, Ill., assignor to the Western Electric Company, Chicago, Ill. Application filed April 27, 1903.

In a telephone exchange system are a trunk line and a connection switch uniting it at one end with a subscriber's line. Signal devices are connected with the subscriber's line, together with means for applying specialized calling current to the trunk line at the other end to selectively actuate the signal devices.

774,320. Electric Signal. Frederick H. Gray, Leavenworth, Kan., assignor of one-half to Walter V. Thomas, Leavenworth, Kan. Application filed February 1, 1904.

A main feed conductor and a main return conductor are connected by a normally open local conductor. A circuit-closer momentarily closes the local conductor and an electromagnet in circuit with the local conductor is provided with a normally open armature. A branch conductor is in circuit with the local conductor and the armature for dividing the current between the feed conductor and the magnet when the local conductor is momentarily closed by the circuit-closer.

774,332. Signaling Apparatus for Telephone Switchboards. Frank R. McBerty, Evanston, Ill., assignor to the Western Electric Company, Chicago, Ill. Application filed December 26, 1899.

A telephone line and spring jacks have normally open terminals, and a winding of a signal controlling electromagnet is in the line circuit between the spring jacks and the sub-station. A closed bridge of the line circuit is connected with the line intermediate of the spring jacks and magnet coil, and another winding of the magnet is placed in the closed bridge. (See cut on next page.)

774,342. Burglar-alarm System. Harold D. Stroud, Chicago, Ill., assignor of one-half to A. Miller Belfield, Chicago, Ill. Application filed December 22, 1902.

Combined with a telephone transmitting circuit are telephone apparatus at the central station and an alarm apparatus at the subscriber's station, comprising means for sending a message over the telephone circuit and means for opening and closing the transmitting circuit when the message is being sent. (See cut.)

774,385. Automatic Fire Alarm. John W. Griffin, Pawtucket, R. I., assignor to the Griffin Automatic Fire Alarm Company. Application filed March 23, 1904.

A spring-actuated circuit-closing contact is held normally out of contact by a fusible collar. Upon the fusing of the collar by heat the spring is released and the circuit closed, giving the alarm.

774,391. Holder for Electric Incandescent Lamps. Peter Kleber, Wiesbaden, Germany. Application filed July 9, 1903.

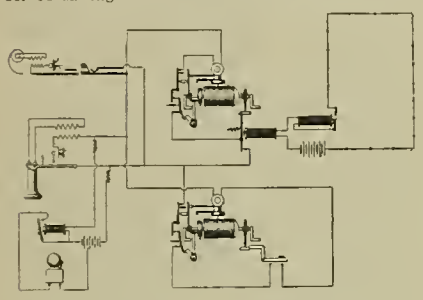
In a holder of the character described are a lamp socket, a casing, a sleeve having elastic parts adapted to engage with the socket and fitted to slide in the casing, and a spring adapted to force the sleeve into the casing.

774,404. Base for Incandescent Lamps. Alfred Swan, New York, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed April 1, 1901.

A base for an incandescent lamp comprises a threaded metallic shell to inclose the neck of the lamp having a dome-shaped bottom. A center metallic contact is perforated to facilitate connection of one of the lamp wires and a web of highly fluid or liquid glass solidifies around and closely unites the center contact to the dome-shaped bottom of the shell.

774,432. Spark Plug. Edward B. Jacobson, West Somerville, Mass., assignor to the Pittsfield Spark Coil Company, Pittsfield, Mass. Application filed September 4, 1901.

Details are described of an insulated plug adapted to carry the sparking terminals into the combustion chamber of an engine.



NO. 774,342.—BURGLAR ALARM.

774,460. Rheostat. Montgomery Waddell, New York, N. Y. Application filed November 25, 1903.

In a rheostat are a series of resistance bodies adapted to be brought into contact with each other and provided with contact surfaces of progressively different areas from one end of the series toward the other.

774,469. Binding Post. Harry J. Guttman, Chicago, Ill., assignor to the Strowger Automatic Telephone Exchange. Application filed May 4, 1903. Renewed October 3, 1904.

A binding post for telephone exchange use is described.

774,481. Railway-signal System. Oscar J. Lee and Myron H. Richardson, Chicago, Ill. Application filed June 2, 1902.

In a railway signaling system are a pair of line conductors normally maintained at a difference of electric potential, a third conductor and a number of signal devices interposed in multiple between the conductor and one of the first-named conductors. Contacts are arranged in multiple between the third conductor and the remaining one of the first-named conductors, and located at points corresponding to the signal devices.

774,494. Speed Control of Electrically Propelled Vehicles. John S. Raworth, London, England. Application filed June 5, 1903.

In a regenerative motor-control system for electrically propelled vehicles there are combined with motors a shunt field circuit, a variable resistance in the circuit, means for varying the resistance in circuit, means for controlling the armature circuit, and interlocking means so arranged that the armature circuit cannot be made or broken until the field is at its strongest.

774,498. Automatic Interlocking-signal System for Railways. Benton C. Rowell, Chicago, Ill., assignor to the Rowell-Potter Safety Stop Company, Portland, Maine. Application filed May 19, 1900.

Signal-shifting circuits are each provided with a circuit shifter or switch for automatically opening opposing signal-shifting circuits and closing its own signal-shifting circuit when a train enters one section. A second circuit shifter or switch actuated by the movement of its blocking appliance causes a second break in opposing signal-shifting circuits.

774,506. Insulated Rail Joint. Christian J. Buck, Gallitzin, Pa. Application filed May 12, 1904

A splice bar for rail joints having a portion of its body rectangular in cross section consists of two members, one of the members being cut from the squared portion of the splice bar. A strip of insulation is interposed between the members.

774,524. Trolley Guard for Electric Railways. John Kress, New Rochelle, N. Y. Application filed March 16, 1904.

A trolley guard for electric railways comprises a turntable, a trolley pole supported thereby, a fork, a ball-and-socket connection between the fork and the pole and a trolley wheel supported by the fork.

774,529. Electrothermic and Vacuum Appliance. Charles C. F. Nieschang, Fort Wayne, Ind. Application filed August 29, 1904.

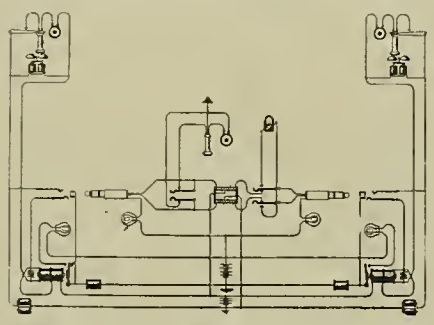
A vacuum dome has in connection therewith a receiver. Means are contained within the dome for the generation of electrothermic rays which are adapted to be directed into the receiver. Means are also provided for exhausting the air from the dome when the mouth of the receiver is closed.

774,534. Trolley. John W. Rockafellow, Sergeantsville, N. J. Application filed August 18, 1904.

Guards mounted on the trolley harp are adjustable toward and from the periphery of the wheel.

774,543. Party-line Telephone System. Felton Vollmer, Winsted, Minn. Application filed November 20, 1903.

In a party-line telephone system revoluble shafts, each located at a station, are rotated by motor mechanism. Time-controlled mechanism governs the motor mechanism and electric mechanism controllable at will from each of the stations is supplied for stopping and starting the motor mechanism without disturbing the time-controlled mechanism.



NO. 774,332.—TELEPHONE SIGNALING SYSTEM.

774,548. Insulator for Fibrous Material. Raymand Andlauer, Kansas City, Kan., assignor of three-fourths to William Brendel, Kansas City, Mo. Application filed February 16, 1904.

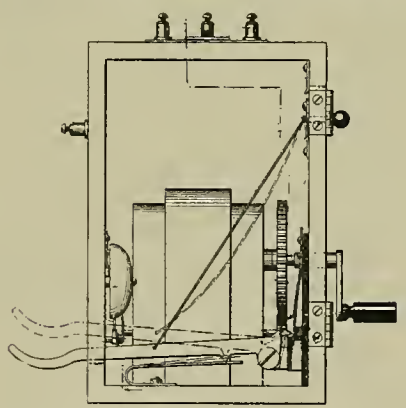
Details are described.

774,608. Attachment for Party-line Telephone Systems. William A. Shackelford, Lexington, Ga. Application filed December 3, 1903.

In a party-line telephone system are a movable switch hook for normally supporting the receiver, a local mechanical alarm controllable by movements of the switch hook for producing a sound and thereby actuating the transmitter when the receiver is removed from the switch hook. (See cut.)

774,611. Electrical Coupling. Frank J. Sprague, New York, N. Y., assignor to the Sprague Electric Company, Bloomfield, N. J. Original application filed April 30, 1898. Divided and this application filed July 7, 1900.

A pair of mating couplers, each consisting of a supporting casing are associated with an insulating body supported and protected by its casing, and contacts held by the insulating body. A cover is supplied for one of the casings which serves as a latch between the couplers.



NO. 774,608.—ALARM FOR PARTY LINES.

774,618. Electrically Operated Block-signaling Apparatus. Charles W. S. Turner, Mountville, Va. Application filed December 22, 1903.

One rail is composed of block sections insulated from each other and the other rail constitutes a continuous conductor rail. A train circuit including a battery is in electrical connection with the block sections and means for bridging over between a block section and the continuous conductor rail are supplied. Train connections also bridge over between a block rail and the continuous conductor rail to close the circuit and operate the signal.

774,619. Safety Attachment for Locomotives. Charles W. S. Turner, Mountville, Va. Application filed December 22, 1903.

The track is energized and a traveling connector is adapted to close a circuit on the engine and by the agency of electromagnets to shut off steam when another train enters the block on the same track.

774,620. Railway Signaling Apparatus. Charles W. S. Turner, Mountville, Va. Application filed December 22, 1903.

Block-signaling stations are connected by a normally open circuit, including signaling mechanism in each station. Closed circuits are connected with the railway track, part of which are in communication with one block station, and part in communication with the other, the closed circuits including indicating mechanism and means for automatically closing the normally open circuit upon the breaking of any of the closed circuits.

774,624. Electric Cigar Lighter. James Waters and Frederick V. Thompson, Philadelphia, Pa. Application filed April 15, 1904.

Details are described.

774,668. Burglar Alarm. Harry T. Johnson, Jersey City, N. J. Application filed April 2, 1904.

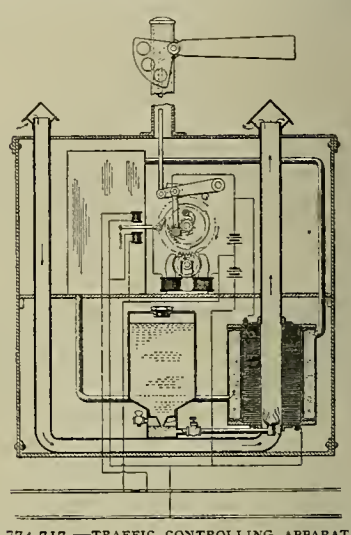
A window spring is provided with sash-controlled contacts and auxiliary contacts free from the control of the sash and comprising a member movable into the path of the sash when the circuit is broken.

774,701. Electric Illuminating Arrangement for Railway Vehicles. Friedrich W. Schneider, Frankfort-on-the-Main, Bockenheim, Germany, assignor to Society of Voigt & Haeffner, Actien Gesellschaft, Frankfort-on-the-Main, Germany. Application filed September 15, 1902.

The generator is operated by the car axle and a governor regulates the speed of the generator to a constant value, regardless of the speed of the train.

774,717. Railway Traffic-controlling Apparatus. Clyde J. Coleman, Rockaway, N. J., assignor to the Hall Signal Company. Application filed April 11, 1904.

Railway traffic-controlling apparatus comprises a local source of thermal energy, continuously operating energy-transmuting apparatus, and traffic-controlling means, the thermal energy being continuously converted by the transmuting apparatus and the traffic-controlling means being in co-operative relation to the transmuting apparatus and operatable by its converted energy. (See cut.)



NO. 774,717.—TRAFFIC CONTROLLING APPARATUS.

774,724. Telegraphic Transmitter. Alfred C. Gilmore, Chicago, Ill. Application filed May 6, 1903. Renewed October 14, 1904.

Details are described.

774,728. Liquid-contact Chamber for Electrically Wound Mechanism. Percy L. Clark, Bristol, Conn., assignor to A. L. Clark, Elgin, Ill. Original application filed October 13, 1902. Divided and this application filed December 2, 1903.

In combination with a magnet-energizing circuit is a liquid-contact chamber mounted for tilting, and means for tilting it to cause the liquid to flow from one end to the other, the chamber having a dam or barrier between the extreme positions of the liquid, adapted to cause the latter to accumulate during the initial tilting action. The cross section of the chamber cavity at the location of such obstruction is such as to afford ample room for the passage of the liquid, the means for tilting the chamber being adapted to tilt it past the position at which the dam arrests the liquid to a position at which the liquid may move en masse over the dam.

EXPIRING PATENTS.

Following is a list of electrical patents (issued by the United States Patent Office) that expired on November 15, 1904:

373,043. Signal for Telephone Instruments. J. M. Baker, Paola, Kan.
373,046. Electrical Railway. B. Bidwell, Philadelphia, Pa.
373,061. Electric Temperature Regulator. L. F. Easton, La Crosse, Wis.
373,064. Galvanic Battery. C. Gasner, Jr., Mentz, Germany.
373,088. Therapeutic Battery. M. A. Morehouse, Johnsburg, N. Y.
373,102. Electric Bell. G. M. Sternberg, U. S. Army.
373,103. Electric Valve Controller. G. M. Sternberg, U. S. Army.
373,104. Electric Valve Controller. G. M. Sternberg, U. S. Army.
373,108. Electric Motor. E. Thomson, Lynn, Mass.
373,138. Clock-synchronizing Apparatus. C. J. Hexamer, Philadelphia, Pa.
373,145. Dynamo Electric Machine and Electromotor. Wm. Main, Brooklyn, N. Y.
373,146. Electromotor and Dynamo Electric Machine. Wm. Main, Brooklyn, N. Y.
373,152. Telegraph Key. A. Oakes, Taylor, Wis.
373,160. Electric Train Signal Apparatus. J. C. Tiffany and J. R. De Mier, Las Cruces, N. Mex.
373,207. Mail Box Indicator. J. P. Tirrell, Somerville, Mass.
373,211. Magnetic Separator. J. Wenstrom, Orebro, Sweden.
373,289. Sectional Draw-rod for Placing Electric Wires in Underground Conduits. W. H. Hart, Brooklyn, N. Y.
373,369. Automatic Regulator for Dynamo Electric Machines. C. D. Jenney, Indianapolis, Ind.
373,383. Railway Telegraphy. G. T. Woods, Cincinnati, Ohio.
373,394. Electric Cable. A. E. Dolbear, Somerville, Mass.

WESTERN ELECTRICIAN

EVERY SATURDAY

Vol. XXXV. CHICAGO, NOVEMBER 26, 1904 No. 22

A Swiss Hydro-electric Plant for Small Industries.

By Franz Koester.

In a country like Switzerland, where there are many small scattered industries, there is great demand for some system of cheap distribution of power. This may easily be supplied by electric distribution from the many waterpowers. A typical illustration of a plant for utilizing waterpower in this way is at Les Clees-Yverdon, in Switzerland. This plant supplies power to some towns more than 3,200 feet above sea level, for example, St. Croix and L'Auberson, the world-renowned toy-manufacturing villages.

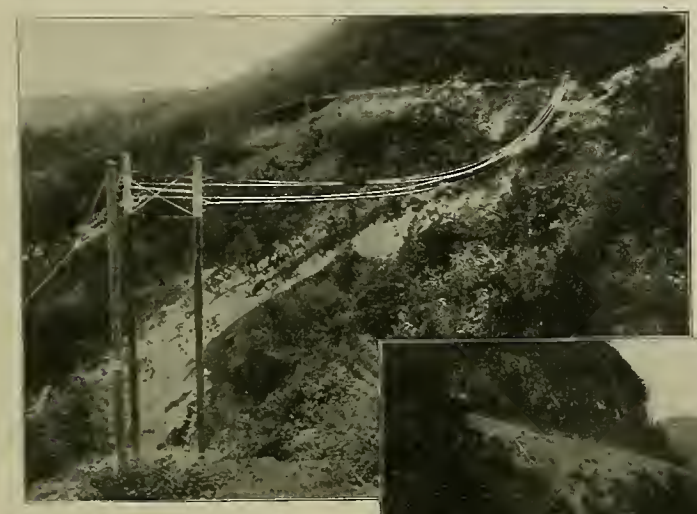


Fig. 1. Long Span Crossing a Gorge in the Mountains.

The water is taken from the River Orbe, which is an outlet of Joux Lake. It runs underground for some miles, and emerges in a wide valley, flowing into Neuenburger Lake. As Joux Lake affords a steady flow to the river, the water level is quite constant, and makes an ideal waterpower.

Fig. 2. Power House on the River Orbe.

Near the village of Ballaigues is a concrete dam (Fig. 4), which makes a reservoir whose headwaters are 2,032 feet above sea level. Water is delivered part way through a tunnel and then through a canal running along the mountain side for a distance of 11,808 feet. This canal is covered over to protect it from stones and earth from the mountain side. Ten manholes in the cover provide easy access for repairs and inspection. Near the end of the canal is a floodgate for use in very high water. From the end of the canal a steel penstock 47 inches in diameter leads to the power house at the village of Les Clees.

The total head is 158 feet, which, allowing for the friction head, is 147 feet net. Using 141 cubic feet per second, this would develop 2,400 horsepower gross, or 1,800 net from the turbine.

If it should become necessary to supply more power, there is another waterpower near by owned by the city of Yverdon which would add 4,000 horsepower.

Soon after the plant was first erected an unprecedented flood caused considerable damage to the bulkheads as well as some small damage to the power house and equipment. When the bulkheads were rebuilt they were made unusually strong. Large stones are used in the bed, over which is a layer of concrete 31½ inches thick, reinforced by I-beams. Besides the heavy headgates which bed on this concrete, there is a floodgate 6.56 feet by 9.75 feet, which may be used in case of high water. A canal of concrete is arranged to carry the flood water direct from this gate to the main riverbed.

The power house (Fig. 2) is built on the right bank of the River Orbe, near the bridge at the village of Les Clees. As the ground there is very soft it was found necessary to cover the entire space for the foundation of the power house with a layer of 23½ inches of concrete, with a cross grillage of eight-inch beams. This construction prevents one part of the building settling more than another. The power house itself is 85.2 feet long by 32.8 feet wide, and is arranged for six turbine units 300 horsepower each. These are shown in Fig. 3. An annex is built on one side for the switchboards. A three-story building adjoins the end wall, for the residence and office of the superintendent.

The turbines are horizontal with Jouval draft tubes and cylinder gates. They were made by Piccard, Pictet & Co. of Geneva. The cylinder gate is balanced by water pressure, and thus works easily and noiselessly. It is operated by hand or by a motor with ratchet device, operated direct from the turbine shaft and regulated by a centrifugal governor as a relay. The motor regulator works on the same principle as the hydraulic governor except that it has the advantage (which the hydraulic governor has not) of working with water from the main penstock, which need not be clean.

The electric generators are direct connected to the turbine shaft through a flexible and insulating coupling made with two parallel plates carrying lugs on their inner faces around which is wound a leather strap. In these mountain districts it is necessary to maintain complete insulation of the generators on account of the influence of atmospheric electricity.

The generators are of the Oerlikon induction type, of three-phase 5,200 volts and 50 cycles. The stationary armature is made up of a cast-steel mantel carrying two rows of rings—one on each side of the revolving field. The rings are of laminated iron and have 42 slots containing 21 coils each of 34 turns of copper wire insulated with mica. Between the two parts of the armature outside of the revolving field are the exciter coils made up of 480 turns of 5.5-millimeter wire. The revolving field has two rows of pole-pieces, seven on a side, made up of laminated iron dovetailed to the rim. The exciter generator is mounted on the overhanging shaft of each main generator.

Wires are run from the generators through conduits under the floor to the switchboard, which is made up of panels of white marble mounted on an iron framework concealed by wooden moldings. All switches, lightning arresters and connecting wires on the high-tension circuits are mounted on double-petticoat insulators. Double-throw switches are provided for each machine for throwing it into connection with either one of two bus-bar systems. Each machine has its own panel on the switchboard fitted with cut-out, double-throw switch, ammeter, voltmeter and instrument transformer. This small transformer also serves the phase indicator. Each machine panel also carries an amperemeter and rheostat for the exciter current. The center panels of the switchboard are set apart for the distribution

A supplementary switchboard carries instruments for lighting the power house and the village of Les Clees and a switch for a six-horsepower motor in a nearby sawmill.

Six main-line circuits distribute the current with four to eight wires to each circuit. The lime and cement works at Beaulmes have a separate line about five miles long and use about 200 horsepower. All wires are run on double-petticoat porcelain insulators. Each pole is provided with a lightning arrester in the form of a cap which is grounded with a special wire. The average distance between poles is 130 feet, but in crossing gorges they are sometimes 985 feet, and in one case (Fig. 1) 1,050 feet apart. All high-tension branch circuits are provided with switches for cutting out the branches in cases of emergency.

The entire length of the high-tension circuits is 42.5 miles, using 240.9 miles of copper wire weighing about 103 tons. There are 30.3 miles of low-tension circuits using 127 miles of copper wire weighing about 51 tons. Fig. 5 is a map showing the location of the transmission lines.

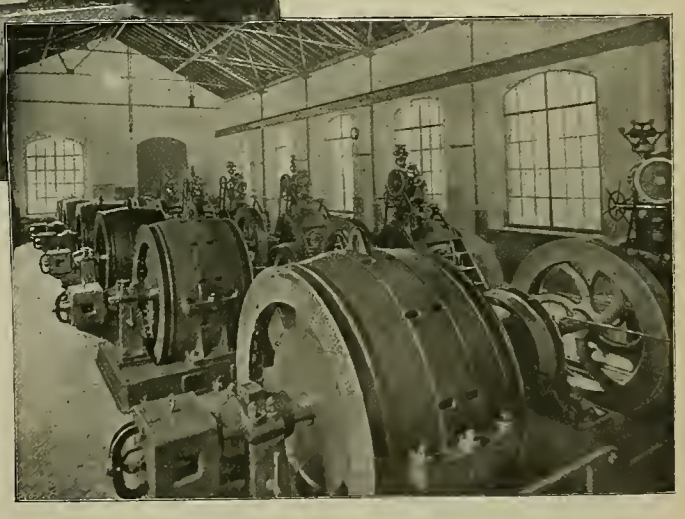


Fig. 3. Turbine-driven Units in Power House on Orbe River.

A SWISS HYDRO-ELECTRIC PLANT FOR SMALL INDUSTRIES.

There are from one to 10 transformer stations in each village, Yverdon having the largest number. There are 50 transformers in use having a total capacity of 1,038 kilowatts. All of the secondary wiring system is carried overhead, and in order not to disfigure the streets the wires are run on the roofs or around the rear of the buildings. The lamps are 120 volts, uniformly distributed on a three-phase system, and they burn with great steadiness, owing to the small fluctuations in the power load and the small drop in voltage from the generator. There are altogether in use 8,473 incandescent lamps, from 10 to 16 candlepower. At Yverdon there are 74 arc lamps with a total candlepower of 119.

There are 109 motors now in use, from one-tenth to 130 horsepower, aggregating 612 horsepower. Among them is one of 120 horsepower for the use of the workshops of the Jura-Simplon tunnel, well known as the longest tunnel in the world.

All motors are of the Oerlikon manufacture. Up to two horsepower the motors are made without special starting arrangement. Larger motors have

a rheostat connected in the field circuits so that when they start the current may be regulated not to exceed the normal. The construction of the motor is such that it may have double the power for starting. Ordinarily the motors are connected in the low-tension circuit, but there is one motor of 45

FIG. 4. CONCRETE DAM FOR SWISS POWER PLANT NEAR BALLAIGUES.

horsepower at Yverdon on the high-tension circuit of 5,200 volts.

As no meters are installed, there is a tariff for the use of light as follows: Up to 400 hours per year for 10 candlepower 1.93 cents, for 16 candlepower 2.7 cents, for 25 candlepower 3.6 cents; up to 800 hours per year, 2.31, 3.67 and 4.64 cents, respectively; more than 800 hours per year 2.9, 4.45 and 5.8 cents, respectively. For power purposes the

FIG. 5. MAP SHOWING LOCATION OF TRANSMISSION LINES OF LES CLEES-YVERDON SYSTEM.

charge varies from $48 per horsepower per year for small motors (one-half to one horsepower) down to $30 per horsepower per year for 30 horsepower. Greater power is charged for by special arrangement.

There is a specially low rate made for both light and power service when used during certain specified hours.

The plant is operated day and night, except on Sundays from 9 a. m. to 2 p. m.

The entire electric installation was furnished and constructed by the Maschinenfabrik Oerlikon, Zurich, Switzerland.

Uses of Electric Power in Agriculture.

By V. M. Arana.

It is not more than a quarter of a century since electricity began to be used as a lighting agent on a practical basis; only 10 years since the electric current has become such a potent factor in traction, manufactories, chemical and mining industries, and now, like the subtle ether pervading all matter, electric energy seems to pervade every branch of industrial activity. The advent of electric power in agriculture is comparatively of very recent occurrence; from all indications its general adoption will not be slow, and it is destined to play an important role in all regions where farming is of paramount importance.

There are three important reasons for this. In the first place, modern farming is no longer characterized by the patriarchal methods of the past, which largely depended on Nature to perform most of the work. Now human effort and ingenuity have devised many methods by which Nature's processes cannot only be supplemented and aided but greatly improved upon by the use of artificial means, and electric energy adapts itself wonderfully to this end. Then, the modern tendency of consolidation by uniting large farming interests under financially powerful owners makes possible the investment of capital on a large scale, without which the investment in machinery and other appliances would be out of the question. If farming were confined to the thousands of meager landowners, who are too poor to spend money in improvements, the gigantic strides made in modern plantations and farming establishments would have been impossible to bring about. And lastly, the great abundance of waterpower in the neighborhood of agricultural regions and the marked success met with in electric transmission plants have served as a powerful encouragement to "harness" waterfalls and use the transmitted energy in agriculture and allied industries.

Among the most successful enterprises, one which is at present producing wonderful changes near the Pacific Coast, is waterpower transmission as applied to irrigation. This industry practically means the transplanting of large bodies of water from places where they would run to waste to places where they become inestimable. A bold achievement, indeed, and one which is possible owing to the remarkable progress made in high-voltage transmission during the last few years. By this means the energy of torrential mountain streams, representing thousands of horsepower, is successfully sent across mountains and chasms a hundred miles away to barren stretches of land. There the energy is applied to motor-driven pumps and made to raise millions of gallons of water from wells sometimes many hundred feet deep and stored in mammoth reservoirs for irrigation.

California, Colorado and Montana are the states which have benefited mostly from the application of transmitted energy to irrigation. There are some places in those states where the annual rainfall is less than four inches, while it takes about 20 inches to produce crops. The total area of irrigated land in the United States was 9,487,077 acres in 1902; the net increase from 1899 to 1902 was nearly 22 per cent., which means that in a little over 12 years, at the same rate of increase, the acreage of irrigated land would double. When one realizes that nearly all the increase of late years has been due to electric power irrigation the above results are certainly very encouraging.

The influx of capital and people into those regions consequent to the benefits produced by irrigation has undoubtedly created new markets for the power originally transmitted for irrigation and to operate mining machinery. The power companies whose main revenues come from selling water or leasing mains have lately added a new line to their business—they sell electric current for lighting and power. Thus, it is apparent that electric power transmitted for the purpose of irrigation has accomplished the dual task of making vast tracts of arid land productive and of fostering an increase of demand for the power itself.

There are two general conditions under which electric pumping stations for irrigation are being installed. One requires water for the event of a drouth, in which case, river water becoming greatly diminished, irrigation from pumping stations is depended upon to save the crops. This case is, however, seldom resorted to as at its best it is merely a safeguard. Drouths may not occur in a lifetime, or they may repeat year after year; therefore, installations of this nature are "all a gamble," as westerners put it. They greatly resemble the fire-insurance business, for if no drouth occurs the investment in machinery is wasted money, just as that paid for policies when no fire occurs.

Some of the plants originally installed for the purpose of saving crops by electric irrigation are now, however, utilizing their machinery and power the year round by establishing industries and availing themselves of the by-products of the farm or plantation to be used as raw material. Not long ago a New York contracting firm was asked for a complete installation to manufacture cotton-seed oil. The specifications called for two large induction motors to drive the machinery; these motors were also to be ready for belting to low-speed direct-acting pumps. The pumps were to be started whenever there was need of water for irrigation, which was perfectly feasible as the manufacture of oil could be stopped at any time, no loss of any sort resulting from its indefinite suspension in case the pumps were to work for months.

There are three pumping systems in use now. The first includes deep-well pumps, which are mostly used for small quantities of water, and as their connecting rods and other moving parts are large and clumsy, generally low speeds are required. Direct-acting pumps belted to low-speed motors is the usual practice. The second and most important system includes pumps used for comparatively shallow wells and in which the ground water is generally at a constant level. This system of pumping is by far the most widely used when electric pumping is depended upon for irrigation throughout the year. The pumps most extensively used in this connection are direct-connected centrifugal pumps. The third system consists of the air lift, which is a very slow and crude method and whose only advantage lies in the cheapness of its installation. This system is seldom used in large installations; it is mostly confined to small and isolated stations which belong to individuals.

It has been pointed out that some transmission plants which were originally intended for irrigation had virtually developed entire communities, and thereby in many cases had opened new markets for using the electric current. There are some cases in actual existence which to a certain extent are the reverse of that condition. These are instances where electric-power developments, at first intended for lighting and power, have made possible agricultural industries by means of electric pumping for irrigation—of course without detriment to their original line of business. In many cases where transmission plants were operated for light and power it was observed that considerable energy not contracted for was available during many hours of the day; that the power chart showed that in 24 hours hardly two-thirds of all the energy at their disposal was actually consumed, although the machinery was running at all hours.

Power companies at once took the matter up and found the solution of the problem by selling the energy for irrigation purposes at very low figures, with the express understanding that pumps were to be shut down during or near the hours when the generators were carrying the peak of the lighting and power load. This was entirely satisfactory to those interested in irrigation, as with the construction of reservoirs the time for the operation of the pumps was immaterial to them. It is needless to point out that after that the power companies were

putting in their pockets money from energy which otherwise would not have been utilized.

Electric power is seldom if ever used for agriculture when its generation entails an expense of fuel. Consequently, one is apt to find its application for that purpose only in those countries where waterpower is found in abundance and where manufactories in neighboring cities do not offer a good market for electric power. It is in an eminently agricultural country like France, where there is abundance of waterpower, that any great use of electric power in agriculture is met with. Although in that country, especially in the neighborhood of Lyons, Lille and other great silk-manufacturing centers, a great deal of waterpower is used in driving spindles and looms.

Grenoble is a great center of distribution for electric energy, derived from "white coal," as Frenchmen have christened waterpower. Of nearly 20,000 horsepower developed around there, 3,000 horsepower is used for agricultural and similar industries. The bulk of this power is used in the making of wine and preparation of preserved fruits. There are many juice-pumping and circulating machines operated by electric motors, and their introduction has been received by manufacturers with great satisfaction. The use of electric power in wine distilleries has many advantages, due to the absence of smoke and vapors, which always affect the purity of liquors. The use of electric heaters and driers for preparing raisins and other varieties of preserved and dried fruit has also gained a firm foothold. The great advantage claimed for electric-heating apparatus in connection with work of this nature is the nicety with which the degree of temperature can be adjusted and the great convenience in regulating the passage of the current to the exact time needed for cooking or drying the fruit, which, if done by other means, requires considerable time, labor and inconvenience.

Mexico is another country where the abundance of waterpower and the fertility of its semi-tropical soil contribute to the use of electric power in agriculture. Already gigantic strides have been made there as well as in other Latin-American countries. Electric power is now used extensively for the preparation of cane sugar, in the elaboration of alcohol and in handling of produce.

Not long ago a plantation in Vera Cruz, Mexico, whose capacity is 1,000 tons of sugar per month, contracted for a 1,200-horsepower plant of four units to be used for power and lighting in the plantation buildings. The sugar-cane industry is one requiring machinery having very low speeds, and which, through the long cane carriers and bagasse dumpers, makes unavoidable considerable lost motion and waste of power in gearing. The cane is placed in a long and narrow moving platform, made up of wooden slats held together by chain gearing. This, acting exactly like an endless belt, feeds the mill rolls constantly with cane. On the other side of the mill a similar contrivance—the bagasse conveyor, relieves the mill rolls from the obstruction of the already crushed and squeezed cane. To the mill rolls a juice pump is usually geared, so the complete train of mechanism, sometimes 50 to 100 feet in length, clumsy and heavy as it is, nearly in all cases was driven by one large steam engine.

The application of electric power to this industry is already resulting in economy of energy, and the convenience of having all those heterogeneous parts driven by individual motors is simplifying the operation considerably. For some waterpower regions new types of cane mills are already being designed to conform with the new system of drive. The use of electric trucks to carry cane and other plantation products as well as the employment of electric elevators to lift grain and fuel for storage or shipment have also passed the merely experimental stage.

Electric plows and threshers having storage batteries for their propelling power have already been used in Europe. A French manufacturer of electric machinery has recently patented such implements, and already large sales are reported. It is claimed that such machinery only requires an investment of 75 per cent. of the one necessary to employ the same machinery driven by steam or animal power; this is, of course, considering the low rates at which waterpower is generally sold throughout eastern and southern France.

The Southwest Missouri Electric Railway Company has recently purchased a number of branch electric railways, which will be added to its growing system. The recent additions include the Chitwood branch, extending from Joplin to Chitwood; the branch from Prosperity to Duenweg and a line connecting with the Chitwood branch. The consideration for the three properties was $121,000.

Weissmann Electric "Pearls" at the St. Louis Exposition.

Electric "pearls," which are features of an ingenious kind of incandescent lighting, designed by Mr. G. Weissman of Paris to be used for decorative purposes, were described in the Western Electrician of October 29th, and beautiful effects may be obtained by their use. The accompanying illustrations show the adaptability of these devices for artistic lighting, and in the exhibition of the Parisian dressmakers in Manufacturers' Building at the World's Fair the "pearls" were preferred for decorating the collective exhibit. This exhibit is composed of four rooms beautifully lighted with Louis XVI. basket-shaped electroliers, garlands and friezes matching with the decoration and displayed with perfect artistic taste. As shown in Fig. 1, the Weissmann lighting system gives a striking effect to the handsome dresses on exhibition.

FIG. 1. WEISSMANN ELECTRIC "PEARLS" USED IN DECORATING AND ILLUMINATING EXHIBIT OF PARISIAN DRESSMAKERS AT ST. LOUIS EXPOSITION.

The Weissmann exhibit in Electricity Building also attracts a great deal of attention, and an original idea of it may be obtained in looking at Fig. 2, which represents a detail part of the exhibit; a mantel-piece decoration of high artistic value with the reflecting effect of the mirrors showing a few of the Weissmann chandeliers exhibited. The Weissmann electroliers have also been installed by a number of exhibitors for decorating their booths, such as Revillon Frères, Pfeiffer-Brunet, Leon, etc.

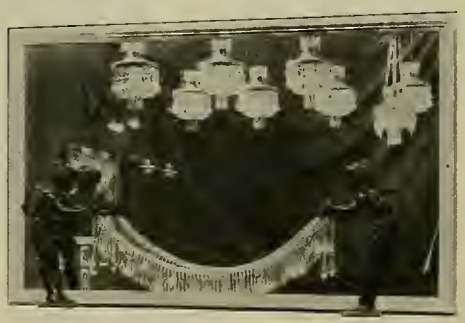


FIG. 2. WEISSMANN ELECTRIC "PEARL" EXHIBIT IN ELECTRICITY BUILDING, ST. LOUIS.

Recognition of these pearls in this country supplements success in Europe, where many engineers have endorsed the merits of the system with regard to safety, and encouraged the general public to adopt it.

The electric "pearls" can be easily set in a great number of beautiful combinations and designs. Many displays make it possible to obtain very quaint panel decorations and garlands along the cornices and under mirror frames, looking almost like jewels. Mr. P. Lethenle of the French electrical section of the St. Louis Exposition is the representative of these unusual "pearls" in the United States.

Telephone Syndicate to Build a Lighting Plant.

The syndicate which controls the Pittsburg and Allegheny Telephone Company is preparing to build a large electric-light plant. While the companies will be distinct, the interests will be identical. The underground-conduit system of the telephone company has only about one-fourth of the space occupied. This may be used for conducting the lighting lines, as will also the poles of the telephone company. Robert C. Hall, who has the matter in charge, states that about $2,500,000 will be expended on a plant to be located at some point on the river front. He further said that a lighting business is a logical part of the telephone business. This line will be developed, not in opposition to the company that is already operating, but under plans that will make new business. It will be largely in the line of block business, and furnish current for power where private plants have heretofore been operated.

Method of Locating Grounds on Underground Conductors.

A convenient method of locating grounds on underground cables, which is an adaptation of the loop test, was described in a paper read by Mr. L. A. Ferguson at the International Electrical Congress held in St. Louis last September. An abstract of this important paper was given in the Western Electrician of November 12th, though the part relating to the ground dectector was not given in the abstract. The following description of the method is taken from Mr. Ferguson's paper:

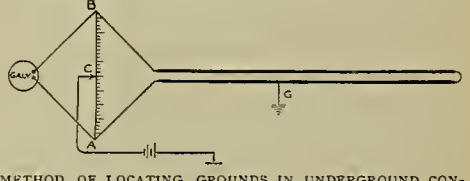
Where one conductor of a multiple-conductor cable is grounded and another conductor is clear the following adaptation of the loop test can be used to advantage. This method also applies to single-conductor cable where another conductor is available for the return. The two conductors must be of the same size or corrections will have to be made for the difference in the resistance of the two sizes.

The grounded conductor is joined to the good conductor at the opposite end from which the test is to be made. A resistance wire is used, made up in the form of a straight wire bridge or wound on a threaded drum. The wire is calibrated throughout its length. Contact (C), referring to the diagram, is arranged so that it can be moved along the resistance wire throughout its entire length. A battery is connected between the contact (C) and ground and a galvanometer between the terminals (A) and (B). In making tests (C) is set preferably at the middle point of the resistance to start with. When contact is made, the galvanometer will swing to either one side or the other, depending on the location of the ground Contact (C) is then moved along the resistance wire until no deflection is obtained upon the galvanometer. It will be evident that the distance from (A) to (C) of the resistance wire will represent the distance from (A) to (G) on the conductor which is grounded.

This can be represented by the following formula, wherein (L) represents the total length of the conductors joined together, and (AC) and (BC) represent the relative distance measured on the resistance arm:

$$\frac{AC}{BC}=\frac{AG}{BG};\ \text{or}\ \frac{AC}{BG}=\frac{AG}{L-AG}.\quad \text{Solving } AG=\frac{AC\,(L-AG)}{CB}.$$

(L) may be expressed as the length of the conductor in feet where the two conductors which



METHOD OF LOCATING GROUNDS IN UNDERGROUND CONDUCTORS.

are joined together are of the same size or as the resistance of the conductors where the conductors are made up of two or more different sizes of cable. It will be noted that this test is independent of the resistance of the fault. The resistance of the fault should be low enough to permit a sufficient amount of current flow to allow satisfactory indication upon the galvanometer.

A Weston portable galvanometer with the zero in the center of scale is used.

This loop test has been found very satisfactory and on lines ranging from one to five miles in length the trouble is usually located within 100 or 200 feet, and as trouble of this kind usually comes in manholes this means that it is located exactly.

In case the conductor on which the ground occurs is entirely burned in two and the insulation at the point at which cable is damaged is sufficient to withstand 1,000 volts or more, the ground can be readily located by measuring the relative charging current from each end of the cable.

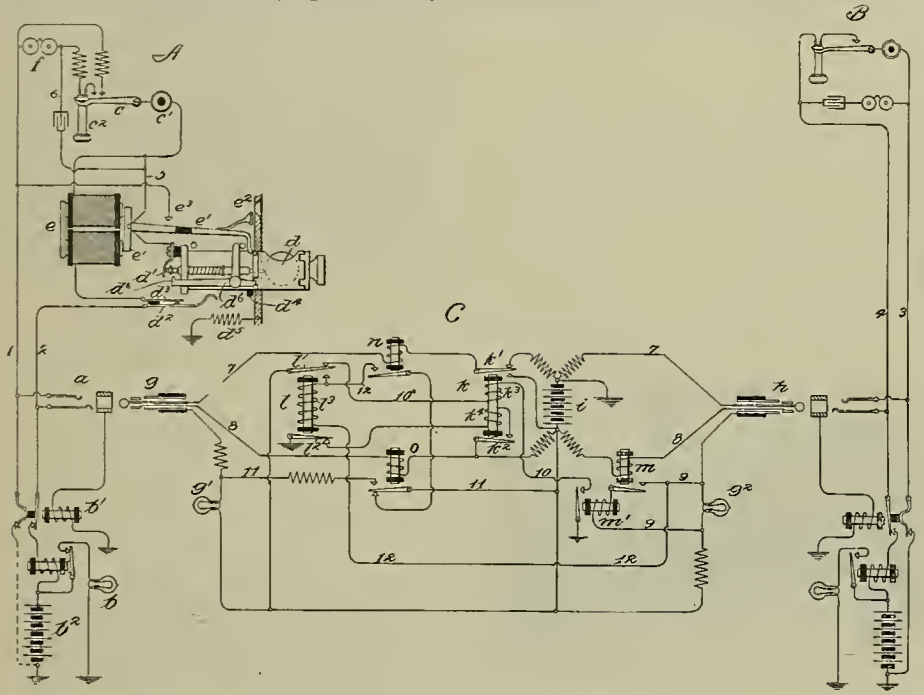
Improvement in Toll-line Telephone Systems.

W. W. Dean of Elyria, O., the well-known telephone engineer and inventor, has made some recent improvements in toll-line systems which are of interest. By toll line in this case is meant lines to which are attached some form of coin-operated telephone or else a service meter.

The object of the invention is to provide means whereby a charge may be made for each use of a subscriber's telephone in originating a connection in which the subscriber is actually placed in communication with the party called for. More specifically it is to compel the user of the telephone manually to operate his toll device, whether it be a prepayment device or a service meter, or to do any other required act in order to place the telephone or accessory apparatus in operative condition.

Another object is to make the necessity for such special act on the part of the telephone user dependent upon the action of apparatus at the central office which is brought under the control of a switch at the sub-station of the called subscriber, so that the subscriber may be relieved of the special act and the coin returned or no charge registered on the service meter when the connection called for cannot be made, when the called subscriber fails to respond or when the line is used in response to calls from other stations.

Generally speaking, the invention consists of a blocking device for preventing telephonic communication from a toll-line sub-station, together with apparatus at the central office for actuating the blocking device, the apparatus being brought under the control of the called subscriber in the course of establishing connection between the toll line and another line. Mechanism is associated with the toll device at the toll-line sub-station and adapted for manual operation by the user of the telephone for counteracting or reversing the blocking mechanism to establish the operative condition of the system. The telephone user at the toll-line sub-station is thus not compelled to operate his toll device until connection has been actually completed with the line of the called subscriber and the called subscriber has responded. When the called subscriber takes his telephone from its hook to answer the call, the operation of the blocking mechanism on the toll line is automatically brought about, so that the toll-line subscriber is obliged to operate his toll device in order to converse.



IMPROVEMENT IN TOLL-LINE TELEPHONE SYSTEMS.

The accompanying illustration is a diagram illustrating a telephone toll line and another line extending from sub-stations to a central office and a pair of plugs and their plug circuit at the central office for uniting the lines.

The usual telephone talking and signal-receiving apparatus is provided at the sub-station, together with a gravity telephone switch-hook for controlling the circuits through the apparatus. In addition, the sub-station is provided with a toll box or prepayment device for receiving coins, the toll box being associated with the telephone line, so that the deposit of a coin is necessary in order to transmit a signal to the central office. This toll box is provided with a coin receiver (d), adapted to slide to and fro in its framework.

A sliding plunger is mounted in the coin receiver and is adapted to be engaged by a coin pressed in the receiver, the plunger being pushed against a contact spring (d') to connect the framework of the toll box with the contact spring. The framework of the toll box is grounded through a resistance coil of, say, 500 ohms. A pair of contact springs (d^2) (d^3) are provided in the toll box, normally engaging one another, and the sliding coin receiver carries an insulated lug (d^4), which is adapted when the receiver is pushed in to deposit the coin in the toll box to engage one of the contact springs and separate them. A polarized electromagnet is provided in the toll box, the magnet having a centrally pivoted tilting armature (e'). This armature performs three functions: First, when in its normal position it prevents the coin receiver from being pushed in; second, it carries a visual signal (e^2), which is displayed in an opening of the toll box when the armature is tilted in a contra-clockwise direction, and, third, when the armature is so tilted it serves as a relay, closing circuit with a contact anvil (e^3). The telephone switch lever is connected with the limb (2) of the telephone line by a conductor, which includes serially the transmitter, the windings of the polarized magnet (e), and the contact springs (d^3) (d^2), in the order named. A branch conductor is tapped on between the transmitter (c') and the magnet (e), the conductor being connected with the armature of the magnet and with the spring (d'), associated with the sliding coin receiver. The contact (e^3) is connected directly with the limb (1) of the telephone line. The telephone receiver is included, together with a condenser and one winding of the induction coil, in a conductor, extending from one of the contacts of the switch-hook to a point between the transmitter and the magnet (e).

The other contact of the switch-hook is connected with the limb (1) of the telephone line through the other winding of the induction coil. Normally, when the telephone is not in use, the receiver hangs upon the hook, so that the switch lever is out of engagement with its contact anvils. But when the telephone receiver is taken for use the lever rises and engages with both of the contact anvils. The usual polarized signal bell is included, together with the condenser, in a bridge of the line to receive incoming signals. The spring (d') is thus connected with the limb (2) of the telephone line by way of the armature (e') and the windings of the magnet, and when a coin of suitable size is placed in the coin receiver the circuit to earth through the resistance is completed at the contact (d'). The armature of the electromagnet normally rests in the position shown, so that the arm carried thereby is in the path of a lug carried by the sliding coin receiver, preventing the coin receiver from being pushed in. When, however, the magnet (e) receives current of suitable direction, it will tilt its armature to remove the obstruction and permit the coin receiver to be pushed in to deposit the coin in the cash box, and at the same time the tilting of the armature will close the contact (e^3) and also display the signal (e^2). The closing of the contact (e^3), it will be observed, short-circuits the telephone apparatus.

Passing now to the apparatus at the central office, the operator is provided with the usual answering and calling plugs united by link conductors through the windings of a repeating coil for connecting telephone lines together. In accordance with the "central-battery system" a central source of current is connected in a bridge of the link conductors between the windings of the repeating coil in a manner well understood. The side of the battery which is connected with the conductor (7) is grounded, and the other or free pole is connected, through supervisory signal lamps with the third contacts of the plugs. When one of the plugs is inserted in a spring jack, this third contact registers with the testing of the jack, which is grounded through the cut-off relay, so that upon the insertion of a plug in the jack of any line the cut-off relay associated with that line is excited and acts to disconnect the line-signal apparatus from circuit.

Station (B) is illustrated as an ordinary telephone sub-station, having the usual telephone apparatus in a bridge of the line and a gravity telephone switch for controlling the circuit of the bridge.

The operation of the system may be traced as follows: Supposing the subscriber at the toll-line sub-station (A) is desirous of communicating with subscriber (B), he first signals the central office by depositing a coin in the coin receiver. This closes the circuit of the limb (2) to ground through the magnet (e). Current now flows from the grounded-line battery (b^2), through the line relay, out over limb (2) of the line, through the winding of magnet (e) to the armature thereof, to contact spring (d'), to the plunger of the coin receiver, and thence through the framework of the toll box to ground. Current flowing in this circuit excites the line relay at the central office; but the direction of current is such that the armature of the polarized magnet (e) is not moved. The circuit of the line lamp (b) at the central office being completed by the line relay, the lamp is lighted, indicating to the attendant that a connection is desired. To answer the call thus made, the answering plug is inserted in the spring jack of the toll line, thus cutting off the line-signal apparatus from the circuit and connecting the line with the apparatus in the plug circuit, including the battery (i). It will be understood, of course, that the operator is provided with the usual telephone and calling appliances. The subscriber at the toll-line sub-station having removed his telephone from its hook, converses with the central-office operator and gives her the number of the subscriber wanted. In taking his telephone from its hook he has closed a bridge of the line, including his telephone apparatus in the usual manner, and the contact (e^3) being open and the contacts (d^2) (d^3) closed, the circuit is in operative condition. The magnet (e) is unaffected by the substitution of the battery (i) in the plug circuit for the line battery (b^2), since the polarities are the same. In practice one battery is used both for a line-signal battery and for the battery (i) in the plug circuit. Supervisory relays (n) and (o) will both be excited at this time by current flowing out over conductor (7) of the plug circuit to the limb (1) of the telephone line, through the telephone apparatus and the magnet (e), back over the other limb (2) of the telephone line and conductor (8) of the plug circuit, to the negative side or free pole of the battery. Having ascertained the number of the called subscriber, the operator inserts her calling plug in the spring jack of the called line and signals over the line in the usual manner. When the subscriber at station (B) answers the call by removing his telephone from its hook, he closes a bridge of the line conductors, thereby closing circuit through the supervisory relay, which, being excited, closes a shunt, including the subsidiary relay (m'). The relay in drawing up its armature closes a circuit to ground from the free pole of the battery, the circuit including the armature (l') and back contact of the relay (l). Current flowing in this last-mentioned circuit through the winding (k^3) excites the magnet (k), so that both armatures are drawn up, and armature (k') transfers the connection of conductor (7) from the grounded pole of the battery (i) to the free pole. Armature (k^2) in closing against its front contact completes a path to ground from the side (8) of the plug circuit between the pole of the battery and the relay (o), the grounded path including the retaining winding (k^4) of the magnet and being controlled by the armature (l^2) of the relay (l). Current flowing through the winding (k^4) keeps the magnet excited independent of current in the winding (k^3), so that the magnet, once excited, is rendered independent of further changes in the condition of the circuit of the called line. The operation of the electromagnetic switch brings about a reversal of current through the magnet (e) at the toll-line sub-station and blocks the use of the telephone until the calling subscriber operates his toll device. The conductor (7) being connected with the free pole of the battery (i), the circuit of the negative current is traced over limb (1) of the telephone line, through the telephone apparatus at the toll-line sub-station, through the windings of magnet (e) to the conductor (2), to the spring jack at the central office, to the conductor (8) through the supervisory relay (o), to the point where the armature (k^2) is tapped on, thence through the winding (k^4) of the magnet (k), to ground by way of the armature (l^2). Current may also flow from the battery through one winding of the repeating coil, directly to the armature (k^3); but enough current takes the path to the sub-station to operate the relay (e), and it will be noted that the current through the relay has been reversed. The armature (e') will therefore be swung in a contra-clockwise direction, and will close the contact (e^3), thus establishing a short-circuit of the telephone apparatus to prevent its use, at the same time displaying the signal (e^2) and removing the obstruction from the coin receiver (d), so that the coin receiver may be pushed in. The calling subscriber, seeing the signal displayed, knows that the called subscriber is waiting and that the coin receiver (d) must be pushed in in order that his ap-

paratus may be put in condition for talking. The calling subscriber will then push in on the button which is mounted on the outside of the coin receiver, and the coin receiver will slide into the box to deposit the coin. As the receiver slides in at the moment the coin is disposed of, the insulating lug carried by the coin receiver engages the contact spring and separates it from the contact anvil (d^3), whereby the circuit of the limb (2), including the magnet (e), is broken. The limb (1) of the telephone line, however, remains closed to ground through the framework of the box.

The calling subscriber at the toll-line sub-station having pushed in the coin receiver as far as it will go and deposited the coin, removes the pressure, whereupon the coin receiver is returned by a spring to its outer position, and the current through magnet (e) being reversed by the re-establishment of the normal circuit conditions at the central office, the armature (e') of the magnet is tilted to break the short-circuit at (e^2) and permit the use of the telephone apparatus. When the coin receiver (d) returns to its outer position the stop (d^6) is withdrawn from its engagement with the plunger carried by the coin receiver, so that the contact with the spring (d') is broken and the ground removed from the line. The return of the coin receiver also re-establishes the circuit at the contact points (d^2) and (d^3). The two subscribers are now in communication, and no further act on the part of the calling subscriber at the toll station is necessary, since the releasing device (1) at the central office maintains the circuit of both windings (k^3) (k^4) of the blocking switch broken.

Dynamo with Longitudinal Armature Plates.

By Dr. Alfred Gradenwitz.

The novel type of dynamo described in this article is intended for ensuring a more satisfactory ratio of the output to the weight of the machine than has hitherto been possible.

The output of electrical machines, apart from purely mechanical factors, is, as is well known, limited by the heating of the material, due to internal-energy losses as well as by the armature reaction. Should it therefore be possible to reduce the internal losses, to facilitate the removal of the internal heat and to act against the armature reaction, a corresponding improvement would necessarily result.

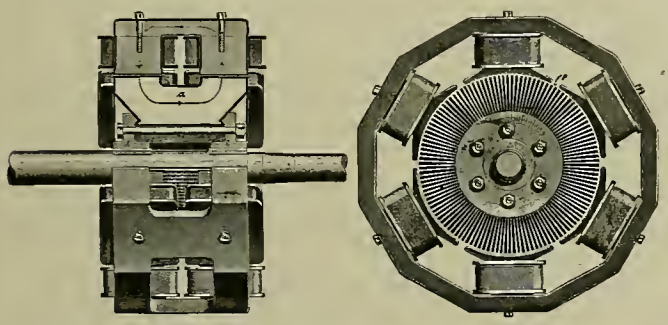


FIG. 1. DYNAMO WITH LONGITUDINAL ARMATURE PLATES.—SECTION AND END VIEWS.

Fig. 1 shows the arrangement of the active parts in the case of the dynamo being designed as a direct-current machine. The armature core, instead of consisting of sheet-metal rings concentric with the axis, is made up of sheet-metal disks (a) arranged parallel to the direction of the axis. The core disks are united in bunches and so kept in position by flanges as to produce wedge-shaped air gaps between the different disk bunches. The lines of force in the inductive magnetic field will take the course represented by the arrows. The system of field magnets includes two pole rings placed beside one another in the direction of the axis, each two corresponding poles lying close to one another. The poles of adjoining pairs have also alternate signs. The armature windings are located in the outer parts of the gaps between the various sheet-metal bunches.

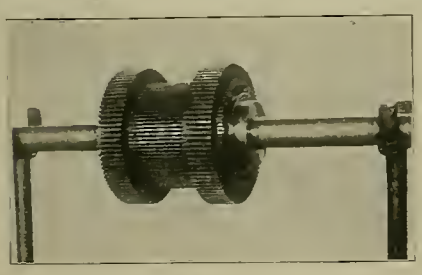


FIG. 2. ARMATURE CORE HAVING LONGITUDINAL PLATES.

The large number of wedge-shaped air gaps axially traversing the armature will obviously result in energetic cooling effects. It will further be inferred that, on account of the direction the lines of force of the transverse magnetic armature fields, as well as of the stray fields round the various armature conductors, the magnetic conductivity is considerably diminished by the peculiar arrangement of the armature iron. The armature reaction will therefore be low and the self-induction of the armature coils relatively smaller on account of the favorable influence exerted by the screen effect of the various armature plates. Fig. 2 is a picture of the armature core and Fig. 3 shows how it is mounted within the two rows of poles.

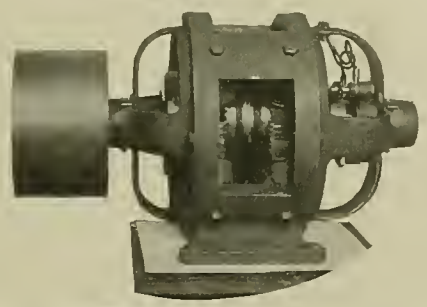


FIG. 3. VIEW SHOWING METHOD OF MOUNTING ARMATURE.

Regarding the question whether the iron losses will be smaller than an ordinary machine, special experiments had to be made, and more especially since great losses by Foucault currents were anticipated. These experiments were carried out by Prof. W. Kohlrausch, director of the Imperial Physico-technical Institute of Charlottenburg, Germany, on a 45-horsepower continuous-current motor. The machine was first made to drive a permanent load as a motor at 250 volts pressure at the terminals and 150 amperes armature current, with a view to ascertaining the heating of the armature and magnet coils, the number of revolutions being 610 per minute. Before the experiments were begun the surrounding temperature as well as the resistance of the magnet and armature coils had been measured. After both the armature and magnet coils had assumed a stationary temperature, measurements were repeated and by calculation from the increase in resistance the surplus temperature of the armature was found to be 27.3° C. and that of the magnet coils 54.5° C. These low figures are evidently due to the efficient cooling.

The magnet coils having each 700 windings and the shunt-current intensity being 4.33 amperes, the number of field-ampere turns per pole was 3,031. The armature windings had 398 rods and the armature-branch current amounted to $150 \div 2 = 75$ amperes. The armature had therefore for each pole

$$\frac{398}{4} \times 75 \times \tfrac{1}{2} = 3{,}730$$

ampere turns. The ratio of field-ampere turns to armature-ampere turns was therefore equal to

$$\frac{3{,}031}{3{,}730} = 0.81.$$

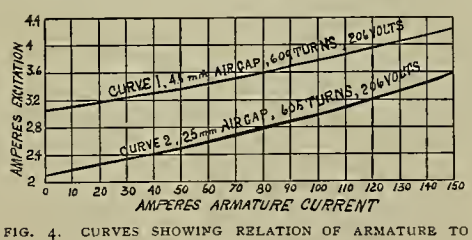


FIG. 4. CURVES SHOWING RELATION OF ARMATURE TO FIELD CURRENT IN DYNAMO WITH LONGITUDINAL ARMATURE PLATES.

The brushes were with all loads placed in the geometrically neutral zone. No sparking was observed.

The influence exerted by a diminution of the air-gap between the armature and pole surfaces was examined afterwards. To do this the machine was, without any previous alteration, operated as generator with constant tension and angular speed and loaded gradually while the shunt current required was being observed. Curve 1 in Fig. 4 represents the values of the shunt currents in terms of the load. By interposing sheet-metal disks two millimeters in thickness between the pole-cores and pole-shoes the air-gap was afterward reduced from 4.5 millimeters to 2.5 millimeters, that is, by 45 per cent., and the experiments repeated when Curve 2 in Fig. 4 was obtained. The brushes in these experiments also remained in the geometrically neutral position. No sparking was observed. The above ratio amounted in the latter experiment only to

$$\frac{700 \times 3.6}{3{,}730} = 0.675.$$

From the above it is to be inferred that the influence of the armature field is inappreciable.

The iron losses were next determined from tests at no load for different numbers of revolutions and degrees of saturation of the armature iron according to two different methods, when practically agreeing loss curves (Fig. 5, Curve 1) were found. The weight of the armature plates in the machine experimented on being 145 kilograms, the iron losses per kilogram or per cubic centimeter are readily found from the curves for all degrees of saturation and numbers of periods. In order to obtain comparative data the curves of the iron losses that would ordinarily occur under the same conditions have also been calculated for 145 kilograms of sheet metal and plotted—Curve 2, Fig. 5. It is seen that for the same value of the saturation and number of periods the iron losses in the new type of dynamo are considerably smaller, the more so as the saturation is less.

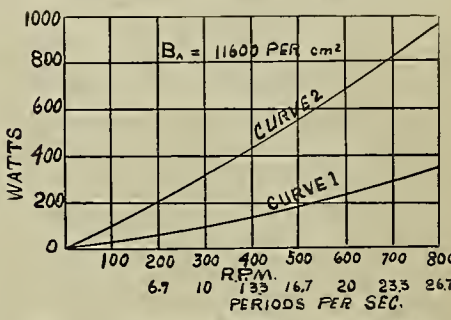


FIG. 5. COMPARATIVE CURVES OF IRON LOSSES.

The following is a record of the weight of material of the machine:

Armature plates	145.0 kilograms.
Armature copper	57.7 "
Magnet copper	72.0 "
Pole casing with pole cores and pole shoes	278.1 "
The remaining, excepting belt disk	459.5 "
	1,012.3 kilograms.

The utilization of the material, in spite of the rather unfavorable square cross section of the pole-cores, has thus been found to be very satisfactory. The air-gaps and, accordingly, the weight of the magnet copper could moreover be reduced considerably, as seen from the experiments above recorded. In machines lately built the pole-cores have been given a circular cross section, when much more satisfactory results were obtained and only two kilograms of copper and eight kilograms of iron were required per kilowatt, with an output of 50 kilowatts and 660 revolutions per minute. These conditions will be further improved to a high extent in the case of greater outputs, and the same design is suitable also for alternating-current machines.

The machine is manufactured according to the patents of Mr. C. Dittmar by the Schüttdorfer Maschinenfabrik of Schüttdorf, Germany.

The Private Trolley Car.

A writer in the St. Louis Globe-Democrat speaks of private trolley cars in the following terms: "Arranged with a sleeping apartment, a drawing room, a kitchen and dining room, the private trolley car is an interesting development of the interurban electric railroad systems of the country. One of these cars is on exhibition; and their cost being so far below that of the private car on steam railroads, they are quite within the reach of persons who can't afford the others. When the electrical lines become more numerous and more generally connected, private trolley cars may be expected to appear in flocks; they are less expensive than the smaller yachts. They only require a 'crew' of two—three, including the cook. They are far more preferable than automobiles, being safer, more comfortable and moving with greater speed. The landscapes to be seen from their windows are as interesting and the occupants have the time to look at them, while the automobilist, who must watch his vehicle, hasn't. Yachting is always restricted in its possibilities by the inevitable necessity that to enjoy it you have to stay on the water; whereas, the trolley car can go nearly everywhere that the yacht does and a thousand other places besides. Accidents due to collisions of trolley cars are seldom fatal, though rather frequent."

WESTERN ELECTRICIAN

EVERY SATURDAY.

PUBLICATION OFFICES:
510 Marquette Building, - CHICAGO.
TELEPHONE, MAIN 1746.

Eastern Office, 193 Times Building, New York.
Telephone, 3806J Cortlandt.

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted. This paper is entered at the Chicago postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year: single copies, 10 cents. When change of address is requested, the **old address** as well as the new should be given.

CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—**the only general electrical paper published in the West**—thoroughly covers a territory *exclusively its own.* THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be furnished on application.

REMITTANCES.—All checks, drafts and other remittances should be made payable to the order of the publishers, the **Electrician Publishing Company,** and addressed to the offices of publication, Suite 510, Marquette Building (204 Dearborn Street), Chicago, Illinois, U. S. A.

CONTENTS OF THIS NUMBER.

A Swiss Hydro-electric Plant for Small Industries. By Franz Koester. Illustrated 423, 424
Uses of Electric Power in Agriculture. By V. M. Arana. 424, 425
Weissmann Electric "Pearls" at St. Louis Exposition. Illustrated 425
Telephone Syndicate to Build a Lighting Plant 425
Method of Locating Grounds on Underground Conductors. Illustrated 425
Improvement in Toll-line Telephone Systems. Illustrated 426, 427
Dynamo with Longitudinal Armature Plates. By Dr. Alfred Gradenwitz. Illustrated 427
The Private Trolley Car 427
Editorial 428
Exhibits Power Plant at St. Louis. By Richard H. Pierce 429
Street-railway System in Ottawa May Become Property of City 429
Chicago Freight Tunnels Pass Into New Hands 430
Locomotive to Be Operated by Diesel Engine 430
Ohio Interurban Men Discuss the Freight Question 430
Gas-engine Plant for Electric Railway 430
Chicago Street-railway Situation 430
Pocket Volt-ammeter. Illustrated 430
Proposed New Railway Power House at Lafayette, Ind. 430
Automatic Pump Controller. Illustrated 431
Commutator Truing Devices. Illustrated 431
Meter Patent Litigation 431
Chicago Meeting of the Institute 431
Lighting Rates in Brooklyn to Be Reduced 431
Ohio Telephone Notes 432
Indiana Telephone Items 432
Telephone News from the Northwest 432
Michigan Telephone Matters 432
Bell Output for October 432
General Telephone News 432
Telephone Men 432
Manufacturers and Dealers 432
Electric Train-lighting System. Illustrated 433
General Greely Reports on Alaskan Telegraph System 433
New Equipment for Monterey County Gas and Electric Company 433
The Point of View. By Walter C. Kerr 434, 435
Book Table 435
"Scientific American Reference Book" 435
"The Conductometer and Electrical Conductivity." By Rollo Appleyard 435
Municipal Electrical Employes in New York and Chicago 435
Reported Lighting Merger in Baltimore 435

DEPARTMENTS.

Correspondence 435, 436, 437
Great Britain 435, 436
New York 436
Dominion of Canada 436
Indiana 436
Ohio 436, 437
Michigan 437
New England 437
Southeastern States 437
Northwestern States 437
Pacific Slope 437
Personal 437
Electric Lighting 437, 438
Electric Railways 438
Power Transmission 438
Publications 438
Automobiles 438
Telegraph 438
Miscellaneous 438
Trade News 439
Business 439
Illustrated Electrical Patent Record 439, 440

DATES AHEAD.

American Society of Mechanical Engineers (annual meeting), New York City, December 6th, 7th and 8th.

Electrical committee of the Underwriters' National Electric Association (annual meeting), 32 Nassau Street, New York city, December 7th.

Interstate Independent Telephone Association of America (annual convention), Auditorium Hotel, Chicago, December 13th, 14th and 15th.

A VERY excellent address is that of Mr. Walter Craig Kerr, entitled "The Point of View," and delivered to the graduating class of the Stevens Institute of Technology at Hoboken, N. J., last summer. It is sane, reasonable and uplifting—really helpful, in short. It was especially intended for young engineers, but it can be read with profit by all persons thoughtful enough to pause on occasion to take stock of their accomplishment in life. We have been for some time endeavoring to find space to reprint this address and are pleased that we have succeeded in this issue.

OBVIOUSLY the commercial requirements of today call for a printing-telegraph system—one by which actual printed words may be sent and received, instead of the slow and complicated Morse code, yet the telegraph operator of the present time bends in the same position over his key and sends the same system of dots and dashes flashing over the wire as did Morse himself over 50 years ago. Progress in all lines of electricity since the invention of the telegraph has been wonderful, and even the telegraph itself is now far different in the details of its construction and the scope of its application than it was in the early days, its utility being greatly broadened in that a single wire may be made to carry more than one message at the same time and even transmit speech as well. But the fact remains that in all these years inventors have been unable to break away from the Morse code, wonderful in itself and an everlasting monument to the fame of its inventor, but hardly the most adaptable in this time of fast living when the minutes count.

The fact that the printing telegraph is not to be found in all telegraph offices instead of the Morse key is, however, no indication that great effort has not been expended in this direction. Neither has this effort been altogether wasted, for many inventors have been on the verge of success, and every time this has been the case the goal has been made easier of attainment for those that followed after. Systems of printing telegraphy within the last two or three years have been developed by various inventors who lay claim to having solved the problem and who have operated their systems in an apparently satisfactory manner. But for one reason or another, often on account of too complicated and expensive apparatus, none of these systems has come into extensive use. But in the same manner that the autographic method of letter writing in our business life has been relegated to the rear and the typewriter substituted, so will the printing telegraph some day become one of the necessary factors in the rapid transaction of business, and it is to be hoped that this day is not very far distant.

IN VIEW of the history of previous exhibitions it is more unfortunate than surprising that the sweet bells of the St. Louis Exposition should be jangled over the question of awards to exhibitors. There is a controversy between the World's Fair National Commission and the Exposition Company over the question of the former body's rights in the matter of approving or disapproving the lists of awards given out by the Superior Jury. It is reported that the National Commission is determined to yield no ground in the dispute, maintaining that, under the law, it is entitled to a final voice in the distribution of the awards. The Exposition Company, according to the national commissioners, has been disposed to ignore the federal authorities, giving out lists, or partial lists, of awards to the press and public before they had been sent to the National Commission for approval.

"Unless the Exposition Company concedes our jurisdiction in this matter and extends to us the privilege of a final review of the lists, abiding by our decision, we shall appeal the matter to Washington," said National Commissioner Frederick A. Betts recently. "We maintain that we are upheld in our position by the law, and, if necessary, we will evoke the law to settle the affair. Our position is the same as it has always been—we do not propose to be ignored by the Exposition Company in a matter over which we are supposed to exercise final jurisdiction." The Exposition Company is understood to have taken the position that the approval of the National Commission of the awards announced by the Superior Jury is a matter of form and that the disapprobation of the National Commission could not affect awards made by the Superior Jury. When giving out the lists of awards for publication before they had been approved by the federal representatives, the Exposition officials explained that the lists were published merely as a report of the proceedings of the jury and not as an authentic and final list of awards.

It therefore appears that no "authentic and final" list of awards has as yet appeared. The controversy is only another evidence of the unsatisfactory condition of the whole exposition-award system. The jurors are men of standing and no doubt strive conscientiously to make fair awards. But they are not infallible and must judge by the exhibits which are before them. Sometimes a false impression is thus created. If, to take a suppositious case, the Krupp Works made no exhibit of armor plate, confining their display to other products of their factory, and if, say, some English company did display armor plate, a superlative award granted to the latter would not necessarily mean that its armor plate was superior to that of the German concern. And yet the "only superlative award for armor plate at the St. Louis Exposition" might be heralded abroad and create a misapprehension. Then, too, there are conflicts of authority, as in the present instance, and often discredit is thrown on the entire arrangement. There is certainly room for reform in the whole system of making awards at international expositions. An equitable, exact, simple plan should be devised and promulgated at the time exhibits are solicited.

BIG THINGS are promised on behalf of the Chicago Subway Company, the new corporation with authorized capital stock of $50,000,000 which appears to have secured control of the fine tunnel system underlying the streets of Chicago's downtown business district. It is said that the men back of the new company are capitalists controlling or influential in the companies owning most of the steam railroads centering in this city. If this is true, the fact is of especial importance, for the railroad people, with their freight terminals, are in position to take full advantage of the plans which have been made for the electric transportation of merchandise on narrow-gauge railways in the tunnels. Doubtless the change in owners will mean the more rapid development of a system by which freight to and from the business district can be handled more quickly and economically, the congestion of traffic in the downtown streets relieved, and pavements saved from much wear and tear. Not only will the congestion of traffic in the central district be reduced, but many horses should be taken off the streets, which will be a distinct advantage. The railroad companies, too, should be able to deliver freight to the door—the sub-basement door or elevator hatch—of the consignee, as express packages are delivered now. Not only freight but coal will be hauled in tunnels, to the corresponding relief of the streets, as everyone who is familiar with the large number of grimy, bulky coal wagons constantly in service on the downtown thoroughfares will admit.

Much has been printed in the Western Electrician describing the manner in which, so far as the plans have been perfected, this desirable result is to be accomplished. Only last week an illustrated article on the subject was a leading feature, and this was only one of several articles appearing at intervals since the issue of July 25, 1903, when the freight-carrying project was first announced in this journal in a column article. It is therefore with some amusement that we read squibs such as the following from Everybody's Magazine for December: "The New York subway has been advertised and celebrated copiously. Everybody knows about it. Meanwhile scarcely a word has been said about a great and original Chicago enterprise, an underground system of freight transportation. New York sends passengers out of the air and sun into crypts. Chicago hopes to relieve the congestion of the streets by carrying freight, coal and ashes in tunnels 25 feet under the ground." In view of the interest excited by the underground system among persons conversant with transportation problems in this country and Europe, the naive assertion that "scarcely a word has been said" is ludicrous. It would be more in harmony with the fitness of things if some of the popular magazines were not so sure of things that aren't so.

Exhibits Power Plant at St. Louis.

By Richard H. Pierce.

The power plant of the Exposition, which is located in the Steam, Gas and Fuels Building and in the west end of Machinery Hall, furnishes all the light and power used in the service of the Exposition. It includes the big pumps for fire protection, the compressors for the compressed-air service, and the engines and dynamos which furnish electric current for all the lighting of the grounds and buildings and for operating the Intramural Railway, the automobiles, the electric launches, the motors for pumping the water which flows over the Cascades, and the many motors throughout the grounds and buildings wherever useful work is done or exhibit machinery operated.

The Exhibits Power Plant comprises that portion of the power plant which is composed of machinery and apparatus furnished by exhibitors. It includes 35 of the 51 boilers located in the Steam, Gas and Fuels Building, together with their accessories. It includes the steam engines and generators which furnish all the electricity for operating the Intramural Railway and the arc-lighting system, and one-half of the general lighting and power service of the Exposition. It also includes the compressors for compressed-air service and the engines and dynamos which furnish the power for operating all the electrically driven machinery in Machinery Hall and in the Steam, Gas and Fuels Building. It is composed of machinery and appliances furnished by 119 exhibitors, including the leading companies both of this country and Europe, and represents a market value of over $1,000,000.

A mere cursory inspection of the power plant will entirely fail to give the visitor any idea of its plan and scope. All that is apparent to one so viewing the plant is a number of large and ponderous machines, quietly moving and appearing to make little effort or to give out but little power. The thoughtful observer, however, may here behold the greatest and most wonderful of all the processes shown at the Exposition, i. e., the process, or, rather, series of processes, by which the stored energy of coal is transformed and retransformed by successive steps, appearing in the furnaces as heat, in the boilers as the energy of steam, in the engines as the energy of moving masses, and in the dynamos as electricity, to be distributed by unseen wires throughout the vast area of the Exposition and again transformed into the energy of turning wheels, of flashing lights and rushing waters.

From the time the coal leaves the mines it is never again moved by the hand of man. Arriving on the track in the west end of the Steam, Gas and Fuels Building, in the hopper bottom self-dumping cars of the Exposition company, it falls by gravity into a pit beneath the track; from this time on it is automatically handled by its own energy. First, it is crushed, then elevated into a large storage tank; from here it is conveyed to a bucket elevator which carries it up to an elevated runway, along which it is again carried around the building by a conveyor and dropped into hoppers in front of each individual boiler. From these hoppers it falls into the furnaces upon moving grates, along which it continues its course until what remains leaves the rear of the grates as ashes, its energy having been given up to the boilers, transforming their contents from water into steam.

The steam, through large pipes located in a tunnel, is conducted to Machinery Hall, where it sets into motion the huge engines which drive the dynamos. In these the energy is transformed into electricity, and from the dynamos the electricity is conducted by cables to the four switchboards, from which it is distributed through thousands of miles of cables and wires to all parts of the grounds and buildings. The cables and wires are the veins and arteries of the Exposition, and the power plant is its ever-throbbing heart.

Although the conditions of an exposition are such as to necessitate the use of various sizes and types of boilers, engines, dynamos and accessories, instead of a number of units of uniform type and size (as is common in modern power-station practice), nevertheless the Exhibits Power Plant considered in detail is thoroughly representative of standard types and the most approved practice.

The coal is handled by an electrically driven, automatic conveying system. The boilers are almost all fired by mechanical stokers and are equipped with induced draft. The boilers are all of the water-tube type. Most of them are of horizontal type and built for 175 pounds working pressure. There are, however, similar boilers designed for 250 pounds pressure to furnish steam for turbines; also five vertical boilers and seven marine-type boilers of European make, several of which are to operate at 300 pounds pressure. The plant also includes feed pumps, heaters, purifiers and other accessories, all furnished as exhibits by firms for the most part leaders in their respective lines. The engines and dynamos are of varied sizes and types, but each by itself represents an up-to-date standard type. They are arranged in several distinct systems, according to the service for which they are suitable.

The general lighting and power service is furnished by a three-phase, 25-cycle, 6,600-volt system. In this service there are four generators, ranging from 1,000 to 3,500 kilowatts in capacity. One is driven by a vertical and one by a horizontal steam turbine, one by a cross-compound horizontal and one by a horizontal and vertical compound engine, this being the largest engine in the plant, having an economical rating of 5,000 horsepower and a maximum capacity of 8,000 horsepower. This system operates the incandescent lamps and motors through the grounds, including those which drive the cascade pumps, which are themselves a part of this plant.

The arc-lighting service is furnished through constant-current regulators by a 60-cycle, 2,000-volt system. The generators are single-phase, two-phase and three-phase, with frequencies of 50 and 60 cycles. The engines are compound, triple and quadruple expansion. The quadruple engine has six cylinders and is operated at 300 pounds of steam and at a speed of 333 revolutions per minute.

The Intramural Railway is operated with a direct-current 550-volt system. All the generators are of one type and make, but the engines vary in make and include simple, tandem and cross-compound horizontal, and cross-compound vertical types, and one generator is driven by an impulse waterwheel, the water pressure of 300 pounds per square inch being furnished by a triple-expansion mining pump located adjacent to the wheel.

The power service in Machinery Hall is furnished from a 250-volt direct-current system. The types of engines and dynamos for this service are all different and include a direct-connected gas-engine unit, operated with gas generated by a producer located in the Steam, Gas and Fuels Building.

All the large steam engines in the plant are equipped with condensing apparatus of the most modern types, including both jet and surface condensers.

The entire power plant has a capacity of 35,000 horsepower at normal rating of engines, and a total maximum capacity of over 50,000 horsepower.

The full list of the names of exhibitors in the Exhibits Power Plant, alphabetically arranged, is as follows:

Acton, John, Brooklyn, N. Y.; American Engine Company, Bound Brook, N. J.; American Steam Gauge and Valve Manufacturing Company, Boston, Mass.; American Steam Meter Company, Chicago, Ill.; Alberger Condenser Company, New York city; Allis-Chalmers Company, Milwaukee, Wis.; Armstrong Bros. Tool Company, Chicago, Ill.; Ashton Valve Company, Boston, Mass.; Aultman & Taylor Machinery Company, Mansfield, Ohio; Barnes, B. F., Company, Rockford, Ill.; Baum Separator and Machine Company, Manheim, Pa.; Blake, George F., Manufacturing Company, New York city; Bradley Manufacturing Company, Pittsburg, Pa.; Bristol Company, The, Waterbury, Conn.; Brown-Corliss Engine Company, Corliss, Wis.; Brown Hoisting Machinery Company, Cleveland, Ohio; Buckeye Engine Company, Salem, Ohio; Buffalo Forge Company, Buffalo, N. Y.; Builders Iron Foundry, Providence, R. I.; Bullock Electric Manufacturing Company, Cincinnati, Ohio; Burt Manufacturing Company, Akron, Ohio; Cameron, A. S., Steam Pump Works, New York city; Carey, Philip, Manufacturing Company, Lockland, Ohio; Chicago Pneumatic Tool Company, Chicago, Ill.; Clonbrock Steam Boiler Company, Brooklyn, N. Y.; Consolidated Engine Stop Company, New York city; Connersville Blower Company, Connersville, Ind.; Cookson, T. J., Cincinnati, Ohio; Crosby Steam Gauge and Valve Company, Boston, Mass.; Crocker-Wheeler Company, Ampere, N. J.; Crane Company, Chicago, Ill.; Dearborn Drug and Chemical Works, St. Louis, Mo.; Deming Company, Salem, Ohio; Direct Separator Company, Syracuse, N. Y.; Doble, Abner, Company, San Francisco, Cal.; Dunham, C. A., Company, Marshalltown, Iowa; Duesseldorf-Ratinger-Rohrenkesselfabrik, Ratingen, near Duesseldorf, Germany; Eyermann, Peter, St. Louis, Mo.; Elsaessische Maschinenbau-Gesellschaft, Muelhausen, Germany; Fairbanks, Morse & Co., Chicago, Ill.; Famous Filter Company, St. Louis, Mo.; Fisher Governor Company, Marshalltown, Iowa; Flower, Walter L., & Co., St. Louis, Mo.; Fort Wayne Electric Works, Fort Wayne, Ind.; Fowler, John, & Co., Leeds, England; Gardner Governor Company, Quincy, Ill.; General Electric Company, Schenectady, N. Y.; Goetze, Friedrich, Burscheid, near Cologne, Germany; Goulds Manufacturing Company, Seneca Falls, N. Y.; Gould & Eberhardt, Newark, N. J.; Green Engineering Company, Chicago, Ill.; Greene, Tweed & Co., New York city; Greenwald, I., & E. Company, Cincinnati, Ohio; Harrisburg Foundry and Machine Works, Harrisburg, Pa.; Harrison Safety Boiler Works, Philadelphia, Pa.; Heine Safety Boiler Company, St. Louis, Mo.; Hisey-Wolf Machine Company, Cincinnati, Ohio; Holmes Metallic Packing Company, Wilkesbarre, Pa.; Hooven, Owens, Rentschler Company, Hamilton, Ohio; Huyette, P. B., Philadelphia, Pa.; Ide, A. L., & Sons, Springfield, Ill.; Jeanesville Iron Works Company, Hazleton, Pa.; Katzenstein, L., & Co., New York city; Kunkle, E. B., Company, Fort Wayne, Ind.; Lagonda Manufacturing Company, Springfield, Ohio; Laidlaw-Dunn-Gordon Company, Cincinnati, Ohio; Lane & Bodley Company, Cincinnati, Ohio; Lidgerwood Manufacturing Company, New York city; Lombard Governor Comany, Boston, Mass.; Lukenheimer Company, Cincinnati, Ohio; Manzell Bros., Buffalo, N. Y.; Medart Patent Pulley Company, St. Louis, Mo.; Minerallac Company, Chicago, Ill.; Murray Iron Works Company, Burlington, Iowa; National Electric Company, Milwaukee, Wis.; National Equipment Company, St. Louis, Mo.; National Steam Pump Company, Upper Sandusky, Ohio; Neal & Brinker Company, New York city; Nicholson, W. H., & Co., Wilkesbarre, Pa.; Niclausse, J., & A., Paris, France; Niles-Bement-Pond Company, New York city; Northern Electrical Manufacturing Company, Madison, Wis.; Norton Emery Wheel Company, Worcester, Mass.; Nugent, William W., & Co., Chicago, Ill.; Otis Elevator Company, New York city; Pawling & Harnischfeger, Milwaukee, Wis.; Pittsburg Gauge and Supply Company, Pittsburg, Pa.; Pure Water Engineering and Construction Company, Johnstown, Pa.; Reed, F. E., Company, Worcester, Mass.; Reliance Gauge Column Company, Cleveland, Ohio; Reliance Machine and Tool Works, St. Louis, Mo.; Schaeffer & Budenberg Manufacturing Company, Brooklyn, N. Y.; Schuette-Kessel-Konsortium, Geestemuende, near Bremerhaven, Germany; Seebohm & Dieckstahl Company, Sheffield, England; Shaw Electric Crane Company, Muskegon, Mich.; Sherwood Manufacturing Company, Buffalo, N. Y.; Shultz Belting Company, St. Louis, Mo.; Sirocco Engineering Company, New York city; Sight Feed Oil Pump Company, Milwaukee, Wis.; Skinner Engine Company, Erie, Pa.; Societe Alsacienne de Constructions Mecaniques, Belfort, Alsace; Societe Anonyme des Etablissements Delaunay Belleville, St. Denis (Seine), France; Societe l'Eclairage Electrique, Paris, France; Sorge, A., Jr., & Co., Chicago, Ill.; Standard Gauge Company, Syracuse, N. Y.; Stanley Electric Manufacturing Company, Pittsfield, Mass.; Steam Appliance Company, Milwaukee, Wis.; Stepto, John, Shaper Company, Cincinnati, Ohio; Stilwell-Bierce & Smith-Vaile Company, Dayton, Ohio; Wagner Electric Manufacturing Company, St. Louis, Mo.; Walker Electric Company, Philadelphia, Pa.; Warren Electric Manufacturing Company, Sandusky, Ohio; Warren Steam Pump Company, Warren, Mass.; Weber Gas and Gasoline Engine Company, Kansas City, Mo.; Wheeler Condenser and Engineering Company, New York city; Wilmarth & Morman, Grand Rapids, Mich.; Wood, R. D., & Co., Philadelphia, Pa.; Worthington, Henry R., New York city; Yale & Towne Manufacturing Company, New York city.

Street-railway System in Ottawa May Become Property of City.

A Canadian correspondent of the Western Electrician writes that the City Council of Ottawa, Ont., has approached the Ottawa Electric Railway Company with the view of purchasing the road, and that the secretary of the railway company has sent a reply stating the directors will ask the shareholders to sell out their shares at $250 a share, the market value being $230, payment to be made in city of Ottawa four per cent. bonds. The secretary explains that the original shareholders have been purchasing any shares that were for sale, and are not selling any. There are 10,000 shares in all, so that the offer is to sell the road for $2,500,000.

A sub-committee of the council has reported that if it cannot make satisfactory arrangements for the purchase of the road, equipment, waterpower and franchise of the company the city will buy the stock, the council proposing to pay for the road with municipal bonds bearing interest at four per cent., and it is figured out that with a surplus of profits around $100,000 a year from the road there would be a sufficient amount for the liquidation of the interest charges and a substantial balance to the company's credit. The franchise of the road does not expire for 20 years, and the road is increasing in value very rapidly, as are also its earnings.

Since making its first offer to sell, the company has increased the selling price to $3,000,000, to cover the bonded indebtedness of $500,000. The financial statement of the company for the last year shows earnings of over $128,000, after paying running expenses. The profit for the year was over $94,000. The company for years has paid a dividend of eight per cent.

Chicago Freight Tunnels Pass into New Hands.

The property of the Illinois Tunnel Company, which owns the 20 odd miles of freight tunnels under the loop district of Chicago, has been taken over by a new holding company, just incorporated at Trenton, N. J., with a capital stock of $50,000,000, to be known as the Chicago Subway Company. The new company is backed by the leading steam railroads entering the city, and as these roads will be directly benefited by the tunnel system through the improved method of transferring and distributing freight, the plan is to have them directly interested in the further development of the underground scheme.

Readers of the Western Electrician have been kept well informed of the progress and development of th Chicago freight tunnels, and it is only necessary to state here that more than 20 miles of the system are complete and electric locomotives are already earning a revenue for the company in the way of removing excavations from the large buildings now in course of erection.

The Illinois Tunnel Company will continue to be the operating corporation under the charge of President A. G. Wheeler, but a new board of directors composed of practical railroad men, it is said, will be put in office. Among the names of those interested in the new company and who are suggested as probable directors are Edward H. Harriman, controlling the Union Pacific and Southern Pacific systems, and a strong factor in the management of the Chicago and Alton, Illinois Central and other railroads; James Stillman, president of the National City Bank of New York and representing railroad interests in the East and West; Jacob H. Schiff, member of the firm of Kuhn, Loeb & Co., and a factor in the Pennsylvania and other roads, and P. A. Valentine of Armour & Co., and a director in a number of railroads. Ernest Cassel, interested in the London "tube" railway, and Robert Fleming, the English banker, who is credited with the reorganization of the Atchison, Topeka and Santa Fe railroad, are others who are said to be interested.

It is stated that the new development has nothing to do whatever with the recent reports of a possible street-railway subway for the city, and the following official statement from President Wheeler makes clear the object of the new deal:

"The tunnels finished under the streets, to prove of great benefit to the community, must have the traffic diverted from the streets and transported through the tunnels. While no question was ever in anyone's mind that ultimately this would be accomplished, yet to have the community reap the benefit of the removal of such congestion at once it became necessary that the parties controlling the steam railroads with terminals in Chicago should be interested in the tunnels and immediately use the tunnels for the transfer of the freight from the railroad terminals to the basements of the business houses.

"To produce this result and get the tunnels in full operation at the earliest date the holders of two-thirds of the stock of the Illinois Tunnel Company sold their stock to a corporation called the 'Chicago Subway Company,' this corporation being controlled by the owners of all of the steam railroads that terminate in Chicago, and represented by E. H. Harriman and James Stillman of the National City Bank, New York city; Kuhn, Loeb & Co., through Jacob H. Schiff, and P. A. Valentine of Chicago, who is the local representative of the railroad interests."

Locomotive to be Operated by Diesel Engine.

The Southern Pacific Railroad Company is said to have contracted for a distinctly new type of locomotive which will be tested for railroad service; it was designed by Joseph H. Hoadley. A Diesel engine will be used to drive dynamos which will furnish electrical power for the propulsion of the train. The points of advantage which this type has over the ordinary steam locomotive, it is thought, will bring about considerable economy of operation. The steam locomotive has to carry its fuel and water, amounting to a weight at the beginning of the run of about 25 tons, with the additional weight of the tender. With the Diesel engine the efficiency is much higher and the weight of the fuel required for a long run is comparatively small.

The new type of locomotive, being driven by motors, allows of a much longer wheel base than in a steam locomotive, wherein the wheel base is limited by the length of the connecting rod, which with good design cannot be much over 12 feet long for high speed. The lengthened wheel base takes off much of the strain on the rails at sharp curves. In coasting down grades the new type of locomotive will run smoothly, while a reciprocating engine running with steam shut off will pound the track with the heavy connecting rods, loosening spikes and jarring ties.

Four duplex Diesel engines will furnish the necessary power for the dynamo of a single locomotive.

Ohio Interurban Men Discuss the Freight Question.

The subject of freight business was thoroughly discussed at a meeting of the Ohio Interurban Railway Association in Toledo on November 17th. The meeting was held at the Boody House, and besides a good attendance of the Ohio members, a number were present from Indiana and Michigan. It was the general opinion of all present that some arrangements must be made for the interchange of freight business, not only among the electric roads, but with the steam roads also. The electric roads originate a great deal of business which they have trouble in handling, because they cannot send it through to its destination. Could rates be made through, over other electric roads and steam roads, then the plan would prove profitable to all concerned. William J. Green of the Springfield, Troy and Piqua and General Superintendent Tarkington of the Detroit, Monroe and Toledo Short Line, favored going to the Legislature for a law compelling steam roads to exchange business with the electric lines, providing they would not make the arrangement voluntarily.

Another feature entered into this discussion. Not all the electric roads are in position to handle express and freight business extensively. Some are constructed of light material and are not equipped with the right kind of cars for the work. But even these do some business, and until they can take an equal hand in the business it will be necessary to protect them in some way.

The mileage coupon book was explained and its merits discussed, with the hope that many other roads will recognize its advantage and take it up. At the present time something like 15 roads have adopted the system and put it into use.

Messrs. Coen of the Lake Shore, Young of the Toledo, Bowling Green and Southern, and Green of the Springfield, Troy and Piqua, were appointed a committee to prepare a proposition on standard rules for checking baggage. General Superintendent Tarkington of the Detroit, Monroe and Toledo Short Line invited the members to take a trip to Detroit in a special car over his line, and most of them accepted. They returned to Toledo about midnight.

Gas-engine Plant for Electric Railway.

A somewhat unique departure from established methods in electric traction has recently been undertaken at Warren, Pa. The Warren and Jamestown Street Railway Company is equipping an alternating-current single-phase electric-railway system to operate between Warren, Pa., and Jamestown, N. Y., for which power will be supplied by gas engines operating upon natural gas. The equipment is now being constructed by the Westinghouse Companies at East Pittsburg, Pa.

The power station will be located at Stoneham, Pa., two miles from Warren. The initial equipment will consist of two gas engines, each of 500-brake-horsepower capacity. They will be of the horizontal single-crank double-acting type, direct connected to two 260-kilowatt generators furnishing current at voltage sufficient for direct use upon the high-tension transmission line. The power equipment also comprises a 55-horsepower gas engine for operating an air compressor and exciter unit. Natural gas will be used, furnished by the local distributing company. In this district the gas has a calorific value of about 1,000 British thermal units per cubic foot.

Transformer sub-stations, five in number, will be located along the right-of-way. These will receive the high-tension current from the transmission line and reduce the voltage to such an extent as to render it more suitable for use in single-phase motors. The present motive-power equipment will comprise four quadruple sets of single-phase motors, each approximately 50-horsepower capacity.

An interesting feature of the system is the arrangement for operating the alternating-current motors upon the direct-current trolley lines within the city limits.

The Warren and Jamestown street railway is not a newly organized system, as it has operated part of the present lines for a period of 11 years. Three years ago the company began experimenting with the use of gas power, with sufficient success to influence it in the now exclusive adoption of gas engines for the entire power generation. The operation of the new system will be watched with much interest by the engineering public.

Chicago Street-railway Situation.

The much-talked-of and long-delayed unification of the Chicago City Railway Company and the Union Traction Company seems at last to have been accomplished, and this move is at least favorable to a more speedy settlement of the franchise question. The only thing which has stood in the way of a merger, it is said, has been the securing of the money necessary to buy out the South Side company. This contingency, it is said, has been met by the injection of new blood into the situation in the persons of John J. Mitchell and Marshall Field of Chicago.

The entering of a new set of financiers into the deal and the announcement that the new interests have about completed a consolidation bring a ray of hope for a solution of the traction puzzle. A franchise ordinance covering the entire surface system, and at once considering the claims of both companies can now be framed.

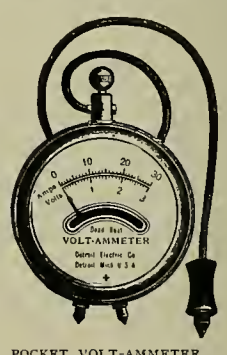
Whether the present tentative ordinance for the Chicago City company will be brought before the City Council before the spring election, if at all, cannot be said. It is more likely that a new ordinance containing in a general way the sentiment of the present tentative one but covering both systems will be drawn up.

All the persons connected with the Union Traction Company talk as if they considered the proposed acquirement of the Chicago city property as practically assured. It was explained, however, there would be no merger, in the strict meaning of the word. There are legal and economic objections to this. What is expected to be done is to acquire control of the Chicago City stock and then make some kind of a leasing arrangement by which the two companies would be under the same management. The legal identity of each would be preserved.

The plans formulated contemplate also the union without any referendum to the underlying companies of the Union Traction. What is done will be in the name of the Union Traction Company alone and outside of the underlying corporations, which will not be direct parties to it.

Pocket Volt-ammeter.

The accompanying illustration shows a small pocket meter that is made by the Detroit Electric Company of Detroit, Mich. The instrument is handsome and durable and there are no wheels or springs in the mechanism to get out of order and



POCKET VOLT-AMMETER.

the parts are not intricate. As seen by the picture, the instrument is shaped like a watch and may be carried conveniently in the pocket. The leads are brought together in a terminal plug. The instrument is a volt-ammeter and may be made to read either volts or amperes up to three or 30, respectively.

Proposed New Railway Power House at Lafayette, Ind.

The street-car lines in Lafayette, Ind., which are a part of the Ft. Wayne and Wabash Valley Traction Company's system, are to have a new $200,000 power plant. This was determined on November 17th by the officials of the company, who, with eastern capitalists and several experts, are now making a tour of inspection of the entire system. The new power plant will be constructed with a view to serving interurban lines with power. The entire system is to be overhauled. The Ft. Wayne and Wabash Valley Traction Company is now building from Logansport to Lafayette. A further extension southwest is contemplated. The eastern terminal of the system will be Lima, Ohio, and the western, Champaign, Ill. The official party consisted of Charles Murdock, C. D. Emmons, W. K. Schoepf, D. R. Duncan and Mr. Elliott.

Automatic Pump Controller.

The accompanying illustrations show an automatic pump controller designed by the Westinghouse Electric and Manufacturing Company for use with polyphase motors of from five to 50 horsepower capacity. By its use, the pump is automatically started when the water in the tank falls below a predetermined level and is again automatically stopped when the water reaches a certain depth. The actuating power is a single combination of

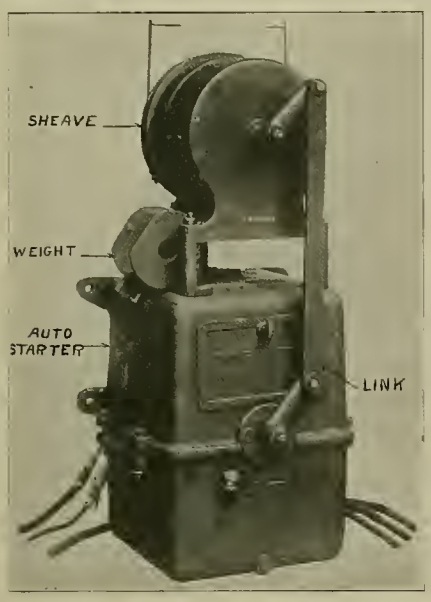


FIG. 1. AUTOMATIC PUMP CONTROLLER.—FRONT VIEW.

ropes and levers, as shown in the accompanying diagram, connected with a float in the tank, and with the starting lever of the device. It is thoroughly reliable in its action and no attendance is necessary except the occasional inspection all machinery requires.

In principle the controller consists of a Westinghouse oil-immersed auto-starter, with a starting and stopping mechanism connected by a link as shown in Fig. 1 and governed by a weighted lever. This lever moves freely through an arc of 138 degrees in a slot in the drum of the automatic device, falling this distance when the action of the float has turned the drum sufficiently to lift the weight just past a perpendicular position. As the water level is lowered, the drum is turned by the falling float and the weight is slowly lifted until it reaches and passes an upright position and falls through 138 degrees, throwing the handle to a full running position and

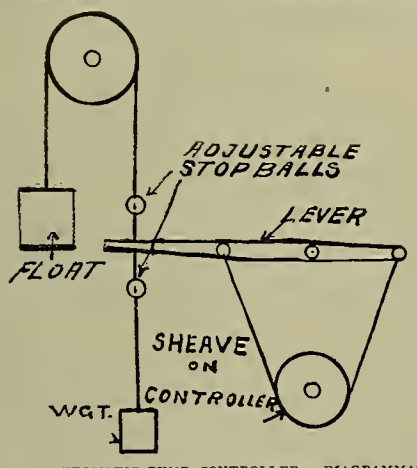


FIG. 2. AUTOMATIC PUMP CONTROLLER.—DIAGRAMMATIC VIEW OF LEVER MECHANISM.

starting the pump. As the water rises, the rising float turns the drum in the opposite direction and the weight is lifted until it falls to its original position, throwing the handle in the opposite direction to the "off" position and stopping the pump.

In order to secure an even and gradual action of the auto-starter, the impetus of the falling weight is checked by the action of a dash pot, which can be adjusted to regulate the speed of the movement. The weight-arm or lever moves loosely upon the shaft, and as it falls it compresses two spiral springs. These are coiled loosely around the shaft and press against a casting which is keyed to the shaft, but which is prevented from turning by a pawl held by notches in the main casting. The weight-arm compresses the springs and then trips the pawl which the springs move quickly to the next notch. The pawl is tripped three times in the downward movement of the weight. Each time it is tripped it allows the shaft to be turned a certain distance by the compressed springs, and the auto-starter is thrown through the three notches, starting or stopping the motor.

The attachment for operating the controller shown in the diagram, Fig. 2, is designed for use when the controller is placed below the tank. If desired, the controller may be mounted above the tank, a rod being attached to the float and passed through the end of the lever replacing the rope illustrated and the stop-balls being attached to this rod. Owing to the many different conditions of installation and the simplicity of the float mechanism, the Westinghouse company does not furnish this portion of the outfit, but simply the controller as illustrated.

Commutator Truing Devices.

A uniformly smooth surface concentric with the axis of rotation is the first factor in efficient operation of any commutator machine. Devices for truing commutators are of interest and the accompanying illustrations represent three types that are manufactured by the Fort Wayne Electric Works of Fort Wayne, Ind.

Fig. 1 shows the shaft-type truing device, which is designed for mounting directly on the shaft of the armature or on the pedestal of small machines having removable bearing caps. In many cases where it is not inconvenient to remove an armature from the bearings this device is satisfactory. In street-car barns and repair shops work of this nature can

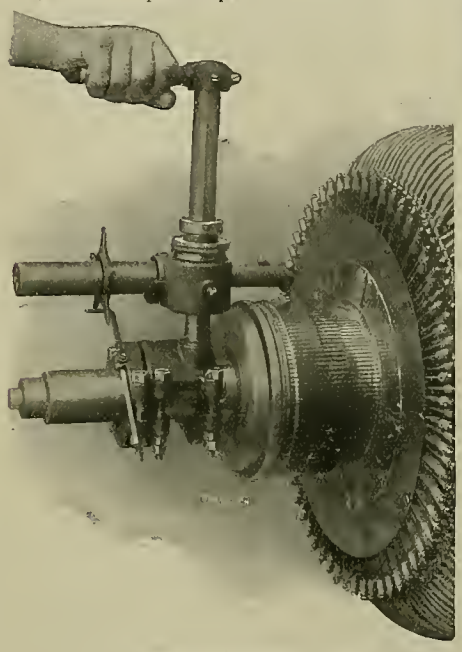


FIG. 1. SHAFT-TYPE TRUING DEVICE.

be done at night. When mounted on the shaft, as shown, the device is revolved about the commutator with the shaft as a bearing and the tool is moved across the commutator by a screw actuated by a detent clamp fastened to the shaft.

The pedestal-type shown in Fig. 2 is designed for mounting on the bearing pedestal in place of the bearing cup. When this device is used the armature is revolved in its own bearings by means of a handle clamped to the pulley. If the bearing-bolt holes are not the right distance apart to take the device on its own base, a pair of bolsters are used. The bolsters allow variation from four inches to 15 inches in distance across shaft between bolt holes. This device can be mounted on any pedestal having dimensions within these limits.

The tool has a horizontal travel of 21 inches, be-

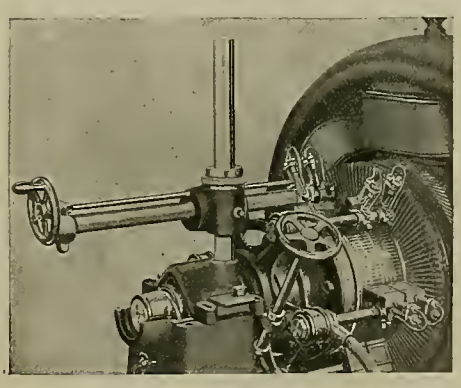


FIG. 2. PEDESTAL-TYPE TRUING DEVICE.

ginning three inches inside the fastening bolt in the base of the device and a vertical adjustment of 12 inches, beginning four inches from the center of shaft without bolsters, or six inches with bolsters. This device will, therefore, when mounted on the bearing pedestal, be suitable for machines having a commutator diameter under 36 inches.

For generators having the brush mechanism mounted on a yoke carried by the field frame the yoke-type truing device shown in Fig. 3 is recommended. The yoke type consists of a carriage for the tool holder having a screw feed and a bracket for attaching to the brush yoke. The bracket replaces two brush-holder brackets on the brush yoke and is made to fit the yoke of the particular machine on which it is to be used. The carriage is

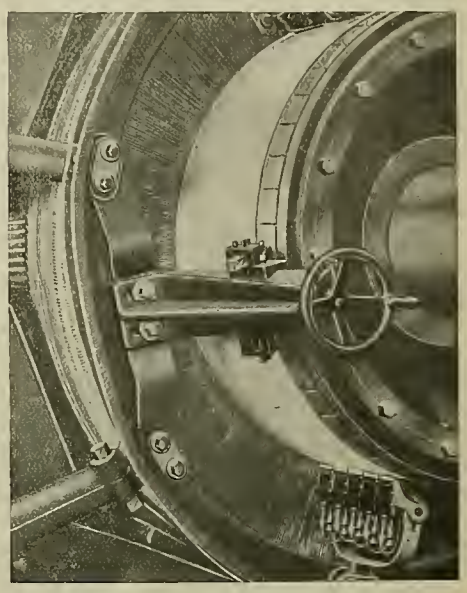


FIG. 3. YOKE-TYPE TRUING DEVICE.

made in two sizes, either of which can be used with any one of 13 different brackets.

The yoke-type truing device is made in such sizes and combinations of parts as to be suitable for any of the company's direct-current generators or motors having brush mechanism carried on the frame of the machine. The size of frames for which this device is adaptable runs from 25 to 800 kilowatts.

Meter Patent Litigation.

A decision of considerable importance was handed down by the Circuit Court of the United States for the District of Indiana on November 1st, it being in the case of the Siemens & Halske Company, complainant (General Electric Company), versus the Duncan Electric Manufacturing Company. The complainant claimed infringement of three patents (Nos. 550,823, 604,465 and 698,653) on electric meters granted to the defendant, Thomas Duncan, and assigned by him to complainant.

One claim was in controversy in the first-named patent, but the court held that the defendant's patent at the time he applied for it could not claim priority and therefore had to be construed strictly. This being the case, the patents which were assigned to the complainant are not infringed by the apparatus now manufactured by the defendant.

The decision of the court as to the remaining two patents was based upon details of the mechanism and the bill was dismissed for want of equity.

Chicago Meeting of the Institute.

The next meeting of the Chicago branch of the American Institute of Electrical Engineers will be held on November 29th, and, pursuing this plan, the Chicago meetings will hereafter be held on the Tuesday next following the New York meetings.

The paper of the evening will he by Mr. James Lyman of the General Electric Company, Chicago, upon "Recent Observations of European Lighting and Railway Practice." This paper, together with the two papers read at the New York meeting—"Factors Influencing Subway-motor Specifications," by Lewis B. Stillwell, and "Problems on Electric Traction on the Long Island Railroad," by O. S. Lyford, Jr.—will be discussed.

Lighting Rates in Brooklyn to be Reduced.

A reduction in the price of electric current will be made in Brooklyn, to take effect on January 1st. The reduction is in the retail rate and will have a bearing on the bills of the majority of the consumers, though some of the large or wholesale consumers will not be affected. Under the new figures the maximum rate instead of being 20 cents is 15 cents per kilowatt-hour, with material reductions for increased hours of burning. For the first and second hours' average daily consumption the price will be 15 cents per kilowatt-hour; third and fourth hours, 10 cents; fifth and sixth, 7½ cents, and in excess of six hours five cents per kilowatt-hour.

Ohio Telephone Notes.

Advance sheets of the report of the secretary of state show that within the last year 36 telephone and telegraph companies have been organized, with a combined capital stock of $927,750. Within the same time companies have added $1,982,700 to their capital stock. The year has not been as good for the development of telephone business as some in the past.

Chimes, in place of the regular telephone bells, are being given a trial at the Colonial and Euclid hotels by the Cleveland Telephone Company. In places it would be much better to have a different signal than the harsh bells now in use, and should the chimes prove satisfactory, they may be adopted in all places where the noise of the other style of bells is unpleasant.

The Merchants' Police and District Telegraph Company of Covington, Ky., has made a motion to have its case transferred from the Circuit Court to the United States court. As the Kineons, who own the company, have been cited to answer for contempt of court, the question now is whether their suit can be transferred until the accused are purged of the charge.

George C. Kappes, formerly night manager of the main Bell exchange at Cincinnati, will be manager of the new Canal exchange, just opened. This exchange is modeled upon the latest designs for telephone work and is up to date in every particular. The third floor of the building is devoted to the operating department, while the second contains lounging rooms and other conveniences. The first floor will be used for telephone stores and a school of instruction for operators. It was necessary to change 5,000 numbers when the exchange was cut in. This will prove a great addition to the Bell service in Cincinnati. H. Schumard will succeed Mr. Kappes as night manager at the main exchange.

P. W. Huntington & Co., bankers at Columbus, took the last block of $150,000 of Citizens' Telephone stock a few days ago, and none is now left on the market. Eugene Gray & Co. are associated with the bank in the deal which disposed of half of the last lot of stock issued by the company.

Sol. P. Kineon of Cincinnati has succeeded in connecting his lines in Cincinnati with Butler, Ky., which is reached by line of the Home Telephone Company of Louisville. This will eventually give the Kineon lines connection with all the southern territory covered from Louisville. Several other points in Kentucky are also reached by the Kineon lines. As the company in Covington, in which the Kineons are interested, has been enjoined from building or operating lines, Mr. Kineon was compelled to construct this line himself, and is operating it in an individual capacity. He secured permission from owners of houses in Covington to string his wires over their tops. It seems that the competitors of Mr. Kineon's enterprises in Covington have mistaken the individual lines for company property, and brought their injunction suit against the Merchants' Police and District Telephone Company, which does not own these lines. C.

Indiana Telephone Items.

The Wabash Telephone Company has installed a new switchboard in Monroe City to accommodate its increased patronage.

The Greenwood Telephone Company has increased its capital stock from $10,000 to $15,000 for the purpose of making improvements and extensions. E. A. Robinson is president.

The Nostrom Lock-out Telephone Company of Muncie has filed incorporation papers with the secretary of state. The capitalization is $600,000. The company proposes to manufacture telephones, telephone parts, devices, supplies, instruments, appliances, etc., and other electrical machinery. George A. Ball, John S. Smith and A. L. Johnson are the principal incorporators.

The New Long-distance Telephone Company is preparing to build a line between Columbus and Hope in Bartholomew County.

A new company composed of F. P. Lyons, E. L. Peter, W. E. Collane, J. H. Copeland, Henry Reinhart and others has purchased and taken over the New Co-operative Telephone Company's property in Flora. These men a few weeks ago purchased the Miller system at Flora and the two systems have been merged. The new company has incorporated as the Flora Telephone Company and the capital stock is $25,000. A large number of citizens of Carroll, Cass, White, Clinton and Tippecanoe Counties are interested in the company.

The Central Union Telephone Company has bought the Independent telephone system at Bunker Hill in Miami County and is now coupling on the customers of the local line to its own line. J. H. Wiles was the owner of the local system and the purchasing company contemplates many improvements.

The latest evolution in telephoning in Indianapolis has been installed by the Denison Hotel in its grill-room. The Central Union has put in a complete equipment of the newly patented automatic cafe telephone. A patron may talk with friends or transact business while he eats.

The telephone was quite a factor in Indiana in the collection of election returns immediately following the recent election. The systems now reach every county in the state, while the long-distance lines added to the list of achievements. At 9:30 Senator Fairbanks called for Washington and the connection was made quickly. The chief executive and the newly elected vice-president conversed for several minutes, after which Mrs. Roosevelt and Mrs. Fairbanks chatted for a while, while the guests at each end of the copper wire listened smilingly. S.

Telephone News from the Northwest.

The local telephone company at Albert Lea, Minn., has changed over 180 automatic telephones to a central-energy manual system.

The local exchange at Sparta, Wis., is being rebuilt. The rates have been adjusted, $2.25 per month being charged for business connections and $1.50 for residences.

The Tri-state Telephone Company has opened a toll booth in Benson, Minn., and has applied to the council of Rochester, Minn., for toll privileges.

The Twin City Telephone Company of Minneapolis and St. Paul has issued its regular quarterly directory. The pages have been made somewhat longer and the type is set solid, in order to keep the book from becoming too bulky. The toll connections have increased to the point where it takes several pages to include them all. The list of subscribers using private branch exchanges and interior systems shows a good increase from three months ago.

A. E. Cronquist, J. A. Lang and F. E. Payne have been granted a franchise for a local telephone exchange at Erskine, Minn.

An effort is being made to bring about the merger of the telephone systems at Mt. Sterling, Iowa, under one management.

A franchise has been voted at Estherville, Iowa, to a local telephone company, which will enter into competition with the Western Electric Company. It has incorporated as the Emmet County Telephone Company, capitalized at $50,000.

The Mutual Telephone Company will put in a new exchange at Stuart, Iowa.

The Nebraska Telephone Company is putting in new cables costing $35,000, to accommodate the increase in subscribers which is expected during the coming year, at Omaha, Neb.

F. W. Miller and others have incorporated as the Council Bluffs (Iowa) Independent Telephone Company, with $100,000 capital. The company will ask for a franchise shortly. E. H. Lougee is president.

J. W. Ward of Little Falls has purchased the local telephone exchange at Sauk Center, Minn. R.

Michigan Telephone Matters.

The convention of the Upper Peninsula district managers of the Michigan State Telephone Company was held a few days ago at Marquette and was the first meeting of its kind, but hereafter the managers will assemble in conference every six months. All sections of the peninsula were represented and, in addition, President Jackson, General Manager Ladd and Attorney Thompson of Detroit were present. The reports show that local business everywhere was satisfactory and that long-distance service was such as to be seriously taxing facilities. Among other improvements contemplated is an additional toll line from Detroit to the straits with the view of an extension to Marquette.

There is some trouble between the Ypsilanti council and the Independent Telephone Company over the attempt to tear up the street to lay conduits. It seems that the company is doing this under its state rights, but the council was to establish the route. The committee which was to establish a route did so, but had never reported back to the council. The telephone company accepted the route and has attempted to go to work. It is also stated that a bond was ordered filed to insure that the streets be left in as good a condition as before the excavation. The city claims that no such bond was filed, although the company states that a copy of it will be sent.

The Michigan State Telephone Company is introducing a new cable system in Mt. Clemens, which, when completed, will be one of the finest telephone lines in the state. This exchange has an immense amount of state line work. W.

Bell Output for October.

A substantial increase in gross output, accompanied by a heavy record of returned instruments, characterized the October instrument statement of the American Telephone and Telegraph Company, the exhibit being as follows:

October:	1904.	1903.	1902.
Gross output	113,760	111,749	92,601
Returned	50,772	49,885	37,155
Net output	62,988	61,864	55,446
January 1 to October 31:			
Gross output	990,369	923,978	900,935
Returned	425,697	408,716	383,844
Net output	564,672	515,262	517,091
Total outstanding	4,344,189	3,665,582	3,042,697

At the last meeting of the Chicago City Council an order was passed providing for a special committee of nine—three from each of the committees on judiciary, finance, and gas, oil and electric light—whose duty it shall be to consider all phases of the telephone question.

GENERAL TELEPHONE NEWS.

The Farmers' Mutual Telephone Company has been incorporated at Seattle, Wash., with a capital of $200,000. C. S. Wiley and others are interested.

The Bell Telephone Company's exchange at Ogden, Utah, is being inspected by Architect Kletting of Salt Lake with a view to drawing plans for doubling the size of the plant. A new switchboard has been ordered for Ogden at a cost of about $35,000.

The exchange of the Macon County Telephone Company at Decatur, Ill., was damaged a few days ago by fire which destroyed the Decatur Hotel and other buildings. The escape of the telephone girls from the operating room on the fourth floor of the Arcade Building was prevented by smoke, and it was only by the prompt action of Manager Hankins and the firemen that the girls were rescued through the windows. The loss to the telephone company is estimated at $3,000.

The question as to the status of the telephone girls in Paris, raised at the time of Miss Sylviac's prosecution, was settled definitely recently by the decision of the Correctional Appeal Court. Mr. Boulloche, who was prosecuted about the same time as Miss Sylviac for the use of offensive language to telephone girls and condemned to pay a $25 fine, has been acquitted, the court finding that telephone employes are mere public servants, and not functionaries or representatives of authority.

After the smoke of the supposed war between the Bell and the Independent interests at Lima, Ohio, has cleared away it seems that not much damage has been done. One would be led to believe the Independents had about given up hope all through that section if the reports could be believed. George Risser of the Ottawa exchange seems to have gone over to the Bell, but Van Wert, Celina, St. Marys, Delphos and other places that were called into conference with representatives of the Bell people held out apparently, and it is now stated that they will continue their allegiance to the United States Telephone Company for long-distance service. The latter has contracts with the local companies that would probably involve them in litigation should they go over to the Bell people.

The Elyria Telephone Company of Elyria, Ohio, is just completing its new multiple-tap cable system. The company has installed several thousand feet of underground cable and more than 100,000 feet of aerial cable. A new multiple common-battery switchboard has also just been completed. It is the intention of the company to offer several different kinds of service, such as individual service, party-line service and measured service, which will apply to both business and residence telephones. The engineering and management of the plant are under the supervision of Mr. L. W. Stanton of Chicago. Mr. Stanton, together with Mr. E. H. MacPherson, chartered accountant under the Canadian government, went over a number of the leading telephone bookkeeping systems and worked out one applicable to this particular plant.

TELEPHONE MEN.

Dwight Wallick, an electrician employed by the York Telephone Company for the last five years, has resigned his position with that company. He has accepted a similar position with the Pennsylvania Telephone Company.

J. M. Flannagan of Lansing has been appointed local manager of the Michigan State Telephone Company at Albion. He succeeds E. B. Emery, who has been the manager for about a year and who will go to Jackson to continue in the employment of the telephone company.

F. J. Wakefield, manager of the Wyandotte telephone exchange for the Michigan State Telephone Company, will take charge of the Lapeer exchange. The employes of the Wyandotte office have presented Mr. Wakefield with a handsome Masonic watch charm, and the members of the National Union, of which he is president, gave him a watch fob. His successor has not been appointed.

MANUFACTURERS AND DEALERS.

Plans have been drawn for a new factory for the American Electric Telephone Company of Chicago, to be situated at State and Sixty-first Streets, the property to be 800 by 1,200 feet and the cost to be approximately $150,000. The style will be ornate and the building will be ready for occupancy May 1, 1905, when the company will move from its present location at 36 West Jackson Boulevard.

The International Telephone Manufacturing Company, Chicago, it is said, has devised a system which enables it to build its regular self-restoring drop magneto switchboard in such a manner that the system may be used originally as a generator-call local-battery plant and changed at any time into a strictly central-energy system, by simply adding the necessary central-office battery and power plant. Changing from generator-call to central energy, does not require discarding any part of the central-office apparatus.

Electric Train-lighting System.

Train lighting by electric power developed at the axle has always presented difficulties which have rendered most of the methods tried unsatisfactory. The control of the current, the arrangement of parallel connections and the charging of the battery present certain difficulties which have to be overcome. Thus, for instance, it has been attempted to secure uniform pressure by elastically suspending the dynamo in such a manner that when a certain efficiency was overstepped the belt slipped and the pressure was thus maintained within certain limits. Connections were made at certain speeds by an ordinary centrifugal governor. The latter, however, was considerably affected by vibration and the like, and either made or unmade the connections too early or too late or broke them again when they had been made, and so on. In other cases the control was effected by means of contact instruments. In most

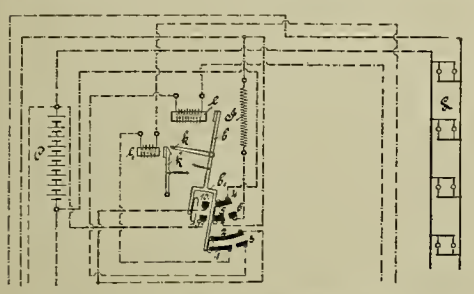


Fig. 1. Locking Lever and Connections.

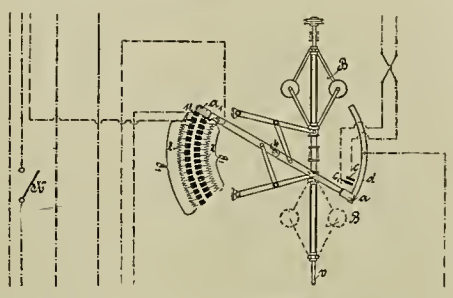


Fig. 2. Governor Mechanism.

ELECTRIC TRAIN-LIGHTING SYSTEM.

cases the circuit-closers were operated by relays or by means of ordinary centrifugal governors. All these systems had the disadvantage of being very much interfered with by vibration and subject to frequent breakdowns and to wear of apparatus through constant working, and they also produced unsteady light.

F. W. Schneider of Frankfort-on-the-Main, Germany, has developed an idea in this direction which is promising, and a patent has been issued to him upon the system.

Fig. 1 is a diagrammatic view of the locking lever of the device and its connections, and Fig. 2 is a diagrammatic representation of the governor and its connections.

The arrangement is controlled by a compound governor which is not affected by vibration. The governor comprises two centrifugal governors (B) (Fig. 2), placed on one spindle and acting in opposite directions, their oscillating masses being at an angle of 90 degrees to each other. These governors are adapted to operate a rotatable lever (4) in such a manner as to assist each other and move the lever, external influences being entirely eliminated. The lever which is moved by the compound governor according to the speed of the car carries at one end a contact roller (a) and at the other end a similar roller (a_1). When at a certain speed the lever is moved so as to make contact at (7) and (8) by means of the roller, the shunt-coil of the dynamo is placed in circuit with the battery (C) (Fig. 1). The roller (a) immediately upon the contacting at (7) and (8) makes contact at (c) and (d), whereby the solenoid (e) is energized and operates the lever (b b), which is then locked by the catch (k). The dynamo is thus by means of the contact (10) placed in parallel connection with the battery and by means of the contacts (4), (5) and (6) with the lamps (L) with an intermediate resistance (J), which absorbs the difference between the discharging pressure and the dynamo pressure. When the speed increases the roller (a^1) is moved over the contacts (8) and the pressure is kept uniform by placing resistance in the exciting circuit. If the speed decreases, the reverse takes place. When the roller (a) moves back over the contact (c_1) and connects the latter with (d), the solenoid (e_1) is energized and the catch (k) is caused to release the lever ($b\,b_1$), whereupon the latter returns to its former position. The dynamo is thus disconnected and the resistance in front of the lamps is short-circuited. By means of the contacts (2 1) and (2 3), respectively, the lever (b) open-circuits at the end of its respective movements the solenoid which has operated it, so that no sparks are produced by induction at the contacts (c) and (c). The solenoid current is interrupted immediately after it has done its work and contact is prepared for the other magnet. When the dynamo has been disconnected the shunt-circuit is broken by means of the roller (a) and the shunt-coil short-circuited by the contacts (7) and (11).

For the purpose of obtaining a current of similar direction whether the train is traveling forward or backward an automatic reversing device is used. When the direction of travel is reversed a reversing arm is moved to the right or left by a tappet wheel operated by a spindle of the governor, the object being attained by reversing the exciting current or the main current. The tappet wheel rotates between two arms, and these arms bear to the left hand and right hand, respectively, being elastically held against studs on the reversing lever by springs, and each arm is adapted to move the lever in one direction and to yield freely in the other direction.

All resistances are so calculated that during the parallel connection the dynamo electromotive force corresponds to a single-cell electromotive force of 2.2 volts from the battery.

If the battery which is only discharged to a very slight extent during normal working is to be charged at intervals of from eight to 10 days, this can be done during the daytime or while the lamps are in use. In the latter case a resistance normally in circuit is short-circuited by means of a two-pole switch in order to slightly increase the pressure. To absorb this extra pressure a resistance is at the same time put into circuit in front of the lamps.

In order that a complete apparatus need not be provided in each car and that one main apparatus can serve the entire train, automatic switches and small batteries must be placed in the other cars. In order to suffice for the fall of potential throughout the train, the batteries must, however, have a potential of at least 110 volts and comprise cells. Batteries of this kind are expensive, difficult to insulate and require much labor. For this reason two groups of lamps are provided in each car, the second group comprising lamps which take a normal number of watts and large electromotive force (110 volts), whereas the lamps of the first group take a small number of watts and very low electromotive force. The former group is fed by the main generator, the latter by the battery. For this reason the battery can be considerably smaller and need only comprise a very small number of cells, so that the cost of their installation is reduced and their maintenance rendered considerably more simple.

General Greely Reports on Alaskan Telegraph System.

An interesting account of the work performed by the Signal Corps of the United States Army in installing the all-American telegraph system in Alaska is given in the annual report of General A. W. Greely, chief signal officer of the United States Army. The report characterizes the undertaking as unique in the annals of telegraphic engineering and states that the system in Alaska contains 2,079 miles of cable, 1,439 miles of land lines and 107 miles served by wireless apparatus.

General Greely says that after thorough consideration he decided to install material of American manufacture, to be operated by American soldiers and to be laid by American ships, except some cable instruments and machinery. A selected force of men has been so trained that today the Signal Corps of the army is competent to operate, in war emergency, a submarine cable of any length.

Repairs in Alaska are maintained, the report says, by parties stationed at log cabins about 40 miles apart, one Signal Corps repairman, with two assistants from the line of the army and a dog team being at each cabin. The men meet the terrible condition of hardship and privation uncomplainingly and with a fortitude characteristic of the American soldier.

The Nome wireless station has daily and uninterruptedly transmitted the entire telegraphic business of the seaward peninsula, 5,000 words being exchanged in one afternoon between Safety Harbor and St. Michael. The Signal Corps of the army, according to the report, is now regularly operating the longest wireless section of any commercial system in the world. The annual business of the Seattle-Sitka cable is estimated at $25,000, and during the year there has been spent $56,935 for Alaska telegrams handled by the Signal Corps.

Speaking of the Philippines, the 16 most important islands of the archipelago are now connected by cable, which lines are recognized as indispensable both by the military and civil authorities. During the year there has been collected and deposited in the insular treasury of the Philippines telegraph line receipts to the amount of $58,675, there having been sent, including government business, all told, more than 2,000,000 messages, the net expense being $325,901.

It is a matter of the utmost importance that signaling apparatus of suitable character be installed at the more important military defenses along the Atlantic and Pacific coasts to permit of intercommunication between the army and the navy. It is strongly urged that steps be taken by the United States to adhere to the international telegraph convention, and that international regulations to govern space telegraphy in time of war be adopted.

New Equipment for Monterey County Gas and Electric Company.

New additions have been made by the Monterey County (Cal.) Gas and Electric Company and the installation represents the newest products of the National Electric Company of Milwaukee. This plant constituted the exhibit of the Kilbourne & Clark Company, Pacific coast agents of the National company, at the eighth annual convention of the Pacific Coast Electric Transmission Association, held in Monterey last June, and it proved of double interest to the members of the convention who inspected it because of the fact that in it was shown for the first time on the Pacific Coast a type of machinery that had not before been seen in operation there.

In detail the installation consists of a 200-kilowatt generator and motor-generator set consisting of a synchronous revolving-field motor with a capacity rating of 162 kilowatts, which drives by direct coupling a 550-volt direct-current railway generator with a rating of 150 kilowatts.

The 200-kilowatt alternating-current generator is of the belted type, with two bearings, pulley slide rails and belt-tightening device, complete in every respect. It is of remarkably substantial construction and follows very closely the structural design that has become well established in American types of revolving-field generators. Its erected weight is 12,850 pounds and its inherent regulation is well within six per cent. of unity power factor. It is run at a speed of 600 revolutions per minute and consequently delivers current at 60 cycles. It is provided with 12 poles on its revolving field. With an atmosphere temperature of 25° C. the temperature of the machine will not rise above 35° C. Under a continuous 24-hour run at full normal load results were considerably better in that the actual rise under these load conditions was but 22° C. above the temperature of the surrounding air. In fact, it has been found to stand a remarkably heavy overload without serious heating, and in regular service it has often been called upon to operate for considerable periods of time at an overload of over 50 per cent.

As to the efficiencies of the generator, they are as follows: 93 per cent. at 25 per cent overload; 92.5 per cent. at full load; 91.25 per cent. at three-quarter load, and 88 per cent. at half load.

The exciter runs at a speed of 1,450 revolutions per minute, is normally rated at 12 kilowatts at 110 volts, and is belt-driven from a pulley placed on the end of the generator shaft. It, too, is remarkably cool in its operation and there are no evidences of sparking or flashing at the commutator, even under conditions of extreme overload.

The motor-generator set runs at a speed of 720 revolutions per minute, and in operation it has been found that the temperature of the synchronous motor does not exceed 25° C. above the temperature of the surrounding air, and the direct-current generator does not exceed a rise of 25° C. in any part when both machines are working under full-load conditions.

An interesting feature in connection with the motor-generator set rests in the fact that a 22-inch pulley with a 16-inch face has been placed on the shaft between the motor and generator and that this pulley is belted to the flywheel of a 200-horsepower high-speed Buckeye engine. This gives absolute flexibility to the plant, since during the hours of light load both the units of the motor-generator set may be run as generators, and the motor-generator set affords the link by means of which the railway load may be coupled in with the two-phase load, or vice versa. Obviously this enables a day alternating-current service to be maintained in conjunction with the railway load at minimum efficiency in operation; and, though the installation of the motor-generator set may appear anomalous in view of the fact that the current for its operation is taken from generators located within the same premises, it is in reality the rational solution of the problems presented by the local conditions which prevail.

The Point of View.[1]

By Walter C. Kerr.

It is a pleasure to talk to a lot of young men who are about to become engineers. It was not so long ago that I came to your age less well prepared, perhaps, than any of you. When I look back at the engineering education through which men of my time were launched and then consider the training you have had and the opportunities before you I have reason to wonder why I am here.

I hesitate to advise you. You have already had so much advice that I do not know whether you can hold more. What I can say in a few minutes will amount to little, so let me use these minutes to suggest that you advise yourselves along certain lines which I will propose by way of point of view. If you look straight you will see straight. You cannot think wrong and act right. Your perspective will be distorted if you haven't the right point of view.

You are leaving a good institution for a good world. Your alma mater has built up around you excellent facilities for giving you what you need, and other institutions have likewise cared for their own.

The so-called liberal education has always been highly academic. Trade-school engineering has been strictly non-academic. The two have joined hands fortuitously in our modern institutions. The liberal education has become less and the technical more academic, with advantage to both. There is, however, danger of engineering education growing too academic for several reasons: One is the disposition to include in technical training a liberal education, which of itself is not undesirable. Another is that engineering professors often lean unduly toward academic views and processes, and thus lose touch with the spirit of the engineering world. Greater than either of these is the tendency of all things to move in the line of least resistance, and all learning which depends upon the intellect alone is more easily acquired than that which depends upon other sources. The proof of this need go no further than to remember that no literature is finer than that written 2,000 years ago; no philosophy has fundamentally improved upon that of the ancients; the highest flights of intellect and mathematics were reached during the ages in which the world was observed to be composed of four elements—earth, air, fire and water.

A review of knowledge shows the great preponderance of the intellectual over the material, and it is only within late centuries, in fact almost the last century, that the human mind has seemed capable of turning from the lesser resistance of intellectual attainment to the greater capacity for physical observation and comprehension. We have but recently come to the era of intense mental operations, dealing with laws and principles which require insight greater than the intellect can grasp unless aided by the senses. Contrary, therefore, to common belief, I assert that the highest refinement of knowledge follows from the highest use of the senses; and that it has taken thousands of years of pure intellectual development to attain a state in which the powers of nature can, through the human intellect, be made useful to mankind and add largely to knowledge. Do not, therefore, get a wrong view of the faculties involved in science, in the application of the laws of nature, applied mechanics and the powers of comprehension which underlie engineering. There is still room for doubt—not debatable here—as to what constitutes liberal education.

I hope for the time when the spirit of engineering as found in practice will form a more definite part of engineering education. This, I think, must come through the professor keeping in close practical touch with the engineering world. There are various ways in which this may be accomplished, but I know of none better than by each professor doing a reasonable amount of practical work for commercial purposes. Under some conditions this may be consistently accomplished during a portion of his time, but I am inclined to think that eventually our professors will devote all their time to instruction while they teach and go periodically into the world, a few years at a time, for practice. Thus the professorial life would not be so exclusively educational, and our growing engineering institutions may be enabled to enlarge their faculties by the devotion to teaching of a portion of the time of men who are primarily engaged in commercial work.

Now that you have your so-called education, what are you going to do with it? I cannot tell you, but I can suggest some points of view.

Begin by forgetting yourself. All thought of self is some form of selfishness, and selfishness never produced anything better than more selfishness. It often breeds something worse. Genius is all right in its way, but it will not do your work. Get a right idea of work. Remember that time is the essence of most things, and is not inconsistent with thoroughness.

We hear much about opportunities. They are everywhere plentiful. Remember that your opportunity is the little one that lies squarely in front of you, not the large one which you hope to find further along. Many a man is surrounded with opportunities who never seizes one. There are traditions that Adam, William Tell and Sir Isaac Newton each had an affair with an apple, but with different results.

Your first duty is always to that which lies across your path. The only step which you can take in advance is the next one. This leads to a simplicity of action which is commendable. Don't ramble.

The refinement of thought which is apt to follow high training often leads the mind to overlook simplicity and to even seek complexity. The wealth of modern appliances tends likewise; and it is thus easy to acquire that over-refinement, often termed theoretical, as against the simplicity which is called practical.

From one point of view all graduates can be divided into two classes—those who think their knowledge is a little long for their opportunities; and those who think most anything is a little long for their knowledge. Both are apt to think that the knowledge they have acquired will become the essence of performance. You will soon find that knowledge hasn't much to do with effectiveness. It is necessary only as words are essential to the expression of thought. You will find knowledge a good tool, but not the vital force with which you perform. You will fall back upon human effort and action and find that it is the human engine and not the knowledge engine that does the work.

Cultivate singleness of purpose. This is more important than you may think. It is intuitive with the comparatively ignorant, and often absent in the highly trained. We are frequently surprised at the great competency of the ignorant contractor or foreman, on whom judgment is often passed by saying that he is a practical man and gets results. Analysis will show that his best quality is singleness of purpose, which leads him to vigorously do the one thing before him, without distraction following from knowing or thinking about too many other things. The broadening power of education and training increases the range of contemplation, but unless the power of concentration is cultivated there follows a tendency to scatter instead of to acquire that singleness of purpose which leads to effective action. David Starr Jordan has said: "The purpose of knowledge is action. But to refuse action is to secure time for the acquisition of more knowledge. It is written in the very structure of the brain that each impression of the senses must bring with it the impulse to act. To resist this impulse is to destroy it. * * * This lack of balance between knowledge and achievement is the main element in a form of ineffectiveness which, with various others, has been uncritically called degeneration." Thus President Jordan shows how even much more than a little knowledge may be a dangerous thing. The highly trained man therefore needs as a complement to his training unusual powers of concentration in order that the virtue of singleness of purpose may not be lost. This faculty a man must have or acquire himself. It is not in the books. It cannot be taught. It can only be suggested by precept and example.

From directness of purpose naturally follows diligence in getting what you go after and not being easily turned aside by resistance. When you are getting what you go after, get it all. Avoid the mediocrity of compromise. Be thorough and stand for full competency in everything, from main essentials to details. Just so far as education, assisted by concentration, contributes to singleness of purpose it is useful, but where by length, breadth or depth it dilutes human effort it lacks value. It is, therefore, not so much the question how much educational training you have as it is how you use it. Some can use a little with great effect, because their point of view is right; others scatter so badly that they cannot use their knowledge at all; while some distorted minds seem to have a faculty for misapplying a large amount of acquired knowledge through complicated processes full of error. To be right, you must be 100 per cent. right. Charity may pardon human nature its percentage of delinquency, but this is a human matter. The laws of nature, mathematics and engineering do not pardon anything. The man may therefore be absolved from censure, but his work must stand the rigid test of inviolable law. Nor is it too much to say that you must be right the first time. Much of our engineering is only done once, and it must be done right that once. A man who has learned by experience to do a thing deserves no credit for doing it right. He is then only a repeating machine. Real power is characterized by ability to perform right the first time that which a man never did before. Such performance involves the power to assimilate and adapt experiences, of more or less like or unlike kind, in a way to bring forth correct results. This is the true use of experience, wherein a man is a thinking, active power, and not a mere repeater.

Clearness of thought is an essential often lacking. This, too, follows from concentration and singleness of purpose. Many minds confuse themselves with a wealth of ideas, grading from the well formed to hazy, indistinct conceptions. You can clear your mind by proper habits of thought. Train yourself to separate essentials and non-essentials and confine your consideration to the essentials; to distinguish between what you know and what you only vaguely surmise, clearly eliminating opinion from facts. Nothing is more helpful than conference with yourself, in which you determine what you think of your own thoughts. This is aided by the moderate cultivation of system—thinking in an orderly manner, beginning at the beginning, ending at the end, and being sure to have a middle. With this there should be no slavery to system, but let each find his own logical way.

Besides what are commonly known as ideas, men have intuitions—sometimes called impressions or opinions—which they cannot readily prove. These I believe are identical with reason, except that while reason is composed of a sequence of distinct ideas, each capable of expression, intuitions follow from the capacity of the human mind to integrate small ideas and impressions, each of which is too small to stand alone, or to be readily expressed, but which integrated form a concrete mental impression, called an intuition, and which is of exactly the same character as reason, except that it is composed of smaller and almost intangible units. Do not, therefore, discard intuitions as inferior to reason. Analysis will sometimes develop intuition into an expressible logical thought.

You have all had ideas and you will have more of them. Some ideas seem bigger than others. These mental forces, like other forces, only do work when in motion. Hence your ideas are only valuable when put into execution, and this often requires more talent than to originate them. Some men seem to consider their ideas so good that they will execute themselves.

A point of view is involved in the power to rationalize. This again is a thing which each man does for himself in his own best way, and its essence consists in asking oneself whether the thing is reasonable. It is a great check upon error. It applies equally to nearly everything of which engineering is composed. It is the power of the human mind, after performing in more or less systematic and conventional ways, to stand off and look at results and ask oneself whether they are reasonable. One man will figure that certain material weighs 200 tons, and believe it. Another will say that there is something wrong in that, for it all came on two cars.

Every young man comes sooner or later upon a dilemma in which he is more or less drawn in opposite directions by his confidence on the one hand and timidity on the other; a desire to perform backed by the courage of his convictions, but on the other hand resisted by his inability to see his way through in orderly progression to a desired end. This is about the time to show your nerve. Don't be dazed and baffled, but make a start. Use your wits and you will get somewhere, and if you cannot always see the end it will constantly get nearer and plainer when you go as far as you can see and then see how far you can go.

Another point of view concerns engineering expression. This may be through designs, drawings, mathematical determinations, or words, and finally by work done. The lamest of these is words. All engineering is so non-literary in character that the use of language is too much neglected, leading to expressions that do not properly convey thought. In engineering it is not rhetoric but diction that makes expression clear, and diction is best learned from the dictionary. It is well for a young engineer to cultivate his vocabulary and learn to use words in their right sense. They are then usually understood, even by those who have less knowledge. A word of caution, however, against assuming that a lack of facility of expression can cloak an absence of knowing what you think. Engineering documents, specifications and letters are full of misstatements, due to the careless use of language. Conciseness cannot be overestimated. Brevity is desirable, but not at the expense of clearness. Conversely, a certain degree of facility should be acquired in reading the words of others. Some seem incapable of understanding plain language when spoken or written. Anyone persistently failing to understand the language of others has limitations needing correction.

One of the worst attributes in engineering, and which is fundamentally born of conceit, tends to fasten error, censure and responsibility on others. There are times when a man needs to stand himself up in front of himself and ask: What is the matter with me? The capacity of any man to admit his own error and frailty of judgment is a measure of strength rather than weakness.

Perhaps no personal attributes are of greater importance in the conduct of the business affairs of an engineering life than good cheer and non-contentiousness. Not only because these are right and agreeable, but because they enable a man to work better, to be better understood, and they add weight to his opinions. There is a certain reasonable optimism of manner that makes a man and his ideas welcome, even though they must of necessity sometimes be critical. To vote aye and believe that things can be done makes a man helpful to others and to enterprises. Discontent is not a sign of progression.

Each of you probably has a preconceived notion of following some line of engineering. Be careful about your self-analysis. The field is large and has room for all of the various types of men, some of whom incline to constructive operations, others toward inventive, some to the contemplative. Again, within all these divisions, some tend toward professional and others trade work. No one can advise what is best for you. This you must find out for yourself. I cannot help, however, a certain predilection in

1. An address delivered to the graduating class of Stevens Institute, Hoboken, N. J., June 16, 1904. The author is of Westinghouse, Church, Kerr & Co., the well-known engineers.

favor of a young man being just an engineer, and not any particular kind of an engineer—not specializing while too young, but developing along versatile lines, ready to turn his hand equally well to any task within his general scope. In this there is a good deal in the point of view, and the man who believes he can apply himself in one direction about as well as another will come nearer doing it than one who thinks he cannot.

When you start your practical work you will doubtless try to improve things. That is a legitimate purpose, if not overworked. I am not going to attempt to tell you what needs improvement, but the one improvement that most things need is in the line of sufficiency. You can think this over for yourself and apply it where it fits.

There is another point of view seldom considered. It relates to environment and the power to vary. It is pertinent to engineering. Man ascended through and exists under the laws of an organic evolution, which occurred almost entirely in early geological ages, under water, within a few miles of shore, under substantially constant temperature, constant pressure and uniform food supply, and thus in about the simplest possible environment. It was caused, primarily, through the force known as the power to vary, and the reason that evolution spanned the space from the simple cell to the vertebrate animal in so short a time was that this power was not resisted by complex environment. When organisms emerged from the water to the more complex environment of the land, and as environment grew constantly more intricate its resistance retarded evolution and resulted in fixation of species until ordinal evolution practically ceased. It is the complexity of the environment of the world that presses upon you and tries to hold you back from the exercise of your native power to vary. A good environment is certainly less harmfully resistant than a bad one, but remember that environment is not a force. It is not a producer. You are the producer. Whatever be your power to vary, environment will only resist and reduce it.

Therefore, remember that all the good you accomplish is going to come out of yourself. You cannot borrow it and you cannot make it out of that which has been poured into you by education or otherwise. All that you receive is only a certain quantity of knowledge, acquired by education, experience or other training, which will have a certain influence upon what comes out of yourself as your own. It is the inherent capacity to perform with your own brain which will make you what you become, and not the mere transmission of that which you have acquired. Your knowledge, therefore, is of little avail until you make it inherently a part of yourself through mental assimilation and utilization. The clearer you comprehend these things the more readily you can make use of them as against the process of mere acquirement with a vague motive that in some way or other what you acquire may be of benefit, or that environment will be the force that makes your talent effective. Some have gone through experience without acquiring it, and many a man who has received an education has not got any because he allowed it to be a thing apart from his personality, and it slipped away.

BOOK TABLE.

Scientific American Reference Book. Compiled by Albert A. Hopkins and A. Russell Bond. New York: Munn & Co. Pp. (5¾ by 7⅝ inches), 516, with 598 illustrations and six colored plates. Price, $1.50.

It is said that there are 50,000 facts recorded on subjects of interest to everyone in this well-arranged reference book. The various subjects in the 20 chapters are conveniently arranged for ready access, and by the aid of an exhaustive index it is easy to find the information desired. The chapter relating to patents, trademarks and copyrights is a thorough one and is designed to be of particular assistance to investors. The chapter dealing with mechanical movements contains nearly 300 illustrations and is a particularly valuable feature of the book. Weights and measures occupy a considerable section of the book, and among the many other topics covered are space telegraphy, telegraphy, telephony, railroads, manufactures, education, government, etc.

The Conductometer and Electrical Conductivity. By Rollo Appleyard. London: H. Alabaster, Gatehouse & Co. 1904. Pp. (5¼ by 8½ inches) 40, with two illustrations. Price, 36 cents.

This little book, which is divided into two parts, gives in part No. 1 a description of an instrument called the conductometer, which is used to ascertain the conductivity (reciprocal of the resistance) of an electrical conductor. The conductometer gives its results in percentages of a standard in whatever manner 100 per cent. conductivity may be defined. Numerous quite complicated formulæ are involved in the use of the conductometer, all of which are explained in the book, and in the compensations which must be made for standard and for mass differences. A complete list of instructions how to use the instrument are given, together with a number of examples. The second part of the book is devoted to a discussion of what the term "conductivity" is, how its unit is derived, etc. It also gives the course of procedure, which should be followed in ascertaining or establishing the "100 per cent. conductivity" which is to be used in connection with the calculations which are to be made with the aid of the conductometer.

Municipal Electrical Employes in New York and Chicago.

Officials records show that there are in the employment of the city of New York 131 persons connected with electrical pursuits, who receive a total annual remuneration of about $146,600. The highest salaried electrical officer of the city is Michael R. Brennan, who receives $4,000 a year. He is the superintendent of telegraphs and has the entire responsibility for the 1,333 miles of telephonic communication in the five boroughs. Mr. Brennan has been connected with his bureau for 28 years, having started on March 28, 1876, and he has practically seen the installation of every police telephone from the commencement. He has an assistant superintendent in the person of Edward W. Murphy, who receives $3,000 a year, and there is a deputy superintendent for Brooklyn—Frank C. Mason—at $2,700. In this department also there are 16 sergeants engaged in telephone work at $2,000 each, and also seven linemen who have $1,200 a year. In the electrical bureau in the Department of Gas and Electricity the chief electrician, Frank E. Brown, receives $3,300. In the same department are Henry F. Blackwell and Hubert Wynkoop, classed as electrical engineers, at $2,400 each; one inspector at $1,800, and 19 at $1,350 each. The Board of Education employs three inspectors of electricity at $40, $30 and $27 a week, respectively; two battery men at $4 and $3.50 a day; two linemen at $4 a day, and one electrician at $30 a week. An inspector of overhead wires in the Water Department receives a salary of $1,252, and an inspector of gas and electricity $1,500. This bureau also employs a chief inspector of exterior wiring at $1,252 and three other inspectors at $782. The last-named officials are perhaps the lowest paid inspectors in the employ of the city, and they are joining the other inspectors in asking for increased salaries. It is curious to note that a battery man in the police department receives only $2 a day, whereas his colleague in the Department of Education gets twice as much. In nearly every department of the city's administration there are telephone operators, generally young women. The salaries of these vary from $450 to $900. Of the male telephone operators, one receives $900 a year; the lowest remuneration for a male operator being $420. The chief inspector of electrical conductors draws a salary of $1,500 a year, and under him are six others with a salary of $1,250 each. These inspectors have been appointed at the rate of one per annum, and more will probably be appointed in the future. An electrician in the Bureau of Public Charities receives $1,050.

In Chicago the city electrician, Mr. Ellicott, receives $5,000 a year. As the city operates arc-lighting plants for its streets, the total number of electrical people on the municipal pay-roll is undoubtedly larger than in New York. The chief clerk of the Department of Electricity gets $1,800; chief engineer, $1,800; 17 inspectors each draw $1,200. Lamp trimmers are paid $68 a month and linemen $3 a day. In the Bureau of Fire-alarm Telegraph the chief operator at the main office is down for $3,250. The superintendent of construction gets $2,500, and 13 operators receive from $1,400 to $1,800.

Reported Lighting Merger in Baltimore.

It is reported in Baltimore that there is a deal on for the consolidation of the Consolidated Gas Company and the United Electric Light and Power Company to control all the lighting interests in Baltimore under the domination of Thomas F. Ryan and Anthony N. Brady of New York and the Continental Trust Company of Baltimore. A syndicate of Baltimore bankers who have been interested in the affairs of the Consolidated Gas Company are making the effort to secure an option on the shares held by the stockholders. The Maryland Telephone and Telegraph Company is also mentioned in connection with the deal, the intention, it is said, being to either force the Maryland into the combination or compel it to abandon its electric-lighting plans.

The city of Philadelphia, according to an official announcement by the Baltimore and Ohio railroad, has offered the use of a building for the establishment of a permanent museum for railroad appliances, locomotives, cars, etc. Concerted action by leading railways to assure maintenance pending permanent endowment will be taken to preserve intact the various collections of railroad exhibits made at the St. Louis Fair. The Baltimore and Ohio has taken the initiative to carry the plan of a permanent museum to an effective conclusion.

CORRESPONDENCE.

Great Britain.

London, November 9.—The London County Council has decided to take a somewhat drastic step in connection with the electrification of the horse tramways in the North. I think I have pointed out on a previous occasion that in an act of 1900, in order to secure the co-operation of the London borough councils, the County Council inserted a clause to the effect that it would not adopt the overhead system in any borough without the consent of the borough council. Events since 1900, however, have not proved the wisdom of the adoption of the conduit system on any and every route, and the experts now advise the council that the trolley system could be adopted on many routes in the North with great advantage. But the London borough council has been educated up to a sense of horror at the prospect of the overhead equipment, and consequently is holding tight to the powers which were given it under the act of 1900, and this, together with the unwillingness of the County Council to incur the heavy capital expenditure necessary on conduit tramways, gives the appearance that the North London horse tramways will never be converted to electric traction. To surmount these difficulties, the County Council has determined to ask Parliament to relieve it of its obligations to the borough councils under the act of 1900, and in the interests of the traveling public it is to be hoped they will be successful.

The question of the acquisition of the telephone system of the National Telephone Company by the government has once more cropped up, and a deputation of municipal representatives to the postmaster-general yesterday made a rather unusual suggestion. It was urged that if the government purchased the whole of the telephones of the kingdom, both company and municipal, as seems to be the general inclination, in a few years time, this would tend to restrict the energies of the municipalities in the meantime. On the other hand, the deputation argued, if those municipalities that wished to work their own systems were allowed to do so, a much better result would be arrived at. But quite fairly, in reply to this, the postmaster-general pointed out that if the latter course were adopted, the government would be left with all the unremunerative business, while the large profitable towns would remain in the hands of the local authorities. He most definitely refused to adopt such an attitude while he was in power, and with this the deputation had to be content.

As is usual at the meetings of submarine cable companies of late years a reference is always made to wireless telegraphy. At the meeting of the Western Telegraph Company last week, the chairman, in this connection, said that in common with most other submarine cable companies, they had been approached for the purpose of making some arrangement by which telegrams might be sent to their stations and forwarded from there by wireless telegraphy. A good deal of this had been done in the early stages of the Russo-Japanese war, and it all tended to confirm the view that they had held for many years, viz., that wireless telegraphy could never be more than an auxiliary to the submarine cable. It could never be a competitor. Now that this has been proved in practice, probably submarine cable shareholders will feel themselves in their old state of security.

Whether the Royal Commission on London Traffic is ever to confer any benefits upon London still remains very problematical. Although the last evidence was taken as far back as May, no report has yet been issued to Parliament, and as a consequence no new schemes affecting London can be presented to Parliament this year. But this holding back of new schemes for three years in succession has conferred upon Mr. Yerkes, who owns the District Railway and a number of undeveloped tube railways, an inestimable boon, for it has allowed tremendous progress to be made. In fact, it may be found that by the time the Royal Commission has reported that the opening of the Yerkes series of railways will have met many of the drawbacks hitherto complained of, and that when the other suburban steam railways are electrified, London may possibly be as completely equipped with rapid means of communication as the piecemeal legislation in the past will ever allow it to be. It may also be found, probably, that Mr. Yerkes has secured that very monopoly which many were anxious he should not have, for, be it remembered, all new lines competing with him have to receive parliamentary sanction, in spite of anything contained in the Royal Commission's report.

The fire brigade committee of the London County Council has made some suggestions to the Board of Trade as to what precautions against fire it thinks should be imposed upon tube railway companies. Without pledging itself in any way, the Board of Trade has agreed to call for an opinion from the chief officer of the council's fire brigade as to whether sufficient provision is made in the matter of hydrants, hose, etc., but a suggestion by the County Council that on all tube railways the motors should be carried in separate incombustible compartments has been dismissed as impracticable. As a matter of fact the Central London Railway has just dis-

carded separate locomotives on account of the vibration which was caused by their use.

It is well known that great dissatisfaction has been felt with our patent laws for many years, and that the new act which comes into force on January 1st next was drafted to overcome some of the existing difficulties. At the Civil and Mechanical Engineers' Society last week, the president suggested that all patents should be given the same validity, and at a very much lower cost. He also suggested that the yearly fees should be arranged according to whether the patent was successful or not. G.

New York.

New York, November 19.—The New York and Long Island Traction Company, the largest corporation of its kind on Long Island, is making much progress with the laying of its trolley tracks from Rosedale to Brooklyn. This line has to cross the tracks of the Long Island railroad, which is apparently bitterly opposed to its rival. The New York and Long Island Traction Company expects on December 15th to have cars running over its new line from Freeport, L. I., to Brooklyn. This line is 17 miles in length, and express trains will run the distance in 50 minutes or less.

The Central Long Island Railroad Company is planning to construct and operate a trolley line from Cold Spring Harbor to Mineola, to form part of a large belt line of trolleys on the island.

The prolonged struggle between the Port Chester and the Westchester traction companies was apparently ended yesterday, when the state railroad commissioners approved of the increase of the capital stock of the New York, Westchester and Boston Railway Company from $1,000,000 to $20,000,000. The Westchester company will build an electric railway from Harlem to Portchester and other places, as previously announced in the Western Electrician.

On Monday the New Haven railroad began work on its proposed six-track electric railway from New York to New Rochelle. Headquarters for the construction work have been opened at New Rochelle with a large staff of engineers and surveyors.

Everything is ready for the commencement of the construction of the trolley tunnel under the North River, connecting Cortlandt Street, Manhattan, with Jersey City. It is estimated that the work will require two years.

Police Commissioner McAdoo is asking for the installation of a ring of electric lights at Columbus Circle, placed in such positions as to indicate the proper way for automobiles and other traffic using the driveways in Central Park.

Some say that since the subway was started the number of trains on the elevated lines have been reduced. Personal investigation does not confirm this allegation. The fact is that for quite a number of uptown districts, the elevated service is preferable to that of the subway. The bulk of the subway traffic is to and from the express stations.

Public clamor for a better subway express service outside the rush hours has led August Belmont to announce a 90-minute all-day service of expresses in the near future. The company pleads inability to obtain a sufficient number of expert electricians and plasterers. The present traffic on the subway is estimated to be 200,000 passengers a day. That on the Manhattan elevated lines is estimated to be 1,000,000. The east-side branch of the subway, along Lexington Avenue, is now ready for operation, and is announced for official opening next Wednesday.

The Brooklyn Daily Eagle is now putting in three new multiple presses, making five in all. All the machinery in the Eagle office is driven by electricity, and when the new presses begin to run the Eagle will have the largest and best newspaper presses in the state. D. W. W.

Dominion of Canada.

Montreal, Que., November 19.—The forty-fourth annual meeting of the Montreal Street Railway Company was held last week, at which the annual report showed that the net earnings of the company were $952,826.80, as compared with $905,939.01 last year. Managing Director W. G. Ross stated that during the last season the company had relaid 16 per cent. of its total mileage with 96-pound steel rails, with steel ties and concrete bed. Up to the present time 40 per cent. of the total 32 miles of trackage have been relaid in the most substantial manner. The old board of directors was re-elected.

The service on the Grand Valley railroad, running from Paris to Galt, Ont., will be inaugurated next week.

The Toronto and Scarboro Electric Railway Company has secured a perpetual and exclusive franchise for the running of cars on the Kingston road.

B. E. Drew of Cranborne, B. C., is arranging to install an electric-light plant in that town, utilizing an adjacent waterpower.

The Horse Shoe Power Company has been formed in Phœnix, B. C., to develop the power obtainable from the Kettle River above Canyon City.

The Brantford Electric and Operating Company is seeking a 10-year renewal of its lighting contract with the city of Brantford, and offers to install the alternating enclosed-arc system.

John Galt of Toronto has examined the Rosseau River, 20 miles from Emerson, Man., and has reported on it favorably as a source for economical waterpower, in combination with long-distance electrical transmission.

A company has been formed to build an electric railway from Fort William to the top of Mount McKay, where there is a lake three miles wide and 10 miles long, which is to be made into a new summer resort. The company has already secured the right-of-way through the municipalities concerned. The power will be obtained from the Kakabeka Falls, which is now being harnessed for the purpose of generating electric power and transmitting it to Fort William and Port Arthur. H.

Ottawa, Ont., November 19.—Experts have agreed upon the sum of $196,000 as the price to be paid by the city of St. Thomas, Ont., for the gas, electric-light and power plant at present owned by a company. The city's original offer was $188,000, which the company refused, and the matter was referred to arbitration, but an agreement was reached without an appeal to the arbitrators. The by-law for the purchase of the plant will be submitted to the ratepayers in January.

The waterpower on the Wabnapitae River, which is being developed by Messrs. Cochrane and McBittie, will be in a position to deliver electric energy next spring. The dam has been completed and the machinery is now being installed. Arrangements have been made to supply the town of Sudbury, Ont., with electricity for light and waterworks, and it is probable that power will also be supplied to the Mond Nickel Company, which has been closed for one year and is now preparing to resume operations with vigor.

It is stated that the Dominion government has under consideration certain legislation looking to the federal acquisition of the trunk lines of telephones and telegraphs in Canada. At a meeting in London, Ont., a short time ago, of the Union of Canadian Municipalities, a resolution strongly favoring such a system of ownership and operation was heartily adopted. The subject is a very large one, and it is expected that the initial steps along that line will constitute one of the principal items, if not the most important, of government legislation to be submitted to the new Canadian Parliament when it assembles in January next.

It is said that the Hamilton Street Railway Company of Hamilton Ont., is anxious to sell its property and franchise to the city. It can be bought for some $800,000 or $900,000. The bonded debt is $500,000. The amount paid for the stock of the old tramway company when the road was electrified, was $205,000, paid by the Cataract Power Company of Hamilton, and the amount advanced by the latter company to the street-railway was $170,000. The president of the railway company stated that the company would be doing well if it could realize the sum of $875,000 by the sale, and even intimated that it could be purchased for less. The roadbed is in bad shape as well as the rolling stock. There are about 24 miles of track, 50 cars and three barns. The company offers to throw in the franchise. W.

Indiana.

Indianapolis, November 19.—The Marion and Eastern Traction Company was incorporated on the 16th inst., with a capital stock of $30,000. The company's headquarters will be in Marion, and the declared purpose is to build and operate street railways in the cities of Marion, Van Buren, Warren, Bluffton and Decatur, and connect the same with an interurban system. R. E. Breed, W. B. Dodds and J. J. Coleman are among the principal promoters.

The Marion Motor Car Company, with principal office in Indianapolis, was incorporated during the week. The capital stock is $100,000. The company will manufacture, repair and deal in motor cars, motor boats and motor vehicles of all kinds. L. C. Boyd, H. M. Landon, R. H. Hassler and others are the incorporators.

At a special meeting of the City Council of Alexandria on November 12th that part of the franchise ordinance exacting a payment of $2 per lineal foot from the Indianapolis, Hartford City and Celina Traction Company for use of paved street was repealed, and the streets desired by the company were given without charge. The company contracts to build and have the line in operation within a year.

The Indianapolis and Northwestern Traction Company makes the novel announcement of excursion rates to St. Louis and return. The connection is made with the Clover Leaf at Frankfort, and a special rate for the round trip of $4.40 is given, against $6 by the steam roads.

More than half the grading for the Wabash and Rochester electric traction line between Wabash and Rochester, a distance of 36 miles, has been completed ready for the ties. It is the purpose to have this line in operation by May of next year. It was announced on the local stock exchange today that the Indianapolis and Eastern Traction Company had declared a cash dividend of 15 per cent. on the preferred stock of the company. This is the first dividend paid on the stock.

A movement has been started conducive to closer relations among the various electric traction lines of Indiana. Nothing in the nature of a trust or merger is contemplated, neither will the proposed agreement have anything to do with fares, but will be for the common benefit of the companies along mechanical lines, and will probably regulate the matter of transferring freight from one traction line to another, and the sale of interchangeable mileage books. There is quite a demand for an agreement in these two matters. Partial arrangements along these lines have been made between a few of the lines, and it is the purpose to perfect a freight and passenger agreement and system between all the lines. Paul H. White of the Indianapolis and Martinsville Rapid Transit Company is working out the details and says the electric traction business is soon to assume great proportions in this state.

According to statements made by traction officials, a joint terminal station to cost $50,000 is to be erected in Logansport next spring. All traction companies entering the city will share the cost and the service of the station. S. S.

Ohio.

Cleveland, November 19.—E. S. Nichols of Wapakoneta has been appointed receiver of the Sandusky Southwestern Electric Railway Company, and F. O. Olson, general manager, has been temporarily enjoined from disposing of property and money said to be held by him, some of it in his own name. Lyman N. Means, treasurer, and one of the stockholders, brought the suit. The company was organized with a capital of $1,000,000 and the Cleveland Trust Company holds a trust deed for $2,000,000. About 45 mils of grading has been completed. The road was planned to extend from Wapakoneta to Kenton and Lima to Bellefontaine.

While no confirmation has been secured, it is reported in Cleveland that the Cleveland and Southwestern has secured a portion of the Lodi branch of the Baltimore and Ohio between Wooster and Millersburg. This is about 19 miles in length and will be used as an extension of the electric road south. The Cleveland and Southwestern is constantly looking for opportunities to extend its business and make its service better.

In the Electric Building at Cleveland a school of instruction for motormen and conductors is maintained by W. F. Weh, claim adjuster for the Cleveland Electric Railway Company. The men are taught how to prevent accidents and instructed in the manner of treating injured passengers.

Reports are current that negotiations have been almost completed for the sale of the property of the Dayton Electric Light Company, Dayton, to an eastern syndicate. Dr. J. E. Lowes, president of the company, was in the East this week, accompanied by J. C. Reber of the Home Telephone Company, Attorney E. P. Matthews and others. The report is to the effect that a good price has been offered for the property, upon which many improvements have been made in recent years. Plans have been made to put all the wires underground.

A franchise for an electric railway from Empire to the Jefferson County line has been granted to L. W. Healy of the East Liverpool lines. As there is now a line from Wheeling to Empire, an extension from this point to East Liverpool and from there to Beaver will make a continuous line from Wheeling to Pittsburg.

Councilman Henry F. Walker has introduced an ordinance in the Cleveland council providing for a 20-year extension of the franchise of the Cleveland Electric Railway Company, on condition that the company sell seven tickets for 25 cents. One public meeting has been held since that time, when people were invited to discuss the matter.

The City Board of Tax Review has added $115,000 to the valuation of the property of the Cleveland Electric Illuminating Company.

George R. Scrugham has retired as president of the Interurban Railway and Terminal Company of Cincinnati, and Charles H. Davis has been chosen to fill his place. The other officers are: Vice-presidents, E. H. Davis and L. H. Brooks; treasurer, J. M. Kennedy; secretary, W. E. Hutton. The road now has over 100 miles of track in operation, and the reports from all departments showed that it had been doing a good business. Mr. Scrugham has sold the greater part of his interest in the company to the Harrison estate, and this is represented in the board by C. L. Harrison. Guy W. Mallon and Ellis G. Kincaid retired from the board, and it now consists of seven members. The company represents a combination of the Cincinnati and Eastern, the Suburban Traction Company and the Interurban Terminal Company.

The Cuyahoga Light and Power Company of Cleveland has been incorporated with a capital stock of $25,000 by C. L. Denton, H. J. Caldwell, M. V. Little and others. It is supposed the company was formed to consolidate the lighting plants of a number of business blocks and office buildings on Euclid Avenue and Ontario Street.

Mayor Fich has formally announced his veto of the ordinance giving the Toledo Railways and Light Company an extension of franchise, on condition that seven tickets are sold for a quarter. At the same meeting a long letter from President Henry Everett was read, declining to accept the franchise. He declared the company could not now and never would accept a franchise containing such stringent conditions as to expenditures on extensions and improvements. Mr. Everett feels that the company should at least have something to say regarding this

matter. He says that on the terms of the franchise as prepared by the committee, 25 tickets for $1 and a two-cent fare for children is the best than can be done. O. M. C.

Michigan.

Detroit, November 19.—It is understood that active steps have now been taken looking to the construction of an electric railway from Lansing to Jackson. W. A. Boland is at work securing the right-of-way. The material on the old line from Grass Lake to Chelsea will be torn up and used by Mr. Boland in his new enterprise.

The Monroe city and county officials and business men came to Detroit Thursday night as guests of the Detroit, Monroe and Toledo Short Line to celebrate the opening of the line between Monroe and Detroit. The management of the Short Line provided three special cars, and a banquet was served at the Metropole Hotel. A number of after-dinner speeches were made, including addresses by Mayor Sisung of Monroe, ex-Lieutenant-governor John Strong, Matthew Slush of Mt. Clemens and ex-Secretary of State Harry A. Conant.

H. A. Everett of Cleveland, Ohio, and a party of prominent electric-railway men have made a record-breaking trip on Mr. Everett's private car "Josephine" from Cleveland to Detroit. The total time for the entire trip was five hours and 12 minutes. Mr. Everett states that there has been no traffic arrangement made between the Detroit, Monroe and Toledo and the Lake Shore electric railway whereby a continuous ride can be taken from one city to the other, but that this is now being talked of and is not beyond the range of probability. Among others in the party who came in the private car were J. J. Stanley, general manager of the Cleveland Electric; Warren Bicknel, president of the Lake Shore Electric; F. J. Pomeroy, president of the Cleveland and Southwestern; C. W. Wasson, president of the Cleveland, Painsville and Eastern; H. R. Newcomb, president of the City Savings and Trust Company, Cleveland; George T. Bishop, president of the Northern Texas Traction Company; F. W. Brooks, assistant general manager of the Detroit United, and W. H. Tarkington, general superintendent of the Detroit, Monroe and Toledo Short Line. The latter piloted the party over the Short Line from Toledo to Detroit. The visitors were met at the Cadillac by ex-Judge C. J. Reilly and others.

The Municipal Electric Lighting Commission of Detroit has accepted the new engine and generator which has been in the power house for the last three months, but with which there was some trouble at the time of its installation.

A meeting of local capitalists has been held at Gaylord for the purpose of soliciting funds to build a new electric railway from Gaylord to Otsego and also to build a summer resort. It is understood that a right-of-way for the road has been secured.

The limited car service of the Detroit, Ypsilanti and Ann Arbor electric line will be inaugurated about November 28th. The cars will make about three stops in Ypsilanti and three in Ann Arbor and one each in Chelsea and Grass Lake. They will also stop at Dearborn and Wayne on signal for passengers from Ypsilanti and points west.

The Flint Auto Brass and Aluminum Company has been organized at Flint to manufacture machine-finished brass, aluminum and other metal castings, wood rims, brass and metal auto rails, auto parts and sanitary finishings for automobiles. The capital stock is $25,000. The company is negotiating for the lease of the large brick plant of the Flint Harness Company and expects to have the plant running by January 1st.

The Incandescent Light and Stove Company of Detroit has been incorporated with a capitalization of $600,000. C. G. W.

New England.

Boston, November 19.—The storm of November 13th, which reached hurricane proportions in Northern New England, did heavy damage to electrical properties. Upward of 700 broken telegraph poles were reported in the state of Maine, and both telegraph and telephone communication, as well as trolley service, were badly crippled for several days.

At the annual meeting of the Berkshire Street Railway Company, held in Pittsfield, the officers were re-elected and three additional directors were chosen; namely, Fred T. Ley, H. A. Moses and H. C. Page. The annual report showed a good surplus, and it is stated that after January 1, 1905, the company will begin to pay four per cent. dividends. The company has asked for authority to issue $200,000 additional bonds, bringing its total up to $1,000,000.

A trolley line connecting the city of Holyoke with the town of Ware, via Granby, Belchertown and Enfield, is projected by local capitalists of the places through which the line would run. An executive committee and a committee on the necessary legislation have been formed, and the matter of connections with other lines at Holyoke and Ware is to be arranged, if possible, before construction work begins.

The State Board of Railroad Commissioners has decided adversely to the petitioners on the matter of increased rates of fare on the New Bedford and Onset road, a reduction to former charges being prayed for. The board finds that present rates are not excessive. A similar decision has been rendered by the commission on a petition from Wakefield residents, relative to fares on the Boston and Northern railway.

The Boston Transit Commission has taken title to two estates for entrance and exit purposes for the new subway. One is on Lagrange Street and the other is on Essex Street, where 1,349 feet of land, now occupied by an $8,600 structure, which will be razed, cost the commission $71,800. B.

Southeastern States.

Charlotte, N. C., November 19.—The Citizens' Rapid Transit Company of Richmond, Va., has secured certain amendments to its charter covering in detail the route to be followed, and it is stipulated that the work shall be completed by the end of the year 1905.

The Mount Olive Light and Power Company of Mount Olive, N. C., has been chartered, with an authorized capital of $100,000, by M. T. Kell and others.

It is stated that work will be started within the next year on the projected route of the electric railway from Atlanta, Ga., to Anderson, S. C., the chief promoter being G. O. Etheridge of New York. The line will carry both passengers and freight.

An electric railway will soon be started between Alexandria, Va., and Washington, it is reported, and the necessary capital has been secured for the work.

The Georgetown (S. C.) Electric Company has been reorganized and the following officers elected: President, H. C. Case of Philadelphia; vice-president and general manager, S. S. Ingman of Florence, S. C.; secretary and treasurer, S. C. Case of Philadelphia; local manager, L. Mouzon of Georgetown. Extensive improvements are contemplated.

A. J. Whaleburg and William Lang of Detroit, Mich., are promoting an electric railway between Lexington and Richmond, Ky. The chamber of Commerce of Richmond is interested in the scheme to build the line.

The Birmingham (Ala.) Light and Power Company has just completed a new freight and express depot in Ensley, Ala., to meet the demands of the largely increasing business.

A decision has been rendered in court dismissing the injunction to prevent the mayor and City Council of Waynesboro, Ga., from entering into a contract for the lighting of the streets by electricity. L.

Northwestern States.

Minneapolis, November 19.—The electric-lighting plant at New Richmond, Wis., will be remodeled and improved at a cost of about $3,000.

A. E. Park of Chicago and others are considering the feasibility of building a trolley line from Valley Junction to Creston, Iowa. Stock is now being subscribed.

F. M. Sanger of the Council Bluffs (Iowa), Tabor and Southern Electric Railway Company has announced that construction on the proposed line will be started early in the spring.

M. R. McAdoo of New York city was elected as the new president of the Winnebago Traction Company of Oshkosh, Wis.

The Lincoln (Neb.) Traction Company has offered to settle its paving-tax case with the city for about $14,000. The disputed taxes amount to about $40,000. It is thought that the council will accept the proposition.

An effort is to be made to compel the Sioux City (Iowa) Traction Company and the Sioux City Gas and Electric Company to place all their wires underground.

A new cut-off system is being investigated in St. Paul which may be put on the lines of the Twin City Rapid Transit Company. It will be used to shut off the current on sections of the lines in the neighborhood of a fire. The plan has been investigated by the city Board of Fire Commissioners and was pronounced satisfactory. R.

Pacific Slope.

San Francisco, November 18.—The Bay Counties Power Company has entered into a contract with the Burrell Construction Company for the erection of two towers, one on each side of the river at Sacramento, Cal., to connect its plant in Sacramento with its line at Davisville.

A. H. Cheney of the Madison Mercantile Company has purchased the electric-light plant at Arcata, Cal. The price is said to be $20,500.

The Northern California Power Company has secured a long-term contract to supply the Mammoth mine and smelter at Kennet, Cal., with power. A sub-station will be built at the mine and will have a capacity of 1,200 horsepower.

In the reorganization of the Snoqualmie Falls Power Company, under the name of the Seattle-Tacoma Power Company, many improvements are contemplated. N. H. Latimer of Seattle, Wash., is president of the new company; O. D. Calvin, treasurer, and Thomas B. Hardin, secretary. It is the intention to double the capacity of the Snoqualmie plant by installing a 5,000-kilowatt generator driven by a 10,000-horsepower turbine wheel. If the Supreme Court of Washington decides the litigation now pending over the White River power plant favorably to the company, work will immediately begin on the deevlopment of the generating station near Sumner, about nine miles from Tacoma, Wash.

The Eagle Valley Railroad Company has been incorporated at Baker City, Ore., by W. L. Vinson, John Waterman and T. Basche. The capital stock is $1,000,000. The principal place of business is Baker City.

It is understood that the Condor Power Company has plans for the enlargement of its plant to more than treble its present capacity. Contracts have been made for lighting Medford, Ore., and it is believed the council of Jacksonville, Ore., will buy power for lights. Pole lines are projected for Ashland and Grants Pass, Ore. When the enlargement is completed, the capacity will be from 1,600 to 2,000 horsepower. C. R. Ray of Jacksonville is manager of the company.

The consolidated Portland Railway and City and Suburban Railway Companies of Portland, Ore., will expend $750,000 in the improvement of the street-railway systems of Portland. There are 106 miles of car lines in the city and 100 of these will have to be gone over and improved. A.

PERSONAL.

H. M. Smith, formerly with the Lake Shore Electric Railway Company, has accepted the position of general manager of the Rockford and Interurban Railway Company at Rockford, Ill.

Regan Houston of San Antonio, Tex., has resigned the presidency of the San Antonio Gas and Electric Company and the San Antonio Traction Company.

S. J. Dill has resigned as superintendent of the Michigan Traction Company to go to Youngstown, Ohio, where he will assist in constructing the electric railway between Youngstown and East Liverpool.

L. S. Humes, St. Paul manager of the Western Union Telegraph Company, has been appointed general superintendent of the Great Northwestern Telegraph Company, with headquarters at Toronto, Ont. W. R. Chapman of LaCrosse, Wis., has been promoted to succeed Mr. Humes at St. Paul.

E. W. Lloyd of the Chicago Edison Company has accepted an appointment from President Davis to prepare a report on purchased electric power in factories, to be presented at the twenty-eighth convention of the National Electric Light Association. Mr. Lloyd has already begun work on this report, and, as it is a subject of the greatest importance to central stations—the power load is rapidly becoming the important part of the business in many localities—it is to be hoped that managers will take pains to fill in as fully as possible the data blanks being sent out by Mr. Lloyd.

The following-named persons were registered at the booth of the Western Electrician last week: W. C. Smith, Sacramento, Cal.; H. Wilkinson, Columbus, Ohio; James H. Gildersleese, Hudson, Ill.; Luther Benjamin, Hudson, Ill.; F. H. Carter, Ashland, Ore.; C. J. Sutter, Fresno, Cal.; R. Keller, P. G. O. E. Company, Peoria, Ill.; E. Lundeley, Monterey, Mexico; William Ware, McKenney, Texas; Charles Fled, Chicago; Ralph W. Chappel, Troy, Pa.; Edw. Collins, South Bend, Ind.; K. Shultes, Martin, Mich.; John P. Goy, St. Louis; Claud Feightner, Canton, Ohio; George W. Broner, St. Louis.

Mr. Henry Rustin, who, on account of failing health, was compelled to give up his position as chief electrical engineer of the St. Louis Exposition and go to a different climate, has improved in health to some extent and was able last week to return to St. Louis and see the results of his efforts at the Fair. Mr. Rustin planned the splendid illumination at the World's Fair, but it was feared at the time he was compelled to give up that he would not be permitted to see the electrical picture his mind had conceived. The work of carrying out his plans was taken up by other hands under the direction of E. B. Ellicott of Chicago, and carried to successful completion. Mr. Rustin, on his return, looked much better than when he left. He came from Omaha, accompanied by his brother, Dr. Fred Rustin.

ELECTRIC LIGHTING.

The electric-lighting plant at Gaylord, Mich., was entirely destroyed by fire recently.

The Chadron Electric Light and Power Company has sold its system in Chadron, Neb.

The City Council of Waverly, Iowa, has purchased the Healy electric-light plant for $13,500.

The Town Council of Chambersburg, Pa., has decided to recommend the sale of the electric-light plant.

The People's Electric Company of Frankfort, Ky., has secured the contract for furnishing the city with electric lights.

Fire recently destroyed the tar plant owned by the Denver Gas and Electric Company in Denver, Colo.

One man was burned to death and three others were injured. The property loss was about $25,000.

The city of Memphis, Tenn., is considering the municipal ownership of the electric-light plant.

The city of Florala, Ala., has granted a 20-year franchise to William R. McDuffie to construct and operate an electric-light and power plant.

The city of Richmond, Va., contemplates employing an electrical expert to investigate and report on the location and cost of an electric-light plant.

An electric plant is to be installed by the city of Dalton, Ga., for the purpose of furnishing light and power to various industries now using gas.

The board of trustees of the State School of Mines at Golden, Colo., recently awarded the contract for constructing a new heating, lighting and power plant.

The Citizens' Heat, Light and Power Company of Canton, Ill., has been incorporated with capital of $100,000 by A. Howells, William L. Davis and others.

The contract of the Effingham (Ill.) Electric Light and Power Company has expired. No arrangements for further lighting have as yet been made.

On December 2d the citizens of Cookeville, Tenn., will vote on the issuance of $25,000 of bonds for the construction of an electric-light plant and system of waterworks.

The installation of an electric-light and power plant for furnishing light and power to various industries of the city is to be undertaken by the city of Dalton, Ga.

The Scottsville Electric Light and Gas Company of Scottsville, N. Y., has been incorporated with a capital of $20,000. Henry C. Brewster of Rochester is among those interested.

The City Council of Anadarko, Okla., has decided to build a municipal electric-lighting plant, and has employed an engineer to furnish estimates and plans. It is the intention of the council to operate the lighting system in connection with the waterworks system, using practically the same power for both. The waterworks will be in operation within 60 days, and the council expects to be able to light the city within 90 days.

Directors of the Chicago Edison Company have voted to increase the capital stock by 20 per cent., being an amount equal to $1,973,176. The new stock is part of an authorized issue of $5,134,120 remaining in the treasury. The 20-per cent. increase will be put out next year in quarterly installments and will bring the total outstanding capital up to $11,839,056. The money is needed in connection with the continued growth of the business.

In the special election last week on the granting of a 20-year franchise to a Chicago syndicate to furnish electric and gas light to Jefferson City, Mo., the proposition carried by a vote of 863 to 68. This ratifies the sale of the plant to the Chicago people, the consideration being $100,000. The terms of the franchise make it incumbent upon the new company to improve the surface and reduce the schedule of prices which have prevailed.

The Des Moines Edison Light Company has fitted up a special room at its headquarters in Des Moines, Iowa, in which are exhibited electrical appliances and utensils of the latest manufacture. The room is handsomely furnished and by the use of softly shaded electric lamps and miniature electric bulbs a pleasing and attractive effect is produced. Among the appliances exhibited are the electric sewing-machine motor, the electric stove, electric oven, electric teakettles, coffee urns, laundry irons, water heaters, heaters for warming rooms, heaters for curling irons, etc., and not least of the display are the handsome electric lamps, many of the most exquisite oriental patterns.

ELECTRIC RAILWAYS.

The cars of the Leavenworth (Kan.) electric line are now running to the center of Kansas City, Mo., on the Metropolitan tracks. Cars are run on the line every 30 minutes.

The lines of the York Traction Company are to be extended so as to cross McClellan Heights in the southeastern section of York, Pa. This will be the means of a number of fine residences being put up in that section of the city.

The Omaha, Beatrice and Lincoln Electric Railroad Company has bought 80 acres of land in Omaha, Neb., convenient for the erection of freight warehouses, and which will furnish part of the interurban company's right-of-way to the city and to South Omaha.

The number of cars now running on the United Railways' system in St. Louis is not to be greatly reduced at the close of the World's Fair, according to Captain Robert McCulloch, vice-president and general manager of the system. Not so many will be run on the Market, Olive, Page and Delmar lines as have been operated there during the Fair, but most of the cars that will be taken off these lines will be put on others. Captain McCulloch thinks the big system will run during the winter within 10 per cent. of the total number of cars that are in service now or were in service during the heaviest traffic in October. Some changes have already been made in the service to the Fair grounds and others will follow at the close of the Exposition.

An electric railway company has been formed at Siloam Springs, Ark., with Mayor D. Zimmerman at its head, to construct a network of electric lines to handle the fruit crop and other business. Power will come from the Illinois River.

The Lake Shore Electric Railway Company of Norwalk, Ohio, recently carried a number of railroad officials from Detroit to Cleveland in the private car Josephine, and in one instances covered 111½ miles in 121 minutes, without interfering with the regular car schedule.

Ground has been broken just north of Waukegan, Ill., for the roadbed for the Chicago and Milwaukee Electric Railway Company's new double-track line. The company has just closed deals for land for its road. At several points acre tracts have been purchased, but for what use is not stated.

The opening of the new electric railway of the Illinois and Iowa Interurban Railway Company, between Clinton and Davenport, will soon take place. Trial trips with the elegant new interurban cars have already been made, and General Manager Crafts states that when regular service is commenced the run between the two cities will be made in an hour and a half.

Railroad men at Elmira, N. Y., believe that the Delaware, Lackawanna and Western railroad, after three years of study by its high officials, will soon be equipped with electric power. The interest of the officials of the road in the recent trials at Schenectady and their visit to the World's Fair to study the models of engines on exhibition there, are pointed out as corroborative of the report current.

Charles T. Yerkes, on arriving in New York from Europe last week is said to have again declared himself as strongly opposed to municipal ownership of street railways. In an interview he is quoted as follows: "Municipalities should not take over such properties without paying market value for them, as well as for the stock issues. If certain men take the chance, at a time when a certain city or town is in the infancy of its development, of building a traction system, enlarging it as the growth of the community demands, and putting thousands upon thousands into the venture, I candidly believe those men are entitled to make their money in after years without the fear that within a limited period they will be deprived of the result of their enterprise and see their property taken by the municipality at a ridiculously low figure."

POWER TRANSMISSION.

The Northwest Light and Power Company is to furnish the power for a new flour mill which is being erected at Colville, Wash.

The Washington and Oregon Light and Power Company has completed its large power plant six miles above Milton, Wash., on the Walla Walla River. It will be placed in operation early in December.

The Monterey Water, Sewer and Power Company, with an authorized capital of $4,000,000, has been incorporated at Trenton, N. J., for the purpose of constructing water and power plants and building sewers. The incorporators, headed by J. J. Jermyn, are nearly all from Scranton, Pa.

T. A. Shock of the York Haven Water and Power Company, York, Pa., reports that in the recent severe storm in that section not a wire of the system was down, while the loss of other companies was considerable. The machinery, which is gradually being placed in the plant, is arriving rapidly at present and it is thought that the entire plant will be fitted up in the next few days.

Large natural reservoirs have been discovered, it is said, by W. T. Love in the Sawtooth Mountains directly back of Nome, Alaska. Mr. Love proposes to utilize the reservoirs for furnishing water power and in his undertaking has the backing of a wealthy Nome citizen. A stock company has been formed and Mr. Love is now in Seattle, Wash., for the purpose of buying machinery and supplies. The power, when developed into electricity at the foot of the mountains where conditions favor cheap installation, will be transmitted to all parts of Seward peninsula. The company is known as the Sawtooth Electric Power Company, of which Eric Lindbloom of Nome is president and Guy C. Carleton of San Francisco secretary.

PUBLICATIONS.

The second edition of Suplee's Mechanical Engineer's Reference Book, published by the J. B. Lippincott Company of New York, has been issued, with corrections and additions. So great was the demand that the first printing was exhausted in 10 months.

Graphite lubricants made by the Joseph Dixon Crucible Company of Ampere, N. J., are looked upon with favor, and the little booklet which the company has issued regarding these products is at once complete and carefully prepared. Some of the products named in the booklet are Ticonderoga flake graphite, yachting plumbago, heavy graphite machine grease and waterproof graphite grease. Yachting plumbago, frequently called "pot-lead," is used to impart smoothness to the underbodies of sailing yachts. This polishing of the wetted surface is said to increase to a great degree the ease with which the vessel slips through the water, reducing "skin friction."

Three distinct types of arc lamps are illustrated and described in as many new bulletins coming from the Western Electric Company of Chicago. These three types are: Multiple series, constant-current lamps for direct-current circuits; multiple, constant-potential alternating-current lamps and multiple constant-potential direct-current lamps. Under each class there are a number of different types, and each of these types is carefully described and illustrated in the various bulletins. Data necessary for ease in ordering the types desired are contained in the bulletins, such, for instance, as tables containing code word, type, catalogue number, volts at arc, length of carbons, etc. For the operation of alternating-current multiple series lamps several diagrams are shown, together with directions for making connections.

AUTOMOBILES.

An automobile train with four cars was tested a few days ago near Berlin, Germany. By means of special couplings the cars were drawn after the automobile round sharp curves, keeping the same track. The velocity was 15 miles an hour. The train went over meadows at the rate of eight miles an hour. The object of such trains is transportation for war or industrial purposes.

"Spread all over the country," says the Motor World, "will be found windmills and old-fashioned water mills, often very picturesque but of no commercial value. If these power stations were to be fitted up with small electric dynamos and a few accumulators they would form very valuable charging stations for electric cars. In the near future, by the help of such charging stations, electric vehicles will be used for cross-country traveling."

TELEGRAPH.

The Montauk Telegraph Company, as successor to the New York and Long Island Telegraph Company, is applying for extensive pole privileges in and around the town of Hempstead, L. I. The local authorities intimate that the wires must go underground.

A dispatch from London, England, states that at a meeting of the Eastern Extension, Australian and China Telegraph Company, the chairman said that the competition between the two rival routes—those of the company and the governments—was being carried on as actively as ever, but so far the company has succeeded in maintaining its position, notwithstanding unfair treatment accorded it by the several governments interested. The results of the traffic with Australia showed more completely each year that no commercial necessity existed, or ever had existed, for the British Pacific cable, which involved a loss to the various governments of between £90,000 and £100,000 sterling a year, and a serious loss to the company by the abstraction of traffic under the influence of the governments. It is understood that the Pacific cable conference will meet about the first of December next.

MISCELLANEOUS.

Founders' Day exercises will be held on the evening of November 30th at the Thomas S. Clarkson Memorial School of Technology at Potsdam, N. Y.

The Schenectady plant of the American Locomotive Company, which has been idle for a month, has resumed work. Before the end of the year it is expected that the entire force of 5,000 men will be back at work engaged in the completion of the electric locomotives for the New York Central's terminal service in New York and on other orders.

The records of the legal proceedings that have taken place involving the Chicago Union Traction Company since that company went into the hands of receivers in April, 1899, make a library of 12 thick volumes of matter, compiled for the convenience of lawyers. Another ponderous book is in the hands of the binder and material for two more is being gathered.

A new danger signal is being installed along the line of the Aurora, Elgin and Chicago electric railway for the prevention of grade-crossing accidents. It is an electric light which flashes at right angles with the railway tracks at street intersections so that passengers on foot or in vehicles approaching the crossing are warned of the coming of a car while it is 300 yards away. At the same time an electric bell starts ringing. The light is an arc and is so arranged as to shine only up and down the intersecting streets and not upon the track. It is set in operation at the approach of a car by an electric contact similar to that employed in a block-signal system.

TRADE NEWS.

The Electric Supply Company of Savannah, Ga., has increased its capital from $25,000 to $37,500.

The F. M. Russell Fixture Company of Omaha, Neb., has been incorporated and succeeds to the gas and electrical fixture business of F. M. Russell & Co.

Milton Greenebaum of New York city, and business associates have organized the Independent Insulator Company, with a capital of $250,000. The new firm will deal in glass insulators.

It has been decided by the Australian commonwealth that rheostats are auxiliaries and not integral parts of electric appliances or machines, and should be classified as electric materials, free of duty.

Advices from Poland say there is a good opening in that country for electric apparatus, such as motors, batteries, dynamos, accumulators, electric-lighting material, incandescent and arc lamps, electric bells and telephone material. The trade in these goods is expected to increase.

The Bureau of Supplies and Accounts, Navy Department, is inviting sealed proposals until December 6th, for furnishing the New York navy yard with a quantity of searchlight projectors, electric blowers, annunciators and other electrical materials. Blank proposals will be furnished upon application to the navy pay office in New York.

An electrically operated appliance for reproducing cartoons and other drawings is being put on the market by the Rossman Electric Delineator Company of Rochester, N. Y. This concern was incorporated on November 17th at Albany with a capital of $40,000. G. B. Rossman of New York city is financially interested in the new corporation.

It is stated in financial circles that a great electrical company is about to be established under the auspices of the Deutsche Bank, Thomas A. Edison and the Bergmann Elektricitäts Werke Actien Gesellschaft of Berlin. The president of the Bergmann concern, Sigmund Bergmann, is said recently to have visited Mr. Edison to arrange the details. According to one version, the new company will be situated in the United States.

The Specialty Manufacturing Company has recently moved into new quarters at 32 East South Street, Indianapolis, Ind., where every facility for supplying its well-known line of ventilating fans is at hand.

The Barousse Street Car Fender Company of New Orleans, La., has been incorporated with $200,000 capital, to manufacture the "Barousse" street-car fender. Eugene Barousse is president; Ira F. Swahn, vice-president, and F. S. Fowler, secretary-treasurer.

The New England offices of the Allis-Chalmers Company in Boston, which are now in the Board of Trade Building, and the offices of its electrical department, the Bullock Electric Manufacturing Company, in the Journal Building, will be consolidated on December 1st and removed to the State Mutual Building, 50 Congress Street. Mr. George H. Berg will be the manager in charge of the consolidated offices.

Through the Bureau of Supplies and Accounts bids are invited by the Navy Department until November 29th, for furnishing the League Island and Washington navy yards with incandescent lamps, telephone sets and miscellaneous electrical supplies, a full list of which may be obtained upon application to the navy pay offices in Philadelphia and Baltimore, and to the bureau. On December 13th the bureau will open bids for furnishing the Mare Island and Puget Sound navy yards with a quantity of wattmeters, voltmeters, conduit, engine indicators, copper and magnet wire, fuse wire, electric clusters, insulating and Grimshaw tape, carbons, miscellaneous electric supplies and a telephone system. Blank forms of proposal can be obtained either of the bureau or at the navy pay offices in San Francisco, Cal., or Seattle, Wash. The Bureau of Supplies and Accounts is about to change the hour of opening bids from noon to 10 o'clock. This change will become effective December 6th, and no bids will be considered that are received after that hour.

BUSINESS.

The Innovate adjustable hangers for lamp cords, described and illustrated in the Western Electrician last week, are handled by the Innovate Manufacturing Company, 145 Van Buren Street, Chicago.

Thus the Buckeye Electric Company of Cleveland: "General Grant knew but two tunes. One was 'Yankee Doodle'—and all the others weren't. There are only two lamps. One is Buckeye—and all the others aren't. Which will you have?"

The W. R. Evans Engineering and Construction Company, Traction Building, Cincinnati, Ohio, has been organized and incorporated for the purpose of building, financing, promoting and engineering street railways, electric-light plants, waterworks, etc. Mr. W. R. Evans is president of the new concern, and with a staff of capable engineers is able to give satisfactory services.

The Crocker-Wheeler Company of Ampere, N. J., is introducing a new line of variable-speed motors designed for machine-tool drive. These motors are arranged in two classes, the first being adapted to give a constant horsepower throughout a speed range of two to one, and the second being arranged to give a constant horsepower throughout a speed range of three to one. Both of these classes are designed for operation on a single voltage of either 115 or 230 volts.

Three Westinghouse 62½-kilowatt engine-type generators which have been in service in the basement of the New England Building, in Cleveland, Ohio, were recently subjected to a severe test. A fire occurred in the basement where the generators were installed and completely burned away the insulation on the outside of the field coils; the fire department played upon these machines with six lines of hose for one hour. Within one hour from the time the water was turned off the machines, one of them was in operation and carrying its full rated load. The second machine was put in operation later and carried its full rated load, and at the present time two of these machines are operating under the load normally carried by all three of them.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued (United States Patent Office) November 15, 1904.

774,749. Portable Electric Light. Edwin R. Gill, New York, N. Y., assignor to the Electric Contract Company. Application filed January 25, 1902.

A cylindrical casing holds the battery, and upon pressing a spring connections are made and a small incandescent lamp inside the tube is lighted.

774,758. Electric Spark Gap. Thomas B. Kinraide, Boston, Mass. Application filed May 25, 1904.

Heat-separating means consist of a series of thin members of heat-conductive material extending laterally outward and located contiguous to the discharge gap for diverting and separating from the electric current the heat effects and providing a cool discharge between electrodes.

774,760. Self-contained Hand Electrode. Thomas B. Kinraide, Boston, Mass. Application filed July 5, 1904.

A hand device or electrode for hand manipulation at the point of application comprises a portable inclosure provided with a carrying device adapted to be grasped by the hand, the portable inclosure adapted to be connected to a source of high-frequency current and containing within itself means for developing from the current a high-frequency high-potential disruptive discharge current.

774,764. System of Electrical Distribution. Paul M. Lincoln, Pittsburg, Pa., assignor to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Application filed September 30, 1903.

Combined with a source of direct current are a source of alternating current and translating devices to be supplied therefrom, an alternating-current controller, a direct-current controller and means for automatically cutting either of the controllers out of circuit and the other into circuit when the corresponding generator is cut into or out of circuit.

774,770. Central-energy Telephone System. Kempster B. Miller, Chicago, Ill., assignor to the Kellogg Switchboard and Supply Company, Chicago, Ill. Application filed December 19, 1900.

A supervisory signal-controlling electromagnet having differential windings is disposed in the path of current from the source over the line circuit, the magnet being rendered neutral by the current over the metallic circuit during conversation and energized by the excess of the magnetic effect in one of the differential coils at the termination of the conversation. A cut-off relay for the line connects the terminal with the line when operated and renders the signal inoperative. Means are supplied to energize the relay by the act of connecting the cord circuit with the line without unbalancing the signal-controlling electromagnet.

774,789. Electric Arc Lamp. Ralph Scott, Wilkesbarre, Pa., assignor of one-half to Marcus A. Miller, New York, N. Y. Application filed October 14, 1903.

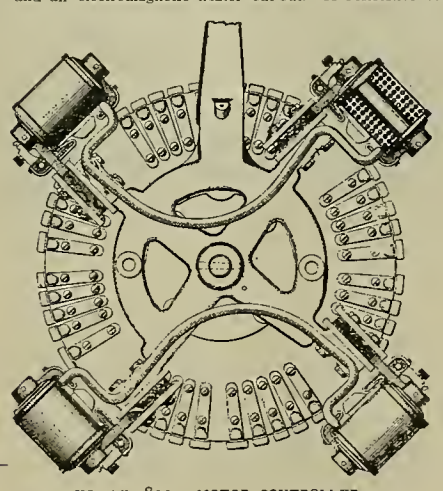
Associated with a movable carbon support are a carbon pencil-engaging pawl, a carbon support beneath the movable carbon support and a plunger carried by the movable carbon support. A circuit is provided for the carbon supports, a coil surrounds the plunger, and means limit the downward movement of the movable carbon support, limiting the degree of release of the clutch.

774,800. Controller for Electric Motors. Hermon L. Van Valkenburg, Pittsburg, Pa., assignor to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Application filed April 14, 1904.

A controller for electric motors having a stationary member comprises a non-conducting disk and circumferentially disposed contact terminals, which are insulated from each other by it and which embrace its edge and the contact portions of which are independently removable. (See cut.)

774,812. System of Distribution for Electric Glower Lamps. Alexander J. Wurts, Pittsburg, Pa., assignor to George Westinghouse, Pittsburg, Pa. Application filed November 9, 1900.

Electric lamps of the type described are connected in series with each other and each has a glower, a heater and an electromagnetic heater cut-out. A resistance coil



NO. 774,800.—MOTOR CONTROLLER.

is connected in shunt to the glower and heater and in series with a cut-out coil of each lamp.

774,813. Electric Signaling System. Samuel M. Young and Fitzhugh Townsend, New York, N. Y., assignors to said Young. Application filed August 22, 1904.

A system of automatic signaling for electric railways comprises a generator and a power circuit, including the rails of the trackway as a return. The trackway is divided into a series of sections by dividing one rail and introducing between its separated ends a conductor which forms the secondary of two transformers connected in series, the secondaries being in parallel across the rails. The arrangement is such that one transformer of each pair will be included in adjacent track sections.

774,815. Electric Indicating Mechanism for Pressure Gauges. James P. Anderson, U. S. Navy. Application filed March 16, 1903.

The pointer of the pressure gauge in traveling over the dial closes various contacts, which close circuits leading to a dial in a distant place. (See cut on next page.)

774,831. Electric Burglar-alarm System. Clyde Coleman, Chicago, Ill., assignor of two-thirds to the Bankers' Electric Protective Company, Chicago, Ill. Application filed December 17, 1896.

Combined with a protective circuit and a responsive device therein is an electrically operated multiple permutating circuit-breaker in the circuit, constructed to produce a series of successive breaks or pulsations of current strength each time it is thrown into operation.

774,836. Vacuum Arc Lamp. Hubert Emonds, Aix-la-Chapelle, Germany. Application filed January 30, 1904.

A closed chamber contains the electrodes and an extension on the chamber acts as a guide for the upper carbon. A carrier is supplied for the clutch mechanism, likewise a solenoid, a movable core therefor, provided with an extension constituting a movable pole piece in proximity to the extension of the inclosing chamber, a soft-iron armature guided in the extension and moving with the movable pole piece, and a clutch carried by the armature. (See cut on next page.)

774,876. Electric Arc Lamp. Thomas Hamilton-Adams, London, England. Application filed August 21, 1903.

A radiating tube is hermetically united to a foundation plate communicating with a guiding aperture, and extends outside of the lamp body for radiating the heat generated by the arc, and this obviates the use of pressure-relieving devices.

774,896. Electric Safety Apparatus for Cars or Trains. William P. Robertson, Bronxville, N. Y. Application filed May 12, 1904.

A train has in combination with its cars provided with gates or doors a controller, a lock therefor, a signal, connections from the signal for an electric circuit for the signal and for commanding the lock, and means under control of either of the gates or doors to cause the operation of the lock and signal.

774,897. Block Signal System for Electric Railroads. Howell W. Souder, Tamaqua, Pa., assignor of one-half to W. D. Zehner, Lansford, Pa. Application filed December 7, 1903.

As elements in an electric-signaling system there are combined a rotating circuit controller, divided into a series of circumferentially separated contact sections, the angular distances between the centers of any two adjacent contact sections being uniform throughout, and means giving the controller a step-by-step rotary movement always in one direction, each step being equal to one-half the angular distance between the centers of two adjacent contact sections. There are also a work-circuit terminal, a feed-connection terminal and a ground-connection terminal, all arranged in the path of rotation of the controller contacts.

774,905. Telegraph Repeater. William E. Athearn, New York, N. Y., assignor to the American Telephone and Telegraph Company, Boston, Mass. Application filed May 13, 1904.

The associated parts are a relay of each line, an associated local circuit, an auxiliary electromagnet included therein and acting upon the armature lever of the relay in the direction of its normal attraction, and a short-circuiting shunt of the local circuit round the auxiliary magnet controlled by the relay of the other line. An electromagnetic resistance or reaction coil is connected in the local circuit outside of the shunt and is adapted, when the shunt is broken, to discharge reactively through the auxiliary electromagnet and to quicken the magnetization thereof.

774,922. Apparatus for Receiving Electrical Impulses. Daniel W. Troy, New York, N. Y. Application filed April 11, 1904.

A local circuit has one portion formed of comminuted magnetic particles in relatively loose contact. There is a normally alternating magnetic flux through the particles, and a winding around the particles adapted to be energized by received impulses. (See cut.)

774,923. Receiver for Telephones or the Like. Daniel W. Troy, New York, N. Y. Application filed June 24, 1904.

A wheel of magnetically permeable material is normally rotated and forms a part of a magnetic circuit. A magnetic armature in sliding contact therewith is directly connected to a diaphragm, and means for varying the friction between the wheel and armature by received impulses are supplied.

774,929. Protecting Diaphragm for Telephone Transmitters. William M. Bashlin, Warren, Pa. Application filed October 28, 1903.

In combination with a telephone transmitter having a mouthpiece is a removable protecting diaphragm arranged over the opening in the mouthpiece and means for stretching and clamping the protecting diaphragm about the edge of the mouthpiece.

774,943. Controller. Ray P. Jackson, Wilkinsburg, Pa., assignor to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Application filed January 20, 1904.

In apparatus for slowly rotating the field magnet of an alternating-current machine are means for successively supplying direct-current energy to the several portions of the polyphase armature winding and for alternately decreasing and increasing, in gradations, the amount of current supplied to each of the portions.

774,954. 774,955. 774,956. Method of Rotating Field Magnets of Dynamo-electric Machines. Charles F. Scott, Edgewood Park, Pa., assignor to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Application filed September 16, 1903.

These three patents relate to a method of rotating the field magnet of a polyphase alternating-current generator, which consists in energizing the field magnet and supplying direct current to the armature winding corresponding to a single-phase and to series-connected armature windings corresponding to two phases alternately and successively, and reversing the current when 180 electrical degrees of rotation have been produced.

774,974. Safety Device for Coupling Alternators. Edwin S. Baker and Herbert A. Scott, Piedmont, W. Va. Application filed November 12, 1903.

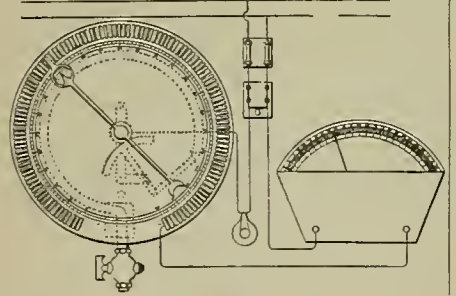
Two alternating-current generators are brought up to the proper voltage and synchronism. A phase indicator is connected up with the generators, and safety devices in circuit with the generators prevent injury to either generator when they are included in parallel circuit with each other on the main-line conductors.

774,976. Electroplating Isolated Designs on Vitreous Surfaces. Leon Blower, New York, N. Y. Application filed March 23, 1904.

The process of forming an isolated metallic design upon an article having a vitreous surface consists in pulverizing the desired metal and mixing it with a suitable flux, applying the mixture in a paste to the vitreous surface in the desired design, fusing the mixture of pulverized metal and flux upon the vitreous surface, and then increasing the thickness of the fused metal in such design by electrodeposition.

774,991. Register for Telephones. George S. Nickum, Salt Lake City, Utah, assignor of one-half to Harry E. Deardorff, Salt Lake City, Utah. Application filed April 4, 1904.

In telephone registering mechanism are a transmitter, a register case connected therewith and having an opening against the diaphragm, sounding mechanism within the register case, registering mechanism within the register case and means for operating the register and sounding mechanism.



NO. 774,815.—PRESSURE INDICATOR.

775,016. Electric Switch. Isaac G. Waterman, Santa Barbara, Cal. Application filed March 9, 1903.

Details are described.

775,017, 775,018, 775,019, 775,020, 775,021. Electromagnetic Valve-controlling Mechanism. Isaac G. Waterman, Santa Barbara, Cal. Application filed May 11, 1903.

These five patents relate to devices for automatically opening or closing the supply and waste valves in a fluid receptacle, such, for instance, as a bath tub.

775,050. Method of Selecting Electrical Impulses. Daniel W. Troy, New York, N. Y. Application filed April 8, 1904.

The method of selecting electrical impulses set forth consists in operating vibratory receiving apparatus by the mutual action of components of received impulses at approximately 90 degrees difference of phase.

775,051. Electrical Valve-controlling Mechanism. Isaac G. Waterman, Santa Barbara, Cal. Application filed August 4, 1902.

An electrical supply circuit and a switch and electrically operated valve embraced therein, a second circuit connected in shunt to the electrically operated valve, a normally open circuit-closer for the shunt circuit and an electromagnet included in the shunt circuit and adapted for opening the switch on closing of the normally open circuit-closer, are the essential features.

775,052. Electric Switch. Isaac G. Waterman, Santa Barbara, Cal. Application filed January 31, 1903.

In an electric switch are combined a movable switch-contact member and a spring for returning it to normal position.

775,053. Electric Switch. Isaac G. Waterman, Santa Barbara, Cal. Application filed June 29, 1903.

Details are described.

775,054. Electromagnetic Valve. Isaac G. Waterman, Santa Barbara, Cal. Application filed March 9, 1903. Renewed December 24, 1903.

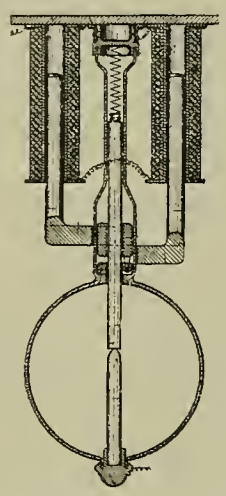
Characteristic features of the device are a valve casing, a valve and a slidable magnet core, a magnet coil for attracting the core, a slidable locking core disposed substantially at right angles to the magnet core and adapted to automatically engage it, and a magnet coil for retracting the locking core.

775,055. Electric Switch. Isaac G. Waterman, Santa Barbara, Cal. Application filed March 25, 1903. Renewed September 7, 1904.

In an electric switch are a stationary contact, a rotary contact arranged to only momentarily or temporarily engage the stationary contact when actuated, a spring-retracted push-button and a pawl carried thereby adapted to snap the rotary contact first on, then off, the stationary contact during the automatic spring retraction of the push-button.

775,056. Electrical Contact-controlling Float. Isaac G. Waterman, Santa Barbara, Cal. Application filed June 25, 1903. Renewed September 7, 1904.

Combined with relatively movable contacts adapted for engagement is electromagnetic mechanism adapted to separate the contacts at the time they are brought together and to keep them separated.



NO. 774,835.—VACUUM ARC LAMP.

775,079. Signal for the Deaf. Albert Ekberg, Minneapolis, Minn. Application filed September 5, 1903.

A spring motor and a rack arranged to be reciprocated thereby are connected to a pivoted arm having a toothed segment meshing with the rack and provided at its free end with a visual signaling device. An electrically operated detent normally restrains the spring motor.

775,105. Electric Baker for Surgical Purposes. Walter S. Edmands, Newton and Charles A. Hoyt, Boston, Mass., assignors to Edward T. Edmands, Newton, Mass., and June Hoyt. Application filed December 17, 1902.

Electric elements electrically connected in groups within the oven are provided with switch connections whereby the groups may be placed in and out of operation singly and jointly.

775,113. Coherer. Walter W. Massie, Providence, R. I. Application filed March 4, 1904.

A coherer comprising a mass of non-magnetic filings contains a magnetized needle supported with its end free of the mass of filings. A mass of magnetic filings is suspended from the needle and makes contact with the non-magnetic filings.

775,123. Apparatus for Electrically Treating Gases. Kristian Birkeland, Christiania, Norway. Application filed June 15, 1903.

Means for producing a magnetic field consist of pairs of electrodes mounted in the field, each pair being arranged to produce an arc; means for supplying current to the electrodes and means for passing a current of gas past the arc in series.

775,145. Electromagnet. William Meyer, Chicago, Ill., assignor to the Kellogg Switchboard and Supply Company, Chicago, Ill. Application filed August 26, 1901.

Combined with a magnet core is a bar of magnetic material connected at one end. An angular armature poised upon and in contact with the other end of the bar is adapted, upon being attracted by the core, to form a closed magnetic circuit with the core and the bar.

775,165. Safety Alarm. Levi N. Coffield, Clarksburg, W. Va. Application filed June 30, 1903.

In an alarm of the character described are a piston chamber, a piston, upright bars secured to opposite sides of the cylinder, a weight guided by the bars and engaged by the rod of the piston, a contact piece adjustable on the rod, an electric circuit and a circuit-closer mounted on one of the bars and having opposite parallel branches between which the contact piece is movable.

775,188. Thermopile Elements. John A. Lyons and Edward C. Broadwell, Chicago, Ill. Application filed July 6, 1903. Renewed July 6, 1904.

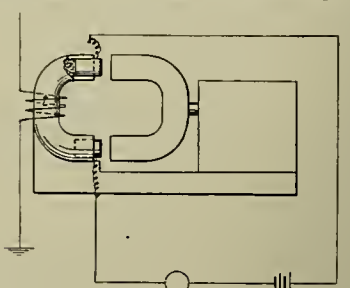
A thermopile has negative and positive elements, one composed of a mixture of iron sulphide and lead sulphide and the other of a mixture of a copper phosphide and another dissimilar metallic salt.

775,199. Railway Signal. Cisco R. Traxler, Winston Salem, N. C. Application filed December 31, 1903.

In railway signaling systems are embodied a compressed-air duct parallel with the roadbed, signals arranged at points distant from each other, signal-operating means, electromagnetically controlled valves for placing the duct in communication with the operating means and a current conductor passing through the duct and protected thereby.

775,201. Telephone System. William R. Whitehorne, Bethlehem, Pa. Application filed April 27, 1904.

A telephone system includes two conducting lines in the same circuit, electrical instruments connected thereon, each provided with a locking device, including a differ-



NO. 774,922.—ELECTRICAL IMPULSE RECEIVER.

entially wound magnet, an indicator and a calling device, with means having its terminals connected respectively to the ends of the lines for operating the calling device of any instrument and for actuating the indicators and the locking devices of the remaining instruments.

775,226, 775,227, 775,228, 775,229. Telephone-exchange System. Harry G. Webster, Chicago, Ill., assignor to the Stromberg-Carlson Telephone Company, Rochester, N. Y. Application filed February 4, 1903.

Means at the sub-station are adapted to close an electrical connection between the telephone limbs of the line. Cord connecting apparatus at the exchange connects the line with another for conversation. A cut-off relay has two differential windings serially included in one limb of the line, and a test contact is connected to the common terminal of the windings of the differential cut-off relay.

775,230. Circuit-changing Apparatus. Harry G. Webster, Chicago, Ill., assignor to the Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y. Application filed December 7, 1903.

A core is provided with pole pieces, an energizing coil for the core, an armature hinged to one of the pole pieces and extending over the other pole piece, switching mechanism disposed below the armature, a distance plate disposed between the swinging end of the armature and actuating springs of the switching mechanism, apertures through the swinging end of the armature and the actuating springs, and pins extending from the distance plate for loosely engaging the aperture, whereby the distance plate is readily removable.

775,274. Insulated Electric Conductor. John A. Heany, York, Pa., assignor to the Teter-Heany Developing Company, Charleston, W. Va. Application filed February 4, 1904.

An electric conductor has upon its surface a series of transversely arranged indentations or notches combined with an insulating covering firmly united to the surface of the conductor and interlocking with the indentations.

775,276. Trolley System for Overhead Electric Lines. James B. Kline, Warren, Pa., assignor of two-thirds to Starling W. Waters and Charles E. Metzgar, Warren, Pa. Application filed February 1, 1904. Renewed October 19, 1904.

A trolley for overhead lines comprises a guard and holder for the trolley wheel consisting of a housing U-shaped in cross-section and provided with rectangular mortises in the upper edges of its opposite sides. Rectangular journal blocks are seated in the mortises, and a trolley wheel is arranged in the housing and provided with an axle journaled at its ends in the journal blocks.

775,282. Electric Furnace. Richard Raddatz, Milwaukee, Wis., assignor of nine-tenths to the Allis-Chalmers Company. Application filed June 23, 1899.

Means for varying the relative movements of the bed of the furnace and the feeding devices are provided together with electrodes having their ends brought within arcing distance of each other in proximity to the point at which the feeding devices deliver material upon the bed.

775,284. Electric Testing Clip. Harry Frankel, New York, N. Y. Application filed December 2, 1903.

Details are described.

EXPIRING PATENTS.

Following is a list of electrical patents (issued by the United States Patent Office) that expired on November 22, 1904:

373,435. Galvanic Battery. H. J. Brewer, New York, N. Y.
373,452. Insulating Joint or Pipe Coupling. Emil F. Genert, Brooklyn, N. Y.
373,508. Printing Telegraph. C. J. Wiley, Brooklyn, N. Y.
373,519. Telephone Apparatus. I. H. Farnham, Malden, Mass.
373,584. Dynamo Electric Machine. T. A. Edison, Llewellin Park, N. J.
373,601. Apparatus for Purifying and Separating Fatty Substances by Electricity. H. F. D. Schwahn, Kansas City, Mo.
373,739. Prevention of Sparking in Electric Motors and Generators. Daniel Higham, Philadelphia, Pa.
373,759. Electric Coupling. G. W. Taylor, Leavittsburg, Ohio.

WESTERN ELECTRICIAN

EVERY SATURDAY

Vol. XXXV. CHICAGO, DECEMBER 3, 1904 No. 23

Electric Power in the Linz Railway Shops in Austria.

By Emile Guarini.

Electric power has recently been introduced at the workshops of the railway company at Linz, Austria. The entire plant has been constructed by the Vereinigte Elektricitäts Actien Gesellschaft of Vienna, and it consists of no less than 25 motors. Two-hundred-and-twenty-volt three-phase current is motive power that has been selected. It is supplied by a three-phase alternator of 200 kilovolt-amperes, driven by a 300-horsepower steam engine. Excepting two 10-horsepower motors, all the motors are on the ring system.

The driving of the traveling cranes and turntables is of special interest. For instance, a traveling crane of 20-ton capacity and a range of 9½ meters, located in the boiler works, is actuated by one single three-phase motor, through the agency of a worm gearing and toothed wheel, mounted on a shaft from which the three movements are derived. A view in the boiler works showing this crane is shown in Fig. 1. The shaft of the motor is connected to the worm gear by a coupling, one half of which acts as a disk brake. The band of the brake is raised by an electromagnet capable of lifting 0.5 kilogram, when current is supplied to it. This traveling crane existed prior to the introduction of electric power. It was found very easy to adapt it to the new circumstances.

The operator for the bridge stands upon the platform and operates the starting mechanism by the aid of a sprocket wheel and chain. There are only three conductors, i. e., one for each phase. There is no frictional transmission, and the motor must never be allowed to run light. The power developed is seven horsepower at 1,440 revolutions per minute. There are four of these cranes or bridges in the boiler works. There are, furthermore, two 45-ton overhead bridges in the locomotive fitters' shop, each provided with three seven-horsepower motors.

Traveling platforms or transfer tables for moving the cars laterally in the shops are adapted to take a load of 12 tons, and they have a speed of movement of 15 meters per minute. They are provided with a three-phase motor of 4½ horsepower at 900 revolutions per minute. The propelling mechanism comprises a chain transmitting device, and worm and gear wheels mounted in an oil bath. A disk brake is placed on the axis of the worm gear, and it is faced with leather. It is operated by means of a pedal and released by the action of a tension spring. The starting device is placed opposite the pedal. Fig. 2 is a picture illustrating this transfer table and showing the arrangement of the trolley by which the three-phase current is collected for the motor.

The bridge for the lateral movement of the locomotives (Fig. 3) is adapted for a speed of 12 meters per minute with a load of 56 tons. The motion is derived from a 10-horsepower three-phase motor, making about 1,330 revolutions per minute.

In these workshops there is also a large riveting machine, which is worthy of mention; it is driven by a 20-horsepower three-phase motor, with shafting and wheel gear. It also drives, by means of a belt, a plant of pumping apparatus. The current is taken from off the general lead. The riveting plant consists of a sextuple pump of 130 atmospheres pressure, with a maximum power of 90 liters of water under pressure, per minute, and also of a differential density accumulator of 40 liters capacity, with two meters travel. Great precision is requisite for the working of this last-named machine, and, to this end, the motor and pump run without interruption. A pressure commutator is merely inserted in the pressure pipe of the pump, and this controls the working of the accumulator.

FIG. 1. ELECTRIC POWER IN THE LINZ RAILWAY SHOPS IN AUSTRIA.—CRANE OPERATED BY THREE-PHASE MOTOR.

The Chicago Subway Company, which is to take over the Illinois Tunnel Company, has made its formal offer for the property. It already has acquired all the stock of the older company, and holds the $12,000,000 of bonds issued. For the stock of the Illinois company $30 a share in cash and $70 in shares of the Chicago Subway Company, par value, is offered. The stock is to be deposited with J. B. Russell & Co., New York, by December 31st.

Municipal Ownership of Public Utilities in England.

James Boyle, United States consul at Liverpool, England, writing under the heading, "Depressed Labor Conditions in Great Britain," has the following to say about municipal ownership of public utilities:

"There is an unmistakable cessation of the tendency toward the 'municipalization' of industries, which seemed to have fairly captivated the English people a few years ago, and which threatened to become almost epidemic, embracing not only public utilities, but a large variety of what had generally been considered to belong to the category of individual enterprises exclusively. Very little is heard just now of new movements in this direction; and indeed there are influences at work, well organized though quiet, which have for their object the wiping out, or, at any rate, the curtailment of 'municipal socialism.' This movement is taking advantage of the fact of the growing opposition to increased municipal taxes, the claim being made that the 'municipalization' of industrial enterprises not only kills individual effort, but adds to the municipal rates. Of course, there is another side to this question. Still, it is significant that local authorities who are committed to the 'municipalization' system are now devoting their chief energies to economy of management, and to bringing out a good financial showing at the end of the year, so that the profits can go to the general fund, and thus ward off any increase in the taxes."

National Electric Light Association Will Meet in Denver and Colorado Springs.

President Davis of the National Electric Light Association has just returned from a trip to Colorado, where he went for the purpose of deciding upon the meeting place of the twenty-eighth convention of the National Electric Light Association. After visiting Denver and Colorado Springs and conferring with a number of western members, it was decided that the business meetings of the convention be held in Denver for three days and the delegates then be taken to Colorado Springs for

the entertainment portion of the meeting, giving two or three days to sight-seeing and social intercourse. The meeting will be known as the Denver-Colorado Springs convention.

American Institute of Electrical Engineers.

The meeting of the American Institute of Electrical Engineers which was held in Carnegie Hall, New York city, on November 25th, brought out a very thorough discussion of the paper presented by O. S. Lyford, Jr., and W. N. Smith, on "Problems of Heavy Electric Traction." Extracts from the paper and discussion appear in succeeding columns of this issue. The subject was one of much interest and the attendance at the meeting when called to order by President J. W. Lieb was large. The president announced that at the meeting of the board of directors that afternoon 53 were elected to associate membership in the association. The following-named gentlemen were transferred from associate membership to full membership: H. P. Gibbs, chief engineer, government of Mysore, Province Bangalore, India; Douglass Burnett, general manager, United Electric Light and Power Company, Baltimore, Md.; A. C. Eastwood, engineer, Electric Controller and Supply Company, Cleveland, Ohio; William Amzi Dick, designing electrical engineer, Westinghouse Electric and Manufacturing Company, Pittsburg, Pa., and Edward Jerome Cook, chief engineer, Cleveland Electric Railway Company, Cleveland, Ohio.

Chicago Branch of the Institute Resumes Its Meetings.

On Tuesday evening last the Chicago branch of the American Institute of Electrical Engineers held its first meeting of the season at the rooms of the Western Society of Engineers. Peter Junkersfeld, local honorary secretary, presided. James Lyman presented the report of the nominating committee, the other member of the committee being George A. Damon. The report was adopted, and the following-named gentlemen were elected as the executive committee of the branch for one year: P. Junkersfeld, H. H. Wait, K. B. Miller, H. M. Brinckerhoff, A. D. Lundy, J. R. Cravath, Prof. P. B. Woodworth, Prof. C. E. Freeman and E. B. Clark. It is the intention to have three members retire from this committee each year. A vote of thanks was given to George A. Damon and T. P. Gaylord, retiring members of the old local committee.

James Lyman read an informal paper, illustrated by lantern-slide pictures, giving "Observations of European Lighting and Railway Practice," the result of a recent vacation tour. Mr. Damon gave an abstract of the New York paper of O. S. Lyford, Jr., and W. N. Smith on "Problems of Heavy Electric Traction." There followed a brief discussion, in which Mr. Junkersfeld, George H. Lukes, W. G. Carlton, Mr. Lyman and Professor Woodworth took part.

Delay in Invention.

Where an inventor deliberately proceeds to complete one specific form of his invention and lays aside the work on another specific form and no reason appears for this course except that it suited his own personal business affairs, the commissioner of patents holds that in law he is not excusable for the delay, as business convenience does not excuse delay in reducing an invention to practice. The commissioner of patents also holds that an assignee of a half interest in a patent cannot prosecute the application to the exclusion of the inventor; but, on the contrary, the inventor can prosecute it to the exclusion of everyone save the assignee of the entire interest. An assignee of a part interest may be represented by an attorney, who may inspect and obtain information as to the case, but who cannot take action in it.

Problems of Heavy Electric Traction.[1]

By O. S. Lyford, Jr., and W. N. Smith.

The Long Island railroad system has at present two passenger terminals in the city of New York, one at Atlantic Avenue and Flatbush Avenue in the Borough of Brooklyn, and one at the Thirty-fourth Street Ferry in Long Island City, Borough of Queens. When the great tunnels of the Pennsylvania, New York and Long Island Railroad Company are completed there will be a third terminal for the Long Island railroad passenger traffic in the Borough of Manhattan. From the present terminals there branches out an extensive system of through and suburban lines, over which is maintained a train service, both express and local, reaching all parts of the island. In addition to the suburban service into these terminals, there is an interchange of traffic with the Brooklyn Rapid Transit Company at two points, and a connection is to be established between the subway system of the Long Island railroad and the extension of the rapid-transit subway now being constructed between Brooklyn and the south end of Manhattan. The accompanying map (Fig. 1) shows the location of the western lines of the Long Island railroad and the new connections which are to be made.

Extensive plans for the electrification of the suburban service of this road have been under consideration for some years. These plans provide for the immediate adoption of electric traction on the lines emanating from Flatbush Avenue and for a progressive extension of electric traction over all of the strictly suburban routes, as rapidly as the conditions shall justify. On some of these routes the traffic is of a purely suburban nature, providing facilities for out-of-town residents to reach Manhattan and Brooklyn. On other sections the important traffic is an excursion movement to and from New York's great playgrounds at the beaches. For the convenience of the suburban residents, a frequent service in comparatively short trains is to be provided, but for the excursion service comparatively long trains are necessary. As a result, the number of cars per train in this system will vary from one to eight, or possibly 10. The initial service, limited to a maximum of six cars per train, results in 52 types of runs, varying in number of cars per train and distance between stops. On some sections the lines are fairly free from grades and curves, but on others the grades and curves are heavier than would be supposed from a general knowledge of the contour of Long Island. These few statements will indicate in a general way the complex nature of the problem involved in the selection of a suitable electrical system for such a service and in the determination of types and sizes of apparatus to be used. In the working out of large enterprises important details are frequently settled by quite simple processes of reasoning. Even in a complex problem like the one under consideration, some main points may be decided in this way.

(a) The number of cars per train varies from one to six, as stated. Eight or 10-car trains may be desirable at times. Such variations in train length cannot be provided for economically with electrical locomotives. Motor cars must, therefore, be used, and for all except trains of one or two cars, more than one motor car per train is necessary. The multiple-unit system of motor-car operation is, therefore, best suited to this service.

(b) The greatest flexibility for make-up of trains is obtained by making all cars motor cars.

(c) On the other hand, the first cost of equipment and the cost of maintenance and inspection is least if the motor selected is of the largest size practicable, and the number of equipments required is thus made a minimum.

(d) For a miscellaneous service of the character contemplated all trains, both local and express, should preferably be provided with equipment having the same speed characteristics, so that all motor cars are available for all classes of service. (Trains may operate as express in one direction and as local in the other.)

(e) For express runs of this suburban service, averaging not over five miles between stops, a moderately high speed, say, 50 to 55 miles per hour, is found by experience in steam practice to be most suitable. For these runs, therefore, it is essential that the electric trains shall be able to approximate these speeds.

(f) Future development of the service, such as increase in number of stops and decrease in running time, will mean heavier work for the motors. Therefore, reasonable reserve must be provided in the equipment, and consideration must be given to equipment which will make possible a convenient increase in number of motors per train.

The largest motor in general use for motor-car trains is of 200-horsepower nominal rating, two of these being about the limit of motor capacity that can be placed on a track with 33 or 36-inch wheels and a reasonably short wheel base. On the basis of condition (c), this should be the motor adopted, provided the train combinations can be effected satisfactorily with motors of this size. Condition (f) is also complied with by selecting the largest motor practicable, as the number of motors per train in the initial service will then be a minimum.

To meet condition (e), a gear ratio must be selected which permits the operation of trains at high speeds without damage to the equipment. On the other hand, the best starting conditions and least heating effect are obtained with high-gear ratio. The gear ratio should, therefore, be as high as practicable and still permit of the maximum train speeds necessary for the express schedules. Provision must also be made for extra speeds which may occur on down grades. From observation of the existing service it was concluded that it is safe to assume 60 miles per hour as a maximum.

The motor cars of the service are to be new steel cars similar to those adopted for the Rapid Transit subway. For the determination of motor characteristics, trailer cars were assumed to have the same size and weight of bodies. The weights assumed were as follows:

	Motor car.	Trailer.
Seated load	81,000 lb.	60,400 lb.
Standing load	88,000 lb.	66,000 lb.

These assumed weights are in practical agreement with the actual weights of the subway equipment.

The 200-horsepower motor was found to be the proper size for the service of the subway; but the schedule conditions are so different that this in itself does not signify that the same motors are suitable for the Long Island railroad conditions where the distance between stops for most of the local runs is greater than that of the express runs of the subway, and the express runs are longer in proportion. More or less of the usual calculating must therefore be done to reach a decision as to whether the characteristics of the standard motor of this size are suitable for this service or whether a smaller size could be used to advantage.

The operating conditions of a large steam railroad introduce limitations which cut down the possible speed of the motive-power equipment. Many of these are conditions over which the engine man has no control and which do not relate to the nature of the equipment—that is, curves, road crossings, junction points, yard limitations, meeting points on

1. Extracts from a paper presented at the meeting of the American Institute of Electrical Engineers, New York, November 25, 1904. Mr. Lyford and Mr. Smith are electrical engineers of New York city, the former with Westinghouse, Church, Kerr & Co.

Fig. 2. Motor-driven Transfer Table for Cars.

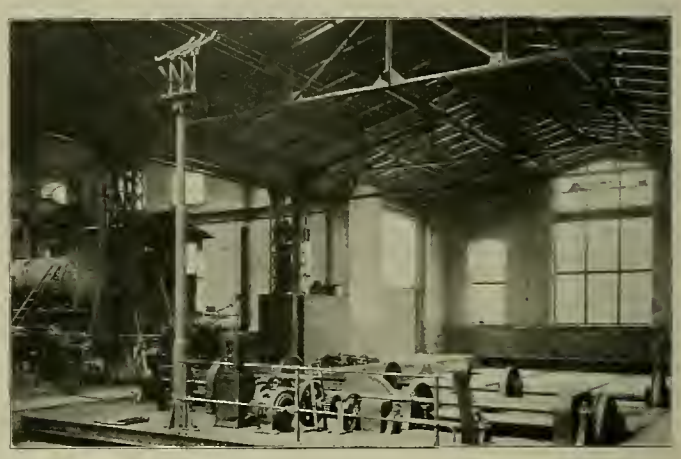


Fig. 3. Motor-driven Transfer Table for Locomotives.

ELECTRIC POWER IN THE LINZ RAILWAY SHOPS IN AUSTRIA.

single-track lines, time to handle baggage and express matter, etc. There are delays at stations and delays during runs, some of which occur regularly, but many of which are intermittent. Because of the complicated service these delays are greater on the suburban lines of a steam road than usually occur in interurban or elevated electric service. It is, therefore, evident that in the electrical operation of such suburban service the loading of the motors will differ materially from the loading in an ideal run which might be made with the conditions removed.

After considering various methods of providing for these conditions it was decided to make a

FIG. 1. MAP SHOWING PENNSYLVANIA TERMINAL AND WESTERN LINES OF LONG ISLAND RAILROAD.

series of tests of the present steam equipment to determine the speed-time characteristics of the steam trains and the degree to which these characteristics are affected by the local conditions. To this end a test car was equipped with a speed-recording device and runs were made over various routes with this car attached to regular trains. Complete records were obtained of the movement of each train throughout a round trip, and observations made of local conditions which affect speed. These records were carefully analyzed and the results tabulated. In some instances the engineers were requested to make the best time possible; in other cases they were not advised that a test was in progress.

In summarizing these test runs comparisons were made between the average speed between stops as actually attained and the possible average speed if best acceleration had been made for each run. It was found that the ratio of the actual speed to the possible speed without local limitations is from 71 to 91.3 per cent. Even when the engineers were requested to do their best they were able in only one or two instances to exceed 90 per cent. of the speed which appeared from the test to be possible.

From these records were selected the four best single accelerations. Curve sheet Fig. 2 shows the speed-time characteristics of these accelerations. Curve (D) illustrates the general character of record made by the instrument in these tests. This

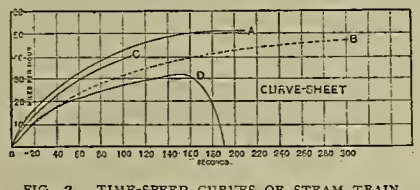


FIG. 2. TIME-SPEED CURVES OF STEAM TRAIN.

run, having been made on a level, conforms exactly with the record obtained. Curves (A), (B) and (C) were obtained on grades, and the actual record has been corrected to illustrate the performance of these trains when reduced to a level. In each case the average acceleration over the run was less than the characteristic shows, but these curves illustrate the maximum that the steam equipment was able to do. The composition of trains and their estimated weights are indicated on the curve sheet. The live load on these runs was so light that it was disregarded. On curve sheet Fig. 3 will be found two curves (E) and (F) of actual runs on grades, compared with run (A) of Fig. 2. According to curve (E) a five-car train on a down grade was accelerated at a rate far below the best performance, and even the three-car train with locomotive No. 35 (curve F) was not accelerated on a down grade with a rate any better than the best single performance on a level.

Curve (A) was made by a locomotive whose weight was 51.5 per cent. of the total weight of train. The officials of the railroad were of the opinion that service equivalent to that which could be performed by this locomotive, No. 59, with only three cars would be sufficient for the electric equipment. The best performance of this locomotive was therefore taken as the criterion by which to work in determining the proper characteristics for the electric equipment. The condition laid down was that the electrical equipment, operating a train with standing load in the cars, should be able to make the same average speed between stops as this particular steam equipment.

Taking curve (A) as a basis, determinations were made of what may be termed the "speed-limit" for steam trains. This is a curve indicating the average speed in miles per hour between stops with the rate of acceleration corresponding to curve (A), without coasting, and with a braking rate of 1.5 miles per hour per second.

Obviously to make the same time the speed characteristics of the electric equipment selected for this service must be such that the schedule can be maintained with similar speed reserve unless the

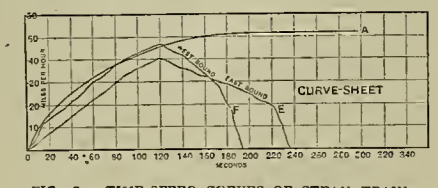


FIG. 3. TIME-SPEED CURVES OF STEAM TRAIN.

limiting conditions are removed. Some of these conditions are being removed and others probably will be. Elimination of grade crossings at roads and junction points, handling of baggage and express matter by special trains, improvement of yard facilities, etc., will make it possible to operate trains at speeds closer to the limit of the equipment. On the other hand, as the population along the road increases the tendency will be to increase the number of stops with as little increase as possible in the running time; therefore it was decided not to make any material allowance for improved conditions in the initial service. The probability of such improvement, however, suggests another precaution to be taken in the selection of equipment, namely, the provision of a suitable reserve in capacity of motors to carry the greater loads which will result from running at speeds closer to the limit.

The electric equipment with the lower-gear ratio has a maximum speed on straight level track of approximately 45 miles per hour, and with the higher-gear ratio 39 miles per hour; whereas the limit of the steam train on the level is 52 miles per hour. For a run of one mile or less between stops, however, the electric train with either gear ratio makes better time than the steam train. For a 1.5-mile run the electric train with higher-gear ratio falls behind the steam train, and at slightly over two miles the electric train with the lower-gear ratio falls behind.

The comparative speeds of these trains are still better illustrated on the speed-limit curves in Fig. 4

The general average length of run between stops for the suburban service is about 1¾ miles. It is evident from the speed-limit curves in Fig. 4 that a three-car electric train with two motor cars and gear ratio 23:59 will average slightly better as to speed than the three-car steam train, but that the same equipment with higher-gear ratio falls considerably below the speed limit of the steam train. From this exhibit it is obvious that schedule requirements indicate that no gear ratio lower than 23:59 should be adopted.

It is also evident from these speed-limit curves that if 23:59 is the lowest gear ratio practicable as determined by the limitations, the three-car train unit will have to be made up of two motor cars and one trailer in order that the requisite speeds may be reached. The weight per motor for this equipment is 30.3 tons, which on this basis of speed requirements is obviously close to the limit.

It is obvious that trains made up into combinations of motor cars and trailers that give less weight per motor will be able to make better speeds than indicated for this three-car train. Furthermore, as the number of cars per train increases the relative effect of head resistance decreases. For these longer trains it is therefore possible that a greater proportion of trailer cars may be used in some instances without reducing the speed limit to such an extent as to prevent the train from making schedule time.

It is not the purpose of this paper to follow out all the technical processes by which final conclusions were deduced as to size and characteristics of motor equipments for the project referred to. Sufficient illustrations have been given to show:

First, that a study of the operating conditions of even a complex project quickly narrows the selection of motors down to one or two sizes, and that these conditions also largely determine the speed characteristics of the equipment; secondly, theoretical methods are now developed to a point of sufficient accuracy to be considered reliable for purposes of selecting equipment; thirdly, short methods may be

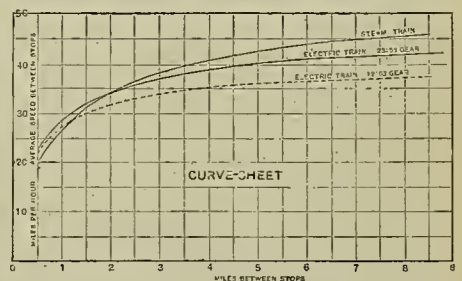


FIG. 4. SPEED-LIMIT CURVES OF ELECTRIC AND STEAM TRAINS.

used with discrimination at least for preliminary determinations.

Discussion (in Abstract).

L. B. Stillwell, New York: A point to which I have never seen attention called is the fact of the average adhesion of the two wheels of a truck equipped with motors; that where the average, we will say, is 20 per cent., the weight upon the two wheels is unequal, is never equal, whatever the average adhesion assumed may be, owing to the tendency to tip the truck. That is to say, the force of the two motors is applied in a horizontal line, passing through the center of the axle.

H. Ward Leonard, New York: One of the first points that the electrical engineer would like to have information on in considering the possibilities of trunk-line electric traction is the amount of horsepower which would be required, and upon that subject it is extremely difficult to get very much information from any data that has been published thus far. However, making the best effort to arrive at approximate accuracy on the basis of the few tests that have covered a sufficient range in the case of steam locomotives to give us some rather definite ideas, I have arrived at the approximate figure that the steam railways of the United States as a whole have about 125 horsepower per mile of line. That is, if you take the maximum horsepower of the steam locomotives and add them all together and take that as the basis of the horsepower I have arrived at a figure of 125 horsepower per mile of line. In the case of the Pennsylvania Railroad this figure seems to be something in the neighborhood of 550 horsepower per mile of line, and in the case of some other roads, as the Pittsburg and Lake Erie, or the Bessemer and Lake Erie, which have very heavy freight service, from the very insufficient data I have at hand I have estimated roughly that the horsepower in those cases reaches as high as 1,000 horsepower per mile of line.

One thing that I wish to speak of in connection with electric locomotives as against steam locomotives is as to the probable first cost. I think there is a practically universal opinion as far as I can discover that the electric locomotive will be a very expensive locomotive with regard to first cost. I do not think that is correct. The steam locomotive of the latest type and largest power will cost, if you consider the locomotive and its tender, taking the entire weight, about five cents per pound; but the only part of that weight which is in useful service is

the weight upon drivers, and when we consider the weight upon drivers the cost of locomotives figures nine cents per pound. Now with the price per pound which has been reached in electric generators I think that it cannot be doubted that in the case of the heaviest locomotive, where the amount of the horsepower will be relatively low compared with the weight by comparison with the high-speed passenger service, that we can make an electric locomotive as a whole to sell for less than nine cents per pound when they have been brought to such a standard as to enable us to get manufacturing processes down to a reasonable figure. It seems to me that the question of the application of the electric locomotive is a question which is largely dependent upon the horsepower per mile of the service which the electric locomotive can replace, and I believe personally that in such cases where there is 250 horsepower employed per mile of line that the electric locomotive can replace the steam locomotives with a very decided economy. The cost of equipping a steam railway of that character complete with the necessary central-station transmission line and locomotives I think would not be far from about 15 per cent. added to the existing capital of the railway, and the very great increase in starting torque and power upon grades will give such a pronounced advantage to the electric locomotive, also the reduction in the cost of fuel, and particularly the very great reduction which will be met with in the cost of maintenance will be very strongly in favor of the electric locomotive, all combining to make the electric locomotive a very certain and strong rival of the steam locomotive in cases where we reach any such power as 250 horsepower per mile of line.

In this connection it may be of interest to say that in the case of the most modern types, the largest sizes of freight locomotives, the cost of maintenance per mile is as much as the cost of the fuel per mile. That is a most startling statement and one which at first sight seems almost impossible, but it is a fact that $3,500 per annum is the cost of fuel and $3,500 per annum is the cost of maintenance on locomotives of the heaviest type such as the 2-10-2 type of Santa Fe locomotives.

Mr. Smith: With regard to the points brought out by the various speakers, Mr. Stillwell brought out the particularly interesting point about the adhesion matter, which has been apparently overlooked to a great extent, and I will simply call the attention of the Institute in that connection to the very interesting paper on braking, by Mr. Parke, who is connected with the Westinghouse Air-Brake Company, which gives results almost exactly the converse of what Mr. Stillwell suggests, of what happens when the brakes are applied to a motor truck.

Mr. Lyford: It was hoped that this paper would bring out a full discussion of methods; in this particular at least the results have been quite flattering. In the paper it was not intended to cover all the phases of the engineering necessary in selecting motors—simply a few illustrations were given bearing upon the points which we desire to make. No attempt has been made to disparage the admirable work done along purely theoretical lines. We desired simply to correct some impressions which have been given. There is no particular claim made to originality. The literature as a whole is lacking in evidence of the character given, however. No doubt other members have such data which would be of great interest to the Institute, data such as we have given, but it has not been produced. The literature is not complete as it should be in that line. Furthermore, it is submitted that whereas recent proceedings of the Institute have given much practical information regarding transmission line, pole-line construction, lightning protection, etc., much information of a similar character regarding experiences in electric traction could be furnished and would be of great value. The plans of the Railway Test Commission, if carried out, will add materially to the literature on the subject, but we do not know just what these results are to be.

Contributed discussion by N. W. Storer of Pittsburg: A reduction of 25 to 30 per cent. in the maximum current required to accelerate a car means on many systems a reduction of the sub-station capacity by the same amount. This is certainly a very decided improvement. Practically the same scheme may be adopted on elevated and subway lines to cut down the fluctuations provided the acceleration in series can be increased. In any case we would favor accelerating at the highest safe rate in series and reducing the current in multiple as much as the schedule will permit. This may be accomplished by the use of two current-limit switches—one for series and one for parallel—in which case the two currents may be made anything desired.

Another question which is agitating the minds of railway people, which has already been mentioned in the paper under discussion, is the lack of margin for making up lost time possessed by the electric-railway system. It is true that the only way a margin can be allowed for on the direct-current system as at present used is in gearing the motors for a much higher speed than required for the regular speed, thus allowing for a much longer coasting line, so that for ordinary service the motors have the power cut off long before the stopping point is reached. This is not as efficient and requires larger motors than are necessary for the usual service. About the only way to avoid this difficulty, and a method which would probably be possible only for locomotive work, would be the use of a booster outfit or a few cells (say 25) of storage battery on the locomotives which could be thrown in series with the line current, or to boost the voltage of the line in case an excess power is required. The power required for high speeds would thus be saved in accelerating. This is a complication which would not be desirable in many cases, but is about the only possible means for increasing the maximum speed. It offers a comparatively simple method for obtaining several efficient speeds.

The single-phase system possesses a marked advantage in this respect, since the type of control best adapted for this system is the voltage control, which enables any voltage within practical limits to be applied to the motor. It is practically independent of the voltage on the line and in this respect is even more flexible than the steam locomotive.

Two-wire System for Train Operation.

A patent was recently issued to H. H. Cutler of the Cutler-Hammer Company of Milwaukee, covering a radically new system for controlling motor-driven cars, operated on the so-called multiple-unit plant. The unique feature of this invention is the fact that both the direction and speed of the driving motors installed on the entire train are controlled by means of but two small wires running the entire length of the train, and by the use of a controller of about the same size as a standard field regulator for a three-kilowatt generator.

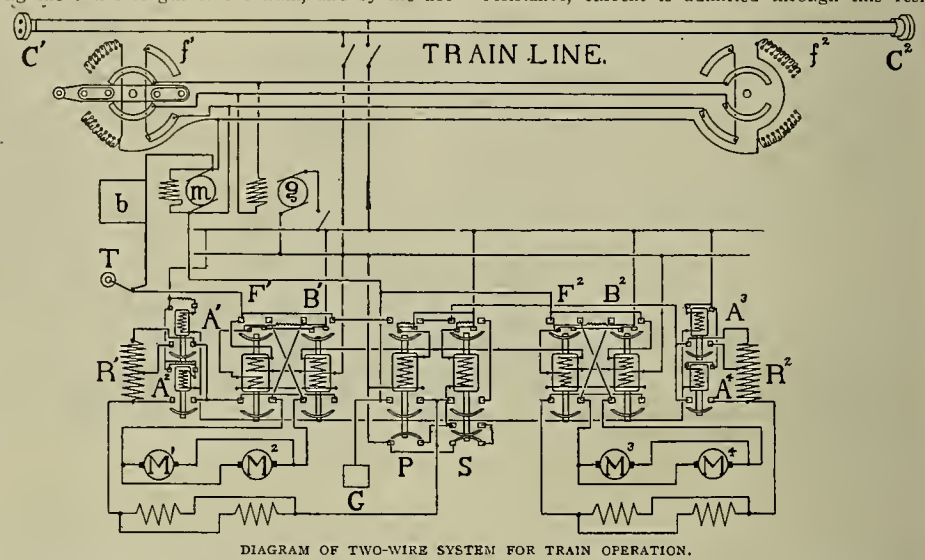


DIAGRAM OF TWO-WIRE SYSTEM FOR TRAIN OPERATION.

The two wires constituting the train line are attached at each end of the car to automatic couplings (C') (C²), which enable the cars to be shifted either end to, thus requiring no attention in coupling up, so far as the electrical equipment is concerned. The maximum current carried by the two-wire train line is the output of a three-kilowatt 110-volt generator when used in connection with six cars equipped with four motors on each car, capable of developing 300 horsepower per car, or 1,800 horsepower per train of six cars. Each car may be equipped with a three-kilowatt motor-generator (M g), shown in the accompanying diagram, capable of controlling the speed of the motors of the entire train, or by another method each car can be equipped with a one-half-kilowatt motor-generator, capable of controlling the speed of its own car only. The direction of travel of the train is controlled absolutely in accordance with the direction of the current flowing in the two-wire train line, and the speed of the train is controlled by the voltage of the current impressed upon the two-wire train line. These wires are utilized for supplying the necessary current for energizing the windings of a number of solenoid switches, which control the current supplied to the driving motors (M') (M²) (M³) and (M⁴), mounted on the trucks.

The two driving motors on each truck are treated practically as one motor, but are provided with an independent solenoid reversing switch (FB) and two solenoid accelerating switches (A) for cutting out the starting resistance (R). Two other solenoid switches (S) (P) are also employed for connecting the motors on one truck, either in series relation with the motors on the other truck or in parallel relation, in accordance with the speed desired. The method of operating the reversing switches in accordance with the direction of the current flowing through the two-wire train line is quite simple. Each solenoid used on the reversing switches (F) (B) is provided with two windings. One of these windings is permanently connected between the trolley (T) or third rail and the ground (G). The other winding is permanently connected to the train line. The winding on the forward solenoid reversing switch (F) is wound left-handed and the winding on the back-up solenoid reversing switch (B) is wound right-handed. It is evident, therefore, that when the current is flowing in the train line in one direction, it will assist the winding of one of the solenoid switches and neutralize the action of the other solenoid winding, so that the desired solenoid switch will be energized in accordance with the direction of the current flowing in the two-wire train line. The windings of the accelerating solenoids and the series and paralleling solenoids are wound to actuate their plungers at different voltages. The operation of the system is briefly as follows:

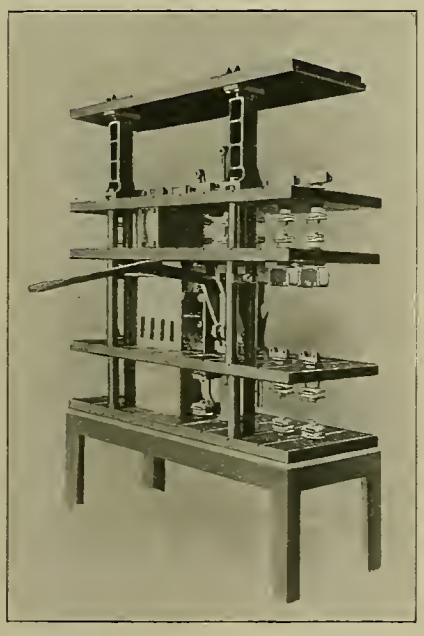
Suppose that each car is equipped with a three-kilowatt motor-generator (M g). At each end of the car is installed a three-kilowatt field regulator (F) having a double set of resistance buttons and segments. An ordinary three-kilowatt 110-volt starting box (b) is also provided. The operator first starts the three-kilowatt motor by means of this starting box. He then moves the field-regulator lever (F') in the direction in which it is desired to move the train. When the lever of the field regulator makes contact with the first step of the resistance, current is admitted through this resistance to the shunt field of the three-kilowatt generator (g), thereby causing it to impress a voltage on the two-wire train line of, say, 20 volts. This voltage is sufficient to supply enough current to energize the forward reversing solenoids (F') (F²), and causes them to lift their plungers, assisted by the current taken directly from the trolley or third rail. The same voltage also supplies sufficient current to energize the winding of the series solenoid switch (S), which attracts its plunger and closes the circuit of the four driving motors (M') (M²) (M³) (M⁴) in series relation. The operator then moves his three-kilowatt field-regulator lever to the second notch, which increases the voltage on the two-wire train line to, say, 40 volts, which is sufficient to energize the first of the solenoid switches (A') (A³) for cutting out the first step of starting resistances (R') (R²). The operator then continues to advance the three-kilowatt field-regulator lever, thus gradually increasing the voltage on the two-wire train line, until finally the second step of resistances (R') (R²) is cut out. The paralleling switch (P) is then energized and the starting resistances (R') (R²) reinserted, which resistances are then again cut out, until the driving motors are finally operating in parallel relation at full speed. The only wires which run the entire length of the car are the two train wires, capable of carrying about 30 amperes and the four-wire cable connecting the two three-kilowatt field regulators, and capable of carrying a small fraction of an ampere in each wire. The solenoid switches controlling the driving motors are assembled in two sets near each truck, so that only four large wires are necessary for connecting the motors on the two trucks in series or parallel relation.

A second method, not shown in this particular patent, has been made the subject of another patent, and installs a one-half-kilowatt motor-generator on each car and varies the voltage of each generator by varying the voltage of the train line. In this case the train line carries current sufficient only for energizing the fields of six one-half-kilowatt generators at 500 volts, or about six-tenths of an am-

pere, the field windings being adapted for 500 volts and the armature windings having a maximum of 110 volts for supplying the various solenoid windings on each car. It will be noticed that there is absolutely no operator's switch in the train line circuit, and that the system is totally different from methods employing a multiplicity of wires running the entire length of the train, and utilizing each wire to energize some particular set of solenoids. The system has a still further advantage in employing a low voltage on the solenoid windings, as well as on the controlling wires. It is possible to control the entire train by means of one wire, using a rail return, but two wires are preferable for practical work. It is also true that it is practically impossible for the operator to too rapidly accelerate the train, for the reason that the potential of the generators used will not respond instantly to changes in the energizing current of their field magnets when designed with this feature in mind. In practice, therefore, the operator has merely to move his controlling lever to the full-speed position, and the train will smoothly and rapidly acquire full speed without further attention.

Cellular Switch Gear for Central Stations.

A good deal has recently been written and said concerning the safety of high-tension switch gear, but considering the importance of the subject too much attention cannot be given to it. A description is here given of the work of Messrs. Walker and Hodgetts of Salford, England, who have set themselves the practical task of demonstrating improvements in the construction of switch gears of the type which has in the past been universally appreciated for use in central stations; particularly upon single-phase systems of 2,000 to 3,000 volts. The accompanying picture shows the new system. The improvements consist of some simple detail alterations to the fuses, with several objects in view, among which may be mentioned the avoidance of



CELLULAR SWITCH GEAR FOR CENTRAL STATIONS.

the use of springs, the provision of a new type of flexible conductor inside the pots and also a mechanical method of fixing the fuse wire in order to replace the existing soldered connections.

In the modification of the general construction of the gear the heavy horizontal slates are taken out of the wall and the switchgear is reconstructed in the reverse position, so that what has been the back now becomes the front and vice versa. This is illustrated in the accompanying picture of a trial board. It will be noted that there are four sets of bolts and distance pieces holding the slates together, and it is found that a very rigid self-containing switchboard can be obtained in this way, although in actual practice on a board of the size illustrated six or eight bolts are used. The bolts are cemented into the distance pieces and so the construction becomes as solid as if it were mounted into the wall. It will be seen at once that by this means the switches and fuses are removed from the operator. He is shielded from any possible arcing from these by two thicknesses of slate slabs.

At first sight it is suggested that this method introduces a back which has hitherto been absent from the type of gear in question, but on afterthought and inspection it will be found that the objection to a back is practically removed in that it is possible to see from the station any person at the back through certain portions of the gear. Moreover the fittings at the back are now shielded in identically the same way as those visible at the front in the original design. G.

Pyro-electrolytic Furnace.

Production and control of temperatures by electric heat within the range above the maximum temperature available for combustion and below that of the electric arc are accomplished by a new device recently patented by Charles P. Steinmetz of Schenectady, N. Y.

In carrying out the invention Mr. Steinmetz makes use of the fact that many refractory materials—such, for example, as refractory oxides, silicates, wolframates, chromates, etc.—are of comparatively high resistance at ordinary temperatures, but increase in conductivity when heated, their conductivity increas-

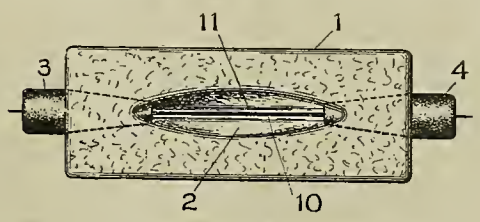


FIG. 1. PLAN VIEW OF PYRO-ELECTROLYTIC FURNACE.

ing with the temperature. Such conductors are designated by the term "pyroelectrolytes." By exposing such pyroelectrolytes to a difference of potential and heating them by some means to a suitable temperature they become conducting, whereupon current commences to flow, giving rise to heat, the degree of which may be regulated or maintained at any desired point by correspondingly regulating the amount of energy expended in heating the pyroelectrolyte. The temperature at which these substances become conducting depends upon the substance, some requiring very high temperatures—as, for example, the pure oxides—while others, as the alkali silicates, become conducting at comparatively low temperatures. In making use of this feature for the purpose of electric heating the substance to be heated is exposed either directly or inclosed in a vessel of very refractory material to the heat generated in a mass of some chosen pyroelectrolyte.

In its practical application the invention is capable of numerous modifications.

In the diagrams, Fig. 1 is a plan view of an electric furnace, and Fig. 2 is a sectional view.

Where comparatively small quantities of material are to be heated it is convenient to make the furnace out of a block or blocks of pyroelectrolytic material either hollowed out or formed with a depression for containing the substance to be acted upon. In the particular arrangement shown a block of pyroelectrolytic material is indicated at (1) and is provided with a depression having a horizontal section approximately elliptical, such as is indicated at (2), the depth of the depression being greater at the middle portion than at the ends.

The terminals through which the electric current is conducted to the furnace consist of some suitable material—such, for example, as carbon—formed into blocks fitted into openings communicating with the retaining recess or cavity for the material to be heated. The carbon terminals are indicated at (3) and (4) and are conical in shape and engage with corresponding openings in the opposing ends of the block (1) of pyroelectrolytic material. Current is transmitted to the terminals (3) (4) by a suitable conducting circuit, indicated diagramatically by the lines (5) (6), connected in series with the secondary (7) of a step-up transformer. The primary of the transformer has its winding subdivided so that either a greater or a less portion of its length may be included in circuit with the primary supply mains (8) (9), thereby offering a means for varying the electromotive force impressed upon the terminals of the furnace. The means thus indicated for varying the electromotive force, and consequently the current supplied to the furnace, are merely by way of illustration, and it will be evident that any other suitable and appropriate means for performing this function may be employed.

As has already been stated, the pyroelectrolytic material forming the walls of the furnace is practically a non-conductor when cold, so that in order to cause current to flow it is necessary that some means for initially heating it should be provided. There are various arrangements which are suitable for this purpose. Thus, for example, heat may be applied to the furnace walls from some external source as by means of a blowpipe or some similar source of intense heat. It is convenient, however, to produce the initial heating of the pyroelectrolyte by arranging some refractory conducting material between the terminals of the furnace and either close to or embedded in the pyroelectrolyte. In the diagrams are shown a small rod or filament (10) of carbon extending between the terminals (3) (4) and embedded within a recess (11) in the bottom of the cavity (2).

In starting the furnace a suitable difference of potential is impressed upon its terminals, heating the filament (10) and so communicating heat to the adjacent pyroelectrolyte, which becomes conducting, and current from the source commences to flow, giving rise to a degree of heat determined by the difference of potential impressed upon the furnace.

In furnaces of this character the phenomena taking place are widely different from those occurring in methods of heating by the electric arc. In an arc furnace—such, for example, as a carbide furnace—the potential gradient or drop in voltage along the heated space is comparatively low as compared with the potential gradient or drop in voltage in a pyroelectrolyte heated by the electric current, the potential gradient in the carbide or similar furnace being of the magnitude of 10 volts per inch as compared with 1,000 volts per inch in the pyroelectrolytic furnace above described. This large potential gradient by giving rise to the possibility of a large expenditure of electric energy in a confined space explains the capability of the pyroelectrolytic furnace for producing extremely high temperatures.

By the operation of the invention temperatures can be produced and maintained from the relatively low temperature of fusible alkali silicates, as glass, up to the extremely high temperatures of fusible orthosilicates of alumina, etc., and chemical reactions produced at these temperatures.

A further application of the invention would be for melting refractory oxides and silicates, as those of alumina, etc. When melted in the arc, no clear and transparent products can be secured, since the

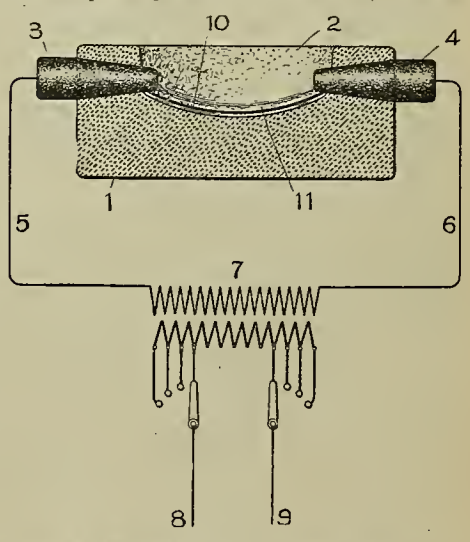


FIG. 2. SECTIONAL VIEW OF PYRO-ELECTROLYTIC FURNACE.

temperature of the arc is beyond the boiling point and at the dissociation temperature of these substances and the resulting mass is thus filled with air bubbles and partly dissociated. By raising to, however, and maintaining the temperature exactly at or slightly above the melting point of these substances they can be fused satisfactorily.

Most precious stones, as the topaz, sapphire, emerald and ruby, are alumina or aluminum silicate more or less colored by foreign material. Others are oxide and silicate of beryllia and zirconia. It has been found by experiment that by heating aluminium silicate by this means it fuses to a transparent mass, colored yellowish in the present instance by impurities and of the nature, hardness and composition of topaz, and it has been possible by the use of small traces of chromic oxide and cobaltic oxide to get green and blue transparent masses of the nature of emerald and sapphire.

The Spokane Southern Traction Company, promoted by M. F. Mendenhall of Spokane, Wash., has increased its capital stock from $500,000 to $2,000,000, and now proposes to build a trolley line to Colfax. The system as planned will rival the Graves project in the same field.

WESTERN ELECTRICIAN

EVERY SATURDAY.

PUBLICATION OFFICES:
510 Marquette Building, · CHICAGO.
TELEPHONE, MAIN 1746.

Eastern Office, 193 Times Building, New York.
Telephone, 3806J Cortlandt.

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted. This paper is entered at the Chicago postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the **old address** as well as the new should be given.

CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—**the only general electrical paper published in the West**—thoroughly covers a territory *exclusively its own.* THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be furnished on application.

REMITTANCES.—All checks, drafts and other remittances should be made payable to the order of the publishers, the **Electrician Publishing Company,** and addressed to the offices of publication, Suite 510, Marquette Building (204 Dearborn Street), Chicago, Illinois, U. S. A.

CONTENTS OF THIS NUMBER.

Electric Power in the Linz Railway Shops in Austria. By Emile Guarini. Illustrated 441, 442
Municipal Ownership of Public Utilities in England.. 441
National Electric Light Association Will Meet in Denver and Colorado Springs 441, 442
American Institute of Electrical Engineers 442
Chicago Branch of the Institute Resumes Its Meetings.. 442
Delay in Invention 442
Problems of Heavy Electric Traction. By O. S. Lyford, Jr., and W. N. Smith. Illustrated. With discussion. (American Institute of Electrical Engineers).. 442, 443 444
Two-wire System for Train Operation. Illustrated..444, 445
Cellular Switch Gear for Central Stations. Illustrated.. 445
Pyro-electrolytic Furnace. Illustrated 445
Editorial 446
Metric Measurements. By Alexander Siemens. (British Institution of Electrical Engineers) 447
Electricity and the Contractor. By Howard S. Knowlton 447
Transformer for Thawing Ice in Water Pipes. Illustrated 448
Gas Engine Adapted for Heavy-duty Electric-light and Power Work. Illustrated 448
Electric Automobiles for Express Service in Washington. 448
Possible Waterpower Developments in Missouri..... 449
Convention of District Managers of the Westinghouse Company. Illustrated 449
Ohio Telephone Notes 450
Telephone News from the Northwest..... 450
Michigan Telephone Matters 450
Indiana Telephone Items 450
Use of the Telephone in Reporting Football Games... 450
New Companies 450
General Telephone News 450
Ottumwa Telephone Company Reorganized..... 451
Copper Market 451
Telephone Companies Gain a Point in Canada..... 451
Telephone Development in the City of Mexico..... 451
Braking High-speed Trains. By R. A. Parke. (International Electrical Congress)..... 451, 452
Ontario Power Company Contracting for the Delivery of Current 452
New Members of the Institute..... 452
Business Opportunities Abroad 452
Prize Design for an Edison Medal..... 452

DEPARTMENTS.

Correspondence 453, 454, 455
Great Britain 453
New England 453
New York 453
Dominion of Canada 453, 454
Ohio 454
Indiana 454
Northwestern States 454
Michigan 454, 455
Rocky Mountain States 455
Pacific Slope 455
Personal 455
Electric Lighting 455, 456
Electric Railways 456
Societies and Schools 456
Publications 456
Miscellaneous 456
Trade News 456, 457
Business 457
Illustrated Electrical Patent Record..... 457, 458

DATES AHEAD.

American Society of Mechanical Engineers (annual meeting), New York City, December 6th, 7th and 8th.

Electrical committee of the Underwriters' National Electric Association (annual meeting), 32 Nassau Street, New York city, December 7th.

Interstate Independent Telephone Association of America (annual convention), Auditorium Hotel, Chicago, December 13th, 14th and 15th.

SUBWAY ventilation is attracting as much attention in New York as though it had not been threshed over in London, particularly in the case of the steam underground railways, for the last 30 years. Londoners testify that the atmosphere in the tunnels used for steam-railroad traffic is never good, and on a foggy day is usually very bad. Indeed, persons unaccustomed to it are apt to be greatly oppressed by the combination of smoke and fog and frequently experience an earnest desire to get to the open air at the first stopping place. And yet, with all, discomfort and not serious danger seems to be the menace of the vitiated atmosphere. It is therefore quite unlikely that any serious trouble due to lack of oxygen will be encountered in the operation of the New York subway, and if it should be necessary, electrically-operated exhaust fans may be easily installed.

WE received lately a notice from Laundry Workers' Union, No. 22, of Chicago, announcing a forthcoming lecture course. A leaflet accompanying the note set forth that this trades union believes in the "Chautauqua idea" and in systematic reading. The plan is called "spare-minute education," and the subjects of three lectures announced were "Education All Through Life," "An Illustrated Journey Through Germany and Belgium," and "The People's Part in Public Improvement." It is of further interest to observe that Laundry Workers' Union, No. 22, is composed of women, for so we infer from the fact that the officers are women. These progressive laundry girls are to be heartily commended on their manifest desire for intellectual improvement. They have set a good example for labor organizations composed of men in the electrical and other industries.

WHAT threatened at one time to become a dispute of serious proportions between electrical interests in Denver and Colorado Springs for the privilege of entertaining the National Electric Light Association has been settled to the apparent satisfaction of all hands by the selection of both cities. The meeting will be known as the Denver-Colorado Springs convention. The arrangement is that the business sessions shall be held for three days in Denver, and thereafter the delegates and visitors will be taken to Colorado Springs for two or three days of sight-seeing and social intercourse. Thus both cities will participate in the benefits of the convention, if the plan outlined is followed by those who attend. To do so will make a considerable demand on the time of the eastern men, considering also the time consumed in railroad journeys, but as Colorado will be virgin soil to many of the visitors and as this will be the first Rocky Mountain convention of the association, it is earnestly hoped that the official programme will be observed.

HEAVY electric traction of a class to which the proposed electrification of the suburban service of the Long Island railroad belongs involves problems in the calculation of motor sizes, gear ratios, train weights, acceleration, etc., which do not occur as important factors in the design of ordinary interurban lines. The paper presented by Messrs. O. S. Lyford, Jr., and W. N. Smith to the American Institute of Electrical Engineers last week upon "Problems of Heavy Electric Traction" is full of interest. It is devoted to some of the engineering questions which have arisen in the planning of the electrification of the suburban service of the Long Island road. The paper, besides laying before the reader the present status of this work, explains some of the methods followed by the designers to get away from the purely theoretical methods of going about the necessary calculations which are usually employed, especially those relating to train acceleration. In order to do this test runs made on the Grand Rapids, Grand Haven and Muskegon railway and on the Detroit, Ypsilanti, Ann Arbor and Jackson railway in Michigan were observed, and the results of these tests were plotted in the form of curves. By comparing these curves with plotted curves from theoretical formulas it was sought to obtain a verification of the accuracy of all the elements entering into the calculations.

The authors of the paper have evidently put much thought and work upon it, with the object in view of arriving at some simple method of predetermination in the handling of problems of heavy electric traction. While the work which they have done is excellent and will be welcomed by engineers generally as a source of information, it is still open to the criticism of the purely theoretical man who attacks such problems by the aid of old and tried formulas, and who will no doubt say that the theoretical methods which the authors appear to disparage, after all, give results but little removed from the results as shown by the actual tests as recorded in the paper.

Owing to lack of space, only extracts of the paper and discussion can be given in the Western Electrician. These appear on other pages, the parts which are given being selected as having a direct bearing on the work thus far done on the electrification of the road, without considering in detail the methods followed.

UNLESS there be an extension at the last moment, this week marks the passing of the Louisiana Purchase Exposition at St. Louis, for it is announced that the books of the Exposition Company will be closed on December 2d. The event is of more than fleeting interest, as it is probable that it will be several years before another great international exposition is held in the United States. There will be other expositions, of course—the Lewis and Clark Centennial Exposition at Portland, Ore., under the presidency of Mr. H. W. Goode, a former electrical man of Chicago, is scheduled for 1905—but present indications are that there will be a long breathing spell before another world's fair, or universal exposition, such as those of Philadelphia, Chicago and St. Louis, will take shape in this country. And this prospect is not to be regretted. The exposition idea has been worked pretty thoroughly within the last dozen years, at least in the central and eastern parts of the country, with several minor exhibitions and two great ones; and if there is a long interval of relief, exhibitors and visitors, now exposition-surfeited, will return to the arena, perhaps a decade hence, like giants refreshed.

While the total attendance at the St. Louis Exposition has been a disappointment to the management, in that it is considerably less than the number that had been hoped for, it is gratifying to learn by an official announcement that the Exposition Company has settled its accounts with the various banks and trust companies, as well as with the United States government, and that it now has no bills payable on its books save for comparatively insignificant current accounts. Therefore, it seems assured, the balance will be on the right side when it is finally struck. Probably there will be no return, or only a slight return, on the capital stock, but at any rate the Exposition has maintained itself, which is more than some croakers would admit a month ago.

But it is not to the profit-and-loss account that one must look for the value of expositions. In the language of the lamented McKinley, they are the time-keepers of human progress. And in this view, the St. Louis Exposition has, on the whole, worthily fulfilled its mission. It has been a great exposition, planned on magnificent lines; and if the execution fell something short of the plan, it did not do so in any essential or vital particular. The aim—the educational idea—was high and fine; the performance, if not up to the very highest degree of excellence in all departments, was good; and if the whole undertaking was not carried through with precise completeness in all details, it was because so much was attempted, while it is also to be borne in mind that any shortcomings were more noticeable by reason of the very richness and fullness of so many of the multifarious human activities represented at the exhibition.

Electrically considered, the Exposition did not reveal many novelties. The foreign exhibits of electrical machinery, too, were rather scanty. The 3,000-horsepower gas engine from abroad that many electrical men hoped to see did not appear; neither was anything heard, apparently, of the effort that was to have been made to transmit electric power, to the extent of a tenth of a horsepower, through space, without wires. But the lighting effects were striking, and there was a display of American electrical apparatus that was creditable as a whole and in some respects brilliant. It is to be remembered that the electrical exhibits were viewed by many more non-electrical than electrical visitors, and it was admirably planned for the educational benefit of the former class.

St. Louis will witness the close of its fair with varied feelings, no doubt. Not every hope was realized; but the people of that city will have the satisfaction of knowing that the Universal Exposition of 1904 was great in conception, beautiful in design and worthy in execution.

Metric Measurements.[1]

By Alexander Siemens.

One feature of electrical measurements has contributed more than anything else to the rapid rise of the industry, and that is the adoption of the same units of measurement in all countries. The idea of such a system originated with Prof. Wilhelm Weber of Göttingen about 70 years ago, but the British Association for the Advancement of Science has the honor of having taken the first step to realize the proposal of Weber by appointing a committee to suggest practical electrical units. This committee, after due deliberation, chose as the basis of its system the centimeter, the gramme, and the second, and I should like to know why they chose the metrical units, unless they had convinced themselves that these were the best for the purpose. At that time (1861) there was no question of international units, nor had the metrical system been adopted as universally as it is now; all the more weight ought, therefore, to be attached to the decision of this committee, which consisted of eminent scientific men and prominent engineers, so that both the theoretical and the practical aspects of the question were kept in view during their deliberations. Certainly there is no doubt about the beneficial effect of the adoption of this system by all countries, and I have no recollection of ever hearing that the decimal division adopted in it has given rise to any difficulties. It is true some modifications have become necessary, which were discussed and accepted at a series of international congresses called for the purpose, but so far as I am aware nobody has ever suggested that it would be to the advantage of any country to start a system of electrical units of its own. In spite of this favorable experience we all know that there exists still an obstinate resistance against the general introduction of the metrical system into this country, although it has been shown over and over again that the reasons advanced for this obstruction are based on fallacies and are opposed to the experience of other countries. Such an attitude is very largely due to want of practice with a thoroughly consistent system of weights and measures. In this connection it is significant that all engineers who have had to deal for any length of time with metrical measurements, unhesitatingly prefer them to the English want of system. I am of course aware that some prominent engineers profess to have tried to work with metrical units and have been unable to work as quickly and easily with them as they could with their accustomed units. About them one is tempted to say that their conclusion in this particular matter is about as reliable as that of a man who tries to skate, and after his first attempt gives it as his opinion that you cannot move faster by skating than by walking. Another big outcry is raised against the metrical system on account of the great disturbance of all business transactions that would result from the change of weights and measures, and appalling figures are marshalled as to the expense of giving effect to it. It does not appear that other countries have been ruined by discarding obsolete weights and measures, nor should the expert opinion of the inspectors of weights and measures be ignored, who unanimously consider the introduction of the metrical system to be a pressing need to put an end to the existing confusion, and advocate in addition that such an introduction should be made compulsory. The very same thing has been recommended by two or three parliamentary committees after hearing innumerable witnesses for and against the change. Why should such well-considered opinions be calmly ignored, and why should the bogie of expense be trotted out before the public when the real sentiments of the opponents about the disturbance of trade, caused by a change of weights and measures, are disclosed by the fact that they themselves advocate a revised British system based on the inch, the introduction of which would have the same disturbing influence as that of the metrical system, but would lack the advantage of making the international metrical system the universal one? For it cannot be doubted that the example of Great Britain would immediately be followed by the British colonies and by the United States, so that the whole community in all civilized countries would enjoy the same advantages as the electrical engineers already possess.

Against this argument the opponents of the metrical system usually point out that even in France some instances can be found where the old measures are used in preference to the metrical ones, but on examination it turns out that only the old names are preserved in some districts and in some trades, but that in reality the measures in use are based upon metrical units. The few exceptions are only proving the rule, and it would be as wrong to say that the metrical system is not universally used in France or Germany as it would be to contend that English is not the language of the United Kingdom, because you can find people in some remote parts who do not know that language. As a last resort the expense of changing the screwthreads is urged against the change to the metrical system, and the Continental practice of calling their system "Whitworth Thread" is considered an incontrovertible proof that the metrical screwthread is impracticable. If all taps and dies and leading screws had to be exchanged at once it would certainly be a costly affair, but such a measure is not likely to be adopted, as no advantage could result from it. For the real difficulty with screwthreads is that giving dimensions on paper is not sufficient to insure that the screws, manufactured according to such instructions in different works, are really interchangeable. This subject has been investigated by a committee of the War Office, and its conclusions throw a very interesting light on the controversy. In its opinion it is only possible to obtain interchangeable screws if the leading screws by which they are made have all been cut on the same screw-cutting lathe, or are at least cut on benches which are fitted with a leading screw manufactured on the original bench. If another link is interposed differences in the screw turned out become perceptible. As a consequence of the finding of this committeee a screw-cutting lathe has been set up at the National Physical Laboratory, where leading screws for screw-cutting lathes are to be manufactured. The same experience has been made in other countries, where nominally "Whitworth's Threads" are used. It is not possible to make screws interchangeable by prescribing their dimensions; the only way is to obtain taps and dies or leading spindles cut by the same tools. If it is not a case of extreme accuracy there is no difficulty in cutting English thread by means of a metrical leading screw or vice versa. By using a wheel with 127 teeth on the driving-axle an accuracy of 1:6350 can be obtained, which is sufficient for ordinary purposes. In any case it is much to be regretted that such a useless encumbrance of our daily life and such an obstacle to foreign trade as the English system of weights and measures has not yet been abolished.

1. Part of a presidential address to the (British) Institution of Electrical Engineers delivered in London on November 10, 1903.

Electricity and the Contractor.

By Howard S. Knowlton.

Anyone who takes the trouble to compare the methods of modern building construction with those of but a few years ago cannot but be impressed with the increasing number of labor-saving plans and devices which have been adopted by progressive contractors. A very few minutes observation of almost any large office building, hotel or store in its early stages of development is all that is necessary to demonstrate the extent to which the division and systematic control of labor have been carried by the contractor in charge of the work. Much still remains to be done, however, along the line of displacing unskilled labor—or better, releasing it for other work—by mechanical or electrical methods of accomplishing the required result.

Close observation of general engineering and building construction, railroad maintenance and allied activities brings to light the fact that muscular power can probably never be entirely eliminated in the organized work of the world. Selective intelligence cannot be superseded, but it is important to constantly study the problem of putting the machine in the laborer's place. It is not always realized that unskilled labor is a heavy expense in large industrial enterprises, because the wages of the individual are far from imposing. At five per cent. interest, however, the capitalization of an unskilled laborer earning $1.50 per day, or $450 per annum, amounts to $9,000. If he can be replaced by a machine whose interest, depreciation, taxes, repairs, insurance and power cost per year runs up to 20 per cent., there will be a financial saving up to $2,250 investment. A case in point is that of the contractor who pumps out his excavation by hand, generally using two laborers to the pump, even though he employs arc and incandescent lamps at night to enable the work to be pushed hard and fast. It is hard to see why motor driven pumps are not installed when the power circuits are available at many points on the job, particularly as the first cost of such an outfit would probably not exceed 2½ per cent. of the $4,500 which it will pay to spend to do away with each pair of laborers engaged in pumping. This reasoning naturally applies with greater force to large undertakings than to small, because it does not pay to make elaborate preparations for doing a simple piece of work.

The inefficiency of the ordinary steam engine used for hoisting has long been realized by contractors, but its great range of usefulness has until lately enabled it to do its work under all sorts of conditions with little or no competition. Recent experience with electric power, however, has shown that where current is available at reasonable cost, say from 10 cents per horsepower-hour downward, it is a great mistake not to consider the advantages of the newer methods before beginning an extensive piece of work. The electric hoist uses power only when it is in actual operation, and then takes power in close proportion to its load; its efficiency far exceeds that of a wasteful donkey engine in point of fuel consumption; it is frequently capable of more work with the same attendance than the latter can accomplish; it often has a greater field of usefulness than the steam engine, and it is cleanly, practically noiseless and always ready for immediate use. At night it can be used in the most fastidious residence section without causing the slightest disturbance. Being light in weight, it can readily be transported to any part of the work and may raise itself from one floor of a building to another.

The steam boiler of the donkey engine must be kept fired all day and in cold weather during the night as well. The exhaust of the engine often frightens horses; the smoke and soot begrime everything animate and inanimate within the neighborhood, and the fire risk is always present. The premises are bound to be characterized by smoke, steam, ashes, coal dust, leaky pipes and more or less water. It has been said with truth that the steam engine works by day and the electric hoist by the piece. The latter may present a slight fire risk if it is improperly wired, but in operation this risk is insignificant. The compactness and portability of the electric hoist make it possible so to locate it that the operator is always within sight of his work. In underground work the economy, reliability and safety of the electric hoist increases with leaps and bounds in comparison with other methods. Steam engines are simply out of the question in mines which are operated with regard to efficiency, freedom from danger and steady, continuous service.

The electric hoist may be so mounted on the mast of a derrick that the distribution of the load as well as its raising and lowering is entirely under the control of a single operator. Thus the control of the machine equals or excels the accuracy with which a steam engine may be operated in such service, and it is entirely free from the jerky motion which is commonly found in the latter machine as used in contract work. Here the uniform torque throughout the entire revolution of the motor armature works to the distinct disadvantage of the reciprocating engine just as it does in the acceleration of rapid-transit railway service. This nicety of control gives the electric hoist a notable value in such work as placing stone and handling heavy steel girders.

In lumber yards or on wharves the motor-driven hoist finds a sphere of continual usefulness. Mounted on a truck, it is easily moved from place to place, and it possesses many advantages for the loading and discharging of vessels. Within a building the electric hoist can be used inside the most expensively finished rooms long after the air-befouling and begriming donkey engine has been obliged to evacuate the premises. When the hoist is so placed that the operator can see the work which is being done, it is often possible to swing the piece into place in less time than it would require to get the signals to an engineer so located that he cannot see all that is going on. Furthermore, the electric hoist used in connection with derricks can readily be so mounted that it will serve as a partial counterweight and thereby lessen the strain on the derrick and guy ropes. When the hoist is mounted so as to swing with the boom and thus enable the operator to always face his work, a notable increase in capacity is obtained. In determining the relative economy of steam-driven and electric hoists, the proper basis of comparison is the cost of operation for a given amount of work handled rather than the cost per day or per month. Often contractors adhere to the donkey engine because electric power is not available at some suburban or outlying point where the building under consideration is to be erected. This drawback will disappear as the extension of commercial power circuits becomes greater and as central-station men realize the amount of new business which awaits exploitation in the hoisting field as well as in other phases of contracting. The induction motor is so well suited to hoisting that the limitations of direct-current transmission no longer apply. Pile drivers, stone crushers and other machines are equally applicable to electric driving.

An operation frequently encountered in contract work is the tearing down of old buildings. Probably in the majority of cases the brick and stone walls are demolished by gangs of laborers working with pick and shovel. Here the old question of muscle at $1.50 or thereabouts per day per man, vs. machinery, comes in, and there would seem to be a chance for economy through the use of electric or pneumatic rock drills in helping the slower picks in the work of destruction. Still another gain in efficiency arises from the use of double ladders for up-and-down travel, which saves considerable time in the course of a month. The portable telephone and the megaphone likewise should prove useful.

Transformer for Thawing Ice in Water Pipes.

Thawing ice in water pipes by electricity, a subject which has been under discussion since 1899, but which has created renewed attention during the last year, promises to be a paying business for central stations located where severe winters are common. Last winter a few companies tried it in a more or less experimental way, and reports have been made showing the profit in the work. Illustrated herewith is a transformer outfit designed and

TRANSFORMER FOR THAWING ICE IN WATER PIPES.

built by the Pittsburg Transformer Company of Fittsburg for this particular service.

The outfit consists of a transformer, as shown in the picture, adapted to operate on any circuit of approximately 1,100 or 2,200 volts and 60 or 133 cycles. The transformer will deliver a current of 300 amperes continuously, or currents of about 600 amperes for periods of half an hour.

On the back of the transformer are mounted a heat indicator and a choke coil. The heat indicator consists of a section of lead pipe connected in series with the transformer, and the temperature which this assumes is a guide as to the heating of the pipe under treatment. The choke coil consists of a few turns of heavy copper bar with a movable laminated-iron core. When this plunger is pushed entirely into the coil the transformer secondary may be short-circuited, but no more than normal current will flow.

The object is to send current through the frozen section of pipe. One secondary lead should be connected to the pipe inside of the house and the other lead connected to a nearby hydrant outdoors, or to a pipe inside of a neighboring house.

The transformer is connected to the primary line in the usual way, altering the connections on the porcelain terminal block, if necessary, to adapt it to the line voltage, as shown on tags attached to the transformer.

Any standard fuse block may be used to protect the transformer. These are fused with a 20-ampere fuse for 1,100-volt circuits or with a 10-ampere fuse for 2,200 volts.

The hand is kept on the heat indicator and the plunger pulled out little by little until the indicator is hot enough. Water will usually begin to flow slowly in five or 10 minutes.

One of the advantages of this outfit is that it weighs but 235 pounds.

Gas Engine Adapted for Heavy-duty Electric-light and Power Work.

Embodying many distinctive points of value and representative of the most advanced gas-engine practice in Europe, the Cockerill gas engine, herewith illustrated, will be of particular interest to electrical engineers who have to do with electric-light and power stations.

The gas engines of this system, which are handled in this country by the Wellman-Seaver-Morgan Company of Cleveland, Ohio, are of the well-known four-cycle type, in which only one impulse caused by the combustion of the gaseous mixture takes place during one stroke of the complete cycle, or in two revolutions. The engine acts as a pump as well as a motor. The gas mixture is drawn in during the first (forward) stroke and compressed during the second (return) stroke, exploded in the third (forward) stroke and exhausted in the fourth (return) stroke. This action takes place on each side of the piston, as the cylinders are built double-acting. A view of the engine is shown in Fig. 1.

Taking up the various parts of the engine separately, the design of the cylinders presents the following important features:

Owing to the considerable differences in temperature occurring in the cylinder, it is necessary to provide for free expansion, and this is obtained by supporting the cylinder in a cradle, one end only being attached to the main girders of the engine bed. The power of each end of the cylinder is transmitted directly through the girders to the engine frame, as the two heads of each cylinder are connected by through-going bolts, and the power developed in the back end of the cylinder is transmitted through these to the front end. The cylinder proper is therefore not subjected to the stresses incidental to power transmission.

The pistons are steel castings in one piece and secured to the piston rod by means of a collar and nut. No taper is used on the rod, and the wedge action caused by tightening the nut, and thereby tending to split the piston, is avoided. A special feature of the engine is the water-cooled piston-rod nut, which is an additional preventive to premature ignition. The pistons do not bear in the cylinders, but are supported outside the cylinders by cross-heads.

All valves of each cylinder end (see Fig. 2) are operated by a single cam; therefore, in a four-cylinder double-acting gas engine there are only eight cams in all. The valve gear though performing the regulation of the mixture in a perfect manner, is of the greatest simplicity, and consists of only a very few parts in motion. The side shaft (SH), driven by the engine shaft and making one revolution to two of the latter, because of the four-cycle principle, carries a cam (C) for each cylinder end. This cam serves for operating both the inlet and outlet valves. The cam revolves in the direction indicated by the arrow (1). When the lobe of the cam begins to act on the roller (r) the latter and the rod (T) rise, the lever (B) oscillates, and its end (b) descends. This movement causes both the mixing valve (M) and air valve (L) to open. The latter, which is fixed to the mixing valve (M), uncovers the air ports (A). The moment of opening these valves corresponds exactly to the dead-center position of the piston at the beginning of the suction stroke. In the first part of the suction stroke, air only is therefore drawn in. The double-beat gas valve (V) concentric with the mixing valve, remains closed. It is operated by the lever (D), whose outer end (E) engages with the latch (F) of the lever (G), when the inlet valves are on their seats. During the opening of the mixing valve the spring cap (H), fastened to the mixing-valve stem, compresses the spring (S), as the spring cap (I) on the other end is fastened to the hollow stem of the gas valve, which, being blocked by the latch, remains closed. The connection (K) and its parts act as a link of variable length between the levers (B) and (D). An eccentric (Q) on the side shaft (SH) operates a small cam (m) by means of the rod (T'), the oscillating lever (N) and the rod (O). The center of oscillation of lever (N) is variable and under the control of the governor, and the effect of the displacement of this center is similar to a change of the length of the rod (O). The cam (m) operating on the roller (P), secured to the end of the lever (G), disengages the latch (F) at a definite moment predetermined by the governor, and the gas valve (V) opens quickly, the amount of opening being limited by the space between the piston and the bottom of the dash-pot cylinder (K). The proportions of the lever (B) and (D) are such that the opening of the valves (V) and (M) and also the slide (L) bear a fixed relation with one another. From the moment of the opening of the gas valve, which corresponds to a certain predetermined position of the piston during the suction stroke, air and gas in proper proportions are admitted so as to give a good mixture. Whatever, therefore, the moment of cut-off may be, the proper quantity of gas and air for a good mixture is admitted. The two valves and the slide remain open until the end of the suction stroke. At this moment while the roller (r) descends on the lobe of cam (C), the large spring (R) closes the mixing valve and the air slide, and the link (K) returning to its original length, transmits the descending motion of (B) to (D), and closes the gas valve (V). A small spring (s) is introduced, so as to permit the mixing valve (M) to continue its motion and seat itself should the valve (V) touch its seat before (M) can close.

The piston on its return stroke compresses the charge, the inlet and outlet ports of the cylinder being closed; but as the variable quantity of mixture followed a certain volume of air and completed the 100 per cent. of cylinder volume, the best mixture remains close to the igniters, located in each cylinder head, and therefore firing is assured, even with smallest load.

A little before the dead center corresponding to the end of the expansion stroke, the lobe of the cam (C) touches the roller (t) and acts by means of the rod (U) and the levers (W) and (X) upon the exhaust valve (Y), opening the same. This valve remains open during the exhaust stroke (second return stroke of the piston), and is closed on the dead center corresponding with the beginning of the next suction stroke by means of the spring (Z), which acts at all times to close the valve, and presses the roller (t) against the cam (C).

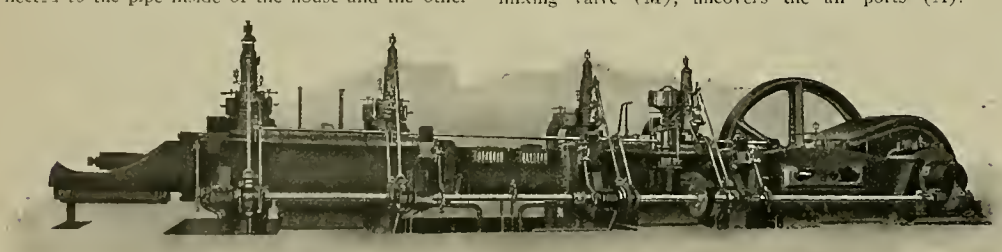


Fig. 1. General View of the Engine.

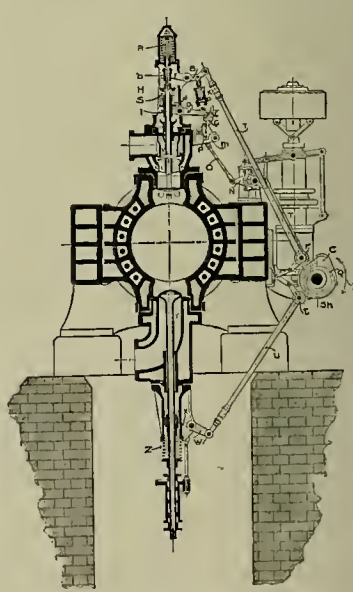


Fig. 2. Detail of Valve-Operating Gear.

GAS-ENGINE ADAPTED FOR HEAVY-DUTY ELECTRIC-LIGHT AND POWER WORK.

Electric Automobiles for Express Service in Washington.

Members of the board of directors of the Adams Express Company were recently in Washington, D. C., and directed that electric automobiles be installed in the delivery business in that city. Ten machines were immediately put into service, and a few days' trial in this capacity has convinced the management that business can be carried on with greater dispatch and at a less expense than by the horse-drawn vehicles. Eventually the company will have between 30 and 35 machines in use in Washington. They will be operated by the company's own men, who are being trained by experts. The automobiles being used by the company were manufactured by the Lansden Company of Newark, N. J. Each machine weighs 3,000 pounds, has a capacity of one ton and is equipped with a 60-cell Edison battery of the ferro-alkaline type. The company has set aside a large portion of its stable on B. Street, which will be used as a garage. This garage has a charging station with a switchboard capable of accommodating 18 machines.

Possible Waterpower Developments in Missouri.

Messrs. E. Johnson, Jr., and F. W. Hanna, engineers of the United States Geological Survey, have recently examined three springs in Missouri, and Mr. Johnson has submitted a report on the possible development of waterpower from each spring. They are Greer Spring in Oregon County, Alley or Big Spring and Blue or Round Spring, both in Shannon County. The report will undoubtedly interest many people.

Greer Spring is located in the north-central part of Oregon County about 1½ miles south of Eleven Point River, eight miles northeast of Alton, the county seat of Oregon County, and 16 miles due south of Winona, Shannon County. It derives about one-fourth of its water from an underground stream which emerges from a cave in a high limestone bluff and three-fourths from the so-called "boil," 100 feet distant and seven feet lower, the source of which is unknown. It rises at the head of a deep and narrow valley, through which it flows in a rapid descent to Eleven Point River.

On September 30th the engineers ran a line of levels from the water surface at the top or cave exit of the spring to the water surface in Eleven Point River and return. They found an almost uniform fall, amounting in all to 53.94 feet. There are numerous points at which dams could be built, as solid rock for foundation work and abutments is plentiful. A stone and timber dam developing a fall of about nine feet is already in existence on this stream. By means of a horizontal turbine and endless wire rope it transmits power to a large grist mill located at the top of the valley about 200 feet above.

A gauge was established by which the flow was determined to be 362 cubic feet per second at a gauge height of one foot. The discharge was found to be 265 cubic feet per second at a gauge height of 0.72 foot. No storage could be developed here. At times of minimum flow, which is not far from 265 cubic feet per second, a head of 54 feet can be developed without backing the water over the spring. When Eleven Point River is at a high stage this head fall would be correspondingly decreased, but the flow of the spring is then greater, as it changes more or less with the rainfall, and probably at least 20 feet more head could be developed without injury by backing water over the spring.

The minimum discharge (265 cubic feet per second) and the minimum fall (54 feet) will give 1,626 horsepower, gross, or (using 80 per cent. efficiency) 1,301 horsepower, net.

Alley or Big Spring is located six miles west of Eminence, the county seat of Shannon County, Mo. It emerges at the base of a high sandstone bluff located on the side of the comparatively broad valley of Jacks Fork of Current River. After flowing a distance of about one-half mile it discharges into Jacks Fork.

Conditions are such that a dam could be built only at the head of this spring, where there is at present a small stone and timber dam which furnishes power for a grist and sawmill. On October 2d Messrs. Johnson and Hanna ran a line of check levels from the present surface of the spring above the dam to Jacks Fork and found the total fall to be 17.24 feet. Both spring and river were then probably at their lowest stages. On the side of the high bluff north of the spring's outlet a flume leading from the dam to the river could be economically built. By means of this flume and of turbines placed near the river the fall noted—17.24 feet—could be nearly all utilized. The engineers also determined that the discharge of the spring at its lowest stage is 85 cubic feet per second.

No storage could be developed here. A dam of considerable height might, however, be built at the site of the present one, provided no injury resulted from the backing of the water. This dam would need to be semicircular in form and 300 or 400 feet long at its crest, the length depending on its height, which could be from 10 to 70 feet.

Without raising the water in the spring above its present level, 164 gross horsepower, or 131 net horsepower (using 80-per cent. efficiency), could be developed. This would probably be the minimum power during the year and the maximum during the summer months.

Round or Blue Spring is located 14 miles northwest of Eminence. It is situated at the bottom of a natural well about 50 feet in diameter, one side of which is formed by a high bluff. Through an opening on the other side, 18 feet below the surface, the spring flows out and discharges into Current River, which is about a quarter of a mile distant.

The engineers ran levels from the surface of the spring to the surface of the water in Current River and found the fall to be only 3.87 feet. River and spring were then at a very low stage. The flow was at that time only 23 cubic feet per second.

No storage can be developed here and no opportunity is afforded for building a dam. By sealing up the opening in the well, however, the water of the spring could be made to rise and overflow the top, thus giving the stream a total fall of 22 feet to the river. With the help of this fall 57 gross horsepower, or 46 net horsepower, could be produced. This would probably be the minimum power developed during the year and the maximum during the summer.

Waterpower could probably be developed at numerous places on Eleven Point River. Near Greer, Mo., the river has a flow of 31 cubic feet per second. Current River also offers many chances for the development of waterpower. At a point 200 feet above the entrance of Round or Blue Spring its flow was found to be 411 cubic feet per second.

Convention of District Managers of the Westinghouse Company.

During the week ended November 19th the district managers of the Westinghouse Electric and Manufacturing Company gathered at the works at East Pittsburg and discussed plans and methods for the coming year. These conventions are annual occurrences and are productive of great good, bringing together men from all parts of the United States whose experiences are the natural outgrowth of conditions under which they labor.

Those attending the convention were Calvert Townley, general agent, New York; G. Pantaleoni, general southwestern manager, St. Louis, Mo.; R. L. Warner, New England agent, Boston, Mass.; E. W. T. Gray, New York; D. E. Manson, Boston, Mass.; W. S. Heger, San Francisco, Cal.; F. B. H. Paine, manager export office, New York; C. W. Underwood, Buffalo, N. Y.; C. F. Medbury, Detroit, Mich.; G. B. Dusinberre, Cleveland, Ohio; W. F. Fowler, Baltimore, Md.; C. A. Bragg, Philadelphia, Pa.; M. P. Randolph, Seattle, Wash.; S. J. Keese, Los Angeles, Cal.; P. N. Jones, Pittsburg, Pa.; D. E. Webster, St. Louis, Mo.; T. P. Gaylord, Chicago, Ill.; L. M. Cargo, Salt Lake City, Utah; J. R. Gordon, Atlanta, Ga., and T. J. McGill, Minneapolis, Minn.

On Wednesday evening the management gave a banquet to the visiting managers, at which all of the executive officers of the company were present.

A feeling of optimism was evidenced throughout the convention regarding the business situation and the prospects of continued prosperity throughout the country.

W. S. Heger of San Francisco stated that the outlook on the Pacific Coast was never better, work being plentiful and money easy. "Mining projects in California are flourishing," he said, "and they appear to have plenty of money behind them. This insures large installations of Pittsburg electrical machinery."

L. M. Cargo of Salt Lake City said that the election of Roosevelt had given a decided impetus to mining development in Utah, Arizona, Nevada and New Mexico, capital, which prior to that had been timid, being induced to pour money liberally into dormant investments.

J. R. Gordon of Atlanta, Ga., said: "The South will soon have the greatest boom of its history. For the last two years the cotton crop, the barometer of southern prosperity, has been phenomenal. Business conditions reveal a greater stability and the increase of manufacturing in the South is extraordinary. Abundant waterpower, easily available, will prove an enormous boon and a producer of business for Pittsburg."

F. B. H. Paine, manager of the export department, remarked: "The outlook for foreign business has never been more promising for American manufacturers, because never before were Europeans more alive to the superiority of American manufacturing methods. Pittsburg apparatus always has the preference because of its superiority."

C. A. Bragg of Philadelphia said: "The outlook for general industrial activity was never brighter. While there has been plenty of capital during the last year, timidity over unsettled political conditions prevented its investment. Lack of confidence has disappeared and hopeful buoyancy is observable everywhere."

The views expressed by E. W. T. Gray of New York were to the effect that: "New York suffered severely the last year because of building strikes, but these have subsided and business has been good there for six months. It is a foregone conclusion that it will be even better, as cheap money is abundant, and there is no lack of financial support for any legitimate enterprise."

WESTINGHOUSE DISTRICT MANAGERS AT PITTSBURG.

The following list of names refers to the accompanying picture, which represents most of the gentlemen in attendance at the convention:

1. E. W. T. Gray.
2. D. E. Manson.
3. C. W. Regester, manager, Cincinnatt, Ohio.
4. C. B. Humpbrey, manager, Detail and Supply Department.
5. Charles A. Terry, secretary and attorney, New York.
6. Frank H. Taylor, second vice-president.
7. W. S. Heger.
8. F. B. H. Payne.
9. G. B. Griffin, assistant manager, Detail Supply Department.
10. C. W. Underwood.
11. Charles F. Medbury.
12. J. E. Johnston, manager, Dallas, Texas.
13. George B. Dusinberre.
14. R. L. Warner.
15. L. A. Osborne, fourth vice-president.
16. S. L. Nicholson, manager, Industral and Power Department.
17. James C. Bennett, auditor, East Pittsburg, Pa.
18. M. P. Randolph.
19. Calvert Townley.
20. J. R. Gordon.
21. C. S. Cook, manager, Railay and Lighting Department.
22. W. M. McFarland, acting vice-president.
23. C. A. Bragg.
24. S. J. Keese.
25. W. F. Fowler.
26. C. F. Scott, consulting engineer.
27. Walter Cary, manager, Sawyer-Man Electric Company, New York.
28. S. H. Anderson, credit manager.
29. N. S. Braden, sales manager, Canadian Westinghouse Company, Hamilton, Canada.
30. F. H. Shepard, engineer on unit-switch control.
31. P. N. Jones.
32. S. E. Webster.
33. L. M. Cargo.
34. T. J. McGill.
35. G. Pantaleoni.
36. F. F. Rohrer, correspondent, main office.
37. J. W. Sterns, Mountain Electric Company, Denver.
38. A. Goodby, correspondent, main office.

Ohio Telephone Notes.

All the subsidiary companies of the Federal Telephone Company made a gain for October over last year. The Cuyahoga made the best showing, the gain in gross earnings being $7,000 and in net earnings $3,500. The company also made a reduction in fixed charges and increased the surplus for stock. The United States Company's comparisons for September of this year with the corresponding month last year are also good. The Federal companies are making excellent progress.

Probate Judge Jones has granted the Middletown Home Telephone Company a franchise to operate a system in Middletown, with privilege to string wires and build conduits in certain portions of the city.

Telephone apparatus was arranged on the rostrum of the Baptist Church at Delaware on Thanksgiving day and many people who could not find room at the church listened to the sermon over the wires. This is the first time the telephone system has been used for church services in that old college town.

The Stafford and Marietta Telephone Company of Marietta has been incorporated with a capital stock of $10,000 by George W. Robinson, A. G. Hughes and others.

Owing to the death of Judge James M. Thomas the Portsmouth Telephone Company of Portsmouth has been reorganized by the election of the following officers: President, I. S. Grimes; vice-president, Joseph S. McKell, Chillicothe; secretary and treasurer, Dr. W. D. Temper; general manager, E. E. Knox.

Toledo telephone offices will hereafter hold long-distance operators responsible for all toll bills that may be incurred, it is said. The operator must collect in full for each message or the amount of shortage will be taken from her salary. The companies have also made a rule that operators shall not call for individuals, but instead the number of the telephone only.

City Solicitor Butler of Columbus has refused to draft an ordinance regulating the construction of pole lines for telephone, telegraph, lighting and heating companies until the board of public service furnishes in the rough the ideas to be incorporated. He declares he is not an electrician and that this work should devolve upon someone who knows something about it. After the matter is prepared, he says, he will then reduce the ordinance to legal phraseology. C.

Telephone News from the Northwest.

A telephone company has been formed at Odin, Minn., to build local and rural lines.

The rival telephone lines at Marion, S. D., the Hofer and the Steninger systems, have consolidated, Dr. Hofer purchasing that portion of the Steninger system which is in Marion. The two systems will be continued as the Marion Telephone Company.

Charles O. Ryan of Eldora, Iowa, has been named receiver for the Hardin County Telephone Company, operating exchanges at Eldora, Ackley and Steamboat Rock, Iowa.

Work has been started rebuilding the local exchange for Wheaton, Minn.

The Anson Telephone Company of Anson, Wis., has been formed and will establish a local system, connecting with the long-distance lines of the Wisconsin Telephone Company.

The Farmers' Telephone Company of Litchville, N. D., has been formed.

The Southwestern Minnesota Telephone Company seeks a local franchise at Westbrook, Minn.

The telephone system at Auburn, Iowa, has been placed in commission.

The Emmet County Telephone Company, which has been voted a franchise at Estherville, Iowa, will begin work at once on its new system, and expects to have the line in operation by spring.

The Council Bluffs (Iowa) Independent Telephone Company has filed articles of incorporation with $100,000 capital. E. H. Lougee was elected president and F. J. Day secretary. Work will be started at once on a new system at Council Bluffs.

The Eldon (Iowa) Telephone Company will improve its system extensively this winter. About 5,000 feet of new cable will be installed.

The Yellowstone Park Telegraph and Telephone Company has completed its new line as far as Bozeman, Mont. R.

Michigan Telephone Matters.

The Citizens' Telephone Company of Marshall has increased its capital stock from $15,000 to $50,000.

The Michigan State Telephone Company has a large gang of men at work in the city of Marshall making improvements to the plant. The Citizens' Telephone Company recently purchased the local Independent exchange, which it is operating. The Bell company is putting in telephones free until 300 subscribers are secured.

It is understood that the Michigan Telephone Company, in fighting the Independent Telephone Company of Ypsilanti, is pleased with the action of the City Council in voting that the Independent company remove all the conduit material it has on the streets and on public property. The bond which the company has promised has not yet arrived, and the manager at Ann Arbor states that the material will be removed to private property for the time being, but asserts that the plant will be installed. W.

Indiana Telephone Items.

The New Long-distance Telephone Company is building a direct line between Bloomington and Bedford.

There is a strong probability of the Cumberland Telephone Company securing a franchise in Evansville. Mayor Covert has called a meeting of the City Council, city officials and representatives of the telephone company, with a view to settling the telephone question. No intimations have been made as to what the final outcome will be or as to what stand the city will take when the matter comes up for discussion during the conference. The company has made overtures, offering $2,250 for a 25-year franchise. It is generally believed that the city will be able to settle the question on much better terms than that offered by the company. The public will be invited to the meeting, and the hope prevails that the wrangle and litigation which have retarded developments for years may soon be ended by an equitable settlement of the franchise question.

The success of the department of telephone engineering in vogue at Purdue University, in charge of Prof. J. C. Kelsey, has caused, it is said, the Ohio State University and the schools of technology of the East to think seriously of opening similar departments soon. Applications have been received at Purdue by men who want to take the two-year course in telephony, but this is refused them because the department would become crowded with special students. The study is only a part of the course of electrical engineering. Juniors and seniors may take telephony in pereference to steam-engine and boiler work. There are now 25 in Professor Kelsey's class, and the prospects are for a much larger class next year. There is quite a demand for Purdue students as experts to take charge of telephone lines and exchanges. S.

Use of the Telephone in Reporting Football Games.

A good illustration of the use to which the telephone may be put in reporting football games was given in Chicago at Marshall Field on the occasion of the game between the teams representing Northwestern University and the University of Minnesota on November 19th. The Northwestern Telephone Exchange Company of Minneapolis, 425 miles from Chicago, received the reports of the game during its progress. These reports were given to the Minneapolis newspapers and bulletined by them for the benefit of the public.

At the Chicago end of the long-distance line connections were made by the Chicago Telephone Company's system with apparatus on the field. The representative of the press who was to report the game walked about along the side lines with an ordinary breast transmitter similar to those used by telephone operators hung from his shoulders. He was also provided with two receivers with headpiece, enabling him to hear better the questions coming to him over the line and also shutting out to some extent the noise of the "rooting." The reporter carried, besides this apparatus, 150 feet of conductor connecting his instrument to a point about the center of the field, so that he was given a range of 150 feet in either direction and was thus enabled to have the play at all times under his direct observation.

The conversation was carried on directly between the correspondent and the Minneapolis exchange, and no trouble whatever was encountered in understanding everything that was said. The arrangement of the apparatus used at Marshall Field was planned by Mr. J. H. Riddel, manager of the Chicago Telephone Company's Oakland exchange.

NEW COMPANIES.

The Georgetown and Camfield Telephone Company in South Carolina has been chartered with $500 capital.

The Chase County Telephone Company of Champion, Neb., has been incorporated with a capital stock of $10,000.

The Sampson Telephone Company has been incorporated to build and operate in Clinton, N. C., and has a capital of $20,000.

T. H. Ferris of Utica, N. Y., and business associates have organized the Independent Telephone Securities Company of Utica with a capital of $800,000.

The Auburn Telephone Company of Auburn, Ill., capitalized at $35,000, has been incorporated and will operate a telephone system. The incorporators are W. H. Ramsey, E. R. Conklin and F. W. Kelly.

A company has been formed to build a telephone system in Hamilton, Ga. Fred Miller of Hamilton is president of the company and W. E. Farley is general manager.

GENERAL TELEPHONE NEWS.

C. W. Bartlett & Son have purchased an interest in the Fairbury (Neb.) Telephone Company.

The Phœnix Telephone Company of Texarkana, Tex., will extend its long-distance line to Sherman, Tex.

The Alvin and Angleton Telephone Company of Alvin, Tex., will extend its line to Friendswood in Galveston County.

F. B. McElroy and S. A. Jones have applied to the city of Dallas, Texas, for a franchise to construct a telephone system.

The trustees of Ocean Park, Cal., have sold to W. L. Porterfield a franchise to operate a telephone system at that place, his bid being $550.

The Bell Telephone Company has just completed a long-distance line from Wilmington, N. C., to Mullins, S. C., giving Wilmington eight long-distance circuits.

Articles of merger and consolidation have been filed by the Winchester Telephone Company of Virginia and the Cumberland Valley Telephone Company of Baltimore.

The Colorado Telephone Company of Denver has voted to increase its capital from $5,000,000 to $10,000,000, and will extend its lines to Nebraska, Kansas and the East.

Directors of the Christian County Telephone Company of Ozark, Mo., are contemplating increasing the capital stock of the company for the purpose of improving the system.

Royland Smith of Dallas, Tex., has gone to Palestine, Tex., where he will have headquarters as the new district manager of the Southwestern Telegraph and Telephone Company.

Extensive improvements to its telephone system are contemplated by the Belmont Telephone Company of Wheeling, W. Va. It is proposed to increase the capital of the company from $75,000 to $150,000.

A private telephone system to connect the National Palace, Chapultepec Castle, and the private residences of President Diaz in the City of Mexico is to be installed under the direction of Oliver L. Araiza, an electrical engineer.

The Rainy River International Telephone Company of Canada has been incorporated with a capital of $250,000. The provisional directors are D. Robertson, P. T. Roberts, J. A. Mathieu, H. Williams, P. A. Smith and H. A. Sissons.

The Birmingham (Ala.) Railway, Light and Power Company has made arrangements with the Southern Bell Telephone Company for the installation of a private telephone exchange, which will be put in at once.

The Commercial and Industrial Association of Selma, Ala., has induced the Southern Bell Telephone Company to install the latest improved telephone service in Selma, work to be commenced in the near future.

The Alaska Telephone and Telegraph Company has taken over the Nome telephone system and the Boyd long-distance telephone line at Nome, Alaska. A. E. Boyd has been retained as manager and a number of extensions will be built under his supervision.

The striking telephone girls formerly employed by the Pacific States Telephone Company at Portland, Ore., are busy circulating a petition asking that a competitive company be given a franchise. Members of the Operators' Union generally are engaged in the work and claim to be meeting with encouraging success.

A recent meeting of the Business Men's Association was held in Salt Lake City, Utah, to protest against the prevailing rates of the Rocky Mountain Bell Telephone Company. After listening to a statement from the manager of the telephone company it was decided to make a thorough investigation before definite action be taken.

Steps are being taken to establish a rural telephone system in the county of Waterloo, Ont., Canada, and a company with that object in view is being organized. The system will probably be operated by the municipality of Waterloo. Some years ago there was a farmers' telephone company in the county, but it was bought out by the Bell Telephone Company.

The American Telephone and Telegraph Company recently made the largest express shipment that ever passed through the express office at Norwich, Conn. The company is about to install a circuit from New London to Willimantic and a large quantity of wire, crossbars and miscellaneous supplies for the work was brought to Norwich by freight. Owing to the manner in which the recent storm crippled the telephone service at Troy, N. Y., the company in order to have the system repaired as quickly as possible took the Norwich material and shipped it by express to that city. The consignment weighed 27 tons and it was gathered from various sections of the city over which it had been distributed. The express charges amounted to $550.

Ottumwa Telephone Company Reorganized.

S. W. Crosby of Ashtabula, Ohio, and H. W. Stecher of Cleveland have closed up the business of the Ottumwa (Iowa) Telephone Company by making the transfer of the title to all the property previously held by that company to the Ottumwa Telephone and Electric Company. These gentlemen represent the creditors of the old company who bought it in when it was recently sold. The business has been reorganized and will henceforth be known as the Ottumwa Telephone and Electric Company, of which Mr. Crosby is president and Mr. Stecher secretary.

Howard Herr will be retained as manager and will have full charge of the company's interests in Ottumwa. Under Mr. Herr's direction the business of the company has continuously grown from a small beginning until it now has nearly 1,400 telephones in the city and 700 in the country immediately surrounding. These, with the connections that can be reached through the exchanges in the smaller towns, give the subscribers access to about 15,000 telephones in Wapello and adjoining counties. In addition to these arrangements the line has been entirely rebuilt.

Copper Market.

Recent heavy demands for copper have sent prices soaring. The present market price of 14¾ cents to 15 cents a pound, as compared with 12⅝ to 12¾ cents last September, indicates a striking change. This rise in price has been expected and is the outgrowth of actual requirements in trade. With exports at the rate of 20,000 tons a month for the last 10 months, nothing else could be expected; the foreign demand alone took enough copper to prevent market depression. Expectations of a more active business for next year are not without foundation, supplies being greatly reduced by export. A gentleman prominent in the copper trade for the last 20 years says: "We are just entering a period of development in the copper industry that will surpass anything the metals trade has ever known. Demand for copper, owing both to the immense variety of new uses found and being found for it and the rapid extension of electric traction and the enormous increase in electrical installations of every sort, has way outrun production. Seventeen-cent copper in the immediate future seems certain, and that a much higher range of prices will prevail for a long time to come may be anticipated with confidence."

Telephone Companies Gain a Point in Canada.

The Privy Council of London, England, has given a decision of importance to every municipality in Canada. In the case of the city of Toronto vs. the Bell Telephone Company is was decided that the company has the right to erect poles and to lay conduits without the consent of the city. The Bell company got its charter from the Dominion government. In the Quebec case the question was raised whether the company had the power to operate in the provinces without the provincial consent. The company applied to and obtained from the Ontario Legislature a charter in which was inserted a clause which the Dominion charter did not contain—that the company could not operate on any street without the consent of the municipality. The city of Toronto tried to hold the company to this provision and litigation ensued. Justice Street gave judgment in favor of the city, but this was reversed by the Court of Appeal. The city appealed to the Privy Council, which dismissed the appeal and gave judgment for the company.

Telephone Development in the City of Mexico.

It is expected that the Mexican government will soon act on the plans submitted some time ago by the Mexican Telephone Company for the installation of a central-energy telephone system and the placing of its wires underground in the central portion of the City of Mexico. As soon as the necessary official authority is granted the company will begin the construction of conduits and place an order for the building of a switchboard of the central-energy design.

Jose Sitzenstatter, who obtained a concession from the Mexican government not long since for the installation of a new telephone system in the City of Mexico, has gone to Stockholm, Sweden, to confer with L. M. Ericsson & Co. of that city, who are to finance the enterprise. The terms of the concession require that work must be commenced on the new system within six months from November 1st.

Braking High-speed Trains.[1]

By R. A. Parke.

During a hearing upon an application for a charter for the New York and Port Chester Railroad Company before the New York Railroad Commission some 3½ years ago, the writer was called upon for expert testimony concerning the distance in which electric trains might be stopped, in regular service, from a speed of about 60 miles an hour. It was then that expression was first publicly given to the opinion that the special conditions under which the brakes are applied upon trains of such high speeds warrant a force and promptness of application which could be employed at low speeds only with serious shock and danger of train rupture. For years prior to that time the uniform teaching and recommendation of the Westinghouse Air Brake Company, as given in instruction cars and by authorized representatives of the company, had been emphatically opposed to the use of what is commonly known as the "emergency application" of the quick-action air brake in ordinary train service, and a proposition which contemplated the use of the emergency application of the quick-action air brake, and particularly the more powerful high-speed form of air brake, appeared to the average railroad officer as nothing short of heresy. Members of the railroad commission promptly instituted a line of questions which made it quite evident that they were similarly impressed.

One of the fundamental grounds upon which the New York and Port Chester railroad sought to justify the granting of a charter for a railroad line paralleling a steam railroad already in operation was the materially improved local express-train service which it was proposed to attain through the superior rate of acceleration acquired upon electric trains by the use of the system of multiple control of motors operating upon the axles throughout the train, and the higher rate of retardation to be obtained through the high efficiency of the emergency application of the air brake, in bringing such trains to a station stop.

In presenting the matter to the railroad commission elaborately arranged curves indicating the rates of acceleration and retardation had been prepared by the able engineer, Mr. C. O. Mailloux, which appeared to justify the claims for the improved character of train services contemplated by the company. Although multiple-control systems of electrical train control were at the time in successful operation, it did not appear that the rate of retardation indicated by the stopping curves had been attained in regular service, and the high efficiency of the proposed train service was characterized as impracticable and chimerical by those opposed to the granting of the charter.

It is a notable fact that while the effort to attain high acceleration in bringing electric trains to the required speed had involved costly extension of the application of motors to a number of cars throughout the train—being applied in some cases to the trucks of all the cars—practically no effort had previously been made to realize a higher rate of retardation in regular service than that which had been regularly employed in steam-railroad service through the service application of the ordinary automatic air brake. Without attempting any discussion of the merits of multiple-control systems of electric locomotion, or the commercial limitation of the expense justified in extending the application of motors to a number of cars throughout the train, it may properly be suggested that commercial economy may not result from an indefinite extension of such systems. The inadequacy of a single motor car for the acceleration of a train of several cars easily justifies the application of motors to the trucks of one or more additional cars, depending upon the number of cars in the train; but it may also be readily understood that a point may be reached in the increased acceleration due to multiplication of motors, beyond which the addition of other motors is accompanied by too small a measure of increased acceleration to justify the added expense of installation and maintenance.

An illustration may be found in the operation of city waterworks' systems. It is a well-understood fact that refinement of pumping machinery is justified up to the attainment of a practical duty of somewhere in the neighborhood of 90,000,000 gallons; beyond this, further refinement, whereby an increased duty is accomplished, is attended by an increased cost of plant and of repairs and necessitates a higher grade of skilled oversight and attendance which more than compensates for the fuel economy acquired. It is not fuel economy, but it is commercial economy of operation which defines the limit of such refinement and establishes a duty which may not be exceeded with commercial advantage. Similarly, the extension of multiple-control systems to the application of motors to more than a certain limited proportion of the axles upon a train may easily be attained by an ultimate cost whereby economy of operation is impaired.

The pertinence of the foregoing observation lies merely in the fact that while the application of multiple-control system has in some cases apparently been pushed to extremes in an effort to improve electrical train service by attaining the very highest accceleration at the sacrifice of commercial economy, the absence of any effort to attain a fuller measure of the possible rate of retardation in stopping is the more noteworthy. That materially increased stopping efficiency may with propriety be employed in high-speed train service, it is the purpose of this paper to demonstrate; and, as every start requiring high acceleration is necessarily attended by a corresponding stop in which a higher rate of retardation correspondingly improves the character of the train service, it is obvious that if increased expense is justified in moderately increasing the rate of acceleration, materially increased stopping efficiency at a comparatively small cost is entitled to careful consideration.

To those who are familiar with the results of experiments with the friction of brake shoes upon carwheels and the difference in the conditions of brake application at high speed from those at low speed, the proposal to increase the force of application of the brake shoes upon the wheels at high speeds will excite no comment.

The various trustworthy experiments upon brake-shoe friction have uniformly demonstrated a declining ratio of the friction to the pressure of the shoe upon the wheel at increased speeds. For the same brake-shoe pressure the friction excited at a speed of 60 miles an hour is but about one-half that which occurs when the speed is but 20 miles an hour. Other causes result in a reduction of the brake-shoe friction during continued application of the brakes, and this result combines with the increase of the friction through reduction of speed, during the retardation of the train, to maintain a comparatively uniform though slightly increasing rate of friction throughout the stop until quite near its close. Thus, the average rate of retardation of the brakes, when applied to the wheels at a speed of 60 miles an hour, is about one-half of that acquired with the same brake-shoe pressure when the initial speed is but 20 miles an hour. It is evident, therefore, that the same rate of retardation—which may with entire propriety be employed at all speeds—can only be acquired by increased pressure of the brake shoes upon the wheels to correspond with the reduced rate of friction occurring at the higher speeds.

Moreover, an application of the brakes which will produce a given rate of retardation at one speed without danger to the rolling stock or discomfort to the passengers may also be applied at any other speed with no more danger or discomfort. The high-speed brake was designed more particularly for use upon high-speed trains, and it employs a considerably greater brake-shoe pressure in emergency applications than that of the ordinary quick-action brake to more nearly realize the rate of retardation obtained in the emergency application of the quick-action brake upon trains of lower speeds. At such a high speed as 60 miles an hour, however, even the emergency application does not develop greater brake-shoe friction than does a full-service application of the quick-action brake at a speed of 20 miles an hour. It is true that the service application is attended by a comparatively gradual application of the brake-shoe pressure, while the emergency application develops the greater brake-shoe pressure very quickly; but experience and observation seemed fully to justify the conclusion that the reduced rate of friction at the higher speeds would permit the use of even the high-speed brake without noticeable shock or disagreeable sensation.

Though the conviction thus expressed 3½ years ago was based upon observation, experience and knowledge of the results of experiments upon brake-shoe friction, it was, nevertheless, so far as practical employment in train service was concerned, a theoretical conclusion. Since that time experiments in the use of the high-speed brake upon passenger trains have amply confirmed the writer's views upon this subject, and demonstrated the absence of disagreeable effect as well as the highly increased rate of retardation in employing the emergency application of the high-speed brake for stops in high-speed train service. The time and distance saved in such stops permit the employment of the maximum speed up to a comparatively short distance from the stopping point and cause the train to be brought to a quick, smooth stop in much less than half the time and distance required for an ordinary service stop.

That the shortened running time and increased efficiency of high-speed train service—particularly local express-train service—by the employment of such higher rate of retardation, may be attained at a small fraction of the expense at which a lesser improvement in such efficiency can be obtained through the increased acceleration resulting from extending the multiple-control system from the use of motors upon one-half the cars in the train to their application to all of them seems hardly open to doubt. The neglect to take advantage of this higher rate of retardation would seem to be attributable chiefly to the long-established doctrine that emergency applications must not be employed for service stops under far different conditions. It is to be understood that such a doctrine still applies with all its force to the operation of passenger trains at moderate speed as well as to freight-train service. It is only under the special conditions of uniform operation at high speeds—not less than 50 miles an hour—that the recommendations of a most powerful

1. A paper presented to Section F of the International Electrical Congress at St. Louis. Mr. Parke is special agent for the Westinghouse Air Brake Company.

application of a most powerful brake in all stops properly applies.

In addition to the advantage of effecting a reduction of from 50 to 75 per cent. in the time and distance required by a service application of the brakes, a collateral advantage of material importance is the much greater accuracy of the stop. In a stop by a service application of the brakes, the application is affected by the personal judgment of the operator, whereby an element of uncertainty is introduced which almost invariably requires a subsequent release and a second application of the brakes, in order to bring the train to a stop within the range of the station platform. This frequently involves more or less "drifting" of the train at greatly reduced speed, to avoid stopping short of the station and not infrequently involves backing of the train because of inaccurate judgment in the application of the brakes, whereby the train runs beyond the stopping point. In the use of the emergency application not only is the individual application of every brake, very much more prompt and powerful, but the rate of serial application from car to car is almost instantaneous and is automatically established to the exclusion of any influence of the operator's judgment. Grade and alignment of the roadway, of course, influence the stopping distance; but such influences are readily determined for each stopping point, and the point at which the motive power should be shut off and the emergency application of the brakes should occur may be designated by a post or other permanent signal, whereby the train will be brought to a stop at the desired stopping point.

In comparison with the rate of acceleration in starting steam-railroad trains, the rate of retardation in ordinary service stops has been so high that it is not unnatural that increased efficiency of train service has suggested higher rates of acceleration in starting rather than improved retardation in stopping; but it should now be clear that a really efficient high-speed train service may be obtained only by also employing the maximum practical rate of retardation by which so large a reduction of the time and distance of stopping is counted. Electric train service furnishes exceptional conditions for attaining the maximum retardation as well as the maximum rate of acceleration—though for different reasons. Where trains are drawn by steam locomotives the conditions existing at the locomotive and the variable load carried in the tender involve limiting the braking power so that the retarding force is considerably inferior to that realized upon the cars. Where electricity is employed the motive power is applied directly to the cars themselves in such a manner that the maximum braking efficiency may be obtained as well upon motor as upon other cars, and the whole train is thus subject to the maximum rate of retardation.

While the special conditions of high-speed train service permit realization of the maximum obtainable retardation in ordinary station stops, it will be understood, of course, that all the ordinary means of general brake efficiency are contemplated in connection with the brake apparatus. In a paper presented to the American Institute of Electrical Engineers and published in the January (1903) volume of proceedings, the writer pointed out the more important features of the brake apparatus for attaining such hign efficiency. They included efficient foundation brake-gear automatic slack adjuster to maintain the minimum piston stroke in the brake cylinders, and brake beams hung between the wheels and adapted to regulate the brake-shoe pressure so as to compensate for the transfer of weight from the rear to the forward pair of wheels of each truck during the application of the brakes.

In addition to such general considerations an exceedingly important element of braking efficiency is the character of the brake shoes applied to the wheels. Extensive experiments have demonstrated a very wide variation in the frictional quality of brake shoes of different materials, and, further, a marked difference in the friction of the same brake shoe upon wheels of different materials. It is, in general, found that the maximum frictional resistance occurs in the application of soft cast-iron shoes to chilled cast-iron wheels, and the friction-producing quality generally declines as harder brake-shoe materials are employed. It should not be concluded, however, from this general relation of the hardness of the brake-shoe materials to the frictional quality, that soft material only should be employed in brake shoes. Besides the cost of soft brake shoes, which wear rapidly, the trouble and expense of replacement, together with the complications arising from rapid wear, are highly persuasive elements in favor of the use of harder materials. If the inferior frictional quality of the harder brake shoes is compensated by correspondingly increased pressure of the brake shoes upon the wheels, the operative objection to the hard brake shoe practically disappears. The question is to a large extent a commercial one. Increased pressure upon the harder shoes involves, of course, somewhat increased wear; but when, in each case, the brake-shoe pressure is so adapted to its frictional quality that the maximum retarding friction is acquired, the practical question resolves itself into the relative cost of initial installation and of subsequent maintenance—to which must be added due consideration of trouble and annoyance arising from the necessity of frequent attention.

Within the last two or three years two different series of experiments with the high-speed brake have furnished most interesting and important information bearing upon this subject. In one series soft cast-iron brake shoes were employed with chilled cast-iron wheels. In the other the "Diamond S" form of brake shoe (of hard cast iron, with steel inserts) was used with steel-tired wheels. Otherwise the conditions were fairly comparable, the tests being conducted in the same general locality. In the case where soft cast-iron shoes were employed the initial air-pressure in the brake cylinder was about 85½ pounds, which became reduced toward the end of the stop to 60 pounds. In the tests with the Diamond S brake shoe the initial air pressure on the brake cylinder was also about 85½ pounds, which, by the use of special high-speed reducing valves, became reduced to a final minimum of from about 69 pounds from a speed of 80 miles an hour to about 78 pounds in stopping a six-car train from a speed of 50 miles an hour. Moreover, in some instances a brake-cylinder pressure of 75 pounds or more occurred in applications of the brakes at speeds of 20 miles per hour (and even less) without producing wheel-sliding of an injurious character or exceeding that which occurred with the use of the soft cast-iron brake shoe when the final minimum air pressure in the brake cylinder was but 60 pounds. The stopping distances were phenomenally short in the tests with the Diamond S brake shoe, averaging 602 feet from a speed of 50 miles an hour, 982 feet at 60 miles an hour, and 1,334 feet at 70 miles an hour—the shortest authentic stops on record.

It is true that these tests were made in dry weather and that the rails were more or less affected by sand, in which the soil of the country abounded, and particles of which were carried about by wind. It is very doubtful whether such high-terminal brake-cylinder pressure might be safely employed even with such hard brake shoes under the varying rail conditions of regular service, the corresponding total brake-shoe pressures, as customarily calculated, being from 104 to 117 per cent. of the weight of the braked cars; but these experiments clearly illustrate both the fact that wide difference in the frictional quality of brake shoes should be given proper consideration in determining the brake-shoe pressure, and also the fact that with a properly determined pressure certain forms of hard brake shoes may yield as good, or perhaps even better, average retarding influence than soft cast-iron brake shoes. It is worthy of note that the material in the brake shoes employed in these experiments was so hard that a number of the shoes were broken during the tests—but without apparently affecting their utility, inasmuch as the form of the shoes remained unchanged, the parts being held in place by a steel plate cast in the outer surface of the shoe.

The foregoing considerations assume the use of the automatic air brake. Inasmuch as high-speed trains have been under consideration, no other form than an automatic brake could properly be considered. In the case of a service employing single cars the advantage of an automatic brake practically disappears and more simple forms of apparatus may be employed to advantage; but, where two or more cars are assembled in trains, and particularly in high-speed trains, the necessity of providing for the contingency of train partings permits but the one prudent and safe course of employing an automatic brake, and thus far the automatic air-brake alone has become safely established as meeting all the requirements of service. The necessity of the most efficient high-speed train service requires in addition the most forcible application of the most efficient form of automatic air-brake—the emergency application of the "high-speed" brake.

Ontario Power Company Contracting for the Delivery of Current.

It is announced in a circular issued to bankers and brokers as well as to others likely to be interested in bonds that the Ontario Power Company has entered into a contract with the Niagara, Lockport and Ontario Power Company for the sale of 30,000 electrical horsepower, the same to be delivered at the international boundary line by July 1, 1905, together with an additional 30,000 horsepower to be delivered at the same point by January 1, 1907. The contract is said to run until April 1, 1950, with the right to renew it for a period of 60 years more.

Under the agreement the Niagara, Lockport and Ontario Power Company is to take this power at the international boundary line near the whirlpool where the gorge is narrow, and there a transformer station is to be built. From this point a transmission line is to be built as far east as Rochester, N. Y., by July 1, 1905, the performance of the contract being guaranteed by the forfeiture of a specific sum as liquidated damages in case of non-performance. While the Niagara, Lockport and Ontario Power Company has a franchise to develop power by means of a surface canal extending from the upper river, the circular states that this contract is made with the Ontario Power Company because of the long time it would take to develop power at Lockport. It would thus seem that the possibility of any power development at Lockport is very remote. The contract for power and the construction of a transmission line eastward toward Rochester indicates that transformer stations will probably be erected in Lockport and other places for the commercial distribution of transmitted energy from Niagara.

New Members of the Institute.

The following-named persons are among those elected to associate membership in the American Institute of Electrical Engineers at the directors' meeting in New York city on November 25th:

Adams, Spencer, Lima, Peru.
Alexander, G. R., Central California Electric Company, Sacramento, Cal.
Beaujon, A. R., East Coast Electric Light, Power and Ice Company, West Palm Beach, Fla.
Berry, M. R., Pittsburg, McKeesport and Connellsville Railway Company, Connellsville, Pa.
Carter, H. H., Barbados, B. W. I.
Dunstan, A. St. C., Alabama Polytechnic Institute, Auburn, Ala.
Enström, A. F., Royal Technical Academy, Stockholm, Sweden.
Feilden, T. J. V., Electrical Magazine, London, England.
Flowers, A. E., University of Missouri, Columbia, Mo.
Gaiennie, L. R., Kinloch Telephone Company, St. Louis, Mo.
Goettling, G. M. W., Edison Electric Illuminating Company, Boston, Mass.
Hammond, Robert, Westminster, England.
Harris, W. W., Union Electric Light and Power Company, St. Louis, Mo.
Hesketh, Thomas, Folkstone Electricity Supply Company, Folkstone, England.
Hill, Lucien, West Penn Railway and Lighting Company, Connellsville, Pa.
Lambert, T. B., Chicago, Ill.
Meyer, H. J., Shreveport Gas, Electric Light and Power Company, Shreveport, La.
Moore, W. D., Lima, Ohio.
Morris, D. K., Birmingham, England.
Morse, L. G. E., London, England.
Moses, R. P., Mt. Copper Company, Taylor, Cal.
Newbery, Jorge, Buenos Aires, A. R.
Owen, Llewelyn, Peoria Gas and Electric Company, Peoria, Ill.
Renström, J. A., Reyla Power Plant, Pachuca, Mexico.
Skinner, W. E., Canadian Westinghouse Company, Winnipeg, Manitoba.
Snyder, H. R., Louisiana Purchase Exposition Company, St. Louis, Mo.
Stone, E. W., Asheville Telephone and Telegraph Company, Asheville, N. C.
Strickland, T. P., Sydney, N. S. W.
Walborn, I. G., Telluride Power Company, Provo, Utah.
Webb, A. C., Sydney, N. S. W.

Business Opportunities Abroad.

The electric street-railway system in the city of Salzburg, Austria, is to be extended.

The agents of the city of Shanghai, 63 Leadenhall Street, London, England, will furnish particulars concerning the building at Shanghai of an electric-railway 24 miles in length.

Civil Engineer Alfio Dini of Cremona, Italy, will furnish particulars concerning the erection of large electric works at Cassano. It is also proposed to build an electric railway between Cremona and Milan.

The Licenciado Benjamin Barrios, in the City of Mexico, has received a concession for building an electric railway between the capital and the city of Puebla.

The town of Darjeeling, British India, will introduce electric lighting.

The town of Guirgiu, Roumania, will construct waterworks, and the town of Botoschani an electric-lighting plant.

The municipality of Almendralejo, province of Badojos, Spain, will introduce electric lighting.

The telephone system of Abyssinia is to be largely extended.

Eleven electric cranes are to be contracted for by the city of Ghent, Belgium.

The Association des Industriels de France, No. 3 Rue de Lutèce, Paris, has offered a prize of $1,500 for the best electric meter which is submitted to it by December 31st next.

Prize Design for an Edison Medal.

At a recent meeting of the jury appointed to select a design for an Edison medal commemorating the invention of the incandescent lamp, the competition being under the auspices of the National Sculpture Society, there were present J. Q. A. Ward, chairman; Daniel C. French and Augustus Saint Gaudens, for the National Sculpture Society, with Edward D. Adams and T. C. Martin appearing for the Edison Medal Association and on behalf of the American Institute of Electrical Engineers. After a further examination of the 29 designs submitted in competition, the committee, by unanimous action, awarded the first prize of $1,000 for the successful design, including its execution in such shape and detail as will permit direct reduction to medal size, to Mr. James Earl Fraser. The second prize of $100 went to Mr. Adolph A. Weinman, and the third prize of $50 to Miss Evelyn B. Longman. The successful competitor, Mr. Fraser, has been requested to develop his design for final consideration by the committee.

Farmers near Kalispell, Minn., are reported to have organized the Flathead Valley Railroad Company, which will build electric lines radiating from Kalispell to various parts of the valley. Much of this valley is now without transportation facilities and the electric lines will furnish an outlet for the produce of the valley.

CORRESPONDENCE.

Great Britain.

London, November 16.—After remaining in abeyance for nearly three months the offers made by Mr. Robert Hammond, the consulting engineer to the Dublin corporation, to take over and run the new three-phase station which has recently been erected there, came up for further consideration last week. It will be remembered that in consequence of many antagonistic statements as to the efficiency and capabilities of the works erected under Mr. Hammond's supervision, this gentleman offered to take sole charge of the works for a period of seven years and to sell current to the corporation at 1½d per unit, his remuneration being the difference between 1½d and anything less per unit at which he was able to produce electrical energy. Immediately those individuals who had been loudest in their denunciation of the probabilities of the new works, changed their opinion and argued that if Mr. Hammond could do these things and hope to make a profit, assuredly the corporation could do likewise, and that on no account should the control of the works go out of the hands of the corporation. In the meantime Mr. Hammond has addressed a further communication to the corporation offering it still more favorable terms, or he will take over the entire undertaking for 21 years, paying the interest, sinking fund and depreciation and supplying current at present prices. Therefore when these various proposals came before the corporation for consideration there was a strong muster of members; but probably in view of the later offers of Mr. Hammond the desire to scoff them was not so prominent as it has been since August, when the offer was first made. It is true that the chairman of the electric-lighting committee strongly urged that the offers be rejected forthwith, but after some discussion a proposal to form a special committee of the whole corporation to carefully consider the matter was carried.

The latest information concerning the working of the Lorain surface-contact system of tramways at Wolverhampton is to the effect that during the last 12 months it has been entirely satisfactory and has more than justified its claims for safety and reliability. The maintenance costs are being reduced and there is a strong belief that the total working costs for the present year will be considerably below the average of other towns where the overhead trolley system is employed. There are now 20 miles of single track, while there were only 6½ miles last year, and there are 30 cars in use and 10 more on order. This is distinctly encouraging and it would appear that the system is to be a success in England in spite of, and not because of, the Wolverhampton corporation, having regard to what took place at the end of the 12 months' trial of the system.

Mr. Alexander Siemens of the firm of Siemens Bros. & Co., London, delivered his presidential address to the Institution of Electrical Engineers last week. Mr. Siemens is a prominent member of the Employers' Federation, a body organized in opposition to trade unionism, and it was not surprising therefore that he should have devoted a large part of his address to this matter. His point was that salvation in the future lay in cheapening the cost of production, and that this obtained while the present conditions of employment of labor in England continued to exist. There was not sufficient co-operation between masters and men nor sufficient elasticity in trade-union rules to allow of this being done. Later on in his address Mr. Siemens argued in favor of the adoption of the metric system of weights and measures in this country and adduced much the same arguments as he did two years ago when discussing the matter at the Institution in opposition to the late Sir Frederick Bramwell, who was one of the strongest supporters of the retention of our existing system. The last part of the address was devoted to the question of improving our patent laws. Mr. Siemens disapproves of the system of preliminary search adopted in America and to be introduced here by the new act which comes into force next January. He contends that this should be carried out by the patentee, who is much more able to judge of those patents which may anticipate him. His address raised several controversial points, but as the rule is that no presidential address may be discussed, no one could touch upon them. In all probability, however, a discussion will be in the technical press.

Mr. J. W. Swan, F. R. S., inventor of the incandescent lamps, has been created a knight on the occasion of the king's birthday, and the Hon. C. A. Parsons of steam-turbine fame has been made a commander of the bath (C. B.).

The County Council of London has been trying for many years to secure parliamentary powers for running tramways over the Thames bridges. To foreigners no doubt it seems strange that there are so few means of communication between the north and south of London, but there is a certain section both of the London press and of members of Parliament who habitually oppose any proposal of the sort. At present therefore and apparently for many years to come people coming from the south of London to the city have to disembark on the south of the river and then walk some half a mile or more to their work. Once again, it is true, the council intends to seek parliamentary powers for these tramways, but the present condition of legislation is all against success.

During recent years many large schemes of tramway intercommunication have been constructed in the Midlands and North of England. Another such network has been put into operation in the Leeds and Wakefield district of Yorkshire, and the total length of track will eventually be some 75 miles. In spite of the opposition to running powers by a company over the lines of the Newcastle corporation this new company has already arranged for running powers over the Leeds corporation tramways, and no doubt others will follow as the lines are extended. The company has its own power station, where three-phase current is generated at 6,300 volts, the frequency being 25 cycles per second. The sub-stations, which are at present four in number, are equipped with 200-kilowatt rotary converters. The increase in the number of undertakings such as these will no doubt have an accelerating effect so far as the electrification of our railways is concerned, for the competition now set up by electric tramways is too much for the railway companies to cope with by steam. G.

New England.

Boston, November 26.—The Boston and Providence Street Railway Company, which will build a trolley line of the most up-to-date character between the two cities named, has organized with the following board of directors: George K. Webster, North Attleboro; B. D. Sumner, Henry F. Ross, F. C. Hinds, Newton; James F. Shaw, P. W. Sprague, George A. Putnam, Boston.

At the annual meeting, on November 22d, of the West End Street Railway Company, which is under lease to the Boston Elevated Railway Company, the board of directors was re-elected. The annual report stated that there had been a net increase of $760,000 in four per cent. bonds during the year and an increase of the capital stock by the additional issue of 3,000 shares, which netted the company, premiums included, $269,970.

The annual report of the Boston Rapid Transit Commission, which has the supervision of subways and tunnels and the construction thereof in Boston, has just been issued. The document contains a report upon the work accomplished in building the new tunnel from East Boston, under a portion of the harbor, to connect with the Boston central subway system. This report is submitted by Howard A. Carson, the commission's chief engineer. There is also a financial statement of the cost to date of the subway system, including alterations, the total being given as $4,134,758.05. The Boston Elevated paid as rental for the use of the subway for the year ended June 30th the sum of $213,420.44.

The Massachusetts railroad commissioners have authorized the Boston and Worcester Street Railway Company to issue $160,000 20-year 4½ per cent. bonds, for track-building work. They have also authorized the Berkshire Street Railway Company to issue $100,000 20-year 5½ per cent. bonds for extensions. The Worcester and Holden Street Railway Company has asked the commission for authority to issue $25,000 additional stock for extensions.

Following the announcement that the Bristol County Street Railway Company's property is to be sold at public auction comes the statement that similar disposition will be made of the Middleboro, Wareham and Buzzards Bay system. The date of sale is December 17th. Both roads have been in financial difficulty and in the hands of receivers (John T. Burnett and John L. Hall) for several months. It is believed that consolidation of the two lines would enable them to be run profitably, and the sale may result in such a change of management and operation.

In the town of Wilmington about 75 signatures have been obtained to a petition in behalf of a legislative bill for the chartering of an electric power company to utilize the waters of the Deerfield River and its tributaries by erecting a big power plant below Readsboro. Among the promoters of the project are R. C. Corson, George W. Plumb and Faxon Bowen. They ask for the right to erect poles, run wires and supply light and power to the towns of the Deerfield Valley. An authorized capital of $200,000 is contemplated.

Practice crews are operating electric trains in the East Boston tunnel and the finishing touches are in progress on the stations and approaches in preparation for the opening of the route, which is expected to take place early in the coming month.

The New Hampshire Traction Company is to be reorganized, holders of 4½ per cent. first-lien sinking-fund bonds and certificates of indebtedness having chosen Charles F. Ayer and Alfred D. Foster of Boston and Otto T. Bannard of New York as a committee for the formulation of the plan. The company, which was organized about two years ago, controls 135 miles of electric railway in New Hampshire and northeastern Massachusetts, comprising the Amesbury and Hampton; Seabrook and Hampton Beach; Haverhill and Plaistow; Haverhill, Plaistow and Newton; Portsmouth and Exeter; Dover, Somersworth and Rochester; Exeter, Hampton and Amesbury; Hudson, Pelham and Salem; Haverhill and Southern New Hampshire; Lawrence and Methuen, and Lowell and Pelham; also the Rockingham County Light and Power Company and the Granite State Land Company.

The new electric railway from New Haven to Wallingford, Conn., was opened on Wednesday, November 23d. The connecting link from Montowese to Wallingford, just completed, makes a through trip from New York to Boston by trolley possible, via New Haven, Hartford and Springfield. It is owned and operated by the Consolidated Railroad Company.

Work has begun on the construction of the tunnel in the Washington Street section of Boston, and the second contract for one of the sections has been let to Patrick McGovern, who was awarded the first-section contract about a fortnight previous, to be completed in June, 1905. B.

New York.

New York, November 26.—The subway extension from Ninety-sixth Street up Lennox Avenue to One-hundred-and-forty-fifth Street was opened without ceremony at midnight on Tuesday, when an ordinary passenger train with a few officials on board and less than 50 passengers made the first trip. The Lennox Avenue stations present a very unfinished appearance, but this has not deterred a large patronage of the cars. The express-train schedule during the non-rush hours has been augmented so that there is now practically a three-minute service from early morning till midnight between City Hall and Ninety-sixth Street, the trains alternating from that point up the west and east branches. The connection of the subway in the Bronx is timed to be put in operation at midnight tonight in advance of the completion of the tunnel under the Harlem River. Statistics show that during the first four weeks of operation there was a daily average of more than 200,000 passengers. There have been a few mishaps in the working of the system, but no really serious delays.

The East Side Civic Club met on Wednesday to celebrate the opening of the branch of the subway on Lenox Avenue. Club members strongly urged that a new East Side subway be built to free the East Side from its present congested state, and they proposed that a branch should also be built to run to the lower East Side, running across town from west to east.

The question of plans for future subways about New York city depends much upon the question which is now mooted before the Rapid Transit Commission as to sending before the Legislature a bill including a provision for the removal of the clause from the present act exempting subways from taxation. The commission thinks it is strong enough now to demand the removal of such an exemption.

It is alleged that the Commercial Cable Company intends to unite with the American Telephone and Telegraph Company. The Commercial Cable Company controls the Postal Telegraph-cable Company, but is, itself, controlled by the Mackay company. A step which is believed in Wall Street to point toward the rumored consolidation has been the obtaining from the secretary of state at Albany on Wednesday a certificate of "extension of purposes" so as to include the right to purchase, hold and dispose of the bonds and securities of other corporations.

During a fire early last Saturday morning much inconvenience was caused by the cutting of the fire-alarm cables. At the investigation which ensued Fire Commissioner Hayes told the representatives of the New York Edison Company that this practice during fires was quite intolerable, to which the representatives of the Edison company answered by proving that the cable cutting was entirely an accident.

Two new 75-kilowatt direct-current generators driven by two 120-horsepower engines are to be installed at the power house at the Brooklyn end of Brooklyn Bridge.

The Magnetic Control Company of New York city was incorporated last week with $1,000,000 capital to manufacture electrical and magnetic machinery. The directors are: A. Leonard Brougham, George W. Giddings, Albert Graham, Arthur J. Raymond and Jackson Wallace of Brooklyn; Myron D. Law of New York and William Klinger of Hoboken, N. J.

The report of the expert electrician appointed by Secretary Morton on the proposition to consolidate the power plants at the Brooklyn navy yard has been received by the secretary. It was proposed to provide one general power plant in place of the existing separate plants now in use for each bureau. The report has not yet been made public, but it is generally supposed that it favors consolidation in the interest of economy. D. W. W.

Dominion of Canada.

Winnipeg, Man., November 26.—The City Council of Brandon, Man., has given the Western Electric Light and Power Company of Brandon the same privileges as those enjoyed by the Brandon Electric Light Company and the company now goes on with its work.

The Eau Claire Light and Power Company of Calgary, N. W. T., has been given a contract for lighting the streets of Calgary and will immediately proceed to buy and install an arc-light plant for that purpose. Thomas Underwood is mayor.

The Canadian Northern Telegraph Company is

building an additional line from Winnipeg to Brandon, Man. This new line will run along the Carberry extension through Portage la Prairie as far as Carberry and thence along the highway to Brandon, thus giving the company two routes into Brandon.

The Vancouver, Westminster and Yukon Railway Company has taken steps to have a telegraph line established between Vancouver and New Westminster. Mr. E. J. Little, general superintendent of the Great Northern telegraphs, has been looking over the proposed line preparatory to the poling and wiring.

The Bull River Falls Power and Light Company has commenced work on its electric-power plant at Cranbrooke, B. C. A flume two miles in length will be built. H.

Toronto, Ont., November 26.—The Board of Control has decided to buy out the Consumers' Gas Company of this city and run it as a municipal concern and has instructed the city treasurer to purchase $1,000,000 worth of stock as a beginning. R. T. Coady is the city treasurer.

It is proposed to submit a proposition to the taxpayers of Westmount, Que., for authority to buy an electric-light plant to be run as a municipal plant. Part of the power will be obtained from a garbage consumer. The estimated cost of the electric plant and the garbage consumer is $225,000.

Experts engaged to value the plant of the St. Thomas (Ont.) Gas and Electric Light Company have arrived at a satisfactory settlement of the price to be paid by the city of St. Thomas. The sum of $196,366.38 was settled upon as the purchase price of the works. The plant will be overhauled and additions made to it. W. B. Doherty is the city clerk.

Harry Symons of Toronto has made a successful application before the Board of Railway Commissioners at Ottawa on behalf of the Niagara-Welland Power Company for four permissions. Two of them were for crossing privileges over the Grand Trunk railway, another to cross the Toronto, St. Catharines and Niagara electric railway and the fourth was to settle the mode of crossing the Toronto and Niagara Power Company's transmission lines. He also obtained permission to construct a canal under the tracks of the Grand Trunk in the township of Stanford; also for the construction of overhead flumes over the Grand Trunk tracks in the same township.

Plans have been prepared for a new power house for the Southwestern Traction Company at London, Ont., and as soon as the site has been chosen tenders will be called for. The building and equipment will cost about $200,000. A. E. Welch is the manager of the company.

The Algoma Power Company of Berlin, Ont., has been incorporated with a capital stock of $100,000 to construct and operate works for the production and distribution of electricity. The directors are D. B. Detweller and C. K. Hagedorn of Waterloo, Ont., and others. H.

Ohio.

Cleveland, November 26.—Events of the last week tend to straighten out the affairs of the Everett-Moore syndicate. The Citizens' Savings and Trust Company of Cleveland purchased about $600,000 of the Northern Ohio Traction and Light gold bonds at a fair price and $60,000 bonds were sold to another syndicate. The proceeds of the latter will be used to reduce the floating debt to $50,000. The sale of $8,200,000 bonds of the Detroit United was also made to an eastern syndicate. A large portion of the proceeds of this sale will be used to retire bonds of the old Detroit Citizens' Railway Company, which are due in July, 1905. The sale, however, clears up the troubles of the syndicate in that direction. It has been stated that the indebtedness of the syndicate has been reduced from $4,500,000 to $1,500,000 within the last year. A member of the bankers' committee is quoted as saying that within a short time sufficient funds will be realized to clear up the affairs and put the business wholly in the hands of the syndicate.

An ordinance was introduced in the City Council at Cleveland a few days ago for the purpose of granting the Cuyahoga Light and Power Company a franchise to operate in the streets and alleys, subject to existing regulations. This is the new company that was incorporated a week or two ago. City Solicitor Baker says that the council has no power to grant a franchise to the new company, as the statutes provide that where a lighting plant is already in operation in a city, a vote of the people is required for a franchise for a new company.

A resolution has been prepared by the Cleveland Board of Health which has for its purpose the limiting of the number of persons who shall ride upon any one street car. The number shall not exceed as many passengers as can be seated on all the seats and half as many again standing, and the conductor of the car is expected to be responsible for the violation of the rule.

Cars on the Columbus, Urbana and Western will be in operation from Columbus to Fishinger's Mill by December 10th. The portion of the road now in operation is producing a good income.

The Lake Shore Electric has allied itself with the Clover Leaf in making Fair rates to St. Louis. Considerable business has already been originated by the electric road.

Captain J. Benson Foraker is having a private car constructed that will be unique in many respects. As far as possible electrical devices will be used for all purposes. The buffet will have a complete electrical cooking outfit.

G. B. Saltzgaber is promoting an electric line from Van Wert to St. Marys, where it will connect with the Toledo and Ohio Central.

The Springfield, Charleston, Washington and Chillicothe road has been completed to a point near South Charleston, and the first car made a trip over it a few days ago.

It has been decided to use a current of 2,500 volts instead of 1,750 in the electrocution of criminals in the penitentiary hereafter. The last electrocution required three applications of the current. With an increased current there will be little danger of death not taking place on the first application, although it may be necessary, it is said, to make some arrangements to prevent burning the flesh where the sponge electrodes contact.

Cleveland councilmen are still working to arrange some plan for a cross-town line. The people, especially of the eastern portion of the city, are clamoring for accommodations of this kind.

C. W. Comstock, president of the Cincinnati, Georgetown and Portsmouth Railway Company, is building an electric line from Bethel to Felicity, Ohio. The new line will touch the Cincinnati, Georgetown and Portsmouth at Bethel and will form a feeder for it. The extension of the original line to Russellville is almost completed. In a distance of 3½ miles there are trestles 300 feet long and 50 feet high. O. M. C.

Indiana.

Indianapolis, November 26.—The Evansville and Henderson Traction Company has not yet established its right to cross the Ohio River on the Henderson bridge, and for that reason the Board of Public Works has granted the company an extension of time in which to begin the work of building the road.

At a recent meeting of the directors and officials of the Evansville and Eastern Electric Railway Company, reports submitted showed that the work on the line was being rushed according to contract and that the affairs of the company were in first-class condition. W. H. McCurdy, president of the Hercules Buggy Company, was elected to succeed L. E. Fricke on the board of directors, and F. W. Reitz was elected vice-president, to succeed J. W. Fuquay.

S. W. Williams, Dr. C. W. Benham and other promoters of the Western Indiana Traction Company, with principal offices in Vincennes, have recently returned from New York, where they succeeded in financing the proposed road for $1,250,000 with the Trust Company of America. The road will be constructed in the immediate future and will run through several towns in Knox County, and thence to Terre Haute.

The stockholders of the Columbus, Greensburg and Richmond Traction Company held their annual meeting in the company's office in Indianapolis on November 19th, and elected directors, who chose the following-named officers: President, H. F. Holland; vice-president, Walter McConaha; secretary, A. H. Carter; treasurer, William P. Myer.

More than usual interest attaches to the filing of articles of incorporation by several traction companies during the week, because of the large development they promise. The first of these is the Interstate Traction Company, with principal office in Bluffton, Ind. The capital stock is placed at $150,000. The object of the company is stated to be for the construction and operation of a traction line from Marion, Ind., to the city of Lima, Ohio, extending through Grant, Huntington, Wells and Adams Counties in Indiana, and the counties of Vanwert and Allen in Ohio—a distance of 90 miles. The incorporators are C. H. Bundy of Marion, F. M. Caldwell, J. H. Painter, John C. Curtis, E. L. Murry, J. S. Postal, A. G. King and A L. Sharpe of Bluffton.

Another new company is the Indianapolis, Newcastle and Toledo Electric Railway Company, incorporated with a view of building a system of electric traction lines that will touch 27 eastern towns and cities and serve an estimated population of 150,000. The capital of the company is $3,500,000, and large blocks of the stock have been subscribed for by the following promoters of the large enterprise: R. M. Churchman, D. M. Parry and W. E. Stevenson of Indianapolis, E. H. Bundy, C. S. Hernley, F. M. Ingler of Newcastle and Eli Maroni and C. N. Mikels of Frankfort. The new company absorbs the Indianapolis, Newcastle and Winchester company, incorporated a few weeks ago, the proposed line of E. T. Ice from Newcastle to Muncie and the projected line of C. N. Mikels from Newcastle to Richmond. All of the proposed branch lines will parallel steam lines with the exception of the Maxwell branch to Greenfield. Mr. C. S. Hernley, vice-president and general manager, while in Indianapolis to file the papers said: "There is a necessity for a straight short line between Indianapolis and Lake Erie. There is a growing section of the country to be served, besides we expect to do a good freight business by piercing the oil fields and transporting oil to the Belt road in Indianapolis. According to present plans, the power house will be constructed at Newcastle."

As the result of a street-railway war in Michigan City, the Chicago, South Shore and South Bend Electric Traction Company proposes to build a road in 10 days. Nearly a year ago the company obtained a franchise to build its line in Michigan City, with the condition that the line was to be in operation by December 1, 1904. An extension of time was denied by the council, and the company immediately began the preparation to build the link through the city within the prescribed time.

The Indianapolis and Cincinnati Traction Company has received two new cars for freight and baggage—the first of a large installment of new equipment ordered for the line to be opened between Indianapolis and Rushville in a few days. The Shelbyville branch will also be equipped for hauling freight at the same time.

The American Lighting Company of Baltimore, Md., is bidding against the Evansville Gas and Electric Light Company for lighting the streets of Evansville for five years. The bids by the American company will be on several different styles of lamps. Indications point to higher rates than there are in force at present.

Manager Reynolds of the Northwestern Traction Company announces that the company is now ready to furnish farmers along its line with electricity for various uses. He says there is no question that electricity is an economical power for use on the farm for the operation of farm machinery and lighting buildings. "We are now ready to take up the question with prospective customers and make such arrangements and rates as will be entirely satisfactory to them," said he.

The Kokomo Electric Company has been incorporated to carry on a general manufacturing and trading business in electrical supplies and appliances.

The Chrisney Electric Light Company has incorporated with a view to installing an electric-light plant in Chrisney, Spencer County. S. S.

Northwestern States.

Minneapolis, November 26.—John Harry is making preparations to put in an electric-light plant at Alma, Wis.

H. R. Healy has sold the electric-light system at Waverly, Iowa, to the city, the consideration being $13,500.

An ordinance has been framed at Iowa City, Iowa, granting a franchise to the Iowa City-Davenport Interurban Railway Company.

Dr. W. F. Pierce and others of Carson, Iowa, propose building a trolley line from Carson to Council Bluffs.

An electric railway from Vinton, Iowa, to Belle Plaine is projected.

Plans have been perfected to build an electric railway from Kenosha, Wis., to Lake Geneva.

The Omaha (Neb.), Lincoln and Beatrice Interurban Railway Company is planning to handle freight, in addition to its passenger traffic, as soon as its new line is completed.

An electric-light plant will be put in at Melrose, Minn.

The Jordan (Minn.) Electric Light and Heating Company will install a large storage battery in order to give a 24-hour service. F. J. Leonard has been elected president and J. E. Casey secretary of the company. R.

Michigan.

Detroit, November 26.—The Standard Electric Company has begun suit against the Scenic Railway Company to foreclose, under an alleged mechanics' lien, on the buildings, machinery, etc.

The Adrian and Ann Arbor Electric Railroad Company has asked the Ann Arbor council for a franchise and agrees to have the line in operation 18 months after a franchise is granted.

It is understood that the General Electric Company is figuring on estimates to convert the branch of the Michigan Central railroad running south through Sturgis to Goshen, Ind., into an electric line. Estimates and designs are being gotten out for the electric locomotives to operate the line. It is understood that the Westinghouse Electric and Manufacturing Company of Pittsburg is also furnishing estimates and plans. The road passes through fine farming country, and if converted into an interurban line will handle passengers and freight. This will be the first steam road in Michigan to be converted into an electric railway.

A director of the Detroit, Monroe and Toledo Short Line recently stated that a contract had been made with the Holland Palace Sleeping Car Company of Indianapolis to furnish the sleepers to be run out of Detroit to Cleveland, and it is understood that this arrangement will go into effect in the near future.

It is now quite certain that the Detroit-Bay City electric line will be constructed. The right-of-way is practically all secured. There is, however, considerable doubt in Pontiac as to the road coming through that city. On November 3d the council granted the company a franchise allowing 20 days for its acceptance.

The Coldwater Common Council has granted a franchise to the Toledo and Michigan electric railroad, to be built to Coldwater from Adrian, next

season. The roadbed is already graded to a large extent. The franchise for the Battle Creek and Coldwater electric railway was up for final passage, but Promoter Griffin declined to accept the terms and requested its withdrawal.

Beginning Monday, the Detroit, Ypsilanti, Ann Arbor and Jackson electric railway will inaugurate its new limited service. The company is now arranging the runs, which will include several innovations. It is expected to do away with the special students' tickets, which have been sold to students attending the university and other schools at the rate of $7 per 1,000 miles. It is said that nearly 100 students travel between Ann Arbor and Ypsilanti every day.

The Wayne Automobile Company of Detroit has filed articles of association, incorporating for $300,000. Of this capital, $8,200 has been paid in cash and $24,000 in other property, including the assets of the Wayne Automobile Company, at present located in Detroit. The stockholders are Charles L. Palms, William Kelly, Roger J. Sullivan, J. B. Book and E. A. Skae. C. G. W.

Rocky Mountain States.

Salt Lake City, Utah, November 24.—The Washoe Power and Development Company has nearly completed its canal and electrical power plant which will supply electrical energy for the cities of Sparks and Reno, Nev. As the buildings are now almost ready for the installation of machinery and the canal, which has been in course of construction for two years, will be finished within a month or two, it is stated by the management that the new plant will be thoroughly equipped and in operation by the first of March of next year. The plant will have an initial capacity of 1,000 horsepower, this to be increased later to 3,000. The company was incorporated in 1892 with J. E. Humphrey as president, John Evans, vice-president, and F. H. Norcross, secretary. The authorized capitalization of the company is $300,000.

I. B. Perrine, whose headquarters are at Boise, Idaho, has filed upon the waters of Trout Creek, near the Blue Lakes, where a fall of 50 feet will generate 1,200 horsepower, and at which point he proposes to construct an electric plant.

The Idaho Power and Transportation Company is preparing to commence work on the construction of a dam at Idaho Falls, Idaho, with a view to the installation of a power plant at that point.

Preliminary steps for organizing a company to construct a series of electric railways branching from Kalispell, Mont., to all parts of the valley, have been taken by the Chamber of Commerce of Kalispell. F. W. Tinkel heads a committee on organization.

The Havre Electric Company has been incorporated at Havre, Mont., with a capital stock of $100,000. The incorporators are H. W. Turner, M. Hebgen, J. H. Smart and others of Butte, Mont.

Frank Brown, manager of the Jumbo mine at Lewiston, Idaho, has purchased a complete electric power plant to be installed at the mine by January 1st. This plant will furnish sufficient power for all the mining machinery on the property. G.

Pacific Slope.

San Francisco, November 25.—Daily communication is now maintained between the space-telegraph stations at Mare Island and Goat Island, but the signal service from the Farallons has been discontinued. The Navy Department, however, is to reestablish the system soon, and George E. Hanscom will be sent out to install the apparatus.

The San Francisco Gas and Electric Company is striving, by means of injunction suits, to prevent its only dangerous rival, the Mutual Electric Light Company, from laying wires in the various important thoroughfares in San Francisco. Two injunctions have been obtained. The Mutual Electric Light Company is constructing a power house at Spear and Folsom Streets, and is laying a duct 12 inches square containing 11 electric wires, down Market Street. The work includes two underground stations in each block, about six feet deep, seven feet long and five feet wide, made of brick and topped with an iron cover. The ducts are made of wood, covered with tar or creosote. The San Francisco Gas and Electric Company claims that, being laid in close proximity to its gas mains, electrolysis will take place and great damage will result.

The Peerless Electrical Works, 284 Stevenson Street, San Francisco, is doing the electric wiring in the new building being erected on Commercial Street, opposite the United States Treasury Building.

A huge 15-foot bowlder rolled upon the flume of the American River Electric Power Company's power house near Stockton recently, and the service was cut off for some time.

The Martland Electrical Company is doing the electrical work in a building in course of construction at 235 Third Street, San Francisco.

The trustees of Santa Ana, Cal., have adopted an ordinance granting to the Los Angeles-Interurban Railway Company the right to construct and maintain an electric railway in the city of Santa Ana.

Work is to begin within a year on the proposed electric railway between Santa Maria and Guadalupe, Cal., the franchise for which has been granted.

D. L. Huntington, general manager of the Washington Power Company, states that it will be but a short time before conditions at Post Falls, Wash., will be such that the company will have a power plant there with a capacity of 18,000 horsepower. It is understood that the company will in the near future begin extensive improvements on the plant at Spokane, Wash., with a view of increasing the capacity in that city.

The Spokane Southern Traction Company, promoted by Mark F. Mendenhall of Spokane, Wash., has increased its capital stock from $500,000 to $2,000,000, and has enlarged its plans from the building of an electric road across Moram Prairie to building across the Palouse country to Colfax. A traffic contract has been closed with the Washington Power Company to enter the city over the power company's lines. Plans are completed and finances are assured for the construction of a main trunk line and several branches, aggregating over 100 miles in length.

The Cuyamaca Mining Company, which is developing the Stonewall mine in the Cuyamaca Mountains near San Diego, Cal., will erect an electric plant in the near future.

The Thomas Day Company is furnishing the elaborate electric fixtures for the Security Savings Bank Building on Montgomery Street, near California Street, San Francisco, at a cost of $2,000.

An ordinance has been presented to the City Council of Seattle, Wash., providing for the submission to the people of a proposition to issue bonds in the sum of $250,000 for the distribution of lights to the residence districts. An ordinance has also been presented instructing the Board of Public Works to purchase from the Seattle Electric Company its street-lighting circuits and appurtenances connected therewith.

The Pacific Electric Railway Company has a large force of men at work double-tracking its line between Hermosa and Redondo, Cal.

The Weidenthal-Gosliner Electric Works will install the electric wiring and apparatus for Mary T. Rae in an eight-story building on Powell Street, near O'Farrell, San Francisco. The work will cost $1,091.

The Loon Lake Water and Power Company has been incorporated at San Francisco by S. Forbes, C. Forbes, W. Gregory and others. The capital stock is $200,000.

Attorney L. F. Puter, representing the North Mountain Power Company, has presented a petition to the supervisors of Humboldt County, Cal., for a power franchise. The date of its sale has been fixed for December 15th.

The Joshua Hendy Machine Works has secured the contract for the wiring of the large building being erected in San Francisco on Sacramento Street, near Drumm. A.

PERSONAL.

Nelson Stow, said to be the first builder and operator of an electric street-car system in Binghamton, N. Y., died at his home in Binghamton, on November 20th.

Frank H. Bristol, vice-president of the Bristol Company of Waterbury, Conn., manufacturer of recording instruments, was instantly killed on November 21st by a fast passenger train which struck his closed automobile in which he was crossing the tracks of the New Haven Railroad in Waterbury. Mr. Bristol was prominent in Waterbury and throughout the state.

William J. Hammer of New York, well known as a consulting electrical engineer and an enthusiastic electrical collector, was in Chicago last week, on his way to St. Louis, where he has, or did have, a remarkable historical exhibit of incandescent lamps, which was one of the features of the display in the Palace of Electricity. Mr. Hammer was also one of the electrical jurors of award.

Thomas D. Lockwood, Dr. Louis Duncan, Dr. F. A. C. Perrine, Charles F. Scott and W. S. Barstow, all prominent in the electrical industry, have become members of the faculty of the Polytechnic Institute of Brooklyn in a consultatory capacity. In the order named, each will be identified with a special branch, as follows: Telephony, telegraphy and patent practice; electric traction; electric power transmission; commercial engineering; central-station engineering.

Frank E. Scovill, superintendent of the Austin Electric Railway Company of Austin, Texas, was tendered an oyster roast by the employes of the company on the occasion of his recent departure for Laredo, Texas, where he assumes the management of the street-car company of that city. The employes presented Mr. Scovill a handsome gold watch and chain. Several hundred of Mr. Scovill's personal friends in Austin also made the occasion of his departure a memorable one to him by a gathering at the Austin Club, where he was presented a large diamond stud.

The following-named persons were registered at the booth of the Western Electrician at the World's Fair, St. Louis, last week: H. G. Belcher; William N. McIntyre, Sparta, Ill.; William McFadden, National Soldiers' Home, Wisconsin; J. W. Johnson, Almont, Iowa; W. C. Hoover, Springfield Traction Company, Springfield, Mo.; E. N. Hardy, Union Light and Power Company, St. Louis, Mo.; W. H. Venghn, I. C. R. R., Evansville, Ind.; F. W. Mullen, St Louis, Mo.; Mr. and Mrs. A. C. Berny, Worcester, Mass.; Harry Little, East St. Louis, Ill.; Sig. Losos, East St. Louis, Ill.; Herbert Baker, Chatfield, Ohio.

A dispatch from Boston says that two 15-year-old boys of that city have established wireless telegraphic connection between their homes, half a mile apart. This recalls the fact that 30 days after the appearance of the first published accounts of Bell's invention of the telephone two New York boys had built and were successfully operating an experimental telephone system of their own. These two boys have since achieved distinction in the electrical field, and have for many years been allied in business. They are Prof. Francis B. Crocker of Columbia University and Dr. S. S. Wheeler.

Frank J. Colbert died at his home in Detroit on November 12th in his 31st year. Some months ago he went to Milwaukee to act as private secretary to Mr. G. F. Randall, president of the National Electric Company. While acting in that capacity he was taken ill and was brought home for treatment. His progress for a time was favorable, but an operation was ultimately deemed advisable, from the effects of which he never recovered. Several years ago Mr. Colbert was business representative in Chicago of the Electrical Review of New York. He was a bright, engaging young man, gentle in manner, with a keen appreciation of the humorous in life. He was universally liked, and the news of his death will be distressing to all who knew him.

The report in Chicago on Monday morning that Miss Maud and Master Stanley Arnold, children of Bion J. Arnold, who are with their mother at Colorado Springs, Colo., had lost their way on a lonely part of Pike's Peak, caused considerable anxiety to Mr. Arnold and his friends. The children, 17 and 15 years old, respectively, had climbed Pike's Peak on Saturday in company with a companion. On the return trip darkness overtook them and they were compelled to spend the night without shelter in the mountains, having lost the trail in the darkness. Searching parties were sent out, but the anxiety of Mrs. Arnold and friends was relieved at noon on Sunday, when the young people returned to Colorado Springs, having found the trail themselves. A telegram from Mrs. Arnold stated that the children had been safely returned.

Dr. Louis Duncan, who is known throughout the technical world for his attainments in electrical work, has become associated with the staff of the Allis-Chalmers Company of Milwaukee. Dr. Duncan has been retained by the Allis-Chalmers Company as an expert in electrical patent work in connection with its electrical department, the Bullock Electric Manufacturing Company of Cincinnati. This connection has only recently been made possible by the retirement of Dr. Duncan from the chair of electrical engineering at the Massachusetts Institute of Technology, to which he was appointed in 1892. Finding that it would be impossible to do justice to the Institute, unless he gave up his constantly growing business as a consulting engineer and expert, Dr. Duncan decided to resign his chair. He will continue to make his headquarters in New York.

ELECTRIC LIGHTING.

The Ramona Light, Heat and Power Company of Ramona, I. T., has been incorporated.

A new electric-light plant has just been finished at Lynch, Neb., the first light being furnished last week.

The Board of Public Works of Oneida, N. Y., is receiving bids for lighting the streets and public places.

The Norton Light and Cold Storage Company has been incorporated at Norton, Kan., with a capital stock of $35,000.

The new electric-lighting system of Sandersville, Ga., has just been completed and a satisfactory test of the lights was made.

The Nebraska Lighting Company has been incorporated with a capital stock of $100,000. The company will be located in Plattsmouth, Neb.

The machinery for the new power house at Newberry, S. C., has been received and the old arc lamps will soon be replaced with improved street lamps.

The City Council of Hobart, Okla., recently bought the electric-light plant for $74,000, but, it is said, after an indignation meeting in the town the action was rescinded.

The El Paso Gas and Electric Company of El Paso, Texas, has been incorporated with capital of $500,000 by Barret Ridgely of Washington, D. C., George Goodnow of Waukegan, Ill., and others.

Articles of consolidation and merger of the Negaunee and Ishpeming (Mich.) Street Railway and Electric Company with the Negaunee Gas Light Company have been recorded. The new corporation will be known as the Marquette County Gas, Light and Traction Company and will be capitalized at

$400,000. The directors are Thomas A. Rockwell and Thomas B. Clerk of Evanston, Ill.; George A. Rockwell of Oshkosh, Wis.; John H. Bryant, Jr., of Chicago, and E. B. Finch of Ishpeming, Mich.

The Patterson Street Lighting Company of St. Paul, Minn., with $50,000 capital has been incorporated by Charles Patterson, Thomas McDermott and others.

S. C. Dorrell of Walnut Ridge, Ark., and associates contemplate building a $25,000 electric-light plant in Pocahontas, Ark., where they have applied for a franchise.

A new electric-light plant is to be established in Atlanta, Ga., by the Peachtree Lighting Company, just organized, by Arnold Broyhs, Martin Amorous and Edward Brown.

The municipality of Barcellos, Portugal, offers a 30-year concession for the erection of an electric-light and power plant. The company must furnish the town with 160 16-candlepower incandescent lights and six 50-candlepower arc lights for $1,620 a year.

The Denver Gas and Electric Company, Denver, Colo., continues to send out cards, booklets and folders, adorned with attractive pictures and catchy sentences intended to set prospective customers thinking about the company's products and the advantages in using them.

The municipal-light plant located in East Joplin, Mo., was destroyed by fire a few days ago. The East Joplin fire department apparatus in the same building was also destroyed. The department at that time was answering a call in another part of town. The loss is probably $75,000.

The Yankton Improvement Company of Yankton, S. D., has been organized with a capital stock of $100,000, with Isaac Piles, William S. Stockwell, Sanford G. Donaldson as incorporators. The plan is to ask the City Council for a franchise to build and operate an electric-light and gas plant.

ELECTRIC RAILWAYS.

A new electric-railway company is applying for a franchise in San Jose, Cal., from the western part of the city to Santa Teresa.

The electric railway of the Indian Territory Traction Company from South McAlester to Hartshorne is expected to be completed by January 1st.

Traffic on the Aurora, Elgin and Chicago third-rail line during October was exceptionally good and the report shows good gains in earnings. The gross receipts from the month were $42,712. The net earnings were $21,511 and $18,799, respectively, for October, 1904 and 1903.

Horace E. Andrews and J. J. Stanley of Cleveland have inspected the Fonda, Johnstown and Gloversville road, which parallels a portion of the New York Central in New York, and it is reported that negotiations are now under way for its purchase by the Vanderbilt interests.

Colonel W. H. Chase of Toledo, Ohio, is promoting an electric railway between Kansas City and St. Louis, a distance of 225 miles. Congressman J. H. Southard of Toledo is interested in the plan and it is stated that it has been financed. The route is 22 miles shorter than the shortest line now in operation between the two cities. The plans include high-grade construction.

The Circuit Court in Cleveland, Ohio, has declared invalid the Denison Avenue franchise of the Forest City Railway Company, better known as the "three-cent-fare street-car line," on the ground that the company did not have the necessary frontage consent. An injunction against the company was allowed. Mayor Tom L. Johnson is credited with being interested in the company.

Suit has been brought to prevent the St. Louis Transit Company surrendering its lease to the United Railways Company of St. Louis and to require Brown Bros. & Co. of New York, who negotiated the deal, to return all stocks, bonds and other securities received from the Transit company since September 1, 1904. The defendants named in the suits are the United Railways and Transit companies.

The Chicago City Council at its last meeting rejected an order for the appointing of a committee to investigate the genuineness of the petition for a referendum of all franchises for street-car companies at the spring election. The petition contains 133,903 signatures and it was estimated that to do the work of investigating in a thorough manner would cost the city $25,000. The council, by refusing to investigate the petition, takes it for granted that the document is all right.

George C. Webb has been appointed receiver for the Blue Grass Consolidated Traction Company of Lexington, Ky., which was incorporated with a capital stock of $7,000,000 to build a system of interurban roads about Lexington and the central part of the state. The property of the company, which consists largely of valuable franchises, will be sold at public auction. It is believed the company will realize enough to pay all debts. Senator George B. Davis of Detroit controls the company. It is understood that the Cincinnati Trust Company will underwrite $7,000,000 bonds of the Blue Grass Traction Company and it will thus be able to go ahead with its plans of extending operations and building new roads. A line from Lexington to Versailles is a possibility within the next 12 months.

A resolution was placed before the City Council of Evanston, Ill., recently to allow the Chicago, Milwaukee and St. Paul railroad to change its motive power from steam to electricity. This is believed to be a forerunner of the proposed plan to make connections with the Northwestern Elevated railroad, and it is said that if the resolution is approved the railroad company may sublet the privilege to the Chicago and Milwaukee Electric Railroad Company, which now operates cars between Waukegan and Evanston. The measure was referred to the transportation committee.

The Chicago and Southern Traction Company has just been incorporated by Chicago men, who propose to begin work on the building of an electric railway from Chicago to Kankakee, with stations at Harvey, Homewood, Matteson, Monee, Peotone, Manteno, Tucker and Bradley. The stockholders have elected William S. Reed president, Attorney Charles F. Davies vice-president, John B. Reed secretary, and Robert Woods of Indianapolis treasurer. Mr. Davies said that more than two-thirds of the right-of-way had been secured and that the capitalization of $100,000 would be increased to $5,000,000 and work started as soon as possible.

Alderman Foreman, chairman of the Chicago local transportation committee, has received a letter from Haakon Erikson, manager of the Christiania (Norway) municipal street railways, in which he asks advice on how to treat the traction problem in the capital of Norway. He states that the Christiania City Council soon must settle the question of taking over the property of a great private tramway company, the franchise of which expires in 1905, the city having power to acquire the tangible holdings at their real value. The company has asked a new franchise. He wants a short account of the state of Chicago's traction question and "its further supposable results." Alderman Foreman does not know what his reply will be, but says it will be "interesting."

SOCIETIES AND SCHOOLS.

At the next meeting of the Electrical Section of the Western Society of Engineers, which will be held in Chicago on December 16th, Prof. Henry Crew of Northwestern University will lecture upon "Modern Theories of Electric Arc and Spark."

Secretary Dudley Farrand of the National Electric Light Association has notified the members with regard to the annual meeting of the Underwriters' National Electric Association, to be held in New York city on December 7th. A number of interesting changes and revisions of rules as to wiring, fixtures and other matters relative to electric-light and power supply, that deeply affect the welfare of the central-station industry, are to be considered. The National Electric Light Association, which has always followed insurance questions closely, is taking an active and vigilant interest in all that tends to perfection of methods and increase of safety.

PUBLICATIONS.

A circular from the G. and C. Merriam Company of Springfield, Mass., publisher of Webster's International Dictionary, calls attention to the new edition of that work which has recently been issued containing 2,380 pages, 5,000 illustrations and 25,000 new words, bringing it abreast of the growth of the language.

"Automatic-start Induction Motors" is the title of bulletin No. 3062, coming from the Emerson Electric Manufacturing Company of St. Louis. The bulletin describes clearly the advantages of the motors, which are a new type. A diagram of field connections is also given which aids in obtaining a clear understanding of the apparatus. Dimension drawings and data upon the different types are contained in the bulletin for convenience in ordering.

William Roche of New York city, who is the manufacturer of a large number of specialties in the electric line, such as dry batteries, gas-engine igniters, spark plugs, spark coils, flashlight cigar lighters, etc., has issued a small catalogue describing these articles collectively. There is besides the mere description of apparatus considerable helpful information given in the booklet, such things being treated as the insulation of the secondary circuit of induction coils, regulation of the rheotome, make-and-break mechanism, etc., all of which apparatus has its periods of being vexatious to the operator.

"The time has come when every business man in Brooklyn and every householder whose income is sufficient to meet the ordinary requirements of a comfortable existence can afford and can enjoy the notable comforts and conveniences of an electric service" is the announcement which comes from the Edison Electric Illuminating Company of Brooklyn in the form of a circular. This bold assertion is not all that is contained in the little circular, however, but it contains also that which goes to prove the statement—facts and figures. The circular is a neat form of advertising literature.

MISCELLANEOUS.

A large party of northern and southern capitalists recently visited the Narrows on the Yadkin River near Salisbury, N. C., where the Whitney Reduction Company will soon begin active operations.

Sir Ernest Cassel, the well-known Anglo-German financier who made all the monetary arrangements for the great Nile (Egypt) dam works and who is a close friend and trusted adviser of King Edward, is in this country in connection with the establishment on the banks of the Nile of a system of trolley motors for the towing of barges and dahabiyeh. This will relieve the traffic of the railroad to upper Egypt and will, it is said, enable the conveyance of passengers and freight in one-tenth of the time hitherto required to dispatch them by water, steamboat traffic being very much restricted.

A deadlock has arisen between Mayor Fagan of Jersey City and President Thomas N. McCarter of the Public Service Corporation, which organization controls all the electric power, motor and lighting companies in North New Jersey. The mayor wished to inaugurate extensive improvements in the main streets, and having got the public sanction requested the company to co-operate. The president answered by protesting against the mayor's treatment of the company he represented, and he refused to take any steps in this direction until certain vexatious requirements against the company are withdrawn.

The executive committee of the Philadelphia Fire Underwriters' Association in a bulletin to members calls the attention of the public to the dangers to life and property from Christmas displays, decorations, signs, etc., in churches, public buildings, mercantile establishments and especially department stores. The use of Christmas greens, harvest specimens and other inflammable materials, such as draperies, scenery, cotton to represent snow and the like (especially in connection with electric and other lighting systems) is decidedly an increase of hazard, it being impossible to make displays of that nature perfectly safe.

TRADE NEWS.

The Phœnix Iron Works Company of Meadville, Pa., states that the International Philippine Jury of the Exposition at St. Louis, in its capacity of associate of the board of the Exposition, under the presidency of Secretary of War Taft, has awarded the company a gold medal for the compound engine exhibited in the power plant of the Philippine Government Board.

O. G. Remington, representative of the firm of Wm. McLean & Co., Melbourne, Australia, has been in this country some few weeks in behalf of his firm and is about leaving for a week in England and on the Continent. Mr. Remington intends to be in New York again about December 21st for a few days, en route back to Australia, where he will be open to negotiations from any manufacturer desiring an Australian connection who has lines to offer of merit. His New York address is care of Astor House. His company already handles exclusively in Australia the products of a number of large American electrical concerns.

Suits have been brought against the Jaeger Miniature Lamp Manufacturing Company of New York city and the American Endoscopic Company of Providence, R. I., for infringement of an incandescent lamp on a patent granted to Thomas A. Edison, No. 444,530, in which suits the Edison Electric Light Company is complainant. Two suits in which the General Electric Company is complainant have also been started against the Germania Electric Lamp Company for infringement of patents to Spiller & Massey, No. 537,493, and Mark H. Branin, No. 532,760. The bills of complaint in these four suits were filed on November 22d.

The Bureau of Supplies and Accounts, Navy Department, is inviting sealed proposals until December 13th for furnishing the navy yards at Boston, Mass., Newport, R. I., and Portsmouth, N. H., with a quantity of motors, starting panel, rheostats, generating sets, signal boxes, controlling apparatus for Westinghouse rotary converters, desk fans, ventilating sets, Weston ground detector, signal cable, magnet wire, arc lamps and miscellaneous electrical material. A list of articles required, together with blank forms of proposal, will be furnished bidders upon application to the navy pay offices in the cities mentioned or to the bureau at Washington.

The Providence Engineering Works of Providence, R. I., one of the oldest exclusive builders of large power steam engines, has decided to go into the electrical field and to supply electric motors of smaller power than the steam machines, which it has a reputation for building. After exhaustive investigations and tests extending over many weeks the Providence concern adopted the Storey motor as the machine with which to make its entrance into the electrical field. Mr. Storey, it is said, has been endeavoring to organize a company to manufacture and sell his variable-speed motor and other electrical devices, but instead has closed a contract

with the Providence company for the extensive manufacture and marketing of his motors under the Storey name and supervision.

The plant of the United States Carbon Company of Cleveland, Ohio, is for sale. It is well located as regards railroad and shipping facilities and has its own power plant, lighting and heating system with all modern conveniences. Full information may be had by addressing the Guardian Savings and Trust Company of Cleveland.

The Lee Paper Company of Vicksburg, Mich., has just ordered a 200-kilowatt generator from the Northern Electrical Manufacturing Company of Madison, Wis., for the equipment of its new mill. This is the most recent in a long series of sales of Northern apparatus in paper-mill work, the most prominent installation being the plant of the Consolidated Water Power and Paper Company of Grand Rapids, Wis., resently described in the Western Electrician.

BUSINESS.

E. R. Crolius & Son of Chicago, manufacturers of the Star soldering stick, call attention to the fact that this stick has been on the market for over 10 years and on account of its convenience and effectiveness has given universal satisfaction. Another product of this company well received by the trade is the Crolius commutator compound, which also is in wide use. To anyone not yet familiar with the soldering stick or the commutator compound a free sample will be sent by the manufacturers on request.

The American Electric Fuse Company of Chicago, New York and Atlanta, manufacturer of the Allen-Bradley electric-crane controller, announces that it is now prepared to accept orders for all sizes of electric controllers. The company has been busy in the last six months preparing for the market a number of new designs of controllers. Three months' free trial are given with the privilege of returning the goods if not satisfactory and also one year's guarantee against any repairs. The company before January 1st will have a complete line of rheostats of all types which it will sell under the same guaranty as the crane controllers.

The Electric Storage Battery Company of Philadelphia has recently closed the following contracts for Chloride accumulator installations: Two three-wire batteries for the Union Electric Light and Power Company of St. Louis; one three-wire battery and one exciter battery for the Edison Electric Illuminating Company of Boston; one three-wire battery for the Rochester Railway and Light Company and an increase in the capacity of the first battery installed; an exciter battery for the Interborough Rapid Transit Company, New York; a railroad regulating battery for the Public Works Company, Bangor, Me.; a lighting and power battery for the New York Hall of Records, and a large number of residential and isolated lighting batteries.

The Abner Doble Company, San Francisco, Cal., engineers, has been awarded the grand prize for its exhibit of a 170-horsepower tangential water wheel. The wheel develops 170 horspower at a speed of 700 revolutions per minute with a water pressure of 300 pounds per square inch, equivalent to a hydraulic head of nearly 700 feet.

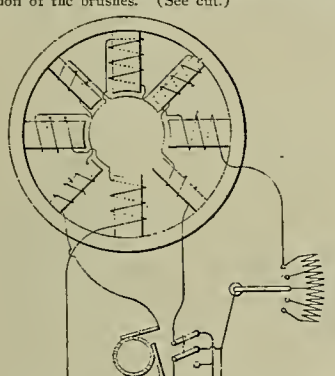
The Central Electric Company of Chicago is sending out circulars to the trade calling attention to the fact that it is prepared to supply from Chicago stock, Christmas-tree lighting outfits and states that the figures it is able to quote are unusually attractive. The outfit contains 27 lamps, two-candle-power, of assorted colors, red, green, blue, frosted, canary and amber. There are 24 sockets and 27 lamps, the three extra being included in case of breakage. The sockets are waterproof and, being enclosed, eliminate the possibility of an electric shock; 50 feet of lamp cord, attachment plug for Edison or T.-H. base, as specified are supplied. Each socket has three strands of eight lamps each, which properly distributes the lamps. The entire outfit will cover a space 15 by 18 feet, enough illumination to light a room 30 by 30, with a 12-foot ceiling.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued (United States Patent Office) November 22, 1904.

775,310. Variable-speed Motor. Mathias Pfatischer, Philadelphia, Pa. Application filed April 7, 1904.

Connections include the coils of alternate poles in shunt relation to the armature, and other connections include other alternate coils in series relation with the armature. Means are arranged to adjustably vary the strength of the field in the shunt coils independently of the series coils whereby the armature is enabled to rotate at variable speed and variable load in either direction without sparking and without variation in the position of the brushes. (See cut.)



NO. 775,310.—VARIABLE-SPEED MOTOR.

775,311. Motor Case and Gear. Leroy S. Pfouts, Canton, Ohio. Application filed August 15, 1904.

Mechanical features of a motor gearing and casing are the basis of the patent.

775,317. Electric Controller. Harry C. Smith and George E. Lippert, Chagrin Falls, Ohio. Application filed April 2, 1904.

In an electric controller are combined a cylinder, a piston contained in the cylinder and arranged to be moved in one direction by fluid pressure, other means for moving the piston in the opposite direction, a contact piece, a swinging arm connected and movable with the piston, a swinging contact piece on the swinging arm and arranged to be moved into and out of engagement with the first-mentioned contact piece.

775,322. Insulated Rail-joint. George A. Weber, New York, N. Y., assignor to the Weber Railway-joint Manufacturing Company, New York, N. Y. Application filed January 27, 1904.

An insulated rail joint, having insulation beneath the base of at least one rail, has a holding device in the form of a piece of tape of suitable material interlaced with the insulation and suitably held in position in the joint for maintaining the insulation in position.

775,334. Alternating-current Electric Motor. Benjamin G. Lamme, Pittsburg, Pa., assignor to the Westinghouse Electric and Manufacturing Company. Application filed February 27, 1904.

An electric motor having field-magnet pole pieces provided with slots parallel to the armature axis contains also neutralizing conductors that extend through the slots and around the spaces between the pole pieces and magnetizing coils that surround the pole pieces and the adjacent portions of the neutralizing conductors.

775,337. Wireless Telephone. Roberto L. de Moura, New York, N. Y. Application filed October 4, 1901.

In a system of wireless telephony is a call device comprising a microphone, a tube carrying the microphone at one end, a receiver at the other end, an enlargement in the tube intermediate of its ends, and openings in the enlargement to permit communication between the outer air and the contained air column. (See cut.)

775,358. Street-car Fender. Joseph M. Wilderman, St Louis, Mo., assignor of one-half to Louis J. Ringe, St. Charles, Mo. Application filed March 12, 1903.

The car fender is arranged to be held in a partly raised position by an energized electromagnet. Upon the de-energization of the magnet the fender is let drop to its lowest position.

775,380. Cash Register with Distant Indication. William H. Muzzy, Dayton, Ohio, assignor to the National Cash Register Company, Jersey City, N. J. Application filed January 28, 1904.

Incandescent lamp signals to correspond to the various keys on the cash register are thrown into and out of circuit by the keys and indicate the respective keys and cash drawers.

775,390. Electrical Signaling Apparatus. Sewall Cabot, Brookline, Mass. Application filed March 23, 1904.

Combined with a control line is an operating electromagnet, a preparatory electromagnet, armatures for the magnets, closure contacts and electric connections between the control line and the coils of the electromagnets and between the respective coils of the electromagnets, of which the closure contacts are reciprocally controlled by the armatures.

775,408. Electrical Register and System Therefor. Louis A. Schmidt, Chicago, Ill. Application filed February 5, 1904.

A registering device for telephones comprises two counter members and co-operating transmitter devices connected in circuit with the respective main lines, means for effecting a relative movement of the counters and corresponding transmitter devices to take a tactual reading of the positions of the counters and transmit such reading over the main lines, and independently operable responsive devices connected in circuit with the main lines at a receiving station remote from the meter station.

775,416. Electric System of Transmission. Charles G. Burke and Edward J. Burke, Brooklyn, N. Y., assignors of twenty-one thirtieths to John Q. A. Whittemore, Boston, Mass. Application filed December 17, 1903.

An automatic transmitter has means associated with it for sending signals of different intensities. The apparatus includes sending and receiving aerials, a recorder, and means responsive to the different intensities for causing the recorder to record the different indications sent.

775,442. Electric Arc Lamp. Tito L. Carbone, Berlin, Germany. Application filed April 19, 1904.

An arc lamp comprises a frame with a base and top piece and inclined bars connecting the base and top. Holders slide on the inclined bars and carry converging carbons.

775,445. Controlling Switch for Electric Circuits. Maxwell W. Day, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed May 9, 1904.

In a controlling switch for electric circuits are a rotatable shaft, a controller drum carried by the shaft, stationary contacts adapted to be engaged by the drum, two stationary commutators concentric with the shaft, resistances connected to the commutators, and a bridging member carried by the shaft and engaging the commutators, the points of engagement of the member with the two commutators being relatively displaced with reference to the segments of the commutators.

775,453. Regulating Dynamo-electric Machines. Wilbur L. Merrill, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed June 11, 1902.

An alternating-current dynamo contains a vibrator for controlling the voltage and means for supplying the vibrator with direct current of a voltage varying in response to variation of voltage of the dynamo.

775,458. Dynamo-electric Machinery. Henry G. Reist, Schenectady, N. Y., assignor to the General Electric Company. Application filed May 9, 1902.

The field magnetic circuit is provided at one or more portions with two paths for the magnetic flux, one of the paths including a slot in the material forming the magnetic circuit and the other a reduced cross section of the magnetic material of a length greater than the width of the slot.

775,461. Electric Circuits and Apparatus for Railway Signaling. Henry W. Spang, New York, N. Y., assignor to James R. Fancher, New York, N. Y. Application filed January 19, 1903.

Two lines of rails of an insulated section of railway track and a generator connected with farther end of the section are the fundamental parts of the system. Two relays, normally out of circuit, are located at points distant from each other, independent short signal circuits for distant and home signals, located ahead of the near end of the section and respectively controlled by relays.

775,472. Method of Converting the Energy of Fuel into Electrical Energy. Hugo Jone, Chicago, Ill. Application filed November 18, 1901.

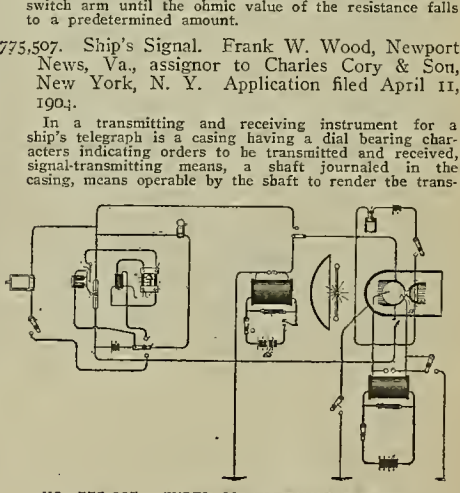
The method of generating electrical energy consists in first combining a metal as the positive plate, with carbon as the negative plate, and an alkali as the electrolyte, in a galvanic cell, at an elevated temperature, generating electrical energy by oxidation of the metal, and then reducing that battery product which contains the metal oxidized in the battery reaction to the metal by means of the oxidation energy of fuel, and repeating the oxidation of the metal with generation of electrical energy.

775,501. Controller. Ernest Schattner, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed May 13, 1904.

A motor-starting rheostat, having a self-reducing resistance, has means for closing the circuit therethrough, a contact, a switch arm arranged to fall by gravity into engaging relation to the contact to short-circuit the resistance, and means for arresting the movement of the switch arm until the ohmic value of the resistance falls to a predetermined amount.

775,507. Ship's Signal. Frank W. Wood, Newport News, Va., assignor to Charles Cory & Son, New York, N. Y. Application filed April 11, 1904.

In a transmitting and receiving instrument for a ship's telegraph is a casing having a dial bearing characters indicating orders to be transmitted and received, signal-transmitting means, a shaft journaled in the casing, means operable by the shaft to render the transmitting means effective, a handle to rotate the shaft provided with means associated with the dial to assist in the control of the transmitting means, an audible-signal circuit, a magneto generator in the circuit, and means controlled by the shaft to operate the generator.



NO. 775,337.—WIRELESS-TELEPHONE SYSTEM.

775,521. Telephone System. George M. Crockett, New York, N. Y., assignor of one-half to Irving H. Brown, Plainfield, N. J. Application filed June 19, 1903.

A relay at one sub-station is connected with the corresponding telephone instruments and with one of the main lines arranged to break the circuit at its station or the station or stations farther on the line from central upon the closing of the circuit of the telephone instruments at the corresponding station.

775,529. Electrically Operated Railway Track Switch. George H. Fretts, Springfield, Mass. Application filed January 20, 1904.

Insulated conductors support a trolley switch insulated therefrom. Electrical trolley-switch-actuating mechanism is adapted to be energized by a current established through the trolley. Electrical track-switch-actuating

mechanism has means for causing the energizing of the mechanism simultaneously with the trolley-switch-actuating mechanism when the insulated conductor sections are energized by the trolley.

775,535. System of Alternating-current Distribution. Adolf E. W. Meissner, Charlottenburg, Germany. Application filed June 16, 1899.

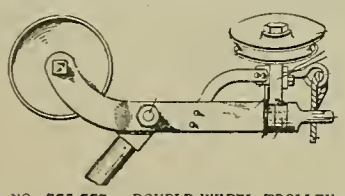
A pair of rotary transformers has means for supplying current thereto and mechanism for varying the relative speeds of the transformers. A rotor is supplied with alternating current from one transformer, and a stator supplied with current from the other transformer.

775,560. Oscillating Motor. Theodore M. Foote, New York, N. Y. Application filed March 17, 1904.

The motor comprises a shaft suitably journaled, an arc-shaped core carried by the shaft, a series of windings inclosing the core and means whereby the windings may be successively energized. A field magnet causes the core and shaft to rotate upon the energization of the windings.

775,592. Insulating Support for Electric Third Rails. Walter H. Barnard, New York, N. Y. Application filed July 28, 1904.

An insulating support for electric-conductor rails comprises a base, an insulating block secured thereon and a rail-receiving clamp secured on the block and movable around it.



NO. 775,777.—DOUBLE-WHEEL TROLLEY.

775,627. Overhead Trolley. Joseph G. Johnston, Detroit, Mich., assignor to the American Car and Foundry Company, St. Louis, Mo. Application filed September 9, 1904.

Two inclined rails having alining ends in different horizontal planes have a hoist adjacent the ends of the rails to receive the trolley from one rail and transfer it to the other rail. A trigger forces the trolley from the hoist, and an abutment is provided against which the trigger strikes when the trolley is in position to be transferred to one of the rails.

775,654. Electric Furnace. Aldus C. Higgins, Worcester, Mass. Application filed April 4, 1904.

An electric furnace is comprised of a shell adapted to contain and come in contact with the material to be fused, and a base separable from the shell upon which the charge is entirely supported when the shell is removed.

775,665. Circuit Controller. Archibald D. Scott, Providence, R. I., assignor to the Varley Duplex Magnet Company. Application filed November 6, 1903.

A pivoted lever having a flexible extremity is associated with a contact point opposed to the extremity. A stop normally holds the lever out of contact with the point and means are provided for violently throwing the lever against the stop to create momentum in the flexible extremity. Other means prolong the contact thus produced between the lever and the contact point.

775,680. Resonance Relay. Peder O. Pedersen, Copenhagen, Denmark. Application filed July 31, 1901.

The relay consists of a pair of oppositely arranged tuning forks, vibrators stretched between the forks and located in a magnetic field, and a contact device controlled by one of the tuning forks.

775,689. Base for Incandescent Lamps. Alfred Swan, New York, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed March 27, 1903.

A base for an incandescent lamp comprises metallic contacts to which the lamp wires are attached, and a metallic bulb holder secured to, but insulated from, the contacts by glass, the bulb holder having a flange formed thereon which is embedded in the glass.

775,692. Electromagnetic Circuit Controller. Eugene W. Vogel and Charles H. Morrison, Chicago, Ill., assignors to the Railroad Supply Company. Application filed March 21, 1902.

Details are described.

775,714. Electric Heater. Edward P. Weggen, Jefferson City, Mo., assignor of two-thirds to Charles Tweedie, Jefferson City, Mo., and William J. Schott, Topeka, Kan. Application filed April 22, 1904.

A coil is disposed adjacent to the member to be heated, the coil being provided with windings, and conductors connected with one of the windings at points remote from the member to be heated. The points are selected from different parts of a winding remote from the member to be heated for the purpose of rendering uniform the distribution of heat.

775,723. Electric Burglar Alarm. Amos Getto, New York, N. Y. Application filed April 27, 1904.

A member is connected rigidly upon a spindle to be turned to different angles. Contact mechanism is mounted upon the member and opened and closed by movements of the member. Electric circuits are connected with the contact mechanism, and a bell is included within the circuit and energized thereby.

775,732. Battery-charging Apparatus. Hermann G. Pape, New York, N. Y. Application filed May 17, 1904.

In a battery-charging apparatus are combined a charging cord having a single connector provided with terminals of like form, a battery having a single connector provided with terminals of like form, but unlike the terminals of the cord connector and arranged to be connected in interfitting relation therewith, and a polarity indicator having a pair of terminals corresponding in form with the terminals of the battery connector, the polarity indicator and each connector having a terminal indicator to facilitate the proper connection of the parts.

775,736. Electric Signaling System for Railways. Emilio Sera and Floriano Stolfi, New York, N. Y. Application filed July 18, 1904.

In an electric signal system are an open circuit, electric batteries and signaling devices in the circuit, and pole-changing devices in the circuit, the pole-changing devices being adapted to change the poles of the batteries at different intervals.

775,752. Manufacture of Barium Hydrate. Fredrik Jahn, Ridley Park, Pa., assignor to Harrison Bros. & Co., Philadelphia, Pa. Application filed September 5, 1903.

A process of obtaining barium hydrate from barium sulfid consists in electrolyzing a solution of the latter between electrodes of which the anode is larger than the cathode with interposition of a porous partition whereby some of the barium hydrate is formed in the cathode compartment while the remainder and greater part is formed along with polysulfids in the solution in the anode compartment.

775,777. Trolley. Edward L. Naret and Joseph R. Ernst, Morgantown, W. Va. Application filed September 16, 1904.

The trolley is comprised of two wheels following the wire, one in a horizontal and the other in a vertical plane. (See cut.)

775,779. Rosette for Suspending or Supporting Incandescent Lamps. Harry E. Rossiter, Sunbury, Pa. Application filed June 2, 1904.

A base member and a cap member, the two having metallic spring and plate connections between, are adapted to support an incandescent lamp. The base member has a socket provided with a lateral entrance and undercut opposite walls. The cap member has opposite walls adapted to extend within the planes of the undercut walls.

775,797. Railway Signaling Apparatus. John T. Cade, Midland township, Bergen County, N. J., assignor to the General Railway Signal Company, Gates, N. Y. Application filed October 6, 1902.

A counterweight is arranged to throw the signal to danger when released and a motor controlled from the signal tower brings the signal back to "clear."

775,808. Trolley. Joseph B. Elker and James F. Tobin, Pittsburg, Pa. Application filed January 26, 1904.

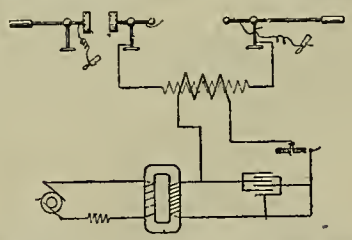
A casing is secured to the pole and a trolley wheel is resiliently mounted and extends within the casing.

775,830. Typewriting Machine. George M. Kitzmiller, Norfolk, Va., assignor to the Electric Typewriter Company of Norfolk, Norfolk, Va. Application filed August 4, 1904.

Electromagnetic means, controlled by the key levers, manipulate the printing devices.

775,834. Electromagnetic Brake. Robert C. Lowry, New Westminster, Canada. Application filed August 13, 1903.

In an electromagnetic brake are a bar or bars pivotally arranged, a suspending device and one or more brake wheels mounted at each end of the bars and adapted to be brought into contact with the magnetized car wheels.



NO. 775,871.—VARIABLE AIR-GAP CONDENSER.

775,835. Electromagnetic Brake. Robert C. Lowry, New Westminster, Canada. Application filed August 13, 1903.

In an electromagnetic brake are a bar arranged between the wheels and non-magnetic brake shoes carried by the bar, the ends of the bar being adapted to come in direct contact with the peripheries of the wheels.

775,844. Electric Time Switch. Clifford S. Moore, Holyoke, Mass., assignor of one-half to Burton C. Read, Holyoke, Mass. Application filed December 23, 1903.

The essential parts are a movable actuating member of a switch, a slidable member connected to the movable member, a weight arranged to co-operate with the slidable member, a swinging lever having a weight-supporting abutment, a detent for the lever, and a clock-actuated part, arranged to trip the detent at a predetermined time.

775,846. Wireless Telegraph. Robert L. de Moura, New York, N. Y. Original application filed October 4, 1901. Divided and this application filed January 16, 1902.

A transmitting apparatus comprises a set of Hertz-wave antennæ, a source of cathodic waves, and a source of actinic waves, means whereby the changes of a prearranged code may be impressed on one or more of the sets of waves, and means for directing all the waves to a distant station. (See cut.)

775,857. Dynamo-electric Machinery. Henry G. Reist, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Original application filed May 9, 1902. Divided and this application filed May 18, 1903.

In combination with the shaft of a main dynamo are an auxiliary dynamo provided with a shaft operatively connected to the first-mentioned shaft, a support for the auxiliary machine eccentrically mounted with respect to its shaft whereby the distance between the two shafts may be varied by rotating the support, and means allowing a rotation of the field of the auxiliary machine with respect to its shaft and to the support.

775,867. Trolley. William S. Stockton, Philadelphia, Pa. Application filed August 18, 1904.

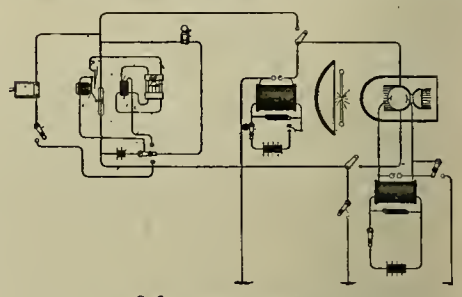
Details are described.

775,869. Portable High-frequency Apparatus. Frederick F. Strong, Boston, Mass. Application filed May 23, 1904.

A portable high-frequency apparatus has all its different sets of mechanism constructed as separate units independently removable and provided respectively with plate contacts for automatic electrical connection in proper relation when the separate units are placed in the cabinet.

775,870. Portable High-frequency Apparatus. Frederick F. Strong, Boston, Mass. Application filed May 23, 1904.

A high-frequency apparatus consists of a transformer, condenser, high-frequency-coil primary and high-frequency-coil secondary, having all of the parts concentrically and compactly arranged.



NO. 775,846.—SPACE-TELEGRAPH SYSTEM.

775,871. Variable Air Gap Condenser. Frederick F. Strong, Boston, Mass. Application filed May 23, 1904.

The apparatus comprises means for producing a current of excessively high frequency, an applying electrode and a convective discharge means in series therewith between the electrode and the producing means for interposing in the current a convective spray discharge, thereby modifying the current for therapeutic work. (See cut.)

775,872. Rotary Spark-gap. Frederick F. Strong, Boston, Mass. Application filed May 23, 1904.

The device comprises a fixed disruptive discharge electrode, a rotary electrode co-operating therewith, and arc-producing means in series therewith located adjacent the electrodes.

775,891. Apparatus for Generating Electric Currents. Charles S. Bradley, Avon, N. Y. Application filed September 11, 1897.

An alternating-current induction generator driven by a prime mover, a speed-varying device for the latter, and control devices for increasing the speed of the generator above synchronism by an amount corresponding to the ordinate of the torque curve of the generator at any particular load are the essential parts.

775,892. Galvanic Element or Battery. Paul Brandt, Schöneberg, near Berlin, Germany. Application filed April 20, 1904.

Combined with a positive-pole electrode, and a negative-pole electrode surrounding the former, are a connection between the two electrodes, located at the lower ends, an isolating layer having the connection embedded in it, another layer of an isolating material situated upon the element, and a comparatively large filling aperture in the upper layer.

REISSUE.

12,286. Plural Lamp Socket. Reuben B. Benjamin, Chicago, Ill., assignor to the Benjamin Electric Manufacturing Company, Chicago, Ill. Application filed August 25, 1904. Original application filed May 17, 1904.

A plural lamp socket having a number of lamp-holding devices forms the basis of the patent.

EXPIRING PATENTS.

Following is a list of electrical patents (issued by the United States Patent Office) that expired on November 29, 1904:

373,859. Regulator for Electric Generators. R. P. Sellon and William M. Mordey, Victoria Works, Belvedere Road, County of Surrey, England.

373,862. Mechanical Telephone. J. P. Sunderland, Brooklyn, N. Y.

373,883. Application of Accumulators to Electric Lighting. T. P. Conant, Brooklyn, N. Y.

373,910. Telephone Call Box. C. E. Schribner, Chicago, Ill.

373,915. Induction Telegraph System. G. T. Woods, Cincinnati, Ohio.

373,925. Telegraph Pole Protector. H. P. Copeland, East Orange, N. J.

373,934. Electric Arc Lamp. C. A. Homans, Winchester, Mass.

373,948. Winding Armatures of Dynamo-electric Machines. C. E. Schribner, Chicago, Ill.

373,967 and 373,968. Telegraphy. P. B. Delaney, New York, N. Y.

373,971. Commutator Connection for Dynamo-electric Machines. J. W. Easton, New York, N. Y.

373,975. Electrical Horometer. B. M. Hammond, San Antonio, Texas.

374,013. Electrical Indicator for Weighing Scales. J. E. Tarbox, Lynn, Mass.

374,017. Automatic Circuit-Opener. J. P. Tirrell, Somerville, Mass.

374,028. Electric Door Opener. A. C. Wochrle, New York, N. Y.

374,038. Telegraph Instrument. C. G. Burke, Richmond Hill, N. Y.

374,088. Electric Organ Action. H. L. Roosevelt, New York, N. Y.

374,103. Manufacture of Telegraph and Other Poles or Posts. D. Wilson, County of Essex, England.

374,120. Arc Light. C. B. Noble, Cleveland, Ohio.

374,072. Electric Temperature Regulator. W. S. Johnson, Milwaukee, Wis.

WESTERN ELECTRICIAN

EVERY SATURDAY

Vol. XXXV. CHICAGO, DECEMBEP 10, 1904 No. 24

Betterments of the Chicago and Milwaukee Electric-railway System.

During the last year the Chicago and Milwaukee Electric Railway Company has done much to improve and extend its system, about $1,000,000 having been expended in laying new track, widening the roadbed and enlarging the power plant. This system at present comprises one of the most important interurban lines in the vicinity of Chicago, and the work of extension is not yet completed, for it is the intention of the company ultimately to extend the line to Milwaukee, a distance of about 75 miles from Evanston, Ill., the present southern terminus of the road.

The Chicago and Milwaukee electric railway has been in operation for a number of years and the system was described quite elaborately in the Western Electrician of October 21, 1899. The great impetus which has been given to its development recently, however, furnishes much which will be of interest at the present time.

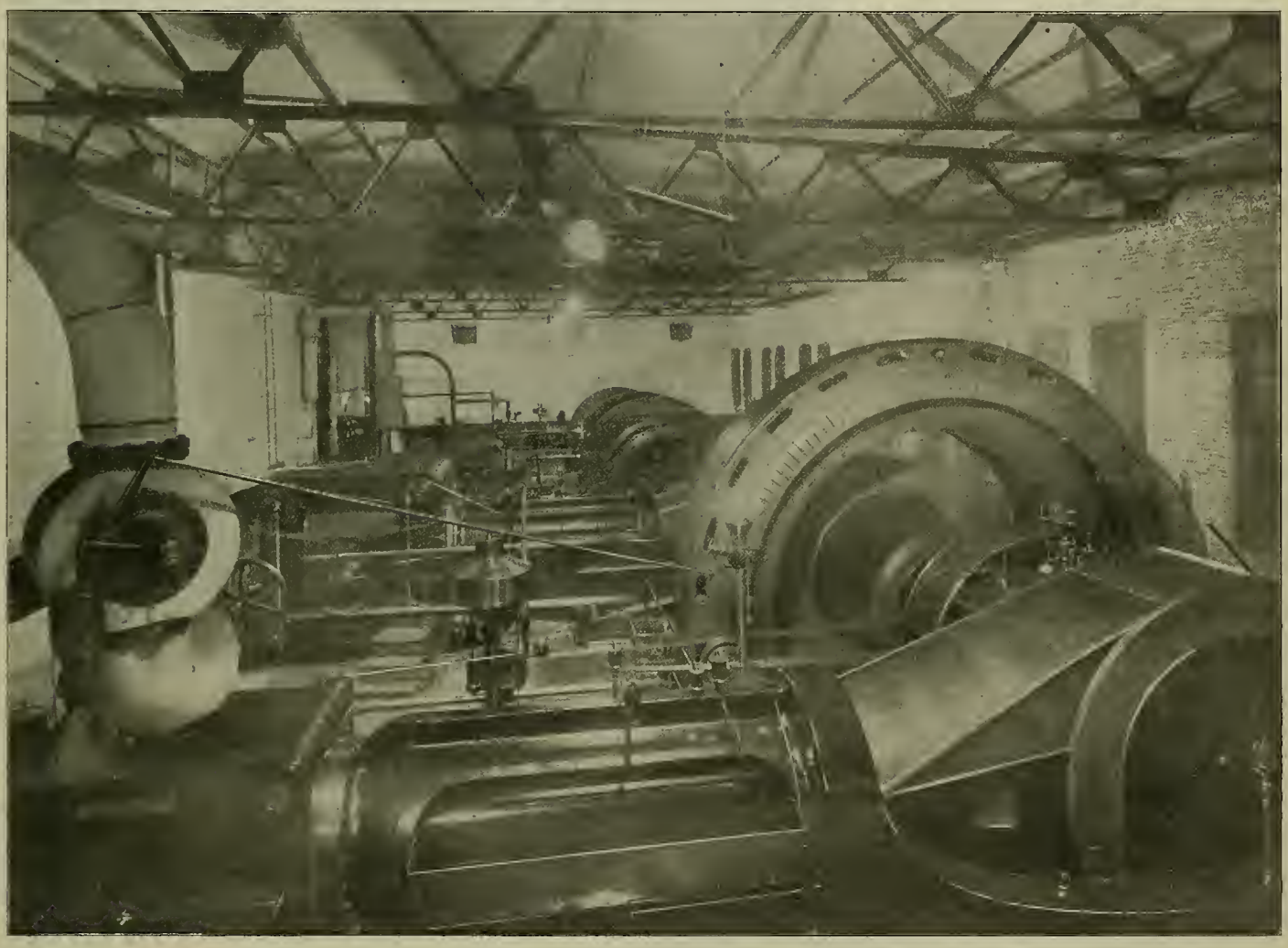


FIG. 1. BETTERMENTS OF THE CHICAGO AND MILWAUKEE ELECTRIC-RAILWAY SYSTEM.—INTERIOR OF ENGINE ROOM IN POWER PLANT AT HIGHWOOD.

Fig. 2 is a small map indicating in a general way the location of the line, the map not having been drawn to scale, however. On the map, also, the line is indicated as reaching the heart of Chicago, though as yet connections have not been made to allow of this. From the center of Evanston the road now extends north to Llewellyn Park, Wilmette, Kenilworth, Winnetka, Lakeside, Glencoe, Ravinia, Highland Park, Highwood, Fort Sheridan, Lake Forest, Lake Bluff, North Chicago and Waukegan. There is also a branch connecting with the main line at Lake Bluff running west through Rondout and terminating, for the present, at Libertyville, which, with the connection now planned with the Northwestern elevated railroad, will enable the Chicago and Milwaukee Electric Railway Company to give these 17 towns quick and frequent service to the business center of Chicago. Though the manner in which this connection is to be accomplished has not been stated definitely, it has been thought by many that recent application of the Chicago, Milwaukee and St. Paul steam railroad for a franchise to connect with the Northwestern Elevated road, is a forerunner of the movement to get the Chicago and Milwaukee electric road admission to the city and that the franchise when obtained will be sublet to the electric road.

The territory through which the electric road operates is among the finest adjacent to Chicago, practically all of the towns being suburbs of Chicago and rapidly increasing in population. Between each suburban town there is at present an open country district, which, from present indications, will eventually be divided into country estates or suburban homes to such an extent that the territory traversed by the road, at least as far north as Waukegan, will be one continuous residence district. Educational advantages along the route are particularly good. Northwestern University is located at Evanston; Northwestern Military Academy at Highland Park; Lake Forest University, with its affiliated preparatory schools at Lake Forest, and there are at least eight private schools, all in flourishing condition, located along the line. Country clubs are numerous and well supported, there being eight now established within reach of the electric road. Fort Sheridan, a military post of considerable size, attracts many visitors, and near Fort Sheridan there has been established a pleasure resort known as Fort Sheridan Park.

Farther south on the line from Fort Sheridan at Ravinia is located Ravinia Park, owned and operated by the electric-railway interests. This park is somewhat out of the ordinary in the line of amusement resorts operated by electric railways in that it furnishes attractions both summer and winter. Here, besides the park itself, are a theater, a casino and a stadium. The theater seats about 1,100 people and contains a well-equipped stage and a large pipe organ. Throughout the fall performances are given every evening, and during the winter twice a week. The stadium is a steel structure seating 2,000 people and facing an open field for athletic sports. Thus there are furnished attractions for patrons of the electric line for the whole year instead of for the summer months only, as is the case with most parks which are run in connection with interurban lines.

Roadbed and Overhead Construction.

The road as it now stands is the equivalent of about 70 miles of single track, built partly on private right-of-way and partly on public roads. By glancing at the map the following explanations will be clear: About three-fourths of the road from Evanston to Waukegan is laid over private right-of-way. From Evanston to Lake Forest is all double track. From Lake Forest to Waukegan but a single track is now operated, though a second track is being laid. At Lake Bluff, however, construction has been commenced for a four-track roadbed, which will be ultimately extended in both directions to the ends of the line, making the line the first four-track electric interurban railway in the United States. Fig. 8 is a view of this construction at Lake Bluff, showing the widening of the roadbed and a short strip of double track at this point which, however, does not at present extend to Lake Forest, where the double track properly ends, as already stated.

The Libertyville division extends from Lake Bluff in a westerly direction through Rondout to Libertyville, a distance of about six miles, as shown in Fig. 2. Work is now under way also on an extension west from Libertyville to the new town of Rockefeller,

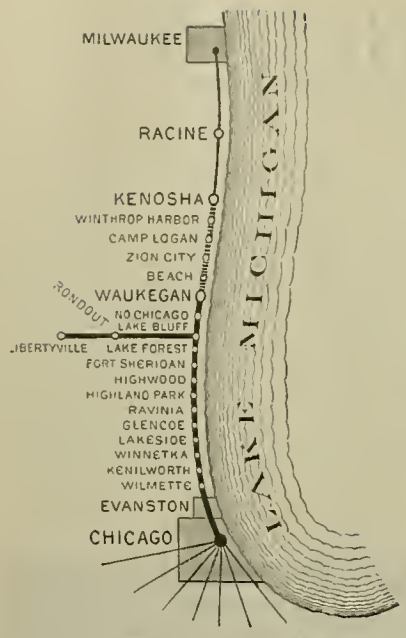


FIG. 2. MAP OF TERRITORY SERVED BY CHICAGO AND MILWAUKEE ELECTRIC RAILWAY.

which is just springing up on the line of the Wisconsin Central steam road. At Lake Bluff the Libertyville division divides. One branch extends north to North Chicago, a distance of three miles, paralleling the main line, but on the opposite side of the Chicago and Northwestern railroad. The two tracks of this branch, together with the double track of the main line, when completed, will form a section of the ultimate four-track line. The second part of the Libertyville division joins the main line at Lake Bluff, but before doing so dips underneath the tracks of the Chicago and Northwestern through the subway, which is shown in Fig. 9.

Looking at Fig. 9, a glimpse may be caught of a second subway in the background, which is for the accommodation of a wagon road under the main line of the electric road, avoiding a grade crossing at that point. The subway and approaches under the Chicago and Northwestern were constructed at a cost of approximately $40,000. Just west of Lake Bluff a deep cut of about 160,000 cubic yards was made in order to obtain easy grade for the trains leaving the subway.

At Rondout, on the Libertyville division, the company has built heavy concrete abutments and heavy through-girder bridges to cross over the tracks of the Elgin, Joliet and Eastern railway, and the main line of the Chicago, Milwaukee and St. Paul railroad, in order to avoid a grade crossing. Approaches to these bridges are built on a grade of less than one-half of one per cent. and contain about 200,000 cubic yards of filling.

Sixty-five-pound T-rail is used on private right-of-way throughout the system and 85-pound steel girder rail where the road is in a street. The track is all laid on standard first-quality white-oak ties, with iron and concrete culverts, stone and concrete abutments and retaining walls, and steel viaducts and bridges. The work done during the last two years is of a high grade of standard steam-railroad construction.

The overhead construction is of the most modern and substantial kind, using wood and iron poles, and No. 00 trolley wire with secondary feeders of 300,000 and 500,000-circular-mil cross-section. High-tension transmission lines, consisting of No. 4 and No. 0 wire extend from the power house at Highwood in each direction, so arranged that the transmission circuits are in duplicate, thus providing for temporary breakdowns and future extensions. All of the insulation of the high-tension lines is designed to carry a working pressure of 13,200 volts.

FIG. 3. EXTERIOR OF POWER PLANT AT HIGHWOOD, WITH CAR BARNS ON RIGHT.

Power Plant.

Power for the Chicago and Milwaukee electric railway is generated in one central plant located at Highwood, some distance north of the center of the system. Here are also located a car barn, repair shops and office building, all contained on a seven-acre tract of land. Fig. 1 is an interior view of the generator room of the power plant as seen from the switchboard gallery. In the foreground of the picture is shown the largest generating unit, which

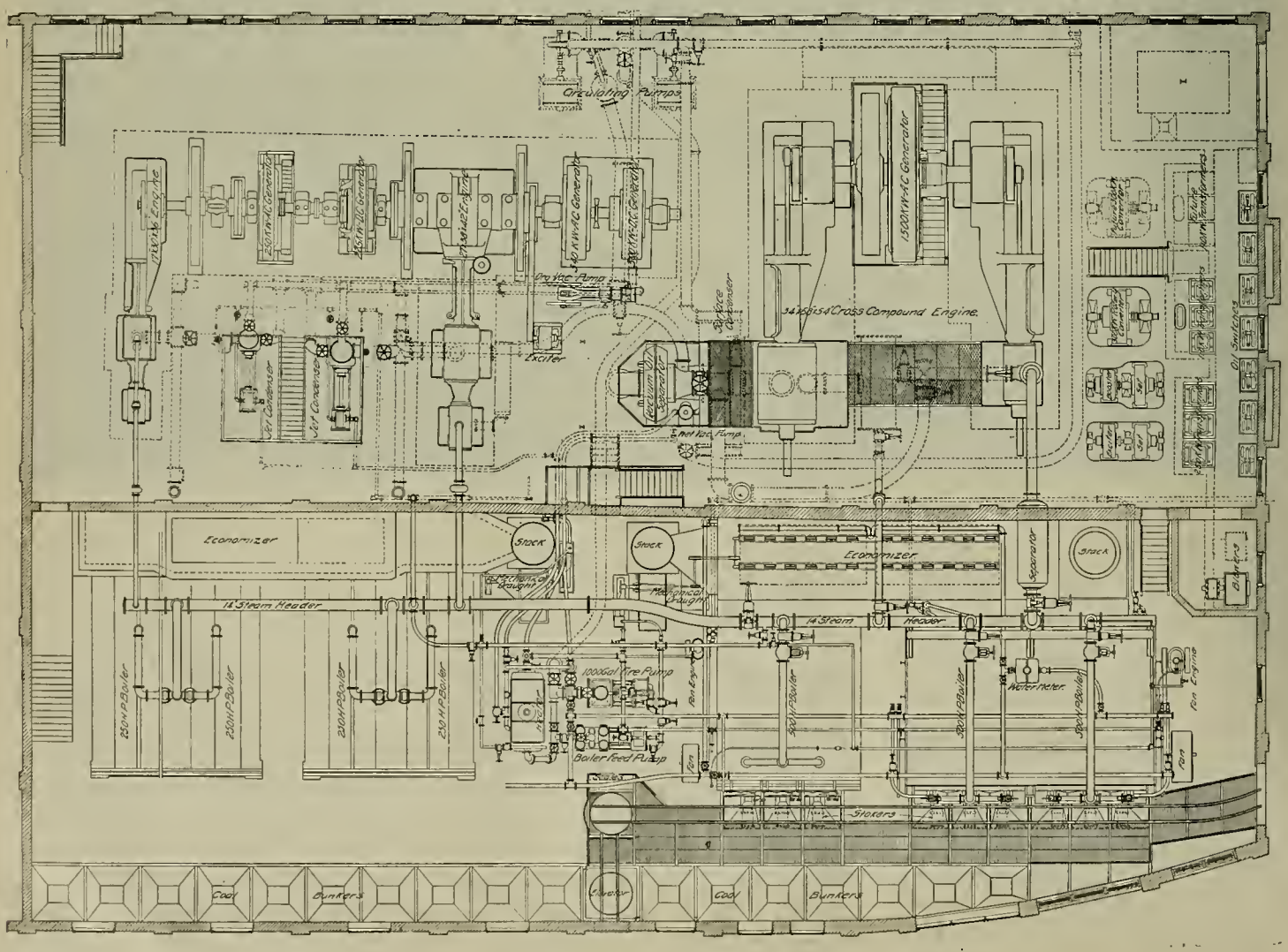


FIG. 4. PLAN OF POWER HOUSE OF CHICAGO AND MILWAUKEE ELECTRIC RAILWAY AT HIGHWOOD.

consists of a 1,500-kilowatt alternating-current 13,200-volt three-phase generator, which furnishes current direct to the transmission lines. This generator is direct connected to a 34 by 68 by 54-inch cross-compound condensing engine.

On the other side of the main generator there are two other sets, consisting, respectively, of a 250-kilowatt alternating-current and a 225-kilowatt direct-current generator direct connected to a 17 by 30 by 36-inch engine, and a 540-kilowatt alternating-current and a 300-kilowatt direct-current generator direct connected to a 34 by 68 by 54-inch engine. The old direct-current switchboard is mounted back of the two smaller generating sets. All the generators mentioned were manufactured by the General Electric Company and the engines by the Filer and Stowell Company of Milwaukee.

Other electrical apparatus located in the power house is indicated in Fig. 6, which is a view showing the alternating-current switchboard, the lightning arresters, mounted above the board, the oil switches, transformers, rotary converter, exciter set and booster. Fig. 7 is a wiring diagram of the station which, with the exception of a few minor details, represents the connections as they now are, while Fig. 4 is a plan of the power house. Fig. 5 is a cross-section of the power house. By studying these three

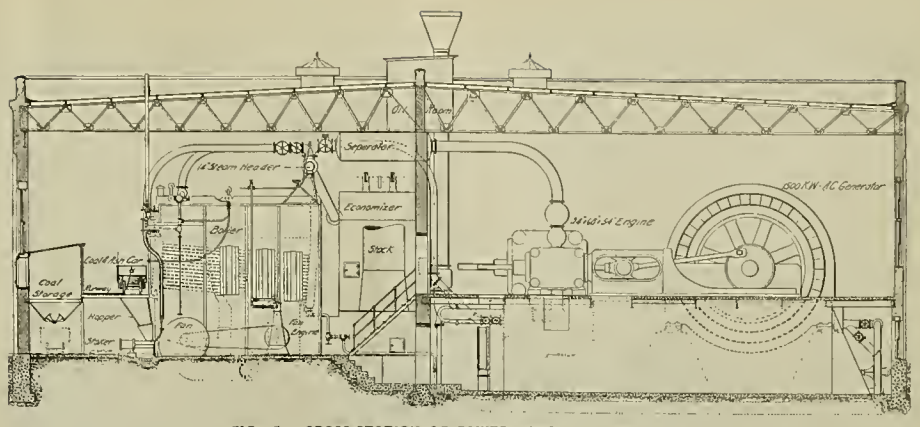


FIG. 5. CROSS-SECTION OF POWER HOUSE AT HIGHWOOD.

FIG. 6. SWITCHBOARD, OIL SWITCHES AND TRANSFORMERS IN HIGHWOOD.—POWER PLANT OF CHICAGO AND MILWAUKEE ELECTRIC RAILWAY.

diagrams carefully a very good idea may be obtained of the general layout of the station.

The switchboard, as shown in Fig. 6, consists of 16 panels. It contains panels for the high-tension feeders, exciter panels, generator panel for the larger machine and two spare panels. Beneath the switchboard and against the rear wall are seven oil-break switches for the high-tension circuits. They have a capacity of 300 amperes each.

Six transformers are located underneath the switchboard. Three of these may be seen in the picture and are of 110-kilowatt capacity each. They operate in conjunction with a 300-kilowatt rotary converter, which is the largest of the three machines shown in Fig. 6. The other two machines shown in this picture are an exciter set and booster set. Beyond the three transformers mentioned are three others of 250 kilowatts each, which step the pressure of the two smaller alternating-current generators previously mentioned up to the 13,500 volts of the transmission line.

Steam is generated in a boiler plant containing four 250-horsepower Aultman & Taylor boilers equipped with Hawley down-draft furnaces, two 500-horsepower Edgemoor water-tube boilers equipped with Jones automatic stokers, and one 500-horsepower Babcock & Wilcox water-tube boiler, also equipped with a Jones automatic stoker.

The plant contains modern coal and ash-handling apparatus and economizers. Cooling water for the condensers is obtained by the use of two cooling towers, which are shown in Fig. 3, which is an exterior view of the power plant. The condensing water is contained in a large reservoir shown in the foreground of this picture.

In a separate building from the main power house is located a 288-cell storage battery for reducing the fluctuations of the load, the tanks being constructed of sufficient size to allow of a 55 per cent. increase. The battery was furnished by the Electric Storage Battery Company.

Sub-stations.

There are three sub-stations located along the line, at Winnetka, Libertyville and North Chicago, where the 13,200-volt three-phase current from the transmission lines is reduced to 500-volt direct current for the operation of the cars; for several miles each side of Highwood the direct-current generated at the main power house is used.

The sub-station at Winnetka contains two 500-kilowatt rotary converters, six 185-kilowatt stationary transformers and four remote-control oil switches. There are also a storage battery of 288 cells and a booster having a capacity of 470 amperes at 60 volts.

Libertyville sub-station and passenger "depot" is shown in Fig. 10. It contains, besides the electrical apparatus, a waiting room and lunch room, with apartments above for the man in charge. The apparatus installed in this station consists of one 300-kilowatt rotary converter and three 110-kilowatt transformers. This building is of pressed brick and was constructed at a cost of $15,000. At North Chicago is located the newest sub-station of all. This contains two 300-kilowatt rotaries, six 110-kilowatt stationary transformers and a 288-cell storage battery, besides a 28-kilowatt booster.

Car Equipment and Operation.

The equipment of the line consists of 23 closed double-truck passenger cars. Seven of these are equipped with four 50-horsepower motors and six with four 75-horsepower motors. The cars are from 38 to 51 feet long over all and seat 40 to 48 passengers. There are also 25 double-truck open passenger cars, seating 56 passengers each; two double-truck express cars, 38 feet over all; one rotary snow-plow; one large snow-sweeper; 12 flat cars; five steam locomotives, and 43 side and center-dump gravel cars. In Fig. 3 are to be seen a number of the latest type of cars upon the road. In addition to the above equipment, the Chicago and Milwaukee Electric Railway Company has bought all the rolling stock of the Intramural railway of the Louisiana Purchase Exposition Company.

All of the company's buildings are substantial and of practically fireproof construction. During the last year the company has built a number of waiting stations of artistic design along its lines. The company owns extensive gravel beds along its line at Libertyville, and this gravel is in great demand for macadamizing streets and concrete work in the 15 towns along the company's line from Evanston to Waukegan, and an extensive business is developing in this direction.

The Libertyville division, as stated, is built for heavy freight and passenger traffic, connecting at

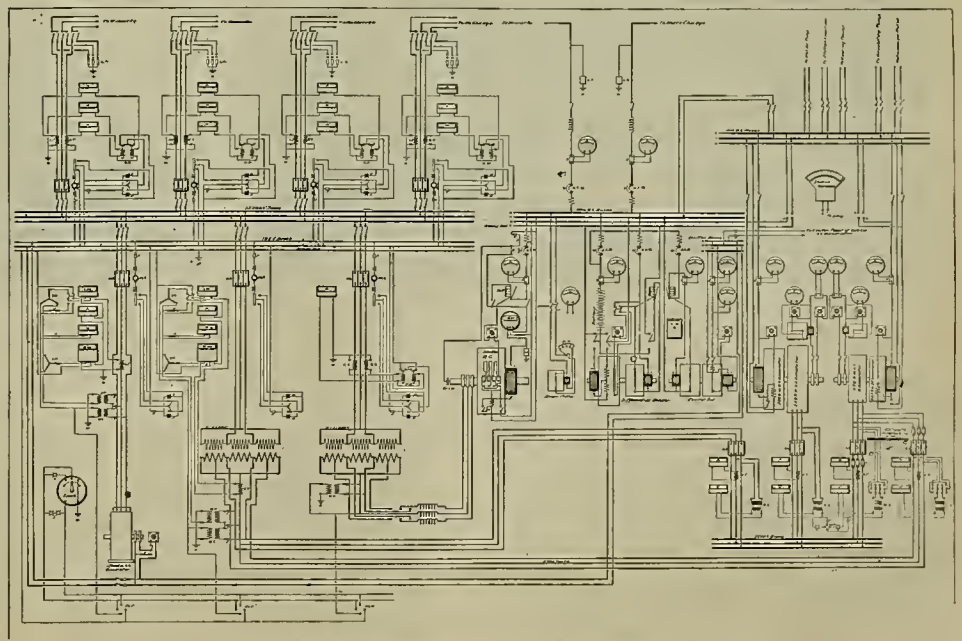


FIG. 7. DIAGRAM SHOWING WIRING CONNECTIONS AT HIGHWOOD POWER PLANT.

Rondout with the Elgin, Joliet and Eastern and the main line of the Chicago, Milwaukee and St. Paul railroad, and when extended to Rockefeller will connect there with the Wisconsin Central railroad. Freight, therefore, on the St. Paul or Wisconsin Central roads which is destined for points along the electric line may be readily transported across over the Libertyville branch, and will not be compelled to go to Chicago and then be brought back over the Chicago and Northwestern.

EXTENSIONS.

Extensions of the road are planned from Waukegan on up through Kenosha and Racine to Milwaukee, though whether this will be done independently by the Chicago and Milwaukee electric road or in conjunction with existing lines is not yet determined. This much is assured at least, that the company will build over its own right-of-way as far as Kenosha. All the new work will be four-track construction, and the single-phase system will be put in operation north of North Chicago. What single-phase system this will be has not as yet been determined, but it will be one which will allow of the cars operating also over the direct-current lines.

While this road is the outgrowth of a small road originally extending between North Chicago and Waukegan, which was added to by the construction of a road between Highland Park and Fort Sheridan, and eventually connecting the two together by single track, all of which was of more or less pioneer construction, the character of the territory through which the road passes and the development of the business of the road has been such as to warrant almost the entire reconstruction of the original road, so as to make it conform to the class of work done during recent years.

The officers of the company are: President, A. C. Frost; vice-president, H. S. Oakley, and secretary and treasurer, G. M. Seward. The general offices are in Chicago.

The engineering work upon this system is in the hands of the Arnold Electric Power Station Company of Chicago, the electrical end being under the direct supervision of Mr. W. A. Blanck at Highwood.

FIG. 8. EXAMPLE OF WIDENED ROADBED OF CHICAGO AND MILWAUKEE ELECTRIC RAILWAY AT LAKE BLUFF.

St. Louis Exposition Is Closed.

At midnight on December 1st the great Louisiana Purchase Exposition at St. Louis was brought to a close. Electricity, which all through the Exposition had been prominent, likewise was the distinctive agency in the closing ceremonies. The last day had been designated as Francis Day in honor to President Francis of the Exposition, and many expressions of esteem and appreciation were made in recognition of the work of the man who so successfully directed the great Fair.

Promptly at 12 o'clock midnight President Francis, surrounded by a crowd estimated at 100,000 persons, threw a switch which had been arranged at the foot of the Louisiana Purchase Monument, and slowly, as though reluctant to lose its beauty, the grand illumination dimmed. Simultaneously the current which operated the Cascades was cut off, and, with the darkening of the main picture, the beautiful torrents of foaming water were forever silenced.

The work of dismantling the buildings began immediately following the close, and within two weeks, it is estimated, all the exhibits may be removed from the grounds. Representatives of the Lewis and Clark exposition to be held in Portland, Oregon, next year were present and selected many exhibits to be sent west. Negotiations for the sale of the property of the exposition itself, it is said, have been closed with the Chicago House Wrecking Company, which concern, it is said, for a consideration of $386,000, comes into possession of the 11 big exhibit palaces, stock barns, festival hall, the colonnade of states, pavilions, aerodrome, bank, intramural railway, hospital, press buildings, electrical construction, police and fire stations, with other World's Fair structures that cost $15,000,000. Everything except the rolling stock of the intramural, which has been sold separately, the state, foreign and Pike buildings, are included in the deal.

The official figures of the attendance at the St. Louis fair have been made public, and place the total attendance for the 187 days of the Exposition at 18,741,073. The attendance of the closing day was 203,101. Those who registered at the booth of the Western Electrician during the last week of the fair were the following-named: Harry E. Dyer, Western Electric Company, Chicago; Charles J. Quinn, Brooklyn; B. H. Lage, New York; Dr. C. C. Quale, Chicago; O. C. Quale, Kirkhaven, Minn.; Charles W. Cary, Denver, Colo.; Julius M. Foster, Santiago, Chile, S. A.; George Steppe, St. Louis; E. Zimmerman, St. Louis.

Lewis and Clark Centennial Exposition.

BY FRANK L. MERRICK,
Manager General Press Bureau.

Out in the Pacific Northwest, 2,000 miles from the biggest of world's fairs, which has now faded into history, a smaller but none the less beautiful exposition is building—the Lewis and Clark Centennial at Portland, Ore., to commemorate the 100th anniversary of the exploration of the Oregon country by Captains Meriwether Lewis and William Clark.

This western world's fair will be a gem of artistic beauty and grace, placed in a unique setting, the like of which has never before been conceived. Occupying 402 acres adjoining the principal residence section of Portland, on the gentle slopes and terraces overlooking Guild's Lake and the Willamette River, with the snow-capped peaks of Mt. Hood and Mt. St. Helens in the distance, the site presents a picture of nature entirely original in exposition building.

For compactness and attractiveness of feature and environment the exposition will be without question the greatest fair ever held.

It can be seen, studied and comprehended within the means and time that the average person has at his disposal. There will be no dreariness of architecture to tire the eye, no long miles of aisles to weary and ache the limbs, no hot summer days or nights to sap one's vitality, no burning winds sweeping over a dry plain to enervate and depress the visitor, no roads that will alternately be dust or mud, according to atmospheric conditions. All will be perfection, or at least the nearest approach thereto ever achieved by an exposition. Man's genius and nature's endowments work hand in hand in the making of the Centennial Exposition. What man could not do, nature has done; what nature left undone, man has accomplished. Engineering skill has smoothed hillocks, leveled depressions, rounded off sharp corners, rooted out knotted trunks of trees, aligned the lake shore, covered the old forest floor with the verdure of the Pacific West, and molded the exposition grounds into a bower of beauty.

Nature's contribution to the scene will of itself compensate any sight-seer for a trip to the exposition. At St. Louis a syndicate of capitalists spent several hundred thousand of dollars upon a feature known as the "Tyrolean Alps." To this people paid an admission for the purpose of refreshment and gazing upon imitation mountains. The visitor to the Centennial Exposition may, without extra charge, sit among the shade trees in Centennial Park, and look upon the sublime peaks of the Cascade range, and enjoy more real scenery in one minute than all the Tyrolean Alps creations have to offer.

Of the gross area of the site, 180 acres is on the mainland and 60 acres forms a peninsula extending out into Guild's Lake. This lake is a fresh-water body 220 acres in extent, separated from the Willamette River by a narrow strip of land. The main

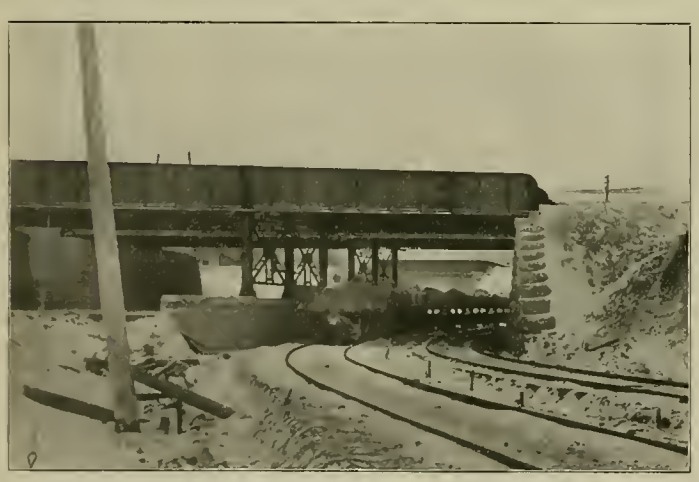


Fig. 9. Subway Under Chicago and Northwestern Tracks at Lake Bluff.

Fig. 10. Combined Sub-station, Waiting Rooms and Dwelling at Libertyville.

BETTERMENTS OF THE CHICAGO AND MILWAUKEE ELECTRIC RAILWAY SYSTEM.

exposition structures occupy the ground bordering upon the lake. Eight large exhibit palaces, marvels of symmetrical beauty in design, form the "main picture." These buildings, some of which are finished and others rapidly nearing completion, are: (1) Agriculture, (2) Liberal and Industrial Arts, (3) Foreign Exhibits, (4) Forestry, (5) Fine Arts, (6) Mines and Metallurgy, (7) Territorial Building, and (8) Machinery, Electricity and Transportation. Around these on the outer edge cluster the state, territorial and other minor pavilions. The Administration Building, where the executive offices of the Fair will be located, is situated at one end of the beautiful colonnade entrance.

Many states will erect pavilions, among them being Oregon and Massachusetts. The Oregon Building, which will be a handsome club house of the colonial design, holds a commanding position near the main entrance. The Massachusetts Building will be the same one used at St. Louis. It will be taken apart and shipped to Portland, where it will be re-erected.

On the peninsula in the center of the lake will be located the extensive exhibit of the United States government. Here a large government building will be erected. It will be an imposing structure, characteristic of Uncle Sam's exposition buildings, with two towers, each 260 feet high. Besides this main building there will be constructed several minor structures, among them being the Forestry, Fisheries and Irrigation Building and the United States Life-saving Station.

Columbia Court is the central plaza of the exposition and is situated between the Agriculture and Liberal Arts buildings. It consists of two wide avenues, between which are spacious sunken gardens with spouting fountains and beautiful beds of vari-colored flowers. Passing through the court one comes to a parapet at the head of a series of terraces of velvety lawn sloping down to the edge of the lake. Leading down from this parapet to an ornate boat-landing is a flight of broad steps, flanked on each side by massive balustrades. On either side of the stairway are banked beds of blooming roses. Here at night on this entrancing spot with thousands of lights reflected in the still waters of the lake will be given band concerts, pyrotechnic displays and other outdoor features.

The "Trail," which is the amusement street of the exposition, corresponding to the Pike at St. Louis and the Midways of other expositions, has an entirely new environment for this feature of an exposition. It is situated upon a wide bridge which spans the lake and connects the peninsula with the mainland. With the unrivaled water facilities thus offered much attention will be directed to concessions for aquatic features. Many new and attractive shows will grace this bridge, and when the visitor goes up the Trail next summer he will experience many a new sensation.

The exposition will open June 1st and close October 15th and will represent an outlay of approximately $5,000,000. This includes the cost of laying out the grounds and the amounts expended for buildings, exhibits and all other purposes. The largest participant is the government, which has made an appropriation of $475,000. As the government has on hand an exhibit worth more than $300,000, which requires little reinforcement or addition, its action is equivalent to $800,000. Next in rank is the state of Oregon with an appropriation of $450,000, which is at the rate of nearly $1 for every man, woman and child in the state. No state having so small a population as Oregon has ever appropriated so large an amount toward an international exposition. Strange as it may seem, Oregon is better able to give so large a sum than many of the older and richer states for the reason that it has no state debt and is constantly increasing in population and expanding its industries.

Copyright, 1904, by Lewis and Clark Official Photo. Co.

FOREIGN EXHIBITS BUILDING AT LEWIS AND CLARK EXPOSITION.

The Exposition company, which was organized and financed by the people of Portland, will expend $420,000, which was raised by the sale of stock.

Other states that have appropriated sums ranging from $10,000 to $35,000 are: California, Montana, Idaho, Utah, Missouri, Washington, Wyoming, Nevada, North Dakota, Minnesota, Arizona, Virginia, New York and Massachusetts. The total state appropriations aggregate $560,000. Besides the above states many others will probably make appropriations when their legislatures meet this winter.

Foreign participation will be extensive, the exhibits being largely drawn from the Louisiana Purchase Exposition, as the countries could not be expected to make a new effort for an exposition following so close upon the St. Louis show. As a result only the cream of what the foreign nations displayed at St. Louis will be transferred to Portland.

Installation of exhibits will begin in January and the present advanced condition of the grounds and buildings insures a completed exposition when the president presses the button on opening day.

Copyright, 1904, by Lewis and Clark Official Photo. Co.

GRAND STAIRWAY, LIBERAL ARTS AND FOREIGN EXHIBITS BUILDINGS AT LEWIS AND CLARK EXPOSITION.

Lighting the Exposition.

By James R. Thompson,

Chief Electrician Lewis and Clark Exposition.

Electrical effects not possible in an exposition the size of that which has just closed at St. Louis will be introduced at Portland next summer at the Lewis and Clark Centennial Exposition. In producing these effects a grand total of over 70,000 electric lights will be used and a 4,000-horsepower turbine will be required to supply the current.

The principal lighting scheme of the exposition may be seen by following the major axis of the grounds. This axis starts at the colonnade entrance, passes through the central plaza, called Columbia Court, crosses Guild's Lake, and passes through the center of the main government building on the peninsula.

The colonnade entrance opens onto Pacific Court, which will be illuminated by large pillars of light. The visitor is then in position to look along the Lewis and Clark Boulevard, on which will face the principal buildings, all of which will be brilliantly outlined with frosted eight-candlepower incandescent lamps. Columbia Court, situated on the other side of the Lewis and Clark Boulevard, between the Liberal Arts and Agricultural Buildings, and which contains the sunken gardens, leads the spectators to the Grand Stairway, which, with the Sunken Gardens, will be lighted by large post electroliers having staff pedestals and arms designed to give a spray effect and each containing 27 Meridian lamps.

From the Lake View Terrace at the top of the Grand Stairway the principal view of the illumination will be obtainable. The Grand Stairway, crossed by boulevards, leads to the boat landing, and directly opposite across Guild's Lake, are the government buildings. The principal government structure is flanked by two towers 260 feet in height with the ends extended by half domes, and running from each tower is a peristyle connecting two smaller flanking buildings—the Territorial and Irrigation Buildings—the whole being arranged in a semi-circular plan. As the style of architecture is the Mission renaissance, it is possible for a lighting design to bring out the outline in perfect shape.

Centennial Park, a natural park which occupies several acres to the northwest of the main group of buildings, will be brilliantly illuminated by 7,000 16-candlepower lamps placed in among the shrubbery and trees. Beginning at the far corner of the park—the northwest corner—the Bridge of Nations, 2,000 feet long, connects the mainland with the government peninsula. The near end of the bridge for a distance of 800 feet will be used as the amusement street of the exposition and is called the Trail. Beyond this the Bridge of Nations proper will be illuminated by six-light post electroliers.

The bridge will be constructed in semblance of an arched stone bridge and the arches will be outlined with eight-candlepower lamps. The principal boulevards and the Esplanade, which, beginning at the boat landing at the foot of the Grand Stairway, extends out into the lake a short distance, then turns westward and crosses the Bridge of Nations, will be illuminated by the same style of post electroliers as those used on the bridge.

Advertising Almost Respectable.

In a recent letter to the New York Sun Mr. Tesla spoke, among other features of the New York subway, of the advertising signs that have been criticized. He made this curiously worded statement: "A few more words in relation to the signs. With all due respect to general opinion, I entertain quite a different view on that subject. Advertising is a useful art, which is being lifted continually to a higher plane, and will soon be quite respectable. It should not be hampered, but rather encouraged. I would give the Interborough company every facility for exploiting it, restricting it only in so far as the artistic execution is concerned."

WESTERN ELECTRICIAN

EVERY SATURDAY.

PUBLICATION OFFICES:
510 Marquette Building, - CHICAGO.
TELEPHONE, MAIN 1746.

Eastern Office, 193 Times Building, New York.
Telephone, 3806J Cortlandt.

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted. This paper is entered at the Chicago postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the **old address** as well as the new should be given.

CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—**the only general electrical paper published in the West**—thoroughly covers a territory *exclusively its own.* THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be furnished on application.

REMITTANCES.—All checks, drafts and other remittances should be made payable to the order of the publishers, the **Electrician Publishing Company,** and addressed to the offices of publication, Suite 510, Marquette Building (204 Dearborn Street), Chicago, Illinois, U. S. A.

CONTENTS OF THIS NUMBER.

Betterments of the Chicago and Milwaukee Electric-railway System. Illustrated 459, 460, 461, 462
St. Louis Exposition Is Closed 462
Lewis and Clark Centennial Exposition. By Frank L. Merrick. Illustrated 462, 463
Lighting the Lewis and Clark Exposition. By James R. Thompson 463
Advertising Almost Respectable 463
Editorial 464
Arc Lighting Here and Abroad. By Francis B. Badt. Illustrated 465
English Impression of American Electrical Engineering .. 465
Mysterious "Wireless" in the North Sea 465
Ohio Telephone Notes 466
Telephone News from the Northwest 466
Indiana Telephone Items 466
Next Week's Meeting of the Interstate Independent Telephone Association 466
New Companies 466
Underground Construction for Small Telephone Exchange. Illustrated 467
Bell Ownership in Subsidiary Companies 467
Indianapolis Telephone Company to Build 467
Government Departments and Space Telegraphy 467
General Telephone News 467
Small Automatic-starting Induction Motor. Illustrated. 468
Mr. Parsons Leaves New York Rapid Transit Commission 468
Electrical Trades Association at Dinner 468
Fireproof Porcelain Sign Letters. Illustrated 468
Electrical Exports for October 468
$40,000 Damages for Death from Electric Shock 468
The Electrical Fire Hazard. By C. J. H. Woodbury. (Brooklyn Institute of Arts and Sciences) .. 469, 470, 471
Book Table—Western Electrician's Lamp-lighting Schedule for 1905 471

DEPARTMENTS.

Correspondence 471, 472, 473
Great Britain 471
New York 471
Dominion of Canada 471, 472
Ohio 472
Indiana 472
Michigan 472
Texas and Mexico 472, 473
Pacific Slope 473
Personal 473
Electric Lighting 473
Electric Railways 473, 474
Power Transmission 474
Societies and Schools 474
Publications 474
Telegraph 474, 475
Miscellaneous 475
Trade News 475
Business 475
Illustrated Electrical Patent Record 475, 476

DATES AHEAD.

Interstate Independent Telephone Association of America (annual convention), Auditorium Hotel, Chicago, December 13th, 14th and 15th.

Northwestern Electrical Association (annual convention), Hotel Pfister, Milwaukee, Wis., January 18 and 19, 1905.

AS THERE are "diseases of civilization"—entirely modern maladies requiring new remedies—so does the industrial advancement of the body politic seem to bring new complaints in its train. At least, this is the view of some of the shippers by the Great Lakes and the waterways connected therewith. It is again asserted that at some future date the Dominion government will discuss with the Washington authorities the advisability of appointing an international commission to consider the effect upon the level of international waters situated along the boundary of power-development works and hydro-electric enterprises. There are said to be at least three instances where Canada has cause of complaint on this score by reason of works constructed on the United States side of the line. One of these is on the St. John River in New Brunswick, the second is at Sault Ste. Marie, Mich., and the third is in the state of Minnesota. With respect to the last-named, a memorial will shortly be forwarded to Washington, it is said. The construction of the Chicago Drainage Canal is also mentioned as a possible cause of complaint, but this can hardly be taken seriously, as the lowering of the lake level thereby must have been very slight. The same observation applies to the other cases also, no doubt, and it is unlikely that any serious results are to be apprehended from the amount of water so far diverted. But it is conceivable that waterpower developments might be carried far enough to affect navigation unfavorably, and it is not strange that the possibility is attracting attention.

IN THE employment of static electricity in electrotherapeutics it is to be observed, as noted by a recent writer, that the current strength of the static discharges is remarkably small. In fact, it is probably the minuteness of the quantity that permits the employment of the static currents for the production of muscular contractions and other characteristic effects. The diffusion of the static current of such very small amperage produces mechanical effects with a minimum of ionic interchange. It is this fact which eliminates all possibility of danger; for currents of large quantity and possessing power of great diffusion when passed through the tissues of the body are apt to produce electrolytic effects, and are destructive to cell life. With the static currents, the current flow is ample from a Holtz machine having eight revolving plates, 30 inches in diameter, to meet most therapeutic demands, the greater capacity of more powerful machines often producing unpleasant effects. But used with good judgment, static electricity is thought by not a few conservative practitioners to have a large field of employment in medicine, particularly in the treatment of errors of metabolism, local or general.

A FOUR-TRACK railroad for steam operation even is still considered worth talking about; indeed, we believe that there is but one steam road in the country now operating for any considerable distance as a four-track road. Therefore, a four-track electric railway, even if short by trunk-line standards, is worthy of attention. The entire main line of the Chicago and Milwaukee electric railway, now in operation, will within a short time be equipped with four tracks, with very slight grades and with a roadbed approaching in construction modern steam-railroad practice. Work has already been begun on the four-tracking of the line and at the same time extensions are being pushed northward, the goal in view being Milwaukee. When this city is reached and negotiations are concluded by which the line may gain admission to Chicago, one of the finest interurban electric lines in the country will be completed. It will thus connect Chicago with the metropolis of Wisconsin, passing through many thriving small cities en route. Rapid transportation will be offered to suburban residents near the larger cities, and with four tracks on the major part of the system an extensive freight business may be built up without disturbing the passenger traffic. The leading article in this issue is devoted to a description of the Chicago and Milwaukee electric railway and will be especially interesting from the fact that it relates to the first four-track electric interurban line in the United States.

PRESIDENT ROOSEVELT'S message to Congress, while unusually interesting and important, does not contain many references of specific significance to electrical men as such. We may, however, direct the attention of electric-railway managers to that portion of the document relating to safety in railroad travel. Electric railways are steadily encroaching on the field hitherto occupied by steam railroads, and in rising to enlarged opportunities they must accept increased responsibilities in methods of construction and operation. Thus what the president says on this subject deserves the careful attention of those responsible for the operation of interurban railways. Following is a condensation:

The ever-increasing casualty list upon our railroads is a matter of grave public concern and urgently calls for action by the Congress. Many of our leading roads have been foremost in the adoption of the most approved safeguards for the protection of travelers and employes, yet the list of clearly avoidable accidents continues unduly large. The passage of a law requiring the adoption of a block-signal system has been proposed to the Congress. I earnestly concur in that recommendation and would also point out to the Congress the urgent need of legislation limiting the hours of labor for railroad employes in train service upon railroads engaged in interstate commerce and providing that only trained and experienced persons be employed in positions of responsibility connected with the operation of trains. The law of 1901, requiring interstate railroads to make monthly reports of all accidents to passengers and employes on duty, should also be amended so as to empower the government to make a personal investigation, through proper officers, of all accidents involving loss of life which seem to require investigation, with a requirement that the results of such investigation be made public. The safety appliance law, as amended by the act of March 2, 1903, has proved beneficial to railway employes, and in order that its provisions may be properly carried out the force of inspectors provided for by appropriations should be largely increased.

It is of course likely that Mr. Roosevelt had the steam railroads, with their shocking list of accidents, in mind when he made these recommendations. But we cannot forget that only two years ago the president himself was hurt, with a narrow escape from more serious injury, perhaps death, by the collision of an electric car with his carriage in Pittsfield, Mass. Efficient brakes and the best of signaling apparatus are none too good for electric interurban railways. The electric system is introduced as an economic and physical improvement over the steam locomotive. Let it also bring with it a cleaner record of safety in travel.

Four other features in the message may be referred to very briefly. The first is the president's proposals for the irrigation of arid lands in the West. In discussing this work he says, among other things:

During the 2½ years that have elapsed since the passage of the reclamation act rapid progress has been made in the surveys and examinations of the opportunities for reclamation in the 13 states and three territories of the arid West. Construction has already been begun on the largest and most important of the irrigation works, and plans are being completed for works which will utilize the funds now available. The operations are being carried on by the reclamation service, a corps of engineers selected through competitive civil-service examinations. This corps includes experienced consulting and constructing engineers, as well as various experts in mechanical and legal matters, and is composed largely of men who have spent most of their lives in practical affairs connected with irrigation.

As we have previously pointed out, there are power-transmission possibilities in connection with the proposed irrigation reservoirs which should be carefully watched.

The president believes that it is wise to build submarine torpedo boats. All naval authorities do not agree with him, but the building of submarines makes some slight addition to the demand for batteries and motors, which is one good result at any rate.

In relation to coast fortifications the chief executive advises that "We should, however, pay much more heed than at present to the development of an extensive system of floating mines for use in all our more important harbors. These mines have been proved to be a most formidable safeguard against hostile fleets." Explosive mines are certainly a most useful means of harbor defense. They are electrically operated in nearly all cases, and experience during and just prior to the Spanish-American war shows how vital it is that adequate preparation should be made in times of peace. The president's warning should be heeded. Not a few electrical men could give valuable assistance in this work should the government require their services.

It is pleasing to observe a word of recognition of the work of the Signal Corps in laying cables and building telegraph lines in Alaska. "This work has been done in the most economical and efficient way," says Mr. Roosevelt.

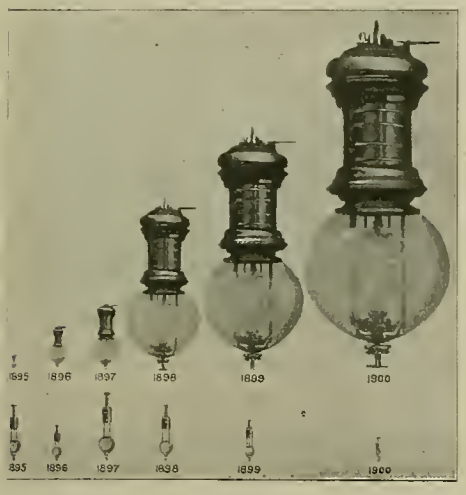
In its entirety the message is an unusually important contribution to state literature. A few scattered extracts give but a scant idea of its vigor and originality. The president has added to his reputation as an author as well as a statesman by this production.

Arc Lighting Here and Abroad.[1]

By Francis B. Badt.

In comparing arc lighting in the United States and abroad one is struck with the great development of the enclosed lamps in the United States, whereas abroad the open arc lamp still holds sway. The reasons, of course, for this peculiar condition have been discussed many a time, and are mainly to be sought in the relationship between the prices of labor and of carbons on one hand, and the cost of producing the current on the other hand. Labor for lamp trimming and carbons being comparatively expensive in the United States, a long-burning arc lamp requiring less labor is preferable here, in spite of the lower candlepower for a given voltage of the enclosed arc.

The accompanying illustration is reproduced from the General Electric Company's bulletin of February 25, 1902, showing a comparison of the sales of enclosed and open arc lamps from 1895 to 1900, which best illustrates the ascendance of the enclosed-arc lamp and the decline of the open-arc lamp in this



COMPARISON OF SALES OF ENCLOSED AND OPEN ARC LAMPS.

country. No exact statistics have been available since the publication of the bulletin referred to, but, from reliable estimates and general observation, it is fair to assume that the sale of enclosed-arc lamps has increased in geometrical progression and that the sale of open-arc lamps has decreased correspondingly.

There is also quite a difference in the systems on which arc lamps are operated in this country and abroad. We confine ourselves to showing the different lamps and systems used in this country. (See Table I.) Table II. gives the so-called nominal candlepower, the amperes and volts at the arc; also the sizes of carbons. The term "nominal candlepower" is fortunately going out of use, and arc lamps are now usually rated by amperes and volts consumed at the arc.

All these, of course, are only average figures, derived from many makes and systems in vogue

Table I A.

ARC LAMPS.

Alternating Current.
High-voltage Constant-potential System.)

- Constant-current transformer for circuits up to 10,000 volts.
  - Enclosed arc lamps in series allowing 78 volts on 60-cycle and 83 volts on 125-cycle current for each lamp. Line drop not included.
- Constant-potential transformer for incandescent-lamp circuit 110 volts.
  - Open lamps
    - Three lamps in series.
    - One lamp on individual transformer stepping down from 110 volts to 35 volts.
  - Enclosed lamps.
    - One lamp in multiple.

Table II.—Arc-lamp Data.

Lamp.	Amp.	Volts at Arc.	Carbons. Upper.	Carbons. Lower.	Remarks.
D. C. Open. Nominal: 2,000 c. p.... 1,200 c. p....	9.6-10 6.8	45-50	M 12x½ in. cored S 12x½ in. solid	M 7x⅜ in. solid S 7x⅜ in. solid	M=Multiple-arc system. S=Series constant-current system.
D. C. Enclosed. Nomioal: 2,000 c. p.... 1,200 c. p. ..	5. 3.	75-80	12x½ in. solid. 12x⅝ in. solid	(stubs) 5x½ in. solid 5x⅜ in. solid	
A. C. Open. Nominal: 2,000 c. p.... 1,200 c. p....	16. 10.	28-30	9½x⅝ in. cored 9½x⅝ in. cored	9½x⅝ in. cored 9½x⅝ in. cored	
A. C. Enclosed. Nominal: 2,000 c. p....	6-7.5	70-80	9½x½ in. cored or vice-versa	6½x½ in. solid	

here. The lengths of the carbons selected in this table are supposed to give, under proper conditions, a life of about 12 hours in the open lamp, and of about 125 hours in the enclosed lamp. The diameter of the carbon given in the table is such as is most commonly used; for greater candlepower efficiency carbons of smaller diameter might be used to advantage, although the life of the carbons, of course, would be reduced. From recent experiments, it seems that the raising of the current density increases not only the mean spherical candlepower, but also improves the quality of the light and the steadiness of the arc.

English Impression of American Electrical Engineering.

In concluding a serial article on "The Visit of the Institution of Electrical Engineers to America" a writer in the Electrical Review of London gives the following impression of electrical-engineering practice in the United States:

A feature of all the newer power stations was the almost complete control of the plant from the switchboard, which in itself was of the diagram type, having mounted on it only the instruments and small control switches or presses which controlled the main electrically operated switches. The highest alternating-current pressure on the switchboard panels did not often exceed 115 volts, derived from potential transformers. The field rheostats, the main engine governors, the main and feeder switches, the main steam stop valves, etc., were generally motor operated, usually being placed out of sight of the switch gallery, tell-tale colored lamps and indicators informing the switchboard attendant as to whether they were open or closed. Batteries seem to be very little used, probably due to the very large size of the average power station, where there would be no capital saving by their introduction. It is generally admitted, though, that they would be advantageous in sub-stations.

All the power and light distribution outside the actual business centers of the cities is carried out by the aid of overhead cables. Transformers are mounted on the top of the posts at points where energy is required for local use. This overhead construction is very unsightly and little care seems to be exercised in choosing straight poles, which does not add to the neatness.

The construction of the streets was deemed very poor and the tramway tracks were decidedly bad. The overhead construction was often of a very flimsy character. It was not at all unusual to see a feeder being used as a span wire and thus serving a double duty. The use of wooden posts undoubtedly does away with the necessity of having good insulators, which is an economy. One trolley line used on constructional work at Niagara Falls was attached to the wooden cross-arms of the posts by the simple method of twisting a piece of wire around both, the only insulation being that due to the post itself. This, of course, was an extreme case.

The high speed at which the trolley cars are operated must be seen to be appreciated; 30 miles an hour is often attained in the cities and 40 to 70 in the country. The almost universal adoption of air-brakes, however, means that the cars are well under control. It would seem that the introduction of air-brakes into England would be of great advantage, more especially on the heavier cars, for it is a successful power brake that is entirely independent of the car motors. The use of such a brake also ensures that the brake-blocks are not kept in a position where they just rub on the wheels, as is so often done by drivers in England, when using a hand-brake, so as to enable them quickly to apply the brake when necessary, regardless of the power they are wasting.

The curves on the double track, when turning a street corner, were nearly always too close to each other, with the result that two cars could not pass each other without colliding. The straight-running trolley head is in use almost without exception.

Horse and cable-drawn cars are still in use for special reasons in New York and Chicago, and many of the tramway concerns are in a far from flourishing condition, the dividends, if any, being very low.

To English minds the railway level crossings seemed very unprotected and dangerous.

The practice throughout the country seems to be to let each man look out for danger for himself, there, apparently, being no grandmotherly, or otherwise, Board of Trade to look after him.

The single-phase railway problem is one that is absorbing a great deal of attention at present, and good results are being obtained; already one commercial road is equipped and another is in course of equipment.

It was very noticeable how complete a control of the electrical business the two large electrical manufacturing concerns in the United States have, other firms not seeming to have the opportunities they would get in England for introducing their manufactures.

Disappointment was expressed at many of the machine shops, for though there are some very fine shops in America, there are also others which could learn many lessons from England. Perhaps the most striking feature was the radical change in practice that has been brought about by the use of high-speed steel. No process discovered in recent years has effected such an increase of manufacturing capacity and such a general revolution in machine design. Incidentally it has caused a temporary difficulty in setting piecework prices.

It was very striking to note how comparatively young the leaders in American engineering enterprises are; most of them have made their names before leaving the thirties behind, and are consequently men with a long future before them.

The courtesy of the Americans to the visitors was very open-handed and generous, nothing being too much trouble for them to undertake in the way of entertainment or instruction. This was much appreciated by the visiting party, as it enabled them to see much in a short time with a minimum of fatigue, and all carried away with them a very pleasant recollection of American energy, enterprise and hospitality, as evidenced by the electrical-engineering section of the community.

Mysterious "Wireless" in the North Sea.

A Russian naval officer, in a semi-official account of the famous North Sea incident by which English fishing boats were fired on by the Russian squadron, mentions in an interesting manner the extent to which space telegraphy is alleged to have figured in the affair. Following is an extract from his story:

"The following day, the 8th [21st] October, at eight o'clock in the evening, when it was already quite dark, we received by wireless telegraph the information that behind us at a distance of 30 miles was the transport Kamchatka, which, owing to some trouble with its machines, had fallen behind the detachment (the cruisers Dmitri Donskoi and Aurora), and that it was being followed by several torpedo boats, which were not, however, attacking.

"The order was at once given by wireless to Admiral Enkwist, who was ahead with the two cruisers Donskoi and Aurora, to slow down and await the Kamchatka or to steam ahead and not show themselves to the torpedo boats, which, of course, were also reading our telegrams, but did not know whence they came.

"But the Japanese all the same made an attempt to find out our whereabouts. While we were exchanging messages with the Kamchatka we suddenly began to receive a series of telegrams:

"'Where is the squadron?' 'Indicate your width and length,' 'Which place is the Suvoroff in?' All in pure Russian and with the signature 'Kamchatka.'

"These telegrams appeared suspicious to us, and to make sure that it was really the Kamchatka who was sending them, instead of replying we ordered them to give us the Christian name and patronymic of one of the officers of the Kamchatka.

"This was received with complete silence, the questions ceased, but the conversation with the Kamchatka continued regarding the cause of her falling back, etc., but in cipher, so that the Japanese were unable to understand anything.

"It was evident that the questions which were telegraphed were made by Japanese taking advantage of our telegraphing the Kamchatka and that they wanted to find out where we were, that is the battleships, which they were trying to get at."

Table I B.

ARC LAMPS.
Direct (continuous) current.

- Series Arc Constant-current System.
  - Open lamps.
  - Enclosed lamps
- Multiple or Multiple-series Coostant-potential System.
  - Open lamps.
    - 110-volt circuit two lamps in series.
    - 220-volt circuit four lamps in series.
    - 550-volt circuit 10 lamps in series.
  - Enclosed lamps.
    - 110-volt circuit.
      - One 110-volt lamp in multiple.
    - 220-volt circuit.
      - One 220-volt lamp in multiple or two 110-volt lamps in series.
    - 550-volt circuit
      - Two 220-volt lamps in series or five 110-volt lamps in series

1. From advance sheets of a forthcoming revised edition of the Dynamo Tenders' Handbook.

Ohio Telephone Notes.

The meeting of the Ohio Independent Telephone Association will be held in Columbus some time in March, according to arrangements made a few days ago by the executive committee which met in Columbus. In the meantime district meetings will be held through the winter and delegates will be chosen. The state meeting will be devoted to a general discussion of the subjects that will be decided upon later, several papers forming the basis for the talks. James B. Hoge, Ed. L. Barber, Frank L. Beam, Cyrus Huling and Dwight Sapp were present at the Columbus meeting.

Arguments have been made in the case of the Queen City Telephone Company in the Circuit Court at Cincinnati. It will be remembered that the Common Pleas Court reversed the decision of the Probate Court in granting the telephone company the right to operate in Cincinnati and the case was taken up on appeal.

The motion of Sol. P. Kineon and George G. Kineon of Cincinnati to remove their case from the Circuit Court at Covington to the Federal Court has been granted. The Kineons had been restrained from bulding telephone lines through Covington. It is alleged that they built a line after a restraining order had been issued against them and an order of contempt was entered against them. There was then a question as to whether their case could be removed to the Federal Court as long as this charge was hanging over them.

The Montgomery County Telephone Company will in a short time be in position to begin operations extensively in building lines to connect all the post-offices of the county. In addition the complete network of lines will furnish service to all farmers who desire it. The people who are interested in the Dayton Home Telephone Company are also the leading stockholders of the new company. The capital stock is $100,000 and most of it has been sold. Columbus men have purchased quite a block of it. J. C. Reber and Manager Miller of the Dayton Home are the active promoters of the country system. This plan of building country lines in close connection with some plant in a larger city will without doubt result in the very thorough development of Ohio. Frank L. Beam was the first to test the plan and has found that it pays in Franklin County.

A large new switchboard is being installed in the exchange of the Columbiana County Telephone Company which will give it the facilities it has needed for some time. It is believed now that its business will develop rapidly and the officials are well pleased with the outlook. The company has succeeded in getting the new rates firmly established and they will be adequate to the increased service that will now be given.

It is said that the United States Telephone Company will sell $2,000,000 bonds within the next year and a portion at least of the proceeds will be used for extensions and betterments. A pool will probably be formed and the bonds held at 85 or better. They are now in active demand in the Cleveland market at 70. The lines of this company will soon reach all the exchanges in the state and be connected with the other long-distance lines. About $225,000 has been spent the last year in these extensions and the same amount will be put out for the same purpose the coming year. When all the new lines are in operation the business will without doubt show a large increase. C.

Telephone News from the Northwest.

The Hudson (Wis.) Prairie Telephone Company has been incorporated by E. W. Helms and others.

The Sioux City Telephone Company has started pulling the cables through its new conduits, which were laid this summer.

C. A. Walker of Brainerd, Minn., the owner of the local telephone line, proposes a long-distance line to Walker, Minn.

The Cyrus (Minn.) Mutual Telephone Company has been organized.

The Lismore (Minn.) Telephone Company has been formed to build a rural system.

The Tri-state Telephone Company has opened an office at Benson, Minn.

It is reported that the Minnesota Central Telephone Company will meet the competition of local merchants at Springfield, Minn., who are backing a new telephone company there, by opening a general store and meat market. This is in addition to having cut telephone rentals deeply as a matter of competition with the new home company.

The Duluth Telephone Company has about completed some extensive improvements to its local exchange at Cloquet, Minn.

The Madelia Telephone Company of Madelia, Minn., has declared a dividend of six per cent., the second in the 12 months which the company has been running.

The Mille Lacs Lake Telephone Company has completed its line from Aitkin, Minn., to Cove.

The Central Dakota Telephone Company has completed its line to Geddes, S. D., and has put in an exchange there and at Platte.

The Wood Lake (Minn.) Rural Telephone Company has filed articles of incorporation with $30,000 capital. G. A. Boettcher heads the list of stockholders.

The Flandreau (S. D.) Telephone Company has sold its system to George W. Hart of Egan, who owns the lines in and about the latter place. The two systems will be connected.

Noxon & Oglesby have sold the telephone exchange at New Rockford, N. D., to Henry Wilson.

A stock company will be formed to assume the business of the Home Telephone exchange at Grand Meadow, Minn.

The Belmont (Wis.) and Pleasant View Telephone Company has been incorporated with a capital stock of $5,000. F. T. Hinkins is president and John Hillory, secretary.

The Cyrus (Minn.) Mutual Telephone Company has purchased the exchange at Glenwood, Minn.

The Clanton Valley Farmers' Telephone Company has been incorporated at St. Mary, Iowa. O. Springer is president and T. G. Sever secretary.

The Michigan State Telephone Company's system at Sault Ste. Marie, Mich., will be remodeled.

The Jansen (Neb.) Telephone Company has been incorporated with $10,000 capital. J. E. Grebe heads the list of incorporators.

The Alta Telephone Company has been granted a franchise at Alta, Iowa.

The Western Electric Company has secured an injunction, it is said, against the Midland Telephone Company restraining its using the new line into Spirit Lake, Iowa.

The Rockwell Telephone Company is putting in a line from Rockwell, Iowa, to Thornton. R.

Indiana Telephone Items.

The Disko and Laketon Telephone Company filed articles of incorporation on December 1st. This company has a capital of $15,000, and proposes to establish and operate telephone lines in Wabash, Fulton, Miami and Kosciusko counties, with the principal office and exchange in Laketon. Frank K. Zimmerman, E. L. Harmon, H. C. John and others are the incorporators.

An open meeting of the City Council of Evansville was held last week to consider the telephone-franchise question, and the meeting was largely attended. The proposition of the Cumberland Telephone Company to pay the city $2,250 a year for 45 years for a franchise of even years was vigorously opposed by the citizens present. The people of Evansville are insisting that no franchise be granted to any company until after the decision of the federal court is handed down in the case now pending; and that when a franchise is granted the price of resident telephones be fixed at $1 a month and that the company be compelled to make connection with Independent companies.

The interurban telephone system on the Indianapolis, Greenwood and Columbus line came promptly to the assistance of the Pennsylvania Railroad company on December 2d. A collision occurred on the steam line, killing four men and injuring many others. The accident occurred seven miles east of Columbus, and in view of an interurban car on a parallel line. The motorman ran to the nearest telephone post and telephoned Mr. Irwin at Columbus, who brought physicians and citizens to the scene of the wreck on an interurban car.

The Central Union Telephone Company has made the announcement that if it wins its suit in the Appellate Court it will rebuild its plant in Wabash and regain what was lost through aggressiveness on the part of the Home Telephone Company.

The Merchants' Mutual Telephone Company of Michigan City is installing a new switchboard. The officials say the company's unusual increase in business necessitated the new improvement. The company is preparing to extend its lines early in the spring.

A new telephone exchange has been established in Liberty. This is the outgrowth of the merging of the College Point and Brownsville telephone companies.

A new line is being constructed between Rochester and Kewanna by the Rochester Telephone Company.

The South Bend Home Telephone Company claims to have had a very prosperous year. The company installed nearly 57,000 feet of aerial copper wire and about 20,000 feet of underground cable. The system is extended to the scattered suburbs of the city and has connection with surrounding towns and cities. The officials are preparing for an elaborate opening of their improved plant on December 31st. The public will be invited to make an inspection of the modern plant.

The Indiana School of Telegraphy has been incorporated with headquarters in Goshen. The capital stock is $10,000. C. S. Rhodes, superintendent of telegraphers of the Big Four railroad, and J. E. Nusbaum are the principal managers and stockholders. S.

The Utah Independent Telephone Company of Salt Lake City recently opened its new exchange at Ogden. The event was made the occasion of a reception which was attended by the directors of the company and a large number of friends, including Governor Wells. Service between Salt Lake City and Ogden was established with the local system. The Ogden and Salt Lake systems are identical except for size. The new exchange started with 900 subscribers and 25 operators.

Next Week's Meeting of the Interstate Independent Telephone Association of America.

The annual convention of the Interstate Independent Telephone Association of America will be held at the Auditorium Hotel, Chicago, next week, the dates being December 13th, 14th and 15th. The social feature announced on the programme consists of a banquet, concert and vaudeville performance. Reduced rates on railroads have been secured, it is said, and Secretary E. M. Coleman of Louisville, Ky., requests those who contemplate attending the meeting to notify him.

Following is the programme:

TUESDAY MORNING, 9 TO 12 O'CLOCK.

Reception of members and friends by the executive committee at the secretary's office.

TUESDAY AFTERNOON, 2 TO 5 O'CLOCK.

President's annual address.—Henry A. Barnhart, Rochester, Ind.

Report of the secretary.—E. M. Coleman, Louisville, Ky.

Express committee.—G. N. Bandy, chairman, Des Moines, Iowa.

Freight rates committee.—Theodore Gary, chairman, Macon, Mo.

Railroads committee.—F. W. Buffom, chairman, Louisiana, Mo.

Committee on Postmaster-general Payne's order.—L. L. C. Brooks, chairman, Minneapolis, Minn.

Committee on uniformity of equipment and standardization of apparatus.—C. E. Hull, chairman, Salem, Ill.

WEDNESDAY FORENOON, 9 TO 12 O'CLOCK.

Officers and executive board will take charge of delegates visiting exhibits.

WEDNESDAY AFTERNOON, 2 TO 5 O'CLOCK.

"Why Independent Telephone Securities do not Command the Market Price They Deserve According to Their Earning Capacity," O. M. Bake, Hamilton, Ohio.

"What the Independent Telephone Companies Owe the Public. What the Public Owes the Independent Telephone Companies," Theodore Thorward, president Indiana Independent Telephone Association, South Bend, Ind.

"Manufacturers' Duties and their Dues," E. D. Graham, president Mexico Telephone Company, Mexico, Mo.

"Uniformity of Equipment and Standardization of Apparatus the Imperative Demand in the Operating Field," J. H. James, president Minnesota Independent Telephone Association, Mankato, Minn.

THURSDAY MORNING, 9 TO 12 O'CLOCK.

"The Importance of Bringing About, by Legislation or Otherwise, Uniform Telephone Rates for Exchange Service in Towns of the Same Size; also Uniform Toll Rates," E. H. Moulton, president Twin City Telephone Company, Minneapolis, Minn.

"How to Avoid Personal Injury and Responsibility in Telephone Construction Work and Maintenance," R. C. Stephenson, Rochester, Ind.

"Who Are We? How Did We Get There? What of the Future?" A. C. Davis, manager Parkersburg Telephone Company, Parkersburg, W. Va.

"The Evils of Connecting with the Bell," P. C. Holdoegle, Rockwell City, Iowa.

THURSDAY AFTERNOON, 2 O'CLOCK.

Officers and executive committee will take charge of and entertain the delegates, visiting exhibits, etc.

THURSDAY EVENING.

Banquet, concert and vaudeville.

Secretary Coleman is making an energetic campaign by correspondence with exchange managers to promote the success of the convention. One interesting feature is the providing of a credentials certificate to be filled out by the secretary of the telephone company sending delegates. The object of this is "to prevent spies and Bell emissaries from being present at business sessions."

NEW COMPANIES.

The Inter-county Telephone Company has been incorporated with $2,000 capital and will construct a telephone system at Huntsville, Ala.

The Home Telephone Company of Clarksville, Texas, has been incorporated. The capital is $2,500. J. B. King, N. P. Doak and Hiram Glass are interested.

The Rural Telephone Company of Belleville, Ill., has been incorporated with a capital of $2,500. Albert Hucke, L. D. Turner and G. W. Dethardin are interested.

Everett H. Snedeker and several Brooklyn business men have incorporated the Long Island Telegraph and Telephone Company, with a nominal capital of $5,000. The sphere of operation will be in the counties of New York, Kings, Queens, Nassau and Suffolk.

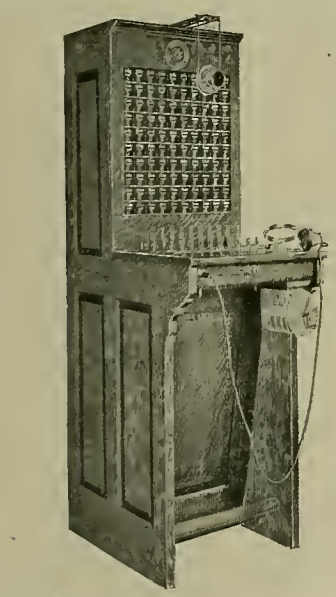
Underground Construction for Small Telephone Exchange.

As a general rule, the average telephone manager has formed the idea that underground construction is altogether too expensive and complicated to be considered for a small exchange. This, however, is probably due to the old habit of doing as "the other company did," which was to use the overhead construction with poles, brackets, cross-arms, insulators, etc. Many new companies of small or medium size that are just starting to put in exchanges are now using the underground system altogether, and they consider that they are "ahead of the game," financially, with a construction that does not use up their profits and energy to maintain.

There are many different methods by which the underground work may be constructed. The main point is to cover the cable or cables with some kind of hard outside covering that will protect them from being damaged either by workmen making other excavations or by acids, gas, etc. At certain intervals the cables run into junction boxes, from which the wires are distributed to the different telephones, or where it may be necessary to make a splice. These junction boxes must be absolutely waterproof and carefully sealed up, as it would damage the entire cable if water could get into them.

UNDERGROUND TELEPHONE CONSTRUCTION WORK IN WAYNE, NEB.

Perhaps the best and most expensive conduit for covering underground cable is cement tubing. This, however, is principally used in large cities, where it is necessary to use many cables. Several other types of conduit are also used with success. Common ordinary gas pipe is frequently employed. Even ordinary angle iron put on top of the cable with sharp corner up may be used in some cases. The simplest way, which should only be used under very favorable circumstances, is to use the cable with its lead covering only. In this case the ditch should be dug in shape of a V and about six inches of dry sand put in at the bottom before the cable is placed in it. On the top of the cable there should be another six-inch layer of sand, and then finally a layer of ordinary brick, after which the ditch is filled up.



TELEPHONE SWITCHBOARD USED IN WAYNE, NEB.

An exchange that has successfully accomplished its underground construction, and which is now enjoying the results, is that of the Wayne Independent Telephone Company of Wayne, Neb. This plant started operations May 1, 1904, with 75 subscribers. It has now about 200, of whom 75 are farmers in the country. The business part of the town has an underground cable 1,200 feet long, with capacity of 250 metallic lines, the "fiber conduit" being used exclusively. The remainder is overhead construction and metallic all through. The views that are here shown illustrate how the work was done.

The inside equipment consists of a 200-line switchboard made by the Swedish-American Telephone Company of Chicago. The instruments are of the same make. One day and one night operator are constantly employed. The cost of maintenance has been reduced to practically nothing, owing to the excellent construction and equipment. When the number of subscribers has reached 300, which is expected to be soon, the monthly rates are to be $2 for business and $1.50 for residence instruments. Farm lines are rapidly coming in, and the company expects to have at least 500 subscribers within the next six months. Toll-line connections will soon be established with Lincoln and Omaha. The company is already giving toll service to all the small towns of the country. Wayne is the county seat of Wayne County and has a population of 3,500. The affairs of the company are in the hands of Mr. F. M. Ferguson, president, and Mr. A. N. Matheny, manager. These gentlemen believe that underground construction for small telephone exchanges is a money-saving enterprise which is bound to be used extensively whenever the exchange managers become familiar with its merits.

Bell Ownership in Subsidiary Companies.

The following table is part of one published by the Boston Financial News and is interesting as showing that paper's estimate of the amount of stock of the subsidiary companies owned by the American Telephone and Telegraph Company:

Name of Company.	Div. Rate.	Total Stock	Owned by A. T. & T Co.
Bell Co. of Buffalo.....	6	$ 5,500,000	$ 2,762,650
Bell Co. of Can.....	8	8,000,000	4,800,000
Bell Co. of Mo.....	8	2,639,100	1,752,000
Bell Co. of Pa.....	8	11,976,600	9,688,140
Cen. Dist. Tel & Printing Co. of Pitts.	8	9,206,940	6,191,920
Cen. N. J. T. & T. Co....	1	961,500	527,500
Cen. Un. Tel. Co..... ..		5,450,927	4,175,952
Ches. & Potom.	2	2,650,000	1,512,100
Chic. Tel. Co.	6	12,553,145	6,760,000
Cin. Tel. Co.	6	3,564,850	1,091,450
Colo. Tel. Co.	6	3,400,000	1,744,250
Cumberland Tel. Co.	6	11,018,540	5,178,000
Del. & Atlan.		397,945	150,667
Duluth Tel. Co.		100,000	56,660
Empire State Tel. Co.		200,000	131,886
Hud. River Tel. Co.	6	4,000,000	2,028,000
Iowa Tel. Co.		1,600,000	648,345
Mo. & Kan. Tel. Co.....	6	3,327,000	1,747,400
Nebraska Tel. Co.	6	1,870,300	1,122,616
N. E. T. & T. Co.....	6	*21,616,000	12,587,500
N. Y. & N. J. Tel. Co....	7	11,995,050	6,117,475
N. Y. & Pa. Tel. Co..... ..		1,000,000	492,900
N. Y. Tel. Co.....	6	33,750,000	21,475,581
Pac. States T. & T. Co...	6	12,000,000	6,021,300
Pa. Tel. Co.	6	2,210,000	1,325,000
Prov. Tel. Co.	8	1,600,000	480,000
Rocky Mt. Tel. Co.....	6	2,097,500	1,021,100
South. Bell Co..... ..		1,000,000	980,500
So. N. E. Tel. Co.....	6	2,990,000	995,400
West. T. & T. Co.....	5	32,000,000	21,440,000

*Does not include recent issue of stock, last instalment payable in February, 1905.

The People's Union Telephone Company has been granted permission to construct a telephone system at Stuttgart, Ark.

Indianapolis Telephone Company to Build

The Indianapolis Telephone Company reports the most successful year in its history. President Sheerin says that since last January it has added 1,856 new subscribers in the city and Marion County. To accommodate these it was necessary to increase the cable and switchboard facilities 25 per cent. The company is now much cramped for office room, and in the early spring will break ground for a new building on its present site in North Meridian Street opposite the Federal Building. The plans, which are now being prepared, contemplate the ultimate erection of a fireproof structure eight stories high, to cover the entire ground, 50 by 195 feet. The part to be erected next year, however, will only be 50 by 100 feet, four stories high, and will be situated on the rear half of the lot. A large amount of new equipment will be placed in this new building next year, and later on the present old building will be replaced by the other half of the new building.

The New Long-distance Telephone Company also gives a favorable report, not only of its own business, but of the business of its connecting exchanges throughout the state. Mr. Sheerin says that a recent computation made up from the returns for taxation, which require telephone companies to give the number of telephones and exchange directories all over the state, shows that Indiana now has 166,000 Independent telephones. Eighty-four thousand of these are within a radius of 50 miles of Indianapolis.

Government Departments and Space Telegraphy.

In his eighth annual report, the secretary of agriculture says that his department, through the Weather Bureau, was one of the first of the executive departments to take up, systematically, experimentation in problems concerned with the development of space telegraphy. By this action research into the physical problems concerned in transmitting messages through the medium of ether waves was greatly stimulated in this country. Probably one of the best, if not the best, instruments anywhere made for the receiving of wireless messages had its inception in the experimental work of the Weather Bureau. Recently a board was appointed by President Roosevelt to consider the whole problem of space telegraphy and the relation of the government thereto. Its recommendations, which the president approved, will result in the discontinuance of experiments along this line by the Weather Bureau, their transfer to the Navy Department, and the transfer to the Weather Bureau of the meteorological work now being done by the Navy Department.

GENERAL TELEPHONE NEWS.

The Delaware and Atlantic Telegraph and Telephone Company has increased its capital from $100,000 to $400,000.

C. M. Mitchell has sold his telephone exchange in Italy, Texas, to the Southwestern Telephone and Telegraph Company.

R. P. Bonathan of Butte, Mont., who recently purchased the Havre (Mont.) telephone system, will build a line from that city to Chinook.

The Public Utilities Company which has been organized at Carlsbad, N. M., will immediately construct a telephone line between that city and Artesia, N. M.

The city of Lander, Wyo., has granted a franchise for a telephone line which is to be built from Rock Springs. The line will also probably be extended to nearby points.

The Rocky Mountain Bell Telephone Company will construct several rural telephone lines about Missoula, Mont. The total cost will be about $50,000. The company has sued the city of Red Lodge, Mont., to compel it to admit the plaintiff's lines into that city.

A banquet was recently held in Paris in the Palais d'Orsay by the Association of Telephone Subscribers, who term themselves telephone "victims." During the course of the after-dinner speeches Jules Roche, former minister of commerce, said the telephone service of the United States should be taken as a model.

Frank I. Bills, who has been instrumental, it is said, in organizing more than 100 Independent telephone companies in the West, is just now completing new systems in Lincoln, Neb., and Sioux City, Iowa. Mr. Bills has recently been in Denver, Colorado Springs and other Colorado cities where the Independent movement has been agitated.

It is stated that George F. McCulloch of Indianapolis has abandoned effort for a right-of-way through Hammond, Ind., for his projected Chicago-Indianapolis electric road. The council there gave him a franchise two years ago on condition that he have the line in operation by January 1, 1905. He recently asked for more time, but citizens protested at allowing any line to enter the street, and the promoter, it is said, will seek rights for a route through East Chicago, Ind.

Small Automatic-starting Induction Motor.

Fig. 1 of the accompanying cuts shows a new type of induction motor made by the Emerson Electric Manufacturing Company of St. Louis. The sizes range from one-fortieth to one-sixth horsepower, on 60-cycle current, with speeds of from 1,800 to 1,150 revolutions per minute. The motors occupy considerably less space in proportion to horsepower developed than in any heretofore marketed by this company, and are designed for use where space is limited and ordinary types cannot be employed. While they have less radiating surface, they are guaranteed to carry full rated loads without injurious heating. They operate at a constant speed, which cannot be regulated or changed. The speed of these motors is dependent on the number of field poles in the winding and the frequency of the current, i. e., a four-pole motor (such as shown in Fig. 1) will operate on 7,200 alternations (60 cycles) at a speed closely approaching 1,800 revolutions per minute. The motors are not designed to start under any great proportion of full rated load.

Fig. 1. General View Showing Binding-post Block.

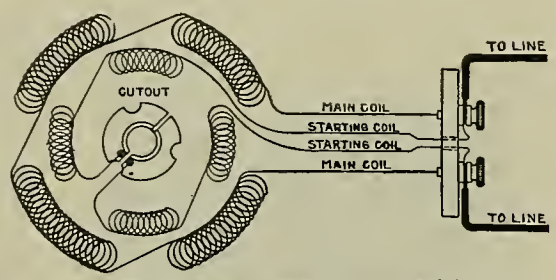


Fig. 2. Diagram of Internal Automatic Switch.

SMALL AUTOMATIC-STARTING INDUCTION MOTOR.

These motors are built with a patented divided-pole form of field winding, comprising an equal number of main and auxiliary or phase coils. The auxiliary field coils (starting coils) are entirely independent of the main field coils, and are in circuit with the line only when the motor is starting. As shown by the diagram of Fig. 2, they are controlled by an internal automatic switch, or cut-out, which disconnects them after the motor has attained sufficient speed. The armature is of the familiar squirrel-cage type, and has no insulated winding of any kind.

Reference to Fig. 1 will show the form of binding-post block employed. The main field coils are connected in series and the leads are attached to the binding posts inside the motor. The starting coils are connected in series with the automatic cut-out, and these leads are brought out through the binding-post block and connected to the binding posts outside. The motor may be readily reversed by changing these leads to opposite binding posts. The binding-post thumbnuts are covered with insulating material. These motors will operate satisfactorily on current differing by not more than 10 per cent. from the name-plate markings, but variations in frequency as well as in voltage affect the motor, and the total variation in current should not exceed that figure.

Mr. Parsons Leaves the New York Rapid Transit Commission.

William Barclay Parsons, chief engineer of the New York Rapid Transit Commission, has resigned in accordance with plans originally made 12 months ago. It is expected Mr. George S. Rice, deputy chief engineer, will succeed to the position made vacant and that Mr. Parsons will resume his private practice or, it is said, possibly go to superintend work at Panama. Mr. Parsons' resignation was accompanied by a letter to President Orr of the commission in which he expressed regret upon returning to the board the commission entrusted to him. He stated that the work begun by him had been finished and that the new work with its new plans and broad development could well be treated by other hands.

Mr. Parsons was born in New York city in 1859. He was graduated from Columbia College in 1879, and from the School of Mines in 1882. At the outbreak of the Spanish-American war he was made chief engineer, with the rank of brigadier-general, state of New York. In 1898, as chief engineer of the American-Chinese Development Company, he made an exploring tour through Eastern China and afterward wrote a book describing conditions in China. He was called to London a few months ago as an expert before a British royal commission which was trying to relieve traffic congestion in the London streets.

The connection of Mr. Parsons with projects for underground rapid transit in New York began when he was 27 years old. In 1886, 1887 and 1888 he was engineer for the New York District Railway and the City Railway, two proposed underground railroads. In 1891 he was appointed deputy chief engineer of the Rapid Transit Commission and assisted in the preparation of the plans for the Broadway route. In 1894 he was made chief engineer of the present Rapid Transit Commission.

Electrical Trades Association at Dinner.

The Electrical Trades Association of Chicago held its annual meeting at the Grand Pacific Hotel, Chicago, on Friday evening, December 2d. The meeting was the ninth annual one in the history of the association and the special feature was a dinner, the first given by the organization. The Electrical Trades Association of Chicago has a membership of 125 and about 75 were present at the meeting and dinner, including men from Cleveland, Cincinnati, Louisville, Detroit, Milwaukee, St. Louis, Kansas City, Omaha, New Orleans and other cities, as well as Chicago.

President E. R. Gilmore, assistant treasurer of the Western Electric Company, presided. He introduced James Wolff of the New York Insulated Wire Company as toastmaster. Mr. Wolff performed his duties in a graceful and pleasing manner. Mr. Wolff called upon several speakers to respond to the toasts. Thomas I. Stacey of the Electric Appliance Company was the first to respond on "The Association." Frank G. Jones of the American Electric Fuse Company responded to the toast, "The Credit Man," and George Cutter amused the diners by his response to "Our Basket of Eggs." Frederic P. Vose, general counsel for the association, handled his subject, "The Law," in a clear and convincing style. Thomas R. Mercein of Milwaukee and others made short speeches. The gathering was considered the most interesting in the history of the association.

Fireproof Porcelain Sign Letters.

The electric-sign business nowadays appeals strongly to the central-station manager, since it furnishes a load that is practically constant for a certain period of the evening hours. One of the greatest, if not the greatest, essential, in the electric sign is that it be absolutely fireproof. Other points to be considered in selecting an electric sign are attractiveness, durability and economy in operation. The true cost of a sign is found in the sum total of expenditures—the cost of the sign, plus the cost of repairs, plus the cost of operating.

FIG. 1. FIREPROOF PORCELAIN SIGN LETTER.

The accompanying pictures illustrate the fireproof porcelain electric-sign letters manufactured by the Colonial Sign and Insulator Company of Akron, Ohio. These porcelain letters are made of vitreous porcelain, with a non-crazing glaze. They are said to combine the snowy whiteness of china with the durability of stone. The letters will last a lifetime without further attention than the occasional renewal of burned-out lamps.

The porcelain electric-sign letters are made concave and of such form that they will reflect the light in parallel rays, enabling one to read the sign at a great distance and at any angle, as illustrated in Fig. 1.

These letters are designed so that they will give the best effect with the smallest amount of current consumption. This design reduces the number of lamps and the candlepower of each, so that a saving of 50 per cent. in operating expenses is said to be secured, at the same time producing a bright, sharply defined letter. Two-candlepower lamps are used in these signs.

FIG. 2. SIGN MADE WITH FIREPROOF PORCELAIN SIGN LETTERS.

The lamps used in the porcelain letters are especially designed so that the light is all radiated from below the face of the letter. This prevents the diffusion of light from one letter to another, and does away with any blurring effect.

The porcelain of which the letters are composed permits the use of color schemes which are permanent. The white face, gold-shaded letter (gold fired on) is said to be one of the most beautiful and the most durable sign letters on the market.

When the signs become dirty they can be washed, and no damage would result if a hose were turned on them, as the letters and sockets are constructed of one integral piece of vitrified porcelain.

The beauty and permanence of the letters compel the makers to use the highest grade of sign body, and they do not spare expense in the selection of materials or in skilled workmanship, as it is not the company's desire to turn out "cheap" signs.

The white concave face of the letters is a reflector which produces a brilliant effect with lamps of even the smallest candlepower, thereby greatly reducing the operating expense of the sign. As these letters are of pure white porcelain, they make a beautiful day sign also.

Fig. 2 shows a neat sign made up. It is made of 16-inch letters and the sign has a royal-blue smalt background and gold-shaded letters. The Colonial company is expecting to establish agencies in every town where lighting current is supplied, and preference is given to the lighting company in placing the agency.

Electrical Exports for October.

The electrical exports from the United States for the month of October amounted to a total value of $1,013,671, as against $844,279 in October, 1903. Goods classified as electrical appliances, including telegraph and telephone instruments, show a decrease for October, compared with a similar period last year, of $7,847. This deficiency, however, is more than overcome by the good showing made by electrical machinery, which shows an increase of $247,809 over the figures for October, 1903. The figures in detail are as follows: Electrical appliances—October, 1903, $430,821; October, 1904, $352,404. Electrical machinery—October, 1903, $413,458; October, 1904, $661,267.

The following-named countries were the principal buyers of American electrical machinery in October: British North America, $169,835; United Kingdom, $120,244; Philippine Islands, $71,378; Japan, $66,754; Mexico, $57,608; British Australasia, $34,740; Germany, $18,806; Argentina, $14,087; British Africa, $13,259; Brazil, $12,347; British East Indies, $8,651; Central American States and British Honduras, $7,906; Columbia, $4,403; Hongkong, $3,774; Cuba, $1,125; Chinese Empire, $1,045.

$40,000 Damages for Death from Electric Shock.

One of the heaviest awards of damages for loss of life ever made in the courts of Kings County, N. Y., was handed in on November 29th by a jury in the Supreme Court in the suit brought by Mrs. Anna C. Morehard against the Richmond Light and Power Company. The plaintiff received $40,000 for the death of her husband from electric shock. Mrs. Morehard is the widow of Dr. Francis L. Morehard, Giffords, S. I. The Morehards had their home wired for electric lighting by the Richmond Light and Power Company, which supplied the electricity for the lights. One night several months ago the lights in the house failed to work. Dr. Morehard went down into the cellar to find out what the trouble was with the lighting arrangements and received an electric shock that killed him. On behalf of the plaintiff it was alleged that the transformer was out of order, owing to the company's negligence, and that Dr. Morehard received the full primary voltage of 2,400 volts, which had passed into the house. The company alleged that the voltage was not greater than that which ordinarily passed into the house. It also alleged that while handling the wires Dr. Morehard himself rubbed off the insulation. Mrs. Morehard sued for $100,000.

The Electrical Fire Hazard.[1]

By C. J. H. Woodbury.

The applications of electricity for illumination and the conveyance of power have outstripped the merely relative conditions of superiority to existing methods and have also reached beyond precedents to the establishment of new expedients.

These vast enterprises have required the largest initial investments during the last 25 years.

The use of copper and consumption of supplies taxed all available resources. It has been the greatest purchaser of copper, requiring the output of the old mines, and stimulated the search for further productive deposits of this useful metal.

The great usage of poles for aerial wires has been one of the elements threatening the forest supply.

The demand of electrical interests for a more economical generation of power at higher standards of accurate regulation has improved steam engines and water wheels, bringing out new types of both, which are also in other industries an advantage to users of power.

The organization of power-generating plants upon a scale whose solidarity inspired confidence in patrons that the product was to be of assured permanence was of itself a new feature in construction.

New tributary industries to fill the gap in insulation between those of submarine cables and electric door bells were established.

The continuous operation of these plants required mechanism whose high standard of construction has stimulated collateral lines of mechanical production and uplifted the character of such work.

Employment has been given to thousands upon thousands, particularly those of high-skilled artisanship.

It has established the new profession of electrical engineering, which has taken unto itself the best in the other branches of engineering, engrafting practical experience upon technical lore, for capital soon found that the useless labor of untrained minds was a most expensive venture.

The pre-eminent service, however, in this development was that rendered by the administrative leaders in these enterprises, who made all things possible by the force of their imaginations, which enabled them to comprehend the possibilities of the future and to endow with confidence the investment of capital in the applications of science for which there were not adequate precedents.

Electric Illumination.

The introduction of electric lighting was never accomplished on the basis of cheapness but on that of quality. Its advantages of brilliancy in illumination, revealing objects as at noonday, showing colors at their true value, applying the light without reference to the limitations of an exposed flame, or the vitiation of air, are all of the highest value in artificial illumination and hitherto without precedent.

It was of great value in all manufacturing, because the perfection of the illumination enabled the production of as good articles under artificial light as by daylight, and this has obviated the well-known differences between summer and winter goods in textiles, as the latter when made to a great extent under gas light during the short days of winter contain a greater number of imperfections.

In some industries requiring accuracy as to color or delicacy in manipulation the working day ended with the sunset.

Whether it be measured by hours or by results, in all cases the use of electricity has added to the working day, and it has aided both the product and the toilers in the benefits resulting from the absence of any vitiation of the air, as is the case to a serious extent by other methods of illumination.

While the sentimental uses of electric illumination may not pertain to this consideration of the question, the fact cannot be ignored that its ministrations to the taste and comfort of humanity are contributions to the general good in the furtherance of happiness and contentment, even to the amelioration of the condition of the rich.

The concentration of electric illumination without regard to the disposal of the products of combustion, as in the case of other illuminants, has been of great value in emergency surgical operations at night, which could not otherwise be performed except by waiting until daylight.

Electrical Conveyance of Power.

The application of electricity to the conveyance of power followed that of lighting and did not reach a full development until the production of large generating units in later years gave scope to its utilities on an economic basis.

This property of transferring energy without dynamic motion between the prime mover and the point of application to the machine has been of the utmost moment in the developments resulting from the removal of mechanical questions from the problems of power transmission.

It has given value to unused waterpowers and harnessed their energy to productive application hundreds of miles distant.

It has modified mill design to the fundamental purpose of construction purely devoted to the operative machinery.

It has changed the location of factories from that of an essential juxtaposition to the site of waterpower or coal supply to those of freight facilities and centers of population available for labor.

The General Fire Hazard.

This reminiscent sketch, indicating the extent and permanence of these achievements of electricity, is presented to call attention to the immensity of the work whose wide range gives rise to great problems when viewed from any standpoint and in any direction.

These questions are so extensive that to treat any one of them equitably it must be considered conservatively.

Among these problems subsidiary to the main questions of construction, operation and administration, is the relation of electricity to the fire hazard, for it is a principle in underwriting that every material possession subject to insurance is to its uttermost details also involved with questions of fire hazard, both external and internal.

It would not be assumed by the lay mind that the stone reservoir which formerly occupied a portion of the park on Forty-second Street and Fifth Avenue, New York, was subject to a fire hazard, yet this structure was damaged over $50,000 by the burning of the Crystal Palace in 1856.

While diminishing the hazards of other methods of illumination, with their attendant mishaps from direct flame, the uses of oil, gas explosions and carelessness with friction matches it must be conceded that electric lighting cannot be claimed to be free from a hazard.

Electric motors, in displacing gas and gasoline engines, or isolated steam boilers with careless attendants, cannot be assumed to remove all fire risk merely because they displaced the burning of highly combustible materials.

In diminishing the use of these methods involving perilous hazard there remains the possible electrical hazard, for this energy which is normally converted into heat at high temperatures when it meets the resistance of arc or incandescent lamps, also produces similar temperatures adequate to ignite anything combustible whenever sufficient electrical energy is diverted from its normal conductors of low resistance and meets with a path of high resistance which converts into heat the portion of its energy devoted to the struggle for the maintenance of the circuit.

Virtually the whole of the precautions for the maintenance of conditions of safety may be summed in the provisions for adequate conductivity and efficient insulation, but in their applications these provisions reach practically to every detail of all electrical plants.

The Underwriters' Rules.

The early installations of electric-lighting plants whose circuits were upon uninsulated wires with earth return caused numerous occurrences which naturally alarmed the underwriters. An investigation by a technical representative of a number of insurance companies and by those of the electric-lighting interests was held, wherein the various incidents which had been the causes of fires were experimentally repeated, and new methods for the installation of plants prepared on behalf of the underwriters.

It was thus noted at the very inception of the commercial applications of electricity to interior lighting that the hazards could be minimized by arrangements which would improve rather than impair the operative conditions of the plant.

The feature of divesting a process of its dangerous elements initiated a new principle in fire insurance which has been widely extended in the technical treatment of various hazards, particularly those of manufacturing processes.

These electrical rules were extended along the lines of the advance of electrical applications, and various technical organizations, municipalities and local boards of underwriters, even individuals and manufacturers, prepared rules whose differences in unessential demands and deficiencies in specifications were sufficient to cause unnecessary vexation and frequent embarrassment, especially to the manufacturing and operative electrical interests.

In March, 1896, the National Conference on Standard Electrical Rules assembled in New York for the purpose of preparing a code embodying specifications covering the conditions of safety in a manner equitable to all the interests involved.

This convention was composed of representatives of underwriters, of those engaged in the manufacture and operation of all varieties of applied electrical apparatus, and also of several scientific organizations.

The various rules were diligently compared and their provisions criticised, and the reports of these meetings with an extensive correspondence containing suggestions were referred to a committee, who prepared the National Electrical Code, which was adopted by the National Board of Fire Underwriters and promulgated by them.

Their committee of electrical specialists meet at stated times to make such amendments, generally by way of addition rather than alteration, as may be necessary to keep in step with the advancing conditions.

It is submitted that this code represents a wider consensus of opinion upon a question of science applied to the service of mankind than was ever concurrently given to any similar question.

These rules are anomalous in their functions. They set forth conditions governing methods of construction, installation and operation of electrical plants, and their specifications receive the utmost consideration from those to whom they apply.

Promulgated by the National Board of Fire Underwriters, they form in their applications the guidance of inspectors of voluntary associations of representatives of insurance companies and do not rest upon any jurisdiction which has power to enforce compliance with their provisions in any manner comparable with the power of the law.

The work of the inspection corps is primarily suggestive in its nature, and as a division it is separate from the insurance rate-making bodies, who, however, consider the electrical conditions in connection with other facts bearing upon estimates of risk.

In the consideration of the functions and jurisdiction of these rules it must be remembered that there can be no exercise of authority without a corresponding measure of responsibility, and as these rules treat upon about everything connected with applied electricity the situation year by year becomes greater and more complex. There is an approach to problems which in the near future may need a stronger body than a voluntary organization, whatever may be the individual constituency of its members, to treat upon the large subjects arising from the congestion of various electric applications, and this administration of the National Electrical Code is being watched with interest in comparison with that of the methods used under the authority of the law in various countries on the other side of the Atlantic.

It is no disparagement to the valuable work of the electrical committee in the advancement of standards of electrical installation and proscription of inferior methods to remark that in the confidence of equitable treatment the electrical interests have co-operated with the underwriters in giving of their specialized skill toward the solution of the difficulties of hazard which have been raised. The improvements of their own apparatus have contained the suggestions of new rules. Slate switchboards made by electrical-lighting companies inspired rules asking for slate switchboards; tubular fuses begat rules to match; telephone companies made protectors to defend their harmless plant, and protectors were demanded; power plants were equipped with circuit closers, and such devices became enruled. Study the evolution of these rules as one may, it will be seen that throughout the whole code the electrical interests were the pioneers in the means for the preservation of plant and the maintenance of continuous service.

All electrical interests appreciate the value of a standardization of methods and expect a similar consistency in their application.

It is not necessary in this connection to specify in detail the methods of providing conditions of safety, as this would approach a paraphrase of the code, which is a manual of over 100 pages, freely distributed to all interested persons, and is familiar in its details to those engaged in installation or manufacture of electrical apparatus.

Yet it may be worth while to refer to some of the general methods to which it applies.

Aerial Lines.

The available routes for aerial lines are so limited that there are frequent instances of propinquity requiring every precaution to be taken to prevent cases of accident to poles or wires, such as would result from any contact between the high-potential wires and those of other systems.

The action of town, county or municipal authorities frequently requires locations of these various lines to be so near together as to be incompatible with conditions of safety.

A United States court has compelled the separation of lines of poles carrying telephone and extra high-potential wires to a distance equaling that of the highest pole, so that in case of a broken pole or wire there could not be any contact between the two systems. While such separation accomplishes the desired result, yet there are many places where there is not sufficient available space for such diverse routes. The Niagara Falls power line has a separate right-of-way, as do numerous other electrical-power lines.

In many instances the owners of telephone and electrical-power lines have mutually arranged to change their routes wherever necessary in order to provide sufficient distances between the several routes, and these agreements have been confirmed by the authorities; in other instances the permission for separation has not been granted.

Wherever these various lines approach each other more closely than referred to above, then it is necessary to use every possible precaution against breakdowns by the adoption of extra heavy construction, thoroughly guyed and braced as occasion may require.

However much the lines may be separated in their general routes, it is inevitable that there should be cross-overs.

In such cases it is desirable that the high-potential wires should be above the telephone lines, as they are of larger diameter and therefore less liable to breakage, and being fewer in number there is the lesser chance of occurrences. The telephone linemen are so accustomed to the innocuous telephone wires that they may inadvertently neglect to observe the

1. An address before the Brooklyn Institute of Arts and Sciences on December 6, 1904. Mr. Woodbury is assistant engineer at Boston for the American Telephone and Telegraph Company.

proper precautions for safety if the high-potential lines were below.

In a cross-over the best condition is when the poles at the ends of the cross-over span are so much above the lower span that a wire breaking at an insulator on the upper span would not be long enough to reach the lower span.

That the pole construction should be substantial and well guyed is an evident feature of these cross-overs.

The end wires on the upper line should be covered by wire loops, known as end-insulator guards, to prevent a wire from jumping over the end of the cross-arm in case of the breakage of an insulator or other mishaps sundering the relation of the wire to the cross-arm.

The wires at the ends of the upper cross-over span should be dead-ended to double-grooved transposition insulators and the line completed by a loop to prevent overhauling in case of a broken wire.

In some instances where it is not feasible to make the upper span at such a great height as the above requires, then a screen of wood strips across a pair of suspension wires affords protection against a contact of the two lines.

A joint pole does not afford a desirable means for a cross-over, as the whole construction is confined to a single pole, but where it is used the upper line should have a transverse frame supporting guard wires and end guards to prevent contact in case of broken wires.

Underground Wires.

The obvious obstruction which overhead wires presented to the operation of the fire departments early gave rise to a public opinion in favor of placing the wires underground. This was far in advance of the state of the art enabling telephonic transmission through cables, and required the development of a new art in the production of underground conductors whose wires should be insulated in such a manner as to permit telephonic transmission and also the development of the continuously drawn lead sheath.

When this was accomplished the telephone wires were placed underground in cities, because the number of the wires was beginning to tax the possible pole capacity.

The largest pole line carried 250 wires, and single cables are now made with 1,200 wires or four and four-fifths times as many circuits, and single underground conduits contain ducts for 90 cables, or over 40 times the capacity of the largest pole lines.

Underground wires were not a refuge for safety from the troubles of overhead lines, for they have difficulties of their own. They are a target for pick and crowbar of laborers on other underground work in cities. Street rollers have crushed them, and strokes of lightning have not only wrought havoc with their wires, but fused them in the ducts. The insinuating leaks from gas mains penetrate ducts and manholes, where they cause destructive explosions.

In times past when attractive propositions of municipal action or other relations caused joint conduits with high-potential wires in the same underground system with signaling wires the electrical leakages of the former were the cause of numerous destructive crosses. The Supreme Court of New York has decided against this manner of joint use of a conduit system.

Electrolysis.

The chemical effects of electricity are well known as a most active agent in industrial chemistry, particularly in electrotyping, where metal is removed from one mass and deposited upon another article. Electricity is used to make and to break molecular combinations in many lines of chemical industry, as the manufacture of aluminum, sodium and other metals, also carbide of calcium, soda ash and other compounds.

In like manner with the single-trolley railroad system the portion of the electricity passing through the earth between the moving cars and the ground plate at the central-power station applies a portion of its energy in making various chemical changes in the earth, many of them to the serious detriment of underground pipes and electric cables.

Any impairment of underground water pipes to the point of rupture is certainly a live issue in the questions pertaining to fire hazards, and hardly less so is any injury to underground conductors connected with the fire-alarm or the telephone systems which are such essential features in the reduction of the fire loss by the prompt manner in which they are able to summon the fire department.

These underground currents remove metal from such buried conductors and also form caustic potash and other alkalies by the electrolysis of alkaline sulphates or chlorides.

If these are formed near to underground conductors they are not corrosively active upon them until the generating current ceases or is greatly reduced.

Metallic sodium has been formed by the dissociation of sodium hydrate in cement by currents of electricity and such events have occurred in buildings where the presence of moisture caused the rapid oxidation of the sodium, producing heat which set fires.

The magnitude of these underground changes may be noted from the large masses of these electro-deposited materials, sometimes a yard in diameter, which becomes attached to the ground plates at central-power stations.

The method of preventing the destructive effects of electrolysis is to attach the positive side of the generators to the trolley wire so that the return current tends to build deposits upon the underground conductors beneath the area traversed by the moving cars. In the vicinity of the power house the destructive effects of the current leaving the underground pipes and cables for the ground plate would be more active than under any other condition of affairs unless conductors reached to the ground plate from such of the pipes as were positive to the earth.

The arrangement of these connections is made from the data of surveys of the electric potential of various conductors to the earth; where it is negative, metal is not being removed from the pipes, and where the electric polarity is positive there is need of bonding to the ground plate.

New electric lines or bridges alter these conditions so that frequent surveys are necessary to preserve the conditions of electrical neutrality. The new East River Bridge and the introduction of electricity as a motive power on the elevated railroads made many changes in the potential map of New York city, in which the lines of equal potential were drawn like the contour lines of equal elevation upon the map of a hilly country, the positive area near the power station being shown in a dark tint.

This line of treatment will stop further destructive results from return currents if applied along these lines, but it is necessary that the work should be done properly and a constant espionage maintained to reveal changed electrical conditions.

Inside Wires.

There is no department of electrical construction which is less properly the subject of amateur work than inside wiring, and none which has been the purpose of more misapplied industry, with the expected adverse results.

There is more constructive detail to the design and arrangement of inside wires than can be taken into consideration at this time. The essentials of wires of ample conductivity are established by a table of sizes which limits the possible rise in temperature of any wire about 30 degrees Fahrenheit.

The selection of insulating material is based upon its exposure to water and dampness.

The possibility of contact with other conductors must be prevented by tubes or other methods of guarding, especially when passing through floors or other portions of buildings.

In manufacturing buildings the wires may be placed upon suitable fixtures, but in commercial buildings and residences where they would be unsightly they are drawn into pipes run through the walls and floors. The modern architect leaves channels in the walls and floors for such tubes, as is done for water and steam pipes. These tubes are to protect the insulation from injury, but they are not insulators.

The switches in electrical systems are the subject of careful design in order to provide that the several conducting parts will be of ample conductivity when closed to convey without heating the currents to which they may be subjected, and whose operation is such that they shall not form arcs when opened.

The most important part of a lighting plant consists in the safety fuses, which are pieces of easily fusible metal introduced in the circuit and of such dimensions that they will be melted by the heat resulting from an undue excess of current.

These safety fuses were first made for the purpose of protecting the filaments of incandescent lamps from destruction by slight increases in the current and afterward applied for the broader purposes of protecting a whole system by opening the circuit whenever the current exceeded its normal quantity.

The heat at the instant of deflagration is sufficient to vaporize a portion of the metal and to throw around small drops in a state of fusion. This in itself would be a cause of fire if the fuses were exposed to combustible material, but for interior wiring it is necessary that they should be suitably enclosed.

The use of open fuses on the motors of street cars has been the cause of numerous fires in transit.

The first line of improvement was to enclose the fuses in tubes and the violence of the deflagration would heat air sufficiently to rupture the arc and aid to the efficiency of the operation of the device.

This was followed by methods of reducing the volume of air by means of asbestos braid around the fuse or filling the tube, except a small air space at the middle of the fuse, with a powder of refractory material, which would not be vitrified by the heat of the arc. These methods reduced the violence of the detonation and also permitted the more accurate calibration of these protectors.

Fire Alarms.

Any allusion to the fire hazards of electricity would be seriously defective, if it did not make mention of the work of the same agency directly in the benefit of the reduction of the fire loss, through the alarms given by the signaling systems.

The electric fire alarm, when first brought out, did not receive any serious attention until the city of Boston bought the territorial right of the patentee, and the results immediately became so valuable that similar alarms were installed throughout other cities.

The automatic fire-alarm systems, in spite of their excessive complications, have been of great value in the concentrated large risks in cities and large manufacturing establishments.

Every telephone is a fire alarm, by which the unskilled can at once state to the fire department the details of place and condition of the occurrence.

There is a secondary hazard to these signaling systems, owing to the fact that in the extent and ramification of all electric wires there are liabilities of mishap when, through accident, there is contact of the wires of different systems, and lighting or power currents are imposed upon the delicate apparatus of the telephone system.

Protectors to Signaling Systems.

At the ends of the telephone lines destructive results from such foreign currents are prevented by apparatus which is subdivided into the various functions which it performs, for there has not been thus far any single device of defending the telephone instruments against the whole range of commercial foreign currents and lightning to which they are subjected.

The form of apparatus used by the Bell Telephone companies, which are especially careful in this regard, consists of a device, which is threefold in its nature, inserted in each line wire.

The first element consists of a fuse made of an alloy which forms part of the circuit, and is contained in a tube of vulcanized fiber. These fuses will deflagrate when exposed to currents of seven to 10 amperes, the capacity of the fuse being varied according to the type of the apparatus.

The next element consists of a pair of small blocks of carbon whose larger surface measures about one by one-half inch, and one of these blocks is connected to the telephone circuit. The corresponding block of the pair of carbons is separated from it by a perforated sheet of mica and is electrically connected with the earth. A small cavity in one of the opposite faces of the carbon is filled with a button of solder, such as is used in automatic sprinklers, and which melts at 160 degrees Fahrenheit.

The distance between these carbons, or the thickness of the mica, is 0.0055 inch, being such that electricity at over 350 volts will pass from the carbon connected with the telephone circuit across this space to the opposite carbon and thence to the earth, thereby relieving the telephonic apparatus of electric tension exceeding 350 volts.

Thus, if the foreign current exceeds the carrying capacity of the tubular fuse, its deflagration opens the circuit at that point. If, however, it is less in volume than the carrying capacity of the fuse, and over 350 volts tension, it leaps across the thin space separating the carbons, and thence passes to earth. The resistance of the tiny arc in the space between the carbons is sufficient to slightly warm the carbons, and cause the fusible metal to flow from its recess and fill the space between the carbons, and thus establishes a conductor of low resistance to earth.

This diminished resistance generally causes a sufficient increase in the current imposed upon a line to cause the tubular fuse to deflagrate and open the circuit, if it did not do so on the first occurrence of the contact which imposed the foreign current on the telephone circuit.

At the subscriber's telephone installation the fuses and generally the carbons are placed in the building near to the point of entrance; but in order that the wire leading to the ground shall be as straight as possible, because lightning does not like to follow turns and bends in a conductor, it is sometimes necessary to place the carbons at some other place along the route of the wires in the building. This separation of the parts is required very infrequently, on an average of about one telephone in 20.

In order to protect the fine wires of the telephonic apparatus from injury by currents which are too small to operate the tubular fuse, and of too low tension to pass to earth through the carbon cut-outs, a third element, known as the heat coil, is employed, in which a fine german-silver wire which forms a part of the telephone circuit will be heated by a current of one-sixth of an ampere to a temperature sufficient to release a conductor ordinarily secured by fusible solder, and pass the current to earth. This latter device is not used at the subscribers' end of the line in those modern types of telephonic apparatus in which the circuit is normally open, except when the telephone is in use, because such coils are an interference with the best conditions of telephone service by adding to the electrical length of the line, and if a foreign current came in contact with the telephone line at a time when the instrument was in use, it would produce noises which would absolutely prevent the transmission of speech, and the user of the telephone would naturally place the receiver on the hook, and thereby open the circuit.

The result of this protective apparatus has been so successful as to establish conditions of immunity in the Bell system of telephony against mishaps to the apparatus resulting from foreign currents and lightning after an experience of many years throughout the Bell telephone system. Such a telephone office appears to be, like a locomotive, the safest refuge in a thunderstorm. Notwithstanding the

number and range of location of telephone central stations, it has not been possible to obtain information of any injury by lightning to any person in such a place.

Whenever the distribution of the telephone service is entirely underground, this system of protection is not necessary at the subscribers' instruments, but is in all cases installed at the telephone central office to protect the whole system against foreign currents imposed upon other parts of the system.

The whole telephone system has over 4,000,000 miles of wire, interlaced throughout the country, and in the communications which are daily traversing this vast network from the Atlantic to the westerly side of the Mississippi Valley, or the similar one at the Pacific Coast, exemption against the disturbances resulting from foreign currents throughout this vast territory is secured through these efficient protectors.

The Underwriters' Electrical Bureau.

The whole foundation of fire insurance, which is said to be the second single tax in this country, is based upon a distribution of averages, and in that examination of facts which is the foundation of science, the allotment of the various losses, both as to cause and amount, is the subject of systematic tabulation, whose results furnish the basis upon which insurance rates are levied, for the old method of competitive guessing is a matter of the past.

The causes which contribute to the origin of fires are largely those of chemical reaction, while the resistances to fire are dependent upon construction and fire apparatus.

Thus the modern method of fire-loss prevention is a technical proposition requiring the services of chemists and engineers.

The National Board of Fire Underwriters maintains a testing laboratory, which contains the necessary facilities for making the various investigations required in this study of matters pertaining to the fire hazard.

It is here that the supplies and subsidiary devices of commercial electricity are put to their proper tests, and the results have great weight in furnishing additional features to the National Electrical Code. Its quarterly reports, containing lists of fires caused by electricity, and stating the deviations from the code which are supposed to have been the origin, are a compendium of exact information on the subject.

The Associated Factory Mutual Insurance Companies of New England were pioneers in the application of technical work to the reduction of the fire loss, a task whose beneficent results have extended beyond the mills which form the specialty of this combination.

The underwriters assume a great task in undertaking to maintain inspections of properties as widely extended and as numerous in detail as that of the commercial applications of electricity.

The results show beyond peradventure that the electrical fire hazard is less than that of other methods of lighting and power transmission, while every telephone being a fire alarm, the signaling systems are potent elements in the reduction of the fire loss.

While the diminution of the ratio of such fire losses appears to be due to this work, as the variable element in the problem, the question naturally arises, Will the future permit its continuation to an extent which will be equal to the greater task of meeting the problems of depreciation of plant, and the congestion of the future to which the present applications of electricity are a mere preface?

If the work remains in hands which can exercise the responsibilities to a uniform jurisdiction, then it will be sustained by the dominance of an approving public sentiment.

BOOK TABLE.

Western Electrician's Lamp-lighting Schedule, Moonlight System, for 1905. Chicago: Electrician Publishing Company. Pp. (3½ by 5⅝), 32. Price, 10 cents.

The schedule contained in this book is based on mean local time as given in the calendar for 1905 and applies to a latitude of about 41 degrees, which means, approximately, New York city, Philadelphia, Connecticut, Pennsylvania, New Jersey, Ohio, Indiana, Illinois, Nebraska, Iowa, Southern Michigan and Southern Wisconsin. For adjoining states north or south of above error may be 10 minutes, to be added or deducted from time given for lighting or extinguishing. The schedule is based on the rules of what is known as the "Philadelphia Moonlight Schedule," viz.: "Light one-half hour after sunset and one hour before moonset. Extinguish one hour after moonrise and one hour before sunrise." The book, among other things, contains an article by F. B. Badt giving an explanation of moonlight schedules and mean local time.

A phase of a political campaign has been injected into the effort of securing the construction of an interurban electric railway between Cedar Rapids and Waterloo, Iowa. To stimulate interest in the projected road campaign buttons are being distributed, bearing in the center the picture of a trolley car, while above are printed the words, "Urbana, Brandon, Shady Grove, Jubilee," and below, "The Farmers' Favorite Line; United We Stand."

CORRESPONDENCE.

Great Britain.

London, November 26.—To judge by the notices which have just been published, the coming parliamentary session will be of more than ordinary interest. Taking the early batch of notices there will be an exceptional amount of legislation concerning London and the District. Notwithstanding the issue by the Board of Trade a few days ago of a statement to the effect that no tube-railway bills would be considered by Parliament until the Royal Commission on London Traffic had reported, quite a number of such bills has been deposited, and provided Parliament does not order all such schemes to be put one side until the royal commission's report is presented, we may look forward to a repetition of the proceedings of two years ago, when Mr. Yerkes and Mr. Morgan were in competition. I have no idea who is promoting the line from west to east and northeast which Mr. Morgan promoted in 1902, but it is certain that Mr. Yerkes will be in opposition, as the line in question will compete with the District railway throughout three parts of its route. The fight for this line will be a three-cornered one, as the Central London railway is also applying for powers over a similar route so far as the city is concerned.

Another interesting feature of the notices in connection with London is the wholesale application for powers to supply electrical energy "in bulk" over a portion of it. In the first place there is a resuscitation of the East London and Lower Thames scheme, which was rejected last year by reason of unsatisfactory financial backing, and another huge scheme proposes to supply electricity over the whole of the administrative county of London, crossing the River Thames at several points. When one imagines the opposition which will undoubtedly be offered to this proposal, and especially by the London Borough Councils, it will be seen at once what a tremendous sum in counsel's fees, etc., such a promotion must incur. In addition to these schemes, however, nearly all the London supply companies are asking to be constituted "power" companies in the widest sense of the term, their applications embracing huge areas for the purpose of supplying "in bulk." Probably one of the reasons for these applications is the disabilities under which all the companies now labor in consequence of the definitions of their special acts. Although limited-liability companies, with the widest possible powers under their articles of association, yet these powers are more or less useless to them by reason of the existence of provisional orders and special acts. By the acquisition of the powers now sought the companies would be able to supply in wholesale quantities in all directions for very great distances from their central-generating stations instead of being, as at present, confined to supplying in detail to a comparatively small area. This applies more especially to those companies which have found it expedient to erect their generating stations outside their area of supply.

In connection with the question of the generation of electricity on a large scale, attention may be drawn to a new phase in this direction, and that is the erection by county councils of large power stations for the supply of electricity in bulk to the various towns within the county area. At present no statutory authority exists for enabling such councils to undertake such work, but they could of course apply to Parliament for special powers. This question has been raised on many occasions at the meetings of municipal associations, but the first county to attempt to move in the matter is, curiously enough, the County of Durham, which has already several large power-distribution companies within its boundaries. There are 108 local authorities within the county area and 77 of these have expressed themselves willing to take a supply of energy from the council if a county scheme were inaugurated. Consequently a committee of the County Council has recommended that an electrical expert be called in to advise on the matter, and that subsequently a conference of local authorities be convened for the purpose of discussing the details.

The Swansea corporation and the National Telephone Company having failed to come to terms upon the question of intercommunication, the corporation has decided to take legal proceedings to enforce the carrying out of the statutory obligations of the company. The corporation is now seeking a loan for £2,000 for extending the municipal service.

Little has been heard of the financial position of the National Physical Laboratory lately, but Sir William Abney, in his opening address to the Society of Arts last week, once more brought the subject to the front. The old question of a large annual state subsidy was once more raised, and Sir William Abney and many others feel that unless something of this nature is forthcoming a serious state of affairs will sooner or later ensue. At present a large amount of material and financial help comes from private sources, which in the nature of things must be unreliable, and it is to be hoped that the government will take a generous view of the matter. In view of the most important work now being carried out in the National Physical Laboratory by a highly skilled staff the possibility of financial want overtaking it should be grappled with at the first sign and a movement now would not be too early.

The Dublin corporation has decided to spend no more money upon its electricity works until satisfied that all the work under the consulting engineer's original contract has been duly executed. It was in this connection that the city resident engineer made two reports to the electric-lighting committee. G.

New York.

New York, December 3.—The Chamber of Commerce has emphatically indorsed the proposed action of the Rapid Transit Commission respecting the subway advertisements. August Belmont displays some inclination to yield to public clamor, but the advertisements have not been removed from the subway stations.

The first case of fire in the subway occurred on Thursday evening, when an express train on Lennox Avenue, running into a misplaced switch, did sundry damage, and finally overturned a can of gasoline. The gasoline was presumably set afire by an electric spark. One man was slightly injured before the flames were put out, but otherwise very little damage was done.

The Interborough Rapid Transit Company has issued Dr. Chandler's favorable report on the air of the subway in the form of a small booklet, obtainable by any passenger on request. The Health Department is not yet completely satisfied with Professor Chandler's report, and is making its own confirmatory chemical and bacteriological tests. As far as is now known, the results of the tests tend to confirm Professor Chandler's optimistic views.

On Wednesday evening Subway Contractor John B. McDonald was the dinner guest of the Manhattan Club. Justice Truax, as toastmaster, recited the early experiences and recent achievements of Mr. McDonald, who was asked to accept a bronze statuette representing Victory. Mr. McDonald, in giving thanks, prophesied that in 1905 the subway would convey 500,000,000 passengers.

On the elevated railroad express trains are announced to run from One-hundred-and-seventy-seventh Street and the Bronx Park to South Ferry from Friday next at a five-cent fare. The distance covered is 14 miles, and the time scheduled 52 minutes. The route chosen will be over the new subway viaduct from One-hundred-and-seventy-seventh Street to One-hundred-and-forty-ninth Street, and thence via the Second Avenue elevated to the ferry at the end of the line.

William K. Vanderbilt is reported to have given financial aid to the Niagara, Lockport and Ontario Power Company, which enabled it last Monday to file a certificate with the secretary of state increasing its capital from $1,000 to $10,000,000. It is now believed that the company's plant will be used to generate power for the electric lines in western New York controlled by the Vanderbilts.

Among electrical contracts recently recorded by the Board of Education is that awarded to the O. K. Electrical Construction Company, 725 Broadway.

The sub-station at Flushing, L. I., was opened for use this week, and supplies electric power to a number of lines of the New York and Queens County Railway Company. Current is received from the Long Island City power house at 6,000 volts and stepped down to 550.

Dr. John F. Fitzgerald, general medical superintendent of the New York hospitals, in the annual report to the commissioner of public charities, recommends that electric elevators be provided for the Kings County Hospital, in place of the present hydraulic elevators. The reason given is that in hospitals of this character, where a life often depends on the expedition of operations, delays and stoppages are not so likely to occur where an electric plant is used.

The members of the Old-time Telegraphers' and Historical Association gathered in considerable numbers last Saturday night at the home of Mr. and Mrs. Charles H. Bristol, 277 Stratford Road, Flatbush, Brooklyn. The president of the association is John C. Barclay, assistant general manager of the Western Union Telegraph Company, and the vice-presidents are Francis W. Jones and Frederick Pearce, both of New York.

Cornelius Vanderbilt is one of the financial backers in a plan recently laid before the Rapid Transit Commission to construct a moving platform under Thirty-fourth Street. It is suggested to connect the new Pennsylvania tunnel with the East Side, connecting also with the present subway. Passengers to and from the subway and the elevated roads are to be transferred free. The platform would carry 47,520 passengers an hour, or more than double that of the subway, and could be boarded at every block. D. W. W.

Dominion of Canada.

Ottawa, Ont., December 3.—George Johnston of Ottawa, the Dominion statistician, says that the amount of waterpower actually used for electrical production throughout the world at the present time is over 2,000,000 horsepower. Of this amount Canada uses over one-tenth, or more in fact than any other country excepting the United States. He gives the figures for the United States at 527,467

horsepower and for Canada at 228,225 horsepower hydraulic.

Application is being made to the Dominion government on behalf of Morrisburg, Ont., for the entire surplus of waterpower available in the Rapide du Plat Canal for the purpose of further developing electric power for the use of manufacturing purposes or otherwise as the corporation may deem expedient.

An electric radial line between the cities of Brantford and Hamilton, Ont., is now an assured enterprise. Messrs. Parsons and Leslie of Toronto, Ont., together with the Hon. Mr. Haines of New York are the principal promoters of the undertaking. They form what is known as the Hamilton, Ancaster and Brantford Radial Company. Already they have made definite arrangements for running rights through the various townships along their proposed line.

The cities of Toronto and Toronto Junction will have power and light from other sources than Niagara Falls and the Humber River. The Credit River is now being dammed at Erindale and poles have already been erected. Erindale is a village on a promontory overlooking the Credit. The main dam is of concrete and the water contained by it will cover a large area.

The revenue of the Toronto Street Railway continues to expand, the total for November this year amounting to $198,150, against $174,038 for November of last year, being an increase for the month of $24,111. The revenue of the Toronto railway is now almost as large as the electric street railway of the city of Montreal.

The City Council of Kingston, Ont., has decided to submit a by-law to the people to raise $150,000 for improvements and extensions to the gas and electric-light plants. Of this amount it is proposed to expend $36,000 on the electric-light plant.

The arbitrators in the matter of fixing the price which the city of St. Thomas, Ont., should pay for the gas and electric-lighting utilities in connection with the city's municipal-ownership move have fixed the price at between $240,000 and $250,000. The ratepayers of St. Thomas will vote on the question in January.

The electric power at Kakapecca Falls, a few miles from the city of Fort William, Ont., is to be developed by Montreal capitalists. The water from these falls has a drop of 125 feet and the rights belonged to Chicago people, who have sold to Herbert S. Holt, president of the Montreal Light, Heat and Power Company, and Charles R. Hosmer, president, and F. W. Thompson, vice-president of the Ogilvie Flour Mills Company. It is understood that arrangements have been made for the immediate construction of a plant that will produce 30,000 electric horsepower at the start and 50,000 horsepower later. W.

Winnipeg, Man., December 3.—One of the largest purchases of Canadian bonds made in some months was recently completed when the Bank of Montreal and N. W. Harris & Co. of New York took from the Winnipeg Electric Railway Company $2,000,000 first-refunding mortgage 30-year five-per cent. sinking-fund gold bonds. A deal has just been put through for the amalgamating of the Winnipeg Electric Tramway and the Winnipeg Power Company under the name of the Winnipeg Electric Railway Company. The new company has exclusive control of all the street-railway, gas, electric power and commercial-lighting business of the city of Winnipeg. The Harris Company, which is said to have already invested over $15,000,000 in Canada, is a large holder of the debentures of the city of Winnipeg.

The City Council of Charlottetown, P. E. I., has commissioned the Delano Osborne Company of Toronto and Montreal to prepare plans and estimates for a civic-lighting and power plant.

The City Council of Fredrickton, N. B., is about to install an electric plant to light the municipal buildings in that city.

The city of St. John, N. B., is about to issue $25,000 debentures for the purchase of the Carleton electric-light plant.

Bids are being called for by William Skeene for the installation of electric dumb waiters in the Fairview Hospital, Vancouver, B. C.

The Town Council of Sussex, N. B., has decided to obtain estimates on building a new pumping station and installing an electric-lighting plant.

The British Columbia Electric Railway Company is taking bids on a large addition to its office buildings on the corner of Carroll and Hastings Streets, Vancouver. Mr. Buntzen is the manager. H.

Ohio.

Cleveland, December 3.—The Ohio Inspection Bureau of Columbus has opened an electrical inspection department which will hereafter give special attention to the new construction work in Columbus. H. C. Harris, who was one of the commissioners on electricity at the Louisiana Purchase Exposition, has taken charge of this work. The lighting and power companies have agreed not to connect their service with any new work until it has been approved by the department.

Charles Kohl has introduced an ordinance in the Cleveland City Council providing for the extension of the franchise of the Cleveland Electric Railway Company to 1925 on condition that the company operate on a three-cent fare basis; that is, three cents for a single fare and five cents for passage with universal transfer. The ordinance also provides for municipal control of the car service, authority of the city to regulate routes and provide for extensions and other things of the kind.

The Columbus, Delaware and Marion of Columbus will soon purchase six new cars 54 feet in length and fitted with plush upholstered seats. The business of this road has outgrown the capacity of the present equipment.

At the annual meeting of the Chamber of Commerce at Toledo Tuesday evening one of the interesting features will be five-minute talks on "Interurbans" by men who know what to say regarding them. Warren Bicknell will speak for the Lake Shore; G. B. Boone, Toledo and Indiana; F. E. Seagrave, Toledo and Western; Matthew Slush, Detroit, Monroe and Toledo; C. M. Smith, Toledo, Bowling Green and Southern; Harry Thompson, Lakeside and Port Clinton.

Articles of consolidation between the Toledo and Northwestern and the Ohio and Michigan Traction Company have been filed with the secretary of state at Columbus. The new name will be the Toledo, Ann Arbor and Detroit Railroad Company and the capital stock is fixed at $1,500,000. J. H. Clauss, the well-known cutlery manufacturer of Fremont, will be the president of the new company.

John Snyder, D. H. Snyder, E. H. Ackerson, Frank Patterson and H. L. Rockfield are the incorporators of the Springfield Construction Company, Springfield, which will have a capital stock of $100,000.

The Cleveland, Wooster, Mt. Vernon and Columbus Railroad Company of Mt. Vernon has been incorporated with a nominal capital stock of $10,000 to build a line through Cuyahoga, Medina, Summit, Wayne, Stark, Holmes, Ashland, Crawford, Richland, Knox, Licking and Franklin counties. J. J. Vail, J. B. Graham, James A. Tillen, Fred W. Jones and E. F. Shelley are the incorporators. The Cleveland and Southwestern reaches Wooster and an extension south would be a step toward connecting Cleveland with Columbus.

The Columbus, Buckeye Lake and Newark has put on a limited car for Sunday traffic that will make the trip from Columbus to Zanesville.

The light committee of the Toledo City Council has decided to advertise for bids for city lighting for the term of five years. A resolution had been adopted calling for bids for from two to 10 years, but this was reconsidered. Some changes have been made in the conditions of the ordinance under which the lighting has been done heretofore.

The Galipolis Gas and Coke Company, Galipolis, has applied for an injunction restraining the City Council from putting into operation two ordinances reducing the prices on gas and electric lighting. The company claims to have sustained a loss of $10 in the operation of the plant for the year ended January 22, 1904.

Electric switches are being installed at several points on the lines of the Toledo Railways and Light Company. They are all controlled by the motorman in his cab. If they prove satisfactory the company may put them in all over the city. Three different makes are now being tested.

The board of review has added $554,440 to the tax valuation of the Cleveland Electric Railway Company. The company had already made a voluntary increase of $53,000.

An ordinance is being prepared for a special election in Cleveland that the people may vote on the question of giving a franchise to the Cuyahoga Light and Power Company, a new concern which proposes to furnish current for light and power.

Louis E. Beilstein, vice-president and general manager of the Toledo Railways and Light Company, has denied the report that he has resigned to take a more important position. Harro Harrsen has tendered his resignation as assistant general manager and will go to Mexico. O. M. C.

Indiana.

Indianapolis, December 3.—The electric-railway situation in Indianapolis is assuming an attitude of high tension. Charles S. Hernley, Robert Churchman, D. M. Parry and others, promoters and incorporators of the Indianapolis and Eastern Indiana Electric Railway Company, are asking for an independent entrance or right-of-way into the city, and assert that they secured the consent of the property owners on the streets over which they wish to build their line and on which they propose to do a freight as well as passenger business. Indications are that during the 60 days of legislation the interurban question will afford matter for the biggest fight of the kind that ever took place in the state.

J. W. Chipman, secretary and general manager of the Indianapolis and Eastern Railway Company (Greenfield line), is arranging to make the longest continuous trip ever attempted by an electric car. With a party of invited guests representing the city administration, the Commercial Club, electrical engineers and the eight other interurban lines entering Indianapolis, he will take a car from Indianapolis to Dayton, Ohio, via Richmond, thence to Springfield, Columbus, Newark and Zanesville, back to Columbus and thence to Troy via Springfield, from Troy to Lima via Piqua, thence back to Dayton via Covington, from Dayton to Cincinnati via Lebanon and return via Dayton to Indianapolis. "This journey over the numerous connecting interurban lines," Mr. Chipman says, "will advise the public of the vastness of the interurban systems of the two states and give some idea of the growing travel over the interurban lines, each line serving as a feeder for the others."

There is an aggressive campaign on now in this state for the creation of a state railroad commission, and the shippers' association is having bills prepared for introduction as soon as the Legislature meets. These bills will include interurban roads along with steam roads and will likewise place them under the jurisdiction of the commission.

A bill is being prepared to make it unlawful for a railway company to ask for a subsidy tax in aid of the construction of its line. It is generally understood that the subsidy method of obtaining aid for the building of electric lines has been abused in this state.

A new electric line is being promoted from Connersville to Cambridge City. The plan is to lease the old Lake Erie and Western road between Milton and Beeson, connecting with the electric line between Milton and Cambridge City, now operating, and to obtain a private right-of-way from Beeson to Connersville. Another line which it is proposed to build early in the spring is a road from Toledo, Ohio, to Kendallville, Ind. F. E. Seagrave, who has constructed a number of lines, is back of the project and is said to have financed the road. It will be known as the Toledo and Western and is destined to become an important link in the chain of electric lines to connect Chicago and Cleveland.

The Terre Haute Traction Company reports great progress in the purchase of a right-of-way for a line from Terre Haute to Paris, Ill. The route will be through Sanford, Ind., and Vermilion, Ill., and the length of the line 20 miles.

The City Council of Michigan City has granted the Chicago, South Shore and South Bend Railway Company an extension of time until December 31, 1905, in which to complete its lines through that city on condition that the route be changed somewhat from that set out in its franchise.

The Indiana Supreme Court has decided that neither the driver of a vehicle nor a street-car company has the exclusive right to the street, and where a motorman negligently runs his car against a vehicle in front of him which is being driven along the tracks and fails to turn out the company is liable.

Frank S. Whitman of Elgin, Ill., has brought suit for foreclosure against the City Light and Power Company of Dunkirk, Ind. A receiver is asked for so the work of operating the plant may not be disturbed.

The Terre Haute Board of Public Works has decided to recommend to the City Council that the bid of the Terre Haute Traction Company for electric-lighting the streets at $75 a lamp per year be accepted.

Samuel J. Smallwood has obtained a franchise for the installation of an electric-light plant in Bartlettsville.

The Business Men's Industrial Association of Mishawaka has closed a contract with Herman Roemunder by which a plant will be establisbed in this city to manufacture a convertible street car. S. S.

Michigan.

Detroit, December 3.—The Detroit, Monroe and Toledo Short Line, recently completed between Detroit and Toledo, made the run of 42 miles from Monroe to Detroit in 50 minutes. The car left Monroe at 8:55 and arrived at the city limits at 9:45, making 10 stops en route.

The securing of the right-of-way for the Detroit and Bay City Traction Company is progressing satisfactorily. Ninety-six miles between Bay City and Detroit has been secured, and but half a mile of right-of-way is lacking between Bay City and Quannicassee, the first section of the road. The chief engineer states that the building operations will probably be begun within 30 days.

Louis Schneider of the Detroit United Railway recently entertained a party of his friends on the special car "Yolande," taking them to Port Huron for dinner.

The new limited service on the Detroit, Ypsilanti, Ann Arbor and Jackson railway has been inaugurated, and a large number of passengers have been carried on the new Blue Label cars. The new arrangement reduced the service for local traffic from half-hourly to hourly service.

The streets of Battle Creek are being pretty well filled up with street-car tracks. The two new roads, the Battle Creek and Coldwater interurban and the Battle Creek and Grand Rapids interurban, which call for 20 more streets in their franchises, will fill up the town with electric tracks.

Articles of association have been filed by the Hammer Motor Company, with $10,000 capital stock, of which $1,000 has been paid in cash and $2,000 in other property, including drawings, patterns and patents. Henry F. Hammer, Leon J. Paszki, Foster W. Allen and Harry W. Nichoalds are the stockholders. C. G. W.

Texas and Mexico.

Austin, Texas, December 1.—A. M. Fisher of Waco, Tex., will probably install an electric-light plant at Uvalde, Tex. The City Council of Uvalde has granted a franchise to J. H. Gerhart to construct and operate a street-railway system in the city.

The Dalhart Ice and Electric Company will install an electric-light plant at Dalhart, Texas.

The electric street-railway system at Laredo, Tex., which is owned by G. Bedell Moore of San Antonio, is to be extended and greatly improved. Frank E. Scovill has been made manager.

An electric-light plant is to be installed at Kirbyville, Tex.

It is announced by W. W. Wheatley, general manager of the Mexican Tramways Company, that the right-of-way has been secured for the construction of a double track from the City of Mexico to the suburb of Churubusco. The material for the construction of this double track has been ordered from the United States. Mr. Wheatley also says that the mule-car line which runs from Tacuba to Atzcapotzalce is to be immediately converted into electric traction.

The official starting of a large amount of new machinery recently installed by the Mexican Gas and Electric Light Company at its plant at San Lazaro, a suburb of the City of Mexico, took place a few days ago. President Diaz honored the occation with his presence.

W. C. Greene, extensive mine operator, has taken the preliminary steps toward establishing a large hydroelectric power plant at the junction of the Arros and Yaqui rivers in the state of Sonora, Mexico, and to construct transmission lines to Cananea and other places in this section, where the power may be utilized in mines and smelters. The distance from the proposed site of the power plant to Cananea is about 80 miles. The plans of Mr. Greene contemplate the development of about 30,000 horsepower, all of which, he says, will be utilized. The surveys for the proposed plant are now in progress and its construction will soon be commenced.

The Mexican government has granted a concession to the Villanueva Company to establish an electric-power plant on the San Geronimo River in the state of Jalisco, Mexico.

The federal government of Mexico has just entered into a new contract with the Mexican Light and Power Company for lighting the City of Mexico for a period of 10 years. The new contract increases the number of arc lights to 1,200 to burn 4,000 hours annually. The annual sum to be paid by the government for the lighting is $325,777. The company is authorized under its new contract to operate its dynamos either by steam or waterpower.

The Tetela Mining Company will establish an electric-power plant on the Rio de la Canada in the state of Puebla, Mexico, for the purpose of generating motive power for operating large reduction works which it will establish at Tetela de Ocampo

Ernesto Brunel has obtained a concession from the Mexican government to establish an electric-power plant on the Zacapu River in the state of Michoacan, near the town of Sabino, Mexico. He is authorized to import free of duty the machinery, etc., which will be required in the erection of the plant.

There is brisk rivalry between the persons who are seeking the franchise from the city of Culiacan, Mexico, to establish an electric-light plant, street-railway system and telephone system for the city. An American company has made application for the franchise, as has also Oscar Braniff, a wealthy citizen of the City of Mexico.

The Mexican Tramways Company has been granted authority to construct a double-track electric car line giving direct communication between Los Angeles and Nino Perido, suburbs of the City of Mexico.

David R. Retana of the City of Mexico has made application to the Mexican government for a concession to establish a large hydraulic-power plant on the Poliutla River in the state of Guerrero. He will also establish a large system of irrigation in that state.

The 90-day option held by S. L. Pearce of Chihuahua, Mexico, for the purchase of the street-railway lines of Chihuahua and the steam railroad which runs from Chihuahua to Santa Eulalia has expired without the transaction being made. The matter may be taken up again later on.

Parraga Bros., who are operating large salt mines near Salina Cruz, Mexico, are building an electric railway five kilometers long to connect the works with Salina Cruz in order to facilitate the shipment of the salt over the National Tehuantepec railroad. A cable line is being built up the mountains where the beds of salt lie.

An electric-light plant has just been installed at Tenosique, Mexico.

The recent inauguration of the new electric-light plant at Tampico, Mexico, was an industrial event of importance to that city. Governor Pedro Arguellas of Victoria attended the ceremony. Amador N. Jaurigui is president of the company which installed and is operating the plant. In addition to providing light for the city and for private consumers it will furnish power for a number of industrial concerns in Tampico.

Rafael M. de Arozarena, who owns the street-railway system of the city of Puebla, Mexico, has increased the equipment of the lines by purchasing 40 steel cars in the United States. These cars will be used in the freight traffic of the road.

A project is on foot to construct an electric railway from Casas Grandes, Mexico, to the Guerrero basin, a distance of 80 miles. It is said that an American syndicate is promoting this project and that the survey for the proposed line is now being made. It will traverse a section of country rich in minerals and a heavy freight tonnage of ore and other material and supplies is assured from the start. The route of the road is through a rough region of country. H. C. Daugherty of Jesus Maria, state of Chihuahua, can give information in regard to the enterprise. H.

Pacific Slope.

San Francisco, December 2.—The trustees of Fresno, Cal., are advertising for sealed bids for furnishing all material and labor to install a complete battery system and equipment for the fire-alarm system at that place.

Isador Fuchs, who has a franchise in Baker City, Ore., for building a street-car line to be operated by electricity, has all the arrangements completed for the construction of a line between the railroad depot and the Natatorium, a distance of 1½ miles. It is possible that the road will be extended to Haines, a distance of about 14 miles.

J. V. Lewis of Wallula, Wash., states that a plan is on foot for the construction of an electric railway from the Homily Rapids to the Horse Heaven section, a distance of about 40 miles.

The United States Electrical Manufacturing Company has been incorporated with principal place of business at Los Angeles, Cal. The directors are C. Maxstadt, F. Maxstadt, I. J. Francis and others. The capital stock is $5,000.

It is expected that soon after the first of the year the Murphy Water, Ice and Light Company will erect an independent electric plant at Needles, Cal., which will be used to light the city.

W. T. Foreman, J. M. Miller and T. H. Sullinger have applied to the supervisors of Colusa County, Cal., for a franchise to construct and operate an electric railroad along the roads of Colusa County. Bids for the franchise will be received by the board up to December 17th. J. W. Crutcher is county clerk.

The electric-light plant at Orcutt, Cal., the new town on the Pacific Coast railway, is being enlarged.

The trustees of Orange, Cal., have passed an ordinance providing for the calling of a special election to vote on the proposition of securing a municipal-light and power system and other improvements.

The North Mountain Power Company has petitioned the board of supervisors for a franchise to erect poles and suspend wires along the roads in Humboldt County, Cal., for the purpose of conducting electricity for power and lighting purposes. Bids for the franchise will be received by the board up to 10 a. m., December 15th.

John McNear has decided to extend the Petaluma, Sebastopol and Santa Rosa electric road to Point San Pedro, Cal.

The Bull River Mining and Power Company of Fort Steel, B. C., intends to install a large power plant for the purpose of furnishing lights and power to the mines in the Kootenay Valley.

Geary Kimbrell of Pendleton, Ore., has gone to the Upper Umatilla River for the purpose of making preliminary surveys for a power site for the Umatilla Electric Power Company.

The Council of Philomath, Ore., has granted the right to construct and maintain an electric-light system in Philomath to A. B. Horning, who is installing a lighting system that will meet all demands for electrical illumination.

C. A. Lunceford of Davenport, Wash., president of the Adams County Electric Transit Company, states that a dam 150 feet wide and 100 feet high is to be built at the Narrows, which, together with a power plant and machinery installed ready for operation, will cost $540,000. This company proposes to build an electric railway in Adams County. The projected route touches the Great Northern at Harrington, Mohler and Edwall; the Northern Pacific at Sprague and Ritzville; the Washington Central at Reardan, Mondovi and Davenport, and the O. R. and N. at Kahlotus, St. John and Colfax.

The Century Electrical Works of San Francisco intends to erect a large factory at Point Richmond, Cal., for the manufacture of electrical apparatus. The plant will be located near Ohio Street and Broadway. The plans provide for a factory costing about $35,000. A.

PERSONAL.

Lord Kelvin has been elected chancellor of the Glasgow University.

Alonzo Burt, president and general manager of the Missouri and Kansas Telephone Company, has returned to Kansas City from an extensive tour of Europe, where he has been spending his vacation. He announces that his company is to make extensive improvements to the telephone system in Kansas City and neighborhood.

Henry L. Doherty of Denver, former president of the National Electric Light Association, is chairman of the general committee of arrangements for the 1905 convention of that association in Denver and Colorado Springs, and his selection will go far to make the convention the brilliant success which is anticipated. He has appointed John Craig Hammond chairman of the advertising committee. It is evident that Denver is going to impress on every electrical man in the country the fact that a big electrical convention will be held in Colorado next year.

Secretary Thomas R. Mercein of the Northwestern Electrical Association, who was in Chicago last Saturday, thinks that the outlook for next month's convention of the association in Milwaukee is good. Promises of several timely papers have been secured.

A despatch from Schenectady reports the death of Cyrus H. Kendall, assistant foreman in the testing department of the General Electric Company's works, whose home is at Norfolk, Conn. Death resulted from a shock obtained in coming in contact with a wire carrying 2,300 volts. Mr. Kendall was 22 years of age and a graduate of Yale.

Richard W. Mead, assistant to the president of the New York City Railway Company, lessee of the Metropolitan street-railway system, New York city, has resigned to accept the presidency of the New York Transportation Company, made vacant by the resignation of Henry Sanderson. The office vacated by Mr. Mead will be abolished and the duties performed by him will devolve on Vice-president Frank S. Gannon.

ELECTRIC LIGHTING.

The city of Lake Charles, La., contemplates installing an electric-light plant.

Lafollette, Tenn., is soon to have a modern electric-light plant to supply its 8,000 people.

W. O. Crumpler has applied for a franchise to construct an electric-light plant at Vicksburg, Miss.

Edwards & Edwards have succeeded to the electric-lighting business of Edwards & Brinkerhoff of Eureka, Kan.

The Colonial Beach (Va.) Electric and Power Company has been incorporated with W. S. Combs, F. F. Ninde and W. F. Renshaw as its officers. The capital is $25,000.

The pioneer mining town of California, Copper City, is now lighted by electricity, the Northern California Power Company having recently extended its line to that city.

J. E. Edwards of Forsyth, Mont., has secured a site for the erection of a power station for the proposed electric-light plant. The building will be rushed to completion.

The Harper's Ferry Electric Light and Power Company is enlarging its plant at Harper's Ferry, W. Va., and contemplates extending its lighting facilities to nearby towns.

An order has been passed by the Chicago City Council requiring all firms or corporations operating electric-lighting plants without a franchise to secure the latter within 30 days.

The Marion Light, Heat and Power Company of Marion, Iowa, is making extensive improvements to its plant. The company has recently secured a new 15-year contract for lighting the streets.

A project is under way to supply the mining camps of Goldfield and Tonopah, Nev., with electric lights and power from Bishop Creek, Inyo County, Cal. The probabilities are that work on the undertaking will begin within a few days.

A. B. Sanders of Shreveport, La., has received the contract, at $37,000 from the city of Lake Providence, La., for the construction of proposed waterworks and electric-light plant after plans by Capt. Arthur Hider of Greenville, Miss.

The Etowah Light and Power Company of Attalla, Ala., has been incorporated, with $24,000 capital, and A. L. Du Pree, J. R. Brown and Adolphus Brown as its officers. The company has purchased waterpower development, and will build an electric plant to furnish electricity for lighting and power.

It is reported that C. K. Durbin and W. S. Iliff of Denver, officers of the Albuquerque Electric Light and Power Company, are at the head of a new company which will establish an electric plant in the vicinity of the American Lumber Company's plant at Albuquerque, N. M.

Sealed proposals in triplicate will be received until December 20th for extending the electric-lighting system at Fort Leavenworth, Kan. Time will form an important consideration in the award. Full information and blank forms of proposal will be furnished upon application to Major D. E. McCarthy, quartermaster, Fort Leavenworth, Kan.

ELECTRIC RAILWAYS.

W. A. Clark is contemplating building a trolley line from Hamilton, Mont., to Missoula, it is said.

Preparations are in progress for more tests of the electric locomotive built for the New York Central to be made in the presence of electrical and railroad experts. The stretch of track laid for this purpose is being lengthened to six miles.

The Belle Plaine and Vinton (Iowa) Interurban, Street and Electric Railway Company has been organized and surveys have been made. The city councils of each place have passed similar ordinances submitting to the qualified voters of the places

the question of granting the necessary franchise for the use of the streets.

The citizens of Logan, Utah, have subscribed $8,000 of the $25,000 necessary for the construction of an electric railway at that place. David Eccles of Ogden, Utah, is behind the project.

The Albuquerque Traction Company of Albuquerque, N. M., proposes to extend its lines to Highlands, but will first construct a line to the American Lumber Company's plant. The company proposes to give the city a first-class electric-car service.

The Adams County Electric Transit Company has floated $3,000,000 worth of its bonds and plans to begin work shortly on its new system with the main line from Spokane, Wash., to the Columbia River. The total length of the road, with its branches, will be over 200 miles. Power will be developed near the confluence of the Spokane River with the Columbia River, and 15,000 horsepower will be developed.

There is strong talk of installing electric motive power on the street-railway lines in Guatemala City, Central America. The current will be secured from one of the electric-light plants that is run by water-power, the power plant being about 30 miles from the city. There are now about seven miles of single-track line, with a prospect of an increase in the near future. At present mules are used. Ricardo Echeverria is general manager of the line.

From figures compiled by the Elektrotechnische Zeitschrift, it is apparent that a considerable development has taken place in electric railways of Germany for the year ended September 30, 1903, as compared with the preceding year. On September 30, 1903, there were 134 railway power stations and 3,692 miles of track, compared with 125 and 3,388, respectively, on September 30, 1902. The capacity of the generators used in 1903 was 133,150 kilowatts and in 1902 120,776.

Elevated railway traffic in Chicago for November shows a small gain in comparison with the corresponding month last year, with the exception of that on the South Side Elevated, the traffic on which for November of last year was abnormally increased by the strike upon the surface lines. Following are the figures of daily average: Metropolitan, 1904, 115,803; 1903, 114,148; South Side Elevated, 1904, 85,160; 1903, 143,398; Northwestern Elevated, 1904, 74,307; 1903, 71,422; Chicago and Oak Park, 1904, 45,759; 1903, 44,691.

By a decision of the Court of Appeals in Albany, N. Y., the Interurban and the Brooklyn Rapid Transit systems of street railways will be required to give transfers to points on any of two lines which they operate in the city of New York. The case in which the above decision was rendered is that of Luke O'Reilly, a Brooklyn lawyer, against the Brooklyn Heights Railroad Company. James S. Lehmaier is chairman of the executive committee of the Transit Reform Committee of One Hundred, which, for the last two years, has been making the fight for free transfers in New York.

A few of the changes in the operation of cars announced by the United Railways Company of St. Louis taking effect after the close of the Fair have been instituted. The Laclede cars that have been going to the south side of the Exposition grounds turn now at the Forest Park loop. The Olive Street cars that have been running to Delmar Garden turn on Hamilton Avenue and go around the Wellston loop. Delmar cars run west to Skinker Road and turn south to the World's Fair, making the loop at the Skinker entrance. Easton cars that have been going to the Pike entrance run only to Wellston as before the opening of the Fair.

According to reports from central Illinois, a line of continuous electric railways from Chicago to St. Louis is a possibility of the near future. The Lincoln (Ill.) News-Herald says: "Large forces of men are engaged in building the interurban from this city south to Springfield, and from Pontiac north to Joliet. One company is engaged on the line from Springfield to Lincoln, whence it is to be extended to Bloomington. Still another company has undertaken the construction of an electric road from Bloomington to Joliet, and that portion north of Pontiac is under construction now. With a line nearly completed between Springfield and St. Louis and a line in active operation from Joliet to Chicago, it is not difficult to see that before very long the entire distance from St. Louis to Chicago will be spanned by an electric road."

The New Jersey Terminal Company, incorporated in Trenton, N. J., recently by A. A. Cook, J. H. Lehman and J. S. Jacobs of New York, with a capital of $2,600,000, intends to reclaim the Hackensack meadows and connect the several railroads crossing them by an electric freight line. It also will build a railroad terminal, wharves and warehouses and bridge both the Hackensack and the Passaic rivers. It is intended to take advantage of the dredging of Newark Bay by the government and build up a great enterprise so that the network of electric-freight roads could be operated between Greenville, where the terminal and warehouses will be, and the roads of the Pennsylvania, Jersey Central, Lackawanna and Erie companies. The work of reclaiming the meadowland has been going on for months and between 500 and 600 acres already have been filled in.

The Chicago City Council has passed the ordinance for an extension of the Northwestern Elevated railroad, which has been before the council for a year. A charge of bribery in securing votes for the ordinance and an attack upon the local transportation committee of the council was made by an alderman. A committee was appointed by the mayor to investigate the charges and report before he signs the ordinance. The extension will leave the main line at Roscoe Boulevard, run west across the Chicago and Northwestern railway, thence north to Montrose Boulevard, and then west to Western Avenue. It is to be built entirely on land belonging to the company, except as it has to cross streets and alleys.

As a result of the successful tests of electric locomotives recently made at Schenectady, it is said that the New York Central railroad will begin work at once to equip its New York and Harlem branch with electricity, instead of waiting a year, as at first intended. It is said to be the purpose of the company to install an electric suburban service between White Plains and the Grand Central Station. In order to do this the tracks will have to be elevated or depressed, both in West Mount Vernon and White Plains. The plans for these elevations and depressions are now being made. The company has already begun work at Glenwood-on-the-Hudson on a large power plant for its proposed electric system between Yonkers and New York city. The power plant for the Harlem branch will be at White Plains.

POWER TRANSMISSION.

The Batesville (Ark.) Power Company has incorporated with $10,000 capital, to develop water-power and transmit electricity for manufacturing purposes.

W. C. Greene of Cananea, Mexico, intends to establish an electric plant to operate the new sawmills of his new timber properties, and the new smelter and nine mills soon to be constructed at the Mulatos Gold Mines in Sonora, Mexico. Power will probably also be transmitted to Nacozari and to Cananea, Mexico.

The San Louis Valley Irrigation, Land and Power Company has been incorporated with a capital of $1,000,000 to build a big reservoir to irrigate land in El Paso, Conejos and Rio Grande counties, Colo., with a principal office in Colorado Springs. Besides the irrigation plant, the company will have a big power plant and supply electric light and power to nearby cities.

A number of concessions for waterpower development have recently been granted in the vicinity of Santander, Spain. French and German firms principally have been studying this field with a view to installing the machinery and electrical apparatus which will be needed. Consular Agent F. Odriozola at Santander states that there is an opportunity for American electrical firms to compete in this field, as previous small sales have given satisfaction. The present projected plants will produce an average of 4,000 horsepower, and in connection with some of them short railways are planned, for which rails and rolling stock will be needed.

One of the latest electric power plants to be organized is the Waynesville Factory Site and Power Company of Waynesville, N. C. The capital stock of the new company is $300,000 and its officers are: President, B. J. Sloan; vice-president, Alden Howell, Sr.; secretary, I. L. Councill; treasurer, Thomas Stringfield; general manager, S. A. Jones, all of Waynesville. The company has under construction a waterpower electrical plant 12 miles from Waynesville, on the Pigeon River, and the first installation of 500 horsepower will be ready for transmission by January 1st. An additional installment of 1,500 horsepower is arranged for to supply various manufacturing plants in the territory tributary to the power.

SOCIETIES AND SCHOOLS.

A strong effort is being made to increase the membership of the Northwestern Electrical Association at the coming convention, to be held in Milwaukee, commencing January 18th. The organization is a good one and the claims of its officers that the practical information gained at the meetings is alone worth many times the cost of membership will no doubt be heeded by electric-light, power and railway companies of the Northwest, all of which are now eligible to membership. The regular gathering together of men of kindred interests is advantageous in many ways. Original papers on subjects of direct interest are read and discussed and there are always present experts willing and able to answer questions relative to the operation of electric plants. Besides, manufacturers and dealers, who constitute the associate membership, exhibit at the meetings new and modern machinery and appliances, thus offering an opportunity for comparison to the operator. Owners, managers and superintendents of electric-light, power or railway plants; electricians, electrical or mechanical engineers, and all persons engaged in the business of generating and supplying electricity for commercial or public use, are eligible to active, and all manufacturers of, or dealers in, electrical machinery, supplies, appliances or material, to associate membership.

PUBLICATIONS.

The "Pretty Girl Calendar for December," issued by the Pittsburg Transformer Company of Pittsburg, Pa., is certainly appropriately named. The advertising is unobtrusive, and the whole effect is tasteful.

An unusually attractive hanger in colors that is being distributed to the trade on application is that of the Moline Incandescent Lamp Company of Moline, Ill. The company incidentally states that the sales of its "Moline" lamps are increasing in a highly satisfactory manner.

A bulletin has been issued by the American Electric and Controller Company describing the "Rheocrat," a controller which is especially adapted to variable-speed motors used for machine-tool drive. The Rheocrat gives a wide range of running speeds, uniform gradation, constant torque and has many other advantages which are described in the bulletin. The exterior of the casing, as shown by an illustration, appears much as does the ordinary street-car controller, but the interior is widely different, containing a small electric motor and commutator device.

A tasteful booklet on "Window Lighting with Fielding Material" comes from the H. T. Paiste Company of Philadelphia. This is the thesis: "If you can show a storekeeper how you can bring people to his door, he will take his chance on getting them inside and making a sale. There is no better, no surer way of bringing these possible customers to his very door than by the drawing power of a handsome front window." Fielding receptacles and rosettes are referred to as making electric window lighting more effective. Many neat illustrations, with prices and other useful information, add to the value of the pamphlet, which was "printed at the Sign of the Ivy Leaf in Philadelphia," and does credit alike to publisher and printer.

"Pumping Machinery" is the title of a 132-page catalogue just issued by Henry R. Worthington of 114 Liberty Street, New York city. The book is printed in two colors. The cover is lined and is printed in black, light green and gold upon a dark-green background, the whole forming an excellent example of the engraver's and printer's arts. The apparatus described in this book comprises all of the types of pumping, condensing and measuring devices developed by this company in the 64 years of its existence, the most prominent being the Duplex Steam Pump, of which Henry R. Worthington was the inventor. Although devoted to one company's products, this publication is in reality an encyclopedia of high-grade practice in the design of pumping machinery.

TELEGRAPH.

At a recent meeting of the Western Telegraph Company in London, Chairman J. W. Barry said the developments in handling war news by the De Forest space-telegraph system at Chefoo, in conjunction with the Western Telegraph Company, tended to confirm the view he had previously expressed that the interesting development of the wireless system might prove a kind of handmaid to the cable system, and the cable companies need not look upon these companies as competitors, but on the contrary as being friends and doing work in the rough and rugged portions of the earth which could only be done by space telegraphy.

An injunction has been granted the Western Union Telegraph Company against the city treasurer of Covington, Ky., to prevent the collection of $1.50 taxes on each $100 receipts at that place. The telegraph company says that the city has no right to levy a tax other than on the franchise and tangible property. The government, in return for giving priority to its messages, it is claimed, gave the company free use of the post roads without hindrance from states or municipalities. The further claim is made that all the streets where the company has lines in Covington are post roads, and therefore the right to levy a tax for their use does not exist in the council.

The challenge for the international cable chess match of 1905 for the Newnes Trophy has been received by the Brooklyn Chess Club from England, but as yet no arrangements have been made for the match, owing, it is said, to the refusal of the cable companies to give the use of their wires at the prices charged in years previous to 1904. This refusal, it is thought, is because the facilities of the cables are too much occupied by the Russo-Japanese war news. The same cause prevented the intercollegiate match last year. Previous to this the average cost of cabling from New York or Boston had been about $20 a game, the six games costing about $120. The increase would bring the cost of cabling to about $300. The British players paying the same price, the total cost of cabling for the two days would come up to about $600. Efforts have been made to interest the Marconi Space-telegraph Com-

pany in the cable matches, but the officers stated that they were not yet ready to undertake so important a contract.

To meet as far as possible the pressing demands for a wider distribution of the daily telegraphic reports of weather observations, arrangements have been perfected for a very generous increase in the number of such reports telegraphed over regular circuits and as special messages. Submarine cables have been laid from Block Island, R. I., to the mainland; from South Manitou to North Manitou Island, Mich.; from Flavel, Ore., across the mouth of the Columbia River to Fort Canby, Wash.; and preparations are being made for laying one from North Nags Head to Manteo, Roanoke Island, N. C.

MISCELLANEOUS.

The commissioner of patents has ruled that a person who has been sued for the infringement of a patent will not be furnished with copies of abandoned applications filed by the patentee merely because he thinks they may assist him. Some connection between the patent and the application must be shown.

The Chicago Warehouse and Terminal Company has been incorporated in Illinois. Its object is to make effective the plans of the Chicago Subway Company to do a general warehouse business in connection with the freight tunnels in Chicago, built by the Illinois Tunnel Company. The new company will develop the Chicago Dock property recently purchased by the Tunnel company, where large warehouses and terminal yards are to be built, it is said.

An "idea broker" is a man who brings people with ideas, often inventors, in touch with capitalists possessing money to invest in good ideas. Such a man recently said: "With 60 per cent. of our applications in the line of mechanical inventions 40 per cent. of these are electrical. It is the great field of endeavor in inventiveness, and it is among these inventors that we find the sanest patrons. The application of electricity in itself is so exact in its requirements that this sanity seems requisite in its experimenters."

The triple-screw turbine-engined steam yacht designed by William White for George Newnes has been launched at Newcastle-on-Tyne. The vessel is a handsome sea-going type of yacht of little more than 1,300 tons. According to the measurements the length over all is 270 feet, 34-foot beam and 20 feet molded depth. Propulsion is obtained by a triple-shafted system of turbine engines with cylindrical boilers. They are calculated to give a smooth-water speed of 15 knots, with a continuous speed of 10 or 12 knots, according to the state of the sea. Ocean speed will be obtained on such moderate coal consumption as will enable the boat to travel about 4,000 miles without having to replenish the bunkers.

The question of raising chestnut trees for a future supply of telegraph and telephone poles is one that is being agitated throughout Maryland, Massachusetts and other eastern states, and in fact as far west as Indiana. In all this region the chestnut is a tree that holds an important place as a timber tree. It will reproduce by sprouting, but it loses its vigor when the root system becomes too old. Trees grown from seed increase both in height and bulk more slowly for many years than those grown from the sprouts. It is not exacting in its soil requirements and sprouts reach a height of seven or eight feet during the first season. Telephone poles are grown in Maryland from healthy stumps in from 35 to 38 years and railroad ties may often be cut in 29 years. According to the last census reports, in Maryland alone the annual market yield of lumber, railroad ties and telegraph and telephone poles amounts to over $100,000, besides large supplies of material for local consumption.

TRADE NEWS.

The electrical firm of Griffen & Noris at Sherman, Wash., has been dissolved and the business will be conducted in the future by Mr. Griffen.

Electrical supply men and dealers of Chicago were the guests last Saturday night at a banquet given by electrical manufacturers at the Grand Pacific Hotel.

The Babcock Electrical Company of Rochester, N. Y., has been incorporated at Albany with a capital of $50,000. The directors are Garrison Babcock, J. L. Hotchkiss and C. T. Chapin.

The Terrell-Hedges Electrical Company has been incorporated with $10,000 capital to manufacture and deal in electrical supplies at Chattanooga, Tenn. The incorporators are N. T. Terrell, M. M. Hedges, W. B. Swaney, Thomas B. Cooke and Battle McLester.

The Southern Electrical Manufacturing Company of Covington, La., has been incorporated with $200,000 capital to manufacture the Simplex arc light. The officers of the company are: President, E. G. Ames of Covington; vice-president, Arnold Heller of New York city; secretary-treasurer, E. J. Frederick of Covington.

A new company under the name of the Kusel & Kusel Automatic Switchboard and Telephone Manufacturing Company, with main office in the Monadnock Building, Chicago, has been launched. The new concern will place upon the market automatic and manual switchboard apparatus. The gentlemen mainly comprising this company are Messrs. I. J. and H. J. Kusel, who have for the last eight years been associated with the Eureka Electric Company.

Sealed proposals will be received at the office of the supervising architect of the Treasury Department until 3 p. m. on December 27th for the installation of a conduit and electric-wiring system for the United States postoffice at Leadville, Colo., in accordance with the drawings and specifications, copies of which may be obtained at the office named or at the office of the superintendent of construction at Leadville, Colo., at the discretion of the supervising architect.

Recent advices from Ireland state that the supply of electrical apparatus, including generating plants, motors and lighting appliances, is rapidly becoming an important department of business in Belfast. Electric motors are now superseding gas engines and direct steam power for many purposes in that city, and in the country districts a start is being made in the application of electric power in the manufacture of linens. In both the shipyards in Belfast extensive installations of electric plant for motor purposes have been made.

It is said in London that several prominent engineering firms, believing that the opportunities presented by India, Persia, Siam and the Far East are of more immediate value than those offered by South African enterprises are devoting their attention to a larger extent than before to the East. Electric railways, fans, motor wagons, improved methods of lighting, artesian-well machinery and domestic conveniences are just now living problems in South Asia, and the field has been covered only to a slight extent. There is a constant demand for inexpensive plants which utilize the latest results of mechanical inventions.

The Navy Department, through the Bureau of Supplies and Accounts, is inviting sealed proposals until December 20th for furnishing various navy yards and naval stations with electrical material as follows: New York yard, insulating tape and steel conduit; Norfolk and Charleston yards, arc and incandescent lamps, switches, circuit-breakers, switchboard panels, dynamo cable, wire, recording wattmeters and miscellaneous electrical supplies; Pensacola and New Orleans yards, weatherproof wire and miscellaneous electrical material. Blank forms and specifications will be furnished upon application to the navy pay offices in the cities named or to the bureau at Washington.

The Supreme Court of Germany has, by its judgment of November 5, 1904, confirmed the validity of the German patent No. 73,830, the property of the Mica Insulator Company, Limited, of the Empire Works, Walthamstow, for the manufacture of micanite plates, and has dismissed with costs the appeal of Meirowsky & Co. of Cologne for the withdrawal of this patent. A few weeks ago the same company amended its English micanite patents No. 10,430 and No. 6,048.

The Cutler-Hammer Manufacturing Company of Milwaukee is building a three-story addition to its factory which will add 50,000 square feet of floor space to the plant. The construction is of the slow-burning type and it is expected that the addition will be ready for occupancy about the first of the year. The cost will be about $50,000. The building will be equipped with the Grenelle system of sprinklers, will be heated by the Paul system and lighted with mercury-vapor lamps. The fire-storage tank, with a capacity of 75,000 gallons, will be located under the boiler room and the fire pump will have a capacity of 750 gallons a minute. The power plant for the entire factory will be in the new building and will be up to date in every respect. As soon as this building is completed work will be begun on an addition to the present office building, to which another story will be added. The third floor of this building will be entirely devoted to the engineering department, while the superintendent, chief of the engineering department, cost department, publicity department and a part of the accounting department will occupy the second floor. The executive offices and the rest of the accounting department will be on the first floor as at present. The works of the Cutler-Hammer Manufacturing Company now occupy an entire block with the exception of a small plot on one corner. Recently this company purchased a plot of ground on St. Paul Avenue, opposite its factory, upon part of which a brass foundry has been erected. Upon the remainder of this property buildings will be erected the coming year for storage and factory purposes.

BUSINESS.

The American Electric Fuse Company of Chicago has received from the official award committee of the Louisiana Purchase Exposition a certificate conferring the highest award upon the company's exhibit of telephone protective apparatus. This official certificate is a handsome document and includes the blue ribbon awarded to the first prize. A number of duplicates of the official award have been ordered for the various branch offices.

The Canadian Westinghouse Company has sold to the Hamilton Cataract, Power, Light and Traction Company for use in its Victoria sub-station at Hamilton, Ont., two motor-generator sets, each consisting of a synchronous motor and a direct-current generator, to be built at the Pittsburg works. The motor-generator sets will be of the two-bearing type, the generators delivering direct current at 550 volts to the railway system, and each being rated at 750 kilowatts. The synchronous motors will take two-phase current at 8,000 alternations and 2,400 volts, and will be rated at 1,380 horsepower. The excess of capacity in the motors is provided so that they may be used for raising the power factor of the transmission system. The Westinghouse Electric and Manufacturing Company, through its agents, Messrs. G and O. Braniff & Co. of Mexico, has been awarded the contract for all the electrical apparatus to be installed at the El Oro Mining and Railway Company, El Oro, Mexico. This contract amounts to nearly $100,000.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued (United States Patent Office) November 29, 1904

775,920. Machine for Collating or Gathering Leaves or Sections of Books. Albert Hess, London, England, assignor to the T. W. & C. B. Sheridan Company, New York, N. Y. Application filed August 15, 1904.

An electric alarm bell is so connected as to give an alarm when the proper number of leaves are gathered together.

775,921. Telephone-call Teller. Henry M. Hile, Canton, Ohio. Application filed July 15, 1904.

An indicating device for indicating the telephone numbers frequently used is mounted on the telephone transmitter.

775,932. Sparking Igniter Device for Hydrocarbon Engines. James W. Packard, Warren, Ohio, assignor to the Packard Motor Car Company, Warren, Ohio. Application filed June 27, 1903.

The sparking device contains a disk of insulating material mounted on a shaft. A contact plate is mounted on the disk and a contact point carried by the governor engages the plate.

775,933. Electric Switch. Isaac H. Parsons, Leicester, England. Application filed February 23, 1904.

A stationary member is provided with fixed contacts and a movable member is provided with a contact arranged to enter the spaces between adjacent fixed contacts. Insulating material is applied to the contact portions of one of the members, so that the movable contact is prevented from making electrical connection with more than one of the two stationary contacts between which it rests.

775,986. Insulator. Samuel Oakman, Cheshire, Mass., assignor to Luther A. Wright, Boston, Mass. Application filed November 7, 1903.

A protecting shield entirely surrounds the body of the insulator and extends downward and outwardly until its outer rim becomes practically horizontal, whereby a broad annular chamber is formed for receiving paraffin or other coating.

775,993. Guard for Trolleys. Joseph B. Short, Wilkinsburg, Pa. Application filed March 1, 1904.

Two trolley wheels are arranged between two flanged guiding plates projecting above the peripheries of the wheels.

776,001. Transformer. William L. Waters, Milwaukee, Wis., assignor to the National Electric Company, Milwaukee, Wis. Application filed August 18, 1904.

Coils are arranged with air passages between them and a core surrounds the coils. A housing incloses the coils and core and has air inlet and outlet openings in the base, the inlet opening communicating with the passages between the coils. A sinuous air passage communicates at its lower end with the outlet opening and at its upper end with the passages between the coils.

776,026. Motor Fan. Gustav E. Jacobson, Newark, N. J., assignor to the Essex Electrical Company. Application filed September 20, 1902.

In a compound motor fan are a supporting rod and a hub pivoted on the rod and having radial arms, each carrying a laterally projecting substantially horizontal pin upon which the fan motor is mounted.

776,028. Speed Governor. Homer N. Motsinger, Pendleton, Ind., assignor to the Motsinger Device Manufacturing Company, Pendleton, Ind. Application filed September 21, 1903.

In a speed governor are combined, with an electric generator, a pawl-and-ratchet mechanism for driving the generator, an electromagnet adapted to separate the pawl-and-ratchet mechanism, and electric connections between the generator and the magnet.

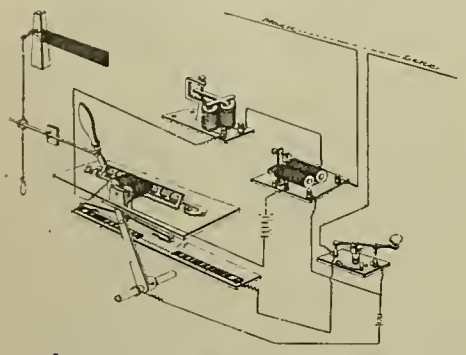
776,064. Trolley. William A. Holland, London, Ohio, assignor of one-half to E. E. Harvey, London, Ohio. Application filed December 11, 1903

Combined with a trolley head are a harp swiveled therein, a trolley wheel mounted in the harp, and means yieldingly retaining the trolley in alinement with the

pole and also serving to detachably connect the harp to the head.

776,067. Multiple Switchboard for Telephone Exchanges. Milo G. Kellogg, Chicago, Ill., assignor to the Kellogg Switchboard and Supply Company, Chicago, Ill. Application filed November 30, 1891. Renewed October 16, 1899.

In a telephone-exchange system are two metallic-circuit lines switched in circuit for conversation. A ground connection is added to the circuit at the central office and a battery and special clearing-out annunciator are in the ground connection. There are a telephone, a switch and a ground connection at each subscriber's station, the switch having contacts to close the ground connection when the telephone is replaced on its switch. The battery has such strength as to operate the annunciators when they are closed to each other on either telephone being replaced on its switch.



NO. 776,120.—TRAIN-ORDER PROTECTOR AND SIGNAL LOCK.

776,068. Multiple Switchboard for Telephone Exchanges. Milo G. Kellogg, Chicago, Ill., assignor to the Kellogg Switchboard and Supply Company, Chicago, Ill. Application filed July 29, 1893. Renewed October 17, 1899.

One side of each line is permanently grounded through its annunciator. Switching apparatus connects together any two of the lines for conversation into a complete metallic circuit, which does not contain either line annunciator. A calling generator at each subscriber's station is located in the main or closed metallic circuit of its line whenever operated to send a signal, either the primary or clearing-out signal.

776,090. Telephone System and Apparatus Therefor. Walter C. Runge, London, England. Application filed December 6, 1902.

Two plug-circuit wires in the exchange are connectible respectively with the two line-circuit wires. A supervisory signal relay at the exchange is in circuit with the first circuit wire and with an earthed battery. Means for earthing the first circuit wire at the subscriber's station are supplied, also means for retaining the supervisory signal in operation when actuated. An electromagnet releases the supervisory signal in circuit with the second circuit wire and a battery.

776,112. Sanitary Rotating Diaphragm for Telephones. Sidney Churchill-Otton, East Melbourne, Victoria, Australia. Application filed May 7, 1904.

A telephone transmitter is provided with a frame having a central opening and a roll carrying a paper diaphragm mounted in one side of the frame and rollers for feeding the paper in front of the transmitter.

776,120. Train-order Protector and Signal Lock. Fryar E. Draper and Edward H. Roy, Nashville, Tenn., assignors of one-tenth to Theodore J. Zoeller, Nashville, Tenn. Application filed January 5, 1904.

In a system of railroad signaling are a train signal, an electric circuit including line signals, a signal-operating lever for actuating the line signal, and a lock for the train signal connected with the signal-operating lever to be simultaneously and automatically actuated with it. (See cut.)

776,144. Automatic Electric Regulator. Alexander McGary, LaGrange, Ill. Application filed April 20, 1903.

In an automatic electric regulator are a solenoid provided with taps, a liquid pot, a series of auxiliary contact points insulated in the walls of the pot and connected with the taps, a conducting fluid within the pot, and means for displacing the liquid within the pot.

776,154. Contact Device for Apparatus for Lighting or Extinguishing Gas. Fredrik Testor, Stockholm, Sweden. Application filed August 16, 1904.

A contact device for electric lighting and extinguishing of gas when a door holt is being pushed or withdrawn is described.

776,160. Telegraph Key. Roye M. Wood, Chicago, Ill. Application filed May 9, 1904.

A telegraph key comprises a base, a block thereon, a leaf spring fastened in the block and carrying the key lever, and blocks adjustable along the spring for regulating the tension.

776,192. Protective Coating or Covering for Storage-battery Plates. Achille Meygret, Paris, France. Application filed June 29, 1903. Renewed April 6, 1904.

A protective coating or covering for storage-battery plates consists of an envelope or sheath formed by dipping the plate or electrode with the active material thereon into a solution containing tetra-acetate of cellulose.

776,214. Electric-railway Signaling System. Marion A. Born, Lawrenceville, Ga., assignor to Early W. Born, Norcross, Ga.; Edward W. Vance, Buford, Ga.; Milton Hopkins Loudon, Kansas City, Mo., and Emma Byles, Washington, D. C. Application filed March 11, 1902.

Combined with the traffic rails are a continuous bare conductor disposed adjacent to one of the traffic rails, a revolubly adjustable hanger arranged on the car or train, and a pair of independent trolley-supporting arms carried by the hanger and having trolleys for engaging the conductor and one of the traffic rails.

776,218. Self-soldering Heat Coil. Frank B. Cook, Chicago, Ill. Application filed January 11, 1904.

The main features of the coil are fixed members, a heat-producing means, a toothed drum inclosing the heat-producing means, and means for turning the drum upon the fixed members and thereby controlling a circuit.

776,220. Controller for Electrical Vehicles. Henry H. Cutler, Milwaukee, Wis., assignor to the Cutler-Hammer Manufacturing Company, Milwaukee, Wis. Application filed April 15, 1903.

Combined with a suitable controlling circuit are electromagnetic windings connected therewith and adapted to respond to variation of voltage, and means for varying at will the voltage impressed upon the controlling circuit without altering the resistance of the controlling circuit.

776,223. Means for Controlling the Voltage from Electric Generators. Isidor Deutsch, Montreal, Canada, assignor to the Electric and Train Lighting Syndicate, Montreal, Canada. Application filed April 30, 1903.

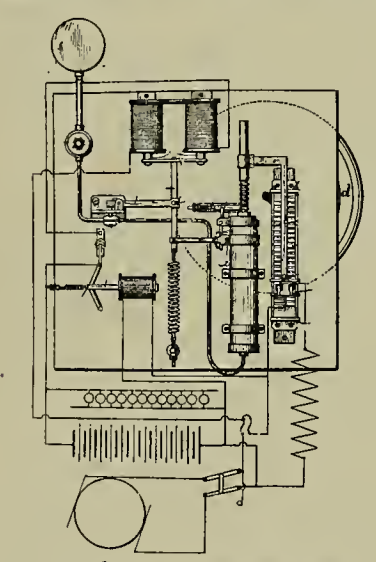
Apparatus for controlling the voltage from an electric generator consists of a main exterior circuit, a shunt field circuit, a rheostat located in series with the shunt field circuit, a vertical row of contacts connected with the steps of the rheostat, a carriage traveling in suitable guides over the row of contacts and co-acting contacts secured to the carriage. A piston and cylinder attachment operated by an expansible fluid and controlled by a solenoid locking device operates the contacts. (See cut.)

776,225. Fireproof Shutter System. William L. D'Olier, Philadelphia, Pa., assignor of one-half to George M. Newhall, Philadelphia, Pa. Application filed June 17, 1904.

A motor is arranged to raise and lower the fireproof shutter.

776,238. Electric Switch and Signal Apparatus. Lawrence Griffith, Yonkers, N. Y. Original application filed November 28, 1903. Divided and this application filed October 18, 1904.

Electric apparatus for operating railway switches, signals and the like comprises an electric circuit, an electric switch in the circuit, a device for operating the switch and an electrically controlled locking device for automatically locking the switch-operating device against a complete return after it has been moved in either direction to energize the circuit. The locking device comprises a mechanical device operated by a single electric unit.



NO. 776,223.—VOLTAGE CONTROLLER.

776,278. Display Sign. Joseph Ward, Wellston, Ohio. Application filed July 23, 1904.

The sign is carried upon a vane upon the edges of which are mounted incandescent lamps, the circuit of which is alternately made and broken by a revoluble commutator device.

776,290. Device for Connecting and Disconnecting the Talking Circuits of Telephones. Addington L. Brincklé, Philadelphia, Pa. Application filed March 23, 1904.

A device for making and breaking the conversation circuit of a telephone comprises a member rotatably encircling the standard of a telephone instrument and adapted to be moved in the path of the receiver arm.

776,326. Multiple Attachment Plug. Harvey Hubbell, Bridgeport, Conn. Application filed February 26, 1903.

A multiple attachment plug comprises an insulating body having pairs of independent recesses, locking contact springs in the recesses, means for electrically connecting the body to an electrical fixture and caps having independent contact posts adapted to engage the locking contact springs, whereby a number of electric appliances may be placed in the circuit simultaneously.

776,337. Wireless Signaling System. Leonid Mandelstam, Berlin, and Hermann Brandes, Strassburg, Germany. Application filed September 8, 1904.

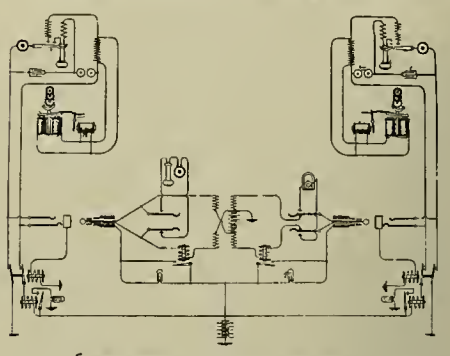
The invention embodies the arrangement of a transmitter and a receiver, the receiving circuit of which is loosely coupled with the aerial conductor and a detector, and a self-induction coil within the receiver circuit. The capacity of the latter is at least twice as large as the capacity of the detector with the object of diminishing the fluctuations of the capacity caused by the detector.

776,339. Electrical Cableway Conveyer. Charles Messick, Jr., Hackensack, N. J. Application filed September 7, 1904.

Electrically operated cableway conveyers or telphers comprise a frame, a motor carried by the frame, shafts also carried by the frame, grooved track wheels mounted to turn on the shafts, a gear connection between the wheels and the motor and a counterweighted downcome having longitudinal, pivotal, swaying relation to the frame and the motor.

776,359. Indicator for Electric Oscillations. Adolf Slaby, Charlottenburg, Germany. Application filed July 26, 1904.

A resonator in the form of a wire coil, one end of which is connected with a metal handle, is combined with fluorescent substances to which metal in finely divided form is applied at places of maximum potential.



NO. 776,429.—SERVICE METER FOR TELEPHONES.

776,374. System of Electrical Distribution. Bion J. Arnold, Chicago, Ill. Application filed December 17, 1901. Renewed January 8, 1904.

In a polyphase system of distribution are a polyphase source of current, transmission circuits supplied therefrom, a translating device, means for supplying the translating device with single-phase current from a circuit of the polyphase system to operate it, and means for supplying additional current of a different phase to the translating device.

776,380. Method of Producing Quick Electrical Oscillations of Different Phases. Ferdinand Braun, Strassburg, Germany. Application filed July 26, 1904.

Production of quick currents in phase difference is accomplished by oscillating elements, in which the electric energy is required to oscilate in phase difference excited by a common oscillating circuit, with which they are coupled either inductively or conductively with different strength.

776,429. Service Meter for Telephone Lines. Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Company, Chicago, Ill. Application filed April 9, 1900.

Means at the central station apply currents of different character to the system. An actuating magnet is responsive to all such currents, a counting mechanism is associated therewith, and a blocking magnet is adapted to prevent the actuation of the counting mechanism, the blocking magnet being responsive to current of one kind only. (See cut.)

776,435. Telephone-exchange System. Edwin H. Smythe, Freeport, Ill., assignor to the Western Electric Company, Chicago, Ill. Application filed May 24, 1902.

Means for operating a switch which normally closes the plug circuit are adapted to be controlled by a magnet, and means actuated in the insertion of the plug bring the switch under the control of the magnet, whereby, upon the insertion of the plug in a spring jack, the electrical condition of the plug circuit will be made dependent upon the potential at the jack with which connection is made.

776,454. Rheostat. William Christensen, Philadelphia, Pa. Application filed August 24, 1903.

The essential features of the rheostat are a central core, a resistance arranged upon the core and comprising a single continuous strip spirally wound to form a series of coils, the portions of the strip between the coils being folded to provide intermediate connections between the coils, and means for cutting the coils into and out of an electric circuit.

EXPIRING PATENTS.

Following is a list of electrical patents (issued by the United States Patent Office) that expired on December 6, 1904:

374,173. Apparatus for Converting Heat Energy Into Electrical Energy. W. E. Case, Auburn, N. Y.
374,224. Incandescent Electric Lamp. M. Wheeler, Boston, Mass.
374,225. Electrical Dental Engine. G. W. Whitfield, Evanston, Ill.
374,236. Electric Railway. E. M. Bentley, New York, N. Y.
374,315. Conduit for Cable or Electric Railways. W. Nier, Kansas City, Mo.
374,329. Galvanic Battery. H. E. Waite, New York, N. Y.
374,348. Underground Conduit for Electrical Conductors. G. W. Cook, Detroit, Mich.
374,374. Electric Governor. W. H. Reynolds, Washington, D. C.
374,390. Telegraph Transmitter. A. Bixby, Baltimore, Md.
374,406. Regulation of Electric Generators. D. Higham, Philadelphia, Pa.
374,439. Transmitter. R. W. Whitney and F Pultz, Cleveland, Ohio.
374,444. Printing Telegraph. A. Bixby, Baltimore, Md.
374,456. Galvanic Battery. F. J. Crough, Eugene City, Ore.
374,458. Underground System of Electric Wires. J. P. Davis, New York, N. Y.
374,495. Coin-operated Induction Coil. W. R. Pope, Baltimore, Md.
374,528. Electric Gas Lighter. J. B. Entz, New York, N. Y.

WESTERN ELECTRICIAN

EVERY SATURDAY

Vol. XXXV. CHICAGO, DECEMBER 17, 1904 No. 25

LIBRARY OF ELECTRICAL ENGINEERING

Electrically Operated Bridge over North Branch of Chicago River.

An electrically operated double-bascule bridge of unusual size for its type has just been completed over the North Branch of the Chicago River at North Western Avenue. It is owned and operated by the city of Chicago and the details of its design were worked out by Mr. John Ericson, city engineer, and Mr. Thomas G. Pihlpeldt, bridge engineer. Figs. 1 and 2 show the bridge closed and open.

The following figures will give an idea of the general dimensions of the bridge: The structure contains three trusses, between which are located two roadways with street-railway tracks. Outside the trusses are two sidewalks. The roadways are each 18 feet in the clear and the sidewalks eight feet, giving a total width of about 55 feet. From center to center of pivots is 205 feet seven inches and from center to center of river piers 189 feet seven inches. Between the fenders (which are groups of piles driven in front of the piers to shield them from injury by the heavy boats) the distance is 168 feet. The bridge crossing is at an angle, so that the absolute clearance for navigation is 100 feet. The total length from abutment to abutment is 368 feet.

Fig. 1. Bridge Closed.

Fig. 2. Bridge Open.

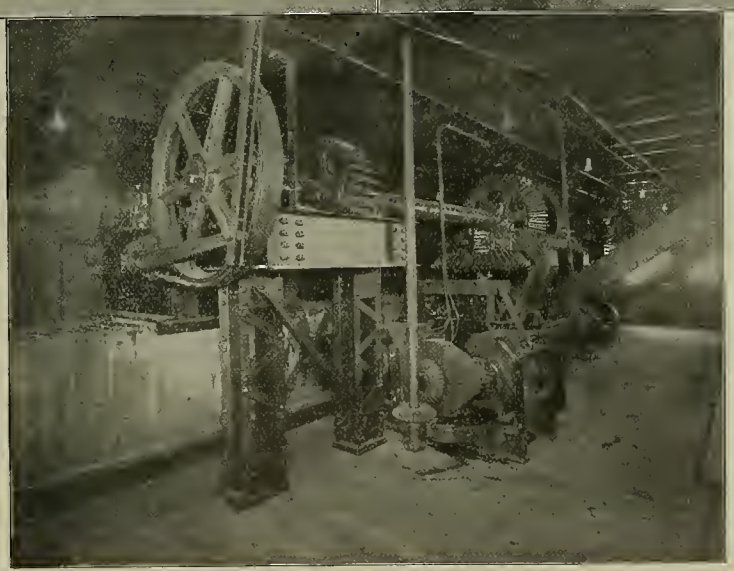


Fig. 3. View Showing Gearing and Motors.

ELECTRICALLY OPERATED BRIDGE OVER NORTH BRANCH OF CHICAGO RIVER.

Portland-cement concrete is used for the abutments and the amount required was 4,500 cubic yards. The curb walls for the approaches are of rubble masonry, and 3,000 cubic yards was necessary for this part of the work. The superstructure is of steel and iron, aggregating in weight 1,090 tons. The counterweights are made of pig and cast iron and weigh 700 tons. The total weight of the machinery is 100 tons.

The two halves of the bridge are entirely independent of each other, there being a bridge tender at each end, who, from his little house situated on the pier, shown in Figs. 1 and 2, has entire control of his half from a switchboard in the house, everything being controlled electrically, including the motors for raising and lowering the bridge, motor-driven pump for drawing out the water which collects in the counterweight pits, the signals and the motors which operate the locking bolts which hold the two parts of the bridge together when down.

With such heavy moving parts and to counteract the enormous wind pressure which is developed on the under side of the bridge when raised, as will be readily appreciated by glancing at Fig. 2, machinery and gearing of great rigidity and strength are required, and this is located in compartments back of and beneath the bridge next to the abutments.

Fig. 4 on the next page shows the arrangement of the principal gearing, to the left being a plan and on the right an elevation showing the manner in which the gears mesh with the bridge chords. The installations at the two ends of the bridge are identical. Fig. 3 is an interior picture taken at the left end of the bridge as shown in Fig. 1. As seen in Fig. 3, there are two motors used, which are of the direct-current street-railway type and of 50 horsepower each. The armature shaft of each motor is connected through an intermediate gear to a horizontal shaft bearing worms which intermesh with two horizontal worm-wheels which are not indicated in either the picture or the diagram. The worm-wheels transmit their energy through vertical shafts to the vertical gears shown, and these in turn rotate a shafting running crosswise of the bridge and bearing three heavy pinions so situated as to mesh with gear teeth which are placed on the peripheries of the circular parts of the bridge chords. These are not ordinary toothed gears, but are pins fitted crosswise between the two parallel members of each chord of the bridge and are perfectly open so that snow and ice do not collect and clog the gearing.

The worm gear gives great power and a reliable control of the movement of the bridge, the motors being able to lift the bridge and sustain it in any desired position. It is said that the bridge might be lifted and sustained against a wind blowing at 80 miles an hour, indicated velocity.

The actual power required to raise and lower the bridge under ordinary circumstances is really very small as compared with the capacity of the motors installed, it being only about six to 11 horsepower for each half of the bridge. Still conditions may obtain at some time with a high wind blowing when a much larger amount will be required.

A powerful hand brake is provided which may be used if desired in lowering the bridge and is operated by a hand lever in the operator's house.

When the two halves of the bridge are closed they are locked by bolts which slide from one half and fit into corresponding recesses in the other half. The bolts are operated by a small electric motor which may be controlled from the switchboard in the bridgetender's house, as already mentioned. From the switchboard the signal lights and the lights in the motor room may also be controlled. Power is taken from the lines of the Chicago Union Traction Company at 500 volts.

The bridge is calculated to bear an equally distributed load of 100 pounds per square foot on the roadways and sidewalks and will also carry the heaviest street cars (22 tons empty and 35 tons fully loaded) and steam rollers.

C. L. Strobel of Chicago was the contractor on this work and G. P. Nichols & Bro. the sub-contractors on the electrical work.

Bombay Electric-light Plant.

Further particulars of the Bombay electrical generating station, referred to in the Western Electrician of August 27th last, are given in the Indian Electrical, Mechanical and Textile News. The plant comprises one 300-kilowatt 5,500-volt three-phase engine-driven alternator and one 500-kilowatt 5,500-volt three-phase turbo-alternator, which are excited by two 100-kilowatt directly coupled dynamos. The frequency is 50 cycles per second. The 300-kilowatt set is coupled to a Brush engine and runs at 333 revolutions per minute when supplied with steam at 150 pounds, superheated by 150° F. It is to be capable of dealing for short times with an overload of from 10 to 15 per cent. and to work either condensing or non-condensing. The cylinders are 16½ inches and 23 inches diameter, respectively, by 10½-inch stroke. It is specified that the speed is to keep within 2½ per cent. up or down, and all bearings have forced lubrication, the oil being cooled by passing through a coil placed in running water. The 300-kilowatt alternator has a stationary armature and revolving multipolar field and is to be capable of running in parallel with the turbo set. Carbon brushes running on phosphor-bronze collecting rings are employed. The turbo set runs at 3,000 revolutions per minute and is of the Brush-Parsons parallel-flow multifold-expansion type, using steam through the full range from boiler pressure to the vacuum. There is a by-pass to allow of high-pressure steam being admitted to the low-pressure portion for large overloads. The lubrication is by two motor-driven three-throw oil pumps, each capable of supplying oil to all the bearings of three such sets. The armature is stationary with form wound coils and the field winding is in slots in the laminated revolving field.

American Society of Mechanical Engineers.

The fiftieth half-yearly meeting of the American Society of Mechanical Engineers was held at New York on December 6th to 10th. The number of members and guests registered was 625.

On Tuesday evening, December 6th, Mr. Ambrose Swasey of Cleveland, Ohio, delivered his presidential address on "Some Refinements of Mechanical Science," the full text of which is printed elsewhere in this issue. Afterward Mr. Charles Wallace Hunt of New York unveiled a portrait of John E. Sweet, who served as president in 1883-4, and whose presence on the platform was greeted with applause. Mr. Hunt referred to the progress achieved by the society since its establishment 25 years ago and of the efforts made in 1879 by Professor Sweet to organize the society.

On Wednesday morning the annual business meeting was held, and the president-elect, John R. Freeman of Providence, R. I., was welcomed. The long printed report of the council dealt mainly with routine matters. The library committee reported as to the arrangements made for the amalgamation of the society's library with those of the electrical and mining engineering societies in the new Union Engineering Building to be provided largely by the generosity of Andrew Carnegie. It is estimated that the maintenance of the joint library will cost each society $4,000 annually. Mr. C. W. Hunt reported that the plans for the new building were well advanced and that they were hoping to overcome legal obstacles so that the new building would be exempt from taxation. Colonel H. C. Meyer, Jr., of New York, made a verbal report on the government coal-testing plant at St. Louis, which is to be temporarily continued until Congress sees fit to make an appropriation for its permanent establishment. So far 180 loads of different kinds of coal have been tested in typical boilers.

The society now numbers 2,801 members of all classes, of whom 162 have been elected under the presidency of Mr. Swasey. The year's income was $41,520 and the expenditure $42,170.

The first professional paper, "A New Hydraulic Experiment," was presented by A. F. Nagle of Buffalo, N. Y. The author gave a formula to determine the rise of water in a standpipe fed from a long distance when the draft suddenly ceases. This formula is that the rise in the standpipe in feet above the level of the reservoir is equal to the square root of the length of the pipe multiplied by the velocity multiplied by 0.176. Sir Benjamin Baker contributed a written discussion on this paper, the secretary saying that this was the first time that they had received a written discussion from an English member.

William W. Bird and Howard B. Fairfield of Worcester, Mass., presented a paper on their twist-drill dynamometer, giving diagrams relating to feed and angle. They recommended a change of angle for drills for ordinary work from the present 59 degrees to 45 degrees.

Gus C. Henning of New York read a paper on "Diamond Tools," and produced a number of specimens of diamond drills and a drilled die for drawing platinum wire for incandescent lamps where it is necessary to have the wire perfectly smooth in order to fuse into the globe. This die was of 0.00125 inch diameter. Very fine wires are produced by consecutive reduction. Diamond tools, he said, although expensive, are economical in use. A die will last eight years without the least sign of wear and one of 0.004 caliber has drawn 550,000 pounds of soft copper wire.

At the session on Tuesday evening a paper on "Centrifugal Fans" by August J. Bowie, Jr., of San Francisco, Cal., was presented in abstract. Mr. Bowie analyzed the loss of energy due to sudden changes of conditions and suggested remedies.

Charles T. Main of Boston, Mass, presented a paper on the computation of the commercial value of waterpowers and the determination of damages for diverted flows. The economical development of waterpower depends upon a number of factors and with the necessary data the value of power can be expressed in horsepower per annum and compared with the cost of steam power with coal at various prices.

C. E. Sargent of Chicago, Ill., forwarded a paper on an indicating steam meter. He described "a simple, cheap and fairly accurate device," which, he says, will indicate steam pressure under varying conditions of load and supply.

Robert S. Hale of Boston, Mass., discussed rules and formulas for staybolts, braces and flat surfaces in boilers. He thought that many bulges in boiler plates were due to overheating and that there was no call for change in design. G. R. Henderson of New York said that in the case of locomotives the water was driven away from the sheet and caused the bolts to be weakened by overheating.

The chief paper of the evening was on "Condensers for Turbines," read by George I. Rockwood, which mainly dealt with a 400-kilowatt Westinghouse-Parsons steam turbine installed recently at the Atlantic Mills, Providence, R. I., where injector condensers are used. The writer's conclusions were warmly contested. F. P. Perry of Allston, Mass., endorsed Mr. Rockwood's views, mainly on account of the high cost and large size of surface condensers. F. M. Wheeler of New York defended the surface condensers, but wished they had "rubber necks." Henry H. Supplee mentioned that Mr. Parsons in England had used an injector to help out the surface condenser. Replying to this discussion, Mr. Rockwood said that his joints were particularly tight and he did not recommend the practice of doping leaks.

On Wednesday morning Charles H. Benjamin of Cleveland, Ohio, read a paper "On the Bursting of Four-foot Flywheels." His first wheel, having six arms and weighing 194 pounds, had a theoretical bursting speed of 1,920 revolutions per minute, but it actually burst at 1,100 when the calculated centrifugal force of the balance weight was 2,760 pounds. A second wheel burst at about 600 revolutions per minute when the centrifugal force of the flanges on one side was about 1,680 pounds and the linear speed of the rim about 125 feet a second. A third wheel, 49 inches in diameter, 6¾ inches rim, 1⅛ inches thick, weighed about 900 pounds. It was built in 10 segments of cast steel with 20 arms of phosphor bronze and reinforced by diagonal braces. This wheel was designed by a Baltimore firm as a model for a proposed 30-foot flywheel. After being driven at 1,650 revolutions per minute it showed minute fractures and very slight opening of the joints. On increasing the speed to 1,755 the wheel burst and projected parts of the rim 200 feet away. The rim speed at the time of the explosion was 372 feet per second, or more than 250 miles an hour, and the tensile stress due to centrifugal force was 13,800 pounds per square inch. The experiment showed among other things that the joints were much weaker than the solid rim. G. R. Stetson of the New Bedford (Mass.) Edison Lighting Company thought that large wheels sometimes broke on account of the metal expanding by heating, and mentioned a wheel with a wooden rim which obviated this trouble.

The secretary presented in abstract a paper by Sanford A. Moss of West Lynn, Mass., "On the Influence of the Connecting Rod on Engine Forces." This was purely a mathematical contribution and was not discussed.

The secretary also presented in abstract a theoretical paper by James B. Stanwood of Cincinnati, Ohio, "On Losses in Non-condensing Engines," based on an extension of the experimental methods of Mr. Willans. The paper analyzed condensation and expansion losses and gave a diagram of adiabatic curves for varying mean effective pressures.

S. H. Bunnell of Watertown, N. Y., read a paper on "The Power Plant of the Tall Office Building." Such plants must develop widely varying powers at unexpected times, as, for instance, when all the elevators of the building happen to be taking their maximum current. F. H. Ball of Bound Brook, N. J., said that the purport of the paper was to demonstrate that compound engines are less efficient than the four-valve type with light loads.

The last paper on Thursday morning was the work of A. Borsody and R. Campbell Cairncross and was read by Prof. C. E. Lucke of Columbia College. He described an ingenious method of measuring temperature in steam nozzles by means of movable thermal couples. These experiments, said Prof. F. R. Hutton, were leading toward a possible solution of the problem of the gas turbine.

On Thursday afternoon the members accepted the

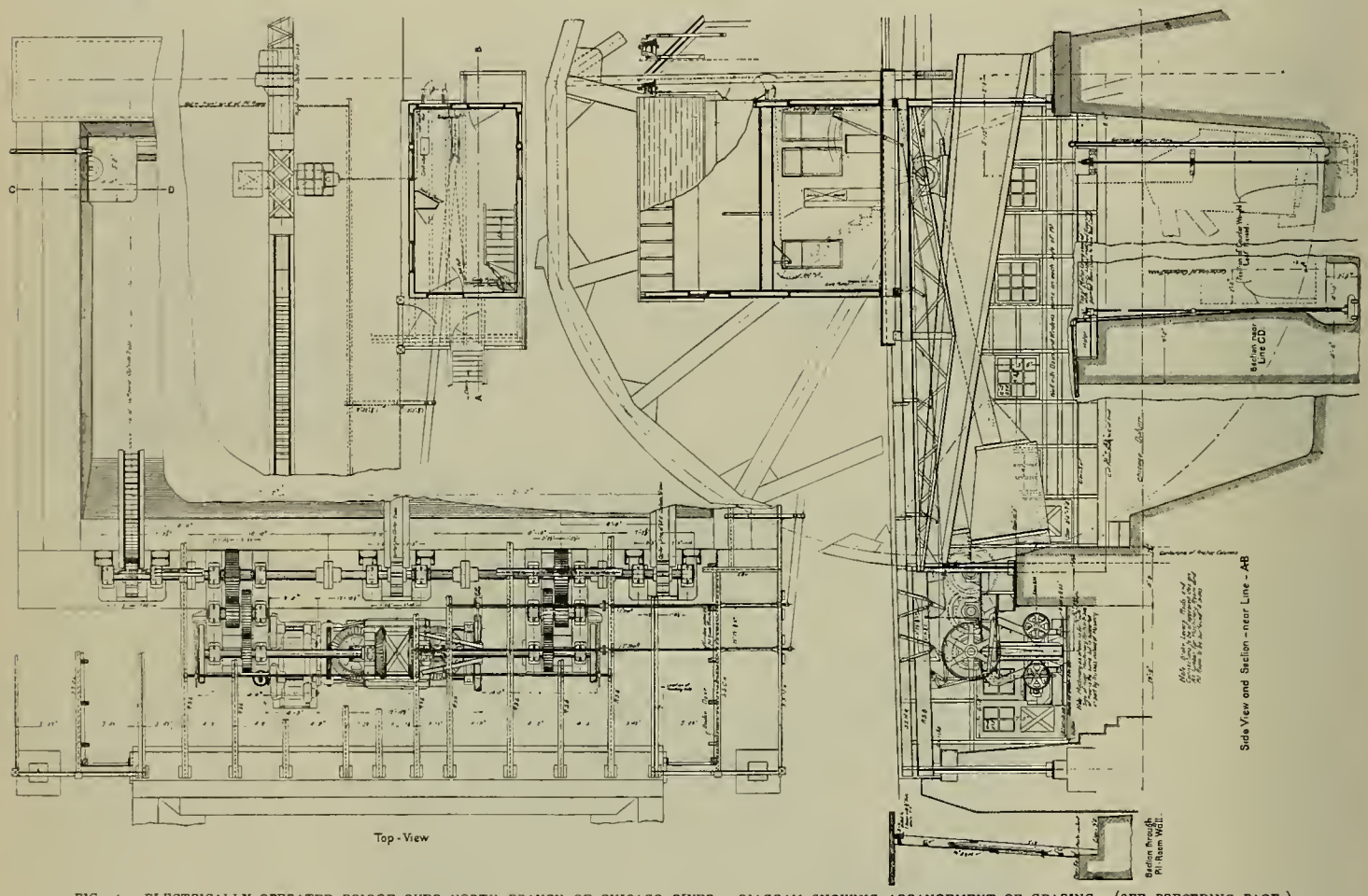


FIG. 4. ELECTRICALLY OPERATED BRIDGE OVER NORTH BRANCH OF CHICAGO RIVER.—DIAGRAM SHOWING ARRANGEMENT OF GEARING. (SEE PRECEDING PAGE.)

invitation to inspect the power house of the New York subway and also saw the new steam turbines at the Edison company's Thirty-ninth Street station. Thursday evening was devoted to a reception at Sherry's restaurant, where Mr. and Mrs. Ambrose Swasey and Mr. and Mrs. J. R. Freeman received a large company. A dance and supper followed.

On Friday morning at the closing session the society received an appendix to the report of December, 1901, on the standardization of engines and dynamos. The appendix was signed by James B. Stanwood (chairman), W. M. McFarland, A. L. Rohrer, Frank Ball and W. B. Forbes and read as follows: "To facilitate pressing the armature upon the engine shaft, the engine builder should reduce the diameter of the shaft beyond the armature fit an amount of not less than 0.006 inch." A preliminary report was also received as to a suggested standard tonnage basis for refrigeration.

G. B. Henderson read a paper on "Fuel Consumption of Locomotives." He presented a diagram from which to calculate both theoretically and practically the fuel consumption in pounds at any mileage from five to 40 and at varying tractive forces and gradients. It was possible to determine the best conditions under which to work a locomotive, and this was not always at maximum speed and load. A lively discussion followed. Mr. A. Cary gave details of recent coal-consumption tests made by the Delaware and Lackawanna railroad, where 30 pounds of coal for each square foot of grate surface was consumed, the coal being a mixture of soft and bituminous. The discussion turned to the subject of having two firemen on a locomotive, which several speakers advocated for large modern locomotives; others calling for a mechanical locomotive stoker. Mr. Henderson said that the tendency was for firemen to have more muscle and less brain, so that hereafter firemen would not so readily develop into engineers.

E. A. Hitchcock of Columbus, Ohio, read a paper in abstract on "Road Tests of Brooks Passenger Locomotives" on the Hocking Valley railroad between Columbus and Toledo. In these tests the unaccountable losses and radiation was reduced to about three per cent. In the ensuing discussion the use of dry pulverized coal in locomotives was not endorsed.

A. Bement of Chicago, Ill., read a paper on the "Discharge of Water with Steam from Water-tube Boilers." He found that with a peculiar form of baffle the evil was partly remedied. Mr. Bement also read a paper on the determination of the efficiency of steam-generating apparatus.

The last paper was by Mr. F. W. Dean of Boston, who dealt with the "Forcing Capacity of Fire-tube Boilers," which type he thought was fully equal to all demands and could not be surpassed by the water-tube form.

Among those present, in addition to those mentioned, were John W. Lieb, Jr., New York; John J. Hopper, Springfield, Ohio; Henry Vogt, Louisville, Ky.; H. L. Whittemore, Milwaukee, Wis.; H. M. Norris, Cincinnati, Ohio; C. J. H. Woodbury, Lynn, Mass.; Sidney Hosmer, Boston; James I. Ayer, Boston; George H. Barrus, Boston; William W. Estes, Providence, R. I.; C. M. Russell, Massillon, Ohio; George S. Searing, Chicago, Ill.; S. T. Wellman, Cleveland, Ohio; W. M. Allen, Cleveland, Ohio; Alex Dow, Detroit, Mich.; Charles W. Naylor, Chicago, Ill.; Henry M. Lane, Cleveland, Ohio; W. B. Bogardus, Jackson, Mich.; G. A. Buvinger, Dayton, Ohio; Paul R. Brooks, Chicago, Ill.; Henry Marx, Cincinnati, Ohio; Jason D. Miles, Miles City, Mont.; John Fritz, Bethlehem, Pa.; Charles F. Hart, Brooklyn; Louis R. Alberger, New York; F. A. C. Perrine, Pittsfield, Mass.; George E. Fisher, Natick, Mass.; Mrs. Ambrose Swasey, Cleveland, Ohio; George M. Brill, Chicago; Oliver S. Shantz, Chicago; G. E. Merryweather, Cleveland, Ohio; Mrs. Samuel A. Parr, Denver, Colo.; Daniel H. Jones, Ampere, N. J.; N. H. Doane, Cincinnati, Ohio; R. Raymond, Brooklyn; Ernest Lee Jahncke, New Orleans, La.; William M. Taylor, Indianapolis, Ind.; L. A. Cupp, Monterey, Mexico; Francis Hodgkinson, East Pittsburg, Pa.; Charles H. Little, Cleveland, Ohio; Robert I. Clegg, Cleveland, Ohio; L. S. Louer, Chicago; C. A. Gates, Massillon, Ohio; H. M. Sage, Chicago; Will J. Sando, Milwaukee, Wis., and H. G. Reist, Schenectady, N. Y.

Proposed Subway System for Chicago.

It is altogether likely that the city of Chicago within a few years will be the possessor of a comprehensive subway system which will provide adequate space for at least two street-railway tracks and for water, gas, sewer and electric pipes as well. Such a subway might contain loops for one North Side street-railway line, two West Side lines and three South Side lines. Differing plans and estimates of cost for the subway work have already been presented in the form of reports to the local transportation committee of the City Council by Mr. Bion J. Arnold and Mr. George W. Jackson, consulting engineers. The following notes upon one plan for the proposed work are taken from the second and more comprehensive of Mr. Jackson's reports.

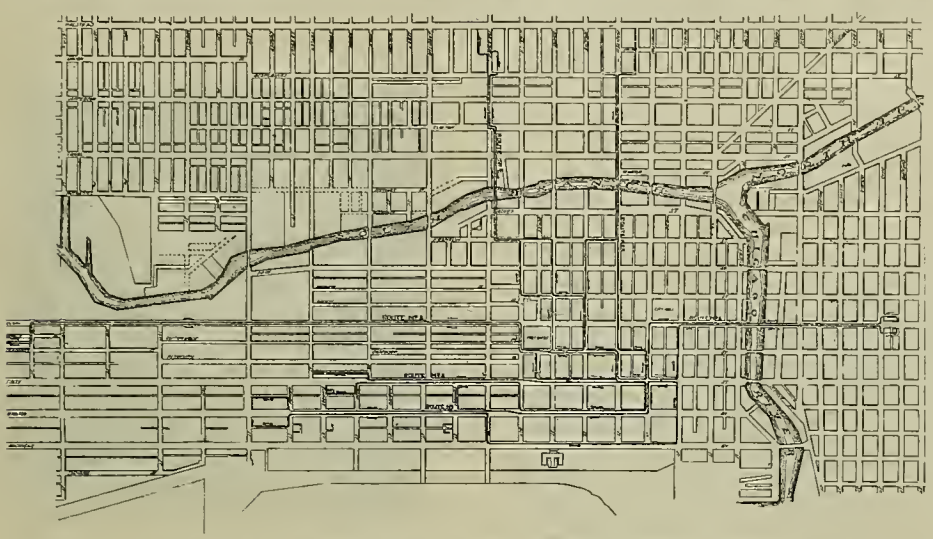


FIG. 1. PLAT OF CENTRAL BUSINESS PORTION OF CHICAGO SHOWING ROUTES OF PROPOSED SUBWAY.

Fig. 1 is a plat of Chicago lying between Chicago Avenue on the north, Eighteenth Street on the south, Halsted Street on the west and the lake on the east. It shows the six different routes of the proposed subway, the arrows pointing in the direction the street cars are to travel.

By the use of such a subway it will be possible for a passenger to pay his fare at any station and on entering the subway take any car he may desire, or a passenger riding from one part of the city on entering the subway can step from one car to a car going to any other part of the city without paying another fare or using a transfer.

The plan, as shown in Fig. 1, will do away with the grade crossings, as all cars would be going in one continuous direction, and in no case would two loops cross each other. This alone would cut down the possibility of an accident to the minimum, as the majority of street-car accidents now occur at the so-called grade crossings, or where two lines cross each other at right angles.

Under this plan additional transportation facilities may be provided for any particular section of the city the committee may desire. Any number of additional connections with the downtown section of the subway can be built for the actual cost of construction to meet the needs of the different divisions of the city. For instance, if the committee desires to provide more adequate facilities for the populous north and northwest sections of the city, a subway could be built under the river at Franklin Street and at Lake Street and connected with the main subway loops at Clark and Washington Streets and at Madison and La Salle Streets. The main loops in the downtown district may be regarded as the basic foundation for a comprehensive subway system which will meet the city's needs for all time by increasing the number of inlets and outlets to the different divisions of the city from time to time as the public necessity demands.

Fig. 2 is a typical cross-section of the Jackson subway for double-track purposes. Spaces (1) and (3) are reserved for the city's use and are each to be nine feet wide by 13 feet six inches high and are to contain the city's high-pressure and other waterpipes, storm-water drainage, fire and burglar-alarm and light service and all corporations' pipes, cables and underground work.

Spaces marked (2) are to be reserved for distributing all service pipes and electric wires into buildings and also to permit of the crossing of the city's and corporations' pipes and wires at right angles and at a street intersection.

The space for the street cars, including a 10-foot walk between tracks and running the whole length of the subway, will be 60 feet. The walk will enable passengers alighting from the cars to go underground to any station they desire and will also allow of the cars stopping at any desired points, thus reducing the possibility of congestion. On the stretch of single track on Wabash Avenue there will be a platform on each side of the track.

Spaces (5) are unobstructed spaces beneath the surface walks.

The estimated costs of construction for the six routes is as follows: Route No. 1, $2,776,197; route No. 2, $1,997,473; route No. 3, $4,071,453; route No. 4, $2,393,546; route No. 5, $2,476,807; route No. 6, $1,894,721. This gives a total of $15,610,197. To this is added the price of purchased property, $1,250,000; engineering and omnibus expenses, seven per cent. of the total, $1,092,713, and incidental expenses, labor, insurance, accidents and possible damages, four per cent., $624,407, giving a grand total of $18,577,317.

"In estimating the cost of the construction of the different cross-sections of the subways," says Mr. Jackson in the conclusion of this interesting report, "I have taken into consideration the construction of stations for the entrance and exit of passengers, stations to be placed not to exceed 450 feet apart, as well as the repaving of the streets and the construction of a practical underground conduit system for trolley purposes as shown on drawing No. 10 [Fig. 1], the placing of the different corporation pipes and cables which now occupy space in the streets in which subway would be constructed, as well as taking care of the city's present utilities and including the building of a new sub-soil and storm-water system and high-pressure waterpipe systems, all of which is covered in the above estimates. In conclusion I beg leave to say that in my judgment the construction of the 50,703 lineal feet of subway and all of the necessary appurtenances can, with the proper executive ability, be completed in 30 months' time without discommoding the general public to any great extent."

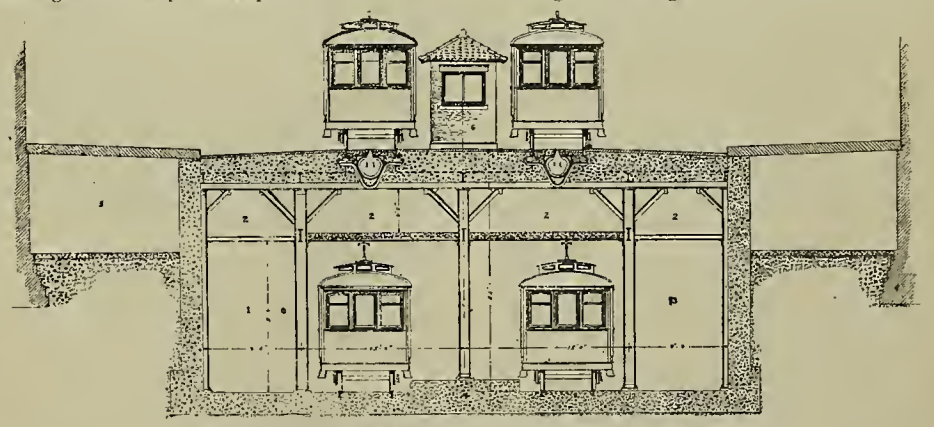


FIG. 2. TYPICAL CROSS-SECTION OF PROPOSED CHICAGO SUBWAY.

The National Electric Light Association has just issued a report on thawing water pipes by electricity. This report is compiled by Mr. George S. Haley of Rutland, Vt., and comprises data received from 75 different companies which have had experience in this direction.

Liquid-contact Voltage Regulator.

Some circuits in which the fluctuations in the voltage and current are very marked—such, for instance, as those used in car-axle lighting systems, street-car headlights, storage-battery charging circuits, depending upon central-station municipal sources of current and the like—require a voltage regulator of more than ordinary range and reliability. Numerous and ingenious contrivances have been invented for controlling or governing the presence and introduction of resistance in such circuits for the purpose of maintaining a constant current or electromotive force upon the supplied circuit. These devices are generally characterized by a row or series of resistance terminals or contacts and a collector, sweep, or contact finger or arm, which is automatically actuated by mechanical means under magnetic control. An invention designed to provide

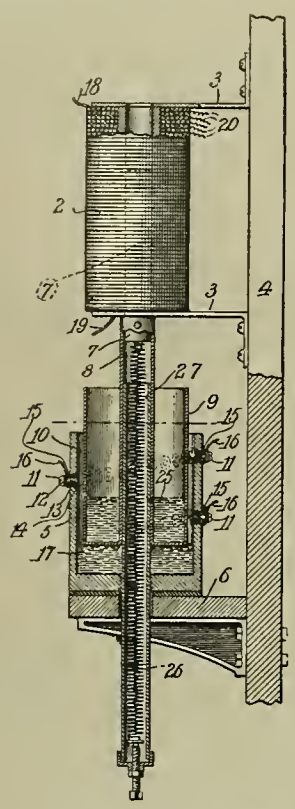


FIG. 1. LIQUID-CONTACT VOLTAGE REGULATOR.—VERTICAL SECTION.

an electric controlier or regulator that shall admit of the subdivision of the resistance to any extent desired or required by the service to be performed by the translating devices in circuit has been recently patented by Mr. Alexander McGary of LaGrange, Ill.

The chief difficulties encountered in the present controllers or regulators, according to Mr. McGary, arise from the employment of a rigid collector brush or sweep in combination with rigid resistance sections or contacts. These elements make it necessary, he says, to employ complex auto-driven mechanical elements that are short lived, the efficiency of which varies with surrounding conditions, which are comparatively slow in operation and which offer a varying frictional and mechanical opposition to quick, accurate movement in place of the uniform forces and conditions which the problem demands. Proceeding on this assumption the inventor determined upon the elimination of the usual rigid or solid metal sweep as well as all of the mechanical and auxiliary electrical and electromagnetic elements and members, and in place has adopted a liquid current collector for co-operation with the necessary resistance-coil terminals or contacts with a simple electromagnetic device for actuating and controlling the movement of the "liquid current collector."

The invention, broadly considered, consists of a liquid container or receptacle having, preferably in its walls, the requisite number of resistance terminals or contacts, suitably insulated and arranged at different points or elevations. A fluid, liquid, or plastic substance, preferably mercury, in the receptacle, co-operates with a liquid-displacing device that is electromagnetically operated or controlled and which by its movement causes the liquid to rise or fall into contact with higher or lower terminals, as the case may be, the liquid being included in the electric circuit and having a suitable terminal in either container.

Fig. 1 is a vertical section of an automatic electric regulator embodying the invention. As shown in the diagram, (2) represents a solenoid, supported by brackets. The measuring-pot or liquid-container (5) is supported upon but insulated from the bracket (6). The pot is preferably arranged beneath the solenoid and contains a central guide or standard (27).

The solenoid core (7) has on its lower end a tubular extension (8) to slide upon the standard (27). The extension carries the displacing device or plunger (9), which is preferably a hollow cup of less diameter than the pot or container, a narrow annular space (10) being left between the plunger and the inner walls of the pot.

The resistance terminals are designated by (11) and are placed close together in an inclined or spiral row, stepping upward from the bottom of the pot to the top. The pot-walls thus accommodate a large number of resistance-coil terminals within a small space measured vertically, and it is obvious that this construction permits the use of as many terminals as may be required for nice regulation by the fine subdivision of the resistance. The difference between the elevations of adjacent terminals or contacts may be as slight or as great as differing conditions require, yet with entire freedom from the usual difficulties pertaining to contact areas and insulation.

The pot is partially filled with a liquid, preferably mercury, which is a good conductor, and when the plunger falls or is depressed it displaces the mercury and drives it upward between the plunger and the walls of the pot or container, forcing the mercury into contact with the exposed or contact ends of the resistance terminals. When the plunger is raised the column of mercury falls and is thus withdrawn from contact with one or all of the terminals, according to the height to which the plunger is lifted.

It will be noted in Fig. 2 that the greatest displacement of the mercury in the pot occurs at the time when there is the least resistance in circuit and that the solenoid has less weight to raise at the beginning of the stroke of the core than after it is partially elevated. The force of the solenoid, however, increases as the core enters it and its increased effectiveness is usually sufficient to compensate for the increased weight of the plunger when lifted. However, it may be preferable to increase arbitrarily the strength of the solenoid as the plunger is lifted

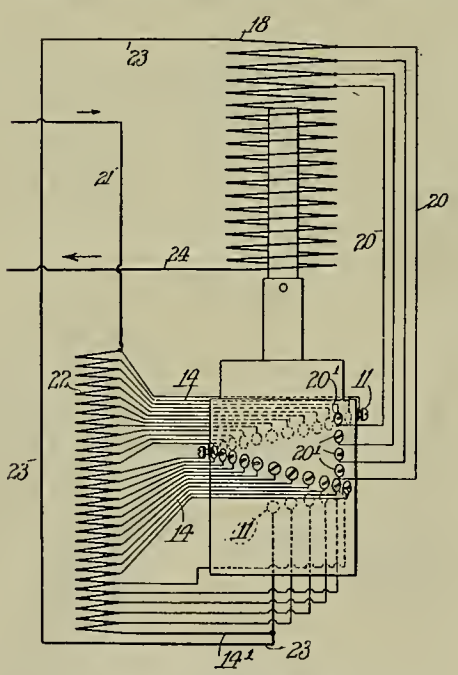


FIG. 2. LIQUID-CONTACT VOLTAGE REGULATOR.—DIAGRAM OF CONNECTIONS.

and to this end auxiliary solenoid windings (2') are employed, formed by tapping the coils of the solenoid at different heights. The taps (20) lead to auxiliary terminals (20'), provided in the wall of the pot and at different elevations. The lowest tap (20) leads to the uppermost terminal (20') and the upper tap leads to the lower terminal (20'). The result of these connections is that when the mercury is elevated in the pot the upper coils of the solenoid will be practically short-circuited or weakened by being thrown into multiple arrangement, while upon the elevation of the plunger and when the solenoid needs assistance the terminals (20'), one or all, will be bared by the fall of the mercury, thereby restoring the corresponding coils to active series circuit in the solenoid to further compensate for the increased weight that must be lifted and sustained by the solenoid.

The Latest form of "Handbook" Telephone.

Ever since the enforcement of the law against the operations of race-track bookmakers in Chicago the police department has been obliged to keep constantly on the alert to circumvent the numerous and ingenious schemes which have been devised for obtaining race-track news to be used for gambling purposes. The telephone has been used repeatedly for this purpose, but owing to the strict surveillance of the police department with the co-operation of the Chicago Telephone Company the gamblers are finding it harder and harder to conceal the telephone connections at the gambling resorts.

Perhaps the latest piece of apparatus for this purpose is the one shown in the accompanying picture, which was discovered recently in a West Madison

THE LATEST FORM OF "HANDBOOK" TELEPHONE.

Street resort by Assistant Police Chief Schuettler's gambling detail. The outfit consists of an ordinary suit case, in which are contained two complete subscribers' telephone sets with three or four cells of dry battery neatly strapped in one corner, the whole just filling the case when packed in a certain position. The two instruments are in multiple and terminate in a short flexible cord conductor carrying a plug. On the under side of a table in the gambling place were sockets or jacks to fit the plugs, and the sockets were in turn connected by concealed tap wires to a line of the telephone system.

The operator of this curious telephone set would stroll into the place and when the way was clear would place the suit case on the table, throwing it open with the instruments ready at hand. A moment sufficed to insert the plug, when the two telephones were ready for business. At the moment an alarm was given, however, the plug would be jerked from its socket, the instruments replaced and all that remained was a very innocent-looking and somewhat dilapidated suit case. The picture is reproduced herewith by the courtesy of the Chicago Daily News.

Central-station Accident in Chicago.

An accident to the Chicago Edison Company's system which, but for the prompt and efficient methods pursued by the company, might have led to serious trouble in the downtown district, occurred on the afternoon of December 12th between 4:30 and 5:15 p. m. At about half past four the lights in the downtown district, which are fed from the network by the Harrison Street station, began to grow dim, and in some parts, especially along State Street, where the load is the most concentrated, almost died out, causing some alarm among the many shoppers who were in the stores at that hour. The trouble did not last long, however, and by 5:30 p. m. the lights were all burning as brightly as usual.

Mr. Louis A. Ferguson, second vice-president of the Chicago Edison Company, made the following statement in relation to the matter:

"The trouble was at the Harrison Street station and was caused by the breaking of the main feed-water line, which interrupted the supply of water to the boilers and at the same time filled the entire power house with escaping steam, rendering it impossible to get near enough to the seat of the trouble to immediately ascertain its exact nature. This trouble, coming as it did, just as the load was increasing to the evening maximum, and the necessity of banking the fires and cooling off the furnaces made it impossible after the break was repaired to raise the steam again quickly enough for this power house to hold its share of the heavy supply which is required throughout the city in the late afternoon in winter. Fortunately no one was injured by the

escaping steam and hot water. The only sections of the city affected by this trouble were those that were supplied from the Harrison Street power house. There was no trouble at the Fisk Street steam-turbine power house."

As fast as possible after the break occurred the load was transferred to the steam-turbine plant of the Fisk Street station, which, although well loaded before, carried the additional load thrown upon it as fast as it could be transferred.

The storage batteries, of which there are 15 connected to the network, rose to the occasion and by their combined output made matters very much less serious than they would have been. They kept the lamps in certain localities near the batteries lighted during the whole time, though the enormous loads at parts farther away caused such a drop that the batteries were not able to keep all the lamps burning.

The Next Convention of the National Electric Light Association.

By John Craig Hammond.

Business men, railroad men and central-station men of the entire West have joined hands to welcome and entertain the delegates to the convention of the National Electric Light Association, which will be held in Denver next June some time in the first full week.

Last month the electrical men met in the offices of the Denver Gas and Electric Company to discuss with Ernest H. Davis of Williamsport, Pa., president of the national association, the subject of holding the meeting in a western city. Denver and Colorado Springs were most prominent in the competition for the convention. Officers of the Colorado Springs Chamber of Commerce and central-station men from that city announced that $5,000 had been pledged for the entertainment of the convention if their city was chosen as the place of meeting. That put the Denver men on their mettle and they said that more than this sum could be obtained from the commercial bodies and business men of their city. A hot contest was in sight, because those in the meeting took sides with one or the other of the competing cities. Then came a compromise.

It was agreed that Denver should have the convention—the business sessions—and that Colorado Springs should have the whole convention for two or three days to entertain the delegates and show them the city, show them its prospects. Then other cities were heard from through the men who wish to see them progress. Many of these will entertain small parties of delegates. Mr. Davis was pleased. He returned to the East. Then he wrote to Henry L. Doherty, president of the Denver company, asking him to act as the representative of the association in the West, to take charge of the arrangements. Mr. Doherty invited the business men, the railroad men and the central-station men to meet with him. They assembled in Denver on November 28th, more than a hundred of them. Those who could not come, wrote, pledging their support.

The business men told those assembled that they were ready to give generous support. Commercial organizations of Denver and other cities in Colorado pledged their support. The railroad men said that low rates could be considered as granted, though still lower tariffs might be obtained from the rate-making board later. They said that one fare from Chicago, St. Louis and points in their territory was a certainty, with a fare and one-third from points farther east to these cities. The hotel men said that charges would not be increased and that special efforts would be made to care for the delegates and visitors.

One of those present suggested that the attendance might be reduced because of the distance of Denver. His statement was met very promptly with the answer that the natural growth of the association would be the first offset to a decrease from the attendance at Boston, where the last convention was held. Then the point was brought out that there is something new to offer the delegates in the West—new kinds of plants; that is, new to most of the members of the association; new ways of using electricity peculiar to the country, and opportunities for new plants. The desire of everyone to see a portion of the country not before visited was set forth as another strong factor.

Then Mr. Doherty informed the meeting that he knew that the members of the association would be entertained better than they had ever been; that he had received assurances of co-operation that made this certain, and finished by saying that not less than $7 would be spent on every person in attendance in Denver alone. As the final action of this general entertainment committee Mr. Doherty and two others were empowered to nominate the active committees and to arrange for further meetings of the general body and the smaller groups of men.

Following is the membership of the general committee:

Orson Adams, Grand Junction Electric and Gas Company, Grand Junction, Colo.; William Mayher, Greeley Power and Light Company, Greeley, Colo.; W. E. Renshaw, Seaton Mountain Electric Light, Heat and Power Company, Idaho Springs, Colo.; F. C. Webber, Leadville Gas and Electric Company, Leadville, Colo.; P. N. Nunn, Telluride Power Company, Telluride, Colo.; R. S. Campbell, Utah Light and Railway Company, Salt Lake City, Utah; John Martin, California Gas and Electric Company, San Francisco; A. Pollock, San Francisco Gas and Electric Company; F. E. Warren, Cheyenne Fuel and Power Company, Cheyenne, Wyo.; C. F. Brown, Roaring Fork Electric Light and Power Company, Aspen Colo.; William T. Wallace, Colorado Electric Power Company, Canon City, Colo.; Herman Webber, La Bella Electric Company, Cripple Creek, Colo.; C. H. Peters, Durango Light and Power Company, Durango, Colo.; George B. Tripp, Colorado Springs Electric Company, Colorado Springs, Colo.; Charles Neely, Fremont Electric Light Company, Florence, Colo.; M. T. Morrill, electric light company, Golden, Colo.; F. P. Dewey, electric light company, Georgetown, Colo.; Gen. Fred. Walsen, electric light company, Idaho Springs, Colo.; H. R. Wray, Chamber of Commerce, Colorado Springs, Colo.; J. F. Vaile, electric light company, Pueblo, Colo.; E. J. Temple, electric light company, Boulder, Colo.; D. O. Freyberger, electric light company, Loveland, Colo.; John Doss, electric light company, Ouray, Colo.; C. Y. Breck, Telluride Electric Light and Power Company, Telluride, Colo.; Nelson Rhoades, Arapahoe Electric Light and Power Company, Littleton, Colo.; W. F. Jones, Gold Belt Consolidated Electric Company, Victor, Colo.; J. B. Wiggenhorn, Florence and Cripple Creek Railroad Company, Cripple Creek, Colo.; G. E. Sethman, Meeker Light, Heat and Power Company; C. W. Badgley, Crested Butte Light and Water Company.

Gen. Irving Hale, General Electric Company; O. B. Kohl, Lacombe Electric Company; John Brannan, Lacombe Electric Company; J. H. Waters, La Bella Electric Company; S. W. Cantrill, Denver Tramway Company; J. A. Beeler, Denver Tramway Company; T. B. Stearns, Stearns-Rogers Manufacturing Company; Maj. S. K. Hooper, Denver and Rio Grande Railway; J. F. Vallery, Burlington Route; W. E. Bridgman, H. J. Mayham Investment Company; E. R. Griffin, Union Pacific Railroad; C. L. Wellington, Colorado and Southern Railroad; D. H. Hoops, Chicago and Northwestern Railroad; G. W. Vallery, Colorado Midland Railway; H. B. Kooser, Missouri Pacific Railway; W. J. Jones, Denver, Northwestern and Pacific Railway; Charles B. Sloat, Rock Island Railway; J. P. Hall, Santa Fe Railroad; D. C. MacWatters, Cripple Creek Short Line; Fred H. Bostwick, Hendrie & Boltboff; J. C. Poole, Stanley Electric Company; H. L. Woolfenden, Gilbert Wilkes & Co.; R. D. Marthens, Nernst Lamp Co.; Mayor R. W. Speer, E. S. Kassler, Montrose Electric Light and Power Company; J. J. Cooper and J. W. Stearns, Mountain Electric Company; Edward C. Means, Adams-Bagnall Electric Company; Edward Pool, American Steel and Wire Company; J. D. Jackson, Western Electric Company; W. P. Carstarphen, Carstarphen Electric Company; H. W. Lawrence, New England Electric Company; P. J. Brown, General Electric Company; R. E. Miller, Crocker-Wheeler Company; Charles S. Onderdonk, Onderdonk Manufacturing Company; R. B. Sullivan, Frank W. Frueauff, Henry L. Doherty, C. W. Humphrey, W. J. Barker, E. T. Sayer, C. N. Stannard, Rufe Gentry, John Craig Hammond, J. Charles Andrews, Denver Gas and Electric Company; William Maher, Albany Hotel; A. R. Hall, Capital Lamp Company; C. H. Speers, Colorado Midland Railroad; J. F. Callbreath, J. S. Temple and Arthur Williams, Chamber of Commerce; J. J. Hernan and N. M. Tahor, Hotel Men's Association; Armour C. Anderson and John McNamara, Real Estate Exchange; J. J. Joslin, George Gano, Merchants' Protective Association; W. S. Iliff, C. K. Durbin, G. W. Cook, James Williams, Thomas Smith, J. J. Henry, B. K. Sweney, all of Denver.

Following are the committees as announced by the three men chosen to select members:

Executive—Henry L. Doherty, chairman; F. W. Frueauff, vice-chairman; G. B. Tripp, H. R. Wray, J. A. Beeler, T. B. Stearns, J. F. Callbreath, Armour C. Anderson, Gen. Fred Walsen.

Transportation—George W. Cook, chairman; J. S. Temple, Major S. K. Hooper, J. F. Vallery, E. R. Griffin, H. R. Wray, C. L. Wellington, George F. Porter.

Finance—George W. Gano, chairman; George B. Tripp, vice-chairman; Gen. Irving Hale, J. W. Stearns, C. K. Durbin, J. A. Beeler, J. J. Hernan, J. F. Callbreath, Armour C. Anderson, Gen. Fred Walsen, John Craig Hammond, G. W. Cook, J. H. Waters.

Entertainment—Philip Cross, chairman; F. W. Frueauff, W. E. Bridgman, T. B. Stearns, G. W. Vallery, G. B. Tripp, H. R. Wray, R. W. Speer, Gen. Fred Walsen.

Hotels—W. J. Barker, chairman; J. J. Hernan, J. J. Cooper, J. F. Vaile, S. W. Cantrill, H. L. Woolfenden, Philip Cross.

Advertising—John Craig Hammond, chairman; John McNamara, T. E. Fisher, S. K. Hooper, J. F. Vallery, N. M. Tabor, D. H. Hoops, J. J. Joslin, D. C. MacWaters, Charles B. Sloat.

Colorado Springs—George B. Tripp and H. R. Wray.

J. Charles Andrews is secretary of all committees. His address is care the Denver Gas and Electric Company, 405 Seventeenth Street, Denver.

GROUP OF MEMBERS OF GENERAL COMMITTEE IN CHARGE OF ENTERTAINMENT OF NATIONAL ELECTRIC LIGHT ASSOCIATION.

San Francisco Street-railway Service to be Operated by Current from Long-distance Transmission.

It has been decided by the officials of the United Railroads of San Francisco to do away with the local generating plants and utilize the power of the California Gas and Electric Corporation for the operation of all its various electric lines. According to the contract just signed by the United Railroads and the power company, the latter will furnish and deliver to the railroad sub-stations sufficient power for all of its purposes, thus permitting the shutting down of the present generating plants. The new arrangement will be in force January 1, 1906. The power will be generated at the various power stations of the California Gas and Electric Corporation in the Sierras and brought to San Francisco over long-distance transmission lines.

The power needed for the operation of the lines lying north of Market Street and between the bay and the ocean, including the park and ocean line south of Golden Gate Park, will be delivered to and distributed from the sub-station at Turk and Fillmore Streets. The current necessary to operate the north end of the San Mateo line, the Ingleside line and part of the Mission Street line will be delivered at the Geneva Avenue sub-station. The power for the operation of the southern end of the San Mateo line will be distributed from the Millbrae sub-station. The present large direct-current generator station at Bryant and Alameda streets will be converted into a sub-station to care for the territory now supplied by it. It has not been decided yet what disposition will be made of the rest of the local power houses.

To prevent any interruption in the service through damage to the long transmission lines, the California Gas and Electric Corporation will establish a gas-engine plant capable of generating the required current on short notice. The California Gas and Electric Corporation now owns seven waterpower stations in various parts of the Sierra Mountains. Electra station in Amador County has a capacity of 20,000 kilowatts. The De Sabla in Butte County is capable of developing 14,000 kilowatts, and Colgate in Yuba County develops 9,420 kilowatts. Four other stations have a combined capacity of 7,400 kilowatts.

G. P. M.

WESTERN ELECTRICIAN

EVERY SATURDAY.

PUBLICATION OFFICES:
510 Marquette Building, · CHICAGO.
TELEPHONE, MAIN 1746.

Eastern Office, 193 Times Building, New York.
Telephone, 3806J Cortlandt.

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted. This paper is entered at the Chicago postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the **old address** as well as the new should be given.

CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—**the only general electrical paper published in the West**—thoroughly covers a territory *exclusively its own.* THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be furnished on application.

REMITTANCES.—All checks, drafts and other remittances should be made payable to the order of the publishers, the **Electrician Publishing Company,** and addressed to the offices of publication, Suite 510, Marquette Building (204 Dearborn Street), Chicago, Illinois, U. S. A.

CONTENTS OF THIS NUMBER.

Electrically Operated Bridge Over North Branch of Chicago River. Illustrated 477, 478
Bombay Electric-light Plant 477
American Society of Mechanical Engineers. (Half-yearly meeting in New York, December 6-10, 1904) 478, 479
Proposed Subway System for Chicago. Illustrated 479
Liquid-contact Voltage Regulator. Illustrated 480
The Latest Form of "Handbook" Telephone. Illustrated 480
Central-station Accident in Chicago 480, 481
The Next Convention of the National Electric Light Association. By John Craig Hammond. Illustrated 481
San Francisco Street-railway Service to Be Operated by Current from Long-distance Transmission 481
Editorial 482
Interstate Independent Telephone Association. (Convention in Chicago, December 13-15, 1904) 483, 484, 485
Convention Notes 485
Telephone News from the Northwest 485
Ohio Telephone Notes 485
Indiana Telephone Items 485
Southeastern Telephone Development 485
General Telephone News 485
Physics and Electricity. By Prof. William Hallock. (New York Electrical Society) 486
New York to Boston in Electric Cars. With map 486
Meeting of Illinois Electrical Contractors 486
Record of Private Ownership in Philadelphia Gas Plant. 486
Electrical Committee of Underwriters' National Electric Association 486
Polyphase Transmission with Single-phase Operation for Railway Purposes. Illustrated 487
Electrification Estimate in Chicago 487
Electric Express Delivery in Washington, D. C. Illustrated 487
Westinghouse Oil Circuit-breakers. Illustrated 488
Electricity for Transcontinental Steam Railroads 488
Distinguished Ladies Inspect Electrical Novelties 488
Western Union Defeated in Pennsylvania Railroad Case 488
Steam Turbines for New Baltimore Power Plant 488
Japs' Methods of Destroying Electrically Charged Entanglements 488
Nobel Prizes Awarded 488
Electricity in an Ohio Coal Mine 489
Another Substitute for Rubber 489
The Sargent Complete-expansion Gas Engine. Illustrated 489
Fargo Rejoices Over Its Street Railway 489
Some Refinements of Mechanical Science. By Ambrose Swasey. (Presidential address to American Society of Mechanical Engineers) 490, 491
Michigan Electrical Machinery to Be Tabulated 491
Importer May File Corrected Invoice 491
Waterpower Possibilities in Texas 491
Mineral Products of the United States 491
Recent Advances in Applied Electrochemistry. By Dr. K. Elbs 492

DEPARTMENTS.

Correspondence 493, 494, 495
Great Britain 493
New York 493
New England 493
Dominion of Canada 493, 494
Southeastern States 494
Ohio 494
Indiana 494
Michigan 494
Northwestern States 494, 495
Rocky Mountain States 495
Pacific Slope 495
Personal 495
Electric Lighting 495
Electric Railways 495, 496
Societies and Schools 496
Publications 496
Telegraph 496
Space Telegraphy 496
Miscellaneous 496
Trade News 496
Business 496, 497
Illustrated Electrical Patent Record 497, 498

DATES AHEAD.

Northwestern Electrical Association (annual convention), Hotel Pfister, Milwaukee, Wis., January 18 and 19, 1905.

Ohio Independent Telephone Association, Columbus, Ohio, March, 1905.

National Electric Light Association (annual convention), Denver, June 6th, 7th and 8th, and Colorado Springs, June 9th, 10th and 11th.

THE NEXT telephone convention is likely to be held by the two Independent associations, the Interstate and the National, united. At the convention of the Interstate association in Chicago this week a committee was appointed to confer with a similar one from the National association, with full power to act, to make arrangements for the consolidation of the two associations. Such arrangements having been perfected, it is understood that the joint committee is to name the time and place of the next convention and that it be a joint meeting of the two bodies. Another important feature of the convention just closed was the action taken toward gaining an entrance for the Independent long-distance telephone systems into Chicago, to connect with the automatic system now in operation in the city. This is an important matter to all Independent operators, and its accomplishment, which seems probable, will mark an epoch in the evolution of long-distance Independent telephony. The convention just closed was a success, although a controversy between many of the Independent manufacturers and one or two of the officers of the association made the exhibits of apparatus few in number. The attendance was good, probably 250 representatives of operating companies being present. The members were manifestly eager for information concerning the proper methods of managing, constructing and operating exchanges, and this may suggest to those having charge of future conventions the wisdom of a good number of technical papers. A strong list of officers was chosen to lead the association in the carrying out of the consolidation proceedings, a move which Mr. Barnhart and Mr. Coleman, the retiring president and secretary, have worked hard to accomplish.

IF THE daily newspapers are well informed—and sometimes they are—there is now more substance than ever before to the hope that the University of Chicago will establish a school of engineering. The prospect is still rather hazy, but somebody seems to have told somebody else that it was a pretty shrewd guess that Mr. Rockefeller had given Dr. Harper a matter of two or three million dollars—charmingly indefinite, this anticipatory talk of large money donations!—to establish such a school. So the hope is still but a hope, although projects such as this often have a mysterious way of becoming imperfectly known in advance of official announcement. It is to be hoped that this is the fact in this case.

Chicago, with its large population and populous contiguous territory, should easily sustain another engineering school of the first class. In the past there has been talk of the affiliation of the strong and useful Armour Institute of Technology with the university as its engineering school, but speculation of this character has not been rife of late. At any rate, two schools would be better than one. In the matter of education, technical and otherwise, one must not regard institutions engaged in the same line of work as competitive in the sense that grocery stores on adjacent street corners are competitive. The emulation should be on the high basis of mighty striving for the diffusion of knowledge, that the community, the nation, and finally the world may be benefited. In a country like ours and in the present age, manual and technical training is of the greatest importance in all grades from the kindergarten to the university. No great university in America can be an educational center of the first rank, well rounded, without an engineering school. Engineering is the art of doing things on scientific principles. Americans pride themselves on their practical facility for doing things. They are demanding the best scientific training to supplement their native ability. Recognizing this situation, as it must, the University of Chicago cannot much longer defer the establishment of its engineering department.

ELECTROCHEMISTRY is not only one of the most interesting of the fields of industrial endeavor into which electricity enters, but it is also one of the most important. Sir Joseph Swan, regarded in England as one of the "grand old men" of the electrical profession, illustrated this when he was asked not long ago by an interviewer for the official organ of the Faraday Society of London what he considered to be the most important and valuable of the applications of electrochemistry. Very naturally Sir Joseph answered that the largest of such applications is undoubtedly copper refining. Which is the most important it is difficult to say; many processes are competing for the honor of that distinction Among the numerous applications of electrochemistry to metallurgy, perhaps the most important after copper refining is that which has brought within easy reach of the public what 50 years ago was in the popular sense a new and rare metal—aluminum. Few realize how the aluminum industry has grown or the point it has reached at the present time, when there is electrically produced and used for an immense variety of purposes between 10 and 20 tons of aluminum every day. Fifty years ago aluminum was equal in cost to silver. It now competes in point of economy with copper. "You alluded to the application of electricity to the alkali and chlorine manufacture," added Dr. Swan. "These are very important branches of the electrochemical industry, and no doubt susceptible of development, but it must be remembered that that is restricted by a limited demand. In close relationship to this is the largely extended manufacture of sodium, due to the employment of the electrolytic method. Then we must not forget the manufacture of calcium carbide."

Thus a cursory survey of the spread of electrochemical processes shows the great value of these methods, which are, while comparatively new, yet quite old in principle, for the origin of electrochemistry is traced to Volta. Especially where power is cheap and plentiful, as in the vicinity of waterpowers, do these processes flourish, and it cannot be doubted that the development of electrochemistry is destined to show still greater triumphs.

AS TRANSMISSION lines become longer and voltages higher the question naturally arises, What is the maximum distance to which power may be transmitted on a commercial basis? Primarily, of course, there are two factors which in the broadest sense will determine this question. These are the cost of power at the generating station and the price that can be obtained at point of delivery. The difference between these two elements must cover the cost of transmission, the interest on investment and the profit. In a general way it appears that the annual cost per kilowatt for transmitting power may be continually reduced by increasing the amount of power transmitted, in all directions except the cost per kilowatt due to line conductors, which cannot be reduced. The limiting distance, therefore, will depend, finally, upon the cost of line conductors and upon that alone. In a paper prepared for the next meeting of the American Institute of Electrical Engineers, Mr. Ralph D. Mershon, an engineer particularly well qualified to discuss the subject, has brought out this fact plainly and then, after making a number of assumptions which seem to be fairly taken, he has arrived at a series of general equations expressing the relations between the distance of transmission and the quantities which govern it. By inserting in these equations various coefficients as to the purchase price and selling price a series of curves has been drawn, and from these some interesting conclusions may be derived.

The maximum amount of power dealt with in the paper is 500,000 kilowatts, probably too high to be seriously dealt with at the present time. However, 200,000 to 300,000 kilowatts is within the range of immediate possibility, and it would probably require a net revenue of 12 per cent., not alone for dividends, but also as a protection to bonds. Under these conditions the limiting distance may be taken at 550 miles. It also appears that the voltage will be fixed, not by atmospheric losses, but by economic conditions. The author has gone about his work in a very capable and thorough manner, and the various factors which are used in deducing the equations which he has arrived at as the basis of his conclusions seem to have taken into consideration every element which can effect the final results. The paper is valuable in itself and should bring out a good discussion.

INTERSTATE INDEPENDENT TELEPHONE ASSOCIATION.

The fourth annual convention of the Interstate Independent Telephone Association of America was called to order in the banquet hall of the Auditorium Hotel, Chicago, on December 13th at 2:30 p. m., with President Henry A. Barnhart of Rochester, Ind., in the chair. The attendance was the largest of any opening session of any previous meeting of the association, and there were many new faces, as well as more familiar ones, indicating a lively interest in the proceedings to follow. There was a notable absence of exhibits at the convention, only a few of the manufacturers and supply men making a display of apparatus.

Before taking up the regular programme which had been prepared, President Barnhart asked if anyone had anything of a preliminary nature which should be taken up. E. M. Coleman of Louisville, Ky., secretary of the association, responded with a suggestion that the chairman appoint three members to serve as a credentials committee and to assist the secretary, in accordance with a resolution passed at the last convention of the association, which provides that admission to the sessions of the association be by properly approved credentials. This committee, as appointed, consisted of Walter Matthews of Maysville, Ky., P. C. Holdoegle of Rockwell City, Iowa, and William J. Fee of Milford, Ohio. Mr. Holdoegle moved that, for obvious reasons, the word "executive" be inserted before the word "sessions" in that part of the resolution passed at the last convention relating to credentials, and which reads as follows: "Resolved, That at future conventions no one be admitted to the sessions of the association except upon presentation to a regularly appointed doorkeeper of a certificate bearing the indorsement of the company or firm he represents and further indorsed by the secretary of the association." The motion prevailed.

President Barnhart then delivered the annual address of the president. He spoke clearly and with a dignity befitting the office he holds.

President Barnhart's Address (Abstract).

In an address before our convention of one year ago the importance of our having connection with Chicago and Chicago with our multiplied thousands of enterprising telephone subscribers was urged, applauded by the convention and approved by the press and people of the city. But the conditions of isolation stand precisely the same today and the imperativeness of this mutual need is more pressing than ever before. We have St. Louis, Minneapolis, St. Paul, Cincinnati, Louisville, Indianapolis, Cleveland, Toledo and Detroit. Why can't we have Chicago connections and thereby bridge the last chasm in the Central West which bars perfection in convenience and efficiency in long-distance telephone service?

The fixed programme for the daily sessions of this convention is before you and in its pages you will observe that topics vital to our business welfare and to the welfare of the telephone-using public are listed and assigned to men of broad intelligence and practical experience for presentation and to you, sirs, for effective consideration. Some of these have to do with the theory and practice of successful telephone endeavor; some invite consideration of the law and the liberty of our vocation; some suggest the duty of operator to public and public to operator; some will point out the needs of broader and better facilities for handling our business at home and abroad; and most important of all, some raise the danger signal against marching, heedlessly, into future embarrassment and ultimate trouble by trusting manufacturers who would betray us to the enemy for a mess of pottage.

A great railroad system in this country once asked the public for a suggestion of a forceful warning to travelers who crossed the right-of-way in jeopardy of passing trains. Many answers were received, but on one the management unanimously agreed. It was, "Stop; look; listen." Have you thought of such precaution in the heavy and constant investments you are making in the Independent telephone field? If you have not and are traveling heedlessly toward the Bell Telephone Company's audacious and selfish right-of-way, I beseech you to "stop, look and listen." The very life of our existence in a most commendable and promising enterprise may depend upon our discretion in the matter of guarding well against the machinations and deceptive intrigues of a business competitor that has shown us no consideration other than intimidation and arrogant and destructive competition.

We may survive as Independents by buying Bell-made apparatus and by subscribing and paying for Independent telephone periodicals which publish page after page of Bell advertisements and covertly put Bell arguments; but that we are constantly strengthening the enemy by doing so must be so plain that a wayfaring man, though a fool, would readily distinguish the folly and the danger of doing so. It is said that he that seeth and believeth not shall be damned (or words to that effect), and he ought to be (figuratively speaking) if he is an Independent operator who depends on Independent connections, Independent support and Independent protection and then gives his patronage and the destiny of his business to the Bell company.

Gentlemen, we are here for business, and we have tried to arrange our programme so you will not only have full opportunity to participate in the deliberations and conclusions of the convention, but you may, here in comfort, have ample time to examine apparatus and supplies, make new acquaintances, renew old ones and profit not only by what you hear but what you see.

Following the applause which greeted the president's address, E. M. Coleman read his report as secretary of the organization.

Secretary Coleman's Report (Abstract).

It is only necessary to repeat briefly the salient points mentioned or discussed in the official report of 1903, namely: the three distinct lines of attack instituted and deeply laid plans to be carried out by the Bell Telephone Company in its attempt to break down all competition, and thus again give the octopus full sway in its unwarranted oppression of the public, to wit:

1. By securing control of Independent telephone-operating companies, or the one which serves as the center of a cluster of operating companies, thereby destroying the efficiency of the whole cluster.

2. The attempt to enter and control the long-distance business of this country, thus placing the operating companies and the public at their mercy.

3. And last, but not least, the deepest-laid plot of them all—the one which would be easiest to carry into effect and which would cost the Bell company far less money in the aggregate than either of the two schemes mentioned above—and that is to secure the controlling influence, or power to dominate or manipulate, the Independent manufacturing interests in this country.

The advisability or wisdom of trying to conceal, or hide, or cover up, the conditions that exist and the events that have transpired that affect your personal interest as well as your organized interest since your last annual convention is not apparent to those who have been in touch with what has transpired.

The first law of nature, as well as the highest law of man, is self-preservation and self-protection, and there can be no legitimate reason why official lips should be closed and silence be the watchword when the facts are so apparent and the effects so potent relative to your own business interests, and especially when your competitor knows all too well.

Again, official position, responsibilities and obligation demand that you should know the exact status of affairs calculated to affect your own business, and official duty is not performed when facts are withheld that do affect your business, especially if the tendency is to do hurt.

It is presumed that no man connected with this organization, either in the capacity of a representative, delegate or official, has any inclination, much less is it the choice of anyone to enter into any contention, struggle, fight or warfare against the interests of anyone else in any line of activity connected with the Independent movement, yet it is due you to know and it becomes my obligation to tell you that certain manufacturing concerns in this country undertook more than a year ago to devise ways and means by which this organization should be demoralized or its effectiveness as an organization should be destroyed.

Your last convention demonstrated that their attempt at the meeting of 1903 was a failure, but in due time the same or similar schemes looking to the same end were again instituted on a broader scale to the extent that those who seemed so specifically interested in an attempt to destroy your organization branched out in due time in the inauguration of a regular, systematic boycott; therefore opened up correspondence with the various manufacturing concerns and supply houses in this country, using their personal influence in an effort to prevent those concerns located outside of Chicago from making exhibits at this convention, their plan being that if they could keep the manufacturers and supply houses from making exhibits at this convention they would so cripple the convention financially that ultimate annihilation and disintegration would be the result, and hence their designs accomplished.

Isn't it a strange picture, isn't it a paradoxical proposition for you to undertake to comprehend, how it is and why it is that certain manufacturing interests should undertake to demoralize and destroy your organization in the United States? The organization of the very people from whom they get all their revenues, to whom they must sell all their products, and from whom they have realized their vast profits?

These brief statements and suggestions are made simply that you may be brought to a point to stop, and think, and to appreciate properly the attitude in which you are placed, and duly contemplate what the future may possibly have in store for you and your business and your investments.

So determined have certain parties been in their deeply laid plans to thwart the purposes of your organization that secret conferences and meetings have repeatedly been held, devising ways and means by which this organization could be killed.

Let this report speak plainly and boldly, because your money is at stake and the obligation of an official is to point out to you just the conditions that exist right now in your own channels of business.

It is a lamentable condition if the time has come when the official of an organization of this character cannot perform his functions as such and cannot carry out your instructions as an organization without being condemned and criticised and persecuted because he undertakes the performance of the duties and powers delegated to him by you when in annual convention assembled.

But, to more pleasing matters to be considered. The growth of the Independent movement in this country is already phenomenal. Today the Independent people of this country have over 3,000,000 telephones in service, while the Bell people only claim 1,270,000. Your toll-line systems are being rapidly built and extended all over this country until soon a complete network will bless every town and city with connection with the outside world.

In round numbers 140,000 pieces of literature have been mailed out from the secretary's headquarters during the convention year 1904.

The pressing demands upon the official secretary have been so great until the plan of reorganization mapped out by your special committee during the year becomes absolutely essential for the proper conduct of your organized business.

And the financial burden of taking care of the expenses from one convention to another becomes rather heavy.

You will admit the necessity of a reorganized plan when you are made aware of the fact that it costs your secretary out of his own pocket from $800 to $1,500 per year to defray the necessary expenses of your association. This burden, under the old plan of organization rested upon him, and upon his efforts principally in making the next succeeding convention a success, could any assurance be based for the replenishing of his depleted private exchequer.

Traffic arrangements of great importance between a number of strong, Independent long-distance companies have been entered into and such steps inaugurated as will prove of great benefit to the Independent movement in this country.

Some of your officials and committeemen have devoted much of their time during the past 12 months in an effort to execute your will, and in traveling over the various states, perhaps 14 in number, thus getting in contact with the operators in their own field of action, profound and lasting impressions have been made as to existing conditions.

There is a growing sentiment among the Independent operators in this country that cannot be checked, that cannot be hindered, that cannot be weakened, that cannot be smothered. And that sentiment is thoroughly grounded and sufficiently based on the conviction that they, as Independent operators, deserve the right of self-protection and self-preservation, and that surely there is some practical plan by which such protection may be had and the perpetuity and permanency of the business be thus placed beyond any question.

But you must realize and you evidently do appreciate the fact from your own experience and observation in your own home localities, where you have to contend with the Bell company, that the question of rates is no longer the basis of competition, because the Bell company has cut its rates all over this country and in nearly every locality to a figure as low, and in many instances much lower, than the rates charged by the Independents, and you are bound to see that in the near future competition will not be based upon rates at all.

No man who really thinks and has the logical mind with which to analyze conditions and therefore is able to read the future by the history of the past, can doubt for one moment the truthfulness of the statement that the competition in the future between the Independents and Bell company will be based entirely upon the efficiency of the service rendered.

This, as every other index finger in the Independent telephone movement, at present points to the absolute necessity beyond all question or quibbling to the adoption of a uniform standard apparatus, and this cannot be accomplished by any man or little coterie of men simply because they may be possessed of a large amount of capital, but it must be the expressed wish and determination and decision and by the action of the organized operators in this country. You, and you alone, can lay the permanent foundation upon which can safely rest the great fabric or superstructure of your business in the future.

In the name of all reason, common sense, practical judgment and business experience, is it not the proper thing for you to take such action as will certainly, surely, effectively and permanently cement you together? This can only be accomplished by a common financial interest or joint investment, because such a condition alone can successfully bind together the thousands interested in the varied, intricate questions involved in the prosecution of any great business enterprise.

Committee Reports.

Committee reports were then called for. George N. Bandy of Des Moines, Iowa, chairman of the express committee, stated that the principal grievances which Independent operators had experienced with the express companies had been largely removed within the last year, and for this reason he did not think it necessary to make a long report. He said that most express offices were now using Independent instruments and paying the regular rental.

L. L. C. Brooks of Minneapolis, Minn., chairman

of the committee on Postmaster-general Payne's order, as it was named last year, had sent in a long report, but as he could not be present at the opening session, it was held over to be read upon his arrival. Charles E. Hull of Salem, Ill., ex-president of the association, stated that the special committee on uniformity of equipment and standardization of apparatus had not completed its report, and he was given further time.

PLAN CONSOLIDATION WITH THE NATIONAL ASSOCIATION.

Secretary Coleman laid before the association an outline of the deliberations of a joint conference of representatives of the Interstate association and the National Independent Telephone Association, held in Chicago, on November 18th, which had for its object the consolidation of the two associations. He said that the actions of the conference were unofficial, the meeting having been called by individuals who had no authority from their association, but who were willing to bear the responsibility, believing that the members of both organizations would favor a comprehensive plan for closer relationship.

Those present at the meeting on November 18th were Henry A. Barnhart of Rochester, Ind., Charles E. Hull of Salem, Ill., and E. M. Coleman of Louisville, Ky., representing the Interstate association, and J. B. Hoge of Cleveland, Ohio, J. G. Splain of Pittsburg, Pa., and Ed. L. Barber of Toledo, Ohio, representing the National association. Mr. Coleman at the conference submitted a long statement in which he said that this was the third attempt in which he had been instrumental in trying to bring about a consolidation. He expressed the belief that his association would favor the move. Mr. Hoge, for the National body, submitted a statement pointing out the urgent need of consolidation and the trend of the times toward organization. He outlined at length the necessity of standardization and united effort and said that this could be accomplished better by one organization than by two. After reviewing the situation at length, and drawing an expression of willingness for a union from both sides, a resolution was adopted at the conference in November to the effect that each association appoint a committee of five men, "and that these 10 men shall be empowered to effect a permanent organization by a union of the two associations in question. And this committee of 10 shall determine when another convention of Independent operators shall be held, which shall be a joint meeting of the two associations under the plan that may be adopted by the 10 men constituting the joint conference mentioned above, the object of which shall be the ratification of the work of the joint committee provided for in this agreement."

Turning from the consideration of this subject, the Interstate association accepted an invitation from the American Steel and Wire Company inviting the members of the association to go to Waukegan on Thursday, by special train, to inspect the plant of the company at that place. On motion of C. E. Hull the convention then adjourned, to reconvene in executive session in 20 minutes.

At the executive session a resolution was offered by C. E. Hull, as follows: "Resolved, That the chairman of the association appoint a committee of five, himself included, to meet a like committee from the National, to consider ways and means to consolidate, with power to act, and with the proviso that the membership of this association be continued in the consolidated association with all their present rights and privileges."

An animated discussion followed the presentation of this resolution, on the point of who should constitute the committee. Those entering the discussion were George N. Bandy of Des Moines, Iowa, Secretary Coleman, C. E. Hull, President Barnhart, J. S. Bellamy of Knoxville, Iowa, and A. B. Conklin of Aurora, Ill., treasurer of the association. These gentlemen became eloquent at times, especially Colonel Coleman, in commenting on the good work for the association performed by President Barnhart. After considering a number of amendments to the resolution, it was finally passed, amended so as to include on the consolidation committee President Barnhart, the president to be elected, the secretary to be elected, and two men to be chosen by Mr. Barnhart. The session then adjourned for the day.

Wednesday's Proceedings.

READING AND DISCUSSION OF PAPERS.

The second day's session of the convention was opened at 2:45 p. m. on Wednesday and was devoted to the reading and discussion of papers. The severe illness of O. M. Bake of Hamilton, Ohio, prevented his presence, and his paper on "Why Independent Telephone Securities do not Command the Market Price They Deserve According to Their Earning Capacity," was not read. Several members expressed disappointment at not hearing this paper. In response to an inquiry as to the best way to secure financial backing for Independent telephone systems, Mr. B. F. Wasson said the money should be raised at home. Create an interest in your enterprise, put in good instruments and apparatus with durable construction, and then with good service local capital will support you. The speaker created a ripple of laughter when he said that some years ago he borrowed $50,000 from his friends and started what is now one of the large Independent exchanges in Illinois. But recently, he said, he organized a stock company, issued bonds, and from the sale of these he is now engaged in paying his friends back.

"What Independent Telephone Companies Owe the Public; What the Public Owes the Independent Telephone Companies," was the subject of a paper read by Theodore Thorward of South Bend, Ind. The author said that the Bell company no longer has a monopoly on telephone apparatus, and is now on the same footing with the Independent companies. The people have a right to demand of those receiving franchises that the field be developed. Public sympathy for the "home telephone" will not last long if the service is not kept up to date. Toll-line connections are also due the patrons; although Mr. Thorward did not believe that the public expected the local companies to give long-distance service from New York to San Francisco at once. He said that 97 per cent. of telephone subscribers never use such service and 75 per cent. never talk over toll lines at all. However, the neighboring counties of a local system should be connected. The lines should be constructed of 25-foot, six-inch top cedar poles, 35 to a mile, standard toll-line crossarms, with a No. 10 metallic circuit, copper if possible, transposed every half mile.

Speaking of connecting with large cities, Mr. Thorward said that the Illinois Telephone and Telegraph Company (now controlled by the Chicago Subway Company), operating the automatic system in Chicago, claiming to be an Independent company, owed it to Chicago and the surrounding Independent companies that it connect with the surrounding systems and thereby make Independent entrance into Chicago possible. The speaker said that 90 per cent. of the people appreciate good service and are willing to pay a good rate for it. If the public and the companies deal fairly with each other, he predicted exceptional prosperity for Independent systems the coming year.

The paper was freely discussed. A. B. Conklin of Aurora, Ill., in response to an inquiry by Mr. Preston of Iowa as to the possibility of connecting with the automatic system in Chicago, said that his company, the Interstate Independent Telephone Company, whose fine system of 75,000 telephones centers in Aurora, had been negotiating with President Wheeler of the Illinois company for more than a year for Chicago connections, but had not yet received a satisfactory answer. Mr. Conklin's company had offered to dig a tunnel from the city limits to the tunnels of the automatic system if Mr. Wheeler would secure the permit from the city. Mr. Conklin believes that as soon as the Chicago Automatic company has disposed of some important matters in connection with reorganization, etc., the Independents will receive consideration and in all probability get the desired connection with the automatic system in Chicago.

Others who entered into the discussion of the Thorward paper were R. M. Richmond of Evansville, Wis., W. G. Thompson of Lebanon, Ohio, F. S. Mosher of Sandwich, Ill., Richard Valentine of Janesville, Wis., P. C. Holdoegle, W. M. Hazeltine, J. G. Glass of Pekin, Ill., B. F. Wasson and others.

E. D. Graham of Mexico, Mo., then read an interesting paper on "Manufacturers' Duties and Their Dues." Mr. Graham thought that the operators of exchanges should stand by the Independent manufacturers who have given them apparatus of such quality as to be able to compete with the Bell systems. He said that efficiency in service was fast becoming the basis of patronage. He also thought that manufacturers should in turn protect their customers. "If all of the manufacturers had recognized the importance of performing their duties toward the operator and had loyally and faithfully performed them," he said, "they would have gotten their just dues in addition to the vast amount of money they have received as profits on their business. They would today have had the loyal support, confidence and backing of all operators in the Independent field."

On motion of H. C. Barbour of Ottawa, Ill., the chairman appointed a committee to confer with the Chicago Subway Company relative to its attitude toward giving Independent connections into Chicago, and, if possible, get a written statement from President Wheeler. The committee as appointed was composed of Mr. Barbour, A. J. Vernier of Kankakee, Ill., and Theodore Thorward.

In the absence of J. H. James of Mankato, Minn., his paper on "Uniformity of Equipment and Standardization of Apparatus the Imperative Demand in the Operating Feld," was read by John E. Jones of Jonesboro, Ark. Mr. James reviewed the history of telephony, including the important patent litigation, up to the present, at which time he thinks the instruments and equipment of the better class of Independent exchange is far superior to that of their competitor. His paper was a long one and was a strong plea for standardization of equipment and uniformity of construction. This, he said, with corresponding wisdom in business affairs, was the solution of the long-distance problem of the Independents.

J. S. Bellamy, a large owner of Independent exchanges in Iowa, did not believe in standardization. He said that standardization means the death of improvement. All the Independent men want, he said, is the best there is made. W. G. Thompson of Ohio was of the same opinion as Mr. Bellamy. F. W. Ellis spoke at length in favor of standardization.

Following the discussion of papers and several announcements by the president, the convention adjourned until nine o'clock on Thursday morning.

Thursday's Proceedings.

Thursday's session was opened at 9:30 a. m. The chairman appointed a nominating committee composed of Lichty of Iowa, Graham of Missouri, Hull of Illinois, Matthews of Kentucky, Harper of Wisconsin, Fee of Ohio and Reeves of Indiana.

The paper of O. M. Bake on Independent telephone securities was read by title and discussed. W. G. Thompson said that to float successfully telephone securities, financiers must be educated to the importance, value and need of the Independent exchanges. The company must first secure credit among its friends. G. I. Miller of Boone, Iowa, also discussed the paper.

Rome C. Stephenson of Rochester, Ind., read an instructive paper on "How Avoid Personal Injury and Responsibility in Telephone Construction Work and Maintenance." He spoke of the duty of companies to use appliances of the best make and use reasonable precaution in construction. Many deaths to employes are caused by contact with telephone wires which have become charged by close proximity to electric-light and power wires. The duty of lighting and power companies to use precaution was also outlined and their liability in accidents caused by such contact was shown. He advised constructing telephone wires four feet above the light wires, where they must be close together, and that guard wire be used. Messrs. Stanton, Johnson and Thompson threw light upon the subject in discussing the paper.

The committee which had been appointed to visit A. G. Wheeler of the Chicago automatic telephone company relative to a possible connection of the automatic telephone system in Chicago with Independent telephone systems outside, reported. Mr. Wheeler, the committee said, gave the impression that his company would at any time within three months be ready to consider a proposition from any reliable authority to connect with any system of good construction and equipment. He was willing to build to the city limits to connect, but would probably not sign a contract until a satisfactory test could be made to try any connection effected.

R. F. Johnson of Saginaw, Mich., thought that Mr. Wheeler should state what he considered good, standard construction, and said that his own idea was 40 poles to the mile—25-foot six-inch—and No. 10 copper circuits for all business.

The committee was instructed to continue its conferences with Mr. Wheeler and secure from him a signed agreement to connect with the Independents. A. B. Conklin of Aurora, whose company would probably be the first to connect with Chicago, was added to the committee.

The report of L. L. C. Brooks of Minneapolis, chairman of the committee appointed a year ago to investigate the order from the postmaster-general that only the telephones of one system—Bell or Independent—be used in postoffices, was read by the secretary. The report stated that a strong effort had been made in Washington to secure legislation favorable to the Independents, but nothing has yet been accomplished, except that the order was modified and no Independent telephones have been removed recently. The report recommended a committee selected by the association, one from each state, to push this matter with the government.

The report of the treasurer was read, showing that all money had been expended. Secretary Coleman said that he had spent about $1,200 for the association this year, and up to date had received from various sources only about $600. A committee was appointed to audit accounts and arrange to pay all bills. Mr. Brooks' committee reported an expense of $325.

The secretary reported that 40 telephone companies had joined the association during the year. Mr. Coleman then thanked the association for all courtesies shown him as an officer of the association. President Barnhart, in a few well-chosen words, expressed his gratitude to the association for the many kindnesses shown him.

The nominating committee reported its action. It recommended a vote of thanks to President Barnhart and the other officers, which was given. The following-named gentlemen were then elected as the officers of the association:

President—Theodore Gary of Macon, Mo.
Vice-president—William R. Fee of Milford, Ohio.
Secretary—L. L. C. Brooks of St. Paul, Minn.
Treasurer—A. B. Conklin of Aurora, Ill.
Executive board—C. E. Hull of Salem, Ill., S. S. Lichty of Vinton, Iowa, J. G. Splain of Pittsburg, Pa., Richard Valentine of Janesville, Wis., Walter Matthews of Maysville, Ky., E. D. Graham of Mexico, Mo., C. W. Wells of Marion, Kan., H. A. Barnhart of Rochester, Ind., W. G. Jones of Columbus, Ohio.

The committee which is to have in charge the association's interests in the consolidation proceedings to be conducted with the National association was then announced and consists of H. A. Barnhart, Theodore Gary, L. L. C. Brooks, E. M. Coleman and C. E. Hull.

Convention Notes.

Hall L. Brooks, the popular cedar-pole man of Tomahawk, Wis., was a conspicuous figure at the convention. Mr. Brooks, who is well known for his energy, has built up a most excellent trade among users of cedar poles, and he anticipates a largely increased business during the coming year.

President George L. Lindsley and Manager J. Allan Navarre represented the Lindsley Bros. Company at the convention. The Lindsley company is among the oldest producers of poles, and with its excellent facilities for producing Michigan, Idaho and Washington poles it is enabled to obtain its full share of the cedar-pole business.

R. R. Genge, recently appointed manager of the cedar-pole department of Francis Beidler & Co., Chicago, represented this well-known concern at the convention. Mr. Genge is an old-time cedar man and is well qualified to take care of this growing department of the Beidler company.

The exhibit of the American Steel and Wire Company was among those which attracted most attention. A complete line of telephone wires and cables was shown, including a panel of samples which was exhibited at the Paris Exposition. The exhibit was in charge of Assistant General Sales Agent George F. Rummell. The following-named representatives were also in attendance: C. S. Knight, Jr., manager of the electrical department, W. C. Bogue, George Chandler, F. J. Conkling and W. A. Gairnes.

An attractive display was made in room 640 by the Kester Electric Manufacturing Company of Chicago. The leading feature was the clock made of pins which was on exhibition in a booth at the St. Louis Fair and which has been described and illustrated previously in the Western Electrician. The clock is of exceptionally artistic design and attracted universal attention, and delegates at the convention were enthusiastic in their praise of it. The clock was built to show the possibilities of Kester self-fluxing solder. This solder, together with cans of Kester paste and bottles of Kester soldering salts, completed one of the handsomest exhibits at the convention and served well to increase interest in an excellent line of goods.

Telephone News from the Northwest.

The long-distance line of the Tri-state Telephone Company has been completed from the Twin Cities to Grand Forks, N. D.

The stockholders of the Nicollet County Telephone and Telegraph Company have voted to purchase the local exchange in St. Peter, Minn., for $35,000. The local system includes exchanges in St. Peter and Kasota, and 43 miles of lines.

The Blue Earth Telephone Company of Mankato, Minn., has been granted admission to New Ulm, Minn., for a single-toll instrument, on a 10-year franchise, being required to pay $1,500 for the privilege.

G. W. Hart of Egan, S. D., who owns the telephone system there, has bought the local exchange at Flandreau, S. D. He proposes to connect the two rural systems into one, operated as a whole, independent of either local exchange.

The local exchange at Barnesville, Minn., has connected with the long-distance lines of the Northwestern Telephone Exchange Company.

The Cambridge Telephone Company has been formed at Cambridge, Minn., to build a local and rural system. It is allied with the Tri-state Telephone Company.

The council of Anoka, Minn., has voted to order the Twin City Telephone Company to remove its toll line from that city.

The Southwestern Minnesota Telephone Company has been granted a local exchange franchise at Westbrook, Minn.

A stock company has been formed to assume the business of the Home Telephone Company at Grand Meadow, Minn.

The Rainy River International Telephone Company has been granted a charter to install local exchanges at Fort Frances, Ont., and neighboring towns. The company plans exchanges on the Minnesota side of the river as well, with long-distance connections with Winnipeg.

The town of Geddes, S. D., has voted a franchise for a local and long-distance system to the Dakota Central Telephone Lines.

The Wisconsin Telephone Company is arranging to rebuild its exchange at De Pere, Wis.

Telephone companies in Minneapolis have asked the board of park commissioners to appoint a man who may be consulted as to trimming trees to run telephone wires, the companies to pay his salary.

The Fosston Telephone Company has completed a telephone line from Fosston, Minn., to Winger and Sletten.

An election will be held at Gowrie, Iowa, for the purpose of voting a telephone franchise to J. F. Nordin.

An ordinance has been proposed at Cedar Falls, Iowa, to grant admission to the city of the various rural lines. The ordinance will be satisfactory to the Cedar Falls Mutual Telephone Company.

The South Dakota Telephone Company of Pierre has incorporated with a capitalization of $100,000. A. Ewart heads the list of stockholders. The company proposes to build a telephone line from Pierre into the Black Hills.

The Michigan State Telephone Company is planning building a line next summer connecting the Gogebic Iron range with the copper region. This will be accomplished by connecting Wakefield and Nestoria.

The Bell telephone exchange at Keokuk, Iowa, has been destroyed by fire. R.

Ohio Telephone Notes.

Herbert R. Ashbrook of Toledo has addressed a letter to the Home Telephone Company of Louisville, Ky., asking that the plan of expending earnings for extensions be changed and bonds issued for that purpose. He says the company should begin paying dividends now, in order that its stock and bonds may be worth something in the markets. Mr. Ashbrook figures that the company may begin to pay dividends at the rate of two per cent. on the first of the year. The company has $120,000 bonds in the treasury, and there yet remains of an issue authorized some time ago $1,400,000. With the company paying dividends, there would be a good market for these bonds, and the company could realize on them for the necessary extensions.

Officials of the Cuyahoga Telephone Company are well pleased with the prospects for the company's future. Taking the latter part of this year as a basis, they believe the company will earn six per cent. on both the preferred and common stock in 1905. As a new switchboard was put in this year, there will be nothing to hinder operation for some time to come.

Barber & Brailey of Toledo have sold their bond holdings in the Utica Independent Home Telephone Company, amounting to $75,000, to a syndicate of eastern men.

The Pryor-Bode Telephone Company of Rinard's Mills has been incorporated with a capital stock of $5,000 by J. W. Pryor, G. E. Bode and others.

T. R. Mason, C. A. Carr, H. M. Anderson and others have incorporated the Sugar Grove Telephone Company, Sugar Grove, with a capital stock of $5,000.

Two outdoor telephone booths have been established on Euclid Avenue, Cleveland, by the Cuyahoga Telephone Company. They are made of iron and a directory is fastened on the door inside. For the remainder of this year the service will be free, but after January 1st the regular pay-station charge will be made. If the booths prove successful other stations will be established over the city. Another innovation of this company is the establishment of a place for making coffee and tea for the operators, most of whom bring their lunches with them. This fits in with the co-operative system that was established by the company over a year ago. Officers feel that this idea has been successful, and they are willing to carry the matter a little further, believing that the expense is well incurred.

The new circuit of the United States Telephone Company between Columbus and Toledo is nearing completion. It is in operation to a point near Marysville.

An increase of capital stock from $5,000 to $15,000 has been made by the People's Telephone Company of Chester Hill. C.

Indiana Telephone Items.

The City Council of Lebanon has granted a 20-year franchise to the Central Union Telephone Company to operate a local exchange. The passage of the ordinance was a great surprise to the people, as few knew that such a step was even thought of by the council. The people are opposed to a dual system, and the mayor is asked to veto the ordinance. If the franchise is passed over his veto, it is insisted that the price be fixed at an amount no greater than is charged by the local company at present.

The Central Union Telephone Company has applied for a franchise to operate a local exchange in Crawfordsville.

S. P. Sheerin, president of the New Long-distance Telephone Company of Indiana, has been making a tour of the state, investigating the feasibility of inaugurating a telegraph business over the regular long-distance telephone wires while the latter are in use. The telephone company proposes, it is said, to open telegraph offices and send messages to any point reached by its lines at a material reduction from the rates now charged. The expense will be inconsiderable, since the telephone lines are already in operation and earning a profit on the investment from the telephone business. The question is raised as to the right of the telephone company, under its charter, to operate telegraph lines, but Mr. Sheerin feels confident that there will be no trouble. "Our company has telegraph communication to Lafayette, Marion, Fort Wayne, Muncie and Terre Haute. The wires are used for news service only," said he.

The report of the Home Telephone Company of Fort Wayne, which has made a success in Indiana, shows a total of 3,220 telephones in use, with an average growth of 50 per month. The company owns its own building, worth $40,000, and it has $32,000 in the sinking fund for redemption of $250,000 outstanding six per cent. bonds. It sets aside 6¼ per cent. yearly for sinking fund and pays two per cent. on stock. At a recent meeting C. S. Bash was elected president, W. L. Mollering, secretary, and M. B. Fisher, treasurer.

There is strong competition between the two telephone companies operating in Greenfield. The Independent was almost alone in the field until a year ago, when the Central Union entered. It is now possible to talk with competing points for 15 cents, while with non-competing points which both companies do not reach, the cost is three times as great. Difficulty has been experienced in calling out the fire department, owing to the fact that members of the department have installed different telephones. Mayor Carr ordered the engineer at the city pumping station to pay no attention to an alarm turned in over the Central Union. This order is being generally criticized, and the City Council will consider the matter at its next meeting.

The Blue River Valley Telephone Company has filed articles of incorporation. The capital stock is $12,000. The company proposes to build and operate a telephone system in Washington County, with the principal exchange and office in Salem. J. H. Tattock, C. A. Martin, E. G. Philips, J. E. Brewner and Arthur Purlee are the incorporators. S. S.

Southeastern Telephone Developments.

The Board of Aldermen of Statesville, N. C., has just refused a franchise to the Bell Telephone Company, which desired to enter the local field and buy the local exchange.

The Southern Bell Telephone Company has awarded the contract for a handsome three-story exchange and office building at Greensboro, N. C., to cost about $15,000.

After a long fight a franchise has been granted a telephone company at Anderson, S. C., allowing, among other privileges, the charging of tolls to outside points in the surrounding section.

Estimates are being made by the Southern Bell Telephone Company for putting up aerial cables in the town of Cordele, Ga., thus completing the remodeling of the local exchange.

There is some talk of extending the lines of the Bell Telephone Company about Beaufort, S. C., to reach many farmers. L.

GENERAL TELEPHONE NEWS.

An office of the Sunset Telephone Company is shortly to be established at Sparks, Nev.

The line of the Big Blackfoot Telephone Company between Drummond and Ovando, Mont., has recently been completed.

The Deschutes Telephone Company will at once begin the construction of a telephone line from Bend to Laidlaw, Ore.

The toll line of the Home Telephone Company of Kansas City has reached Ottawa, Kan., and will be extended to the Kansas oil fields.

The business men and farmers around Byron, Okla., have met and organized a mutual telephone company, to build an exchange and rural lines.

A new switchboard which will cost about $35,000 will be installed in the near future at Ogden, Utah, by the Rocky Mountain Bell Telephone Company.

Newspaper reports of a revival of the movement to form a combination of the Independent telephone manufacturing interests of the country are denied by Chicago manufacturers.

In the suit of the city of Wichita, Kan., against the Missouri and Kansas Telephone Company, it has been decided that the telephone company has the same right to extend its wires through the city that the telegraph companies enjoy.

A telephone exchange has just been completed at South Haven, Kan., by R. W. Kemp, contracting engineer of Wichita, for the Farmers' Mutual Telephone Company. Mr. Kemp has also contracted to build the mutual lines for the Chickaskia Mutual Telephone Company from Milan to Wellington, via Mayfield, and for the Oxford Mutual Telephone Company from Oxford to Wellington, via Dalton. The lines, when complete, will connect with the Farmers' Mutual Company at Wellington and make a system of over 2,000 subscribers.

The Stark Telephone, Light and Power Company, in a proposition made to the Board of Control of Toronto, Ont., for an Independent telephone system in the city, offers telephones at a maximum price of $36 per annum for business places and $18 for residences. The company guarantees that it will have 3,000 subscribers in six months and have its system in operation within 15 months. Electric current will be sold at 10 cents per kilowatt-hour, less 20 per cent. discount for prompt payment. Provision is also made for the expropriation of the company's plant if any agreement with the Bell company, tending to destroy competition, is discovered, and the company is to pay 2½ per cent. on its revenue to the city for the first five years and five per cent. thereafter.

Manager R. B. Anderson of the Black Pearl mines in Idaho states that the company is about to install new hoists, to be operated by electricity transmitted from the electric power plant at Payette, Idaho.

Physics and Electricity.[1]

By Prof. William Hallock.

It is in general not very profitable to spend much time in evolving an elaborate classification of the sciences and their inter-relations, nevertheless, it may at times be well to take a survey of the situation, a sort of birdseye view, without any special reference to the boundaries, which are artificial and merely useful for ready reference.

In a way physics should be considered to include both the branches which we refer to under the name of physics and chemistry. Phusis and phusikos and ta phusika refer to the essence of all matter and its nature; nevertheless one branch of the subject has so grown out of proportion to the original trunk, science, that it occasionally forgets its relationship. We may say that the structure of the "atom" of the chemist, the ultimate nature of primordial matter is considered in the domain of physics, while chemistry busies itself with the combinations of these atoms into molecules, the results of the combinations of the molecules into masses and their behavior as such is again physics. Every great generalization, every marked step toward the goal has been in the nature of a simplification, a reduction of the number of the unrelated phenomena of nature. Usually, we think of physics as dealing with elementary mechanics, sound, heat, light, electricity and magnetism. Sound has long since been properly classed as a particular case of the mechanics of elastic matter; heat and light, and most of the phenomena of electricity and magnetism have been similarly relegated to the domain of the mechanics of the "ether," and no one doubts that the other outstanding puzzle, gravitation, will also fall into this class. It is, then, the mechanics of the ether which must hold the solution of all of our conundrums, and that is the direction in which the vast majority of investigators are struggling at the present time. What are the relations of matter and ether, or are they identical? That is the question.

In the latter part of the '70's Sir William Crookes made a brilliant series of experiments upon what he then called "radiant matter." He showed very beautifully that when the greater part of the air is pumped out of a glass tube, and then a current of electricity sent through the gas by means of electrodes, that under these conditions there were sent out from the cathode small particles of matter, traveling at high velocities in straight lines until they struck the other side of the tube, or some intervening object. Ten or 15 years later the investigation of this radiant matter was taken up more vigorously, and Lenard found that by placing a small aluminum window opposite the cathode, he could cause the cathode particles to pass through the metal and travel some distance through the outside air. It had also been found that these particles carried a charge of negative electricity, and were consequently deflected by a static electric charge or by a magnetic field. In the last decade of the last century Roentgen discovered that where one of these particles was stopped by striking upon some object a new form of radiant energy was sent out. Not knowing its nature, he called it X-rays, being recognized the world over as the "unknown quantity." Becquerel, soon after, discovered that uranium emitted a sort of radiant energy, which was then called Becquerel rays. In the mean time the radiant matter of Crookes had come to be known as cathode rays, and Goldstein had shown that a corresponding condition of matter carrying positive electricity could be produced, and called it "canal rays." We have, then, the cathode rays, particles of matter carrying negative charges; when one of these particles strikes, it produces a few waves in the ether, an ether pulse, as when a stone is thrown into a pool of water, this is X-rays. The radiations from radium and its analogues were soon identified as follows: The alpha rays are particles of matter carrying charges of positive electricity, traveling with a velocity of about 20,000 miles per second, and about the size of two atoms of hydrogen, it would take 5×10^{23}, i. e., 5 followed by 23 ciphers of these alpha particles to weigh one gram (a gram is equal in weight to about 15 grains). The alpha particles have a very slight penetrating power; two ten-thousandths of an inch of aluminum, or a sixth of an inch of air will cut off half the alpha radiations. The beta radiations are the radiant matter of Crookes, the cathode rays of the present, particles of matter carrying negative electricity, traveling with a velocity of 160,000 miles per second, they are only one two-thousandth the size of the alpha particle, and are much more penetrating, one half passing through a fiftieth of an inch of aluminum, or two inches of air. The gamma rays are like X-rays, a pulse in the ether, and travel with the velocity of light, 186,000 miles per second.

By the deflection of the alpha and beta particles under the influence of a static field or a magnetic field, it has been possible to determine the above facts, and many other independent phenomena confirm them most beautifully.

When a current of electricity is sent through a solution of common salt the molecules are immediately involved in a series of interchanges, all the atoms of the element sodium immediately start toward the negative plate, because they carry positive charges, and all the atoms of chlorine start in the opposite direction toward the positive plate, because they carry negative charges. Thus the mechanics of electrical conduction is a procession of positively charged particles, ions, traveling in one direction, and a corresponding procession of negative ions in the opposite direction. This is the only way non-metals can conduct electricity. Air is ordinarily a non-conductor; it is not a metal, and it has no postive and negative ions. Under the bombarding influence of the radiations above described, the air is broken up into ions and becomes a conductor, and its conductivity is a measure of the activity of the bombardment. Consequently we may use the conductivity imparted to air as a measure of the degree of radioactivity.

Prof. J. J. Thomson puts forward the hypothesis that the small particles of the cathode rays are the primordial form of matter from which all the elements are built up, and proposes the name of "corpuscle" for them, but they are generally called electrons. He even suggests very beautifully that the electron may be nothing more than a charge of negative electricity, and that when we have about a thousand of these combined with a neutralizing amount of positive electricity, we have an atom of hydrogen, 16,000 gives oxygen, etc. When a gas is ionized, for example, by a beta particle, it has one of its electrons knocked off, and consequently is left effectively positive, and the conditions are fulfilled for conduction of electricity.

The researches of Rutherford, Soddy, Thomson, Rumsay and many others, have led to the following hypothesis as to the mechanics of radioactivity:

The very large atom of radium, some 235 times as large as the hydrogen atom, is in a condition of unstable equilibrium, undergoing gradual disintegration, owing to a loss of some of its original internal energy. The first observable product is a gaseous material called by Rutherford "emanation" this gradually disintegrates farther, and as an end result we obtain helium, a very light inert gas, recognized by its spectrum. There are certainly other products, but they are not in sufficient quantity to be identified. Professor Rumsay has gone even farther, and thinks it possible that elements may be built up by bombarding into an element of lower atomic mass a certain number of alpha and beta particles.

If these hypotheses prove tenable, it would appear that all physics, all matter, everything is electricity, and there is nothing in the so-called material universe but the ether and its mechanics.

1. Abstract of a lecture delivered before the New York Electrical Society, November 30, 1904. Prof. Hallock is one of the faculty of Columbia University.

New York to Boston in Electric Cars.

By the recent completion of an electric railway between New Haven and Wallingford, Conn., it appears that one can now ride from the City Hall in New York city to the Boston State House in electric cars, making close connections at every transfer point. The accompanying map, for which the New York Times is responsible, shows the route.

The cost of the trip, on a fairly comfortable basis,

MAP OF ELECTRIC-RAILWAY ROUTE BETWEEN NEW YORK AND BOSTON.

is from $15 to $17, but this includes stop-overs at first-class hotels. The journey can be made in three days. Four days are better, though, and if the traveler is off for a leisurely vacation he will find it pleasanter to spend an even longer time on the road. The route passes many towns of historic interest, besides country sections of varied and picturesque character. The three-day trip to Boston is divided as follows: First day, New York to New Haven; second day, New Haven to Springfield; third day, Springfield to Boston. The four-day trip is broken up in this way: First day, New York to Bridgeport; second day, Bridgeport to Hartford; third day, Hartford to Ware, Mass.; fourth day, Ware to Boston. The actual cost of transportation to Boston is not much over $3. For $20 it is estimated, one can make the four-day trip from New York and add the one-day journey from Boston to Fall River or Providence, stopping at good hotels at each resting place.

The electric trip from New York to Boston is at present, of course, only fitted for the leisurely tourist. If necessary, however, it would be perfectly feasible to operate an electric through line that could compete, on at least even terms, so far as service is concerned, with existing steam roads.

Meeting of Illinois Electrical Contractors.

The fourth semi-annual convention of the Electrical Contractors' Association of the State of Illinois was held in the assembly room at the Illinois Hotel, Bloomington, Ill., on Thursday, December 8th. The meeting was called to order at 10:30 a. m., and, in the absence of the president and vice-president, Arthur Frantzen of Chicago was chosen temporary chairman. The officers of the association are: President, C. L. Brown of Chicago; vice-president, W. A. Robb of Rock Island; secretary, C. R. Kreider of Chicago; treasurer, E. E. Gibson of Decatur. At 12:30 p. m. the meeting adjourned for lunch, the session being resumed immediately thereafter, adjourning again at four o'clock, when a special car provided by the Bloomington and Normal Electric Railway and Heating Company took the delegates to the Chicago and Alton shops for a tour of inspection, which was greatly enjoyed. In the evening a banquet was held at the Illinois Hotel, where an enjoyable time was had.

The Electrical Contractors' Association of the State of Illinois is affiliated with the National Electrical Contractors' Association of the United States. Matters of mutual interest to the contractors were discussed at the meeting. Much credit is due to Guy Carlton, the Bloomington member of the association, for his untiring efforts in making arrangements and seeing that everything was provided for the comfort of the delegates, also to the Business Men's Association of Bloomington, whoses guests the delegates were. The next meeting will be held at Peoria in June.

The following-named gentlemen were in attendance at the Bloomington meeting:

T. D. Allen, Allen Electric Company, Danville.
F. B. Bolte, Broderick & Co., East St. Louis.
Guy Carlton, Jr., Bloomington.
O. H. Norton, Central Electric Company, Peoria.
C. A. Walker, Electric Construction and Machinery Company, Rock Island.
E. E. Gibson, Electric Fixture and Supply Company, Decatur.
I. N. Feger, Feger Electric Company, Peoria.
Ernest Freeman, Ernest Freeman Company, Chicago.
Arthur Frantzen, Arthur Frantzen Company, Chicago.
T. H. Henkle, Henkle Bros., Springfield.
C. R. Kreider, Kohler Bros., Chicago.
J. W. Tanner, Marrs-Tanner Electric Company, Danville.
A. L. Frankenberger, Marrs-Tanner Electric Company, Danville.
Henry Newgard, Henry Newgard & Co., Chicago.
W. E. Wolgamott, Peoria Electric Company, Peoria.
J. B. Scholes, Springfield.
G. A. Sieber, Jacksonville.
C. E. Stapp, Peoria.

Record of Private Ownership in Philadelphia Gas Plant.

After a discouraging experience of many years with a municipal gas plant, Philadelphia leased the works to a private company for a term lasting from December 1, 1897, to December 31, 1927. According to an article by Hayes Robbins in The World Today, the result has been very satisfactory. Better gas is furnished, and the city gets free gas for street lighting and 10 cents a thousand on all gas furnished private consumers. The concluding paragraph of the article is as follows:

"And the larger significance of this is that it points the way for other municipalities to make it good business policy for public-service corporations to justify their position in like fashion. Set the terms, and then keep watch. Whether a city owns and leases its plant, or simply grants a franchise for the rendering of a given service, the crucial point is in fixing the desired conditions at the outset and retaining some sort of effective club in hand as a penalty for failure of the corporation to perform its duties. The Philadelphia experience shows how much more can be done in this direction than has ever been attempted in most of the cases of unsatisfactory service that are cited today as fit subjects for the municipal-ownership panacea.

Electrical Committee of Underwriters' National Electric Association.

The annual two days' meeting of the electrical committee of the Underwriters' National Electric Association was held in New York on December 7th and 8th, the attendance being very good. The chairman of the committee is Mr. F. E. Cabot of the Boston board of fire underwriters, and the secretary is Mr. C. M. Goddard, also of Boston.

The tendency was toward a simplification of the rules, eliminating as far as possible in the matter of detail and method of construction, placing the code instead on a broad plane. A number of minor changes were made to the rules and some explanatory foot notes added.

Representatives of the following associations were present at the meeting: National Electric Light Association, American Institute of Electrical Engineers, National Electrical Contractors' Association and the American Institute of Architects.

Polyphase Transmission with Single-phase Operation for Railway Purposes.

Among the numerous patents that have been allowed to Mr. Bion J. Arnold of Chicago is one issued to him under the title of "System of Electrical Distribution" on November 29th last, the application having been filed on December 17, 1901. This system has for its primary object the transmission and distribution of energy for railway purposes, making use of the minimum amount of copper, the various circuits of the system being to a great extent balanced. By the use of various trolley conductors along the line associated with the ground return, a three-phase system is employed for the transmission, while the car motors under normal conditions operate single phase.

A further feature of the invention consists in the provision of means whereby additional power may be supplied to the motors driving the vehicles over and above that which could normally be obtained from a main trolley circuit. Instrumentalities for this purpose are preferably provided at those portions of the right-of-way at which there is a considerable ascending grade or at such other points in the line where an especially heavy load will be placed upon the motors during their operation, as at stations to aid in starting.

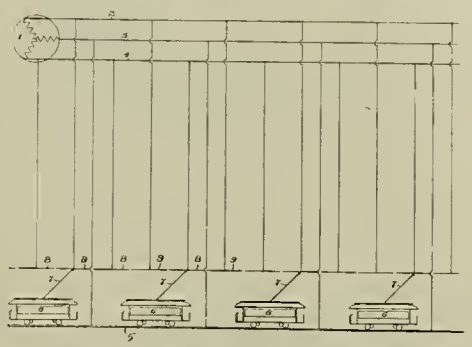
The motors upon the vehicles should be so constructed that they operate efficiently when normally running single phase with the main-trolley or working-conductor construction and also operate efficiently (while exerting a greater torque, however) when associated with a main trolley conductor circuit and the means for supplying the additional power. To accomplish this result single-phase motors are utilized upon the vehicles, which motors are preferably arranged in some suitable manner to be self-starting and to supply a reasonably strong starting torque. They, moreover, should be able to operate efficiently when supplied, for example, with two-phase alternating current, which additional phase is suitably conducted to the motors through the agency of auxiliary trolley conductors.

The vehicle traction motors, constituting one form of translating means that may be supplied with power according to the invention, are supplied with current alternately from the different circuits of the system so that the energy consumed is equalized between the various circuits of the transmission system, and this accomplished through the use of but a single trolley mechanism. The manner of constructing the trolley-conductor system so that a balance of the transmission system may be normally attainable consists in subdividing the trolley conductors into isolated sections and connecting alternate sections to unlike transmission conductors of the system. By electrically uniting another transmission conductor of the system permanently with a ground return a return circuit is provided, which, as a general proposition, includes the rails upon which the vehicle is to operate. The vehicle thus at one time receives power from two of the mains of the transmission system included in one of the circuits of the multiphase transmission system and at another time receives its current from the mains of another circuit of the system which conducts current of a different phase. Thus the vehicle motor while normally operating receives none but single-phase alternating currents from the transmission system. In order to accelerate the operation of the vehicle or to increase the torque of the motor actuating it, the auxiliary current-conducting means are provided so that a vehicle at such portions of its roadbed may be supplied with additional power by receiving current simultaneously from the main and the auxiliary trolley conductors, which are preferably electrically connected to separate mains of the transmission system, so that out-of-phase currents are supplied to the vehicle motor.

An additional conducting or third rail may be employed as the auxiliary trolley conductor to supply the additional phase to operate the vehicles when under heavy load. In order to provide a safe construction for the auxiliary current-conducting rail to avoid accidents to persons or animals crossing the right-of-way, a transformer may be placed between the third rail and the conductors of the transmission system from which it derives its current, whereby current is supplied to the third rail at a voltage sufficiently low to preclude the possibility of any disastrous results when persons or animals accidentally form connection between the third rail and the ground-return rails.

It is preferable so to arrange the controller system that but one operating handle need be employed to effect normal regulation of the speed of the driving motor and also to regulate its speed when the additional phase is required to furnish additional power. Any suitable self-starting single-phase motor may preferably be employed whose construction and circuit arrangement may then vary, if necessary, in accordance with the invention, by placing additional windings thereon corresponding to the additional phase. A motor might also be employed which, while not inherently self-starting, is provided with means whereby it is brought to speed.

The accompanying illustration shows in a general way the essential features of the system. A three-phase alternating-current generator (1) supplies current to the transmission mains, the style of generator shown being in this instance provided with an armature having the Y system of connection. One of the transmission conductors (3) in this particular



POLYPHASE TRANSMISSION WITH SINGLE-PHASE OPERATION FOR RAILWAY PURPOSES.

instance is electrically connected with a ground connection comprising a continuous rail (5) of the roadbed, along which cars are designed to travel. The cars are provided with trolley poles which are adapted to engage the trolley wire included in the conducting circuits.

In order so to arrange the trolley conductors that the distribution of current between the various circuits of the polyphase transmission system is made as uniform as possible, the trolley conductors are subdivided into isolated sections and connect alternate sections with the same transmission main, thus forming two sets of trolley conductors when the invention is applied to three-phase systems of distribution.

Alternate sections of the trolley mains are associated with the same transmission main, as shown in the diagram, the sections (8) (8) (8) being connected with the transmission main (4) and the sections (9) (9) (9) being connected with the transmission main (2), while the ground return, comprising the rail sections (5) is electrically united to the transmission main (3). It will thus be apparent that the cars in operating along the right-of-way receive current alternately from trolley sections (8) and trolley sections (9), so that the cars are at one time—that is, when the trolley wheel or contact is in association with a conductor section (8)—included in a circuit of the generator (1) supplied by the mains (3) (4) and at another time—that is, when they receive current from the sections (9)—included in another circuit of the generator supplied by the transmission mains (2) (3). When a number of cars are continuously operating along the right-of-way the power derived from a polyphase generator and utilized in propelling the cars is very evenly distributed between the circuits of the transmission system, and this advantage is obtained through the use of but a single line of trolley wire which is adapted normally to supply current to the cars.

In practice it is frequently desirable to accelerate the speed of the vehicle above the normal along some portions of the right-of-way or to maintain the normal speed of the vehicle even though excessive load be placed upon the motor. In order to do this, auxiliary means are provided at these portions of the right-of-way, which auxiliary means are adapted to supply additional power to the driving mechanism over that which is normally obtainable from the main trolley wire. The means employed include an auxiliary conductor circuit in the form of a trolley-conductor third rail insulated from the ground-return circuit of the system. The third rail is energized from a transmission main other than the one which is electrically associated with the trolley conducting section paralleling or running alongside of the third-rail section. The length of the sections of the supplemental trolley conductors or third rail will, of course, depend on the local conditions—as, for instance, upon the number of cars operating in the system, their speed and the number of grades and stops. When the car is thus being supplied with energy from the main trolley wire or conductor and also from the third rail, alternating currents of two phases may be supplied to the motor to cause the motor to develop a torque which is in excess of that under which the motor is adapted normally to operate, but which is in conformity with the increased load which the motor is called upon to move.

Electrification Estimate in Chicago.

In accord with the request of Judge Grosscup General Manager John M. Roach of the Chicago Union Traction Company has supplied the receivers with the following statement of the cost of "electrifying" the present North and West Side cable lines:

Chicago, December 10.—James H. Eckels, M. E. Sempsell, John C. Fetzer, receivers Union Traction Company, Chicago: Gentlemen—In compliance with your request of December 3d, I submit herewith estimated cost of changing our present cable system into an electric trolley system:

Total cost of copper, 1,732,000 pounds, at 15 cents per pound	$259,800
Cost of complete installation of 1,500-kilowatt generator in California power house, which includes boilers, foundations and all electric connections	150,000
Cost of 4,500-kilowatt storage battery	375,000
Cost of motor equipment, new, for 318 cars, figuring on G. E. 800 motors	318,000
Cost of trucks for 318 cars	71,550
Cost of water-heating apparatus for 800 cars	80,000
Cost of construction of 16 miles of overhead double trolley, including feed wire	96,000
Total	$1,350,350

This would involve the changing of the entire Madison Street, Blue Island Avenue, Milwaukee Avenue, Clybourn Avenue, North Clark Street and Lincoln Avenue cable lines into trolley lines—about 16 miles in all.

Mayor Harrison and the city officials are watching closely the outcome of the proposition to "electrify" the Chicago Union Traction Company cable lines outside of the downtown district. The city has opposed the substitution of the trolley for the cable in the outside district on the theory that it would give the traction company a much more advantageous position in the fight over the 99-year claims.

Electric Express Delivery in Washington, D. C.

The electric automobile delivery service recently installed in Washington, D. C., by the Adams Express Company is proving a big success, and there is little doubt that it will be continued and extended during the coming year. The local management of the company is preparing data showing the rela-

ELECTRIC EXPRESS WAGON IN WASHINGTON, D. C.

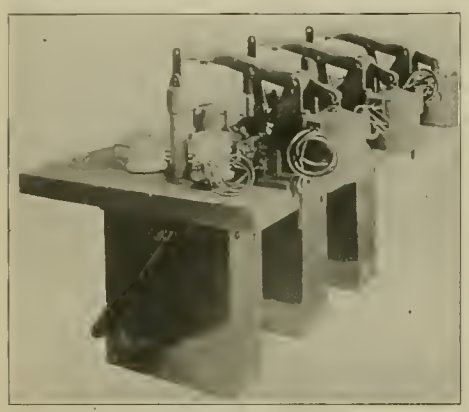
tive cost of operation of the horse-drawn vehicles and the automobiles, and this will be incorporated in a report which is to be made to the board of directors of the company. The accompanying picture shows one of the electric delivery wagons with a load of parcels. Ten of these vehicles are in service and eventually 30 or more will be used. Each wagon weighs 3,000 pounds and has a carrying capacity of 2,000 pounds. It is equipped with a 60-cell Edison storage battery. A garage, with charging facilities for 18 machines, has been provided in the company's stable on B Street.

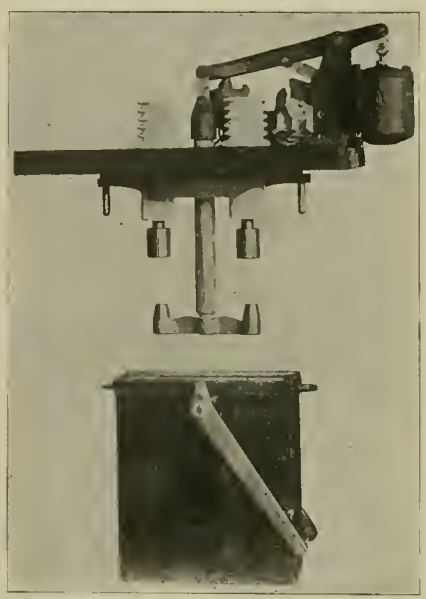
The Mallory Steamship Line has decided to equip all of its vessels with space-telegraph apparatus. The steamship Denver is the first of the liners to be equipped. The De Forest system will be used, and as that company intends to establish many stations along the Atlantic and Gulf coasts, the result will be that the Mallory vessels will always be presumably in wireless range of land. The Mallory Line is the first of the coastwise companies to install the wireless system on its vessels.

Westinghouse Oil Circuit-breakers.

Systems of very high voltage and capacity have received much attention from engineers, but a demand has arisen for a piece of apparatus of somewhat smaller capacity, which shall be compact, reliable, and suited for electrical operation. The Westinghouse system of solenoid operation is especially adapted to such a form of apparatus, and has been used in a new line of circuit-breakers, illustrated herewith. This form of apparatus is automatic, with oil break, adapted for remote control and designed for voltages of from 3,300 to 25,000.

The circuit-breaker is made in single-pole units, each being mounted apart from the switchboard in a brick or concrete compartment. Two, three and four-pole combinations are made by placing the units side by side. The base of each unit is of treated soapstone, and holds two heavy porcelain insulators which carry the stationary contacts and the connection to the external circuit. The movable contacts are at the ends of a U-shaped metal casting fastened at the center to a rod of treated wood, which is moved up and down by the operating mechanism in closing or opening the circuit. The final arc on





WESTINGHOUSE OIL CIRCUIT-BREAKERS.

breaking the circuit is taken by an arcing tip, which may easily be replaced.

The contacts are of the typical Westinghouse design and deserve especial notice. The movable contacts are in the shape of truncated cones and fit into corresponding surfaces in the stationary contacts which are made up of a number of copper springs. This arrangement not only gives a large area of contact but insures a positive contact over its entire surface, and entirely prevents "freezing" under any condition of overload. The tanks are liberally insulated and the inner surface so shaped as to reduce the amount of oil required, and therefore the fire risk to a minimum. The open position is in all cases maintained by gravity.

A simple system of levers and toggles is mounted on the top of the base and a powerful electromagnet is arranged with its movable core attached to the lever system, so that when the magnet is energized the circuit-breaker will be closed. The standard voltage used on the solenoid is 125 volts. A second electromagnet acts as a tripping coil and may be controlled by a relay of any desired type. A small single-pole double-throw switch is mounted on the base and is operated by the motion of the levers in opening or closing this circuit; it controls the telltale indicator and lamp which are mounted in view of the operator.

The entire mechanism is compact and solid in construction, while the insulation has been carefully provided for. As in other Westinghouse oil circuit-breakers, the break takes place near the surface of the oil instead of at the bottom, where there is almost always a certain amount of sediment. These circuit-breakers have no live parts exposed. The oil tanks are firmly held in position by special holders which, by the simple movement of a lever, may be removed and all contacts examined without disturbing any other part of the circuit-breaker. The ultimate breaking capacity of these circuit-breakers is, for single-phase, 6,000 kilowatt; two-phase, 12,000 kilowatts; three-phase, 10,400 kilowatts.

Electricity for Transcontinental Steam Railroads.

Several steam railroads in the Trans-Mississippi region are changing from steam to electric power on their suburban trains, and now investigations are in progress looking to the substitution of electric motors for heavy freight engines on two transcontinental roads. These investigations have already revealed, it is said, that the waterpower in the Cascade Mountains is sufficient to furnish electricity for motors to take the place of steam engines on the mountain division, and that the cost of generating and transmitting electrical energy will be much less than the cost of the coal now used in the locomotives. Last year, it is said, the Northern Pacific and Great Northern steam roads used over 3,000,000 tons of coal, and the average cost was over $2 a ton.

Distinguished Ladies Inspect Electrical Novelties.

The Boston Edison Company takes pride in its exhibition department, the purpose of which is indicated by the name. In a recent issue of its house organ, Edison Light, it tells the following interesting story of this department:

A handsome coupe stopping in front of the exhibition department of the Edison Company is no unusual sight, but when one did so, during the afternoon of Monday, November 14th, and two distinguished and stylishly gowned ladies alighted and entered, the instantaneous flutter of excitement which pervaded the group of 40 or 50 ladies present gave evidence of unusual interest on their part, and this excitement increased as the names of Mrs. Jack Gardner and Madame Melba were whispered about. These two ladies, apparently unconscious of the interest their appearance aroused, proceeded to look over the many electrical exhibits, evincing a lively interest in everything, but especially in those appliances intended for use in the home. The electric cooking, as demonstrated, seemed to appeal to them especially, and Madame Melba no sooner saw the electric irons than she immediately ordered one of the small "ladies' traveling irons" delivered in her apartments in the Hotel Touraine, and drew a pleasing verbal picture of the facility with which her maid would be able to give the finishing touch to some of her delicate apparel.

The house elevator aroused much interest on Mrs. Gardner's part, and she regretted not having known of it when she built her famous "palace" and was obliged to import the kind she there installed, admitting that the one exhibited has some decided advantages over hers. Both ladies showed an unusual knowledge of the advantages possessed by many of the heavier pieces of apparatus, and by their questions evinced an appreciation of their merits hardly to be expected.

The device which appealed most strongly to them both was the dainty little massage machine. When the charming prima donna spied it she immediately expressed the desire for a treatment, and declared, with many expressions of delight, that the headache from which she was suffering when she entered the room was wholly and almost immediately dispelled by a five-minute application of the truly wonderful little machine.

The ladies were anxious to see everything that was to be seen, and after writing their names on the telautograph, and seeing them reproduced in their identical handwriting at the other side of the room, left, with many expressions of pleasure and appreciation of the enterprise of the Edison Company in opening so comprehensive and instructive an exhibition.

Western Union Defeated in Pennsylvania Railroad Case.

A press dispatch from Washington, D. C., states that the Pennsylvania Railroad Company has won its fight for the removal of the poles of the Western Union Telegraph Company from the railroad's right-of-way. The Supreme Court of the United States has decided in favor of the Pensylvania company in the case brought against it by the Western Union company, involving the right of the railroad to remove the poles of the plaintiff. The opinion was handed down by Justice McKenna. The court holds in its decision that the congressional act of 1866, which controlled in the case, does not grant eminent domain to telegraph companies over the private property of railroad companies. By this decision the Pennsylvania company is permitted to retain the wires of the Postal Telegraph company on its lines east of Pittsburg, which were placed there two years ago, when the railroad company, after notifying the Western Union that its contract had expired and would not be renewed, summarily chopped down the poles of the telegraph company at the end of a six-month period of grace.

Steam Turbines for New Baltimore Power Plant.

An interesting feature of the recently announced developments in Baltimore is the exclusive adoption of the steam turbine as the prime mover in the new plant of the Baltimore Electric Power Company. A contract recently closed with the Westinghouse Machine Company provides an initial equipment of 4,000 kilowatts in two generating units of 2,000 kilowatts each. An electrical equipment, complete and modern in every particular, has also been contracted for.

Officers of the company state the power plant will embody the latest developments in steam and electrical engineering. The building is to be of fireproof construction throughout, the structural-steel frame also serving as supports for the boilers and the overhead coal bunkers. Being located outside of the congested districts of the city, all the boilers and heavy machinery will be on the ground floor. Floors and roofs will be of steel-concrete construction.

The company has secured a lot fronting on Gould Street and extending to the Patapsco River. This property comprises 6.4 acres, and by filling in to the wharf line, over three acres will be added to the area, which will give the company sufficient space to take care of the electric needs of Baltimore for a long period. The location of the plant on the water front, with the Baltimore and Ohio and Wabash railroad systems adjoining, affords ample facilities for securing coal either by rail or water. The distance from the center of the city to the new power house is about two miles and a half.

The steam-turbine plant will operate with a boiler pressure of 175 pounds and a superheat of about 100 degrees. A high-vacuum condensing system will be installed, capable of sustaining a vacuum of 28 inches at full load on the plant.

The plant in its entirety has been designed on the separate-unit plan, which virtually consists of a number of distinct power plants, placed side by side, each entirely separate from the other, but each capable of helping out the other in case any link in the system should be disabled. This holds good through the coal-handling apparatus, the boilers, steam piping, turbines, condensers, generators, switchboard, underground cable, etc., from the coal pile to the customer's building. In addition to this precaution against interruption of service, which is thus insured, the company will install a large storage battery, which will ordinarly "float" on the system.

The Baltimore Electric Power Company was recently organized with an authorized bond issue of $7,500,000 and a capital stock of $3,500,000. The officers of the new company are: President, D. E. Evans; treasurer, R. F. Bonsall; secretary, W. T. Spring. Pending a permanent organization, the directors of the new company are H. W. Webb, D. E. Evans, John T. Stone, W. T. Burroughs, R. F. Bonsall, W. T. Spring and George R. Webb

The construction work is already under way, and will be pushed as rapidly as possible, in order that the plant may be complete in all respects and running smoothly by next July

Japs' Methods of Destroying Electrically Charged Entanglements.

Frederick Villiers, artist for the Illustrated London News at Port Arthur, gives an interesting picture in that paper, ilustrating a wire entanglement on Banduzan Hill, the destruction of which gave the Japanese officers much concern, as the wires were understood to be highly charged with electricity. At length, he adds, they hit upon the idea of placing a charge of guncotton at the end of a stout bamboo 20 feet long with a fuse running down the center. Two soldiers then pushed the bamboo up to the entanglement, placed the charge against the supports, and fired the fuse from their end. The men suffered terribly from shell fire from the opposite fort before the Eleventh Division attacked it. After many lives had been lost in the attempt to destroy the entanglement it was discovered that the wires were only weakly charged with electricity, and accordingly they were cut with shears fitted with non-conducting handles."

Nobel Prizes Awarded.

A dispatch from Stockholm, dated December 10th, says that on that day the annual Nobel prizes were awarded as follows: Physics, Lord Rayleigh, professor of natural philosophy in the British Royal Institution; chemistry, Sir William Ramsay; medicine, Professor Pavloff of the Military Academy of Medicine at St. Petersburg. The prize for literature is divided between Frederick Mistral of France and Don José Echegaray of Spain. The peace prize is awarded to the Institute of International Law.

Electricity in an Ohio Coal Mine.

The electrical equipment of the Midvale-Goshen Coal Company at Wainwright, Ohio, although the plant is not yet complete, is of considerable interest. The haulage plant which draws the cars from the mine is operated by a 40-horsepower Westinghouse motor, power being conducted by band-and-pinion wheels to an enormous wheel set at an angle to the horizontal, about which a steel-wire cable passes. This cable connects with a similar wheel at the bottom of the slope inside the mine. It is fitted with small pulleys which run in grooved tracks on the trestle to the mouth of the mine and down the slope to where the cars from the mine proper are met. Automatic dogs on this cable catch the cars when they are placed in position and release them at the highest point on the trestle, whence they run by gravity to the dump. Here they are automatically emptied onto the screen, which in turn throws the coal into the loader. The cars then pass back by force of gravity on the return track to a point where they are caught by the cable and returned to the mine.

The current for the motor is furnished by a 150-kilowatt Morgan-Gardner generator, operated by a 225-horsepower McEwen engine. This generator also furnishes current for electric lights about the plant and throughout the mine and to the 39-inch Morgan-Gardner cutting machines, with which the mine is equipped, one now being in operation. As the plan contemplates the operation of another mine, two more generators are to be installed shortly, one of 100 kilowatts and the other of 150 kilowatts capacity. A 150-horsepower Erie engine has already been installed to operate the smaller machine, and another McEwen engine will be put in for the larger one.

A feature of this mine will be the self-propelling trucks for the coal-cutting machines, which are now dragged around by burros. The trucks and small gathering motors will be operated on the trolley system, wires being placed along the side of the entrance and the rooms. A knife switch will be placed at the entrance of each room, so that the current may be turned off when the machines are not working in any room. This will obviate the danger of miners getting injured by coming in contact with the wires. The introduction of the trolley system will do away with the reels on the machine trucks and gathering motors and make the operation of both more convenient. The tracks will consist of steel bonded rails.

The haulage motor has a mechanism for automatically turning off the current in case of a sudden stoppage of the machinery by accident, thus doing away with the danger of burning out the armatures. To still further reduce the danger of this trouble, the wheel in the slope, about which the cable passes, is fitted with immense steel springs, so that if the cable should get caught or anything else happen to cause a strain, there will be a play of about 18 inches before anything would break or the strain become too great on the motor. The plant is one of the best and most complete in any coal mine in that section of the country.

Another Substitute for Rubber.

The Mexican Press mentions a plant called "guayule" as a substitute for rubber. Carlos Aguirre, general representative of the company La Anglo-Mexicana, says that the company made numerous experiments in extracting from the shrub the gummy substance it contains and transforming it into rubber. When the success of these experiments was assured, the necessary patents were obtained and a small factory was established at Jimulco, state of Coahuila, which for about a year has been in operation, and $150,000 Mexican currency has been invested. The erection of several similar works in the frontier states is now contemplated. One of these plants is expected to furnish employment to about 500 men, and "guayule" to the value of about $100,000 Mexican currency has been contracted for.

The Sargent Complete-expansion Gas Engine.

The first successful double-acting tandem gas engine, and the first and only one to expand the burning charge to practically atmospheric pressure, to vary the point of cut-off of the admission inlet with the load and to advance the time of ignition as the mixture gets weaker and the inflammation slower, is said to be the Sargent engine, which is illustrated herewith. The advantages thus secured are increased efficiency, increased regularity in speed and smooth running under early cut-offs. The general design of this engine, as shown in Fig. 1, is such that all the strains come in a straight line, yet the free expansion of the cylinders and rods is provided for.

In the ordinary gas engine, the piston at full load draws in a cylinder full of combustible mixture, which, after compression and ignition, is expanded to the original volume and released at a pressure of 40 to 50 pounds absolute, and a temperature of from 1,500° to 1,800° F. In the Sargent gas engine the admission of gas and air at full load is cut off at from five-eighths to three-quarters of the admission stroke, depending on the fuel used, which, after compression and ignition, is expanded to the cylinder volume and is released a little above atmospheric pressure with a corresponding temperature of about 400° F. The point of cut-off, while constant for the full and most economical load of the engine, is made earlier by the governor as the load gets lighter or later as the load gets heavier, giving a large degree of flexibility.

No throttling action of the incoming charge, with its corresponding loss of efficiency, is possible, and, owing to the more complete expansion of the burning gases turning the heat into work instead of throwing it away in the exhaust, a lower terminal temperature and consequently a lower average temperature of the cylinders is maintained throughout the cycle. For this reason, engines of this type below 100 horsepower require no water-cooled pistons or rods.

The mechanism of the engine is as follows: A side shaft is driven by the crank shaft and governor through a pair of worm gears running in oil, carrying two cams for each explosion chamber, one for the igniter and one to operate the valve. These comprise all the moving mechanism except the valves and lever, as shown in Fig. 1, the other side of the engine being perfectly plain.

Fig 2 shows a section through the valves of one of the explosion chambers. By removing six nuts the valve bushing and valves can be removed from the cylinder for regrinding or inspection.

Gas is piped to the chamber (A) in the subbase and air to the chamber (B), which pass through the cylinder supports to the chambers (A') and (B'), ready to pass into the mixing chamber when the cam depression (MN) passes the roller and the ports (F) in the piston valve register with the ports (E) and (D) in the bushing. When the piston valve goes down to this position, the confined air in the piston valve dash pot forces open the poppet valve, thus giving free admission to the charge. When the point (N) of the cam reaches the roller, it is forced down, while the other end of the lever goes up, carrying the piston valve which cuts off the admission. The poppet-valve seats and both valves remain in normal position during compression, ignition, and expansion, or until the point (L) on the cam pushes the roller down and the piston up, which opens the poppet, and the exhaust gases pass out through the ports (K) and the elbow (W) to the exhaust pipe under the floor.

The poppet valve seals the opening in the combustion chamber during compression and inflammation, and the piston valve holding against no pressure, works loosely in its bushing, cutting off the admission and guiding the exhaust. As the poppet valve controls both the inlet and outlet gases, both the valve and seat keep cool and need to be ground not over once or twice a year. The mechanism is simple, and as the roller is always bearing on the cam, the valve motion is practically noiseless.

By revolving the piston valve by the index wheel, the blind port (S) varies the mixture to suit the gas, whether it has 100 or 1,000 British thermal units per cubic foot.

The speed of the Sargent engine is controlled by the well-known Rites inertia governor in the flywheel, which advances the valve shaft, in time, ahead of the crank shaft as the speed increases, thus diminishing the mean effective pressure with the load. As the load gets lighter, the cut-off becomes earlier, taking less of a constant mixture of gas and air into the cylinder, but as the burnt products in the clearance do not lessen, the mixture grows weaker and slower burning. If the ignition were at the same point as at full load, the highest pressure would not be obtained till the piston approached the middle of the stroke, where the cooling surface is so increased that the greater part of the heat goes into the water jacket rather than into the work. In the Sargent engine, the time of ignition advances with the cut-off, getting earlier as the mixture gets weaker, thus maintaining the highest pressure at the beginning of the stroke, irrespective of the load.

While the governor controls the speed through all ranges of load, the gas engine, like the steam engine, is not economical with very light loads. Where a variation in the turning moment is not objectionable, one or more of the explosion chambers may be cut out at will by the engineer, by simply raising to horizontal position a controlling lever which holds the exhaust open and the gas and air closed. This is very desirable in blowing engines, as they can be designed so that two explosion chambers will furnish air at 15 pounds and the four chambers at 30 pounds pressure. If at full load the engine is cutting off at three-quarters stroke an overload may be taken care of by a later cut, though at a decrease of efficiency.

The cylinders are oiled by a force feed pump or check-valve lubricators. The valve gets sufficient oil from the cylinders. The side shaft and out bearings are self-oiling. The cross-head guides, pin crank, pin and main bearings, which must be thoroughly lubricated at all times, are copiously oiled by the worm gears, which act as a pump.

Two electric igniters are placed in each explosion chamber in such a position that they are surrounded with a pure mixture at the time of ignition. Either will fire the charge, and should either become short-circuited the engineer is immediately advised.

The engine is started by compressed air. The pressure of the air when turned on at one cylinder puts the starting mechanism into operation and at the same time puts the cylinder out of service as a gas engine. When the engine is up to speed, turning off the air puts the gas engine into commission without changing a valve, cam or lever.

The Sargent gas engines are manufactured by the Wellman-Seaver-Morgan Company of Cleveland, Ohio.

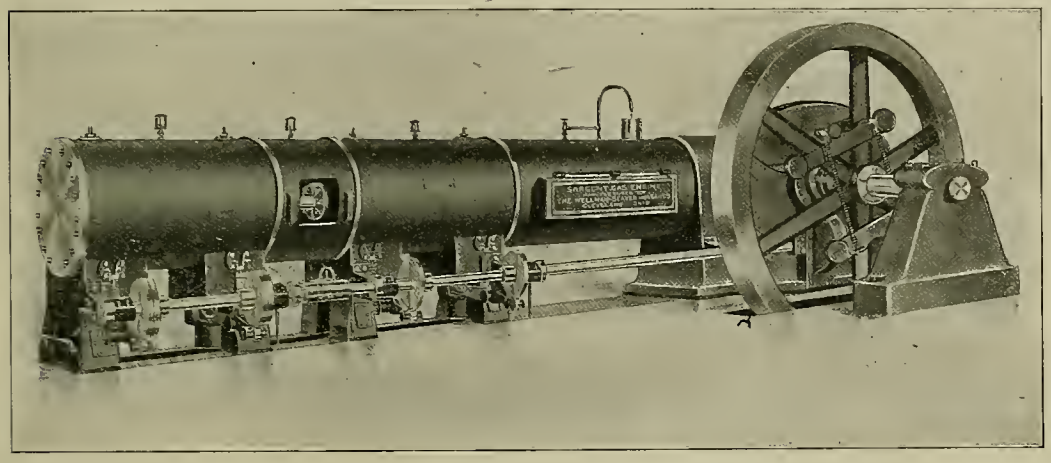


Fig. 1. General View.

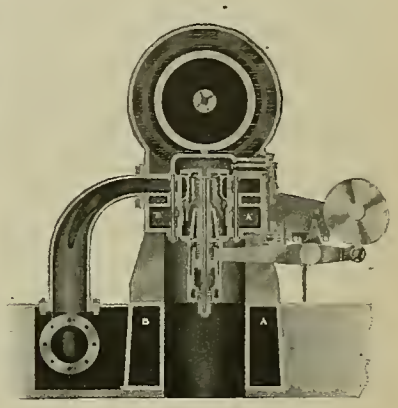


Fig. 2. Section through Valve.

SARGENT COMPLETE-EXPANSION GAS ENGINE.

Fargo Rejoices Over Its Street Railway.

The electric street-railway system in Fargo, N. D., built by the Fargo and Moorhead Street Railway Company, was formally opened to the public recently. The largest parade ever seen in Fargo followed the first modern electric car around one of the city loops. The line extends to the Agricultural College and to Moorhead, and is considered one of the finest systems in the Northwest. General Manager Heath and President L. B. Hanna were in charge of the opening ceremonies. It is said that 10,000 persons paid fares on the cars in one day shortly after regular service was begun.

H. F. McGregor of the Houston Electric Company of Houston, Texas, has been in Corpus Christi, Texas, looking over this city with a view to establishing an electric railway.

Some Refinements of Mechanical Science.[1]

By Ambrose Swasey.

For the subject of my address I wish to speak of a few of those methods and mechanisms which have been developed and perfected to such a degree of refinement that they may be considered as almost beyond the practical, and yet were it not for such refinements they could not possibly be made to serve the utilitarian purposes which make them of such inestimable value to us all.

The division and the measurement of time is today, as it has been for ages, among the most important of the subjects affecting the welfare of mankind, and as time has rolled on and there has been a better understanding of the laws governing the universe, nearer and nearer has been the approach to perfection in the working out of these difficult problems, but the many limitations surrounding them have always kept their full solution somewhere in the future.

The diurnal revolution of the earth, which gives the solar day, and the revolution of the earth around the sun, the solar year, are the arbitrary divisions of time marked off with the utmost precision by the celestial bodies; and while the length of the solar day has, from before the Christian Era, been fairly well defined, the length of the solar year was but approximately known until within a few hundred years.

The length of the year, as counted by the Julian calendar, was too long by 11 minutes and 14 seconds, and this error amounted to 10 full days in the 1,600 years from the time the Julian calendar went into effect, until the introduction of the Gregorian calendar.

A few years ago, when visiting the Vatican Observatory, I was particularly interested in the Gregorian Tower, which forms a part of the Vatican Library Building. After passing through a number of rooms which are used in connection with the observatory, when near the top of the tower, I was taken into the spacious and beautiful calendar room, the walls of which are covered with paintings of the highest order, executed centuries ago, under the direction of Pope Gregory XIII. In the center of the room, and forming a part of the floor, there was a large marble slab, on which was cut a fine line exactly in the true meridian, and upon the line was a special mark which indicated the altitude of the sun at noon of a certain day. On the south wall, near the top of the room, there was a small aperture through which the direct rays of the sun passed at noon, projecting a bright spot on the meridian line.

All of this had been planned and executed by the astronomers in order that they might demonstrate the necessity of reforming the calendar, and when at noon on the 23d of March, 1582, Pope Gregory saw that the altitude of the sun as shown by the beam of light, was not for that particular day, but for the day 10 days previous, he directed that 10 days be stricken from the calendar, and that day should be the 11th of March, instead of the 23d.

With such precision had the astronomers determined the true length of the year, that our present calendar with its intercalations will continue on for 20,000 years, with an error not to exceed a single day.

The line on the marble slab and the aperture through the wall of the calendar room were devices simple in the extreme, and in this day of instruments such a method would hardly be considered, yet they served their purposes admirably, and the placing of that line on the true meridian, with an accuracy never before attained, was considered one of the greatest scientific achievements of that age.

Since an unknown time the day has been divided into 24 hours, and as civilization has advanced, the greater has been the necessity for the utmost precision in the measurement of each hour, with its subdivisions.

The sun dial is not only the earliest, but the most interesting of all the numerous arrangements that have been devised for measuring the divisions of the day. Notwithstanding its limitations, it has been a subject which has attracted the brightest minds for ages. Within these later years there has been a renewed interest in this ancient time-keeper, not only in copying the types of dials, which are valuable because of their antiquity, but in working out new forms. Recently a new dial has been invented, by which the rays of the sun will indicate the true mean time for each day of the year, with an error not to exceed one minute.

The hour-glass, which came later, was considered a much more practical method, inasmuch as it could be used either day or night, and because its use was not confined to a particular location; however, as a timekeeper it was not satisfactory, even in those early days.

The clepsydra or water clock, which is supposed to have been invented by the Greeks, was found to be a much better timekeeper than either the sun dial or hour-glass, and it was a great step in advance toward the accurate measurement of time.

These water clocks are to this day used extensively in the East, more especially in China. Those first used by the Greeks consisted of two water jars so arranged that the water from the upper ran into the lower, and the time of day was determined by measuring the depth of water in the upper jar, and at sunrise each day the water was returned to the upper jar. In the city of Canton there is a water clock which has been running for 800 years, and at the present time it is the standard clock of that city.

This clock consists of four water jars, each having a capacity of eight or 10 gallons. The jars are placed one above the other, in the form of a terrace, the three upper ones being provided with a small orifice near the bottom, through which the water drops into the jar next below, and so on down from one to the other, until the water reaches the lowest or registering jar. In this there is a float, to which is attached an upright, having graduations for the hours and parts of hours, and as the water rises the time can be determined by noting the height of the float in relation to the cross-bar at the top of the jar.

In this improved form of water clock the variation in the flow of water due to the difference in height, is overcome by having a series of jars, the outlet of the upper being so gradnated that there is but little variation in the height of water in the second jar, and in the third the height remains practically uniform, thus insuring a constant head for the water which drops into the registering jar. At the beginning of each day the water is taken from below and carried up a flight of steps to the top.

That such an arrangement has some elements favorable to the accurate measurement of time, there can be no doubt. It certainly has the element of simplicity, and notwithstanding its long service, the only wear noticeable, was confined to the steps leading to the upper jar.

Clocks of the present type, although used as far back as the twelfth century, and possibly earlier, were but fair timekeepers, until several centuries later. Those which the astronomers used in their observatories at the end of the fifteenth century were so unreliable that modified forms of the clepsydra of the ancients were used, and, as they did not prove to be satisfactory, most of the observations were made without the use of clocks.

Galileo's beautiful discovery of the isochronism of the pendulum from the swinging chandelier in the church at Pisa was of great value in many respects, but in none more so than in its application to the measurement of time.

Soon after that great discovery the English clockmaker, Graham, invented the mercurial pendulum, by which the variation in its length caused by the difference in temperature was fully compensated, and some years later Harrison, another English clockmaker, invented a compensating pendulum, which consisted of a series of metal bars having different coefficients of expansion—so that 200 years ago, as it is today, the pendulum was the nearest perfect of all the devices that have been employed for governing or controlling the motions of a clock mechanism.

Every part of the clock, down to the minutest detail, has been the subject of study and improvement, and they are made and adjusted with such precision and delicacy that in testing them the question is, Within how small a fraction of a second will they run? Not content with their marvelous performance when under normal conditions, some of the finest astronomical clocks are surrounded by glass or metal cases, in which a partial vacuum is maintained, and in order that the cases may not be opened or disturbed, the winding is done automatically by means of electricity, the frequency of the winding in some cases being as often as once every minute. These clocks are set up in especially constructed rooms or underground vaults, where they are free from jar or vibration, where the temperature and barometric conditions remain practically constant, and where every possible precaution is taken to further minimize the errors of the running rate. A clock in the observatory at Berlin has run for several months, under these favorable conditions, with a rate having a mean error of but fifteen one-thousandths of a second per day and a maximum error of but thirty one-thousandths of a second per day.

Another clock installed at the observatory of Case School of Applied Science at Cleveland, running under similar conditions, also has a mean error of fifteen one-thousands of a second per day, with a maximum error for several months of but twenty-two one-thonsandths of a second per day.

These are notable examples of the present state of the art of clockmaking, and show the wonderful precision with which minute intervals of time can be measured.

From the time of the invention of Peter Hele, in 1477, of the "Nuremburg animated egg," or "pocket clock," which required winding twice a day, and varied an hour and a half in the same length of time, the development of the watch has kept pace with the "mother clock," and followed closely to it in timekeeping qualities.

These marvelous little machines, whether made at the homes of the peasants among the hills and mountains of Switzerland, where the skill required for making a single part has been handed down from generation to generation, or made in the great factories of this country, where fully 2,000,000 high-grade movements are turned out annually, and where the skill of the workmen has been supplemented by modern methods and machinery, are, notwithstanding the difficulties attending their manufacture, produced so cheaply as to be within the reach of almost everyone.

The larger watch, or ship chronometer, with its escapement so delicately made and adjusted that it must always be kept in the same position, was greatly improved through the efforts of the British government in 1714 by offering rewards of 10, 15 and 20 thousand pounds to any who should make chronometers that would run so accurately that the longitude of a ship at sea could be determined within 60, 40 and 30 miles, and Harrison, the inventor of the compensating pendulum and the compensating balance, which is now used in watches, succeeded in making a chronometer, which, after being tested on a long voyage, was found to run so closely that the position of the ship was determined within 18 miles, and he was therefore paid the full award of 20,000 pounds. The historic chronometer, which marked a new era in navigation, is now numbered among the treasures of the Greenwich Observatory.

Modern ships are equipped with chronometers so accurate and so reliable, and with sextants of such precision that navigators can determine their position in latitude and longitude within a few miles. Therefore, with the increased speed of the powerful ships carrying hundreds or even thousands of passengers, together with their valuable cargoes, the methods and instruments used in navigation have been so improved as to greatly diminish the dangers in crossing the seas.

The perfection attained in the measurement of time, which is of such great practical value in nearly every sphere of life, would not have been possible were it not for the even greater refinements that have characterized the methods and instruments used by the astronomer in determining the length of the day and of the year, which are the fundamental standards of time.

The division of the circle and the measurement of angles have ever been among the unsolved problems of the astronomer, yet in the instruments used by him, circles have formed a most important part.

Long before the telescope was invented, Tycho Brahe, the Danish astronomer, "the founder of modern astronomy," constructed for his observatory instruments of various kinds having graduated circles and arcs of circles. His instruments for the most part were improvements on those used by Arabian astronomers in the eighth and ninth centuries, and these, in turn, were copied after similar instruments used by the Greeks and Egyptians, a thousand years previous, and it is supposed that such instruments were used by the Chinese at an even earlier period, so that graduated circles have come down to us from the far-off ages.

The longer the radius the more accurate the graduations, was the principle upon which the early instruments were made. The Arabians, in about the year 1000, built a sextant with a 60-foot radius and a quadrant with a 21-foot radius, but to Tycho Brahe is due to credit of constructing instruments having circles, much smaller in diameter and graduated with a greater precision than ever before. It was by the use of such improved instruments of his own making, and by his observations which were made without a telescope or any means of magnification, that he was able to give the positions of a large number of stars within less than one minute of arc from the positions given by modern astronomers.

The graduation of an eight-foor mural circle in 1725 by Graham of England for the National Observatory, and of an eight-foot quadrant by Bird, in 1767, were notable steps in advance in the division of the circle and the measurement of angles, but these and similar instruments, although their efficiency was greatly augmented by the use of the telescope, have been supplanted by others more practical.

The first circular dividing engine was made in 1740 by Henry Hindley of New York for cutting the teeth of clock wheels, and it is interesting to note that in the same year Huntsmann, another clockmaker of Sheffield, invented the process of making crucible steel, that he might have a metal suitable for the springs of his clocks.

Of the several engines constructed later, the one most successful and representing the greatest proggress, was that made by Ramsden in 1777. This engine, automatic in its movements, was made especially for graduating circles, and because of the great precision with which he divided the circles of the instruments used by the government, the Board of Longitude awarded him the sum of 615 pounds. A further and most potent recognition of the excellence of his work lies in the fact that all subsequent circular-dividing engines have followed closely the same general principles of construction embodied in the Ramsden engine.

It is most gratifying to all those who are interested in mechanical progress that the Ramsden engine has been preserved throughout all these years, and it now stands in the museum of the Smithsonian Institution at Washington as a monument to the one who made it and as the best example of that time of the art of graduating circles.

Many excellent dividing engines have been made that are quite sufficient in point of accuracy for the work for which they were intended, but the perfection required in the graduation of circles for astronomical instruments is such that it has been found to be one of the most difficult of all mechanical problems to make an engine that will meet such requirements.

1. Presidential address at the New York meeting (December, 1904) of the American Society of Mechanical Engineers.

In such an engine the chief essential is that the spindle carrying the master-plate shall be as nearly round and as closely fitted in its bearings as is possible, for the degree of excellence with which that work is done determines how closely a circle can be divided.

It seems almost incredible that a well-lubricated spindle of four inches in diameter at its largest part and tapering three-quarters of an inch to the foot can be made so nearly round and so closely fitted in its bearings that a movement of one-thousandth of an inch in or out of its bearings will in one case cause it to turn with difficulty, and in the other with perfect freedom, yet this has been found to be within the limits of mechanical refinements.

The greatest accuracy thus far attained in such engines is one second of arc, which arc, with a radius of three miles equals one inch, and at 20 inches, which is the radius of the silver ring upon which the graduations on the master-plate are made, a line one-thousandth of an inch in width is equal to 12 seconds of arc, or 12 times the accumulated errors of any number of divisions, or 20 times the greatest error of any single division.

In automatically graduating a circle it has been found to be impracticable to cut more than six lines in a minute, and it requires about 33 hours to divide a circle into two-minute spaces. As with the running of the finest clocks, the best results can only be obtained when the engine is surrounded with every favorable condition possible. Instead of the large circles and sectors used by the ancients, they have been made smaller in diameter, as the methods for graduating have been improved, until those of the more modern instruments are seldom more than 30 inches, and some of the latest meridian instruments have circles of but 25 inches.

The smaller circles, which can be made and graduated with greater precision than the larger ones, are also less liable to change in form, owing to their weight and the variation in temperature, and with the aid of the reading miscroscope the results obtained would not be possible with the larger circles.

A 25-inch circle read with a microscope having a power of 40, would be equivalent to a circle of about 80 feet in diameter, and a single second of arc as seen through the microscope would be equal to 0.0024 of an inch, a quantity easily subdivided.

A most important adjunct to the astronomer's instrumental equipment is the filar micrometer. With it he determines the errors of divisions, the eccentricity of his circle and measures the angles to within a fraction of a second; and when used at the eye end of the telescope he determines the positions and motions of the stars and the distances and diameters of the planets. In these little instruments, whether of the simple or complex form, the chief requisites are the screw and the cross wires, for upon them the value of the observations and measurements depend.

To make the screw of a micrometer so true that the errors in the threads cannot be detected by its own magnifying power, is an extremely difficult task. These micrometer screws are often made with 100 threads to the inch, and are provided with graduated drums having 100 divisions, the readings being made in tenths of a division.

The cross wires, which are but common spider lines, because of their fineness and the remarkable qualities they possess, are indispensable in micrometric work.

That the repulsive and even dangerous spider has plenty of enemies among the human family, there can be no doubt, yet if the value of the contributions which it has made to the cause of science were generally known, it would surely have a greater number of friends than at present, and most certainly the astronomer will say naught against it, for, after the experience of many years, he has found that the spider furnishes the only thread which can be successfully used in carrying on his work.

The spider lines mostly used are from one-fifth to one-seventh of a thousandth of an inch in diameter, and, in addition to their strength and elasticity, they have the peculiar property of withstanding great changes of temperature, and often when measuring the sun spots, although the heat is so intense as to crack the lenses of the micrometer eyepiece, yet the spider lines are not in the least injured.

The threads of the silkworm, although of great value as a commercial product, are so coarse and rough compared with the silk of the spider that they cannot be used in such instruments.

Platinum wires are made sufficiently fine, and make most excellent cross wires for instruments where low magnifying powers are used, yet as the power increases they become rough and imperfect.

Spider lines, although but a fraction of a thousanth of an inch in diameter, are made up of several thousands of microscopic streams of fluid, which unite and form a single line, and it is because of this that they remain true and round under the highest magnifying power.

An instance of the durability of the spider lines is found at the Allegheny Observatory, where the same set of lines in the micrometer of the transit instrument has been in use since 1859.

The placing of the spider lines in the micrometer is a work of great delicacy, and in some micrometers there are as many as 30, which form a reticule, with lines two one-thousandths of an inch apart, and parallel with each other, under the highest magnifying power.

Step by step, from the methods of the Arabian astronomers to the time of Tycho Brahe and on down to the present day, improvements in the instruments and methods for the measurement of angles have been going on, until astronomers can measure double stars with a separation of one second of arc, and within less than one second they can define their positions in the heavens.

In the realm of the measurements of minute linear distances, and the perfection of curved and flat surfaces, the refinements are even greater than those pertaining to the measurement of time and of angles.

Most important in the linear dividing engine is the screw, and although much had been accomplished in bringing such engines to a high degree of excellence, it was for Professor Rowland to make an engine which has a practically perfect screw; and without doubt it is in all respects the nearest perfect of all the mechanisms that have been employed for ruling lines exactly parallel and equally spaced.

The Rowland engine was made especially for ruling diffraction gratings, which are made of speculum metal, and with it a metal surface has been ruled with 160,000 lines, there being about 29,000 to the inch, and as many as 43,000 lines to the inch have been ruled.

The gratings mostly used have from 14,000 to 20,000 lines to the inch, and with such exactness is the cutting tool moved by the screw that the greatest error in the ruling does not exceed one-millionth of an inch.

The production of these gratings, which has enabled the physicist in his study of the spectrum to enter fields of research before unknown, has not only called for the highest degree of perfection ever attained in the spacing of linear distances, but it has also called for a refinement most difficult in the optical surfaces upon which the lines are ruled. To Mr. Brashear was given the problem of producing such surfaces, and, notwithstanding the many difficulties encountered in working and refining the speculum metal plates, he has made many hundred plates, with surfaces either flat or curved, with an error not to exceed one-tenth of a wave length of light, or one four-hundred-thousandth of an inch.

The established standards of length which are the yard of Great Britain and the meter of France, being made of metal, and liable to destruction or damage, Professor Michelson conceived the idea of determining the length of these standards in wave lengths of light, which would be a basis of value unalterable and indestructible.

For the purpose of carrying out these experiments the interferometer was constructed, an instrument which required the highest order of workmanship and the greatest skill of the optician. Again, Mr. Brashear proved to be equal to the occasion, and made for the instrument a series of refracting plates, the surfaces of which were flat within one-twentieth of a wave length of light, with sides parallel within one second. This was the most difficult work ever attempted in the refinement of optical surfaces.

Professors Michelson and Morley devised a method for using the interferometer for making the wave length of some definite light an actual and practical standard of length. So satisfactory was the result that Professor Michelson was invited to continue the experiments at the Bureau of Weights and Measures, at Sèvres, France, where the standard meter, which is kept in an underground vault and inspected only at long intervals, was used for that important work, which occupied nearly a year. The final result of the experiments shows that there are 1,553,164.5 wave lengths of red cadmium light in the French standard meter, at 15° Centigrade. So great is the accuracy of these experiments that they can be repeated within one part in 2,000,000. Should the material standard of length be damaged or destroyed, the standard wave length of light will remain unaltered, as a basis from which an exact duplicate of the original standard can be made. These two marvelous instruments, the Rowland dividing engine and the Michelson interferometer, show the possibilities in the perfection of linear divisions and the standards of length.

We have recounted some steps of the progress that has been made in the measurement of time, of angles and of length, together with some of the refinements in these measurements, but we are confronted with the fact that, notwithstanding all that has been accomplished from centuries past down to the present time, that, as ever before, there are many imperfections requiring new problems in mechanical science to be worked out for the further enlightenment and welfare of mankind.

Michigan Electrical Machinery to Be Tabulated.

An electrical club of 40 members, consisting mainly of sophomore and junior engineers, has been organized at the Michigan Agricultural College at Lansing. Besides a regular weekly meeting for the discussion of items of interest in the electrical world, each member will, during the coming vacation, inspect two or three power plants, and the information secured concerning these will be used as a beginning in the matter of an exhaustive tabulation of the electrical machinery used in the various Michigan power plants.

Importer May File Corrected Invoice.

An interesting decision in which the importers' contention was sustained has just been rendered by the board of general appraisers in the case of the Commercial Cable Company against the collector of customs at New York. The goods involved consisted of telegraph instruments imported through the port of New York. Entry was made on a pro forma invoice on April 19, 1904, the importers estimating the value of the merchandise at $1,662. Before any action was taken by the local appraiser toward ascertaining the market value of the goods and prior to liquidation of the entry by the collector, the importers produced an invoice, duly certified by the consul, which was filed with the collector on April 21, 1904. On May 3d following the local appraiser made his return, approving the value named on the certified invoice, and finding that the goods had a foreign market value of about $27 less than that made on the pro forma invoice, but being the value exactly stated on the certified invoice. The collector, however, assessed duty upon the goods on the basis of the valuation shown by the entry based on the pro forma invoice. The importers contended that the assessment should be made upon the valuation as shown by the consular invoice and the return of the local appraiser.

The board sustained this contention and overruled the collector's decision, holding in effect that when entry is made on a pro forma invoice and a bond is given for the production of a consular invoice, as required by section 4 of the customs administrative act of June 10, 1890, the entry remains "open" until the conditions of the bond have been fulfilled or until the bond itself has become forfeited. When the consular invoice is duly produced to the collector and approved by the appraiser the entry should be liquidated on the basis of the value shown by the consular invoice rather than of the pro forma invoice.

It is now settled beyond question that, in a proper case, an importer has the right to file a corrected invoice in place of one that he finds to be incorrect. T.

Waterpower Possibilities in Texas.

Waterpower in Texas in many localities is only partially developed, according to a report recently made by Mr. Thomas U. Taylor of the United States Geological Survey. There are, however, many plants in the state which have been built upon scientific principles, with modern machinery, and which obtain high efficiency. A large percentage of the plants now in existence are located on Guadalupe, Colorado and Brazos rivers and their tributaries. Guadalupe River easily takes rank as the most effective of the power-generating streams in the state. There are more power plants on Neches and Sabine rivers and their tributaries than on the rivers farther west, but these plants are usually only small mills of six to 30 horsepower, which are used for ginning cotton, sawing lumber, or grinding corn.

In Eastern Texas the country is heavily wooded and is traversed by many small streams which are for the most part tributaries of Sabine River or Neches River and are not subject to sudden fluctuations in height. The water is held back by the leaves, roots and low-growing vegetation which cover the earth and it flows off gradually, so that there is little occasion for shutting down plants on account of low water. The power plants in Western Texas are larger, but the streams are subject to sudden rises and falls, especially the streams that flow through the mountains of Edwards Plateau, such as the Colorado, Guadalupe and Nueces.

Mineral Products of the United States.

The United States Geological Survey has issued a chart which gives in tabular form the quantity and value of the United States mineral products, annually, since 1894. The total value of metallic products alone in the calendar year 1903 is given as $624,318,008, as compared with $642,258,584 in 1902. Of the metals and minerals, excepting iron, entering into the electrical industry to a considerable extent, the following table shows the quantity and value of the products in 1894, compared with 1903:

	1894.		1903.	
	Quantity.	Value.	Quantity.	Value.
Copper, pounds	364,866,808	$33,141,142	698,044,517	$91,506,006
Lead, short tons	159,331	9,942,254	280,000	23,520,000
Zinc, short tons	75,328	5,288,026	159,219	16,717,995
Aluminum, pounds	550,000	316,250	7,500,000	2,284,900
Platinum, troy ounces	100	600	110	2,080
Mica, pounds	.....	52,388	90,100* / 1,693†	17,128 / 41,990
Uranium and vanadium, short tons	.....	.....	19	5,625

*Sheet, pounds. †Scrap, tons.

The Cunard Line steamer Campania reports that on a recent voyage she was in wireless communication with 12 ocean liners, 10 of which were bound for America and two for Great Britain. When 1,200 miles out the Saxonia, the Ivernia and the Campania were in communication at the same time.

Recent Advances in Applied Electrochemistry.[1]

By Dr. K. Elbs.

Electrometallurgy.

Copper.—The total amount of electrolytic copper produced in the year 1903 was probably about 318,000 tons, of which the United States made 86 per cent., Great Britain nine per cent., Germany three per cent., and France two per cent. During the previous year from the 278,000 tons of pure copper manufactured in North America some 800 tons of fine silver worth $13,000,000 and 7,500 kilograms of fine gold worth $5,000,000 were recovered. G. Kroupa has found that American anode slime contains on an average 50 to 75 per cent. of silver, 0.014 to 0.686 per cent. of gold and 10 to 40 per cent. of copper. The largest factories there turn out as much as 27 wagonloads of copper per day, together with about 300 kilograms of silver and five or six kilograms of gold. The slimes are either worked up by furnacing or in the wet way by extracting the silver and copper with sulphuric acid and then decomposing the silver sulphate with metallic copper. The electrolytic processes which have been proposed for the treatment of copper ores have not proved satisfactory on the large scale, e. g., those suggested by Höpfner and by Siemens and Halske.

Nickel.—A strictly electrolytic method of winning nickel from its ores has not been devised; but T. Ulke has worked out a process for separating nickel and copper, which is practicable, though not altogether new. An alloy, preferably consisting of about 80 per cent. of copper and 20 per cent. of nickel, is prepared from the ore and used as an anode against a copper cathode in a bath of copper and nickel sulphates strongly acidified with sulphuric acid. The anode dissolves, fine copper falls at the cathode and the bath gradually becomes stronger in nickel. A portion of the electrolyte is removed from time to time and replaced by a solution of copper sulphate which need not be pure as long as it is rich in that metal. From the liquid which has been withdrawn either the copper is precipitated as sulphide or the nickel as nickel ammonium sulphate, the nickel being thrown down electrolytically from its ammoniacal solution by means of lead anodes. Borchers and Günther have sugested a similar process and have proposed that during the electrolysis of the nickel white lead or chrome yellow should be made by the Luckow method. For the refining of nickel D. H. Browne uses a hot solution of nickel chloride containing common salt at the works of the Canadian Copper Company, which were removed from Cleveland some time ago to be erected on a larger scale elsewhere.

Mercury.—The only novelty to be recorded is the proposal of H. Becker's to obtain the metal by distilling a mixture of cinnabar and chalk in the electric furnace.

Zinc.—S. S. Sadtler has proposed to obtain a liquid by acting upon a mixture of zinc and zinc sulphide with a strongly alkaline solution of sodium hypochlorite, from which pure zinc may be won by electrolysis. The idea does not appear very promising. A. Salgués has suggested the treatment of zinc ores in the electric furnace, and the process is in operation in the Ariège. No technical opinion has been passed upon it, but in view of the great heat losses in the ordinary metallurgy of zinc, Salgués' process may well prove successful.

Iron.—Stassano has an arc furnace running in Upper Italy upon the pure ores found there which is showing a thermal efficiency of over 60 per cent. The furnace is one of 500 horsepower, taking an alternating current of 2,000 amperes at 170 volts and giving an arc one meter long. At present the yield has the qualities of Martin steel, but by further improvements it seems possible that a crucible steel may be obtained. Keller is using two superposed furnaces, the upper one being a resistance furnace in which the ores are reduced, and the lower one being employed for refining the metal. At La Praz, Héroult is obtaining tool steel of the best quality by smelting a mixture of cast-iron and steel scrap in a furnace shaped like a Bessemer converter, with the aid of two alternating arcs of 4,000 amperes at 60 volts, the output per run being three tons. A similar furnace is being erected in Sweden on the railway between Granbergsdal and Kortfors. Kjellin is making crucible steel of the best quality at Gysinge in Sweden in a furnace which contains no electrodes. An alternating current of high tension but small in volume is led to the furnace, which acts with the molten metal in it as a step-down transformer. The charge consists of one ton of a mixture of charcoal iron and mild steel. This furnace is running regularly and enlargements of the plant are contemplated. The electrical smelting of iron ores can only be successful commercially where coal is dear, waterpower present and the ores are good and cheap; but, on the other hand, it appears as if steel may be profitably made electrically alongside the blast furnace, the dynamos being driven by gas engines fed with the waste gases from the blast furnaces.

Potassium.—A method has been worked out by Lorenz, Clark and Sacher for avoiding the trouble usually experienced from the vaporization of the potassium at the temperature of the bath. Dry caustic potash is fused in an iron vessel and electrolyzed between a sheet-iron anode and a cathode of iron wire. The latter passes through the bottom of a hollow inverted cylinder of magnesite, the mouth of which dips below the surface of the electrolyte. When the cylinder is nearly full of metal it is allowed to cool somewhat, plunged into petroleum and broken. The current efficiency is about 58 per cent. Sodium can be advantageously made in a similar fashion, but not barium from its oxide. The process is not suitable for the electrolysis of chlorides, as the cylinder quickly becomes injured.

1. Extracts from a report in the Chemiker-Zeitung.

Manufacture of Compound Bodies in the Furnace.

Calcium Carbide.—Some of the carbide factories which are unable to find a market for their product have introduced the manufacture of ferro silicons containing from 25 to 75 per cent. of silicon; others, such as those at Landeck and Matrei, are producing silicon-copper containing from 35 to 50 per cent. of silicon. A more promising outlook for this industry lies in the preparation of calcium cyanamide. When calcium cyanamide, $CaCN_2$, is treated with steam under pressure it is decomposed into calcium carbonate and ammonia. When it is extracted with hot water a white crystalline mass is obtained on cooling, which consists of dicyandiamide $(CN_2H_2)_2$; and when this is fused with sodium carbonate the chief yield is sodium cyanide and ammonia. Small quantities of of tricyantriamide $(CN_2H_2)_3$, or melamine, are also produced, but these can also be worked up into cyanide and ammonia. Calcium cyanamide is quite free from poisonous properties. As mentioned elsewhere, calcium cyanamide can either be prepared by heating previously made calcium carbide to redness in presence of atmospheric nitrogen or in one operation by fusing lime and coke in presence of nitrogen in the electric furnace. The former material contains about 20 to 22 per cent. of nitrogen; the latter about 12 to 14 per cent.. Together with the process for making nitric acid elaborated by Oswald, which consists in leading a mixture of ammonia and air over glowing platinum and the partially successful method of causing the oxygen and the nitrogen of the air to unite under the influence of an electric spark, we have now means of preparing ammoniacal and nitric nitrogen compounds from the air, which will be ready for adoption on the large scale before the Chilian deposits of sodium nitrate are exhausted.

Siloxicon.—By heating silica and carbon in an electric furnace, Acheson has prepared a new material bearing this name, which appears to possess all the refractory and chemically indifferent properties found in carborundum. Its formula is C_2Si_2O, or C_7Si_7O, and it is obtained when the amount of carbon in the charge is insufficient to insure complete reduction of the silica, and at a lower temperature than that necessary for the formation of carborundum.

Manufacture of Compound Bodies, etc., by Electrolysis.

Hydrogen, Oxygen and Ozone.—At the present time some 28,000 tons of caustic potash and 5,000 tons of caustic soda are being produced in Germany alone every year by electrolysis of their chlorides, and during the process 625 tons, or 7,000,000 cubic meters of hydrogen are evolved. This cannot be allowed to escape into the factories, for fear of explosions, and it is usually led through pipes into the air, and blown to waste. Naturally the expenses of storing, compressing and forwarding the hydrogen to a consumer are heavy; and in many places it may be cheaper to obtain the gas by direct electrolysis. Nevertheless, the hydrogen obtained as a by-product in the alkali works, might be more generally employed than it is. Since 1899 the works at Griesheim has been supplying all the hydrogen required for filling Count Zeppelin's airship (which holds 10,000 cubic meters); and the factory at Bitterfeld has sent its hydrogen to the military aeronautical department at Berlin. The laboratory at Griesheim also uses hydrogen instead of coal gas. The gas is so light, and diffuses at such high speed, that it is less likely than coal gas to form explosive mixtures with air when it escapes; besides which its flame is hotter, and, containing no sulphur, it does not injure platinum crucibles, nor introduce errors into analytical results. The purification of potable water by means of ozone is fulfilling all expectations. An official report from the Department of Public Health states that the cost is 0.7 pfennig per cubic meter.

Alkali and Chlorine.—A patent has been taken out by the Austrian Verein für Chemische und Metallurgische Produktion, of Aussig, which gives several details respecting the "bell" method of making caustic not previously published. It is stated that the anode carbon should nearly fill the bell, so that the fresh chloride solution run into it can only have a narrow space to flow downward in, thus mixing more thoroughly with the rest of the anode liquid. There must be a certain fixed relationship (depending on the area of the bell) between the distance from the lower surface of the anode to the lower edge of the bell, and the amount of alkali in the cathode liquid which constantly flows away. O. Steiner has carried out some systematic experiments upon the same process. He finds that when run continuously, the bell process shows a current efficiency of 85 to 94 per cent., gives an alkaline liquor containing 120 to 130 grammes of KOH per liter, and a chlorine of 97 to 100 per cent. purity, and requires a current density of two to four amperes per square decimeter of horizontal bell area at a tension of 3.7 to 4.2 volts. Up to a maximum of 130 grammes of KOH per liter, the current efficiency is almost independent of the strength of the final liquor. Steiner also finds the statements made in the patent just mentioned, to be correct.

Hypochlorites.—The plan of adding the chloride of an alkaline earth metal to the chloride solution from which hypochlorites are to be made, has been known for some time; its efficacy depends on the formation of a film of hydroxide upon the cathode, which acts as a diaphragm, and diminishes cathodic reduction. Recently the company, formerly Schuckert & Co., has improved the idea by adding resin or a solution thereof to the electrolyte. There can be no doubt that it is cheaper to manufacture a certain quantity of "active" chlorine in the form of bleaching powder, as is done when caustic is made, than to install special electrolytic apparatus for the production of an equivalent amount of bleaching liquid from common salt, according to the well-known methods. Nevertheless, the preparation of the latter liquid is simpler, cheaper and cleaner than the solution and filtration of bleaching powder, while the operation of bleaching with the liquid is more rapid, and generally more complete; hence the special apparatus is serviceable, and, indeed, preferable, for cotton and linen and in steam laundries.

Chlorates.—As it has been found desirable to keep the chloride solution slightly acid, Lederlin has patented a process for adding a small quantity of hydrochloric acid to the chloride bath at intervals, while Threlfell and Wilson have patented a plan of using a subsidiary cathode behind a diaphragm, and diverting a portion of the current to it, so that the liquid near the anode may be kept acid. The National Electrolytic Company has a method of keeping the electrolyte at the necessary temperature by means of the current itself, and causing the liquid constantly to circulate outside the cell, where the chlorate is recovered by cooling and consequent crystallization.

Permanganates.—The factory at Griesheim has an electrolytic process of manufacturing manganates or permanganates of alkaline earth, earth or heavy metals from the corresponding compounds of the alkalis and the respective chlorides, which give as by-products alkali, hydrogen and oxygen or chlorine.

Persulphates.—According to Levi, alkali persulphates can be easily prepared without a diaphragm in the presence of some chromate. The liquid does not require such rigorous cooling, although above 30° C. the yield diminishes seriously.

Chromates.—The factory at Griesheim has patented two processes for the simultaneous manufacture of alkalis and alkali chromates. In one a salt solution is electrolyzed with an anode of chromium or an alloy thereof; in the other a mixture of a chromium and an alkali salt is electrolyzed with insoluble electrodes and a diaphragm.

Lead Compounds.—Ferchland has a process for making lead peroxide from an aqueous solution of the nitrate. Lead sponge separates at the cathode, lead peroxide at the anode, in coherent plates. The electrolyte becomes acid, and is neutralized by adding lead oxide or carbonate. The lead sponge is easily converted into oxide by heating it in air, and the oxide goes back into the bath. Hartmann has patented a modification of the Luckow method of making white lead, the utility of which appears doubtful. Instead of the lead cathode, which falls to pieces and contaminates the white lead with lead sponge, he proposes to employ a cathode of copper oxide, which is converted into metal, but remains coherent.

Organic Compounds.—Hofer and Moest have described (and the latter has patented) a process for obtaining alcohols by the electrolysis of aliphatic salts, in presence of perchloric acid with indifferent electrodes; sodium acetate, for instance, gives up to 90 per cent. of the theoretical yield of methyl alcohol. A patent has been taken out for the reduction of nitrobenzene to azoxybenzene, by suspending the former in aqueous potash, using a large cathode and a small anode, without a diaphragm. At the boiling point Meister, Lucius and Brüning find that the yield is chiefly azobenzene. Boehringer and Söhne find that nitro compounds can be reduced to amines electrolytically when suspended in alkaline or saline liquids, as well as in acid ones, a copper cathode being employed, and powdered copper being added. When the amine is not attacked by the alkali, the yield is almost quantitative, and the process can, therefore, be combined with a production of free alkali and chlorine. According to a subsidiary patent, the cathode need not be of copper, if powdered copper is used. Various other methods of preparing amines by electrolysis have been patented. During the last year 4,000,000 kilos of electrolytic chlorine were consumed in the manufacture of monochloracetic acid alone, this compound being employed in the synthesis of indigo.

It is reported that a trackless trolley street-railway system has begun operation in Berlin, Germany, with apparent success. The vehicles resemble electric omnibuses, but derive their power from an overhead trolley. They have a speed of 10 miles an hour and are equipped with a special type of wheels to prevent stoppages by snow.

CORRESPONDENCE.

Great Britain.

London, December 3.—The industrial depression which has existed to some extent in Great Britain during the last 18 months has defied a satisfactory explanation from many persons. It is not often, however, that responsible persons talk about this matter. Mr. Walter Emmott, chairman of the Leeds section of the Institution of Electrical Engineers, had something to say on this question in his address last week, and his views are those of a manufacturer. His opinion is that the cause of the depression has not been due to any want of energy on the part of those responsible for the industry, nor has it been due to any strained relations between capital and labor. In his opinion, this depression has attacked practically the whole of the civilized world, and is due to circumstances beyond human control. Had it been confined to Great Britain alone, we might have concluded that it was due to foreign competition. He had carefully studied all the returns and had confirmed his opinion that our safety lay in maintaining a firm grip on those departments over which we now had control, with a view to at least holding our own. In this connection he maintained that the effect of a complete system of standardization on the various engineering industries cannot be overestimated.

Despite the competition of the corporation, the National Telephone Company's subscribers in Glasgow have increased during the last year. The Swansea municipal telephone undertaking for the first year shows a revenue of nearly $20,000. At Portsmouth the corporation has now 2,000 subscribers' instruments connected up, and what is more—an unusual feature in municipal work of any kind here—the work has been carried out within the original estimates of cost.

It was reported in the daily papers this week that the Marconi people had succeeded in transmitting a wireless message from Cornwall to Italy, and that the Italian minister had replied to it by the same means.

An important result of the electrification of the Liverpool-Southport section of the Lancashire and Yorkshire railway is that a through service of trains can now be run over the system of the Liverpool overhead railway, thus making a direct connection with the Liverpool docks, which has hitherto been impossible. On the question of the electrification of steam railways, it is interesting to note that good progress is being made with the scheme of conversion for the lines of the Great Western Railway Company near London. A 10,000-kilowatt power station is to be erected, tenders for which have been let, as well as for the cables.

During the severe snowstorms last week while, on the one hand, several trolley tramway systems were dislocated through damage to overhead equipment, the surface-contact tramways at Wolverhampton were dislocated, owing to the thickness of snow and ice upon the contact studs.

The new alternating-current motor meter, which was placed on the market in England by the Aron Meter Company a short time back, is meeting with much favor, according to the report of the directors for the year, and the company's business generally in Great Britain has assumed a brighter aspect.

During the week several additional tube-railway schemes for London have been deposited with Parliament, one of them competing with the west-to-northeast route for a good part of the way. A strong opinion exists that these proposals should be allowed to come before Parliament, whether the Royal Commission on London Traffic reports or not this year, and unless this wish is acceded to it will be the second time in three years that promoters of tube-railway schemes in London have been put to the expense of promoting their lines and then having to abandon them for the year.

The question of gas engines for central-station work seems again to be attracting attention in Great Britain. One address to a local section of the Institution of Electrical Engineers and also a paper have already dealt with this matter. One opinion is that the present restricted development in the employment of gas engines has not been due to inability on the part of the gas-engine makers to make large engines, but more from the fact that power gas plants have not reached the necessary requirements of a large supply with a capital outlay in first cost and efficiency to compete with a large steam-raising plant.

The treasurer of the Royal Society has received a sum of $5,000 from an anonymous donor, to be devoted to the advancement of science. Two thousand five hundred dollars of this is to be placed to the credit of the catalogue of scientific papers account of the Royal Society and the remainder to the credit of the National Physical Laboratory account. G.

New York.

New York, December 10.—The event of the week, following up the resignation of Chief Engineer W. B. Parsons, has been the announcement of the retirement of J. B. McDonald, the bidder and constructor of the subway. He denies that his retirement is due to friction with August Belmont and refuses to admit that he will be the builder of a proposed Metropolitan subway should Mr. Vreeland obtain a franchise for an independent tunnel. The New York Tribune states that Mr. McDonald received $800,000 for assigning his contract to the Interborough company. A probable successor for the place vacated by Mr. McDonald is James H. Hyde, the vice-president of the Equitable Life Assurance Company, who has just been elected a director of the Rapid Transit Subway Company and the Interborough Rapid Transit Company. Mr. Hyde has large interests in both companies.

The question of the successor to Mr. Parsons is under discussion. The logical candidate would perhaps be George S. Rice, deputy chief engineer. He has been working on subway matters for several years and was formerly engineer of the Boston subway. Other candidates for the position are General Francis Vinton Greene, ex-police commissioner, and Mr. S. L. F. Deyo of the Interborough company.

The subway has passed with credit through its first ordeal of the rush entailed by a snowstorm. The first storm of the season in New York happened on Tuesday and led to a great rush for the dry tunnel. From 4:30 to 6:30 p. m. the subway trains were crowded to their utmost capacity, about 20,000 passengers having got aboard at City Hall. While there were blockades on many surface lines the traffic on the subway went through without a hitch.

The Interborough company has purchased, or is about to purchase, the franchise of the so-called "Steinway" tunnel under the East River, through which it is purposed to run trolleys from Manhattan to Long Island City. Amicable arrangements have been made not to clash with the Pennsylvania railroad tunnel now constructing.

The growing feeling against the overcrowding of surface cars was voiced in the New York Tribune of Thursday last by a letter from Mr. L. Duncan Bulkley. During a snowstorm he avers that there were but few cars running, and that on one of them he heard the conductor ring up 142 fares besides accepting many transfers.

After nearly a year's preparation the Rapid Transit Commission has issued its report on New York city traction for 1903. Plans and pictures elucidate the current problems.

The city budget for 1905 provides for an expenditure of $4,978,752 by the water and lighting department. Of this amount $122,230 is allotted to salaries for lighting and electricity and $3,422,438 for lamps, electricity and gas. Alderman Doull, a former secretary of the department of water supply, gas and electricity, stated before the City Council on Tuesday that gas was obsolete for the purposes of city lighting and predicted that in a few years only electricity would be used. He argued that if the city intended to erect its own lighting plant it ought to confine itself to the setting up of an electric-lighting plant capable of lighting only streets and public buildings.

Alderman Haggerty has framed a voluminous ordinance now under consideration by a committee, providing for rules and regulations for the installation of electric wiring for lighting, heating, machinery, fixtures and all electrical appliances in buildings and other structures within the city of New York. The proposed ordinance covers everything from power stations to electric fans, and if passed will involve the appointment of a large corps of electrical inspectors.

The Brooklyn Rapid Transit Company is making enlargements and improvements in the various stations of the Fifth Avenue and Bay Ridge elevated lines, at a cost of $250,000. The union station at Thirty-sixth Street will be enlarged and reconstructed; extra platforms and two new tracks will be built; the stations on the Fifth Avenue line will be lengthened to accommodate six-car trains, and large shops and a storage yard are to be built at the terminal. The same company is about to increase its service of express trains.

The Atlantic Avenue tunnel, Brooklyn, connecting with the Long Island railroad, is likely to be completed by the first of next June. The progress made by the contractors has been rapid and the work schedule first proposed will be kept. The entire track between the terminus of the improvement at Atkins Avenue and Jamaica has been laid with 100-pound steel rails, and the ducts for the electric feed cables are laid out as far as Jamaica.

G. F. Swinnerton, A. Fogshay and R. K. Thompson have incorporated the Queens-Nassau Electric Light and Power Company, with a capital of $100,000, to serve suburban Brooklyn. Headquarters will be at Valley Stream, L. I.

The John W. Wallace Company of 396-400 South Second Avenue, Brooklyn, is in the market for a number of individual electric motors for its sheet-metal plant. Steam is the present motive power. Its machinery includes a large die punch working with a pressure of 100 tons and said to be the largest of its kind in the world. This company has a new compound sheet metal from which it stamps out solid preserving pans, etc. This composite, which is made by a secret process, consists of 80 per cent. steel, with 10 per cent. facings of nickel and copper on the opposite sides. D. W. W.

New England.

Boston, December 10.—The Boston and Maine Railroad Company has put into effect after a conference between the management and the telegraphers in the road's employment, a new schedule of wages and working hours which is virtually an increase of pay for this class of employes of the road to the extent of adding about $37,000 to the corporation's annual expenses.

Work will be begun soon on the new two-mile stretch of Boston elevated road, which will extend from Dudley Street, the present terminus, to Forest Hills. The railway company is therefore in the market for about 10,000 tons of structural steel. The surveys were made some time ago. The railroad commission's assent has also been asked for by the company in order that the tracks in the new East Boston tunnel may be approved and accepted for use.

A controlling interest in the Fall River Automatic Telephone Company changed hands on Wednesday of last week. The purchasers are said to have been John T. Swift and certain associates. It will be continued as an Independent company, it is understood, and the officers will be retained for the present. E. B. Jennings is president, B. D. Davol treasurer, and the other directors are Quinlan Leary, R. F. Haffenreffer, Jr., Martin Feeney, A. P. Mathewson, R. J. Thompson, Michael Sweeney and Vinton A. Sears, the last-named of Boston.

The annual report of the Boston Elevated Railway Company for the year ended September 30, 1904, has just been made public. Operating expenses were $8,631,553, against $8,259,860 the previous year, an increase of 4.4 per cent.; net earnings, $3,759,799, against $3,699,654 the previous year, an increase of 1.6 per cent.; surplus applicable to dividends, $829,771, against $826,954 the previous year; passengers carried, 241,681,945, against 233,563,578 the previous year.

Ex-Alderman Harry B. Masters died suddenly at Brockton on Wednesday of last week while telephoning from the office of the Standard Oil Company to his home. Accounts of the accident are meager; a man in the office at the same time said afterward that he was so horrified when the fatality occurred that he hardly knew how it happened. He thought Mr. Masters sat down the telephone desk set after using it, and before letting go took hold of the electric-light switch to extinguish the light and so made a connection through his body. Mr. Masters had a firm hold of the electric-light fixture when he fell and the wire became twisted about his wrist. B.

Dominion of Canada.

Ottawa, Ont., December 10.—There are 300 men working on the Marconi wireless station at Port Morien, N. S. One of the towers is now up to a height of 70 feet, two of the others are about 30 feet high, while the fourth tower is only just commenced. The station is not expected to be completed before May or June next, when it will be opened by Mr. Marconi in person.

The members of the finance committee of the City Council of Kingston, Ont., have for six months been negotiating with various telephone companies. The council has now indorsed an agreement for an exclusive franchise to the Bell company for five years. The city is to receive $700 per year, free use of poles for fire-alarm wires, telephones to citizens at $30 for business places and $25 for residences, two party lines for residences at $18 each, and four at $15 each. The company also agrees to erect a fine office building and install metallic lines with latest improved instruments.

The town of Westmount, a suburb of Montreal, having a population of about 10,000, by vote has decided to own a plant to produce electric light, independent of the Montreal Light, Heat and Power Company. This action is in direct opposition to the power company, which obtained control of the field through an amalgamation of previously opposing concerns. A similar antagonistic feeling is said to exist in the city of Montreal.

The Ottawa civic committee which has been looking into the purchase of the electric street railway of the city for the sum demanded by the Ottawa Electric Company, viz., $3,000,000, has recommended that a by-law be prepared for submission of the project to the property owners of the city at the municipal election to be held in January next. The recommendation provides that the system be operated by a commission composed of the mayor and two citizens, not members of the City Council, to be elected for terms of not less than three years each, by the property owners, until the original debt on the undertaking is paid off. It is probable that the proposal will be ratified by the property owners, although there is considerable opposition manifested.

The latest scheme for power development along the Niagara frontier is decidedly unique. It has for its foundation the turning back of the waters of the Chippewa River, making its present source its mouth, and its outlet into Lake Ontario instead of into the Niagara River, as nature has fixed it. The proposition is to have the river empty into Lake Ontario, a short distance from Jordan Station, in Lincoln County, Ont. Those who are promoting the project say that their whole undertaking will be a comparatively easy one from an engineering standpoint. With the course of the Chippewa reversed, advantage can be taken, for power purposes, of the 300-foot drop between the level of the Niagara River, above Niagara Falls, and the level of Lake Ontario. It is claimed that the opportunities, above the Falls, for harnessing the forces of the combined lakes

are practically exhausted, while only a small portion of the estimated horsepower of the great cataract has been utilized. W.

Southeastern States.

Charlotte, N. C., December 10.—The Piedmont Electric Company of Anderson, S. C., has been chartered by the secretary of state, with a capital of $25,000. E. S. Moore is president and treasurer and E. F. Brown, secretary.

The Parr Shoals Power Company of Newberry County, S. C., has been commissioned with $50,000 capital to do a general power business. Those interested are M. G. Houseal, C. H. Cannon and K. W. Sligh of Newberry and C. L. Scott of Greenville.

The Parr Shoals Power Company of Newberry has been granted one year additional time in which to complete work on the road, the limit now being January 1, 1906.

The Board of Aldermen of High Point, N. C., will shortly consider a proposition to sell the electric-light plant, which, it is said, has not proved a paying investment to the city.

The Charleston and Summerville Railway Company of South Carolina, with $1,000,000 capital, has just been chartered to build an electric line between the points named. J. J. O'Connor, George S. Legare and others are interested. The state has also commissioned the Charleston and Summerville Electric Railway Company, in which A. J. Warner of Gainesville, Ga., is interested. While it is stated that the last-named concern will go to work on its plans at once, the first-named, the Charleston and Summerville Railway Company, has not announced its future plans.

The Virginia Automobile Company of Norfolk, Va., has been chartered to build and lease automobiles, etc. Moses Nusbaum is president and the capital stock is $25,000 maximum.

The city light plant at Tarboro, N. C., was recently destroyed by fire, the loss being $3,000.

The city of Asheville, N. C., is considering the problem of installing an electric-light plant at a cost of from $25,000 to $50,000 by converting the old pumping station into an electric plant.

The Atlanta and Carolina Railway Company has been formally organized in Atlanta, Ga., to build an electric line from Atlanta to Greenville, S. C. The capital stock has been raised from $50,000 to $2,000,000. John R. Hosch has been elected president, M. T. Edgerton secretary and Jos. A. McCord of Atlanta, treasurer. The company has right-of-way, it is understood, in a number of counties and to Anderson, S. C.

The light, water and sewerage commission of Griffin, Ga., has awarded contracts to the General Electric Company of New York for the electrical work in improving the electric plant.

Plans have just been completed for the $120,000 office building for the Georgia Railway and Electric Company in Atlanta. The structure will be three stories high and will be used as the general offices of the company.

The Raleigh-Durham (N. C.) Passenger and Power Company has been chartered by the secretary of state for the purpose of constructing an electric line from Raleigh to Durham, 28 miles, and to build two belt lines in Raleigh, and also power and light plants for the two cities. W. J. Nellms, who established the Newport News-Old Point Comfort system in Virginia, is one of the principal incorporators. L.

Ohio.

Cleveland, December 10.—It is stated that preparations are under way for the extension of the Toledo, Fostoria and Findlay from Fostoria northward, where it will connect with another line at Pemberville. At Woodville the connection will be with the Lake Shore Electric, by which either Cleveland or Toledo may be reached.

A franchise has been granted the Hamilton Heating and Power Company by the city of Hamilton to furnish current for light and power to consumers. The company agrees to pay one per cent. of its gross earnings into the city treasury in return for the right to operate in the town.

The Cincinnati Traction Company will entertain its 2,800 employes, with their families, on December 29th at the Music Hall. A large Christmas tree will be provided and amusement will be furnished for both old and young.

The case of the city of Toledo against the Toledo Railways and Light Company relative to universal transfers has been appealed from the Lucas County Circuit Court to the Supreme Court. The decision of the lower court was to the effect that the city could exact transfers only where the roads continued in the same general direction and that a variance of more than 45 degrees relieved the roads from obligation to give transfers.

Arrangements are said to have been completed for a reorganization of the Miami and Erie Canal Transportation Company. Several meetings have been held recently at Cleveland and Akron.

Bids will be received shortly for wiring the penitentiary for electric lights and furnishing current for the same purpose. It is not known whether a plant for that purpose will be installed.

The Newell Street Railway Company, East Liverpool, has been incorporated with a capital stock of $10,000. W. B. Hill, W. E. Wells and others are interested.

All the double-truck cars of the Cleveland Electric Railway Company will be equipped with air-brakes, according to a decision arrived at a few days ago. There has been quite a little discussion regarding the matter of late, and to avoid any further comment the action has been taken. O. M. C.

Indiana.

Indianapolis, December 10.—The Lebanon-Thorntown Traction Company has been incorporated for the purpose of constructing a railway system in Lebanon and Thorntown and connecting the towns with an interurban line, 16 miles in length. It is understood that the Indianapolis and Northwestern Traction Company is back of the project. H. M. Atkinson, A. C. Darley, R. E. Niven, R. P. Wood and F. M. Reed are the incorporators.

The Huntington, Columbia City and Northwestern Electric Railway Company has been incorporated to build and operate an electric railroad between and connecting the cities of Huntington, Columbia City, Syracuse, North Webster, Vawter's Park, Goshen, South Bend and Lagrange. The principal office will be in Columbia City. W. F. McLallen, L. D. Clapham and others are interested.

An amended petition for a franchise to come into the city of Indianapolis has been filed by the Indianapolis, Newcastle and Winchester Traction Company. The company wants to build a spur in Peru Avenue and construct a freight house there. The petition is signed by D. M. Parry, president.

The steam railroads entering Indianapolis have entered into an agreement, it is said, not to deliver any freight to electric lines. It was thought that a railroad is as much bound to deliver freight to one carrier as to another, and if the railroads are under no such legal obligation, the incoming Legislature will be asked to impose such an obligation by law. Shippers say there is no virtue in the claim of the steam roads that there is no traffic agreements or relation between the steam and the electric roads.

Engineers are making a survey of the Tippecanoe River near Monticello for the purpose of locating and building three dams to utilize the waterpower in generating electricity. The company expects to light the city of Monticello and also have sufficient power to operate an interurban railway to pass through this section of the country.

The Matthews Electric Light and Power Company has been incorporated to build and operate an electric-light plant in Matthews. The capital stock is $15,000. Philip Hughes, E. W. Trook and G. S. Reinholt are the incorporators.

The Dunkirk Lighting Company has filed articles of incorporation with the secretary of state. The capital stock is $21,000. The company proposes to build an electric-light plant in Dunkirk. The incorporators are Jesse M. Soper, C. H. Harkins and C. O. Reynolds, all of Chicago. S. S.

Michigan.

Detroit, December 10.—Members of the Street Railway Employes' Association of Detroit have started a campaign to induce the Detroit United Railway to arrange some method whereby the vestibules of the cars may be uniformly heated. Under existing conditions, they claim the motormen endanger their health in the performance of their duties.

It is reported at Marshall that the Michigan Central Railroad Company is making an effort to purchase the property of the Jackson and Battle Creek Traction Company, the third-rail electric road from Battle Creek to Jackson, and the trolley line from Battle Creek to Kalamazoo of the Michigan Traction Company. The road between Kalamazoo and Battle Creek is 24 miles long. The one between Battle Creek and Jackson is one of the best electric roads in the country. It has cut into the Michigan Central's business, between the two points, both in the passenger and freight business.

Manager McGuigan of the Grand Trunk Railroad Company does not hold out very bright prospects for electric traction in the St. Clair tunnel at Port Huron. He said: "Electric engines, such as are used in the Baltimore and Ohio tunnel, could only handle 40 per cent. of the St. Clair tunnel traffic." The new electric locomotives of the New York Central are apparently overlooked.

Capitalists from the East were in Battle Creek last week to finance the interurban railway connecting Grand Rapids, Battle Creek and inland lakes. The right-of-way is secured, except a franchise for Battle Creek, so that rails can be laid in the spring. Battle Creek has been holding up a franchise until it could see the glitter of the real gold.

The Battle Creek and Coldwater Electric Railroad Company recently refused the franchise ready for its final passage by the Coldwater City Council, but an amended franchise was passed in form acceptable to the company. The company will deposit a certified check of $5,000 with the city clerk, guaranteeing the construction of the road within two years between Union City and Coldwater.

According to the tests may by Prof. Henry S. Carhart, the street lights furnished by the Washtenaw Light and Power Company of Ann Arbor were from eight to 18 per cent. below the contract standard, but the company readjusted the circuits according to his suggestions, and the lights are now up to the contract requirement. Charges were made in the council that the company was not furnishing as much light as it was being paid for, and Professor Carhart was engaged to make a thorough test of the system.

The Detroit, Ypsilanti, Ann Arbor and Jackson railway general offices have been moved from the Majestic Building, Detroit, to the old Worden homestead, Ypsilanti, and opened in the new location last week. The only Detroit offices of the company in the future will be the freight and passenger offices maintained jointly by the suburban roads.

The Detroit United Railway, Jefferson Avenue branch, has moved into the new offices and barns at Jefferson Avenue and St. John Road, Fairview village. When the work is all done there will be 11 storage tracks 750 feet long.

The Detroit Press has started a movement to give to street-railway conductors an extra cent when paying the fare, the amount thus collected to be divided at the end of the day between the motorman and the conductor. This plan, if carried out during the holiday season, would yield quite a comfortable sum for each man, and yet would not be a tax upon any street-car rider.

The Edison Illuminating Company of Detroit is preparing to discontinue the use of steam power in its Washington Avenue station, which will be used as a sub-station, operated by the high-pressure current from the Delray plant. When the changes are all made the main offices will be moved downstairs to the ground floor and the entire front half of the building made into offices. The rear half of the ground floor will be used for the rotaries for serving the downtown district.

It is reported in Detroit that the electrical supply dealers of that city belonging to the National association have formed a combine and raised the price of electrical supplies from 25 to 30 per cent. Capt. Frank J. Miner of the firm of Seidler-Miner Electric Company was interviewed and characterized the story of a combine as an absolute falsehood. He said: "We do belong to the national association, but this association is only for the advance of the electrical trade in bringing out new devices and keeping abreast of the times. As for the raise in price of electrical goods, there has been none. Electrical supplies have never been so cheap as this year. The only thing raised was rubber-covered copper wire. This, however, is due to the raise in the rubber and copper market of the last 15 days, and is true all over the country. The manufacturers are forced to increase the price to us and we have to raise it to our customers in proportion." C. G. W.

Northwestern States.

Minneapolis, December 10.—The Minnesota Power and Trolley Company has asked the Minneapolis City Council for permission to erect poles and string wires within the city for lighting and power purposes. It is proposed to offer electric light and power in competition to the Minneapolis General Electric Company.

Plans have been prepared by Oscar Claussen of St. Paul, Minn., for a complete plant for electric-railway, light and power purposes for the Mankato (Minn.) Railway, Light and Power Company. Bids for the construction are to be taken soon.

It is reported that the Electric Power Company of Somerset, Wis., contemplates developing power from one of the rivers near Balsam Lake.

The Yankton (S. D.) Electric Light Company has ordered a new street-lighting system which will cost about $2,000.

R. H. Burton-Smith is promoting a new interurban-railway project with Sioux City, Iowa, as one of the terminals. He is said to have strong backing.

The new electric-lighting plant at Wilmot, S. D., has been completed.

The Mankato Street Railway, Light and Power Company has advertised for bids for the erection of a large power house at Mankato, Minn. It is expected that the construction of a street-car system there will be pushed to completion without further delay.

F. C. Sigler has purchased the Osceola (Iowa) electric-light plant.

George T. Reddington, city clerk of St. Paul, Minn., will receive bids until December 20th for furnishing the street lighting for 1905.

The trustees of the Wells estate have asked for a franchise for an electric-light and heating plant at Milwaukee, Wis.

The Apple River Power Company has completed its new plant at Riverdal, Wis.

The Twin City Rapid Transit Company has notified the St. Paul council that the company will positively not agree to the five per cent. gross-earnings' tax or to the council having the right to regulate fares. A committee has been appointed to confer with the company and, if possible, to bring about an amicable settlement of the litigation which has been carried on for several months.

Guy Robing has been granted a franchise to establish an electric-lighting system at Grey Eagle, Minn. Work on the new plant will be commenced at once.

Citizens of Monticello, Iowa, are considering the advisability of organizing a company to build an electric line from Muscatine to Dubuque.

Curtis & Chase have purchased the electric-light plant at Leon, Iowa.

The Anoka (Minn.) Waterworks, Electric Light and Power Company will add a new 2,000-light dynamo to its equipment.

The trolley line from Waterloo to Sumner, Iowa, will be extended to West Union.

An electric road will be constructed next year from Valley Junction, Iowa, through Winterset to Creston.

The Milwaukee (Wis.) Electric Railway and Light Company proposes to build a railway to Horlicksville.

The trolley line from White Bear, Minn., to Wildwood has been completed by the Twin City Rapid Transit Company.

A company has been formed with $250,000 capital for the purpose of building a trolley line from Council Bluffs, Iowa, through Carson to Des Moines. H. H. VanBrunt of Council Bluffs is president and W. F. Pierce of Carson secretary. R.

Rocky Mountain States.

Salt Lake City, December 8.—The Lewiston-Clarkson Company of Lewiston, Idaho, is preparing to make some extensive improvements in that vicinity, including the establishment of electric power plants, the building of a reservoir and the construction of electric railroads. The money for the contemplated improvements was raised through an issue of $2,000,000 of bonds. Work on the construction of the electric plants and reservoir has already been commenced.

Work on the electric road between Salt Lake City and Ogden, Utah, is progressing rapidly, and in the mean time negotiations have been entered into with the Utah Light and Railway Company to string its wires as far as the northern boundaries of the county. The extension of this system of the Salt Lake and Ogden Railroad Company to Layton will be undertaken early next year, according to a recent statement of the management.

The management of the Cœur d'Alene and Spokane Railway Company of Spokane, Wash., is projecting the construction of a branch line to Rathdrum, Idaho, work on this enterprise to be commenced next year.

An auxiliary plant of the Utah County Light and Power Company of American Fork, Utah, will be established in the near future for the purpose of furnishing power for the mines of Bingham, Alta, Big Cottonwood and other mining camps in that vicinity. The proposed plant will have a capacity of 1,500 horsepower. The estimated cost of the plant s $150,000.

The initial run over the electric railroad of the Nevada Transit Company between Reno and Sparks, Nev., was made a few days ago. This is the first and only electric line in existence in the state.

The Tonopah Light and Power Company of Tonopah, Nev., is installing a new plant at its station to provide electric lights for the city.

Surveys have been completed for the construction of an interurban electric railroad between Salt Lake City and Bingham, Utah, and the management of the Salt Lake and Utah Valley Railway Company gives assurance that the work of construction will be commenced within the next few months. When completed this will be part of the first interurban electric-railroad system in Utah. G.

Pacific Slope.

San Francisco, December 8.—Oscar L. Smith, who is interested in the new electric line to connect Reno and Sparks, Nev., is in San Francisco on business connected with the work.

The Electrical Supply Company has been incorporated at Sacramento, Cal., with a capital stock of $10,000, which is mostly held by C. V. Schneider.

Weidenthal & Gosliner are to install the electric-wiring and telephone system in the building being constructed on Powell Street, near O'Farrell. The cost is to be $1,100.

The California Electrical Works has just received an order for 200 series-alternating arc lamps to be used by the Pacific Light and Power Company at Los Angeles. The Los Angeles Railway Company has given this electrical-supply firm a large order for Thomas high-tension insulators, to be delivered at once.

Among the estimates of the Navy Department for improvements at Mare Island are $15,000 for the enlargement of the electric plant and $10,000 for additions to the electric workshop.

The San Francisco Gas and Electric Company is installing a 1,400-horsepower direct-current generator of the General Electric type at Edison station on Jessie Street and the station is being enlarged. Station "B" on Townsend Street is being gradually put out of commission and there is but little apparatus there now outside of the old arc machines.

The Electrical Supply Company has filed articles of incorporation at Sacramento, Cal., with a capital stock of $10,000. The directors are H. G. May, F. R. Ellison, Fred Meyer, J. C. Hobrecht and C. V. Schneider.

A corps of engineers has been at work for several days running a new route for the proposed electric-railway system about Yakima, Wash., to tap the Sunnyside country. This is the project being pushed by Robert Strahorne of the Northwest Power and Light Company of Spokane, Wash.

The county commissioners of Snohomish County, Wash., have granted to W. M. Snyder and J. W. Hall of Snohomish a 50-year franchise for an electric road from Monroe through the Sultan basin to the "45" mine.

The Washington Central Railway Company has been incorporated at Chehalis, Wash., with a capital stock of $500,000. The incorporators are George E. Long, M. D. Sayles and L. E. Crouch of Portland, Ore. The corporation will acquire, construct and operate a railway, telegraph and telephone line from a point on Grays Harbor near Grays Harbor City to the foot of Priest Rapids, Yakima County, Wash., and a five-mile branch line starting about five miles from Centralia, Wash.

The Edmonds Electric Light and Transportation Company of Seattle, Wash., has completed all preliminary arrangements for tapping the surrounding timber belts with a network of electric lines. The company expects to have the first section of railroad completed by May 1st, and ultimately to open all the territory to the east of Edmonds for a distance of 35 miles. The power house is to be completed by May 1st. A.

PERSONAL.

Mr. S. Morgan Bushnell of the engineering staff of the Chicago Edison Company has just returned from a two-months' trip to Europe, taken for rest and recreation.

William H. Fennell, in charge of the De Forest space-telegraph station at Kansas City, will go to Cuba, it is said, where the company has a government contract for installing a system.

B. R. Hoffman of Detroit, Mich., has been appointed assistant treasurer and assistant to the general manager of the Detroit, Ypsilanti, Ann Arbor and Jackson Railway Company, with headquarters in the new general office of the company at Ypsilanti.

Frank Murphy of Omaha, Neb., president of the Omaha and Council Bluffs Street Railway Company, and identified with many other leading industries of Omaha, died in New York city on December 12th. Mr. Murphy was rated as one of the wealthiest men of his state.

Albert H. Stanley, formerly general superintendent of the Detroit United Railway, Detroit, Mich., was married on December 5th in Milwaukee to Miss Grace Lowrey Woodruff, formerly of Detroit. Mr. Stanley is a young and able street-railway manager, being at present general manager of the electric lines of Newark, N. J.

C. G. Goodrich, vice-president of the Twin City Rapid Transit Company of Minneapolis, it is said, will act in the capacity of adviser for Judge Grosscup in the hearing of the dispute regarding the merits of 100 new cars recently purchased by the receivers for the Chicago Union Traction system from the St. Louis Car Company.

Mr. A. J. Wurts of the Westinghouse Electric and Manufacturing Company, who recently resigned as manager of the Nernst Lamp Company, has been appointed constructing engineer for the Carnegie Technical Schools of Pittsburg. In accepting this new appointment Mr. Wurts does not sever his connections with the Westinghouse Company, but will continue there in his experimental and development work, which has been so interesting and successful.

Reports from Washington, D. C., are to the effect that Prof. Alexander Graham Bell, who has just returned to his home in that city after several months spent in experiments with his tetrahedral cell kites at Baddeck, Cape Breton, firmly believes he has the fundamental principles of the airship in his grasp. Professor Bell's present plan is to devote his time entirely to the construction of a kite of great size that will sustain itself in a slight breeze.

Of Bertrand B. Abry, a young engineer of the Westinghouse Electric and Manufacturing Company, who died recently, the Electric Club Journal says: "He possessed an engineering mind. This combined with a love of hard work and a determination to get things right, no matter what the cost, made his work not only rich in achievement but full of promise. In the words of one of his older associates, 'he was one of the most promising of our young engineers.'" Mr. Abry, who was but 28 years of age, was a former student of the University of Nebraska and a graduate of the University of Illinois.

Samuel M. Manifold has announced his resignation as general manager for the York County Traction Company, the York Street Railway Company and the Edison Electric Light Company of York, Pa., to take effect January 1st, when he will assume the duties of sheriff of York County. It is unofficially announced that A. H. Hayward, general superintendent of the Dayton, Springfield and Urbana Traction Company, will succeed the retiring manager. Mr. Hayward entered upon his electric-railroad career in Cincinnati in 1882 and was connected with the various suburban street-railway companies in Pennsylvania and New York. About a year ago he was in Argentine and Porto Rico, where he was engaged in electrical construction work.

Prof. Harris J. Ryan, professor of electrical engineering in Sibley College, Cornell University, Ithaca, N. Y., has accepted the directorship of the department of electrical engineering in Leland Stanford, Jr., University at Palo Alto, Cal. The electrical department at Stanford has been in charge of Prof. Albert W. Smith until lately, Prof. W. F. Durand, also of Cornell, temporarily taking the place recently vacated by Professor Smith, who is now at the head of Sibley College, Cornell. Professor Ryan is one of the most prominent electrical educators of the country. He was born at Powell's Valley, Pa., in 1866 and graduated from Cornell after a four-year course in electrical engineering. He was one of the electrical jurors at the Chicago World's Fair of 1893, and is a member of the American Institute of Electrical Engineers, of which he has been vice-president. He is a fellow of the American Association for the Advancement of Science and a member of Franklin Institute. Professor Ryan has presented a number of valuable papers to the American Institute of Electrical Engineers on Transformers and other alternating-current apparatus, dynamo design and cognate subjects. At the recent International Electrical Congress in St. Louis Professor Ryan was one of the official delegates representing the government of the United States. He also had a paper on the "Design of Insulators" before Section B of that body.

HARRIS J. RYAN.

ELECTRIC LIGHTING.

The Witthoff Brick Company of Birmingham, Mo., is in the market for machinery and equipment for an electric-light plant.

The city trustees of Orange, Cal., have voted to call an election on January 7th to vote on the issuance of bonds in the amount of $75,000, $15,000 to be used for an electric-lighting and power plant.

Ford, Bacon & Davis of New York are said to have bought out the Knoxville Street Railway and Electric Light Company at Knoxville, Tenn. Extensive improvements will soon be made.

The Albuquerque Electric Power and Lighting Company of Albuquerque, N. M., has purchased the old electric plant of the Cochiti Gold Mining and Milling Company, which is being removed to Albuquerque.

The Yankton Improvements Company of Yankton, S. D., has been incorporated with capital of $100,000. The company will apply to the Yankton council for a franchise to build and operate an electric-light and gas plant in the city of Yankton.

The city of St. Thomas, Ont., proposes to take over the plant of the Gas and Electric Company, and a board of arbitration is at present engaged in settling a difference of valuation between the city and the private corporation owning the property.

At a meeting of the stockholders of the Electric Light Company at Red Lion, Pa., a vote was cast favorable to accepting the proposition of George Heisey of Lancaster, who offered $11,740 for the plant. Mr. Heisey contemplates placing Red Lion, Dallastown and Yoe on one system, with the construction of a plant large enough to light the three towns.

The council of Chambersburg, Pa., has sold the municipal-light plant to a combination of local capitalists, for which Charles Walter, attorney for the Chambersburg and Gettysburg Electric Railway Company, bid $75,550. The combination agrees to light the streets for $74.50 per light per year, furnish municipal incandescent light at 5½ cents and pay 50 cents a pole and $1 per mile for wire as taxes each year. There is strong talk of invoking the aid of the court to prevent the sale, it is said.

ELECTRIC RAILWAYS.

The city of St. Thomas, Ont., owns and operates the six miles of electric street railway within its corporate limits. The road gives general satisfaction as to service, says United States Consul Burke, but at the expense of a deficit ranging between $3,000 and $4,000 per annum.

The Lambertville, New Hope and Trenton Street Railway Company has completed grading between New Hope and Yardley, Pa. Track is being laid from both ends of the line, and the ballasting is well advanced, while poles are up a good portion of the way.

The McKinley syndicate, which has built an interurban railway from Decatur to Springfield and from Springfield to Carlinville, Ill., and is now building electric roads further south, announces that Edwardsville, Ill., will be the center of construction work and the headquarters for managers, workmen and supplies.

Directors of the Chicago City Railway Company have voted to renew last year's agreement with the union of the train-service employes of the street-car line. General Manager Starring of the company has sent word to the union, division 260 of the Amalgamated Street and Electric Railway Employes of America, that its request for a renewal of the old

contract would be granted if the agreement be made to run till December 31, 1905.

The sale of the San Jose and Santa Clara (Cal.) electric railroad with its Alum Rock Park and Tenth Street branches to J. R. Parkinson of Palo Alto and associates has been confirmed. Mr. Parkinson says that the new company will now proceed to the immediate construction of a standard-gauge line from San Mateo to Palo Alto and thence to San Jose, via Mayfield, Mountain View, Sunnyvale and Santa Clara. The trunk line will also be extended to Gilroy and numerous branch lines are contemplated.

Plans are under consideration by the Erie Railroad Company, the Morristown and Erie Railroad Company, which connects with Erie at Essex Falls, N. J., and the Public Service Corporation of New Jersey to conect Newark by trolley directly with Morristown over the tracks of the Morristown and Erie, which is the extension built by Richard McEwen, a paper manufacturer of Whippany, and his associates from the Essex Falls terminus of the Erie railroad to Morristown. The Morristown and Erie is but 11 miles long, and it is said the road could easily be equipped for electric propulsion by either the third-rail or the overhead system.

The fight for a right-of-way to form a connecting link between the Chicago and Milwaukee electric railroad and lines to the north of Kenosha, Wis., is said to have been completed, a deal having been closed whereby the Chicago and Milwaukee electric road has obtained the absolute purchase of a right-of-way from Waukegan, Ill., to Kenosha. It now only remains for the Chicago and Milwaukee company to conclude negotiations with the company operating electric lines from Milwaukee to Kenosha, when through service may be had from Milwaukee to Evanston, Ill., which will ultimately, no doubt, be extended into Chicago. Whether such negotiations will be concluded or whether the Chicago and Milwaukee road will extend a line of its own on up to Milwaukee, however, seems to be a matter of doubt as yet.

SOCIETIES AND SCHOOLS.

At a meeting of the executive committee of the National Electric Light Association, held in New York on December 6th, the dates fixed for the Denver-Colorado Springs convention were June 6th, 7th and 8th at Denver, and 9th, 10th and 11th at Colorado Springs.

The 192d meeting of the American Institute of Electrical Engineers will be held in the Chapter Room of Carnegie Hall, 154 West Fifty-seventh Street, New York city, on Friday, December 23, 1904, at 8:15 p. m. The following paper will be presented and discussed: "The Maximum Distance to which Power can be Economically Transmitted," by Ralph D. Mershon, consulting electrical engineer, New York and Montreal.

The College of Arts and Engineering of the Polytechnic Institute of Brooklyn has issued its announcement circular of the lectures to be given by its newly organized board of consulting professors. The department of electrical engineering now has the services of Dr. Samuel Sheldon, Mr. Charles F. Scott, Dr. Louis Duncan, Dr. F. A. C. Perrine, Mr. Thomas D. Lockwood, Mr. William S. Barstow and Mr. Sydney W. Ashe. A series of evening lectures is announced as follows: Four lectures on commercial electrical engineering by Professor Scott, beginning December 21st and ending March 16th; eight lectures on electrical-power transmission by Professor Perrine, beginning February 9th and ending May 18th; eight lectures on central-station practice by Professor Barstow, begun December 15th and ending March 14th; eight lectures on telephony, telegraphy and patent practice by Professor Lockwood, beginning February 7th and ending May 15th, and eight lectures on electric traction by Professor Duncan, beginning February 15th and ending May 25th.

PUBLICATIONS.

The Wile Power Gas Company, engineers, of Rochester, N. Y., which makes a specialty of gas producers, has issued its catalogue B, illustrating and describing various types of gas producers.

Gaswork versus guesswork, with a few "Wise Whys" thrown in, is the gist of a folder from the Marinette Gas Engine Company of Chicago Heights, Ill. It is intended for "those who are interested in getting the most for their money," and those who "belong" should write to the company for full details.

What the Yost Electric Manufacturing Company of Toledo, Ohio, has to sell in the line of weather-proof lamp and wall sockets, rosettes, etc., may be found in a little booklet sent out by the company. The booklet, though small, will attract attention and does not leave unsaid any essential things about this particular class of apparatus.

Jandus interchangeable enclosed arc lamps, multiple direct-current lamps, multiple alternating-current lamps, constant-current series direct-current lamps, multiple series lamps for power circuits—all these, with structural details, are described in bulletin No. 20, which may be obtained from the F. Bissell Company of Toledo, Ohio. These lamps are adapted for public and private arc lighting on all circuits.

Mercury-vapor lamps for general lighting purposes and for such special service as photography and advertising are exploited in the latest bulletin of the Cooper Hewitt Electric Company of New York city. The bulletin is devoted to a general description of the lamp and a summary of its most noteworthy applications and is a credit to the company's advertising department even when judged by the standard of past excellence.

Electrical novelties and appliances of the latest type, which, as is well known, may be always obtained from the Ewing-Merkle Electric Company of St. Louis, are set forth in a pleasing manner by the company's latest catalogue, which has just appeared. A feature of this catalogue is the large variety of electrical toys for the holiday trade which are listed. Among the other appliances which are handled by the company may also be mentioned electrical decorative outfits, electric heaters, pocket searchlights, private-line battery-call telephones, etc.

The Erie Railroad Company, in order to give its patrons an idea of the diversity of products which are manufactured at points easily accessible to its lines, has issued a pamphlet giving the names of the manufacturing industries which are located along the system together with their products. A glance through this list will attract attention because of the variety and extent of these products, indicating forcibly the great resources of the country tributary to the lines of the Erie road. A map of the territory covered by the railroad system is also shown and the bulletin will be of much assistance to those who are in quest of a favorable locality in which to locate.

When it comes to the matter of high-class advertising literature the Holophane Glass Company of New York and Chicago is always to be found in the front rank and the two handsome booklets which the company is just now distributing do not discredit the statement. One of these booklets is entitled "The Lighting of the Home," and to say that it is a work of art in this line is not putting the statement too strongly. There are many valuable hints contained in the booklet relating to porch and interior lighting for the home illustrated by handsome pictures. "Light vs. Illumination," the other booklet, is a little treatise on the general subject of scientific illumination.

TELEGRAPH.

The familiar Wall Street rumor of telegraph consolidation is once more afloat. It takes this shape: "The entrance of Kuhn, Loeb & Co. into Missouri Pacific and the arrangement of differences between Pennsylvania and Gould interests will, it is understood, be followed by a merger of the Western Union and the Mackay companies, although the latter consummation may not be arrived at for some little time. It is understood that strong financial interests stand ready to finance the combination whenever details are arranged. That there is room for large economies is clear, since the two systems have been in the most active kind of competition, involving the maintenance of two offices in a great many locations where one would suffice." It is likely that there is nothing more substantial to this report than to previous ones.

A bill has been introduced in the House by Representative Wagner calling for a $2,000,000 appropriation to connect the canal zone of the Ithmus of Panama with the United States by submarine cable. The bill provides for the construction and operation of such a cable under the control and direction of the postmaster-general, the secretary of war and the secretary of the navy, the cable to be of American make and to be laid by American ships, provided the cost of an American-made cable will not exceed the cost of a foreign-made cable by more than 10 per cent. The three cabinet officers are authorized to enter into negotiations and establish cable connection with lines running to Central and South America, the West Indies and islands in the Gulf of Mexico, the Caribbean Sea and the Pacific Ocean.

SPACE TELEGRAPHY.

The space-telegraph station of the De Forest Wireless Telegraph Company at the Navesink Highlands, N. J., was destroyed recently by fire. This is the station which was used in reporting the races for the America's cup during the last international yacht races. The station was fully equipped with receiving and sending apparatus, and was used principally in communicating with the De Forest stations at 42 Broadway, New York city, and the one at Paterson, N. J. The loss was about $3,000, and a new plant, it is said, will be installed.

The Navy Department has authorized the commanding officer at the torpedo station at Newport to accept dispatches to and from ships at sea by way of the Nantucket lightship. Orders are being prepared opening to commercial business the following naval space-telegraph stations: Portsmouth, N. H.; Cape Ann, Mass.; Boston and New York navy yards; Cape Cod; Montauk, L. I.; Navesink, N. J.; Cape Henry, Va.; Dry Tortugas, Fla.; San Juan, Culebra; Yerba Buena, Cal., and Mare Island navy yard. Other stations will be opened in a few weeks.

MISCELLANEOUS.

Union electrical workers of Detroit, Mich., will submit bills at the next session of the Legislature calling for the regulation of the trade by an examining and licensing board and creating some regulations for high-tension wires. The men say they want to raise the standard of the workers by requiring an examination and license.

The trials of the Allan Line steamer Victorian, the largest turbine vessel yet built, which was launched at Belfast August 25th, have been so disappointing, it is said, as to raise serious doubts among the Clyde shipbuilders as to the value of turbines in the case of large ships. All the efforts made to get the Victorian near contract speed were futile.

Patent No. 775,577, "Trolley," which was recently issued to Messrs. Edward L. Naret and Joseph R. Ernst of Morgantown, W. Va., and which was reviewed in the Western Electrician's patent record of December 3, 1904, instead of comprising two wheels, one in a horizontal and the other in a vertical plane, consists of three wheels—one in a vertical plane and the other two in planes approximately 45 degrees to the first. The latter pair of wheels is situated so as to clasp the trolley wire and hold it in connection with the main trolley wheel, being operated by a toggle lever to which the trolley cord is attached.

TRADE NEWS.

The Providence Engineering Works of Providence, R. I., states that it has not decided to undertake the manufacture of the Storey motor. A few weeks ago it was reported that this company had adopted the Storey motor as its standard in its decision to enter the electrical field by manufacturing motors.

A. P. Munning of New York, general sales agent of the Cutler-Hammer Manufacturing Company, has been in the West several weeks in the interests of his company. Mr. Munning says that the demand for Cutler-Hammer electric controlling devices has never been as great as it is now, and he reports a most promising outlook for the coming year.

The Banner Electric and Manufacturing Company has been organized to succeed, it is stated, the Risdon Electric Company of Oklahoma City. The new company is incorporated with a capital stock of $10,000, and the officers are C. B. Luck, Charles Risdon and W. K. Snyder. Messrs. Luck and Risdon will be the active members. Mr. Luck was for several years connected with electrical contractors and telephone engineers in Chicago, and for the last year has been installing the new telephone system at Gainesville, Texas.

The Union Electric Manufacturing Company of Milwaukee reports under date of December 12th as follows: "The Cutler-Hammer Manufacturing Company made a motion in the Circuit Court of Milwaukee for an order of the court compelling us to stop manufacturing and selling the automatic starting boxes we are now putting out, but the court, after a full hearing of the case, refused to grant the order for a preliminary injunction or for contempt. The opinion above was filed today." The litigation referred to is based on the Blades patent.

The Brown Corliss Engine Company of Corliss, Wis., has just received a contract from the city of Milwaukee to furnish and erect at the North Point pumping station one 20,000,000-gallon triple-expansion high-duty crank and flywheel pumping engine according to plans and specifications prepared by the city of Milwaukee, and also according to plans and specifications submitted by the company. The total amount of the contract is $64,500. This pumping engine has been the source of considerable discussion in the last three or four months, and practically all of the prominent engine and pump builders of the country have submitted bids on the work. The commissioners of public works of the city of Milwaukee and City Engineer Poetsch visited the plant of the Brown Corliss Engine Company at Corliss, Wis., and satisfied themselves that the concern is amply able to execute the contract. The company is now at work extending its foundry 60 feet in order to take care of the large amount of work on hand and in view. This contract, in addition to the large $100,000 contract recently secured of the Navy Department and some others of smaller proportion, is gratifying to the young manufacturing concern which has associated with it men of engineering ability and standing.

BUSINESS.

The Columbian Electrical Company of St. Joseph, Mo., announces that it now occupies its new building at 820 Frederick Avenue, which contains about 15,000 square feet of floor space. This increased space will facilitate business in each of the four departments—engineering, mechanical, construction and fixtures.

The National Carbon Company of Cleveland makes the announcement that it received the grand prize at the Louisiana Purchase Exposition for all

of its carbon products, including Columbia enclosed arc carbons and Columbia dry batteries. It is asserted that the Columbia carbons are today used in about 90 per cent. of the enclosed arc lamps in service.

The Speer Carbon Company, St. Marys, Pa., announces that it has secured the right and privilege of attaching copper "pigtail" terminals to carbon brushes for all General Electric Company's machines. The Speer Carbon Company is well equipped for handling anything applicable to the carbon brush; and one of its most important qualifications is its ability to make quick deliveries of "pigtailed" brushes, or, in fact, anything in the line of carbon brushes.

The Electric Controller and Supply Company of Cleveland, Ohio, has just shipped the second of two 200-horsepower 220-volt type M. T. magnetic switch controllers to the Lorain plant of the National Tube Company. They are for the control of the reversing motors driving the tilting tables on each side of the plate mill. These controllers give automatic acceleration, which can be adjusted to the maximum rate consistent with safety to motors and gearing. When reversing from full speed forward to full speed reverse the table is automatically brought to a quick stop and accelerated in reverse direction in the least time interval consistent with safety. The magnetic controller with resistances is placed near the motor, thereby effecting economy in the use of heavy wires. The construction of the magnetic controller, however, is such that no matter how rapidly the operating controller may be reversed the current flowing to the motor is automatically limited to a safe value. The controller is especially adapted to the control of motors of any driving machinery which must be quickly accelerated, but which has such heavy parts that with the ordinary manually operated controller dangerous overloads, with consequent damage to the motor and gearing, are liable to occur. Other recent shipments of controllers of this type have been made to the Carnegie Steel Company and to the Lackawanna Steel Company, also to the Illinois Steel Company.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued (United States Patent Office) December 6, 1904.

776,490. Electrode. Frank J. Briggs, Everett, Mass. Application filed September 19, 1903.

Carbons or anodes are arranged in pairs and provided with heads. A copper ribbon is wound around and connects the heads of the two carbons in each pair. A copper top is adapted to be electrically connected and copper lugs extend down from the top between the heads of the carbons in each pair on one side of the ribbon.

776,491. Temperature-compensating Device for Electrical Measuring Instruments. William H. Bristol, Hoboken, N. J. Application filed February 23, 1904.

In combination with a generator of electricity and a measuring instrument having a low-resistance coil is a temperature-compensating device located in proximity to the measuring instrumeot and containing a mercuric column acting on a resistance in series in the circuit for automatically maintaining constant the total resistance of the part of the circuit comprising the measuring instrument and the compensating device under variations in temperature.

776,514. Cleat for Electric Wiring. Emory C. Hunt, Belle Plaine, Iowa, assignor of one-half to C. W. E. Snyder, Belle Plaine, Iowa. Application filed January 26, 1904.

A base and cap-piece are described, the base having a wedge-shaped forwardly tapering bore passing therethrough, and the cap-piece having a central opening adapted to register with the smaller end of the bore of the base.

776,521. Electric Switch. Walter S. Levin, New York, N. Y. Application filed March 28, 1904.

Contact-terminals, a contact-plate adapted to complete a circuit between the terminals, a pivoted lever carrying the plate and independent of the circuit, a second lever pivoted adjacent to the first lever, a rod carried by and movable longitudinally on the second lever, one end of the rod bearing against the first lever, the rod adapted to be moved from one side to the other of the pivot of the first lever when the second lever is rocked on its pivot, and means for keeping the end of the rod in contact with the first lever and to rock the lever on its pivot as the rod is moved from one side to the other of the pivot are some of the features.

776,522. Electric Switch. George B. Low, Newton Center, Mass. Application filed May 23, 1904.

A base, a pair of non-coriducting blocks secured to the base at a proper distance apart, contact-plates secured to the blocks and electrically connected by circuit-wires, a pair of yielding metal switch-plates secured to the non-conducting blocks, and a rotatable key-slotted sleeve journaled in the base are described.

776,524. Automatic Telephone Exchange. Frank A. Lundquist, Chicago, Ill., assignor to M. E. Richardson, Sterling, Kan. Application filed April 30, 1900.

In a switching mechanism for an automatic telephone exchange are a driving pawl and a holding pawl, a shaft provided with a ratchet wheel normally held in a position so as to be out of engagement with the pawls and means for moving the shaft axially so as to bring the ratchet wheel into line of engagement with both of the pawls. Means whereby further axial movement of the shaft will remove the ratchet wheel from line with the driving pawl without disturbing its connection to the holding pawl are provided.

776,526. Electric Brake for Vehicles. Joseph N. Mahoney, Brooklyn, N. Y., assignor to the American Electric Brake Company, New York, N. Y. Application filed January 21, 1904.

The combination consists of a propelling motor adapted to be driven as a generator by the momentum of the vehicle. Means are provided whereby a controller varies the current in the circuit including the field as the speed of the vehicle varies, to control the current in the electromagnetic brake apparatus.

776,534. Means for Automatically Stopping Electric-railway Cars on Trains. William O. Mundy, Louisville, Ky., assignor to the General Electric Company, Schenectady, N. Y. Application filed September 30, 1902.

A safety-switch controls the supply of current to the control-circuits and a tripping device for opening the switch is located adjacent to the track at a predetermined point. Means are connected with the switch and extend from both sides of the car so as to engage the tripping device when the car is run either end foremost.

776,535. Trolley Hanger. Robert W. McIlvaine, Hamilton, Canada. Application filed March 5, 1904.

A trolley hanger having a rail-supporting element and upwardly diverging suspending rods is described.

776,536. Self-closing Telegraph Key. Noble S. McKinsey and Anton R. Nelson, Susanville, Cal. Application filed December 26, 1903.

Means are provided for normally holding the front end of the key lever down aond the circuit closed. The front end of the key-lever has a vertical tubular guide or bearing and a pin or rod movable therein. The friction of the rod in the bearing is sufficient to sustain the front end of the key in its raised position.

776,546. Brush Holder. Edward D. Priest, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed April 19, 1902.

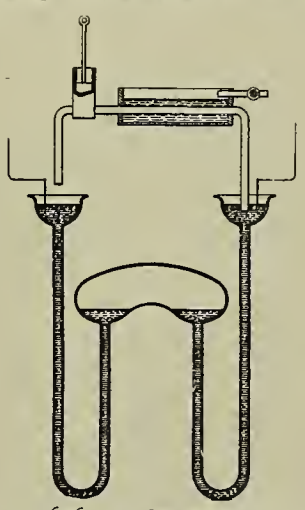
A brush holder has sockets for two brushes, a separate follower for each brush and a single spring acting on both followers.

776,556. Conduit for Electric Wires. Clarence C. Sibley, Perth Amboy, N. J., and George A. Lutz, New York, N. Y. Application filed December 19, 1902.

A metallic conduit for electric wires has a wall provided with a series of countersunk extensions whose walls are slit providing tongues projecting toward a common point and arranged to permit the passage of screws or nails between their ends. The heads of the screws or nails may bear upon the tongues and remain in the countersunk extensions.

776,557. Electric Transmission Mechanism. Charles G. Simonds, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed May 5, 1904.

Two relatively movable shafts in line with each other, and a dynamo-electric machine having its field carried at the extremity of one shaft and its armature carried at the extremity of the second shaft are described. The field has a web extending around the armature and forming a bearing for the second shaft.



NO 776,565.—VAPOR-TUBE RECTIFIER.

776,563. Current Rectifier. Percy H. Thomas, Pittsburg, Pa., assignor to the Cooper Hewitt Electric Company, New York, N. Y. Application filed February 4, 1903. Renewed May 5, 1904.

The method of regulating the density and purity of the gas or vapor in the chamber of a gas or vapor electric apparatus in which one or more of the electrodes is composed wholly or in part of a conducting fluid, consists in circulating through the chamber a portion of the conducting fluid.

776,563. Current Rectifier. Percy H. Thomas, Pittsburg, Pa., assignor to the Cooper Hewitt Electric Company, New York, N. Y. Original application filed February 4, 1903. Divided and this application filed May 6, 1903.

One claim describes an exhaust chamber, a gas or vapor therein, a negative electrode, one or more positive electrodes presenting surfaces within the chamber, at least one of which consists of an enclosed fluid column having an approximately level surface, and means for continuously supplying fresh fluid to the column or columns.

776,565. Current Rectifier. Percy H. Thomas, East Orange, N. J., assignor to the Cooper Hewitt Electric Company of New York. Original application filed May 6, 1903. Divided and this application filed August 23, 1904.

An electrode consisting of a conducting fluid has its outer terminal exposed and subjected to external pressure, the outer terminal being located above the barometric height, whereby a balance is secured between the internal and external pressures by adding to the effect of normal external pressure the weight of a portion of the conducting fluid. (See cut.)

776,633. Lamp Guard. Fred W. Winbolt, Springfield, Mass. Application filed December 26, 1903.

The guard consists of a shell formed of longitudinal wires secured at one end to a closed ring and at the other end to the members of a separated ring. The shell is provided with inwardly projecting means for engaging a lamp bulb at axially separated points in order to support the guard wholly upon the lamp bulb.

776,638. Portable Electric Device. Charles E. Avery, Jersey City, N. J., assignor to the Manhattan Electrical Supply Company. Application filed April 18, 1904.

A circuit-closer for flash lamps and the like comprises a spring conducting arm arranged to establish an electrical connection with one pole of the battery. A resilient tongue is carried by the arm and a lever is pivotally secured to the arm for moving the tongue into electrical connection with the opposite pole of the battery.

776,653. Winding for Electrical Apparatus. Joseph W. Farley, East Pittsburg, Pa., assignor to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Application filed March 16, 1904.

A coil for electrical apparatus has a number of suitably insulated strands disposed one outside of another and in an unequal number of side-by-side sections or turns, the strands of the middle turn or section being bent across each other so that substantially one-half of each strand occupies a complementary relation to the other half as regards distance from the center of the coil.

776,654. Coil for Electrical Apparatus. Joseph W. Farley, East Pittsburg, Pa., assignor to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Application filed March 16, 1904.

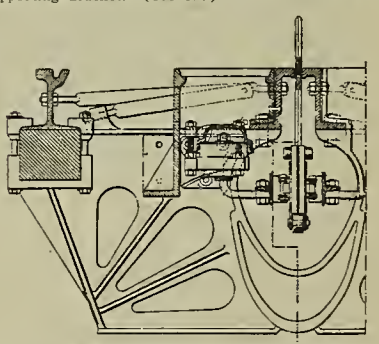
A coil for electrical apparatus comprises two similarly wound sections each composed of a number of suitably insulated strands arranged one outside of another, the strands of one section being joined to those of the other section in reverse order so that the longer and the shorter strands are connected to form turns of substantially uniform length.

776,660. Electric Fuse and Cut-out. Benjamin H. Glover, Buffalo, N. Y., assignor to the Chicago Fuse Wire and Manufacturing Company, Chicago, Ill. Application filed August 13, 1903.

A conductor has a wrapper or envelope having a number of thicknesses and a powdered material between the thicknesses of the wrapper.

776,681. Electric Railway. Richard C. Parsons, Reginald Belfield and William Chapman, London, England, assignors to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Application filed November 16, 1900.

A conduit and a yoke constitute an integral part of the device. A box-like structure is bolted to the yoke and a bracket is secured to the yoke. An insulator is supported by the bracket, a stem passing through the insulator is secured to the top thereof by a nut and projects downward and into the conduit for supporting the conductor rail therein. A cap incloses the top of the insulator for maintaining the insulation between the nut and the supporting bracket. (See cut.)



NO. 776,681.—ELECTRIC-RAILWAY SYSTEM.

776,682. Plow for Electrically Propelled Vehicles. Richard C. Parsons, Reginald Belfield and William Chapman, London, England, assignors to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Original application filed November 16, 1900. Divided and this application filed February 20, 1902.

A current-collecting device for open-conduit electric railways is described, in combination with the portion of a car from which the device is supported and an intervening connecting member that is rigidly fastened to the current-collecting device by soft metal bolts or rivets. The collecting device may become detached by shearing the bolts or rivets when its movement is obstructed.

776,695. Suspension Clamp for Electric Conductors. Edward L. Schwarz and Albert G. Ward, Belleville, Ill. Application filed April 10, 1903. Renewed March 26, 1904.

A clamp for permanently supporting a wire and a temporary support above the clamp and integral with the base thereof upon which a wire may be supported during the operation of suspending a cable therefrom are the features.

776,700. Sparking Device for Internal-combustion Engines. Charles E. Sterne, San Diego, Cal.,

assignor to the Sterne Bros. Company, San Diego, Cal. Application filed May 2, 1901.

A sparking device combining electrodes which are normally out of contact, a rocker-arm for causing a contact, etc., are described.

776,705. Induction Coil. Richard Varley, Providence, R. I., assignor to the Varley Duplex Magnet Company of Providence, R. I. Application filed December 30, 1903.

An induction coil having a number of vibrators therefor and a switch for throwing any one of them into circuit at will form the combination. (See cut.)

776,728. Attachment for Transmitters. William W. Dean, Elyria, Ohio, assignor to the Kellogg Switchboard and Supply Company, Chicago, Ill. Application filed February 6, 1904.

An attachment for telephone transmitters consists of a light open frame adapted to receive a number or other slip and provided with a ring at its inner end to receive the inner end of the mouthpiece by means of which it is clamped in position upon the front plate of the transmitter.

776,735. Trolley-wire Clamp and Feed-wire Support. Thomas A. Furniss, Canonsburg, Pa. Application filed September 7, 1904.

The combination consists of a clamp comprising jaws, a supporting member carried by one of the jaws and cooperating with the other jaw, and means for attaching a wire to the supporting member.

776,752. Power-transmitting Mechanism. William McHaffie, Tenafly, and George D. Beinert, Jersey City, N. J. Application filed September 29, 1903.

In combination with a driven wheel, a movable frame, a driving wheel carried by the frame and movable therewith into and out of engagement with the driven wheel is an electric motor for operating the driving wheel also carried by the frame, a switch for controlling the motor circuit and a common actuator for operating the frame and the switch.

776,789. Insulator. Fred M. Locke, Victor, N. Y. Application filed November 16, 1903.

Two inverted cup-shaped insulator sections are nested together and formed with annular flanges in planes one above the other and at substantially right angles to their axes.

776,803. Trolley-operated Electric Switch. John J. Ruddick, Newton, Mass., assignor to the United States Electric Signal Company of Maine. Application filed March 28, 1904.

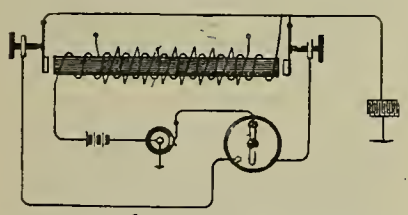
The parts are: A fixed contact member, a movable contact member, a trolley-wire, means for transmitting the movement of the trolley-wire caused by the pressure of the trolley to the movable contact member, and a locking device for the movable contact member, also operated by the trolley-wire. (See cut.)

776,826. Electric Propulsion of Cars or the Like. Orestez H. Caldwell, Indianapolis, Ind. Application filed February 15, 1904.

A stationary electromagnetic field, an electromagnetic field carried by the car and moved by the stationary field, and means for energizing the movable field from the source of energy employed for the energization of the stationary field are described.

776,836. Trolley Track. Charles A. Gower, Lansing, Mich. Application filed July 20, 1903.

The track is composed of two channel-shaped rails having the flanges projecting inwardly with means for retaining them in position without use of bolts or screws.



NO. 776,705.—INDUCTION COIL.

776,849. Electric Switch. William Kingsland, London, England. Application filed March 7, 1904.

An electric switch for alternately making and breaking an electric circuit and for alternately inserting and cutting out resistances by similar consecutive motions of an operating member is described.

776,855. Electric Switch. Ellsworth A. La Har, New Britain, Conn., assignor to the Hart Manufacturing Company, Hartford, Conn. Application filed July 30, 1904.

A face plate having an opening therethrough at a point between the contacts, a shutter to close the opening free to move downwardly between the contacts without touching them, and a contact-carrying plug free to pass through the opening in the face plate and adapted by rotation to connect the contacts in the receptacle are features of the device.

776,866. Electrical Measuring Instrument. Frank W. Roller, Plainfield, N. J. Application filed May 15, 1902.

A device for testing the relative resistance of different portions of a conductor has a portable contact bar carrying a number of terminals adapted to engage the conductor. The contact bar is yieldable and normally tends to assume a position so that its parts are out of alignment.

776,871. Trolley-wheel Oiler. William J. Sloan and John E. Robinson, Cleveland, Ohio. Application filed April 30, 1904.

A pump cylinder and piston is mounted upon the harp, there being circulating passages from the pump through the pin and returning to the pump, and communicating with the trolley-wheel bearing. Instrumentalities are provided for actuating the piston in the cylinder.

776,876. Apparatus for Wirelessly Transmitting Electrical Energy. Daniel W. Troy, Montgomery, Ala. Application filed March 19, 1903. Renewed October 26, 1904.

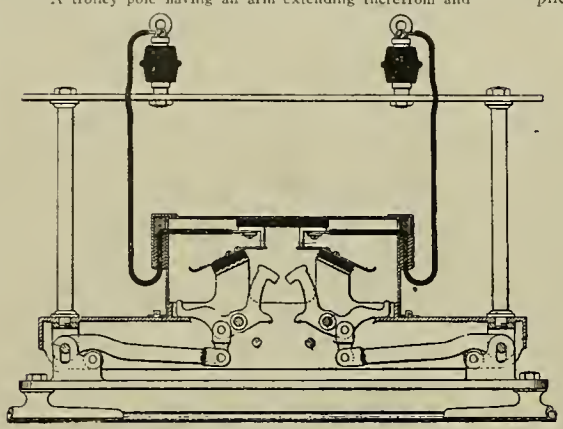
In the wireless transmission of electrical energy by means of electrical impulses transmitted through the earth, an otherwise-insulated capacity area is connected electrically in series through a condenser and a source of electrical impulses to a ground.

776,878. Current-controlling System. William R. Whitehorne, Bethlehem, Pa. Application filed September 22, 1904.

A battery or group of batteries in circuit with a motor, a bank of resistance in series with the battery, a switch for causing the electromotive force of the battery to become either added to or subtracted from that of the current mains, and means for varying the amount of resistance and the amount of battery in circuit are the principal parts. (See cut.)

776,954. Trolley Pole. Charles H. Spangler, Atlanta, Ga. Application filed February 14, 1903.

A trolley pole having an arm extending therefrom and



NO. 776,803.—TROLLEY-OPERATED SWITCH.

a raceway upon the pole in an arc concentric with the arm has means whereby the trolley and its arm are held normally in a plane with the trolley pole.

776,960. Telephone Transmitter. George W. Talley, Atlanta, Ill., assignor of one-half to Robert D. McKown, Atlanta, Ill. Application filed May 19, 1903.

A diaphragm for telephones comprises a sheet of fabric treated with carbon, a mica covering and a protecting surface of shellac or varnish.

776,970. Circuit Changer. James C. Waldo, Sharpsburg, Pa., assignor of one-fourth to John J. Forster, Avalon, Pa. Application filed October 19, 1903.

In the device are a shaft, a contact carried by the shaft, a ratchet wheel mounted on the shaft, reciprocating pawls arranged to engage opposite edges of the ratchet and positive locks operated respectively by the initial movements of the pawls.

776,985. Combinational Telegraph Instrument. Francisco G. Barbosa, Limon, Costa Rica. Application filed December 18, 1903.

The combination consists of a lever mounted upon a journal and free to swing laterally and also to rock in an independent plane, stops disposed below the lever and adapted to be engaged thereby and contact members controllable by lateral movements of the lever, the contact members being closed when the lever is moved laterally in one direction and opened when the lever is moved laterally in another direction.

776,997. Static Electric Machine. Juan G. H. Barboa, Chihuahua, Mexico, assignor of one-third to Christobal M. Ortiz, Chihuahua, Mexico. Application filed August 13, 1903.

A number of cylinders, a flexible belt of insulating material mounted thereon, friction mechanism for engaging the belt, electric connections for the friction mechanism, and collectors for removing electricity from the belt are the features.

776,998. Electric Switch. Thomas A. Cameron, Philadelphia, Pa. Application filed June 14, 1904.

The combination with a lighting circuit consists of a local energy circuit and a public energy circuit, both being normally open, and means included in the lighting circuit and automatically operative to close the public energy circuit. Fusible means to maintain the first mentioned means in a position to close the local energy circuit are provided.

777,014. Apparatus for Transmitting and Receiving Signals. Reginald A. Fessenden, Allegheny, Pa., assignor to the National Electric Signaling Company, Pittsburg, Pa. Original application filed June 2, 1900. Divided and this application filed March 29, 1901.

In a system of signaling by electromagnetic waves are a receiver, means for generating electrical impulses and means for making the receiver unresponsive during the time of generation of electrical impulses.

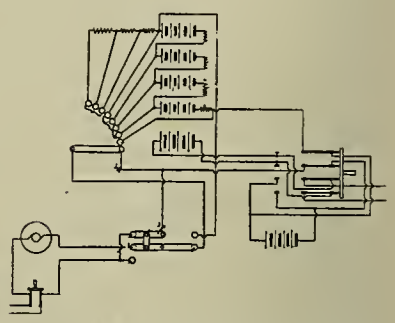
777,027. Convertible Electric Typewriting Machine. George M. Kitzmiller, Norfolk, Va., assignor to the Electric Typewriter Company, Norfolk, Va. Application filed January 23, 1904.

The device comprises a platen, a number of type bars, a series of twisted links and a vertical lever, its upper and lower ends being in vertical planes and bent between its fulcrum point and its upper end. The lever has a projecting arm above its fulcrum point and an extension below its fulcrum point provided with a slot and means for electrically operating the vertical lever. A pivoted key lever having changeable fulcrum points, a number of apertures in the key lever, a vertical arm at right angles to the key lever and slotted at its upper end and pivoted to the key lever in the vicinity of its fulcrum points are other features. The vertical arm is connected to the bent vertical lever and a detachable rod or pin is adapted to fulcrum the key lever and to secure the vertical arm thereon.

777,034. Controlling Device for Electrically Propelled Vehicles. Oskar Lasche, Berlin, Germany, assignor to the General Electric Company, Schenectady, N. Y. Application filed November 4, 1901.

In apparatus for switching electric motors in and out of circuit are means for automatically putting out of circuit one or more individual motors or series of motors on the expenditure of a minimum current, and means for automatically putting into circuit such motor or motors when the motors receiving current become overloaded.

777,039. Electromagnetic Apparatus. Joseph N. Mahoney, Brooklyn, N. Y. Original application filed January 21, 1904. Divided and this application filed March 19, 1904.



NO. 776,878.—CURRENT-CONTROL SYSTEM.

A winding and a shell of magnetic metal inclosing it has a pole piece projecting within the winding and having through it an opening with inclined walls. An armature reciprocable within the winding has its inner end tapered to conform to the taper of the opening in the pole piece, but of such length as to extend through and beyond it.

777,046. Thermostat for Electric Circuits. James P. Robertson, North Sydney, near Sydney, New South Wales, Australia. Original application filed August 13, 1902. Divided and this application filed October 7, 1903.

A device for closing or opening an electrical circuit consists of a flexible normally buckled plate in combination with a thermostat whose action is to effect the buckling of the plate in the opposite direction upon increases of temperature at any place in the area guarded by it.

777,049. Trolley-wheel Guard for Electric Wires. John L. Sullivan, Warren, R. I., assignor of one-half to Josteph Harris, Warren, R. I. Application filed April 19, 1904.

In a trolley-wheel guard for electric wires comprising an arm having one end arranged to be secured to the swinging pole of an electric car and its opposite end terminating in a lateral U-shaped portion is described.

777,052. Trolley Guard. George W. Watson, Kearney, N. J. Application filed February 26, 1904.

A trolley pole having ears and a bolt has a wheel between the ears carried by the bolt and angular plates on the outer sides of the ears. Arms with limiting projections on their inner sides and spriggs for holding the plates in normal position are provided.

EXPIRING PATENTS.

Following is a list of electrical patents (issued by the United States Patent Office) that expired on December 13, 1904:

374,580. Revolving Electric Hammer Tool. W. G. A. Bonwill, Philadelphia, Pa.
374,581. Electric Temperature Indicator. J. C. Boyle, Brooklyn, N. Y.
374,621. Electric Motor or Dynamo Electric Machine. F. Jarvis Patten, Fort Sidney, Neb.
374,631. Galvanic Battery. J. Serson, Boston, Mass.
374,640. Electric Fuse. K. J. Sundstrom, Dover, N. J.
374,652. Circuit-breaker. C. B. Bosworth, Everett, Mass.
374,669. Galvanic Battery. C. R. Freeman, Hartford, Conn.
374,673. Automatic Circuit-closer for Secondary Batteries. W. W. Griscom, Haverford College, Pa.
374,711. Armature. H. B. Slater, Detroit, Mich.
374,728. Dynamo Armature. E. N. Bliss, Newark, N. J.
374,747. Electromedical Apparatus. J. S. Muir, Hanford, Cal.
374,778. Electric Generator and Motor. A. F. Congdon, Philadelphia, Pa.
374,792. Conduit for Electrical Conductors. G. D. Holt, Minneapolis, Minn.
374,842. Safety Strip for Electric Circuits. P. Lange, Pittsburg, Pa., and O. B. Shallenberger, Rochester, N. Y.
374,843. Electric Coupling Device. P. Lange, Pittsburg, Pa.
374,850. Method of Testing Electric Lamp Globes. C. F. Reinmann, Pittsburg, Pa.
374,858. Dynamo Electric Machine. G. Westinghouse, Jr., and H. M. Byllesby, Pittsburg; O. B. Shallenberger, Rochester; Albert Schmid, Allegheny, and E. Hartley, Pittsburg, Pa.
374,860. Apparatus for Measuring Electric Currents. H. Aron, Berlin, Germany.
374,861. Apparatus for Measuring Electric Currents. H. Aron, Berlin, Germany.
374,862. Electric Battery. J. A. Barrett, New York, N. Y.
374,863. Galvanic Battery. J. A. Barrett, New York, N. Y.
374,871. Electric Motor. W. Hochhausen, New York, N. Y.
374,872. Apparatus for Reversing and Controlling Electric Motors and Other Translating Devices. W. Hochhausen, New York, N. Y.
374,883. Electromechanical Movement. H. Van Hoevenbergh, New York, N. Y.
374,907. Multiple Switchboard Test Circuit. C. E. Scribner, Chicago, Ill.
374,910. Regulation of Electric Motors. W. Stanley, Jr., Englewood, N. J.

WESTERN ELECTRICIAN

EVERY SATURDAY

Vol. XXXV. CHICAGO, DECEMBER 24, 1904 No. 26

LIBRARY OF ELECTRICAL ENGINEERING

Some Interesting Features of Aurora-Elgin-Chicago Electric-Railway Operation.

A representative third-rail interurban railway system is that of the Aurora, Elgin and Chicago Railway Company, which has the reputation of operating one of the most up-to-date electric interurban railways in the country. This system was described at length in the Western Electrician of December 1, 1902. Since that time, though no extensive changes have been made in the equipment outside of the addition of a third generator in the power house, the business of the company has increased rapidly and many innovations have been made which add to the comfort of the patrons of the road and make the service now the equal if not the superior of the best steam interurban service between the cities named in the corporate title of the company. The object of the present article is to consider the present work of the company and some recent steps it has taken in the way of furnishing power to farmers, the carrying of milk and newspapers, protection of the third rail from sleet, etc., together with a brief outline of the equipment of the system.

The Aurora, Elgin and Chicago third-rail line extends from Fifty-second Avenue, Chicago, west to Wheaton, Ill., a distance of 19 miles; this portion is double-tracked throughout. From Wheaton a single track extends in a southwesterly direction to Aurora, 14 miles. From Eola Junction, on the Wheaton-Aurora branch, a short line extends northwest to Batavia, at which point is located the one great power house of the system, which was erected and equipped at a total cost of nearly $1,000,000. Another limb of the line, also single track, extends northwest from Wheaton to Elgin, 16½ miles. The single-track portions of the road are provided with frequent sidings, and this, together with a strict operating schedule, gives uninterrupted service.

The tracks are built over private right-of-way, for the most part 60 to 100 feet wide. Cuts on the single-track portions are excavated to a width sufficient to allow of a double track when the time arrives for its construction. Eighty-pound rails with the A. S. C. E. section are used and the roadbed is constructed on the lines of the best steam-railway practice. The aim has been to limit all grades to one per cent. Fig. 3 is a view of a portion of the double-track construction.

The Chicago terminal is a transfer station for connections with the Garfield branch of the Metropolitan West Side (elevated) railway. Two-car trains leave Fifty-second Avenue every half hour for Wheaton, when they divide, one car going to Aurora, the other to Elgin. On the return trip the cars meet again at Wheaton and the two are run in together to Chicago. To give an idea of the speed which is maintained on this road it may be interesting to note that a car recently made the trip from Aurora to the Fifty-second Avenue station, a distance of 33 miles, in 34 minutes. This included seven stops. Cars have been frequently run for short distances at a speed of over 70 miles an hour. The traffic is handled by telephone train-dispatching system, the head train dispatcher being located at Wheaton.

The power house, located at Batavia, is shown in Fig. 1, and was one of the first high-tension alternating-current generating plants to go into operation in which all the switching is done on the high-voltage side of step-upand step-down transformers. Current for operating the line is generated by three 1,500-kilowatt General Electric three-phase generators, having each a 20-foot 80-ton flywheel. These generators are driven by three cross-compound condensing Corliss engines, manufactured by the C. and G. Cooper Company, which run at 75 revolutions a minute. Space has also been left for a fourth similar unit.

The boilers are of the water-tube type of 500 horsepower each and carry a pressure of 180 pounds. The chimney, as shown in Fig. 1, is of brick and stone, 240 feet high, with a flue 11 feet in diameter.

Each generator has its own bank of three transformers, as does also each rotary converter in the sub-stations. The transformers are considered as a unit with the generators and the converters, and in the case of the generators there is no intermediate switch or circuit-breaker.

Current from the main generators after passing through the step-up transformers is raised to 26,000 volts, the leads being then taken through motor-operated oil switches, after which they are led to the high-tension bus bars in a separate compartment of the power house. Besides furnishing power to its own system this station also furnishes the power for the Elgin, Aurora and Southern trolley line.

The system is laid out with six sub-stations, the transmission pressure being 26,000 volts, three phase. The high-tension lines are carried upon cross-arms 24 inches apart, with the insulators on the lower cross-arm 30 inches between centers. Telephone lines for the dispatching service are carried on cross-arms seven feet below the transmission lines. Fig. 3 shows the transmission lines and telephone circuits on the right.

No direct-current feeders are needed, as the third rail is constructed of a special alloy having a high conductivity, and is moreover of large cross-section (1,500,000 circular mils on the main line), giving it ample capacity to conduct the current from the sub-stations to any intermediate point on the line.

Regular sub-station equipment in all the sub-stations consists of two 1,500-kilowatt rotary converters, each with a bank of three transformers. The stations have air-tight bus-bar compartments, which are kept cool by air under pressure delivered by a blower. The machines may be started with alternating current from the transmission line or by direct current from the third rail. When starting, as synchronous motors on the high-tension side, reactive coils are used to counteract the influence of the leading current produced, thus keeping the power factor as near unity as possible.

The cars are of the general type shown in Fig. 2, which offers also a good example of the bridgework along the line. They are 47½ feet long and 39 feet four inches over bodies and seat 56 people. The cars are up-to-date in all particulars, possessing electric heaters, transverse cane seats, toilet rooms, smoking compartment, etc. Four new cars of the same type have lately been added which are several feet longer. These cars, with one express car, one convertible buffet and parlor car, the latter described in the Western Electrician of September 10th, complete the rolling-stock equipment.

Having thus briefly outlined the general equipment of the system, it will be interesting to note some of the new ideas which have been developed by the company. One of these is the method of fighting snow and sleet which was tried last winter with success and which equipment is now a part of every car.

In years past a great deal of annoyance and delay were encountered in fighting sleet which collected upon the third rail, interrupting the traffic. Many plans were devised to do away with the trouble, including various kinds of cutters, etc., all of which proved unsatisfactory. Finally a method was tried which has been successful and which consists in sprinkling the third rail with a solution of calcium chloride ($CaCl_2$). The solution used consists of the $CaCl_2$ mixed with water until the specific gravity is about 1.2. The freezing point of the mixture thus obtained is 30° below zero. The solution is prepared

Fig. 2. Three-car Train Crossing Bridge. Fig. 1. Power House at Batavia, Ill. Fig. 3. View of Double-track Construction.

SOME INTERESTING FEATURES OF AURORA-ELGIN-CHICAGO ELECTRIC-RAILWAY OPERATION.

in large quantities in a 45-barrel tank at Wheaton, from which it is readily delivered to the cars. Upon each car is carried a small galvanized iron tank holding sufficient of the liquid to last the car on a 20 or 30-mile run. A rubber tube passes down through the platform to a brush-like arrangement shown in Fig. 4. The brush is of steel and is pressed upon the rail by a spring. It may, however, be sustained in a raised position by a catch which holds it after it has been raised by the rubber insulating handle shown in the picture. A bent section of gaspipe attached to the lower end of the rubber tube delivers the solution to the rail just ahead of the brush.

The action of the solution upon the ice is a peculiar one, seeming to decay the ice and make it

FIG. 4. APPARATUS ON AURORA-ELGIN-CHICAGO CARS FOR REMOVING ICE FROM THIRD-RAIL.

porous and scaly so that it is readily swept away by the brush, or at least a sufficient amount of it so that the shoe which follows behind is given sufficient contact to deliver the necessary current.

Not only does the solution destroy the ice but it also protects the rail for a limited length of time from the further collection of sleet. The solution is not expensive and the cost is insignificant when compared with the great amount of time and expense saved by its use.

An interesting experiment which the company is making is the furnishing to farmers living near the line with electric power direct from the third rail. The results have been highly satisfactory so far to the farmers who have had the power brought to their farms. Of course the quantities of power sold by the railway company are small and intermittent and there is not a large amount of profit derived from the power thus sold. But it is a far-sighted policy, nevertheless, as anything which contributes to the prosperity of those living in the neighborhood of the line will in the end benefit the railway company.

Thus far there are 40 to 50 farms connected in this way to the system. The power can be used for a variety of purposes, such as threshing, grinding, sawing wood, etc. It is the common practice of the farmers in this part of the state to do their threshing and grinding on the barn floor, so in installing the motor equipment a line shaft is generally employed in the barn belted to the motor and driving in turn by pulleys the various machines.

Fifteen horsepower is the popular size of motor, though some of 20 horsepower have been installed. They are connected by a metallic circuit to the source, one wire being connected to the third rail and the other to the track rail.

The average cost is from $500 to $675 for each installation. This is not far from one-half the cost of a gasoline engine of the same power. No difficulty is experienced in the operation of the motors, which is a much more simple task than the running of a complicated gas engine. Directions accompany each motor and all that the farmer has to master besides the throwing of the switches is the replacement of blown fuses and the care of the commutator and brushes.

So even is the voltage on the third-rail due to its large cross-section and to the ample power supplied that a number of farmers have tried lighting as well as power work. For this purpose six lamps are connected in series and the pressure on the third rail being in the neighborhood of 600 volts, the lights are run somewhat below normal voltage, therefore giving them long life, though they are not quite up to full candlepower.

This is one of the first attempts made by an interurban road to furnish power to adjacent farms and is creating considerable attention. The farmers who are now connected would not change back to the old method, and to all appearances the electric motor has come to stay.

Superintendent Wendell Ballou of the Elgin, Aurora and Southern Traction Company has been prominently connected with the movement, having had the installation of the motors under his personal supervision.

Not only is the farmer benefited by the installation of electrical machinery upon his farm but he is also afforded a ready means for transporting milk to Chicago, which furnishes the best market for this product. Hand in hand with this goes the delivery of early morning newspapers to the various towns along the road. This dual service is performed by one express car, which is enabled to make one paying trip each way per day. The newspaper service was begun in 1903, and it is estimated that as high as 80 or 90 tons of newspapers were carried each month during the summer just past.

As soon as the first installment of the last edition of the morning papers is off the press, which is about 3:30 a. m., they are hurried to the Fifth Avenue terminal station of the Metropolitan Elevated railway, over whose tracks the express car is allowed to pass. Here the car is waiting for them, and by means of a sort of endless-chain lift provided with extending arms to carry up the bundles of newspapers they are lifted up and dumped into the car on the tracks above.

About 25 per cent. of the papers are delivered at Fifty-second Avenue, Chicago, for distribution to Oak Park and nearby suburbs. Twenty per cent. go to Aurora, as many more to Elgin and the remainder are delivered to the Elgin, Aurora and Southern Traction Company for delivery to more distant points. By this means the latest editions of the morning papers can be delivered to the points named from 45 minutes to one hour and 30 minutes earlier than could be done by the steam roads, giving the people the latest edition instead of the "country" edition. The company receives its pay from the publishers on a tonnage basis.

Arriving at Wheaton about six o'clock in the morning the "newspaper special" is ready to begin collecting milk. It is first run to Eola Junction and picks up the milk cans from there in toward Chicago, arriving at Fifty-second Avenue at about 8:40 a. m., where the milk is delivered to the city milk dealers. Fifteen cents per eight-gallon can is charged, which is prepaid by a milk ticket inserted in the holder on each can. The average amount of milk carried each day is about 1,400 gallons.

As an example of another unique departure made by this company may be mentioned the buffet car, which, as stated above, has been already described in the Western Electrician. This car is the first of its kind ever operated upon an electric railway and is a model of convenience. It is intended to permit men living in the cities of Aurora, Wheaton and Elgin or other towns along the line whose places of business are in Chicago to take their morning or evening meals on the way if they so desire. So well is this car balanced that a glass of water filled to within a quarter of an inch of the brim will ride upon one of the tables without the water being spilled when the car is traveling 60 miles an hour and over, which can hardly be said of a dining car upon a steam road even when traveling over a first-class roadbed.

An agreement has recently been reached between the Aurora, Elgin and Chicago Railway Company and the Illinois Central railroad which is not only of much importance to the two interests concerned but which may be looked upon as significant of the general trend toward more amicable relations between steam and electric railways. A freight-traffic arrangement has been entered into by the two companies whereby through freight on the Illinois Central may now be billed to Elgin, Wheaton and Wayne, completing part of its journey over the electric line. The electric company receives a portion of the tariff, giving at the same time the Illinois Central entrance, practically, as far as freight is concerned, to the above-named towns.

The president of the Aurora, Elgin and Chicago Railway Company is Mr. L. J. Wolf of Cleveland. Mr. E. C. Faber is general manager of the company and Mr. Edward F. Gould is the electrical engineer. Both gentlemen make their headquarters at Wheaton, Ill.

Automatic Control for Railway Motors.

Heavy-traffic electric railways necessitate the employment of motor carriages carrying more than one motor, so that they may quickly attain a predetermined rate of speed. In starting these motors have a great strain to overcome, while when traveling at normal speed or downhill the amount of current consumed by the motors becomes less. In order to secure the highest possible useful effect and to save the power wasted by the several motors in running idle fewer motors are conveniently brought into operation for the purpose of generating the diminished amount of power which is required. To this end it should be feasible to switch the desired number of motors out of circuit whenever the actual expenditure of current has decreased, and, conversely, in ascending gradients it will be necessary to switch the whole or part of those motors into circuit again to avoid overloading the limited number of motors which are in operation already. In addition to this all the motors have to be protected from overloading, and this is generally effected by the employment of a maximum cut-out adapted electrically to disconnect all the motors at the same time and to be operated by hand only.

Now the object of the invention illustrated herewith is to enable all or any of the motors to be cut out whenever required by means of automatic mechanism operating independently of any interference on the part of the driver, and thereby to provide for the economical consumption of current.

With this object in view Oskar Lasche of Berlin, Germany, has patented a system which he has

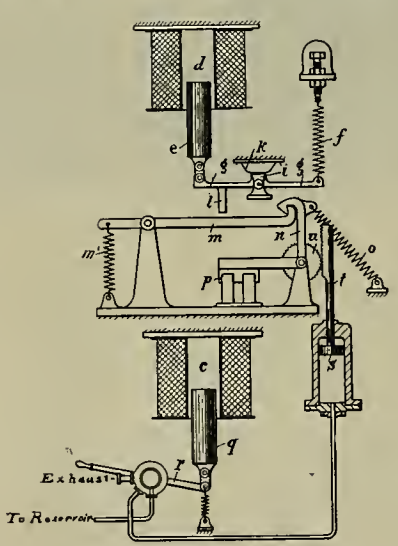


Fig. 1. Construction of Coil.

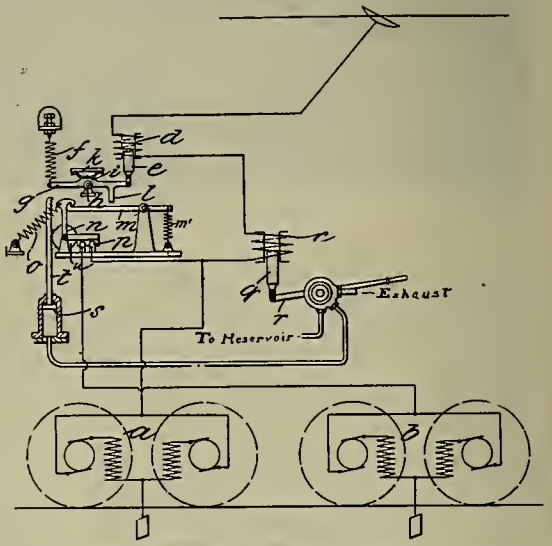


Fig. 2. Connection of Apparatus to Motors.

AUTOMATIC CONTROL FOR RAILWAY MOTORS.

assigned to the General Electric Company and which is the one shown by the diagrams.

As illustrated in Figs. 1 and 2, there are assumed to be two series of motors (a) and (b), each series being supposed, by way of illustration, to comprise two motors connected in parallel in a three-wire circuit common to both. The maximum cut-out (c) is in the main circuit in series with the minimum cut-out (d).

The operation is as follows: The construction of the coil (d), Fig. 1, is such that while current is being expended by the motors (b) at the normal rate the iron core (e) maintains the spring (f) in a state of equilibrium. The double-armed lever (g), pivoted by one arm, supports the iron core (e) and by the other the spring (f), both being adjustable according to predetermined amperages. Rigidly connected with the double-armed lever (g) is a projecting piece (i) supporting a level surface. This surface is adapted to rest against the spring (k), and thus to deaden the vibrations which occur when the iron core (e) is attracted as a result of the impulses of current. Besides, this plane surface and the spring (f) afford the means of providing for differences of current arising in consequence of the switching out and switching in of the other series of motors (h), Fig. 2. When the expenditure of current has reached a given minimum, but not before, the tension of the spring (f) overcomes the attractive force of the coil (d) and the friction between the surface (i) and the spring (k), so that the projection (l) will depress the horizontal lever (m) against the action of the spring (m') and release the bell-crank lever (n). The spring (o), which is thus strained, now comes into operation. It breaks the circuit at the contact point (p), and consequently cuts out of the circuit the second series of motors (b), so that now all the work to be performed devolves upon the first series (a). As regards the coil (c), it lies in the circuit of the series of motors (a) and is so constructed that the iron core (q) becomes attracted the moment the load of the motors attains a given maximum. By the movement of the iron core (q) a lever (r) is set in motion, and this lever, through the intermediate agency of compressed air or water under pressure and by means of the piston (s), rack (t) and toothed wheel (u) closes the circuit once more at the contact point (p). The series of motors (b) is now again supplied with current, so that all the motors available once more perform their share of the work. The same result might be attained by the aid of compressed air, water under pressure, an auxiliary motor or the like. The moment contact has been made at (p) the series of motors (b) again receive current and the coil (d) draws the lever (g) back to its original horizontal position.

The Houston, Licking and Salem Electric Railway Company of Houston, Mo., has been organized to build an electric railway connecting the three towns. The directors are James A. Craven, Robert Lamar and others.

International Jurors in the Electricity Section at the World's Fair.

The accompanying group of portraits shows 38 of the domestic and foreign jurors in the Electricity Section of the International Jury of Awards of the Universal Exposition of 1904 at St. Louis. Many well-known electrical educators and engineers served on the jury. The group picture does not show all the electrical jurors, several not being present at the time the photograph was made. It is, however, the most complete picture of the electrical jury extant. Following is a complete list of the names of the jurors of the Electrical Section, with the assignment to groups and the chairmen, vice-chairmen and secretaries of each group indicated. The numbers refer to corresponding numbers on the portraits in the group. Where no number is given it means that that juror was not present when the group photograph was taken:

GROUP 67.—MACHINES FOR GENERATING AND USING ELECTRICITY.

W. V. N. Powelson, chairman.
6. G. Holschuch, vice-chairman.
26. Prof. H. H. Norris, secretary.
5. E. Solari.
34. C. W. Wason.
P. O. Keilholtz.
H. Floy.
31. E. P. Roberts.
F. G. Baum.
36. Prof. J. P. Jackson.
32. O. T. Crosby.
37. Prof. G. F. Sever.
11. H. Shibusawa.
H. H. Gerry.
Prof. R. B. Owens.
J. W. Esterline.

GROUP 68.—ELECTROCHEMISTRY.

21 Carl Hering, chairman.
25. Chas. F. Burgess, sec.
38. Samuel Sheldon.
12. K. Sosnowski.

GROUP 69.—ELECTRIC LIGHTING.

Harold B. Smith, chairman.
7. Guido Grassi, vice-chairman.
18. B. V. Swenson, secretary.
23. George D. Shepardson.
24. Warren E. Weinsheimer.
C. A. Adams.
10. Alfred Dennery.
22. F. P. Anderson.
33. E. L. Nichols.
8. Prof. W. E. Goldsborough, chief, Department of Electricity.
9. Dr. Kable.

GROUP 70.—TELEGRAPHY AND TELEPHONY.

20. William J. Hammer. chairman.
4. Gaston Roux, vice-chairman.
16. Prof. A. S. Langsdorf, secretary.
3. A. I. da Costa Couto.
17. Dr. F. B. Herzog.
30. Prof. J. C. Kelsey.
Dr. A. E. Kennelly.

GROUP 71.—VARIOUS APPLICATIONS OF ELECTRICITY.

19. E. B. Rosa, chairman.
2. Dr. C. V. Drysdale, vice-chairman.
13. M. C. Buckey.
14. Dr. F. A. Wolff.
27. Dr. Frederick Bedell.
15. Dr. Wm. J. Morton.
1. M. Andre Silva.
28. Dr. K. E. Guthe.
29. Col. Samuel Reber, U. S. A.

INTERNATIONAL JURORS IN THE ELECTRICITY SECTION AT ST. LOUIS EXPOSITION.

Electrical Section of the Western Society of Engineers.

A meeting of the electrical section of the Western Society of Engineers was held in the society's rooms in the Monadnock Building on the evening of December 16th. Professor Crew of Northwestern University read a paper, referred to elsewhere in this issue. According to the rules of the Electrical Section, the officers of the section are to be nominated at the December meeting. The names are then posted for one month and voted upon at the January meeting. In accordance with this provision nominations were made as follows: Chairman, W. B. Hale; vice-chairman, S. G. McMeen; executive committee, W. G. Carlton, George A. Damon and P. B. Woodworth. The election, which will take place at the January meeting, will be the first in the history of the Electrical Section of the Western Society of Engineers.

January 13th is the date of the next meeting, at which a paper by Mr. C. A. S. Howlett upon the "Commercial Aspect of Engineering" will be presented.

Long Overland Wireless Communication.

A telegram from Lee De Forest dated at Kansas City, Mo., on December 15th is authority for the statement that the De Forest Wireless Telegraph Company is now sending messages by space telegraphy from Kansas City to Chicago and Cleveland direct, without relay, breaking all records for overland wireless. It is said that the Kansas City station will be opened on the first of January for commercial business with St. Louis, Springfield, Chicago, Cleveland and Buffalo.

At the Chicago office of the De Forest company it was learned from William H. Ocker, manager, that on the date above mentioned several wireless messages were received at the Chicago station from Kansas City, among them being the following: "John Farson, Farson, Leach & Co., Chicago. Am pleased to be able to send you an aerogram from Kansas City, 450 miles. This is the record up to date. We will begin commercial business from Kansas City to St. Louis and Springfield in a few days and are accepting all the business we can handle. Lee De Forest."

It was asserted later at the Chicago office that a message had been sent to Cleveland from Kansas City, a distance of 725 miles. The Chicago station of the De Forest company at present can only receive messages. The sending apparatus is now being installed and will be in operation within two weeks, it is said.

Chicago Street-railway Situation.

As to the next move in the Chicago traction situation, much depends on what Judge Grosscup may decide in the case, which is on hearing before him at this writing. He has been asked to issue an indefinite amount of receivers' certificates, which is being strongly opposed by the underlying companies of the Union Traction Company. If the judge refuses the application, it is said, the new enterprise in which Marshall Field, John J. Mitchell, J. P. Morgan, Thomas Ryan and others are interested, will be launched. Arrangements are said to have been completed by these financiers where by the Chicago City system and the properties of the North and West Side companies are to be bought and developed into one comprehensive system. The Chicago Union Traction Company is to be ignored, according to the plan.

The Chicago City Council at its meeting this week extended the agreement under which the Chicago City company is operating until February, 28, 1905. The pending ordinance for this company was made a special order for the council meeting of January 23, 1905.

Electrical Method of Thawing Water Pipes.[1]

By George S. Haley.

Aside from the remarkably clean and effective manner in which the electric outfit does its work, no other method being, in my estimation, near enough for comparison, the value to insurance companies must be worth considering. From a reliable source I find that during the year of 1898 insurance companies paid about $300,000 in losses caused by fires started by other methods of thawing water pipes. Everyone is familiar with the usual methods of thawing pipes practiced by plumbers, and when

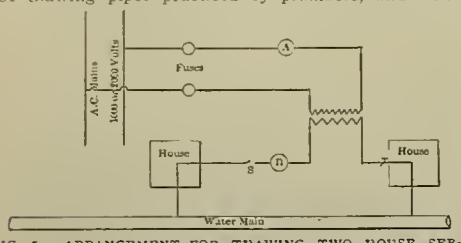


FIG. 1. ARRANGEMENT FOR THAWING TWO HOUSE SERVICES AT ONCE.

digging has to be resorted to it is a very expensive proposition, and even plumbers are justified in rendering the enormous bills credited them.

As to the method of procedure to thaw with electric current, assuming an alternating current of 1,000 or 2,000 volts is available, the necessary requisites are as follows:

1. A transformer of 10 to 15-kilowatt capacity, with 50 and 100-volt secondary; for ordinary house services, 50 volts is sufficient.
2. An ammeter reading to 30 amperes, if placed in the primary.
3. Primary cut-outs.
4. Single-pole switch in secondary.
5. A resistance that can be made as described in Fig. 5.

Connect up the instrument as shown in Fig. 1, leaving the movable electrode out of the water. Close the primary switch and drop the lower end of the electrode into the water, watching the ammeter, which should indicate three to five amperes and which will increase as the electrode is given more contact with the water; the maximum amount of

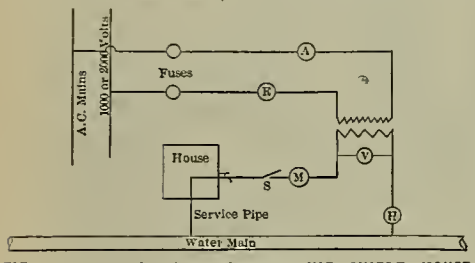


FIG. 2. ARRANGEMENT FOR THAWING SINGLE HOUSE SERVICE.

current will depend on the resistance of the pipe. By consulting the table the amounts of current required for different services, mains, etc., also the length of application, may be approximated.

The most practical arrangement, aside from a transformer made for the purpose, is shown in Fig. 2. A choke coil, made as described in connection with Fig. 4 and placed between the primary switch and the transformer, gives practically the same results and is much more efficient and easily handled.

Before closing the secondary switch, the position of the core of the choke coil should be noted. It should be completely inside the choke coil, and to increase the secondary current, withdraw it until the required amperes are obtained.

Fig. 1 shows two house services being thawed at the same time, one end of each secondary being attached to the sillcock of each house, the resistance

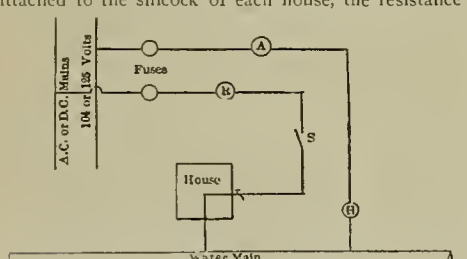


FIG. 3. CONNECTION FOR USE WITH 104 TO 125-VOLT CIRCUIT.

(R) being placed in the secondary circuit. Ammeter (A) indicates the number of amperes in the primary circuit. The transformer should be protected by suitable fuses, located either upon the pole adjacent to the primary feeders or upon the wagon.

Fig. 2 shows one house service being thawed and connected to one side of the secondary feeder, the other being connected to hydrant (H). In the diagram, (A) represents the ammeter in the primary circuit, (M) a recording wattmeter in the secondary, and (V) a voltmeter connected across the secondary terminals of the transformer.

Fig. 3 shows a connection for the use of 104 to 125 volts, alternating or direct current. This arrangement is applicable to isolated plants using two or three-wire low-voltage distribution. (A) indicates the ammeter and (R) the resistance.

Fig. 4 shows a choke coil suitable to control for all purposes a 15 or 20-kilowatt transformer with 2,000 volts primary, and is constructed as follows:

A tube 16 inches long, two inches in diameter, is made by winding a sheet of one-sixteenth-inch red fiber around an iron mandrel four times and held in place by a few small tacks. Two wooden beads are provided, six inches in diameter by three-quarters of an inch thick, and secured to the ends of the fiber tube. A winding, consisting of 200 turns of No. 12 weatherproof wire, is placed on the spool after it has been given several coats of shellac and dried. A core is made of No. 14 iron wire in pieces 16 inches long, held together by a few turns of fine iron wire and covered by two layers of tape. The center wires are cut four inches longer, and over them is placed a wooden handle.

Fig. 5 illustrates the simplest form of rheostat suitable for either primary or secondary, but recommended for secondary sides only, because of safety to those using it. It is a barrel of water to which 10 pounds of common salt has been added, with two electrodes, each made of a coil of 10 feet of No. 2 bare copper wire in a flat spiral, or a six-inch pipe flange, one fastened to the side of the barrel near the bottom, the other so arranged that it can be raised or lowered. The cut shows such an arrangement, which may, of course, be elaborated upon according to the ideas of the user. This form of resistance has been used by the majority of those who have thawed pipes by electric current, probably because it was the easiest obtained; while not strictly up-to-date, electrically speaking, it certainly answers the purpose. A rheostat of this description will handle 300 amperes for a short time; if continued, the water will probably boil over.

Fig. 6 shows a connection used by one correspondent using an ordinary transformer, wound for 1,000 and 2,000 volts primary, and used upon a 1,000-volt circuit; the secondary voltage is 50. (A) and (4) on the diagram indicate the fuse plugs in the primary circuit; (1) (2) (3) indicate plug cut-outs, having but one plug for all three; (B) is a plug used to short-circuit the choke coil. While manipulating plugs (1) (2) (3) and the choke coil the correspondent states that any voltage between 17.5 and 50 is obtainable. It would seem that sufficient variation should be obtained either by the use of the choke coil or by the changing of the connections in the transformer.

Fig. 7 indicates connections of standard transformers giving the voltage from 22 volts to 220. A five-kilowatt transformer is connected to the 2,200-volt primary; the secondary is 220 volts, and feeds the primaries of two 15-kilowatt transformers. The ratio is one to five, their secondaries being connected in multiple.

Fig. 8 is a picture of an outfit used in Durango, Colo., which is the most complete in detail of any that have come to our notice. Four small transformers, taken from the scrap pile, with 55-volt secondaries, were placed in the wagon in front of the switchboard. In the secondary of each transformer is placed a choke coil, described as follows:

The choke coils are about 18 inches long, with a core 2.5 inches in diameter, formed on a brass tube with cast ends, a slot being cut lengthwise through the tube and ends to prevent the formation of a closed secondary circuit in the spool. After being thoroughly insulated, each core is wound with two layers of No. 4 magnet wire. The cores, which are 18 inches long, consist of 500 pieces of No. 14 annealed iron wire, which are assembled around a central iron rod, threaded at each end, with two fiber heads turned to fit the tube. The whole core is covered with several layers of cotton tape coated with insulating varnish. Above each choke coil is placed a 75-ampere double-pole knife switch and a 100-ampere double-pole D. & W. cut-out; also one 350-ampere ammeter and one 150-volt voltmeter. There are also four pilot lamps, one of each being connected to the four transformers, which, by the switches mentioned, can be thrown in multiple. On the back of the wagon cover are placed two General Electric primary cut-outs, and just back of these, not shown, is a 30-ampere, double-pole, quick-break knife switch, placed in the primary circuit. The secondary leads are composed of No. 00 cable wire with connectors made of brass, to facilitate the connections of the pipe system. To use this outfit the primaries are brought from the pole to the cut-outs. The secondary connections are made to two houses, or one house and a hydrant. The primaries and secondaries are then closed and the cores pulled

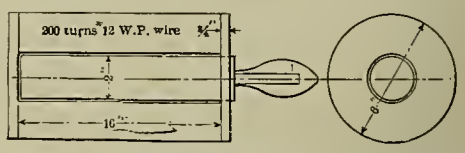


FIG. 4. CHOKE COIL SUITABLE FOR 15 OR 20-KILOWATT TRANSFORMERS.

out of the choke coil until the desired amount of current is obtained.

A transformer is also made by the Pittsburg Transformer Company for the purpose of thawing pipes. [This transformer was described in the Western Electrician of December 3d.]

DATA PERTAINING TO HOUSE SERVICES.

Service Pipe.			Amperes.	Volts.	Time Required.
Length.	Kind.	Size.			
60 feet	Iron	3/4-inch	320	110	25 minutes
80 "	"	3/4 "	300	110	23 "
100 "	"	3/4 "	300	110	11 "
90 "	"	1 "	280	110	10 "
150 "	"	1 "	280	110	2 hours
130 "	"	1 3/4 "	340	110	1 1/2 "
150 "	Lead	3/4 "	250	50	12 minutes
240 "	Iron	3/4 "	250	52	30 "
300 "	"	2 "	250	52	2 1/2 hours
250 "	"	1 "	500	50	20 minutes
700 "	"	1 "	175	55	5 hours
250 "	"	3/4 "	400	50	20 minutes
100 "	"	3/4 "	135	55	10 "
100 "	"	1/2 "	150	20	45 "
380 "	"	3/4 "	300	30	10 "
150 "	"	1 "	200	40	20 "
50 "	"	2 "	500	50	120 "
75 "	"	3/4 "	100	50	5 "
600 "	"	1 "	60	50	60 "
200 "	"	3/4 "	110	50	6 "
60 "	"	2 "	160	50	4 "
50 "	"	1/2 "	250	20	5 "
50 "	Lead	1/2 "	250	15	5 "
220 "	Iron	1 "	60	105	75 "
180 "	Lead	5/8 "	185	35	15 "
45 "	Iron	1 "	140	220	17 "
100 "	"	1 "	175	220	15 "
200 "	"	3/4 "	120	50	1 "
250 "	"	3/4 "	120	50	10 "
20 "	"	2 "	2,000	6	3 "
70 "	"	1/2 "	300	16	15 "
250 "	"	1 "	400	50	20 "
40 "	"	3/4 "	300	50	8 "

ABSTRACTS FROM LETTERS RECEIVED GIVING PERSONAL IDEAS OF CORRESPONDENTS AND OTHER INFORMATION.

From replies received from the various plants throughout the United States and Canada, we learn that at least 75 electric-light and power companies have employed this method of thawing frozen pipes.

A correspondent states that "where the services were frozen between the street main and the curb, the work was paid for by the waterworks; when frozen between the curb line and the customer's outlet, it was paid for by the consumer."

A correspondent writes: "Owing to the discontent among the plumbers when we quoted figures to customers direct, we finally adopted a plan to do the work for plumbers only, thereby relieving ourselves of the trouble caused by bursted water pipes, etc. The plumber takes care of this work himself and is required to be on the ground to superintend that portion of it." A fixed charge was made of $15 per service connection. The amount received by the plumber was not given.

A correspondent states that in his opinion it would be better for the city to own the electrical apparatus, and when not employed for its own use it could rent it to the plumbing establishment or to private parties. His company would be quite willing to detail a man to make connections to these lines, and make a record of current, making a suitable charge for the time of the man and current.

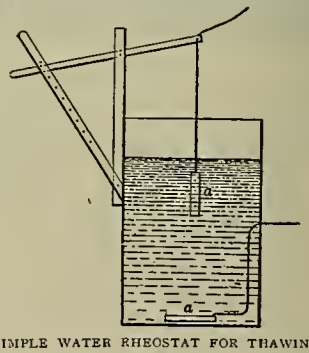


FIG. 5. SIMPLE WATER RHEOSTAT FOR THAWING WATER PIPES.

In other plans, as it has found, the company is liable to get into conflict with plumbing establishments and central labor unions.

The price charged for this work is, in almost every case, a lump sum, which varies from $2.50 to $25 per service. As a rule, the smaller towns charge from $2.50 to $5, generally the latter amount. In the larger cities, the prices run from $10 to $25, averaging about $15 per service. A few correspondents refused to mention the price they charged for the work, but stated that they made it large enough to cover the cost price and make a fair profit.

A correspondent states that the company charges a certain amount for the first service thawed for one day at one setting, and if there are more to be thawed on the same day, only two-thirds of the price is charged for additional services. The charges are based on what it would cost the waterworks department to thaw an ordinary service by the old method, rather than what it actually costs the electric company; the cost to the electric company is very small.

A correspondent states that the average rate was $3; the minimum charge was $2 per service and one

1. Condensation of a report prepared for the National Electric Light Association. Mr. Haley is superintendent of the Rutland City Electric Company of Rutland, Vt.

hour's time for two men, use of apparatus and current, which included the time of moving from one job to another. If more time was consumed, it was at the rate of $1.50 per hour.

A correspondent states that the company charged a lump sum of $15 per house service, out of which it gave the licensed plumber 20 per cent. for collecting and assuming all responsibilities, as to damage to pipes, etc.

A correspondent states that $25 per day was charged for the outfit, including the use of the team,

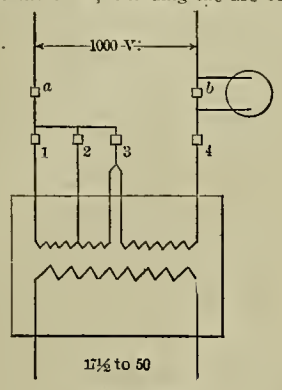


FIG. 6. CONNECTION USING ORDINARY 1000 AND 2000 VOLT TRANSFORMER.

wagon, driver and four linemen; also transformers, wire and other necessary apparatus; the current consumed was also included. The city supplied a policeman and a man detailed from the waterworks.

A correspondent states: "We expect to derive considerable revenue from this source, and will probably advertise a little. The outfit necessary for the operation consists of a horse and wagon, one experienced operator and one lineman. The force should be able to complete work inside of two hours after arriving at the point of trouble. The cost of melting pipe, when done by the plumbers, varies from $10 to $50, depending upon how much bad luck they have had in working upon the wrong part of the pipe, and the time the customer is off from his service in some cases amounts to a week. Under these conditions, we feel that the public will look favorably upon a charge of $10 for quick service."

In regard to measuring the current, but very few correspondents seem to have taken the trouble to make accurate measurements of the current. Usually an ammeter was placed in the primary, in order that the transformers might not be overloaded to such an extent as to cause them to be damaged. A few used both an ammeter and a voltmeter, from which readings were kept and current figured on a volt-ampere basis.

A correspondent used 15-ampere fuses in the primary, and as they were not blown he was satisfied that he did not use much over the amount mentioned. A correspondent states that the only way they could tell how much current they were using

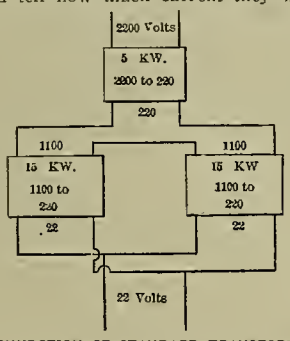


FIG. 7. CONNECTION OF STANDARD TRANSFORMERS WITH VOLTAGE OF 22 TO 220.

was by the way the water boiled in the barrel used for the rheostat.

A correspondent states as follows in reference to the measurement of current: "We find that the water always begins to flow before the lead pipe shows any appreciable heating. We intend, therefore, to dispense entirely with ammeters and instead to make use of the temperature of a piece of lead pipe filled with water, which will be inserted in the low-voltage circuit at the switch. Should the amperes in any particular case be twice as much as is needed—say, 400 amperes instead of 200 amperes—I believe the only effect will be to shorten the time needed for melting the ice and starting the flow of water. The frozen pipe surrounded by earth at a temperature less than 32 degrees Fahrenheit can be regarded as a reservoir for heat, in which a certain quantity of heat must be generated and stored before melting takes place. If this heat is stored in half the time, the same temperature approximately will be attained in each case, and it therefore makes no difference whether or not the current is increased abnormally, provided the time is correspondingly shortened. The only danger in passing an abnormally large current through the water pipe is when the excessive current is kept on until the pipe reaches a steady temperature, and the lead-pipe temperature indicator mentioned above will be an absolute measure of this."

All voltages from 2.5 to 500 seem to have been used. Only a few answers indicate that elaborate tests have been made. The majority of the work has been done, apparently, with little regard to the current consumption, the price charged being high enough to make up for any deficiency in this respect. From one correspondent we have the following:

"A length of 40 feet of one-half-inch lead pipe required 186 amperes at 12 volts applied for five minutes.

"For a length of 20 feet of half-inch extra-heavy lead pipe, 10 volts was required to force 150 amperes through, and from 12 to 15 volts for 200 amperes. With a current of 200 amperes, the water was started in three minutes, but it was found necessary to raise the current to 281 amperes with a voltage of 18 applied for 15 minutes. By this time the pipe was quite warm, the temperature being about 115 degrees Fahrenheit, which proved that there was no longer any ice in the pipe and that the flow of water was obstructed by other causes.

FIG. 8. OUTFIT USED IN DURANGO, COLO. FOR THAWING FROZEN WATER PIPES.

One hundred feet of half-inch lead pipe required a pressure of 37 volts to force 270 amperes through; time required, five minutes. In this case the current passed through 100 feet of water main. The actual kilowatts in this case were 7.5, which, for the space of five minutes, represents 0.62 kilowatt-hour. Another case of 60 feet of half-inch lead pipe in circuit with 60 feet of water main required 200 amperes at a voltage of 10 for 20 minutes to free the pipe. The current consumption in this case was about 0.70 kilowatt-hour. One hundred feet of small service pipe, supposed to be of iron, required 200 amperes at 25 volts for five minutes, the current consumption being about 0.33 kilowatt-hour.

The alternating current seems to be used almost universally for this work, and in only one or two instances has the direct current been used. A correspondent states that in the use of direct current, he found that the energy would all be expended at or near the positive connection of the pipe, he having noticed that the ice had melted and the water boiled in the pipe at the positive connection, while at the negative connection, three feet away, there was no indication of heat whatever. He stated further that the alternating current was much more effective than the direct current, and that he could accomplish more with less than one-half the amperes of alternating current. In one instance he applied from 400 to 480 amperes at 104 volts direct current to a two-inch water main for six hours the first day and eight hours the next, making no impression whatever. After four or five days of very cold weather, he applied 150 amperes of the alternating current, and thawed it out in about three hours.

Transformers of all descriptions were used. In many cases they were taken from scrap piles, and put to good use thawing pipes. The secondary voltage seems about equally divided between 50 and 100 volts; evidently because standard transformers were used, and 50 volts in some instances not found enough, 100 was used, as it covered all cases, regardless, however, of current consumption. In thawing lengths from 100 to 200 feet of service pipes or of mains, the opinion seems to be that from 75 to 100 volts are necessary at times. The average capacity of transformers used is about 15 kilowatts.

A correspondent states that he would advise the purchase of a special transformer for this purpose, with a secondary voltage of 50-75 and 100. This arrangement of voltage, in connection with the water rheostat, he thought, would take care of any case they might encounter. The capacity should be about 20 kilowatts with an overload margin of 50 per cent. for one-half hour. He could afford to pay about $250 for such an outfit, and thought it advisable to induce the city to purchase or carry an investment of such a transformer to be used for this work, and for it exclusively.

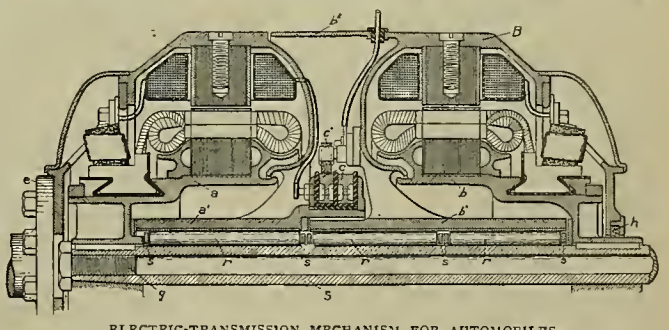
Electric-transmission Mechanism for Automobiles.

A patent has been recently assigned to the General Electric Company by the inventor, Charles G. Simonds of Schenectady, N. Y., which is directly applicable to the driving of electric automobiles and relates to the electric transmission which in this class of vehicle must of necessity be compact, self-contained and practically dustproof.

It has been proposed heretofore to transmit the power from a prime mover to the load with variable relations of speed and torque by means of an electric generator having both parts movable, one driven by the prime mover and the other connected to the load, the generator being driven by a gas engine carried by the automobile. The relative slip of the two members of the generator can be adjusted by varying the field strength of the generator, and in this manner the load speed may be regulated. Moreover, the energy generated by the relative movement of the two members of the generator may be utilized in a motor arranged to convert this energy into mechanical power and to apply it in driving the load. Such a transmission mechanism involves certain mechanical difficulties, since both members of the generator must be made rotatable. In the case of an automobile drive, where the mechanism is subject to hard usage, where the available space is limited, and where all parts are continually attacked by dust, the difficulties of mechanical construction are increased.

The object of Mr. Simond's invention is to provide a strong, compact, self-contained and practically dustproof construction for such a transmission mechanism as has been described above.

Referring to the accompanying illustration, it will be seen that the field (A), which is bolted to the engine flange, is extended on its inner side by a web, so as nearly to encircle the armature (a). The end of this web forms a bearing (a′) for the driven shaft (S), the rollers (r) being inserted between the bearing (a′) and the shaft (S). The armature (a) is keyed to the end of the shaft (S) and overhung to bring it within the field. The shaft (S) is tapered at its end, and armature (a) is keyed to the tapered end and held in position by means of the bolt (g). The rotatable field (A) carries the collector rings (c), by means of which



ELECTRIC-TRANSMISSION MECHANISM FOR AUTOMOBILES.

current may be supplied to the field coils. The brushes (c′) are supported from the stationary field (B) of the second machine. This stationary field also has an extended web practically encircling the armature (b), and the end of which forms a bearing (b′) for the shaft (S). Spacing rings (s s) separate the rollers (r r). The armature (b) is also keyed to shaft (S) and is overhung similarly to armature (a). Stationary field (B) is provided with a flange (b^2), extending into close proximity to the revolving field (A) and serving to exclude dust from the collector rings and bearing. Field (B) is also provided with a dust ring (h), surrounding shaft (S). It will be seen by this arrangement that a practically continuous bearing for shaft (S) is secured through the entire transmission mechanism, rigidity of construction obtained, and maintenance of perfect alignment insured. Furthermore, the structure is practically self-contained, requiring outside support only for the stationary field (B).

Bids will be received by the city of Christiansburg, Va., until January 5th for a franchise to operate the electric-light plant in the city.

WESTERN ELECTRICIAN

EVERY SATURDAY.

PUBLICATION OFFICES:
510 Marquette Building, • CHICAGO.
TELEPHONE, MAIN 1746.

Eastern Office, 193 Times Building, New York.
Telephone, 3806J Cortlandt.

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted. This paper is entered at the Chicago postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the **old address** as well as the new should be given.

CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—**the only general electrical paper published in the West**—thoroughly covers a territory *exclusively its own.* THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be furnished on application.

REMITTANCES.—All checks, drafts and other remittances should be made payable to the order of the publishers, the **Electrician Publishing Company,** and addressed to the offices of publication, Suite 510, Marquette Building (204 Dearborn Street), Chicago, Illinois. U. S. A.

CONTENTS OF THIS NUMBER.

Some Interesting Features of Aurora-Elgin-Chicago Electric-railway Operation. Illustrated 499, 500
Automatic Control for Railway Motors. Illustrated. 500, 501
International Jurors in the Electricity Section at the World's Fair. Illustrated 501
Electrical Section of the Western Society of Engineers. 501
Long Overland Wireless Communication 501
Chicago Street-railway Situation 501
Electrical Methods of Thawing Water Pipes. By George S. Haley. Illustrated. (National Electric Steam Association) 502, 503
Electric-transmission Mechanism for Automobiles. Illustrated 503
Editorial 504
Theory of the Electric Arc and Electric Spark 505
Electrical Outlook in Detroit 505
Book Table 505
Schulz's "Electrical Machinery" 505
Crocker's "Electric Lighting" 505
Abbott's "Electrical Transmission" 505
Wright's "Electrical Furnaces" 505
Municipal Street-lighting Talk in New York 505
Death of Mr. W. Forman Collins 505
Echoes of the Telephone Convention. Illustrated 506, 507, 508
Members and Visitors 506, 507
The New President. Portrait 507
Convention Notes 507, 508
Fuseless Rosettes. Illustrated 508
Guthrie Sign Flasher. Illustrated 508
4,000-kilowatt Alternators to be Driven by 6,000 horsepower Gas Engines 508
Vertical Single-phase Motor. Illustrated 508
West Shore Road to be Used for Electric Cars 508
The Power Plant of the Tall Office Building. By S. H. Bunnell. (American Society of Mechanical Engineers) 508, 509
Electric Mine and Quarry Drill. Illustrated 509
Telephone News from the Northwest 509
Indiana Telephone Items 509, 510
Michigan Telephone Matters 510
British Postoffice Department and Village Telephones 510
New Companies 510
How Avoid Personal-injury Responsibility in Telephone Construction Work and Maintenance? By Rome C. Stephenson. (Interstate Independent Telephone Association) 510
General Telephone News 510

DEPARTMENTS.

Correspondence 511, 512, 513
Great Britain 511
New York 511
New England 511, 512
Southeastern States 511
Ohio 511, 512
Indiana 512
Michigan 512
Northwestern States 512
Pacific Slope 512, 513
Personal 513
Electric Lighting 513
Electric Railways 513
Societies and Schools 513
Publications 513-514
Space Telegraphy 514
Telegraphs 514
Miscellaneous 514
Trade News 514
Business 514-515
Illustrated Electrical Patent Record 515-516

DATES AHEAD.

American Association for the Advancement of Science (annual meeting), Philadelphia, Pa., December 27th to 31st.

Northwestern Electrical Association (annual convention), Hotel Pfister, Milwaukee, Wis., January 18 and 19, 1905.

Independent Telephone Association of Wisconsin (annual convention), Hotel Pfister, Milwaukee, January 25th and 26th.

Ohio Independent Telephone Association, Columbus, Ohio, March, 1905.

National Electric Light Association (annual convention), Denver, June 6th, 7th and 8th, and Colorado Springs, June 9th, 10th and 11th.

OWNERS of isolated electric-light plants in the down-town district of Chicago gave evidence of satisfaction on the occasion, a week or so ago, when the breaking of a feed-water pipe in the Harrison Street plant caused the central-station lights to grow dim or even to go out altogether at a late hour in the afternoon when the State Street stores were thronged with shoppers. The lights in the business houses on the central-station mains were out or very dim, while the fellows with private plants had plenty of light and were doing business. Hence, sundry chuckles and exultation for the isolated-plant people. But there is another side to the story. Accidents to central-station service are very infrequent, but when they do occur they are known to all men. Breakdowns in isolated plants are much more numerous, but when they occur an emergency connection is usually made with the central-station circuits and current is secured at once. In other words, the greater possibility of interruption of service in the private plant is tacitly admitted in most cases by an emergency switch giving connection with the mains in the street. Not infrequently the isolated plants are in distress and call on the central station for relief, but nobody hears of it. The commercial lighting company, on the other hand, must rely on itself alone, and the greatest precautions are taken to insure continuous service for 24 hours a day. An accident seriously crippling the service happens so rarely that the possibility is almost negligible.

THE publication of the report upon "Electrical Methods of Thawing [Ice in] Water Pipes," prepared for the National Electric Light Association by Mr. George S. Haley, is, considering the season of the year, most timely and gives evidence of the enterprise of the association and the thoroughness of the author in gathering this data together and getting it into the hands of members of the association at a time when it will do the most good. Consideration of the report is given in this issue and among the most valuable things it contains are the diagrams and explanations illustrating the method of procedure to follow in thawing pipes by electric current. These explanations will be of especial value to central-station operators, who have thus far not made use of the process, and they are largely in the majority. A large number of letters were sent out by Mr. Haley to central-station managers who have made use of this method with resulting profit. The answers which they give contain much interesting information. In almost all cases the price charged has been a lump sum varying from $2.50 to $25 a service, the higher prices being charged in the larger cities. Few seemed to take the trouble to measure the current required and when an ammeter was placed in the circuit it was merely for the purpose of ascertaining an overload on the transformer. All voltages from 2.5 to 500 seem to have been used, the work being done as a general rule with apparently very little regard to current consumption. Alternating current only can be used with good results, as when direct current is used the effect is to expend the energy at or near the positive end of the pipe, which soon becomes hot while the other end remains comparatively cold. Nearly all of the transformers used were taken from the scrap pile, although one correspondent advised the purchase of a special transformer for the purpose. The secondary voltages used were about equally divided between 50 and 100. Fifty volts in some cases was found insufficient, but 100 volts was found to cover all cases regardless, however, of current consumption. The average capacity of transformers used was 15 kilowatts.

IT IS interesting to observe that the electric interurban railways are gradually compelling the steam-railroad companies to give them some recognition in the matter of the interchange of freight. A joint freight arrangement has been made between the Illinois Central (steam) railroad and the Aurora, Elgin and Chicago electric line, mention of which is made in the instructive article in this issue, entitled "Some Interesting Features of Aurora-Elgin-Chicago Electric-railway Operation." In other localities, too, the steam railroads are beginning to lose a bit of their hauteur and show a little disposition to treat with electric-railway companies in relation to both freight and passenger business. But in some states, like Indiana and Michigan, there is talk of appealing to the Legislature to compel the steam railroads to accept or deliver freight billed from or shipped to points on connecting electric lines. With the growth of electric railways it is obvious that the public will demand co-operation in many cases between existing steam roads and the interurbans. To them a railroad is a railroad, whether operated by steam locomotives or electric motors, and must perform its duties as a public carrier. This is of course the common-sense view of the situation and the steam-railroad companies might as well bow to the inevitable.

Several other rather unusual features of electric-railway operation are mentioned in the article—the sale of electric power to farmers along the line and the newspaper and milk delivery. The supply of electric power by circuits connected to contact and track rails is of particular interest, and we are sure that interurban railway managers will follow the experience of the Aurora, Elgin and Chicago with attention. Another important "wrinkle" is the use of calcium chloride on the third rail to attack ice on the third rail and to retard the further formation of ice. This method is reported to be successful, and thus one of the greatest difficulties encountered in operating third-rail lines in winter appears to be overcome.

MUCH of the hoped-for development of the Philippines depends upon the building up of intercommunication by the means of steam and electric railroads. To this end it has been strongly recommended that section 4 of a bill introduced in Congress on April 15th and now pending should be adopted. In brief, this section of the bill provides that for the purpose of aiding in the construction, equipment, operation and maintenance of railroads using steam, electricity, or any other power in the Philippine Islands, the general government of the islands be authorized to guarantee an income of not exceeding four per cent. upon cash capital actually invested in the construction and equipment of such roads. The guaranty shall apply and shall provide for supervision by the government of the conduct of the finances of the road and its location, construction and maintenance, as well as by the presence on the board of directors of two or more government directors, the number and manner of their selection to be determined by law. Provision is, however, made that the total annual contingent liability of the government—meaning the government of the islands—under the guaranties authorized by the section shall not at any time exceed the sum of $1,500,000, and that no such guaranty shall continue for a longer period than 30 years.

It was the opinion of the committee on insular affairs as well as of the secretary of war and the Philippine Commission that for the Philippine Islands it will be much better to have the railroads constructed under a guaranty upon actual investment and to have the lands held for the people of the archipelago. In the words of the committee report, "the building of railroads is the most important improvement possible for the Philippine Islands. The secretary of war testified before your committee that he knew nothing else which in importance is to be compared with it. More than all other influences combined, a comprehensive railroad system will do away with all the embarrassing variety of dialects and tribes in the islands and will bring about an early unification of the inhabitants—a condition absolutely essential to their highest prosperity and development. Railroads would greatly enhance the value of the lands and other property in the islands, enlarge their trade and increase the intelligence of the people."

Much interest has been shown on the part of serious American capital in the possibility of railroads in the Philippine Islands, undoubtedly predicated upon the assumption of the passage of the bill. Although undoubtedly a large part of this work when begun will be in the line of steam-road construction, the electric railway should come in for its fair share. Investigations which have already been conducted warrant the belief that 10,000 horsepower of available waterfalls exist within 50 miles of Manila. The Angot River, in the province of Bulucan, it is believed, will furnish 4,000 horsepower, and surveys have been made of the Bocotan Falls and several others. With an abundance of waterpower in sight, the electric railway will have a strong argument for its adoption.

Theory of the Electric Arc And Spark.

Members of the Electrical Section of the Western Socety of Engineers gathered at the society's rooms in the Monadnock Building, Chicago, on the evening of December 16th to listen to a paper by Prof. Henry Crew of Northwestern University upon "The Modern Theory of the Arc and Spark." In spite of the importance of the subject and the ability of the speaker, the attendance was rather disappointing.

Professor Crew, in his paper, presented in brief the theories which are now most commonly held to explain the phenomena attending the actions of the electric arc and spark. He presented the ionic theory as the most probable one from which to draw conclusions as to the cause of these phenomena, of which he named 13 which have been observed in connection with arc and spark discharges.

One of the things observed in connection with spark discharges is the very curious one of the spark being unable to pass from one electrode to another through a short space, whereas through a greater distance the discharge will occur. To illustrate this phenomenon, Professor Crew showed a diagram of an apparatus consisting of two glass bulbs connected by a narrow neck. A terminal of the induction coil entering each of the bulbs passed on through them and terminated in the neck, the spark gap between the two in the neck being one centimeter. The neck was separated from the bulbs by plugs, so that the gas in the bulbs might be brought to a higher pressure than in the neck. The bulbs were in turn connected by a long spiral tube. When pressure was applied to the two terminals a discharge was observed to occur from one electrode around through the spiral tube, which was perhaps nearly a meter in length, whereas no visible discharge took place through the spark gap only one centimeter in length. The explanation offered for this phenomenon was that in the gas as contained in the neck there are but comparatively few ions for the conduction of an electric discharge. Since the ions are enabled to conduct their charges by reason of their impact upon one another, there were sufficient of these ions in the comparatively large space of the spiral tube for them in their bombardment to transmit a slight current from one electrode to the other, lighting up the tube with a pale glow. On the other hand, the space only one millimeter in extent between the electrodes in the neck contained but a very few ions, or perhaps none, so that the collision between ions was not sufficient to produce a noticeable discharge.

Other peculiarities of the arc and spark which were dwelt upon in the paper were the formation of a crater at the anode in an arc; the much higher temperature of the anode; the fact that much less voltage is required to maintain an arc once started than is required for starting it, etc.

After the reading of the paper Chairman Hale called upon Mr. Carl Wiler to open a discussion of it. Mr. Wiler said that he had been much interested in the paper from the fact that many of the phenomena observed have a direct bearing upon the work of the arc-lighting engineer. He then went on to make some observations concerning the magnetite arc which he believes to be worthy of the most careful study.

Mr. George N. Eastman and Chairman Hale then asked some questions which were answered by Professor Crew, after which the discussion was closed.

Electrical Outlook in Detroit.

Detroit, Mich., is in rank the thirteenth city in the country, with a population of 336,000. In the manufacture of automobiles, of which the product this year will be not less than $10,000,000 in value, the various factories of the city make one-third of the entire output manufactured in America. The city has 385 miles of city and interurban electric street railways. The city has its own municipal arc-lighting plant, which is limited, however, by the terms of the charter to public lighting. The plant is valued at $825,000.

The Detroit Edison Company does all the commercial electric lighting and industrial-power business of the city. The Edison company property includes a tract of 38 acres of land on the banks of the Detroit River, accessible by four lines of railroad. Upon this site the Edison company has constructed a generating plant of the most modern type, having an initial capacity of 12,000 kilowatts and so planned as to be capable of extension from time to time to any capacity that may be required by the development of the business.

The new plant has recently been placed in operation and enables the company to generate its current at one point and distribute it economically by means of the five sub-stations. A well-constructed system of underground distribution is already in the commercial district. The demand for power, which the old stations lacked capacity to supply, makes available at once for the new generating plant a large amount of new business.

BOOK TABLE.

ENTWURF UND KONSTRUKTION MODERNER ELEKTRISCHER MACHINEN FUR MASSENFABRIKATION. (Design and Construction of Modern Electrical Machinery for Heavy Manufacturing). By Ernst Schulz. Hanover (Germany): Jänecke Bros. 1903. Pp. (seven by 10¼ inches), 132, with 110 illustrations.

This book is partially the result of original research made by the author with other purposes in view and partially the result of information he has gathered from the most up-to-date factories in his own country. The whole he has combined in book form, which he hopes will be of use not only for colleges as a textbook but for practical purposes as well. The latest methods for the design and construction of electrical machinery are embodied in the work and put together in convenient form. The work is divided into two parts, one devoted to direct-current motors and the other to induction motors. Under each are several chapters giving in minute detail the methods of design and construction employed in their manufacture, containing all necessary formulas, constants, etc.

ELECTRIC LIGHTING (Vol. I). By Francis B. Crocker New York: D. Van Nostrand Company. 1904. Pp. (6⅛ by 8⅞ inches), 482, with 213 illustrations. Price, $3.50.

This makes the sixth edition of Vol. I. of "Electric Lighting," which in itself speaks loudly in recommendation of this most excellent work, which, as an exposition of the general subject of generation of electric current, probably has few rivals. The first edition appeared in 1896, and from time to time the book has been revised to meet the rapidly changing methods and practices in the art which have taken place since that time. This last edition of Vol. I. is a practical rewriting of the book, bringing the various branches of the subject up to date, especially in the subject matter pertaining to steam turbines, gas engines, direct-connected units and storage batteries. Vol. I. is devoted exclusively to the generating end of electric lighting, including the engines, generators, switchboard, lightning arresters, etc., all in fact that pertains to the power plant. Transmission, distribution, etc., are left to Vol. II., which is of comparatively recent date.

ELECTRICAL TRANSMISSION OF ENERGY. By Arthur Vaughan Abbott, C. E. New York: D. Van Nostrand Company. 1904. Pp. (six by nine inches), 675, with 377 illustrations, including 16 full-page engravings and 109 tables. Price, $5.

Four editions have now appeared of this estimable work, the last being entirely rewritten and enlarged. To enumerate even the various subjects in the book requires a table of contents several pages in extent, and it may only be said in the short space here allowed that in this one volume is contained a careful analysis and treatment of all the elements which enter into the transmission of electrical energy from the properties of the wire itself to the design and construction of a high-tension transmission line or an elaborate underground system. The practical side of the work is given as careful consideration as the theoretical, even to the splicing of wires and laying of conduits. Numerous fine illustrations are a feature of the book. In a pocket in the back are contained 10 folding diagrams containing the results of an enormous amount of data worked up in the form of curves, from which information may be obtained directly, thereby saving the engineer designing a transmission system much laborious calculation. The method of inserting these curve sheets in a pocket in the book, while it is somewhat cumbersome and unhandy, is about the only way the curve sheets can be made of a size to make them of real value. Taken all in all this book is probably about as thorough and exhaustive a treatment of the subject of electrical transmission as any ever written.

ELECTRICAL FURNACES AND THEIR INDUSTRIAL APPLICATIONS. By J. Wright. New York: The Norman W. Henley Publishing Company. 1905. Pp. (5½ by 8½ inches), 288, with 57 illustrations. Price, $3.

Consisting essentially of a series of descriptions of various electric furnaces, this book is especially timely in view of the strides which have been made during the last few years in electrometallurgical processes. Some of the apparatus described, though it has never been put to practical use, is very interesting, indicating the steps in the development of the electric furnace to its present state and also the great ingenuity shown by inventors along this line. There is today hardly a metallurgical process requiring heat to which the electric furnace has not been applied, some times unsuccessfully, it is true, but at other times offering the only practicable solution of the problem. The illustrations in the book consist principally of sectional diagrams of the apparatus rather than views and are better adapted to show the interior parts than any illustrations taken from photographs could be.

Municipal Street-lighting Talk in New York.

The New York Board of Aldermen on December 2d passed a resolution calling for the preparation of preliminary estimates enabling the city to install and operate a municipal electric-lighting plant, plans for which have been under discussion since March. A large mass of statistics has been prepared on the subject, going back to the beginning of gas lighting in New York in 1823. Disregarding special cases, the average price of gas lighting has varied from $45 per street lamp in 1869 to $17.50 today. Public electric lighting commenced for Manhattan in 1881 at $225.50 per lamp. The price gradually decreased until 1890, since when it has remained steady at $146 for 2,000 candlepower arc lamps. Comparative tables of cost of street arc lighting by contract are presented from 175 American cities, the more important citations, for 2,000-candlepower street lamps, being:

City—	Underground Service.	Overhead Service.	Number of Lamps.	Term of Contract in Years.
New York	$146.00	$146.00	4,867	1
Chicago	137.50	103.00	5,308	1
Boston	120.45	120.45	3,670	5
Philadelphia	110.56	110.56	9,282	1
Providence	109.50	109.50	2,074	5
Baltimore	99.92	99.92	1,625	5
Milwaukee	99.00	81.00	1,812	5
Jersey City	....	97.50	1,402	5
St. Louis	96.38	96.38	968	10
Newark	95.00	95.00	1,950	5
Pittsburg	....	96.00	2,835	1
New Orleans	90.00	75.00	1,665	10
Louisville	....	84.00	1,758	4
Washington	80.00	....	965	1
Cleveland	75.00	75.00	1,098	1
Los Angeles	....	81.00	1,050	1

The estimates for a complete installation for public lighting in New York city, that is for streets and public buildings (it not being proposed to sell current to private consumers) are as follows:

COST OF CENTRAL STATION.

Boiler plant, for 10,000 horsepower, with economizers, stokers, superheaters, piping and foundations.	$500,000
Vertical engines, with condensers, foundations and pipings	325,000
Generating plant of 10,000 kilowatts, including exciters, switchboards, etc., erected	300,000
Building and excavations	250,000
Total	$1,375,000

This is equal to $137.50 per kilowatt, or more than the cost of the plant operating the New York subway.

COST OF PLANT.

Power plant as above	$1,375,000
High-pressure feeders	260,000
3,500-volt feeders (suburban)	40,000
Incandescent distributing circuits	90,000
Constant-current transformers for 12,000 incandescent ligbts	120,000
Constant-potential transformers, 7,500 kilowatts	75,000
Sub-station switchboards	75,000
Arc-ligbt cables and circuits	590,000
Distribution structures	50,000
Arc-lamp poles	495,000
Arc lamps and fixtures	250,000
Nine sub-station buildings	150,000
Real estate for sub-stations	105,000
Engineering and contingencies	370,000
Interest during construction	143,000
Total	$4,208,000

Cost of generation and distribution is given at $367,500 per annum, based, it is said, on a comparison of the statistics of the local electric companies, or an average cost of 1.27 cents per kilowatt-hour. With energy at this price and allowing $5 for maintenance, $20.20 for depreciation and $10.50 for interest, the total cost per annum for each 2,000-candlepower arc lamp would amount to $66.10. With similar allowances the cost per kilowatt-hour for each incandescent lamp would be 5.475 cents.

It is to be remembered, of course, that engineers' estimates are rarely borne out in practice by municipal operation. In few American cities having municipal electrical plants is the annual lamp-cost correctly stated in reports. In many cases it is not accurately known.

The final disposition of the New York municipal project lies with the state Legislature.

Death of Mr. W. Forman Collins.

Mr. W. Forman Collins, vice-president and business manager of the Electrician Publishing Company, died very suddenly on the morning of December 21st. Without warning, just on the point of arising from bed about 8 a. m., in his home in Chicago, Mr. Collins lurched forward and expired instantly in the arms of his devoted wife. It is believed that the bursting of a blood-vessel in the brain was the cause of death. Mr. Collins' colleagues on the Western Electrician are inexpressibly shocked by this sad calamity. They hold the press long enough to insert this brief announcement, reserving until next week's issue a suitable biographical sketch and portrait. In the mean time they offer their heartfelt sympathy to Mrs. Collins—the bereaved wife who in so real a sense was a helpmeet to her husband.

Echoes of the Telephone Convention.

Members and Visitors.

Of those who attended the Interstate telephone convention last week the following-named registered at the office of the secretary:

Ames, F. Z., Central Illinois Independent Telephone Company ..... Rutland, Ill.
Anderson, J. P., Madrid Ice and Telephone Company ..... Madrid, Iowa
Arterburn, C. I., Kansas Telephone Company.... Kansas, Ill.
Baker, A. S., Evansville Telephone Exchange.. Evansville, Wis.
Baker, Fred A., Evansville Telephone Exchange ..... Evansville, Wis.
Bandy, Geo. N., Brighton Telephone Exchange.. Brighton, Iowa
Barbour, Harry C., Ottawa Home Telephone Company ..... Ottawa, Ill.
Bauer, Gustave F. C., Century Telephone Construction Company ..... Buffalo, N. Y.
Bear, S. J., American Electric Telephone Company ..... Topeka, Kan.
Bellamy, J. S., Mutual Telephone Company.. Des Moines, Iowa
Berve, Lewis, Ogle County Telephone Company.. Rochelle, Ill.
Bochert, Otto, J. Andrae & Son & Co..... Milwaukee, Wis.
Boynton, E. D., Boynton Telephone Company ..... Pleasant Plains, Ill.
Brega, M. I., La Crosse Telephone Company. La Crosse, Wis.
Brooks, L. L. C., Tri-state Telephone and Telegraph Company ..... St. Paul, Minn.
Ferris, H. N., Kellogg Switchboard and Supply Company ..... Chicago, Ill.
Finley, H. D., North Manchester Telephone Company ..... North Manchester, Ind.
Fish, Frank M., Badger Telephone Company.. Milwaukee, Wis.
Fix, Ezra, Boswell Telephone Company..... Boswell, Ind.
Frazier, H. P., Hillsboro Telephone Company.. Hillsboro, Ind.
Froost, Otto, Jr., Winona Telephone Company ..... Winona, Minn.
Funch, T. J. ..... Flora, Ill.
Gary, Theodore, Macon Telephone Company.... Macon, Mo.
Givens, H. K., Howard County Telephone Company ..... Fayette, Mo.
Glass, George H., Citizens' Telephone Company.... Pekin, Ill.
Goodrich, W. T., La Crosse Telephone Company ..... La Crosse, Wis.
Goodwin, Frank J., West Lebanon Telephone Company ..... West Lebanon, Ind.
Gough, Cale, Electrical World..... Chicago
Graham, E. D., Mexico Telephone Company.... Mexico, Mo.
Gunst, Jacob M., Hygienic Resonator..... Chicago
Hall, Roy W., Westfield Telephone Company... Westfield, Ill.
Hamilton, G. W., Ogle County Telephone Company ..... Rochelle, Ill.
Hartwell, H. P., Steninger Telephone Company ..... Parker, S. D.
Heiserman, G. M..... Albia, Iowa
Hermis, E. C., Northern Illinois Telephone Company ..... Sandwich, Ill.
Herr, Howard H., Ottumwa Telephone and Electric Company ..... Ottumwa, Iowa
Murdock, William J..... Boston, Mass.
Obright, Norman F., Western Electrician..... Chicago
Pearsall, C. J., Evansville Telephone Exchange ..... Evansville, Wis.
Peterson, S. L., Benson Telephone Company..... Benson, Ill.
Pine, P. R., Tipton and Davenport Telephone Company ..... Tipton, Iowa
Polk, R., Memphis Telephone Company..... Memphis, Tenn.
Pullen, George L., Evansville Telephone Exchange ..... Evansville, Wis.
Ramsey, W. H., Hawkeye Telephone Company ..... Des Moines, Iowa
Redman, R. S., Jasper County Telephone Company ..... Newton, Iowa
Reeve, C. A., Plymouth Telephone Company... Plymouth, Ind.
Rex, O., Home Telephone Company..... Bloomington, Ill.
Richmond, R. M., Evansville Telephone Exchange ..... Evansville, Wis.
Robinson, Wm., Citizens' Telephone Company ..... Muskegon, Mich.
Rogers, W. B., Waverly Telephone Company... Waverly, Ill.
Rogers, Oscar W., Interstate Telephone Company ..... Dubuque, Iowa
Savage, Manford, Home Telephone Company.. Champaign, Ill.
Schafer, F. W., Ida Telephone Company..... Ida, Mich.
Schimeyer, F. M., Citizens' Telephone Company ..... Decatur, Ind.
Schmidthauer, J. C., J. Andrae & Son & Co.. Milwaukee, Wis.
Schuler, Albert, Streator Independent Telephone Company ..... Streator, Ill.

INTERSTATE INDEPENDENT TELEPHONE ASSOCIATION IN SESSION IN CHICAGO LAST WEEK.

Browne, J. J., Consolidated Telephone Company ..... Danville, Ind.
Buell, E. A., De Kalb County Telephone Company ..... Sycamore, Ill.
Burch, L. W., Electrical Supply Company..... Madison, Wis.
Burney, R. E., Citizens' Telephone Company ..... Schoolcraft, Mich.
Burns, W. E., B. & B. Telephone Company.. Hutchinson, Kan.
Butler, W. H., Portage County Telephone Company ..... Ravenna, Ohio
Chance, A. B., Centralia Telephone Company... Centralia, Mo.
Chapman, F. S., Kenton Telephone Company.. Kenton, Ohio
Cole, E. G., Stark County Telephone Company... Toulon, Ill.
Coleman, E. M., Home Telephone Company... Louisville, Ky.
Conklin, A. B., Interstate Independent Telephone and Telegraph Company ..... Aurora, Ill.
Corlis, H. L., Bracken County Telephone Company ..... Augusta, Ky.
Coulter, H. M., Central Electric Company.. Des Moines, Iowa
Cutter, H. L., Telephone Hygienic Company ..... Los Angeles, Cal.
Davis, Karl B., Middleton Telephone Company ..... Middleton, Ind.
Davis, George H., Rushville Co-operative Telephone Company ..... Rushville, Ind.
Densmore, W. D., Citizens' Telephone Company.. Batavia, Ohio
Diggs, A. B., Winona Telephone Company.... Winamac, Ind.
Dilly, Phil, Dubois County Telephone Company ..... Huntingburg, Ind.
Dobbs, A. E..... Chicago
Downer, J. D., Western Electrician..... Chicago
Drawyer, Jno. A., Buda-Bradford-Milo Telephone Company ..... Bradford, Ill.
Eldred, H. M., Standard Telephone and Electric Company ..... Milwaukee, Wis.
Ellis, F. W., Minier Mutual Telephone Company ..... Hopedale, Ill.
Farrell, Hart F., Auburn Telephone Company... Auburn, Ill.
Fenton, S. F., Utah Independent Telephone Company ..... Salt Lake City, Utah
Hertz, P. J., J. Andrae & Son & Co..... Milwaukee, Wis.
Holdoegel, P. C., Central Mutual Telephone Company ..... Rockwell City, Iowa
Hunt, J. D., Rural Union Telephone Company ..... Humboldt, Iowa
Johnson, R. F., Valley Telephone Company... Saginaw, Mich.
Jones, W. G., Prospect Telephone Company... Prospect, Ohio
Keelyn, James E., Citizens' Telephone and Telegraph Company ..... Evanston, Ill.
Kennedy, Steve, Ogle County Telephone Company ..... Rochelle, Ill.
Kiernan, W. H., Sand Point Cedar Company ..... Sand Point, Idaho
Lakey, L. E., Marble Telephone Company..... Marble, Ind.
Laukford, E. A., Solomon Valley Telephone Company ..... Beloit, Kan.
Leyda, G. W., Evansville Telephone Exchange.. Evansville, Wis.
Lichty, S. S., Vinton and Benton Counties Telephone Company ..... Vinton, Iowa
Loomis, O. G., Juneau Telephone Company.... Mauston, Wis.
Mathews, Edw., United Telephone and Electric Company ..... Chicago
Matthews, Walter, Maysville Telephone Company ..... Maysville, Ky.
McPherson, R. B., Livingston Home Telephone Company ..... Howell, Mich.
McQuistan, W. J., Monmouth Telephone Company ..... Monmouth, Ill.
Mead, Morris W., National Cable and Wire Company ..... Pittsburg, Pa.
Mickey, R. K., American Carbon and Battery Company ..... St. Louis, Mo.
Miller, Geo. I., Boone County Telephone Company ..... Boone, Iowa
Morsman, O., Independent Consolidated Telephone Company ..... Dodgeville, Wis.
Mosher, F. S., Northern Illinois Telephone Company ..... Sandwich, Ill.
Much, W. J., London Home Telephone Company ..... London, Ohio
Segerland, Chas., Boone County Co-operative Telephone Company ..... Caledonia, Ill.
Shafer, J. V., Illiopolis Telephone Company.... Illiopolis, Ill.
Shimmel, C. W., Shimmel Telephone Company.... Casey, Ill.
Skinner, C. S., People's Telephone Company ..... Seebrooke, Quebec, Canada
Shoemaker, James H., United States Telephone and Ice Company ..... Waterloo, Iowa
Smith, Geo., Oskaloosa Home Telephone Company ..... Oskaloosa, Iowa
Smythe, W. W., Jr., Fibre Conduit Company..... Chicago
Stanton, L. W., Elyria Telephone Company... Cleveland, Ohio
Sterret, E. S., Henry Telephone Company..... Henry, Ill.
Stevens, C. L., Princeton Telephone Company ..... Princeton, Ind.
Stevens, Vie. H., Sumner Telephone Company.. Sumner, Iowa
Stone, R. C., Delaware and Madison Counties Telephone Company ..... Muncie, Ind.
Taylor, L., Steuben County Electric and Telephone Company ..... Angola, Ind.
Tel, Wm. R., Fee Syndicate..... Cincinnati, Ohio
Thompson, W. Gilbert, Hamilton Home Telephone Company ..... Lebanon, Ohio
Thorne, J. C., Jefferson County Telephone Company ..... Fairfield, Iowa
Thorpe, H., Aberdeen Telephone Company.. Brownsville, Ohio
Thorward, Theodore, South Bend Home Telephone Company ..... South Bend, Ind.
Tucker, U. G., Verden Telephone Company..... Verden, Ill.
Tyler, R. B., Kentucky and Indiana Telephone Company ..... Owensboro, Ky.
Valentine, R., Rock County Telephone Company ..... Janesville, Wis.
Vaniman, A. T., Girard Telephone Company..... Girard, Ill.
Van Middlesworth, Wm..... Racine, Wis.
Veasy, W. J., South Bend Home Telephone Company ..... South Bend, Ind.
Vernier, A. J., Eastern Illinois Independent Telephone Company ..... Kankakee, Ill.

Vlasy, Chas. E., People's Telephone Company ..... Haverhill, Mass.
Von Almen, S. L., Fox River Valley Telephone Company ..... Appleton, Wis.
Wasson, B. F., National Telephone and Electric Company ..... Clinton, Ill.
Wells, H., Ogle County Telephone Company .... Rochelle, Ill.
White, C. O., Bureau County Independent Telephone Company ..... Princeton, Ill.
White, Frank, Home Telephone Company .... Portland, Ind.
Willard, C. K., Mankato Citizens' Telephone Company ..... Mankato, Minn.
Witherell, A. J., Kester Electric Manufacturing Company ..... Chicago
Woodward, D. L., Rural Union Telephone Company ..... Humboldt, Iowa

The New President.

Theodore Gary, the new president of the association is president and manager of six Independent telephone companies in Missouri and one in Kansas. He has lived in Macon, Mo., for 25 years, where he

THEODORE GARY.

has been active in the banking and real-estate business. He has also organized many corporations. Mr. Gary does all the buying for his plants, as well as the financing, and has personal charge of the operating of them. The systems in which he is interested operate 6,000 telephones in Missouri and Kansas. Mr. Gary is 50 years of age.

Convention Notes.

Mr. Mason did the honors for the Central Electric Company.

M. R. Nyman looked out for the Baird Manufacturing Company at the convention.

Mr. Kirkpatrick of the McRoy Clay Works was as usual in attendance at the convention.

That veteran of a score of telephone fights, James E. Keelyn, was there and was greeted by a host of friends.

Messrs. Morrell and Mietz appeared in the interests of the Measured Service Company of Chicago and presented a line of its meters in operation.

W. P. Bowring, secretary and treasurer of the C. H. Worcester Company, Chicago, was on hand and mingled with his friends and customers.

A. Meinema & Co., Union and Fulton streets, city, presented circulars of their selective ringing lockout system. Mr. Meinema was present in person to explain details.

"Manson" is synonymous with Okonite, and Okonite was most decidedly at the convention. Mr. Manson came from New York to be on hand and was warmly welcomed.

The group picture on page 506 is a reproduction of a photograph of the delegates taken in the meeting hall of the Auditorium during one of the sessions of the convention.

The F. Bissell Company, Toledo, Ohio, was this time represented by W. S. Bissell. Mr. Bissell was one of the most warmly welcomed among the supply dealers at the Auditorium.

Of course Mr. Hipwell of the Hipwell Manufacturing Company of Allegheny, Pa., was in evidence. Mr. Hipwell turned up on Tuesday morning and stayed throughout the entire convention.

General Manager Howard X. Foote, accompanied by M. V. Mehrey, was in attendance on Tuesday and Wednesday looking after the Eureka Electric Company's interests. Mr. Foote, however, made no attempt at an exhibit.

H. C. Dodge, Chicago, made an interesting exhibit at the telephone convention of what he calls "a cheap" electric sign. This sign has in it an automatic lamp flasher which turns the lamp on and off at regular intervals without a commutator mechanism, so to speak. The flashing arrangement is extremely simple, and through its use a cheap but efficient electric sign is produced. The lettering of the design may be changed by inserting perforated letters in front of the light.

Secretary R. K. Mickey of the American Carbon Battery Company of St. Louis was in attendance at the telephone convention. Mr. Mickey is an aggressive worker and has made his company felt in Chicago and vicinity.

The banquet which was announced as the wind-up of the convention was abandoned at the last moment. The Waukegan excursion tendered by the American Steel and Wire Company on Thursday afternoon to a large extent took its place.

Western Manager J. R. Wiley, suave, resourceful and obliging as ever, backed by his indefatigable associates, E. J. Pietzcker and W. M. Rogers, was as usual most graceful in doing the honors for the Standard Underground Cable Company of Pittsburg.

The Standard Telephone and Electric Company, Milwaukee, Wis., came to the front with a number of interesting advertising cards explaining the well-known fact that Standard telephones are "money makers." A souvenir was presented in the form of a telephone button.

"Burch of Madison" as usual came early and stayed late and gave the strongest evidence of his favorite expression, "Not as big as the biggest, but as good as the best." Mr. Burch has recently gone into the telephone business in the Northwest and is meeting with much success.

President Joseph Belden of the Belden Manufacturing Company was daily to be seen during the entire convention period. Mr. Belden has built up a prosperous magnet-wire business in Chicago and recently the company has decided to extend its factory on the North Side over a much larger area.

The XXX Electric Supply Company, through its general manager, W. A. Frick, gave a number of important reasons why one should use the XXX test and wire connector. As there are about 14 points of merit claimed for this simple device, it would seem to be worth an investigation on the part of telephone and electric-light linemen.

President Frank G. Jones of the American Electric Fuse Company created a sensation by his distribution of a most strenuous advertisement. Mr. Jones is an energetic and popular manager of a business that of late years has been built up to a remarkable degree. His methods are usually forcible and striking and appeal to telephone people.

Secretary and Treasurer William M. Smith turned up on Tuesday and did the honors for the Chicago Insulated Wire Company. Mr. Smith and President Turlay of the company are ever-welcome guests at all electrical conventions. Mr. Smith reports the wire factory at Sycamore, Ill., as running full blast with a most excellent business behind it.

Frederick L. Merrill, Omaha Building, Chicago, the Chicago and district manager of the Dielectric Manufacturing Company, appeared at the convention in the interests of the Dielectric standard insulating materials. Dielectric products have now become standard among many of the most prominent electrical manufacturers of the United States.

Secretary and Treasurer M. J. Berger of the Vought-Berger Company, La Crosse, Wis., came early and stayed late at the convention. Mr. Berger is one of those enterprising men of the Northwest who from small beginnings have built up prosperous manufacturing companies. The Vought-Berger telephones and switchboards have met with much favor among exchange men.

I. A. Bennett, the popular manufacturers' agent of the Monadnock Block, Chicago, was daily on hand. Mr. Bennett made his reputation as one of Chicago's most skillful advertisers by his brainy and novel advertising schemes presented at a telephone convention. This time, however, Mr. Bennett made no special effort beyond keeping in close touch with what was going on at the Auditorium.

LeRoy W. Stanton, the well-known telephone engineer of the Middle West, was among the prominent ones of the telephone convention. Mr. Stanton at the present time is an exceedingly busy man, and, owing to the large amount of work in his charge, is often absent from his headquarters in Cleveland. He was warmly welcomed at the convention, but was unable to be on hand longer than two days.

The Gray Pay Station Company of Hartford, Conn., made a most interesting exhibit of various kinds of pay stations. The Gray company made a specialty of the exhibition of an "outdoor" pay station. It incidentally may be said that the Gray Pay Station Company is one of the oldest pay-station companies in the United States and, in fact, it was in the pay-station business years before Independent telephony came to the front.

J. H. Montague together with G. H. Pierce and A. B. Chance looked after the interesting exhibit of the Ericsson Telephone Company of New York in a thoroughly efficient manner. The Ericsson company this time presented some very meritorious apparatus. The Ericsson common-battery line relay was an object of much interest on the part of the delegates. This relay was set up to work on about 20 volts through the resistance of the human body; in fact, handles were provided to illustrate the working of the apparatus through the body. A very novel test was presented by connecting six men in series, giving an estimated resistance of 54,000 ohms, to the relay and operating it through this artificial resistance. The company also presented for inspection a 200-line self-restoring indicator switchboard; also a four-party selective system. The strongest claims are made for this latter system, which is said to be non-interfering and not to depend on a frequency or step-by-step principle.

J. Loud presented an interesting linemen's specialty for the Walton Self-locking Block Company. The self-locking block and tackle shown by Mr. Loud met with favor. This block and tackle has the peculiar feature that as the rope is pulled taut it automatically locks itself in the block so that all a lineman has to do is to pull. This specialty is well worth investigating on the part of linemen desiring a load holding block and tackle in which the rope can be locked at will.

The Fibre Conduit Company of Orangeburg, N. Y., with western offices at 1760 Monadnock Building, Chicago, exhibited an extensive line of socket-joint conduit in sizes from 1½ inches inside diameter to four inches inside diameter. Particularly interesting in this exhibit was a piece of conduit which had been buried in the ground 10 years without concrete and which shows no deterioration whatever. Bulletin cards of an interesting nature were distributed. W. W. Smythe, Jr., western manager, was in charge.

Vice-president and General Manager John S. Speer of the Speer Carbon Company was in attendance. Mr. Speer usually makes a business trip about this time of the year in the interest of his carbon company at St. Marys, Pa., and availed himself of the present occasion to "take in" the telephone convention. Mr. Speer reports local business in St. Marys as being in a most prosperous condition. Mr. Speer, as is well known, is manager and head of the new local opera house, the St. Marys lighting plant, and has recently become one of the prime movers in an electric-railway enterprise connecting St. Marys with an adjoining city.

Pearne, Krum & Co. came to the front and utilized the opportunity of the convention to present for the inspection of exchange managers the newest thing in telephony, the Pearne automatic flashlight transfer. The switchboard in which this system was embodied was shown in operation in the Railway Exchange Building, and from the number of telephone engineers that inspected this apparatus it is safe to say that the exhibitors were repaid for their pains. The details of this automatic flashlight-transfer system are as yet not ready for publication, but many operators express themselves as highly pleased with its operation in actual service.

The National India Rubber Company, through its hard-working representative, P. F. Lyons of Bristol, R. I., was at the Auditorium during the entire convention period. Mr. Lyons reminds western patrons of his company of the important fact that the National India Rubber Company now carries a most extensive and varied stock of its rubber-covered wires in its Chicago warehouse at 244 Monroe Street. For a long time the National company has felt the need of a large western stock at the center of the western market and this move in locating large warerooms in Chicago is not only greatly to its credit, but has resulted in a large increase in business where quick shipments from stock are desired.

Among the prominent representatives of large telephone properties was General Manager W. H. Butler of the Portage County Telephone Company, with headquarters at Ravenna, Ohio. Mr. Butler is one of the most experienced men in the Independent telephone field, a graduate of Yale in the class of '90, and incidentally, it may be said, the fastest single-scull oarsman that had ever raced in an intercollegiate contest up to '90. He began early in the telephone business and has been most successful. The Portage company has exchanges at Kent, Ravenna, Mantua, Garretsville and Streetsborough. In addition to these prosperous exchanges the company has now in prospect another exchange at Atwater, Ohio.

A. L. Waterbury, the popular general manager of the sales department of the American Conduit Company mingled with the "boys" at the Auditorium. The American Conduit Company's electrolysis-proof bituminized fiber conduit has met with remarkable success in underground telephone-construction work. The company now has factories located at Los Angeles, Cal., Chicago, Ill., and Chester, Pa. Not only is the conduit used extensively by telephone companies but it enters enormously into general electric-light and power construction. General Manager A. L. Waterbury reports the company in a most prosperous condition. Incidentally it may be mentioned that Secretary Buchanan of the Conduit company recently left to locate himself at the Los Angeles factory until early spring.

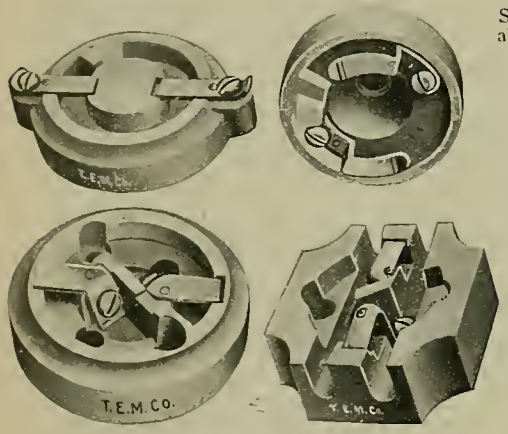
The Stombaugh guy anchor was efficiently represented by Claude L. Matthews, junior member of the enterprising firm of W. N. Matthews & Bro. of St. Louis, the manufacturer of the Stombaugh. Everybody had a card with the words "Have You a Pull" printed in white on a sable ground. On the back was the information that the Stombaugh guy anchor will hold any pull that occurs on the poles of telephone companies and that the Stombaugh guy anchor is extensively used by many prominent telephone companies. Mr. Matthews had on exhibit all of the different size Stombaugh anchors that his firm makes. He also had a series of inter-

esting photographs showing the different uses to which the Stombaugh guy anchor could be put. One of particular interest showed a case where the anchor was bored in under a granitoid sidewalk, saving the great expense of pulling up the sidewalk and relaying it in order to bury a "deadman." On the whole the exhibit of Stombaugh guy anchors was very interesting to the telephone men.

The exhibit of the Central Telephone and Electric Company of St. Louis was one of the most beautiful at the convention. The company's line comprises five, four and three-bar types of instruments, the woodwork being of a very beautiful finish, comprising ebony, mahogany, Flemish oak and quarter-sawed oak. In the exhibit was the Central's original Leader type of telephone, the transmitter being opposite the mouth and the generator at the height of the elbow, with the switch-hook at the same height, allowing the comfortable use of the telephone. The Central company also showed a new type of transmitter, the diaphragm of which is all of aluminum, with polished carbon electrodes and the best imported granular carbon. The main feature of this transmitter is its non-rupturable diaphragm of aluminum. This transmitter is said to be free from packing and its articulation is clear and distinct. The long-distance telephone shown by the company will, it is said, talk over any length of line regardless of transpositions and induction coils. This instrument represents five years of hard, conscientious labor on the part of its inventors, Messrs. Gradolph and Hahne. The Central Telephone and Electric Company was represented by J. S. Cuming, president of the company, and W. F. Gradolph, engineer.

Fuseless Rosettes.

The accompanying illustrations show three types of fuseless rosettes and one type of cap as manufactured by the Trumbull Electric Manufacturing Company of Plainville, Conn. The rosettes are provided with spring tongues in the caps, which allows them to be fitted with cord and "snapped" on after the base is in position.



FUSELESS ROSETTES.

A quarter turn of the wrist does the work. Another feature is the stop in the cap, which allows it to be put on one way only. For arc-light work this is invaluable, as there is no possibility of reversing the current by taking off the rosette cap.

Caps are interchangeable and will fit any style of base. The hole in the cap takes the new code cord.

Guthrie Sign Flasher.

As will be noticed by a glance at the cut, the Guthrie sign flasher, for which the A. S. Doxsee Electrical Company of St. Louis is the general agent,

GUTHRIE SIGN FLASHER.

is enclosed in an iron box. This box is eight by five by five inches, and is so arranged that it can be readily attached to the wall. The box is lined with slate and the binding posts are located on the top so that it is easily installed. The flasher is operated by an extra-heavy special spring motor, which runs from 10 to 12 hours with one winding. All contacts are made of platinum, while all switches are of ample carrying capacity, rated at six amperes per switch. The break can be readily adjusted to operate it in any manner desired. All working parts, binding posts, etc., are distinctly high-grade in material and workmanship.

Advocates of this type of flasher point out that, once installed, it needs no more attention than the periodical winding. Further, it costs practically nothing to operate, as there is no electric motor to consume current. The outfit is compact and simple, and the Doxsee company gives a guaranty for 12 months against any mechanical or electrical defect. All flashers are sent out accompanied by a wiring diagram, and it is reported that they have given entire satisfaction.

4,000-kilowatt Alternators to Be Driven by 6,000-horsepower Gas Engines.

The California Gas and Electric Corporation, San Francisco, Cal., has just placed an order with the Crocker-Wheeler Company, Ampere, N. J., for three 4,000-kilowatt, three-phase, 13,200-volt, 25-cycle, 83-revolution, revolving-field alternators, to be driven by 6,000-horsepower gas engines built by the Snow Engine Company. These generators are to be the largest in capacity in the world driven by gas engines, and will furnish reserve capacity for operating all the street railways in San Francisco and vicinity, as outlined in the Western Electrician last week. This important sale by a company which has been building alternating-current machinery only a few months is indeed a cause for congratulation. It is due in part to the fact, as announced several months ago, that the Crocker-Wheeler Company is the American licensee of Brown, Boveri & Co., the celebrated Swiss electrical engineers. But the reputation for excellence which the Crocker-Wheeler Company has built up during the last 16 years of manufacture of direct-current apparatus has had much to do with the result.

Vertical Single-phase Motor.

The Wagner Electric Manufacturing Company of St. Louis has just added to its line of single-phase alternating-current power motors a neat type of vertical single-phase motor, an illustration of which appears herewith. The special field of application for such a motor is for driving centrifugal pumps and work of similar character. In its general construction the motor corresponds electrically to the well-known forms of Wagner single-phase motors heretofore on the market. Mechanically, the introduction of ball bearings, etc., are distinguishing features, resulting in an excellent efficiency and quiet running of the motor.

VERTICAL SINGLE-PHASE MOTOR.

The Wagner company is prepared to make immediate deliveries on 10 and 15-horsepower sizes, for 60-cycle service. The windings are for 110, 220 or 500 volts, and the speed 1,150 revolutions a minute.

West Shore Road to be Used for Electric Cars.

The Andrews-Vanderbilt trans-state trolley road officials have practically decided, it is said, to use the West Shore railroad from Eastwood to Chittenango, N. Y., exclusively for electric cars and to send the freight which is now hauled over the West Shore road between those points over the main line. From Chittenango to Canastota the plans are to use the West Shore tracks for both freight and electric cars. The plans for the road between Eastwood and Syracuse have not been matured. There is a possibility that a new road will have to be built between those places.

Where the freight and trolley cars run over the same tracks the block system will be used. The electric cars will be equipped with side trolleys instead of a standard extending from the top of the car. The wires will be strung from short poles, reaching to the middle of the cars.

Horace E. Andrews of Cleveland, who is at the head of this system, was in Syracuse recently attending the annual meeting of the Syracuse Rapid Transit Company. Speculation is rife in Syracuse as to what connection Mr. Andrews has with the road which is being built between that city and South Bay, on Oneida Lake. It is understood that Mr. Andrews is a stockholder in the Cleveland Construction Company, which was recently incorporated to undertake the work of building the road, and which bought Frenchman's and Dunham's Islands, the Sagamore Inn and other real estate in the vicinity of Oneida Lake.

The plans of the construction company are of great magnitude. It has been announced that a line of boats will be run along Oneida Lake between South Bay, Sylvan Beach and other points, and that a big dock will be built at South Bay to accommodate freight and passenger traffic. It is said that the plan is to have the boat line connect with the trolley roads at the east and west ends of the lake.

The Power Plant of the Tall Office Building.[1]

By S. H. Bunnell.

The limit of excellence in steam-engine economy stands at about one horsepower produced per pound of coal burned per hour. This duty is only reached by large and thoroughly well-built engines under the most favorable conditions of uniform load, high steam pressure and good vacuum in condenser. Between this remarkable figure and the actual every-day performances of the high-speed engines necessarily used in the restricted spaces of the engine rooms of large city buildings there is a very wide gap. The problem before the designers of power plants of the latter class is to make the best use of steam received at moderately high pressure and delivered into heating systems at a pressure more or less above the atmosphere, with the advantage of atmospheric exhaust only during some five months of the year. The engines using steam under these conditions must develop powers widely varying from small percentages of the full load up to the greatest overload capacity which may be required when nearly all of the elevators of the building happen to be taking their several maximum amounts of current. Together with these requirements, it is demanded that the regulation of the engines shall be practically perfect, as measured by the production of incandescent electric lights without perceptible fluctuation.

For these conditions high-speed engines are almost invariably required and selected. These engines are of three principal types—the simple single-cylinder engine with single steam valves, the single-cylinder engine provided with four valves of Corliss or slide type, thereby separating the inlet from the exhaust and giving practically the economy of the regular slow-speed engine of Corliss type, and the non-condensing compound engine, usually provided with a single valve for each cylinder, but sometimes having separate steam and exhaust valves on one or both cylinders. In most cases these engines seem to be designed to handle the maximum loads of the generators directly connected to them, without much regard to their probable performance in the matter of economy and use of steam when running under loads much below the maximum. It is evident that with exhaust back pressure not less than atmospheric pressure, and most of the time considerably more than this, the number of possible expansions or the ratio of initial to terminal steam pressure is limited to a figure which is not unsuitable for simple engines. Since steam expansion cannot be economically carried below terminal pressure without a waste of developed power shown by the formation of a negative loop in the indicator diagram, the minimum power economically developed by the non-condensing engine is that due to the mean effective pressure consequent upon making the terminal pressure equal to the back exhaust pressure. From this minimum the power can be increased without limit until the engine is taking steam full stroke and operating without expansion. A division of the possible diagram into two separate diagrams by compounding is at the expense of more or less of a gap between the two diagrams thus produced, due to valve friction, condensation in receiver and other losses, the only compensation for which is the decreased range of temperature between inlet and exhaust in the separate cylinders, compared with the range existing in the single-cylinder engine with the same inlet and exhaust pressure. As a matter of fact indicator cards and tests from compound and simple non-condensing engines under the conditions existing in the power plants of city buildings show that the employment of compound engines for this service often gives results inferior to the performance of single-cylinder engines with better valve gear and costing considerably less to construct.

Some time ago Mr. Isaac D. Parsons made a careful study of the conditions of operation of a number of power plants of the class under consideration. His figures were selected as the best and most definite obtainable by an investigation which covered very many buildings and plants differing widely in details, sizes and conditions. Data obtained from 17 plants whose records were accurate and complete were tabulated in convenient form for determining the actual cost of current as compared with the rates charged by central stations. The items making up the cost of current were taken to be labor, coal and handling of ashes, water, lamps, oil and supplies, repairs, central-station service

1. Abstract of a paper presented at the New York meeting (December, 1904) of the American Society of Mechanical Engineers.

Number.	Kind of Building.	Number of Electric Elevators and Maximum Kw. Current Required.	Minimum Lighting Load.	Duration of Minimum Load.	Generators.		Average Per Cent. Total Capacity Developed.	Steam Pressure, Pounds.	Back Pressure, Pounds.	Pounds Coal per Kw.-hour, Including Steam Pump and Any Live Steam for Heating.	Ratio Maximum Day Load to Minimum Day Load.
					Number.	Total Capacity.					
		Kw.	Kw.	Hours.		Kw.					
1	Office building.....	4-100	11	8	4	260	.55	90	0	15½	100-10
2	Office buildiog.....	10-250	11	8	4	575	.75	125	0	10	100- 4
3	Office building.....	6-162	44	10	5	475	.75	115	1- 3	9.1	100-21
4	Office building.....	8-240	.....	.....	3	300	.90	100	4	8.2	.....
5	Office building.....	3- 60	.....	.....	1	40	.65	95	1- 5	11.4	.....
6	Power building.....	15-300	.....	.....	3	300	.90	90	3- 9	11	.....
7	Power building.....	4- 80	.....	.....	3	260	.75	100	2- 5	13½	.....
8	Power building.....	4-100	.....	.....	3	90	.60	100	7-10	14.4	.....
9	Department store..	None	25	6	3	288	.75	90	.....	.....	.....
10	Apartment.....	1- 15	3	8	2	45	.48	90	5	15½	100-17
11	Apartment.....	2- 40	2	8	2	60	.20	100	2- 5	25.1	100- 5
12	Apartment.....	3- 75	.....	.....	3	175	.60	125	3- 5	18.4	.....
13	Hotel.....	None	11	17	2	66	.50	90	4	13½	.....
14	Hotel.....	2- 30	28	.....	2	80	.67	100	3- 6	12.4	100-48
15	Club.....	None	8	9	1	20	.40	80	6	26½	.....
16	Club.....	1- 20	3	12	3	130	.40	90	3- 5	11.1	100-13
17	Club.....	None	.....	.....	2	50	.75	80	3- 5	16.6	.....

where used for periods of minimum consumption to allow of shutting down plant, and interest and depreciation at six per cent. per annum on original cost of plants. Roughly these figures average labor one-third, coal one-third and interest and depreciation one-tenth to one-third, the sum giving the cost of power being made up by the items of minor expense. The amount paid for labor does not depend closely upon the details of the plant installed, except that simplicity of machinery would tend to decrease the cost of labor necessary properly to operate it. A saving in the cost of current would, therefore, be necessarily made chiefly by decreasing the consumption of coal and the first cost and expense of repairs to the machinery.

The accompanying table is adapted from Mr. Parsons' figures, which were published in the Engineering Magazine of January and February, 1902. The last column gives the ratio of the maximum momentary load which might be caused by the simultaneous starting of all the elevators to the minimum lighting load existing during the hours of bright daylight. The extreme ratio shown in any of these buildings is that of No. 4, where the minimum load is (supposing the operation of both elevators during daytime) only four per cent. of the maximum capacity which may be suddenly called for. This, however, is an extreme figure; from 10 to 20 per cent. seems more representative of the minimum load required to be carried by the power plant. It is evident that the mean of the load carried throughout the day by any of these engines would be about one-half of the full load, and that the engines should be designed for best economy at some point considerably below their maximum power, and to operate with reasonable efficiency over a wide range of load. While this is true of all engines of isolated plants for furnishing current to buildings, it is especially the case in the larger plants, since the steady lighting load of office buildings is considerably below the maximum, and the maximum load is only required for an hour or two in the afternoon during the winter months.

These figures [in a table not given in this abstract] indicate that the single-cylinder four-valve engine has a far greater range of capacity with reasonable economy than the non-condensing compound engine, and for the actual conditions of service in power plants of large buildings is much to be preferred. It would seem very desirable that engineers planning power installations of this character should make a careful study of the probable actual running conditions under which current must be furnished, so as to select engines designed to give the best economy under actual conditions instead of, as is too frequently done, letting contracts on the basis of the best load performance guaranteed, in spite of the fact that in buildings where most of the electric current generated is used for power by the various auxiliary machines and the elevators, the full-load capacity is only infrequently and momentarily required.

Electric Mine and Quarry Drill.

The Adams all-steel electric drill, the electrically driven drill shown in the accompanying illustrations, which is manufactured by the Gardner Electric Drill and Machinery Company, Cleveland, O., offers an example of a successful electrically driven rock drill. Mr. Adams, already well known to central-station men as the Mr. Adams of the Adams-Bagnall Company of Cleveland, has profited by the experience of others less fortunate, and in a measure reaped the benefit of their failures. There has been no attempt to work upon impossible lines or create a theoretical product, incapable of standing the test of practical application, but rather a machine that could take its stand by the side of the modern air drill, possessing a similarity of action and appearance, although entirely different in mechanical construction, and capable of doing as much work in the same time as any air drill of equivalent size, with about one-fifth of the power, and doing this, not merely in trials against time, but in steady everyday use.

Fig. 1 of the accompanying illustrations shows the drill mounted on a tripod, while Fig. 2 shows the drill mounted upon a column.

To equip a plant with the Adams all-steel drills, one requires the drill outfits; an engine capable of supplying three horsepower for one machine; five horsepower for two, or if more than two drills are used, then two horsepower for each machine; a generator of equal capacity for supplying the current to run the drills, and sufficient wire to reach the workings and return, with a few extras, such as switches, insulators and brackets for stringing the wires. If current can be obtained from an existing power circuit, the engine and generator are not required, which dispenses with the services and expense of an attendant.

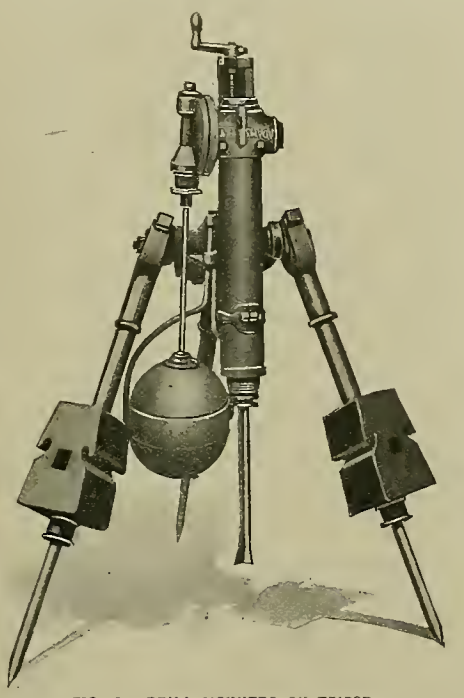


FIG. 1. DRILL MOUNTED ON TRIPOD.

One of the best features of the Adams all-steel drill is the simplicity of its mechanism. The drill is actuated by a loose rod, running through the gear case and motor, and this imparts motion through a pair of bevel gears and crank shaft to the drawbar and piston, the latter being cushioned with gangs of helical springs, which serve to absorb the shock of the blow, to protect the parts from injury, and also to store up energy on the back stroke, which it can expend in forcing the steel into the rock.

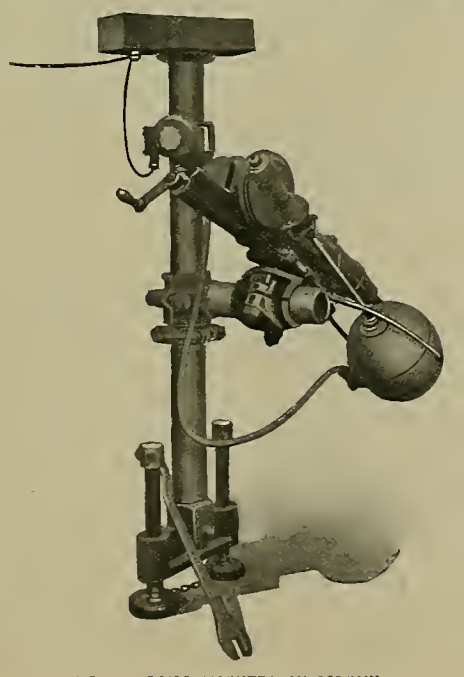


FIG. 2. DRILL MOUNTED ON COLUMN

These springs also prove extremely useful, when using the bit as a reamer or to pull it out of a fissured hole, and are strong enough and so arranged that it makes it almost impossible to stick the bit in any kind of hole in any kind of ground. The drill can also be run freely without any damage whatever, and reaming holes is therefore an easy proposition. The drill strikes from 575 to 600 blows per minute. Among the main features claimed for the Adams all-steel electrically driven rock drill are the following: There is no flexible shaft required; the current does not enter the drill; it is not affected by extreme cold weather, an important feature in its favor. It may be operated in quarries, open rock work and shallow mines where steam or air drills "freeze up." There is no delay with the Adams drill from this source of annoyance and expense; no injurious effects can be experienced if a miner comes in contact with the wires, because low voltages are used, generally 110 or 220; the drill can be turned upside down for putting in lifting holes.

Telephone News of the Northwest.

A company of which H. J. Bergman is president has been formed and will open a telephone exchange at Edinburg, N. D.

The Minnesota Central Telephone Company has completed rebuilding and improving the line from Willmar, Minn., to Morris, and now has a complete metallic circuit from the Twin Cities as far west as Morris.

The council of Moorhead, Minn., reconsidered granting the Tri-state Telephone and Telegraph Company permission to string wires across the city and refused it. The company is proceeding with setting poles for a line through the city, and litigation will follow.

The Marion Telephone Company of Marion, S. D., which recently absorbed the Steninger exchange there, has been incorporated with a capital of $10,000.

The council of Rochester, Minn., has granted a toll-line franchise to the Tri-state Telephone Company.

The Minnesota Central Telephone Company will install a local exchange at Kerkhoven, Minn.

The Rural Telephone Company of Morton, Minn., has built lines to Beaver Falls, Olivia, Morton and Franklin.

The Minnetonka Telephone Company of Excelsior, Minn., has been sold to the Northwestern Telephone Exchange Company of Minneapolis. The transfer occurs January 1st.

The Wisconsin Telephone Company has agreed with the Citizens Telephone Exchange at Sheboygan, Wis., whereby the former retires from the local field and the latter uses the former's long-distance service and rents Bell transmitters.

A telephone system is projected by Indiana Agent Michelet at White Earth, Minn., to the government schools at Mahnomen, Beaulieu and Porterville.

The Farmers' Mutual Telephone Company has been incorporated at Reading, Minn., with $25,000 capital stock, to build a rural system to cover the county.

The Belgrade and Southwestern Telephone Company has been formed to build a line out of Belgrade, Minn.

A special election will be held at Parkersburg, Iowa, on January 7th to vote on a proposed franchise for the Farmers' Mutual Telephone Company. The proposition is opposed by the Parkersburg Telephone Company.

The Iowa Telephone Exchange Building at Keokuk, Iowa, was so badly damaged by fire that new quarters will have to be secured before the system can be placed in working order.

The Independent Telephone Company will construct a new rural line out of Blue Springs, Neb., at once.

The Farmers' Mutual Telephone Company has been voted a franchise at Moulton, Iowa. R.

Indiana Telephone Items.

The Liberty Telephone Company has incorporated with a capital stock of $20,000. The company is organized to install and operate telephone lines in Union, Fayette, Wayne and Franklin counties, Ind., and Butler and Preble counties, Ohio. The principal exchange will be in Liberty. W. A. Bryson, Daniel Rousier, B. M. Grove and James Allen are among the incorporators.

The Amboy Home Telephone Company of Amboy and the Uniondale Rural Telephone Company of Uniondale have increased their capital stock materially for the purpose in each case of making improvements and extensions. Noah W. King is president of the former company and V. M. Hatfield of the latter.

The Standard Bracket and Pin Company of Madison has been incorporated. The capital is $12,000. The company proposes to manufacture and sell arms, brackets, pins, etc. A. L. Schmidlap, G. W. Cofield, B. F. Head and B. F. Law are the incorporators.

The ordinance granting the Central Union Telephone Company a franchise to do a local business in Lebanon has been vetoed by the mayor on the ground that it failed to stipulate the price at which service

would be furnished. A new ordinance will now be introduced providing for a schedule of rates.

The Central Union Telephone Company has applied for a franchise to do a local business in Franklin. The citizens are said to be satisfied with the service given by the Franklin Telephone Company, which has 800 telephones in operation and gives free connection with seven Independent companies. Patrons can talk with nearly every city in the state, and for these reasons a dual system is meeting with opposition.

The Indiana Independent telephone men are encouraged over the prospect of securing long-distance connection with Chicago. They say they will now put their plants in condition to meet the requirements named by President Wheeler of the automatic system in Chicago, and are hopeful of making the much-desired and long-delayed connection. S.

Michigan Telephone Matters.

Business men and other patrons of the Michigan Telephone Company in Benton Harbor and St. Joseph are in revolt because of the notice given that after the first of January a rental of $30 per year will be charged for telephones in business houses. The old rate is $18. Dissatisfaction is so pronounced that there is some talk of the organization of an Independent company. Several months ago the Michigan company and the Twin City company effected an agreement whereby the former was given absolute right to do business in St. Joseph, the latter in Benton Harbor.

The Co-operative Telephone Company has issued a circular in which it says that the Bell people have reduced rates between Detroit and Toledo because the latter are beginning to feel the effect of the Co-operative competition. President W. A. Jackson of the Michigan State Telephone Company is in the East and General Manager Land could not be reached, but General Superintendent H. H. Robinson said he does not think there has been any cut, though he is not certain, because he has been away from the city for a few days. W.

British Postoffice Department and Village Telephones.

An account of an experiment by the British Postoffice Department pertaining to telephones at village postoffices has been written by United States Consul Liefeld at Freiburg, Germany. It is as follows:

"An important experiment which may have far-reaching results is being made by the telegraph department of the general postoffice in half a dozen villages. The object is to ascertain if it is practicable to make village postoffices serve the purpose of public-telephone call offices. If successful, the result will be the removal of one of the disabilities attaching to life in villages.

"For the last six years, although the fact is not generally known, it has been the practice to use the telephone, which officially is a telegraph instrument, to transmit telegraph messages from town centers to small village postoffices. The installation of a telephone wire is cheaper than the telegraph installation and the messages can be sent more expeditiously than by the needle instrument or the A-B-C code, the methods generally used in village postoffices. The messages are written out and stamped by the sender and are sent over the wire by the clerk.

"In the selected villages it is now possible for any member of the public to ring up a subscriber and use these postoffice telephones in the ordinary manner at the ordinary rates. Should the person with whom communication is desired not be on the telephone line the sender can telephone his message to the nearest postoffice and have it sent on by express messenger. In the case of long messages the saving in expense as compared with sending the same message at telegraph rates will be very considerable. Similarly the town dweller will be able to communicate with the villager. The point to be decided is whether this new arrangement meets a real public want."

NEW COMPANIES.

The Delmar (Kan.) Mutual Telephone Company has been incorporated.

The Blue Rapids (Kan.) Telephone Company has been incorporated with a capital stock of $12,000.

The Beverly Telephone Company of Beverly, Kan., has been incorporated with a capital stock of $3,000.

P. R. Smith, William Blair and L. D. Jones of Waketa, Okla., have incorporated as the Grand Valley Co-operative Telephone Company.

A company is being organized in Covington, La., for the purpose of installing a telephone system. H. H. Smith and Paul Labordi are among those interested.

The Cherokee Telephone Company has been permanently organized at Gaffney, S. C., with T. G. McCraw, president; J. V. Whelchel, vice-president, and J. E. Jeffries, secretary.

The Western Telephone Company of Ozark, Ark., has been incorporated with an authorized capital of $100,000. Among those interested are J. F. Maxey, W. H. Fulker and L. D. Huggins. The company proposes to construct and operate telephone systems.

How Avoid Personal-injury Responsibility in Telephone Construction Work and Maintenance.[1]

By Rome C. Stephenson.

It would be impossible to lay down a set of rules to govern a telephone company which, if faithfully observed, in the construction of a plant, would avoid responsibility for personal injuries. In the larger cities where it is necessary to have a force of linemen at work constantly in making repairs and extensions the liability of some workman being injured by a fall from a pole or by coming in contact with a live wire is ever present. A large percentage of the injuries sustained by linemen result from falls received through defective cross-arms which are unable to stand the burden placed upon them. If possible it should be ascertained that all cross-arms used are made of first-class material, free from knots and decay, but as they are usually painted before being delivered, too much care cannot be exercised in the inspection.

The liability of a company for personal injury received on account of a defective cross-arm is much greater where the arm did not show an apparent defect than where the defect was easily observable. If the person injured could by the exercise of ordinary care have seen the defect and the injury resulted from his negligence, the case would be one of mutual fault and the law would neither cast all the consequences upon the company nor would it attempt any apportionment thereof, so there would be no legal liability on the part of the company. But where a lineman is injured on account of some defect in the material used by the company that could not be seen prior to the accident by the exercise of ordinary care, but which defect was known to the company, then the law places upon the company the responsibility for the injuries sustained by its employe while engaged in the performance of his duties.

Neither individuals nor corporations are bound as employers to insure the absolute safety of material or appliances which they provide for the use of their employes. Nor are they bound to furnish the best and safest or newest of those appliances for the purpose of securing the safety of those who are employed. They are, however, bound to use all reasonable care and prudence for the safety of those in their service by providing material and appliances reasonably safe and suitable for the use of the latter. It is, therefore, important that all material to be used by the company wherein defects might cause an accident for which the company would be liable should be carefully and thoroughly inspected by a competent and reliable superintendent prior to its use.

In the work of construction and extension of telephone lines extraordinary care should be taken to keep the telephone lines, as far as possible, away from all electric lines carrying a heavy current, and where the crossing of such lines by the telephone wires is unavoidable it would be prudent in erecting the telephone wires to pass over the heavy-current lines with a space of at least four feet between. In places where it is practical to do so guard wires should be erected below the telephone lines as an additional measure of precaution.

The courts have time and time again decided that the electric-light and trolley wires should be erected in such manner as not to interfere with the service of the telephone system. Where a telephone company operates its line by the single-wire system, in which the earth is used as the return conductor at the telephone exchange and at the houses of each of its subscribers, and the electric currents required for its business cause no hurtful disturbance of natural electrical conditions, and where an electric-railway company operates its road by the single-trolley system, in which it also uses the earth as a return conductor, but generates electricity in such unusual quantities and applies it in such violent and varying currents as to produce an unnatural and disturbed electrical condition, whereby the utility of the telephone plant is destroyed by conduction, the court has held that the railway company is liable to the telephone company for damages to its business.

In running telephone wires it is unavoidable in many instances to prevent them from running near high-current wires, and as telephone wires are liable to become loosened, slacked or come into contact with live wires from other cause, it would be prudent and have a tendency to prevent accidents for which a company would be liable if a regular and systematic inspection should be made of all telephone wires at points where they would be likely to come in contact with live wires.

The dead telephone wire is always one of danger and menace, and when a wire is not in use it should always be disconnected from the building and securely fastened up out of reach so that if it should become a live wire it would not be likely to cause injury. Where a dead wire passed over a trolley line and by sagging came in contact with it and the end of the wire had been allowed to hang for several months within the reach of a person standing on the ground, a telephone company was held liable for the death of one caused by contact with the loose end.

1. Abstract of a paper read at the convention of the Inter-state Independent Telephone Association in Chicago on December 15th. The author is connected with the Rochester Telephone Company of Rochester, Ind.

The Rochester Telephone Company of Rochester, Ind., is now involved in litigation to determine whether the company is responsible for the death of a farmer who was killed by a stroke of lightning. The man was standing 40 feet beyond the termination of a wire fence which ran down to the public highway over 200 feet away, along which highway one of the toll lines of the company had been constructed. After the man was killed it was found that a bolt had also struck some fence posts along the road several hundred feet away, and the telephone wire disclosed the fact that an electric current had also passed along it, as the wire was melted off at the point just opposite the place where the wire fence connected with the fence running along the highway. The complaint against the company was drawn upon the theory that the lightning first struck the telephone wire, which it followed to the point where it melted the wire, causing it to drop down upon the barbed wire and allow the current to pass along the fence wire down to the point beyond which the man was killed. For weeks after the accident occurred the farmers of the neighborhood in discussing the accident argued that when the current was on the telephone wire it became heated, melted and severed and dropped down, heavily charged, upon the barbed wire, and was, therefore, the proximate cause of the death. The attorney who drew the complaint and the farmers that discussed the case seemed to have overlooked the fact that the stroke of lightning was instantaneous and that no power on earth could determine where the current first struck or that the erection of the telephone lines was the proximate cause of the injury.

It is only by unusual vigilance, care, caution and thoughtfulness that the telephone lines can be so constructed and maintained as to reduce the responsibility for personal injuries to a minimum, but, however careful and cautious a company may be, there is always the likelihood of a serious accident resulting from some oversight or neglect upon the part of the company for which it would be legally liable.

GENERAL TELEPHONE NEWS.

The South Side Telephone Company of Hampton-Sidney, Va., has extended its lines to Crewe, Va.

H. T. Holverson has resigned as president and secretary of the Interurban Telephone Exchange Company of Alexandria, Minn.

The Home Telephone and Telegraph Company intends to apply to the trustees of Fresno, Cal., for a telephone franchise. If granted, the company will immediately begin the construction of the new system.

Plans for extensions that will cost $300,000 and which are the first move in building lines that will practically cover the entire Puget Sound country have been perfected by the Independent Telephone Company of Seattle, Wash.

C. E. Sumner of Toledo, Ohio, has applied for a franchise for an Independent telephone system at Spokane, Wash. He agrees to spend $300,000 in Spokane within three years if a franchise is granted him. The proposition will be opposed by the Sunset Telephone Company.

It is expected that at an early date the government will complete the telephone line between Phoenix and Livingstone, Ariz., at the upper end of the Tonto storage basin. The poles have been on the ground for some time, although it is understood that the contract for construction has not yet been let.

John C. Johnson, secretary of the Delaware and Madison County Telephone Company, died at Muncie, Ind., last week. He was highly esteemed in Muncie and as a token of regard all business in the city was suspended during his funeral and for a short period all factories and street cars ceased operation.

The annual convention of the Independent Telephone Association of Wisconsin will be held in Milwaukee on January 25th and 26th. Headquarters will be at the Hotel Pfister. The officers of the association are: President, Richard Valentine of Janesville; vice-president, H. G. Slater of Waupaca; secretary and treasurer, H. C. Winter of Madison.

The Western Electric Company has a force of 10 men at work installing the new switchboard for the Missouri and Kansas Telephone Company at Wichita, Kan. The board is of the latest model central-energy type, with a capacity of 5,000. The total cost will exceed $50,000. The entire finish of the board is of mahogany. G. H. Keep, electrician in charge of the work, thinks that the new board will be in operation in about 60 days.

The city of Chicago has begun a suit in the Circuit Court to force the Chicago Telephone Company to produce its books for inspection, in an effort to secure an accounting. The city bases its demand for an accounting on its agreement with the company that three per cent. of the company's gross receipts should be paid the city for the franchise rights given the company. The dispute is over the receipts in the territories annexed to Chicago since 1889, including the towns of Hyde Park, Cicero and Lake.

CORRESPONDENCE.

Great Britain.

London, December 10.—During the last two sessions of Parliament there have been one or two strenuous fights between tramway companies which have desired to obtain running powers over municipal tramways and the corporations which have been entirely opposed to such an idea. Two notable cases have been Newcastle this year and Birmingham last year, both instances being identical, viz., companies coming from outside districts and wishing to run inside the city. In the case of Birmingham the company lost its case, but came to an agreement, and in the case of Newcastle the corporation lost, and through running now takes place. Beyond what has taken place in Parliament, no statement has ever been issued as to the history of the movement concerning tramway-running powers, but a paper has just been read before one of the tramway associations which puts the whole matter in a very clear way. Strictly speaking the whole of the opposition of the local authorities has been due to a misguided policy that no direct means of tramway communication should be afforded its ratepayers outside their boundaries—at any rate by co-operation with outside authorities. This is exemplified by the circumstance that similar difficulties have arisen between two local authorities. The recent action of Parliament, however, would seem to have instilled a more broad-minded spirit into local authorities generally, for during the discussion on the paper above mentioned a proposal that a tribunal should be established to decide all cases where the question of running powers has arisen was welcomed by a number of municipal delegates. As a matter of fact this is merely a common-sense view of the whole difficulty, and it is not inconceivable that some at least of the local authorities must now realize that their attitude in the past has partaken of the childish.

An addition has just been made to the large number of places of amusement in London where electric power is used extensively in connection with the stage scenic apparatus. The London Coliseum, which will be opened in a day or two, is particularly well equipped, there being a number of motors for working, among other things, a stage, which is built in three concentric revolving rings. The scenery itself will be hoisted by winches worked electrically, and on the switchboard there are nearly 100 switches. The Coliseum will give a different class of entertainment from any house at present in existence over here.

In connection with the waterpower scheme of electric-power transmission in the North of Wales a large mileage of electric tramways is to be constructed amid the beautiful passes and valleys of the mountainous district around Snowdon. From one point of view this would certainly open up some of the most beautiful scenery in Great Britain to thousands who at present find themselves unable to undertake the necessary walking. On the other hand, the ordinary seekers after the beautiful are quite convinced that a sacrilege would be committed were such unsightly things as tram cars and trolleys to be allowed to penetrate such sacred districts. Hence quite an outcry is being raised against permitting these electric tramways to be built, although I fear it will avail little, seeing that a large portion of the necessary parliamentary powers have already been obtained.

With the increasing competition of electric tramways with the local traffic of many of the railways the idea of utilizing single-motor coaches for the latter and thus creating a much more accelerated service is largely being put into force by many railway companies. The Northeastern railway, in addition to its electrified lines at Newcastle, is running single petrol-electric coaches upon other less populous lines, but a rather poor efficiency, from the engineering point of view, is said to be obtained from this combination. Consequently the Great Northern Railway Company has reverted to the petrol engine alone for such work, and an improved coach fitted in this manner is now running upon certain urban lines about 30 miles from London.

The troubles of the London County Council in regard to the conversion of the North London tramways to electric traction would not appear to be diminishing. Last week one of the borough councils which have a veto in the matter resolved by a majority of 20 not to entertain any scheme which entailed the use of overhead wires. The council wished to adopt the overhead system and had hopes of converting the borough councils to this view.

A bill will be introduced this session by the London County Council to enable the London borough councils to undertake the wiring of consumers' premises for electric light. Two years ago a similar proposal was defeated by the London electrical contractors on the ground that it would cut into their business in an unfair manner, and the only compromise they are willing to come to is that the work authorized under the above bill shall be given out to contract. Unless the council gives way in this matter it will find itself involved in a heavy expense to fight the opposition.

G.

New York.

New York, December 17.—A flood tied up the trains in the subway on Wednesday morning through the bursting of a 36-inch water main 100 yards north of the uptown subway station at Eighty-sixth Street.

The Lambert Schmidt Telephone Manufacturing Company of Weehawken, N. J., has furnished a number of telephones which have been installed on the platforms of the subway stations. These telephones are connected with the Interborough company's central switchboard and are available for the use of employes and such of the general public as have need of official information.

Subway Contractor J. B. McDonald, according to expectation, has become associated as a director with the Metropolitan Securities Company. This means that he will be interested in a projected East Side subway in rivalry of that of the Interborough company. Mr. McDonald states that the West Side tunnel which he constructed has not solved the problem of rapid transit, and he foreshadows an independent East Side subway to be built by the Metropolitan Street Railway Company. Mr. McDonald has also become identified with the Port Chester Railway Construction Company, which hopes to have its cars running into New York in two years time. This company was organized this week with a capital of $1,500,000, paid up.

The old "Steinway" tunnel, which was begun in 1890 by Messrs. Steinway, the piano manufacturers, who built the trolley-railroad system of Long Island City, and was blocked through damage cases resulting out of a fatal explosion of dynamite, is now to be taken up and completed by the Interborough Tunnel Company, of which August Belmont is the head.

The Supreme Court, at the instance of William R. Hearst, has granted an injunction restraining the city paying any money to the lighting companies under recent contracts. This means that the companies will have to sue the city for their money and produce evidence on the subject of actual costs. The friends of the Consolidated Gas Company spoke out on Tuesday last in the controversy over the cost of lighting and declared that the company would be obliged to keep up its prices to offset the special franchise taxes of more than $600,000 a year. Mayor McClellan has veered around to a qualified approval of establishing a municipal-lighting plant. There is a plan under way on the part of the capitalists of the Interborough Construction Company to supply the city with cheap light at $90 per arc light. This would mean a reduction of $750,000 a year in the city budget. This company through its big power house at Fifty-ninth Street and also through its control of the subway and elevated lines could install a system of electric-lighting wires on short notice.

Electricity will probably replace steam in all the suburban belt of the New York Central during next year. The plans include the building of a new underground station about 20 feet below the surface of the street for connections with the rapid-transit subway, and the proposed Belmont tunnel under East Forty-second Street to Long Island City, where a connection will also be made with the New York and Queens County Railroad system.

The Manhattan and Bronx Electric Company of New York has been incorporated at Albany. Its capital is $10,000 and the directors are Willis B. Richards, New Rochelle; John S. Clark and James C. Stafford, both of Brooklyn.

There were a few electrical novelties at the Business Exhibition at Madison Square Garden this week. A new model of the Universal adding machine was shown, operated by a 1-20 horsepower motor. A similar motor was attached to a "comptograph." The De Veau Telephone Manufacturing Company of 27 Rose Street, New York, showed several forms of automatic telephones, and the Oliver Manufacturing Company of Philadelphia showed its Equipoise telephone-holder, attachable to desks in awkward places. The Equipoise is used in the post-office at Washington, D. C. There were also some speed contests for telegraphers and a practical demonstration of the typewriting telegraph. Among the telegraphers who entered for the contests were W. M. Gileson, J. P. Gallagher, C. P. West and Miss K. Stetson, all of the Postal company, and Miss Marmion of the Western Union. Andrew Carnegie has offered a gold medal for next year's contests.

D. W. W.

New England.

Boston, December 17.—The Western Massachusetts Street Railway Company, which sought special privileges and a special charter at the last session of the state Legislature, has taken out a charter this week under the general laws relating to street-railway incorporation, and is capitalized for $300,000. It will be 40 miles long, running from Westfield to Lee.

In spite of strenuous objections by the Boston and Maine railroad and the Boston and Northern Street Railway Company, whose lines will be paralleled to a considerable extent by the proposed new Boston to Haverhill trolley company, which has been seeking permission to enter the field, the Massachusetts railroad commissioners have approved the project and intimate their readiness to authorize the building of the road when certain necessary conditions have been complied with.

The Lowell and Boston Street Railway Company will be sold at auction on December 21st at Woburn, subject to a mortgage of $250,000 held by the Federal Trust Company of Boston. The road has been in receivers' hands for a number of months.

Hon. William E. Barrett, the largest stockholder in the Templeton Street Railway Company, purchased the road on Saturday last at a foreclosure sale for $100,000.

The American Loan and Trust Company, holder of $200,000 bonds of the Hampshire and Worcester Street Railway Company, for which a receiver was sought a short time ago by William E. Swindell and others, has filed a petition to intervene and for leave to file a bill of foreclosure of a mortgage made by the company to the complainant as trustee. The case comes up the first Monday in January.

The annual report of the Massachusetts Electric Companies says that weather conditions in the last year were the most trying and unsatisfactory known since street railways have played any considerable part in the transportation of the public. The consolidated income account for the year ended September 30th shows: Gross earnings, $6,380,863; operating expenses, $4,479,520; interest, rent and taxes, $1,462,626; dividends, $466,003; deficit, $27,286. The president, in his report, said that the new turbine power house at Newport was working satisfactorily.

Telegraphers in the employment of the Boston and Maine Railroad Company have been granted an increase in wages, and more satisfactory working conditions at an increase of about $37,000 in the railroad's annual expenses.

A great scramble to secure additional street-railway franchises will take place before the next session of the General Assembly of Connecticut. Established trolley corporations will apply for extended privileges, and new enterprises which will seek incorporation and charters are springing up in all sections of the state.

The bill in equity brought in January, 1903, by Charles G. Kidd of Kirriemuir, Scotland, and G. Henry Whitcomb of Worcester against the New Hampshire Traction Company, New York Security and Trust Company, the Massachusetts Trust Company of Connecticut and Wallace D. Lovell, came on for trial before Judge Peaslee on Monday last. The plaintiffs claim that they were creditors of the Massachusetts Construction Company of Connecticut and Mr. Lovell to the amount of $244,000.

Southeastern States.

Charlotte, N. C., December 17.—It is reported that investigations have been made by a syndicate of New York banking houses of the franchises and charters of the United Railways and Electric Company at Baltimore, Md., and that if the property in Baltimore is secured several million dollars may be spent in improving the system.

The county commissioners have granted the franchise asked by the Raleigh and Durham (N. C.) Traction Company. The Raleigh Chamber of Commerce has also endorsed the proposition to build this 28-mile electric line.

J. B. McClary, who recently resigned the management of the railway department of the Birmingham (Ala.) Railway, Light and Power Company, has accepted the position of general manager of the company at Sheffield, including the public utilities of that town, and Tuscumbia and Florence.

It is given out that the directors of the Baltimore, Sparrows Point and Chesapeake Railway Company and the executive committee of the United Railways and Electric Company have ratified the sale of $1,700,000 4½-per cent. bonds of the Sparrows Point company to the banking firm of Dominick & Dominick of New York and a syndicate formed by J. William Middendorf of Baltimore. The bonds are part of a $2,000,000 issue and are a first lien on the property of the Sparrows Point company, the United Railways and Electric Company having leased the property for a long term.

The Murphy Electric Light and Power Company of Murphy, N. C., has been chartered with a paid-in capital of $6,000. The incorporators are A. J. Gentry, S. W. Lovingood, R. V. Swain and others.

The Hampton Roads (Va.) Railway and Electric Company has secured entrance into Old Point and the government reservation, and the first car was run on the new line recently.

George L. Upshur, representing the American Monorail Company, has made arrangements with the Richmond Electrical Company of Manchester, Va., for the building of the first motor for the line between Baltimore and Washington. The track between the cities named has been partly laid and the stockholders are said to entertain no doubts as to the feasibility of the plan for operating the road and that a five-minute service between Washington and Baltimore may be eventually secured by the monorail system.

L.

Ohio.

Cleveland, December 17.—An order to abolish through car lines has been presented to the Cleveland Board of Public Safety by the Cleveland Electric Railway Company. Under the present arrangement the tracks about the Square become congested morning and evening, and the plan is to break all lines at that point. The safety board seems to be unwilling to allow this change unless it is accompanied by a reduction in fare. As the cars now run a passenger may go almost any place for one fare, including a transfer. The argument is now made that where passengers ride only to the Square a reduction should be made, but if they take a

transfer entitling them to complete their trips on other lines, then the full fare may be charged.

In October the Toledo and Western handled 497 standard freight cars, in comparison with 315 in October, 1903. This indicates a handsome growth in the freight business of the road.

Arrangements between the Dayton and Western and the Indianapolis and Eastern have been made for a through-car service between Dayton and Indianapolis. It has been possible for some time to make the trip by changing cars at Richmond.

Last Wednesday a party of Indianapolis business men visited Cincinnati and other Ohio cities on an inspection trip, with a view to gaining information on the advisability of adopting an interchangeable mileage book, to be used in connection with the Ohio association roads. It is possible that the Ohio Interurban Association may develop into something like the Central Passenger Association so far as that phase of the business is concened. The visitors were entertained at lunch at the Queen City Club by President Kelsey Schoepf of the Cincinnati Traction Company.

While the report has not been substantiated, it is said the Lake Shore Electric Railway Company will shortly apply for membership in the Central Passenger Association. This will bring about a decision on the part of the steam roads as to whether they will affiliate in any way with the electric lines. The Lake Shore Electric had a working arrangement with the Clover Leaf on St. Louis fair business for a time. It also has a special arrangement with the Baltimore and Ohio on the Sandusky division. Attempts to arrange with the Wheeling and Lake Erie, Pennsylvania and some other lines failed.

In connection with the proposed through-car service between Cleveland and Detroit, to be inaugurated by the Lake Shore, it is said that sleeping cars have also been considered, but it has been found that a sleeper would not pass through a number of bridges and that the tracks are so close together in Cleveland and Toledo that it could not pass other cars by about five inches. It is believed that sleepers on most trolley roads are impractical at present for that reason, but it is evident that the road must be rearranged to accommodate them at some time.

The lighting committee of the Toledo City Council has recommended the ordinance granting the East Side Heating and Lighting Company a franchise to operate over a territory covering about half of the East Side. The company agrees to build a plant costing not less than $50,000, and heat and light all the city buildings in that section.

A special committee of the City Council of Youngstown has decided to recommend the issue of $100,000 bonds for the purpose of building an electric-light plant. O. M. C.

Indiana.

Indianapolis, December 17.—The Indianapolis and Northwestern Traction Company carried 971,000 people during the first year of operation, an average of 2,600 a day. This is 16 times the tributary population of the cities, towns, villages and rural districts for three miles on each side of the right-of-way outside of Indianapolis.

Experiments of importance in the solution of electric-railway problems are to be conducted during the next few months in Anderson and on the lines of the Indiana Union Traction Company. They will be the final work of the electric-railway test commission of the Louisiana Purchase Exposition. Next week a car of interesting equipment will be run over the lines of the road to make the records in the series of experiments. The experts in charge will ascertain the elements and effects of resistance, principally from air, when the car is at high speed. A flat car to carry the interurban car, built of steel expressly for this test, will be mounted upon Baldwin trucks equipped with four motors of 300-horsepower capacity. Upon the flat car will be placed the body of an interurban car mounted upon four pairs of small wheels carried in ball bearings, the wheels rolling upon rails spiked to the flat car. When the commission completes its experiments on the Indiana Union Traction lines it will be able to state accurately the effect of all pressure or resistance that an interurban electric car encounters when at full speed. There will be a report also on tests of motors, gearing and other apparatus. "The work to be done is the most important part of the task laid out by the commission, and for it much preparation has been made," said Prof. H. H. Norris of Cornell University. A radical plan has been devised for measuring directly the several components of car resistance. This plan was approved by all the engineers who have been consulted in regard to it, and all agree that the investigation is by all means the most important to which the commission can devote its efforts. The work is under the direction of Professor Goldsborough of Purdue University, who was chief of the electrical department at the exposition and chairman of the executive committee of the Electric Railway Test Commission. Professor Norris of Cornell and Professor Swensen of the University of Wisconsin are here to superintend the test. Electric students and interurban railway men are also interested in witnessing the tests. The cost of the experiments or tests is being shared jointly by the large electric lines of the country.

Indiana electric-railway men are greatly elated over a recent decision of the New York Court of Appeals holding that the steam roads may not refuse to deliver loaded freight cars to the electric lines. This case is identical with the Big Four-Plainfield case, and it is confidently expected that the Indiana courts will make an equally favorable ruling. The incident, however, has created a demand for legislation and a bill is now being prepared.

The first hearing on the petition of the Indianapolis, Newcastle and Toledo Traction Company for an independent entrance to Indianapolis was heard this week. The Terminal company opposes the petition and the fight promises to be strenuous.

The promoters of the Geneva Traction Company report that their line to be constructed between Marion, Ind., and Celma, Ohio, has been financed and work will begin in the spring. The line will traverse a rich part of the country and through the heart of the oil belt. The estimated cost is $2,000,000.

A representative party of Indianapolis business, professional and interurban men made a most notable and extensive tour of Indiana and Ohio electric lines during this week ever attempted before. The men were guests of the Indianapolis and Eastern Electric Railway Company and car No. 15, in charge of J. W. Chipman, general manager, carried the party over nearly 800 miles of electric road. The possibilities of interurban travel from Indianapolis eastward were demonstrated so thoroughly that already arrangements are being made for through service, interchangeable tickets and traffic agreements. While the party was in Ohio the Richmond Interurban Company lowered the grade under the low railroad bridge in Richmond so as to permit the Indiana interurban cars to pass under without trouble, and thus a contention of a year's standing was removed in a few hours' time and at small cost. There will eventually be through service from Indianapolis to Columbus and Zanesville, Ohio. S. S.

Michigan.

Detroit, December 17.—It is authoritatively stated that there is no truth to the story that the Michigan Central Railroad Company contemplates the purchase of the Jackson-Battle Creek electric line.

The Lansing Business Men's Association will hold a meeting for the purpose of securing aid to the project of building an electric line to Pine Lake, a resort about nine miles distant from the city. The Lansing and Suburban Traction Company wants $10,000 for completing the project. A line has been in operation to the Michigan Agricultural College grounds for several years, three miles in length, and it is proposed to make the extension from the college grounds

Electrical Workers Local Union No. 133 gave its second annual ball and electrical display in Strassburg's Academy on Wednesday evening. The hall was beautifully illuminated, 2,500 electric lights being used for the purpose.

Alderman Max C. Koch will ask the corporation counsel for an opinion relative to the power of the Common Council to regulate the rates of the Edison Illuminating Company. A citizen maintains that the present system of rates as charged by the company for illuminating purposes is unjust.

Theron W. Atwood, commissioner of railroads of Michigan during the last two years of Gov. Bliss' administration, has been reappointed by Governor-elect Warner. Commissioner Atwood has jurisdiction in the state over electric lines in certain cases.

The line of campaign to be followed by the Detroit United when its franchises on the principal streets of Detroit begin to expire is suggested in a circular issued for the sale of $8,200,000 worth of the company's bonds, which is accompanied by a letter signed by President Hutchins. The company holds long-term franchises on parts of its lines, granted by township boards before these parts of the city were annexed and which were sustained by the courts. With these stub-end franchises to use as a club on the city, the company may force the community to give it an extension of its rights on downtown thoroughfares. President Hutchins calls attention to the fact that the company charges only one fare on Jefferson Avenue for a trip covering three different franchises, on which it could charge three fares, if it cared to insist upon its legal rights.

The Detroit, Monroe and Toledo Short Line may soon announce direct electric service to Cleveland. A special car carrying officers of the road made the trip Thursday. Vice-president C. A. Black says: "Our road has lost some business through passengers having to change at Toledo. If we find the through service practicable, we shall make some traffic arrangement with the Everett and Moore people, who operate the line between Cleveland and Toledo." The actual running time between the two cities, including all stops except Toledo, was six hours. The run from Cleveland to Toledo took four hours and from the Boody House in Toledo to the Russell House in Detroit two hours. As soon as the details can be worked out, the company will inaugurate a through service between Detroit and Cleveland with the schedule time between the center of the two cities placed at seven hours. C. G. W.

Northwestern States.

Minneapolis, December 17.—A new independent light and power company will ask for a franchise at La Crosse, Wis. It will be capitalized at $200,000. A vigorous fight will be made against granting such a franchise, it is said.

The Interurban Railway Company of Des Moines, Iowa, proposes to build a line from that city to Eldora.

The Cascade Milling Company of Sioux Falls, S. D., will replace the six dynamos in its electric plant with one large generator, which will mean a doubling of the plant's capacity.

The Apple River Power Company has suspended work for the winter on its new power plant at Somerset, Wis., from which electric power is to be brought to Stillwater, Minn. The dam and buildings are practically completed and the machinery will be installed early in the spring.

A new electric-light franchise is being considered by the council at Aberdeen, S. D. It is said to be the most favorable to the city of any franchise in the Northwest.

Preliminary surveys have been made for a trolley line from the Twin Cities to Faribault, Minn., a distance of about 65 miles. If built, the new line will connect with the Twin City Rapid Transit Company's lines.

The new electric-light plant at West Point, Iowa, has been completed and the plant is now in operation.

It is reported that a branch interurban line will be built from Sioux City, Iowa, to Audubon, where it will connect with the new line to be built from Des Moines to Council Bluffs.

George Horn has sold his electric-lighting plant at Cavalier, N. D., to James Lang.

A contract has been granted at Fairfield, Iowa, for a new electric-light plant.

A new electric-light plant is being installed at Withee, Wis. It is owned by Robert Hemphill of Neillsville. R.

Pacific Slope.

San Francisco, December 16.—The Current Power Company has been incorporated at Seattle, Wash., with a capital stock of $2,000,000. The incorporators are Edgar Courtwright, W. H. Boothroyd, Guy C. Hamilton, W. Harry Boothroyd of Tacoma, Wash., J. D. Hanbury, J. R. Carman and Phillip Wheeler of Seattle. Seattle is the principal place of business.

The La Grande Electric Light Company and the Cove Power Company of La Grande, Ore., have consolidated and incorporated under the name of the Grande Ronde Electric Company. The directors are Walter Pierce, J. A. Thronson, T. H. Crawford, Clarence Crawford and T. R. Berry of Union, Ore.

The Electric Supply Company has been incorporated at Sacramento, Cal., by Joseph C. Hobrecht, C. V. Schneider, H. G. May and others. The capital stock is $10,000. The company is formed to take over and purchase the business of which C. V. Schneider is the owner.

J. F. Parkinson, president of a corporation composed chiefly of eastern capitalists, has closed negotiations with the Santa Clara and San Jose Railway Company at San Jose, Cal., for the purchase of the Santa Clara and San Jose, Alum Rock Park and tributary lines. It is the intention to build a trunk line from San Mateo to Redwood City, thence to Palo Alto, thence to Mayfield, Mountain View, Sunnyvale, Santa Clara, San Jose and Gilroy.

It is reported that the Southern Pacific Railroad Company may install an electric plant at Dunsmuir, Cal.

The Washington Water Power Company is planning on the construction of a branch electric line to Silver Lake, in connection with the Medical Lake system. In addition to the Silver Lake branch, the company has applied for a franchise through Medical Lake, Wash., to the western city limits. It is expected that the Medical Lake line will be ready for cars by the first of June.

The Pacific Electric Railway Company will expend about $2,000,000 in a direct line to Covina from Los Angeles, Cal.

A representative of T. H. Warford and William Redaker of Ballard, Wash., has asked the council of Sumas, Wash., for a franchise to operate an electric-light plant in the town of Sumas for a period of 50 years.

H. E. Huntington has purchased the controlling interested in the Pacific Electric and the Los Angeles Interurban Railway Company at Los Angeles, Cal.

The Consolidated Heat, Light and Power Company has been incorporated at San Francisco by William Thomas, Mark L. Gerstle, Robert N. Frick and others. The capital stock is $300,000.

The electric power plant of the Eureka Lighting Company at Eureka, Cal., was destroyed by fire on December 13th. Five dynamos and other machinery were destroyed. The loss is $30,000, with insurance at $17,000.

Warren Gillespie has applied to the council of Los Angeles, Cal., for a franchise for an electric street railway commencing at the intersection of Wilshire Boulevard and Commonwealth Avenue, Los Angeles.

Preliminary surveys for the Salem-Liberty-Rosedale electric line have been commenced by Surveyor Herrick. Mayor F. W. Waters of Salem, Ore., who is at the head of the new company, states that the road will be built if proper assistance can be secured from the people.

The restraining order preventing the adoption and publication of an ordinance granting L. U. Brewer

an electric-light franchise at Seattle, Wash., has been dissolved. Mr. Brewer has been given 30 days to accept the franchise and agrees to pay $1,000 for the privilege of operating a lighting system in Seattle, guaranteeing to have 2,500 16-candlepower lights ready for use inside of six months. He will probably turn the franchise over to the Seattle Electric Company, which will run a service line from its plant.

J. McDowell of Deer Park, Wash., has made application for a franchise to establish and operate an electric-light plant in Reardan, Wash. The ordinance before the council will no doubt be finally passed at the January meeting. The plant will probably be in operation by March 1st. A.

PERSONAL.

August Belmont succeeds the late Senator Hanna as president of the National Civic Federation. His election occurred on December 15th, and the fact was announced by H. H. Vreeland.

John T. Nyhan, formerly superintendent of the Macon (Ga.) Railway and Light Company, has been appointed general manager by the board of directors to succeed J. H. Hertz, who has been compelled to retire on account of poor health.

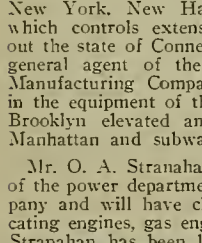
Friends of Mr. T. C. Penington, secretary of the American Street Railway Association, will deeply sympathize with him in the loss of his son, Mr. Charles R. Penington, who died in Arizona on November 30th. The decedent was the paymaster and cashier of the Chicago City Railway Company, by which he had been employed for more than 20 years. He leaves a widow and two children.

C. C. Lewis, who for the last two years has occupied the position of chief engineer of the Schenectady Railway Company, will sever his connection with that company on January 1, 1905, when he will sail for London to enter the employment of J. G. White & Co. Mr. Lewis has been engaged principally to take charge of the work to be carried out by the company at Montevideo, Uraguay, in electrifying the street railways at that place. He has had an extended experience of over 15 years in railway work.

William R. Chapman, the new manager of the Western Union Telegraph Company at St. Paul, Minn., is a native of Canada, having been born in Brighton, Ont., in June, 1864. He commenced telegraphing in Canada in 1879 and held many positions before going to Buffalo, N. Y. In 1883 he came to Illinois and was engaged with the Western Union at Jacksonville and Chicago. Later he became manager for the company at La Crosse, Wis., holding the position for 19 years, until he was promoted to the St. Paul office.

Calvert Townley has received the appointment of assistant to President Charles S. Mellen of the Consolidated Railway Company, closely allied with the New York, New Haven and Hartford railroad, which controls extensive trolley interests throughout the state of Connecticut. Mr. Townley has been general agent of the Westinghouse Electric and Manufacturing Company at New York and helped in the equipment of the Boston elevated system, the Brooklyn elevated and surface systems, and the Manhattan and subway systems of New York city.

Mr. O. A. Stranahan has been appointed manager of the power department of the Allis-Chalmers Company and will have charge of the sales of reciprocating engines, gas engines and steam turbines. Mr. Stranahan has been lately in charge of the engine business of the British Westinghouse Electric and Manufacturing Company, and in that work has met with marked success. He has given much attention to gas-engine developments. He graduated from Cornell in 1890, and immediately entered the service of Westinghouse, Church, Kerr & Co., working up through their various departments, and becoming chief engineer of their Chicago office. When the British Westinghouse Company was formed Mr. Stranahan was appointed to the charge of its engine business. He began these duties in 1900. Mr. Stranahan has not only a wide business acquaintance throughout the United States, but his work abroad has given him an extensive European connection. His new appointment dates from December 1st. He arrived in New York, from England, about the middle of December, and proceeded at once to Milwaukee, where he will establish his headquarters.



O. A. STRANAHAN.

Mr. W. J. Sando, whose high reputation as a pumping-machinery expert has been for some years the subject of favorable comment, is one of the important recent additions to the strong organization of the Allis-Chalmers Company. Mr. Sando has been appointed manager of the company's pumping-machinery department, with headquarters in Milwaukee. Although still a young man, he had filled many responsible places, both in private and public employment, before joining the Allis-Chalmers forces. His last public service was with the New York City Commission on Additional Water Supply, with which

W. J. SANDO.

he served from May 1, 1903, to January 1, 1904, as engineer in charge of the pumping department. Mr. Sando is one of those who have risen to high rank through the practical school rather than the academic. He was born in Scranton, Pa., in 1864. He took the public-school course, and then served an apprenticeship of five years as a machinist in the works of the Dickson Manufacturing Company at Scranton. He followed that with another apprenticeship of two years in the drafting room. Thus equipped he became in 1886 draftsman and inspector of pumping machinery for E. D. Leavitt, M. E., and then was fairly launched on a successful career.

ELECTRIC LIGHTING.

An electric-light plant will soon be constructed in the city of England, Ark., by the city.

The Humble Electric Company of Humble, Tex., has been incorporated with a capital stock of $30,000.

The Montpelier (Idaho) Electric Light Company has increased its capital stock from $25,000 to $40,000.

The erection of an electric-light plant at Lexington, S. C., is contemplated by S. B. George and J. E. Kaufman.

J. K. Nance of Ada, I. T., has purchased the light plant of the Jacksonville Electric Company at Jacksonville, Tex.

G. L. Hawkins and associates have secured the franchise to erect and operate the proposed electric-light plant in Hattiesburg, Miss.

It is reported that Jacob Schiff and associates of New York are trying to get a franchise for an electric-light and gas system in San Francisco.

The city of Wiggins, Miss., has granted a franchise to the Wiggins Electric Light and Power Company to construct and operate an electric-light plant.

The citizens of Chillicothe, Mo., have decided to have the electric lights turned off in the city streets rather than pay an advance of $7 per light on the present cost.

A combined electric-light and cold-storage plant will be operated in Russellville, Ark., by A. Bernard, R. L. Harkey, W. T. Meek and associates, who have incorporated as the Merchants' Light and Cold Storage Company.

The auxiliary electric-light and power plant which the Utah County Light and Power Company of American Fork, Utah, is arranging to install 1½ miles above its present plant in the American Fork Canyon, will, it is estimated, cost about $150,000. The survey is completed.

Bids will be received by the city of Anadarko, Okla., up to and including January 2, 1905, for a complete electric-lighting plant consisting of a 150-kilowatt generator, 200-horsepower engine, necessary pole line, transformers, arc lights, etc. Information may be had of W. S. Sherman, consulting engineer, Anadarko.

Max Hart, a postoffice clerk in New York city, a few days ago bought a trunk at a storage warehouse for $4. Tucked in one of the corners, it is said, he found bonds of the Southern Electric Lighting and Water Company which have a market value of between $17,500 and $20,000. The accrued interest at six per cent., which has not been collected for years, adds nearly $10,000 to the value of his find. Hart submitted the bonds to the inspection of officials of the Twelfth Ward Bank and then in turn to a broker, who established their value beyond question, it is said.

ELECTRIC RAILWAYS.

For the construction of an electric railroad 60 miles long from Depew to Rochester, N. Y., the Buffalo and Rochester railway of Depew, Erie county, has been incorporated. The capital is $3,000,000, and the directors are H. H. Kingston, J. Andrews Harris, Jr., of Philadelphia, and H. P. Bissell of Buffalo.

It is said that the Lake Erie steamer companies are looking with considerable anxiety at the inroads the trolley lines are making on their freight and passenger business. The roads will soon have arrangements for through service between Cleveland and Detroit, and this will undoubtedly hurt the package-freight as well as the passenger business the boats have been having.

The plaintiffs in the suit against Brown Bros. & Co. to set aside the absorption of the Transit company by the United Railways of St. Louis, have petitioned the United States Circuit Court to remand the case back to the St. Louis Circuit Court. The suit, together with injunction proceedings, was brought in the state court shortly after the announcement of the street-railway deal. James Brown, who was named as one of the defendants, secured its removal to the Federal Court on the ground that he was a non-resident.

According to a recent opinion of Attorney-general H. J. Hamlin of Illinois, street-railway crossings as well as those of steam roads are under the control of the state railway and warehouse commission. The significance of this interpretation of the law is found in the fact that the railroad and warehouse commission issued notice a few months ago that no more grade crossings would be allowed to be constructed in the state and that all such crossings now in existence must be guarded by interlocking devices.

A company has been formed at Dunfermline, Scotland, to build an electric railway through the west of Fifeshire. The promoters have given notice to the Fife County Council and the corporations of Dunfermline, Inverkeithing, Cowdenbeath and Lochgelly of their intention, and it is expected the company will begin the construction of the road in the spring of 1905. The road will be 16 miles in length, and besides connecting the towns mentioned will ultimately touch the new naval base on the Firth of Forth. The estimated initial cost is $632,645. The Fife Electric Power Company, which is now building a power plant at Dunfermline, will supply the power required for all purposes in the operation of the tramway system when completed.

SOCIETIES AND SCHOOLS.

The American Association for the Advancement of Science will hold its fifth annual meeting in the buildings of the University of Pennsylvania, Philadelphia, on December 27th to 31st. Several affiliated societies will meet at the same time.

The technical and art school plays an important part in the commercial and artistic education of the young people of Leicester, England. It is a municipal institution, founded about seven years ago, to give a thoroughly modern and scientific training in the more important manufacturing processes and industries carried on in Leicester, and also for the encouragement of artistic pursuits. The curriculum includes among its subjects chemistry, physics, electric lighting, power distribution, mathematics, etc. The technical side of the school has 1,500 students, and its workshops are fitted with modern machinery, tools and appliances, lecture rooms, laboratories, library, reading room, etc.

PUBLICATIONS.

A mailing card calling attention to Wagner transformers and the new type of vertical single-phase motor described elsewhere in this issue is being sent out by the Wagner Electric Manufacturing Company of St. Louis.

A long-established firm dealing in mica is that of Eugene Munsell & Co. of New York and Chicago. Mica for insulation is one of its specialties and consequently it has issued a standard price list on "Electrical Mica" which those interested in mica will do well to look over.

The Ashton Valve Company of Boston has issued a handsome wall calendar for 1905. A picture in colors represents an attractive young woman in a rustic scene. The invitation beneath is "Meet me at the bars." The Chicago branch of the Ashton company is at 160 Lake Street.

An illustrated catalogue of electrical novelties has been issued by the Ohio Electric Works of Cleveland, Ohio. The catalogue, though small, lists a great number of small electric devices of a useful character, such as pocket battery lamps, igniters for gas engines, hand dynamos, induction coils, electric bell outfits, etc.

A "flyer" from the Crocker-Wheeler Company of Ampere, N. J., introduces a new line of variable-speed motors being manufactured by that company. The new motors range from two to 25 or two to 32 horsepower, according to the voltages, which are 115 and 230 volts, respectively, that is, for a 2 to 1 speed range. For a 3 to 1 speed range the sizes are from 1½ to 20 horsepower.

The Citizens' Alliance of Joliet, Ill., has published a handsome booklet of 24 pages, with map and half-tone illustrations, in which are pointed out some of the advantages of that city as a residence and manufacturing center. One of the advantages set forth is the economical and reliable waterpower made possible by the development of the large volume of water from the Chicago Drainage Canal.

Anyone desiring to inform himself thoroughly concerning Bullock rotary converters will do well to obtain bulletin No. 103t from the Bullock Electric and Manufacturing Company of Cincinnati. This bulletin is carefully prepared and handsomely illustrated. Each part of the apparatus comes in for a detailed description and there are a number of interior views illustrating typical installations of Bullock machines.

With characteristic promptness, Secretary T. C. Penington of the American Street Railway Association has his report already printed for the meeting held in St. Louis last October. Besides a list of the officers of the association and the papers presented at the convention, the report contains lists of the members of the association and of representatives of manufacturers and the ladies in attendance

at the convention. All the past-officers are also given since the organization of the association. The present officers are: President, W. Caryl Ely of Buffalo; first vice-president, Elwin C. Foster of New Orleans; second vice-president, John I. Beggs of Milwaukee; third vice-president, Richard McCulloch of St. Louis.

The new edition of the National Electric Light Association's report of rates for commercial lighting and power service has been published. This, the second edition, is about one-third larger than last year's book and contains returns from 750 cities and towns. The first edition, issue in November, 1903, met with general demand, and the present book, revised and larger, will be of great value to members of the association, for whom it is issued.

The Helios Manufacturing Company of Bridesburg, Philadelphia, Pa., American manufacturer of the Bastian electrolytic meter for direct-current work, has issued a new bulletin on this type of apparatus. Some of the advantages claimed for this meter are that there are no wheels, coils, commutators, jewels, permanent magnets or the like to get out of order; extreme simplicity; it cannot be tampered with by unauthorized persons, and is unaffected by heavy excess current or short-circuits.

Not only is the new booklet of the Westinghouse Machine Company upon mechanical stokers neat and pretty to look at, but it also contains information of a useful character concerning the construction and operation of the Roney stoker. About one-half of the booklet is given up to a description of this particular style of stoker, which is followed by numerous illustrations of actual installations. The installations pictured are the finest and most interesting of their kind, and they make an extremely good showing, as the engraving work is of the highest order. As illustrative of the most modern ideas in catalogue work the booklet under consideration may be taken as one of the best examples.

The annual report for 1903 of the Board of Rapid Transit Commissioners for New York city has been issued in the form of a large volume of 300 pages, with many illustrations and maps. The most interesting portion of the report is that dealing with plans for the future. The commissioners realize that when the present subway is completed great congestion of traffic will occur at certain points, and hence they have planned large subsidiary schemes. Various suggestions are made to deal with the traffic over the two existing bridges. A moving platform is also proposed for the Williamsburg Bridge. Full details are given, with photographs, of the construction and cost of the subway and of various lines still under construction. The report of Chief Engineer W. B. Parsons covers 115 pages and gives elaborate technical details of the contracts and subcontracts of the New York subway. The whole report is well worthy of close study by engineers interested in the problem of rapid transit in large American cities.

SPACE TELEGRAPHY.

Owing to interruption of the cable between Penzance and the Scilly Islands the Commercial Cable Company announced recently that service would be resumed by space telegraphy via Falmouth and the Lizard. At the headquarters of the company an official said that the cable in question was a short one owned by the British Postal Service and had no connection with transatlantic cables, none of which touch the Scilly Islands. The distance from Penzance to Scilly is short, but the cable is laid over a rocky bottom and is often out of order, and a wireless system is kept to fall back on. The Commercial official said that the wireless was now being used in connection with the cable in the Hawaiian Islands.

The interdepartmental board appointed by the president to consider the entire question of space telegraphy in the service of the national government has recommended that the Department of Commerce and Labor should have the duty of issuing licenses for space-telegraph marine stations in special cases, under such regulations as will prevent interference with stations necessary to the national defense. It has also recommended that all private stations in the interior of the country should be under the supervision of the Department of Commerce and Labor. To prevent the control of space telegraphy by monopolies or trusts, the board deems it essential that any legislation on this subject should place the supervision of it in the Department of Commerce and Labor.

TELEGRAPH.

During a dinner of the American Asiatic Association in New York city, at which Prince Fushimi was present, a message was cabled to the emperor of Japan and an answer received before the dinner was over.

As stated in the Journal Télégraphique, the Swiss budget for 1905 provides the sum of $44,712 for a telegraph and telephone cable in the Simplon tunnel. Switzerland and Italy are at present connected by two telegraph lines over Simplon Pass.

The quarterly report of the Western Union Telegraph Company states that the net revenues for the quarter ending December 31st, based upon nearly completed returns for October, partial returns for November, and estimating the business for December, will be about $2,000,000. Interest on the bonded debt will amount to $297,550, and $1,217,020 is required for a dividend of 1¼ per cent. on the capital stock issued. Deducting these two amounts leaves an estimated total surplus of $15,920,292.80. The executive committee recommends that a dividend of 1¼ per cent. on the capital stock be declared payable on and after January 16th next. The surplus on October 1st, last, was $15,434,862.80, which indicates that the increase for the quarter ending will be close to $485,430.

An appeal in the suit of Charles E. Schriver and George Rolla Schriver against the Western Union Telegraph Company has been filed in the United States Circuit Court of Appeals. The plaintiffs were awarded $10,800 damages at the trial in the Circuit Court for the eastern district of Iowa. The final decision is important as bearing on the liability of a telegraph company for accepting and transmitting a dispatch in the name of persons other than by whom it is sent. The action arose from a telegram purporting to have been sent by the Bank of Denison, Iowa, to the Commercial Bank at Britt, Iowa, in March, 1902. The telegram was a guaranty that the draft of E. S. Barnes would be honored. On the strength of it the Schrivers, who are cattlemen, sold Barnes eight carloads of cattle and took his draft. The message was delivered to the telegraph company over the telephone.

MISCELLANEOUS.

Dr. Milton Franklin announces that he has discovered a method of measuring X-rays in such a way as greatly to reduce the danger of accidents through them to operators and patients. Dr. Franklin points out that many of the injuries have been due to inability to measure the energy of the emanations from the tube. His method consists in measuring the ionization of the atmosphere by means of an electroscope of special design.

The streets of Munich, Germany, all of which are electrically lighted and cleanly kept, are well paved, about two-thirds with macadam and one-third with asphalt. The cost of maintenance in 1903 was $657,881 and the cost of cleaning $150,018. The electric street-railway lines have a length of 58½ miles; the number of motor cars is 288, and of trailers 281. The street-car lines are nominally in the hands of a private corporation, but in reality the city directs the operation and management and is also responsible for the financial undertakings.

The United States Civil Service Commission announces an examination on January 18-19, 1905, to secure eligibles from which to make certification to fill a vancancy of inspector of mechanical and electrical engineering (male) at $2,190 per annum, in the office of the supervising architect, Washington, D. C. Four subjects will be included, as follows: Mathematics, practical questions in mechanical and electrical engineering, drawing and design, training and experience. The respective weights given for these subjects are 10, 40, 20 and 30. Further information may be had upon application to the commission at Washington.

TRADE NEWS.

The Model Stoker Company has removed from Akron to Dayton, Ohio, where it should be addressed at the corner of Chapel and Kiser streets.

A. F. Hamacek, designer of special electrical and mechanical apparatus, and for many years located at Sturgeon Bay, Wis., has removed to Chicago. Mr. Hamacek is placing on the market a series cut-out for arc lighting.

A company to be known as the Vibrachord Company has been incorporated in St. Louis, Mo., to manufacture and deal in electrical appliances. Among the incorporators are Fred H. Brown and John J. Joyce. The company is capitalized at $50,000.

The Ford Electric and Manufacturing Company of St. Louis has purchased the manufacturing plant and equipment of Rossiter, MacGovern & Co. in St. Louis, as the latter company desires to give more attention to its secondhand business. The company's plant is complete in every respect for the manufacturing of armature and field coils and the repairing and rewinding of electrical machinery of all kinds. Special machinery for special services will be designed and built, for which purpose the company has exceptional facilities.

A new comer into the electrical manufacturing field is the Williams Electric Machine Company of Akron, Ohio, financed by some of the best and strongest financial interests of that city. This company is placing on the market a full line of electrical clutches and electric-stopping or safety devices to be used in stopping machinery in case of accident to the operator. These clutches, etc., are the invention of Mr. H. A. Williams, who is the general manager of the company. This concern is also placing on the market a full line of electrical apparatus, both alternating and direct-current generators, motors, switchboards, controllers, etc., and also undertakes the installation of complete transmission plants, embracing clutches, safety devices, generators, engine motors, switchboards, line shafting and hangers, pulleys, etc., making a specialty of equipping plants complete and all ready for operation.

Sealed proposals are being invited until December 27th for furnishing the New York navy yard with a quantity of desk and bracket fans, panel boards, cable, generating sets and miscellaneous electrical supplies based on specifications which may be obtained at the navy pay office in New York or of the Bureau of Supplies and Accounts of the Navy Department, Washington. The bureau is also inviting sealed proposals until January 17th for furnishing the Mare Island and Puget Sound navy yards with a quantity of motors, generating sets, electric wire, cable and conduit, meters, circuit-breakers and miscellaneous electrical material. Blank forms of proposal may be had upon application to the bureau.

BUSINESS.

The United States metal polish and barkeepers' friend, a product manufactured by George William Hoffman of Indianapolis, Ind., received the highest award at the Chicago World's Fair and also at the Louisiana Purchase Exposition of this year.

H. J. Walser, manager of the A. & W. Electric Sign Company of Cleveland, writes to Pass & Seymour, Solvay, N. Y., to say that in the last two years he has used 60,000 or 70,000 of that company's No. 1072 electric sign receptacles, and that they have proved satisfactory in every way for exterior sign work. He recommends the receptacles favorably to the trade.

The Richardson Lubricating Company of Quincy, Ill., pioneer in the lubricating business, wishes to announce to the electrical trade that it is prepared to furnish lubricating oils and greases of all kinds adapted to electrical needs, and particularly calls attention to its Noxall dynamo oils, cup grease, crank case oil and curve grease. The company is entirely independent and guarantees the high quality of its products, which are subject to refund of money if not all that is claimed.

The Northern Electrical Manufacturing Company, Madison, Wis., recently received an order for three 150-kilowatt slow-speed generators from the Tennessee Coal, Iron and Railroad Company of Birmingham, Ala. The order was received through J. B. McClary & Co., representing the Northern Electrical Manufacturing Company at Birmingham. The Tennessee Coal, Iron and Railroad Company is the largest of its kind in the South, and the order was secured in competition with first-class manufacturing companies.

Machado & Roller of New York city, selling agents for the Whitney Electrical Instrument Company, are pushing a new bond tester which is light and compact and may be carried for long distances by the observer without fatigue. The tester shows on a scale the resistance of the bond in terms of the number of feet of lengths of uncut rail, the resistance of which equals that of the bond. It furthermore shows instantly whether the bond resistance is above or below a predetermined resistance. A single observer may by its use take accurate and rapid readings. The weight of the outfit is about six pounds and, in spite of the length of the scale, which is nearly 15 inches, it is compact and easily transported from place to place.

W. N. Matthews & Brother of St. Louis, the pioneers in the patented anchor business, report that their sales have steadily increased from the start. They first introduced the Stombaugh guy anchor about five years ago; since that time the demand has so increased that their sales for December, 1904, have been more for the first half month than for any other month since they have been selling the anchor. They recently received a gratifying indorsement of the Stombaugh guy anchor, in the nature of an order for 90 anchors to be used in connection with the installation of the De Forest wireless-telegraph masts at the four United States naval stations, Key West, Fla.; Guantanamo, Cuba; San Juan, Porto Rico, and Colon, Panama, on the Gulf of Mexico.

The new factory building of the Hope Webbing Company at Pawtucket, R. I., presents an interesting application of the fan system of heating and ventilation. In connection with an old building and contemplated additions the total cubic contents amounts to about 875,000 cubic feet. In this installation, made by the B. F. Sturtevant Company of Boston, Mass., the distributing ducts occupy no valuable space, for the heated air is forced through an underground system into vertical flues, which are built into the brick walls. From these flues the air is admitted in the usual manner through openings placed about eight feet above floor level. With this arrangement it is possible to concentrate all of the heating surface in a single fireproof casing in connection with the fan, and to eliminate from the entire building all extended systems of steam piping.

A memorable incident of the morning following the close of the St. Louis Exposition was the formal shutdown and inspection of the 600-horsepower Westinghouse steam-turbine generating unit in the Palace of Machinery, after a continuous run of over 3,062 hours—a performance which, it is said, has had no parallel in steam-turbine history. This machine was started on its long run at 9:20 o'clock

on the morning of Monday, June 20th, shortly after its installation at the Fair, and was stopped at 11:32 o'clock on the morning of Friday, December 2d. Charles F. Foster, chief operating engineer of the Exposition, H. M. Holman, supervising engineer at the government exposition gas-engine tests, formerly president of the St. Louis Board of Public Works, and a number of Westinghouse representatives, including Wallace Franklin of Detroit, C. C. Chappelle of Chicago and W. K. Dunlap, managing director of the Westinghouse exhibits, were present when the engine was stopped. It was found to be in perfect condition, and there were no signs of wear, the bearings still retaining the tool marks as they had come from the shops.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued (United States Patent Office) December 13, 1904.

777,061. Cigar Lighter. James I. Ayer, Cambridge, Mass., assignor to the Simplex Electric Heating Company, Boston, Mass. Application filed June 15, 1903.

An electric cigar lighter comprises a casing having an opening for the insertion of a cigar, means for establisbing an electric arc opposite the opening, and means for automatically screening the arc from the user while lighting tbe cigar.

777,067. Automatic Fire-alarm Transmission. George B. Bowell, West Kensington Park, England, assignor to the Pearson Fire Alarm System, London, England. Application filed July 7, 1902.

In a fire-alarm installation are a transmitter consisting of a code break-wheel, escapement clockwork driving the code wheel, brusbes bearing on the code wheel, a magnet, a magnet-armature that when released locks tbe escapement, and an eccentric on the break wheel.

777,091. System of Electrical Distribution for Electric Railways. Josef H. Hallberg, Cincinnati, Ohio. Application filed March 14, 1904.

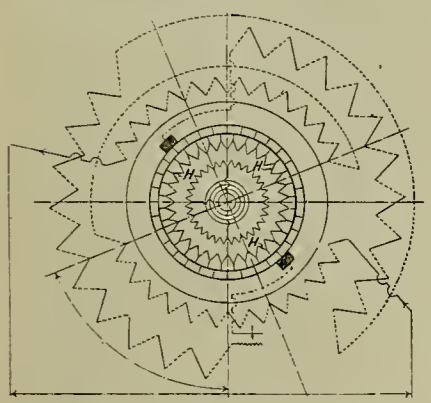
A source of polyphase current is connected with a motor vehicle with means for starting and operating the vehicle by a single pbase of the current transformed into a continuously symmetrical polyphase current when on a portion of the railway and by all of the current pbases when on otber portions of the railway.

777,092. System of Electrical Distribution for Electric Railways. Josef H. Hallberg, Cincinnati, Ohio. Application filed March 26, 1904.

A system of electrical distribution comprises a source of alternating single-phase current, means for modifying the voltage of the current, means for converting the current into polyphase currents of lower voltage and polyphase motors actuated by the polyphase currents.

777,106. Casing for Electric Push Buttons. Henry F. Keil, Bronxville, N. Y. Application filed May 17, 1904.

In a push button are a knob or button, a base having a central recess formed by shoulders and also recessed portions formed beneatb tbe edge or rim of the base, an insulated push-button back piece to rest in tbe central recess, circuit-changing springs to rest on the latter, and a cap or cover baving projections to engage the peripheral recesses and to bold the knob against one of the circuit-changing springs.



NO. 777,198.—ALTERNATING-CURRENT MOTOR.

777,116. Automatic Rheostat. Robert J. Louis, New York, N. Y. Application filed March 4, 1903.

In combination with a rheostat comprising a drum wound spirally with resistance wire are a screw spindle supported longitudinally of the drum, fingers in contact with tbe resistance wire and movable by the screw spindle, means for rotating the drum and screw spindle and means at each end of the drum for reversing the direction of rotation of the drum and screw spindle.

777,118. Emergency Brake. George Macloskie, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed March 21, 1903.

Associated in the controller are a controlling handle, a brake actuated by fluid pressure, a valve for controlling the operation of the brake, means for operating the valve to cause the brake to be applied when the controlling handle is released by the operator, a reversing switch and means operated when the actuating mechanism for the reversing switch is moved into its neutral position to operate the valve to cause the brake to be released.

777,124. Magnet Contact for Propulsion of Cars. James M. Morgan, Toledo, Ohio. Application filed July 28, 1904.

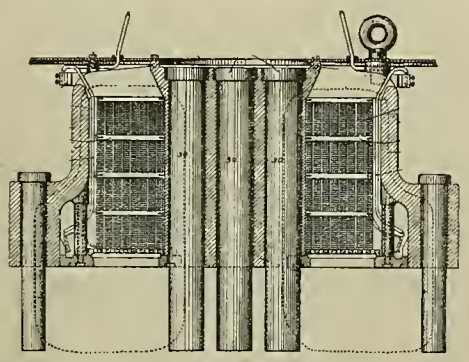
Combined with a sectional conductor rail comprising an oval cap portion having a tapered groove in its under side and a base portion having a longitudinal groove therein are a feed wire associated witb the rail, an armature pivotally mounted in the groove in the base portion and having connection with the feed wire and a portion tapered to seat within the groove in the cap portion, an elemeot movable over the rail and means carried by the element adapted to energize the armatures in the rail as tbey are passed over to have contact with the cap portion of the rail and communicate an electric current thereto.

777,142. Globe. Solon O. Richardson, Jr., Toledo, Ohio. Application filed July 5, 1904.

An inner globe for arc lamps is described.

777,146. Electric Arc Lamp. Lafayette E. Safford, Allegheny, Pa., assignor to the Keystone Electric and Manufacturing Company, Pittsburg, Pa. Application filed August 19, 1903. Renewed May 18, 1904.

In an arc lamp are combined a suitable frame, an electromagnet supported thereby comprising an upper and lower plate, disks of insulating material between the convolutions of the coil, a sleeve of insulating material inclosing tbe coil on the outside, a tube inclosing the coil from end to end and means for retaining the upper and lower plates in position.



NO. 777,221.—LIFTING MAGNET.

777,148. Magnet Coil. Albert Schweitzer, Pittsburg, Pa., assignor to the Keystone Electric and Manufacturing Company, Pittsburg, Pa. Application filed August 9, 1901. Renewed May 18, 1904.

As a new article of manufacture, the electromagnet comprises a spiral coil composed of a strip of insulating material wound to form convolutions and a series of mica disks slit from their edges toward their centers and arranged between the convolutions of the coil with tbeir slits embracing the convolutions.

777,153. Contact Device for Electric Self-playing Musical Instruments. Irving B. Smith, Philadelphia, Pa., assignor to the Stokes & Smith Company, Philadelphia, Pa. Application filed July 14, 1904.

An electrically operated musical instrument having electrical means for controlling the operation of the sound-producing devices, embodies also a contact device comprising in part a series of sets of selectors in circuit with the electrical means, each set of selectors consisting of at least two fingers, one of which is located adjacent to and slightly in advance of the other.

777,164. Electric Make-and-break Mechanism. James C. Waldo, Sharpsburg, Pa., assignor of one-fourth to John J. Forster, Avalon, Pa. Application filed October 19, 1903.

Make-and-break mechanism having in combination two contacts, a part or member movable to engage one of tbe contacts is described. Means are provided for shifting the engaged part and contact, means for retarding such movement, means for separating the part and contact and means for relieving the contact to normal position.

777,172. Telephone Attachment. Herbert G. Addie, Cresco, Iowa. Application filed May 20, 1904.

An attacbment for telephone circuits comprises a condenser, a casing inclosing and conforming to the condenser and having an aperture through its wall, a binding post on the casing and a conductor between the binding post and one side of the condenser. An insulated wire is partly within the casing, being connected with the other side of the condenser and extending through tbe aperture.

777,194. Variable-speed Dynamo. Arthur J. Farnsworth, New York, N. Y., assignor to the Railway Electrical Improvement Company, New York, N. Y. Application filed August 1, 1902.

A variable-speed generating device baving a magnetic field the strength of which is substantially independent of tbe speed variations is associated with a generating circuit relatively movable at a variable speed within the field and means for producing a corrective electromotive force in the circuit comprising a magnetic field, the strength of which varies with the relative movement of the generating circuit at a greater rate at low speeds than at bigh speeds and within which field tbe generating circuit is also relatively movable.

777,198. Alternate-current Motor. Valère A. Fynn, Bradford, England. Application filed September 17, 1903.

In a single or polyphase motor are a stator, a rotor, a commutator and brusbes and a main and an exciting winding on the stator. The exciting winding is displaced with respect to tbe main winding by an angle adapted to give an exciting electromotive force corresponding in phase with the electromotive force produced at any selected points of the rotor commutator in asynchronous running. (See cut.)

777,216. Apparatus for Wireless Telephony. Sigmund Musits, Steinamanger, Austria-Hungary. Application filed November 24, 1902.

Apparatus for wireless telephony embodies a primary circuit comprising a source of electricity and microphones cut into the primary circuit. A secondary circuit is adapted to be influenced by the primary circuit, a telephone is cut into the secondary circuit, a microphone is adapted to be actuated by the telephone and metal cylinders are placed in the secondary circuit, embedded in the ground.

777,217. Telephone Service Meter. Frank R. McBerty, Evanston, Ill., assignor to the Western Electric Company, Chicago, Ill. Application filed April 16, 1900.

In combination with a telephone line and a service meter associated therewith are an actuating circuit for the service meter and means for closing the circuit to operate the meter. A locking circuit for the meter is brought into action in the control of the meter, the locking circuit being controlled by the plug and spring jack of the called line. The locking circuit is rendered inoperative when connection with the called line is broken.

777,221. Lifting Magnet. Stephen Piek, Buffalo, N. Y. Application filed October 9, 1903.

A single magnet coil is arranged with its windings borizontal. A number of pole pieces are placed in the field of the coil and are movable at right angles to the windings of the coil. (See cut.)

777,246. Rheostat. Henry H. Cutler, Milwaukee, Wis. Application filed November 21, 1902.

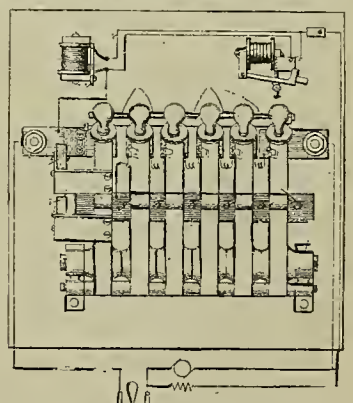
The claims specify a movable element, a retaining magnet for the element, means for returning the latter to its initial position, a thermostat responsive to the heat generated by the rheostat and a switch controlled by tbe thermostat for closing a shunt circuit around the magnet when the heat produced by the rheostatic resistance exceeds a prearranged temperature. (See cut.)

777,250. Submarine Telegraphy. Isidor Kitsee, Philadelphia, Pa. Application filed February 5, 1904.

Telegraphically transmitting messages is accomplished by impressing upon the line successive impulses of opposite polarity, each successive impulse representing a telegraphic symbol or symbol element, one symbol being distinguished from another symbol by a difference in the time unit between two symbol elements.

777,290. Variable Inductive Resistance. Thomas B. Kinraide, Boston, Mass. Application filed May 25, 1904.

Opposite independent coils formed respectively in tbe opposite sides of an alternating-curent circuit co-operate with a magnetic field including opposite cores for the coils and mechanical means for varying the magnetic influence of the field on the current of the coils.



NO. 777,246.—RHEOSTAT.

777,301. Busy Signal for Telephone Exchanges. James L. McQuarrie, Chicago, Ill., assignor to the Western Electric Company, Chicago, Ill. Application filed April 1, 1901.

A local circuit including a resistance is associated with each telephone line having parallel branches one in each plug circuit. Each of the parallel branches is adapted to be closed in registering contacts of its plug and a spring jack of the line. A magnet in each of the parallel branches operates by a source of current in tbe circuit, the source of current and the several magnets being proportioned or adjusted to one another so that each of the magnets is adapted to respond to tbe flow of current in its branch when that branch alone is closed, but not to respond when the circuit of its branch is completed in sbunt of a branch already established at another spring jack of the line.

777,304. Trolley Pole. Andrew L. Prentiss, Buffalo, N. Y. Application filed February 23, 1904.

A trolley pole having an upper section is movable relatively to its lower section. A rotary disk, a spring connected with the disk, a clutch band applied to the disk and having one end connected therewith, a tigbtening lever connected with tbe opposite end of the band and an operating connection between the lever and the upper section of the trolley pole, complete tbe apparatus.

777,310. Telephone Disinfecting Device. William H. Rose, Catonsville, Md. Application filed September 3, 1904.

A vessel containing a disinfecting substance is attacbed to the mouthpiece of the telephone.

777,312. Multiplex Telegraph System. Harry Shoemaker, Philadelphia, Pa., assignor of one-half

to Marie V. Gehring, Philadelphia, Pa. Application filed January 18, 1904.

In a multiplex telegraph system are a master sunflower, a controlled sunflower, means for impressing upon the circuit impulses representing a number of independent messages and means responsive to the impulses for maintaining the controlled sunflower in synchronism with the master sunflower.

777,324. Telephone System. Charles Adams-Randall, Boston, Mass. Application filed December 22, 1903.

A telephone transmitter is arranged in a local circuit at one end of the line; a battery is included in the local circuit, an induction coil has its primary forming a part of the local circuit and the secondary forming a part of the main line. An impedance is arranged in the line circuit, a receiver in the line circuit, and a condenser between the receiver and earth.

777,344. Sash Fastener and Burglar Alarm. Bedford T. Kavanaugh, Chicago, Ill. Application filed February 18, 1904.

Upon the upper part of the window sash is a plate which closes an electric alarm circuit when the window is raised.

777,372. Motor-driven Valve Mechanism. Ernest G. Howard, Springfield, Mass., assignor to the Chapman Valve Manufacturing Company, Springfield, Mass. Original application filed March 31, 1902. Divided and this application filed September 18, 1902.

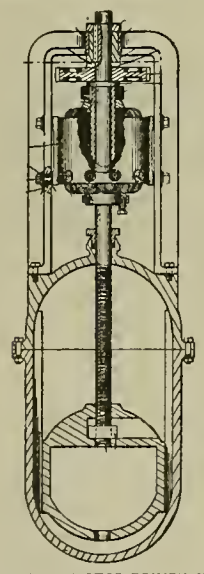
Valve mechanism adapted to be opened and closed independently either by hand or by power comprises a valve, a motor, a gate mounted in the valve body, a rotating non-reciprocating spindle arranged in the valve body to open or close the gate when the spindle is rotated and a train of gears arranged between the motor and the spindle whereby the spindle may be rotated when the motor is operated. A lost-motion device is arranged in the train and normally in position to cause the spindle to rotate when the motor is put in motion. A hand wheel and locking devices whereby the hand wheel and the spindle may be readily put into and thrown out of operative connection with the motor are also provided.

777,373. Motor-driven Valve. Ernest G. Howard, Springfield, Mass., assignor to the Chapman Valve Manufacturing Company, Springfield, Mass. Original application filed May 15, 1902. Divided and this application filed September 18, 1902.

In combination with a valve provided with a rotatable non-reciprocating spindle are a motor having a tubular armature shaft encircling the spindle, intermediate gear connecting the spindle and the tubular shaft and a member for manually rotating the spindle, adapted also to serve as a balance wheel when the spindle is rotated by the motor. (See cut.)

777,374. Motor Disconnecting Mechanism for Valves. Ernest G. Howard, Springfield, Mass., assignor to the Chapman Valve Manufacturing Company, Springfield, Mass. Application filed January 20, 1903.

A valve housing, valve and valve actuating spindle, a motor, connecting mechanism interposed between the motor and the spindle, a clutch introduced into the connecting mechanism to establish and destroy at will the driving connection, a hand wheel frictionally connected with the spindle and means for locking the hand wheel to the spindle are the features of importance.



NO. 877,373.—MOTOR-DRIVEN VALVE.

777,429. Party-line Telephone System. Walter Parker, Leicester, N. Y. Application filed January 13, 1904.

Party-line telephone systems of this class contain a number of movable switch hooks disposed at different stations, lines for connecting one station with another and a commutator at each station, the commutator being provided with separate contacts severally connected with the lines. The commutator is also connected by a ratchet connection with a switch hook and controllable by movements thereof for shifting circuits from one of the lines to another through the agency of the contacts.

777,439. Rheostat. William L. Schmidt, Easton, Pa., assignor of one-half to William S. Brotzman, Easton, Pa. Application filed June 7, 1904.

Oppositely turning winding drums, one of which is made of conducting material while the other is made of non-conducting material and which are provided with one or more conductors wound thereon, are geared together. Suitable cross connections are made by which the conductors are linked together and put in circuit when wound upon the non-conducting drum.

777,468. Holder for Trolley Wires. Frank M. Zimmerman, Aurora, Ill. Application filed September 16, 1904.

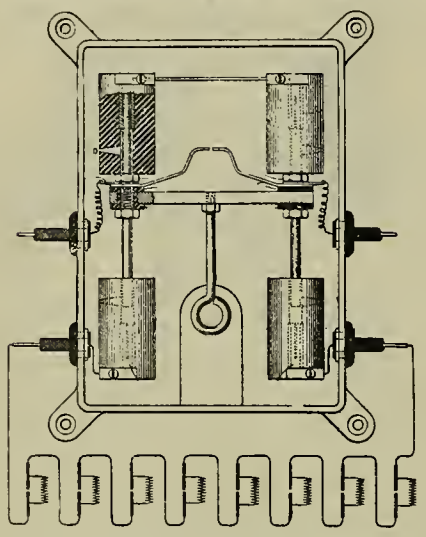
A wire clasp having a stem integral with the clasp and provided with a flange has also an interiorly chambered insulating block and means to insert the stem rotably into the block.

777,489. Speed-governing Apparatus for Electric Motors. Hiram A. Bond, Springfield, Mass. Application filed October 21, 1903.

An electric motor is provided with a controller having a movable controller-governing member. A mechanical governor is connected with and driven by the motor, and has a movable member. A lever engaged by the movable member, a rack bar connected with the lever, a gear wheel with which the rack bar meshes, a second gear wheel rotable in unison with the first gear wheel and a bar having a rack-toothed portion in mesh with the second gear wheel and having a connection with the movable controller governing member are the other parts.

777,490. Electric Arc Lamp. Hugo Bremer, Neheim, Germany, assignor to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Application filed March 26, 1902.

Parallel or converging electrodes with restraining means for holding the electrodes in position, means for releasing the electrodes, an electro-magnetically operated arc-striking and electrode-arresting device and means operated by the forward movement of the arc-striking device for short-circuiting the electromagnet which operates the same are described.



NO. 777,631.—SWITCH FOR ARC LIGHTS.

777,503. X-ray Tube. Robert Friedlander, Chicago, Ill. Application filed September 12, 1904.

A compound terminal is arranged in an X-ray tube comprising a gas-absorbing and a gas-evolving element.

777,506. Thermo-electric Alarm. Anton Haslinger, Allegheny, Pa. Application filed April 30, 1904.

A thermo-electric alarm for use in connection with gas stoves is described.

777,510. Portable Light. Conrad Hubert, New York, N. Y. Application filed July 21, 1904.

A portable electric light comprising a casing and a battery therein contains a body of insulating material and a cover of conductive material. An electric lamp carried by the conductive cover contacts at one terminal with one terminal of the battery, and a resilient circuit closer carried by the conductive cover is arranged to close the circuit by direct contact with the battery.

777,525. Telephone Toll Apparatus. George A. Long, Hartford, Conn., assignor to the Gray Telephone Pay Station Company, Hartford, Conn. Application filed January 5, 1903.

Combined with a channel board having one or more channels adapted to receive a coin and guide it in its passage across the board and signal devices projecting into the channels and adapted to be operated by the coin in its passage is a trap to prevent the retraction of the coin after it has passed beyond the signal devices. The trap comprises an opening through the board in the channel and a guideway from the opening to the edge over which the coin drops from the channel board. The guideway where it leaves the opening is of substantially less width than the opening and flares outwardly toward the edge.

777,535. Burglar Alarm. Joseph W. Pickens and Albert J. Ross, Jonesboro, La. Application filed August 8, 1904.

The circuit of an alarm bell is so connected with a lock that the insertion of a key will close the circuit.

777,536. Electric Controller. Weston A. Price, Cleveland, Ohio, assignor to the Electric and Dental Specialty Company, Cleveland, Ohio. Application filed February 24, 1903.

A conductor formed in convolutions is associated with means for rotating the conductor. A contact member is arranged to contact successive portions of the conductor during the rotation and means are provided upon the exterior of the cover to indicate the rotations of the conductor.

777,544. Telephone System. John G. Roberts, Detroit, Mich., assignor to the Kellogg Switchboard and Supply Company, Chicago, Ill. Original application filed December 15, 1899. Divided and this application filed February 24, 1902.

In the telephone system are combined with a telephone line a source of current and a relay bridged between the two limbs of the talking circuit of the line. A second relay and means for energizing it, a switch at the sub-station, a switch at the central station for controlling the circuit through the relays and a signal controlled by the conjoint action of the relays are the other features of the system.

777,555. Electric Signaling System. Howell W. Souder, Tamaqua, Pa., assignor of one-half to W. D. Zehner, Lansford, Pa. Application filed July 28, 1903.

Several electric lamps are connected in series and a like number of resistances are permanently connected one in shunt about each lamp. Each resistance is of approximately four times the resistance of its companion lamp. A current-supply circuit for the lamps has a potential which exceeds the total voltage of the lamps in series by an amount approximately equal to the voltage of one of the lamps.

777,581. Trolley Pole. John L. Young, Columbus, Ga. Application filed August 26, 1904.

The trolley wheel is mounted on a pole consisting of a lazy-tong construction.

777,583. Sanitary Attachment for Telephone Transmitters. Henry Baethig, Buffalo, N. Y. Application filed April 25, 1903.

An attachment for a telephone transmitter comprises a support or holder for a package of sheets. A suspension arm projects forwardly from the lower portion of the support and a guide rod adapted to pass through the sheets is secured at its inner end to the support and has its outer end detachably connected with the suspension arm.

777,598. Method of Removing Static Electricity from Paper, Yarn, etc. William H. Chapman, Portland, Maine, assignor to the Portland Company, Portland, Maine. Application filed January 25, 1904.

Neutralizing a charge of static electricity in a body is accomplished by passing it through a field of alternating static electricity.

777,599. Apparatus for Removing Static Electricity from Paper, etc. William H. Chapman, Portland, Maine, assignor to the Portland Company, Portland, Maine. Application filed February 8, 1904.

Apparatus for neutralizing charges of static electricity in moving paper or other like substance consists of a conductor stretched adjacent to the surface of the moving substance, a transformer connected with the conductor, a resistance in the primary circuit of the transformer, means for varying the resistance and means for supplying an alternating current.

777,607. Mouthpiece for Telephone Transmitters. Arthur B. Cruickshank, London, England, assignor to himself and Archibald Edward Rykert, Paris, France. Application filed July 27, 1904.

A mouthpiece for telephone transmitters comprises a bell-shaped member, a plate having perforations therein and lying flatwise on the rim of the bell-shaped member, a ring having a circular recess, an absorbent material filling the recess, means for connecting the plate to the rim of the bell-shaped member and means for connecting the ring to the plate.

777,612. Automatic Danger Signal for Elevator Gates. Charles T. Eaton, East Somerville, Mass. Application filed May 18, 1904.

A danger signal for elevators involving an electric circuit and a battery is composed of contact breaker on the elevator car which is connected with an alarm circuit. Circuit changers intermediate the floors are adapted to be actuated by the car contact breaker.

777,616. Electric Trolley. Theophile Euphrat, Norwalk, Conn., assignor of three-fourths to the Hurward Manufacturing Company, and George J. Tischer, New Haven, Conn. Application filed April 13, 1904.

An ice-detaching conducting wheel carried on the pivot of the usual wheel is normally maintained in disconnected relation to the wire. Means are provided for shifting it into connection and maintaining it in substitution for the usual wheel.

777,631. Switch for Arc-lamp Circuits. Robert H. Henderson, Newark, N. J., assignor to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Application filed March 20, 1903.

Combined with a main supply circuit carrying alternating currents are a local consumption circuit and a switch for cutting the local circuit out and in, the terminals of the switch being inclosed in small chambers arranged in pairs. Members of each pair are axially in line with each other and contact pieces are adapted to make contact at opposite ends with the switch terminals. (See cut.)

777,637. Rheostat. Charles H. Keeney and Charles A. Rhine, Milwaukee, Wis. Application filed February 29, 1904.

Magnetic retaining means for a spring-actuated switch member control a switch actuated by the lever. Means are added for deenergizing the magnetic retaining means controlled by the movements of the switch while the lever is retained by the magnetic device.

EXPIRING PATENTS.

Following is a list of electrical patents (issued by the United States Patent Office) that expired on December 20, 1904:

374,959. Dynamo-electric Machine. J. Gray, Medford, Mass.
375,001. Electropneumatic Mechanical Movement. A. Roosevelt, New York, N. Y.
375,007. Galvanic Battery. J. Serson, Boston, Mass.
375,034. Carbon Electrode for Galvanic Batteries. C. H. Wilder, Natick, Mass.
375,118. Electric Gas-lighting Apparatus. C. B. Bosworth, Everette, Mass.
375,238. Electrical Circuit-closer. M. M. Welch, Atlanta, Ga.
375,243. Thermo-electric Generator. E. G. Acheson, Pittsburg, Pa.
375,255. Combined Electric Motor and Fan. H. H. Blades, Detroit, Mich.
375,295. Insulated Electrical Conductor. A. Kissel, Salem, Mass.
375,299. Municipal Telegraph. M. Martin, Malden, Mass.
375,315. Mechanical Telephone. W. H. Eastman and D. J. Adams, Concord, N. H.
375,316. Mechanical Telephone Exchange. W. H. Eastman, Concord, N. H.
375,014. Cut-out for Electrical Distribution Apparatus. M. M. M. Slattery, Woburn, Mass.

WESTERN ELECTRICIAN

EVERY SATURDAY

Vol. XXXV. CHICAGO, DECEMBER 31, 1904 No. 27

LIBRARY OF ELECTRICAL ENG'G

Hydro-electric Plant for Small Industries at Hagnech, Switzerland.

By Franz Koester.

In order to utilize the water of the Aare River a canal was built between the years 1870 and 1880 connecting the river with the Lake of Biel in the western part of Switzerland. This canal is 8.6 kilometers long and was built for the purpose of draining the turf land—"the Great Moor"—and to prevent damage which might arise from sudden high waters.

At the time of building the canal provision was made for the erection of a power plant, but the construction was delayed until a few years ago. The canal for a distance of 3,000 feet from its entrance into the Lake of Biel had to be cut through a hill giving a depth of 111.5 feet and a width at the base of 118 feet. Due to this cut a considerable fall of water was obtained. The head-water canal leading to the power house, as shown in Fig. 2, is 650 feet long and is at an angle of 45 degrees to the main stream. The power house spans this canal and a tail race 1,400 feet long leads from it and empties into the Lake of Biel. For checking the fall of the water from the Aare, this fall being 29.5 feet, a massive dam provided with sluice gates was constructed, the sluices being 100 feet below the supply canal. The law of the state required that the dam be built at least 10 feet above the bed of the canal so as to provide a minimum depth of 10 feet of water. Owing to the nature of the soil through which the canal runs it was found necessary to line the bed and strengthen the sides. The dam is 207.9 feet wide, spanning the entire canal, and is built 466 feet from the entrance of the canal into the Lake of Biel. The dam is divided into three parts and is built with heavy concrete piers which rest on solid foundations.

On the right side of the dam an overflow is provided for allowing the escape of the surplus water and also the floating ice which may collect in the canal. The ice trap may be operated either by an electric motor or by hand. To the left of the overflow are two sluice gates, which are operated by electric motors. These gates are each 32.8 feet wide and are made up of steel plates and stiffened by steel lattice work on the inside. The gates are balanced by counterweights and slide on roller bearings between the piers. The remaining part of the dam, which is 75.4 feet long, is provided with numerous small shutters, which are hinged at the low-water level, the top of the shutters bearing against the bridge which spans that portion of the dam. A traveling crane moves over these shutters, raising or lowering them, in order to regulate the height of the water. At times of very high water these shutters may be lowered so as to rest on the downstream incline of the dam.

The downstream side of the dam is built on a slope of one to 10 in order to prevent the washing away that would occur with a direct fall. At the right side of the dam the canal runs in its natural bed. The supply canal is 88.5 feet wide at the bottom, the sides sloping from the top and being lined with stone. The bottom of this canal is above the level of the bed of the main stream, is lined with stone and slopes toward a trench in the center, so that by opening the sluice gates in the dam the water may be entirely drawn out of the supply canal.

In order to prevent the accumulation of ice in the supply canal iron columns are built in concrete foundations in the canal bed. These columns are, when necessary, equipped with deflectors which prevent the ice from entering the canal. Before entering the turbine chambers the water passes through a rake in the canal, which removes any foreign matter that may have entered.

The power house is built for an ultimate equipment of five turbines, of which four are at present installed. Each turbine furnishes a minimum of 1,300 horsepower and a maximum of 1,500 horsepower. They were built by the firm of Bell & Co. in Kriens.

Each turbine consists of four sets of waterwheels mounted on a vertical shaft, the wheels being of the inside radial-flow type. The turbine is provided with two discharge chambers, arranged one above the other, which join before entering the tail race. The two lower waterwheels take water in at the bottom and discharge at the top, while in the two upper wheels the process is reversed, thus equalizing the strain on the shaft. The vertical shaft revolves on a double-ring bearing at the bottom of the turbine chamber, the bearing being enclosed and surrounded by 25 liters of oil, thus insuring efficient lubrication. The oil is kept cool by means of coils in which water is circulated. The regulation of the turbine may be effected in different ways; the two lower wheels may be regulated by an hydraulic governor, the two upper wheels may be regulated by hand and all four wheels together may be regulated either by hand or by means of the hydraulic governor.

In the summer time, when the flow is great and the head available small, all four wheels are operated; while in the winter time, when the flow is smaller and a large head obtainable, any wheel may be cut out of service as desired. The net fall at times of high water is 18.3 feet, and at ordinary

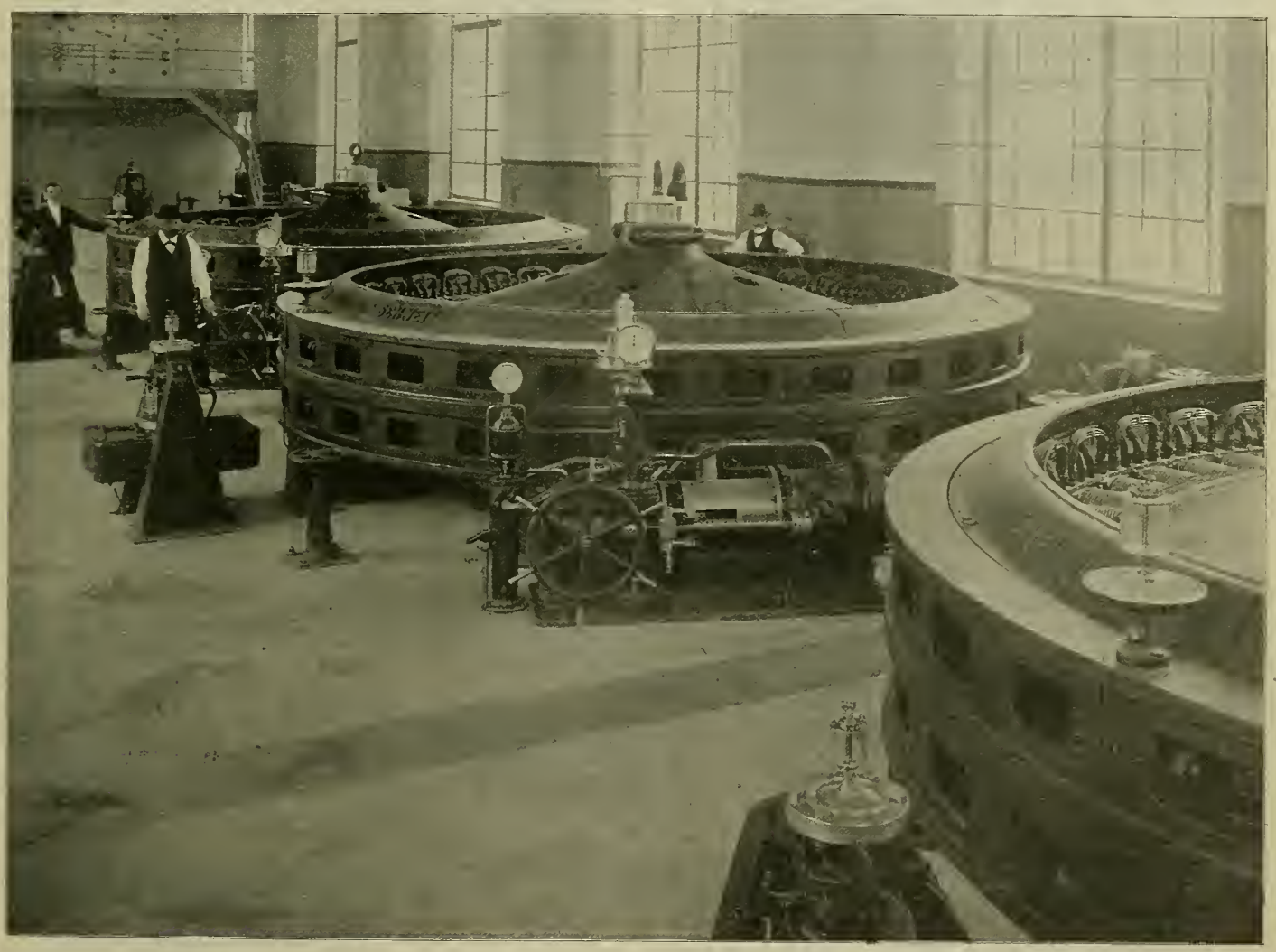


FIG. 1 HYDRO-ELECTRIC PLANT FOR SMALL INDUSTRIES AT HAGNECH, SWITZERLAND.—INTERIOR OF POWER PLANT SHOWING VERTICAL ALTERNATORS.

low water is 23.9 feet, while at times of extremely low water the fall is 29.5 feet. In the latter case the volume of water is 1,918 cubic feet a second, which is sufficient for operating four turbine sets. Each turbine is placed in a separate enclosed chamber from which the water supply may be cut off by means of two gates which move in a vertical plane.

In addition to the large turbines there are three smaller ones which receive their water from a penstock leading from the supply canal. Two of these turbines are of 20 horsepower each and operate the exciters, while the third turbine, which is of 45 horsepower, is used to operate an air compressor by means of which the gates controlling the entrance of the water to the main turbine chambers may be opened or closed. This may be accomplished in 1½ minutes. The last turbine also serves to drive the pumps for the hydraulic governors, each turbine having a separate pump. The turbine chamber may be emptied by means of a centrifugal pump.

The main turbines revolve at a speed of 100 revolutions a minute and are direct connected to the alternators, which are mounted on the same shaft, as shown in Fig. 1. The generators furnish three-phase current at 8,000 volts and 40 cycles per second. The revolving field contains 48 oval poles equipped with rectangular pole shoes at right angles to the poles. The armature is star-connected, the coils being placed in slots in the armature core, the outside diameter being 18.1 feet. The dynamos are so designed that they can develop their full-load output of 1,300 horsepower, giving single-phase current, so that they may at will be connected to the lighting system. The voltage loss in the generators with a non-inductive load is five per cent., and with cos $\Phi = 0.77$ the loss is 15 per cent., showing an efficiency of 94 per cent. and 93 per cent., respectively.

For single-phase operation, with a non-inductive load, the loss in voltage is eight per cent. and the efficiency 93 per cent. Each generator has a separate exciter, which runs at a speed of 550 revolutions a minute and which furnishes 230 amperes at 120 volts.

The exciters are driven by means of cone gearing from a shaft run by the 20-horsepower turbines; they are four-pole machines and separately excited by means of current furnished by small shunt-wound machines which furnish 100 amperes at 120 volts. There are two of these machines, one being held in reserve. The field current to each exciter is separately controlled by means of a rheostat on the switchboard, and the arrangement is such that when a generator is cut out of service a resistance is inserted in the field circuit.

Current from the generators is carried in cables, which are carried on porcelain insulators in roomy ducts to the switchboard, which is in the southern end of the building. The switchboard is arranged with two independent sets of bus bars arranged on the ring system, each set being capable of being broken at four points, so that the plant may be operated as a whole or may be divided into two independent parts—for lighting and for power. The 8,000-volt current is sent directly to the bus bars, the absence of transformers making the arrangement a very simple one.

The generator and distribution switchboards are separated, the latter being located in the rear of the former. The generator switchboard is divided into eight panels, three panels on either end of the board containing the equipment for the generators, which consist of two double-throw switches, an ammeter and voltmeter, a phase lamp and a voltmeter to be used for measuring the voltage in the phases when changing from three-phase to single-phase distribution. Below this equipment is placed the hand wheel of the field rheostat, so arranged that each rheostat may be operated singly, or that they may be coupled and operated in groups. The two center panels are for the bus-bar systems and are each equipped with three ammeters and a voltmeter arranged so as to be capable of measuring the tension at the bus bars of any part of the system to which it is connected. Each panel is also equipped with an ammeter and voltmeter, a rheostat and switch for the exciter-current system.

The distribution switchboard consists of seven panels and contains the switches and measuring instruments for the five high-tension feeder circuits, and in addition a ground detector is provided on the last panel. The bus-bar system is so arranged that any portion may be cut out during operation without causing any trouble or inconvenience. The lines from the distribution switchboard are led to lightning arresters, the arresters being grounded through fuses and water rheostats. The wires are led up the wall in cement ducts and leave the building on heavy glass insulators. A separate small switchboard located near the generator board controls the lighting for the power house and vicinity and also for the town of Hagnech. The current for lighting the power house and vicinity is furnished from a 15-kilowatt single-phase transformer, the distribution being on the three-wire system, with 250 volts between the outside wires. This transformer also furnishes the current for the town lighting. Motors for operating the sluices and gates in the dam are supplied by a 20-kilowatt transformer, which furnishes current in the secondary circuit at 250 volts, and the distribution is controlled from the small switchboard previously mentioned.

The high-tension wires are of copper 6.7 and eight millimeters in diameter. The lines from the building are led to a distributing pole made up of two latticed columns (Fig. 4), and from this point are branched in various directions, and furnish current to numerous industries widely scattered around the Lake of Biel. Near the power plant there is a test line one kilometer long, where aluminum wire is used.

The line to Biel (Fig. 3) consists of 11 wires and is carried on extra heavy double poles, while on the branch lines extra heavy single poles are employed, and at all railroad or water crossings the double-lattice column construction is used. All poles are provided with an iron framework around the top to prevent the high-tension wires from dropping to the ground in cases where an insulator breaks, and at all crossings a system of guard wires is used.

At the entrance to towns the lines are provided with emergency switches operated from the ground and also with lightning arresters, and where the lines run over mountains attaining an elevation of 3,280 feet a lightning arrester is provided on each pole.

The entire lighting system is single-phase, and all the current required is taken from the same phase, and, as the connected motors are all for three-phase current, the regulation of the potential at the power house is easily accomplished on the single phase which is used for lighting. The circuits are branched at the points of application, where are located one, two or three transformers as the demand requires. The transformers are located in small reinforced concrete buildings to each of which is anchored a sheet-steel tower (Fig 5). On the top of this tower are two rings of insulators—one for high-tension and one for the low-tension lines. The lines are led down the interior of the tower and supported by short span wires held in porcelain tubes.

High-tension wires run through three fuses, accessible from the rear of the building, to the transformers. The transformers are oil-insulated, the

Fig. 2. Headwater Canal Leading to Power House.

Fig. 3. Wooden Pole Construction.

HYDRO-ELECTRIC PLANT FOR SMALL INDUSTRIES AT HAGNECH, SWITZERLAND.

FIG. 4. LATTICE-POLE CONSTRUCTION USED IN HAGNECH SYSTEM.

FIG. 5. TRANSFORMER STATION OF HAGNECH SYSTEM.

single-phase type for lighting being from 15 to 30 kilowatts and the three-phase transformers for the motors being from 20 to 40 kilowatts. The transformers are arranged in groups in the station, the lighting transformers all furnishing single-phase current on the three-wire system. All the three-phase transformers for the motors furnish current at 250 volts. The secondary wires pass through fuses accessible from the front of the building and either lead directly to the point of application or to a system of bus bars in the station.

The distribution system serves numerous small towns and also the city of Biel, at which place about 500 kilowatts is used. Here a transformer station reduces the line tension to 2,000 volts and the current is led through underground cables to sub-stations, where it is further reduced to 250 volts for the motors. In addition to this, one phase of the transmission line is connected through a special transformer and furnishes single-phase current at 2,000 volts to a small electric plant at Boezingen. The turbine plant has proved satisfactory in every respect and despite the great number of motors connected to the system there has been no trouble experienced due to flickering of the lights.

In all the numerous points of consumption 1,150 kilowatts is consumed by the motors and 950 kilowatts for lighting purposes. This plant was built for developing the small industries in the city of Biel and towns around the lake and for furnishing power economically at a low cost. In connection with this plant there has been built a calcium-carbide factory at Nidaw, which has five furnaces and uses 2,400 horsepower. This plant is connected with the power house by a three-wire line, the current being furnished through the medium of three single-phase transformers. By building this factory it has been possible to utilize the entire output of the turbine plant, and should the demand for current to supply motors become great enough the supply to the carbide factory can be curtailed. Current for lighting (per lamp per year) and power is furnished at the following prices:

LIGHTING.

Candlepower	10	16	25	32
Over 1,000 hours	$2.70	$4.25	$6.60	$8.40
400 to 1,000 hours	2.10	3.20	5.00	6.40
Under 400 hours	1.40	2.10	3.30	4.20

MOTORS.

Horsepower	1-10	1	10	100
Price per horsepower year	$54.00	$42.00	$37.00	$29.00

From the above it will be seen that with a 100-horsepower motor running 11 hours per day for 300 days the cost of power would be 1.1 cents per kilowatt-hour. A reduction of 30 per cent. from the above price is made for motors using power during periods of no lighting load, and under favorable circumstances a still further reduction is made. The entire electrical equipment was done by Brown, Boveri & Co., of Baden, Switzerland.

Proposed Power Development for Chattanooga.

John Bogart, formerly state engineer of New York, who has been making investigations concerning the proposed development of waterpower on the Tennessee River for the city of Chattanooga, reports that the plan to develop waterpower and render the river navigable is entirely feasible. The city of Chattanooga has authorized the construction of a dam 35 feet high at a point 20 miles below the city. The dam is authorized by an act of Congress and will cost $2,000,000. Although the power plant will be 20 miles down the river, the transmission line for carrying the electrical energy to the city will only be six miles long, across country. It is said that 50 new manufacturing industries have sprung up in Chattanooga within 12 months and all desire to use the proposed electric power.

Electric Power in Railroad Shops at Danville, Ill.

Extensive and modern equipment is a feature of the new shops of the Chicago and Eastern Illinois railroad at Danville, Ill. These shops are located near the center of the system as far as distribution of material is concerned and present many features of interest to the electrical engineer. The grouping of the various shops close to the locomotive roundhouse is the fundamental idea of the whole scheme of construction. Among the things which have been introduced for the comfort of the employes is an efficient heating system known as the Van Auken duplex system of vacuum steam heating.

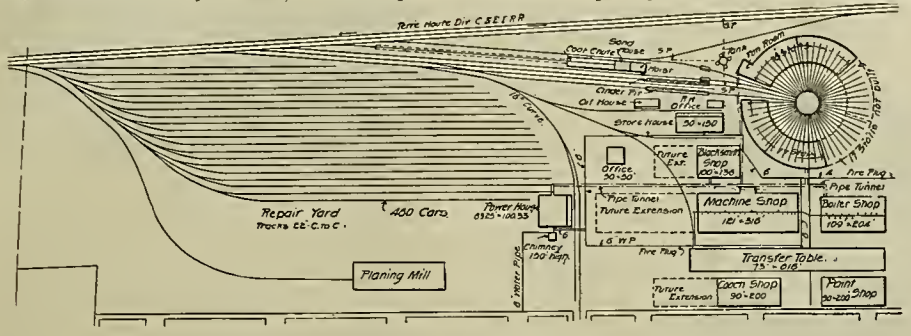


FIG. 1. PLAT OF GROUNDS FOR RAILROAD SHOPS AND YARDS AT DANVILLE.

One of the most important buildings is the machine and erecting shop, shown on the plat of the grounds (Fig. 1). Light for the shop is afforded by an abundance of glazed sash in the side and end walls, and there are skylights in the roofs of both sections. A single saw-tooth skylight over the light machine tools is arranged longitudinally.

The large shop is served by an electric crane having a span of 74 feet 6½ inches and a capacity of 80 tons. The crane has seven motors. Each trolley has an auxiliary hoist of 10 tons. Thirty-three per cent. of the floor space of the shop is served by the traveling cranes. Besides the main erecting shop other important buildings are the blacksmith shop, boiler shop, roundhouse and the power house.

The blacksmith shop is 100 by 136 feet, with walls 24 feet high, and lighted by the usual glazed windows. Specially hooded down-draft forges have been installed. A heating furnace for general purposes is located within the crane circle and in reach of one hammer. The boiler shop is a building 209 feet long and 109 feet wide. The crane in the middle section has a span of 55 feet and a capacity of 20 tons.

Ultimately the roundhouse is intended for 56 stalls, but 17 stalls opposite the entrance will not be built at present. The inside diameter is 124.8 feet and the extreme width of the house is 85.3 feet. A flat wooden roof is divided transversely into three sections, which are supported by circular cast-iron columns seven inches in diameter, three-quarters inch thick and about 20 feet long.

As in all of the latest types of railroad shops, electricity plays an important part principally in machine-tool drive and in lighting. The power house is a substantial structure, about 90 feet by 100 feet, outside dimensions, with coal bunkers 12 feet wide, running outside along the whole length. The building is fireproof throughout, with brick walls, tile roof on steel-roof trusses and cement floors laid on brick arches supported by steel I-beams. A 15-inch brick wall divides the building into two rooms, an engine room about 44 by 97 feet inside and a boiler room 41 by 97 feet, with a clear height of about 30 feet to the roof trusses.

Fig. 2 is a plan of the power house, showing the location of the apparatus, and Fig. 3 is an interior view showing the generating units. Fig. 4 is a cross-sectional view.

The engine-room floor is four feet six inches above that of the boiler-room floor, leaving a height of 25 feet in the engine room. Underneath is a basement eight feet 10 inches high. This arrangement of the power house with the three floor levels has been found very advantageous in the location of the various parts of the plant.

Particular attention has been given to the finish of the engine room. The walls are plastered and a wainscoting of white enamel brick seven feet high extends entirely around the room. The finish of all switchboard and gauge board instruments and of the lighting fixtures is uniform, a "marine" or black-copper finish.

In this room are installed the two generating sets, the compensator set, the two air compressors and the switchboard for the automatic-telephone system connecting the various shops. In the basement pit in plain view from the engine-room floor are the pumps and heater. All of this apparatus can be reached by the 12-ton traveling hand crane installed in the power house. The opening in the engine-room floor directly over the auxiliaries brings them at all times under the eye of the engineer and

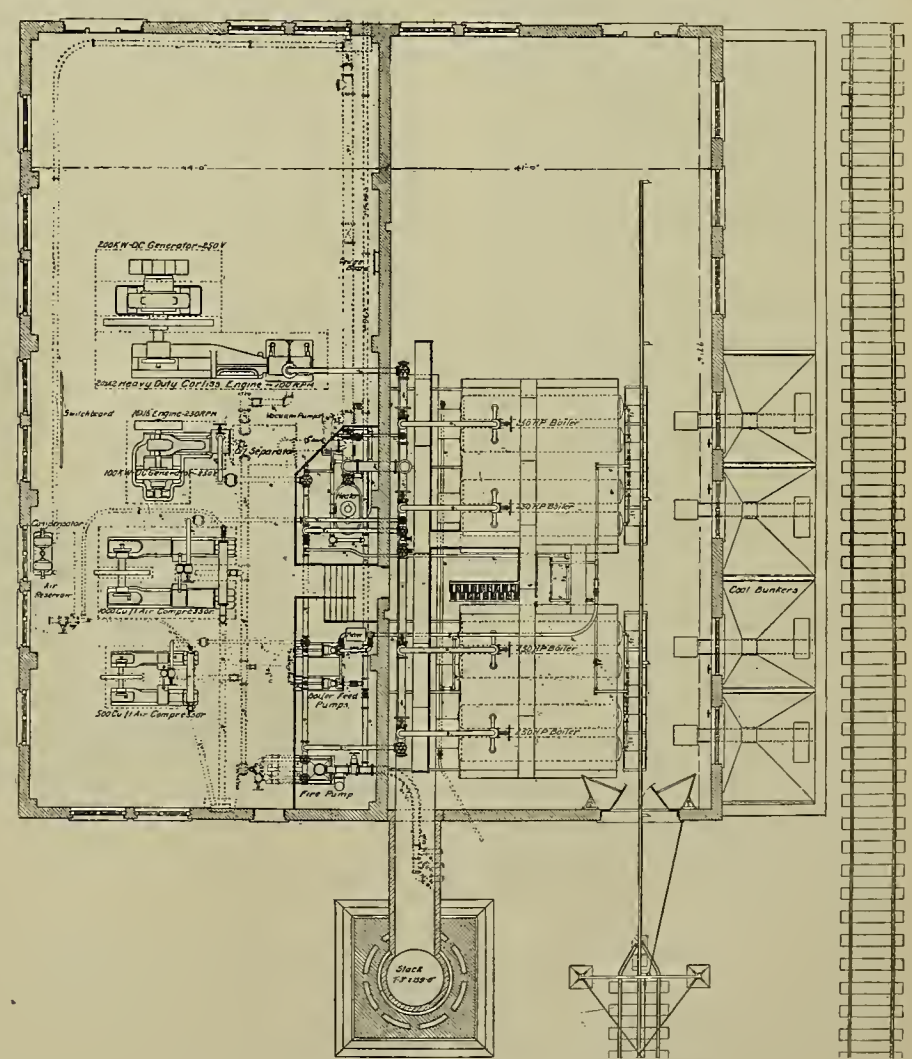


FIG. 2. PLAN OF POWER HOUSE FOR DANVILLE RAILROAD SHOPS.

provides a flood of light in the basement, this being most desirable for the inspection and repairing of piping and machinery.

The electrical system for power distribution is by direct current at 250 volts, the two-wire system being used for motor and power circuits and the three-wire system for lights, a compensator being used at the power station to take care of the unbalance in the lighting load. No reserve generating units have been provided, but every precaution has been taken to make the installation most certain in its operation. All generators, engines and compensators have an overload capacity of 50 per cent. for continuous operation and of 100 per cent. for short intervals.

Coal is delivered on the cars, which are run in on the track alongside the bunkers. From the cars it is shoveled into the bunkers by hand. The bunkers

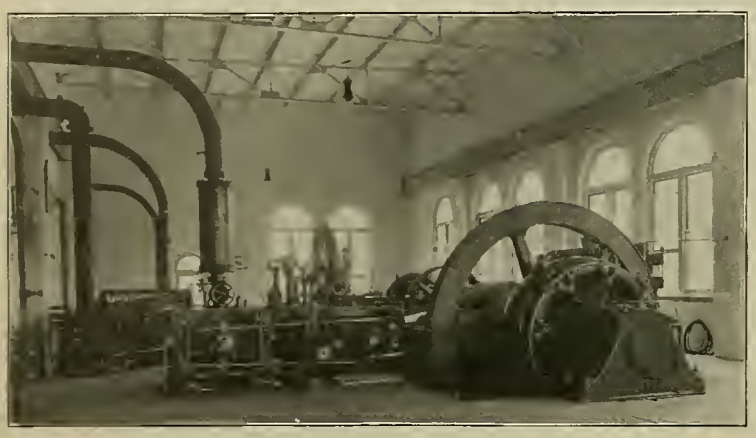


FIG. 3. INTERIOR OF POWER HOUSE AT DANVILLE RAILROAD SHOPS.

are hopper-shaped and at the bottom are provided with a trap door, through which the coal runs by gravity into the firing cars. These cars are drawn in through small doors in the boiler-room wall to the point directly in front of the boilers, from which the grates are fed by hand. Provision has been made in the construction of the bunkers so that the railroad tracks may be elevated, and when coal can be delivered in hopper cars these cars will be run over the bunkers and the coal dumped directly into them.

In the boiler room are installed at present four 264-horsepower Cahall horizontal sectional water-tube boilers, furnished by the Aultman & Taylor Machinery Company of Mansfield, Ohio. The boilers are set in two batteries of two boilers each. They are provided with all possible safety devices and are installed after the most modern practice. Each boiler is provided with two four-inch safety valves, ordinarily set for 100 pounds steam pressure, water columns, three trycocks, two Homestead blow-off valves and a Kirchner high and low-water alarm.

The total capacity of the boiler plant is about 1,000 horsepower. Space is left in the boiler room for the installation of another 500-horsepower battery, as the demand for more power may arise.

The grates have an area of about 55¼ square feet per boiler and are designed normally to burn about 22 pounds of coal per square foot per hour, this being a fair rate of combustion for the kind of coal used. However, the rate of combustion can be pushed much higher, as sufficient draft is provided by a chimney about 140 feet in height, it thus being able easily to take care of overloads that may occur in the operation of the plant.

The gases pass from the furnaces to a breeching made of 3-16-inch steel. The breeching is five feet wide by seven feet high at the smaller end, and 10 feet high at the larger end, the cross-section being rectangular with an arching top. This breeching will be extended the whole length of the boiler room when the future boilers are added to the plant.

The stack is of brick, 140 feet high by seven feet three inches internal diameter, and was furnished by the Alphonse Custodis Chimney Construction Company. The foundation is of concrete, the footing being 20 feet square and 10 feet below grade level. At the top of the foundation is laid a 12-inch course of Indiana limestone. The foundation footing is 10 feet from the outside of the power-house wall, and connection between the steel breeching in the power house and the stack is made by a smoke flue of brick five feet wide by 10 feet high, with arched top.

The engine room, shown in Fig. 3, is of ample size to accommodate all machinery now installed together with future extensions, allowing necessary space for repairs on machinery, yet without waste room. The large engine now installed is a 300-horsepower heavy-duty type horizontal simple Corliss engine, with shafting extended for mounting the 200-kilowatt direct-current generator. This engine is designed to develop 300 horsepower when running at 100 revolutions per minute, taking steam at 100 pounds pressure and one-quarter cut-off. It will carry continuously an overload of 50 per cent. without undue heating or wearing of the operating parts and will regulate within two per cent. each way from its normal speed under variations from no load to full load. This engine was furnished by the Filer & Stowell Company of Milwaukee, Wis.

The smaller engine is a 150-horsepower Ideal high-speed engine, furnished by A. L. Ide & Sons of Springfield, Ill. This also is a single-cylinder engine, arranged to be direct connected to a 100-kilowatt generator. The shaft for the generator armature is flange-coupled to the engine shaft instead of being built in one solid piece. This engine will develop 150 horsepower when running at 230 revolutions per minute, taking steam at 100 pounds pressure and one-quarter cut-off.

The generators were both furnished by the Western Electric Company of Chicago and are compound-wound multipolar 250-volt direct-current machines. The 200-kilowatt generator is designed to run at 100 revolutions per minute, while the smaller machine runs at 230 revolutions per minute. Both of these machines are designed to furnish 250 volts at full load and 245 volts at no load. They are each capable of operating continuously, delivering their full rated output at 250 volts without an excessive increase of temperature in the field coils or armature, and they will, moreover, carry a 50 per cent. overload for a period of two hours without excessive heating. Momentary overloads of 100 per cent. will be safely carried by either. The efficiency at full load is 92½ per cent. for the 200-kilowatt and 91 per cent. for the 100-kilowatt, while efficiencies for less than full loads, of course, are slightly below these figures.

The large generator is designed to carry the normal load of the entire plant during the daytime. On winter afternoons when the lighting load is thrown on in conjunction with the motor load it may be necessary to use the smaller unit in connection with the larger one. In case of injury to the large unit the smaller unit will be able to operate the entire plant for a limited time with possibly a decreased output. The night load will ordinarily be carried by the smaller unit.

The tunnel, about 1,200 feet total length, in which are laid the main piping lines, connects the power house with the various shops. The tunnel is rectangular in section, about six feet high by four feet six inches wide.

Forty-one motors are used throughout the shops for driving the various tools. Of these 11, ranging in size from five to 20 horsepower, used for the group drives, are belted to line shafts. Examples of these installations may be seen in Fig. 5. These motors are installed on brackets supported by building columns or attached to the wall. The starting boxes are mounted on the wall or on iron columns as may be convenient. These are all provided with

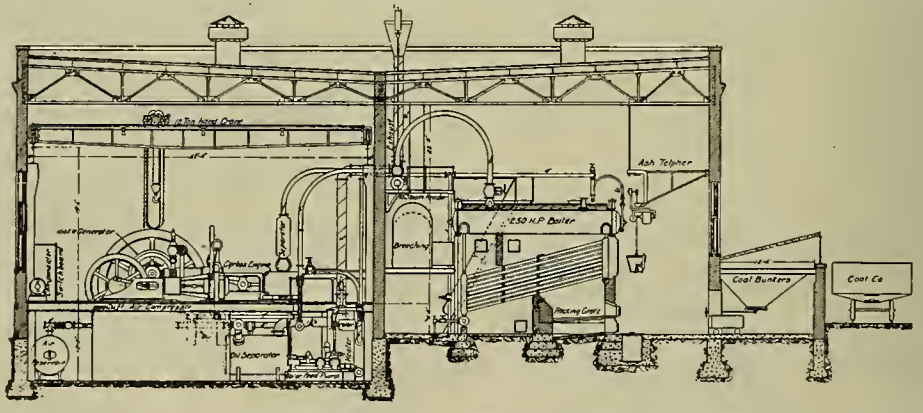


FIG. 4. CROSS-SECTION OF POWER HOUSE FOR DANVILLE RAILROAD SHOPS.

double-pole circuit-breakers which take the place of main switches.

Thirty motors ranging from 1½ to 25 horsepower are used for individual drives and are mounted on the machines they operate. The controllers are mounted on pedestals of special design which provide space in the base for necessary resistance. On the back of the controller is mounted the circuit-breaker, thus bringing all the operating mechanism within easy reach of the operator.

The variable-speed motors used for tools having a speed variation of four to one are of the double-commutation variety and operate on the 250-volt circuit. Three speeds are secured by combinations of commutators which about equally divide the total range and intermediate steps are obtained by a small amount of field weakening. No armature resistance is used to obtain a speed variation.

The controller for operating these motors is of unique and compact design. The controller proper is mounted upon a stand in convenient reach of the operator. Immediately below the controllers and forming one side is a slate slab, upon which is mounted a double-pole circuit-breaker, back of which is a small resistance bank. The three remaining sides of the stand are covered in with perforated iron. The controller of the largest motor, one of 20 horsepower on the 90-inch wheel lathe, only occupies a space of 14 by 20 inches by three feet six inches high. The controller is entirely self-contained, including resistance and protecting devices.

The 90-inch wheel lathe just mentioned, the largest tool in the shop, is deserving of particular attention. Its motor has a speed range of from 250 to 1,000. The controller is in easy reach of the operator, who can increase, decrease, stop or reverse the motor at will. There are no belts used on the tool, the feed being operated by a shaft and bell-crank attachment below the floor. The quartering attachments are operated by two individual three-horsepower motors and are controlled by separate controllers.

The transmission lines from the power house consist of three pairs of 700,000-circular-mil feeders for power circuits and two pairs of lighting feeders, one of 500,000 circular mils and the other of 400,000 circular mils. A pair of No. 2 wires are used for the outside arc lamps, which are on a separate circuit. A No. 0000 neutral wire is carried from the power house, with branches running to all lighting cabinets.

These feeders are of rubber-covered lead-encased cable from the switchboard to a point two feet outside the power-house wall, where they are connected to the triple-braided weatherproof insulated wire used on the pole line. The poles are of wrought iron, 25 feet in height, with malleable-iron cross-arms and iron pins. They are set in concrete blocks five feet six inches in depth and about three feet square.

For the power-distribution service leads are carried from the feeder line to a distributing panel provided with fused main switch and fused branches. The motor leads are tapped from the branch mains and are protected by service boxes which serve the purpose of both fuse and switch. The motors are further protected by circuit-breakers mounted on the starting boxes.

The service wires for the lighting circuits lead to panel boards installed in wooden cabinets. These panels are arranged for the three-to-two-wire system of distribution and are provided with a main fused three-pole switch and the requisite number of fused two-pole switches. For mechanical reasons, nothing smaller than 35-ampere switches are used on these panels.

There are 12 distributing panels for lighting circuits and two for power circuits located in convenient centers of distribution in the various shops. The wiring from the cabinets to lamps is openwork where possible, and in conduit where lines run under floor or on iron columns and along walls from the floor to a point seven feet above floor level.

In lighting the shops arc lamps have been used for general illumination and incandescent lamps have been located over the various machines and benches. In many places, as along walls in machine shop, over the benches, between the engine pits and in the tool room adjustable fixtures have been installed which will support the lamp in any position desired directly over the work. Otherwise the incandescent lamps are pendant over machines or mounted on side walls. The arc lamps are suspended from the roof or between columns at a height of not less than 16 feet from the floor level. Adams-Bagnall 110-volt direct-current enclosed-arc lamps have been installed both for inside and outside lighting. In the office building and storehouse incandescent lamps have been used exclusively as well as in the oil house, where they are installed in vapor-proof globes.

The wiring of the roundhouse is entirely different from that in the other buildings. Fig. 6 is a diagram showing the principles upon which the system is based. On account of the gases, it was desirable to have no exposed wiring, and conduits have been found to rust in a short time. The panel boards used in other buildings were dispensed with and instead the mains carried on the roof on cross-arms, supported on hollow wood masts, which extend through the roof and rest on the top of the seven-inch iron columns supporting the roof trusses. The branch circuits on leaving the mains pass directly to a service box installed on the mast. From the service box, twin wire, lead-incased, passes into the wood mast and continues down through the inside of the iron column to a point about six feet

FIG. 5. EXAMPLES OF MOTOR DRIVE IN DANVILLE RAILROAD SHOPS.

above the level of the floor. At this point a wooden box containing fuse blocks and switch is bolted to the side of the column. The twin cable passes through a hole drilled in the column into a box and to a fuse. From the fuse it passes through a switch, then back into the column and out at the top, whence it is laid along roof supports and down a one-inch iron pipe to the arc lamp. The lamp is provided with a special top, allowing the wires to pass directly to the terminals inside the lamp case. All of the wiring is thus entirely protected from the gases. In the side of the box containing the fuse block is mounted the flush switch controlling the lamp in that section of the roundhouse and two plug receptacles for lamp extension. The receptacles and plugs used in the roundhouse are of special design, so constructed as to pull out from any direction before a strain sufficient to break the extension wire can be brought to bear. This feature is particularly valuable in the roundhouse, where it often happens that the extension lamp is left in an engine through carelessness after use, and when the latter is run out of the stall either the extension cord is broken or the wiring torn out.

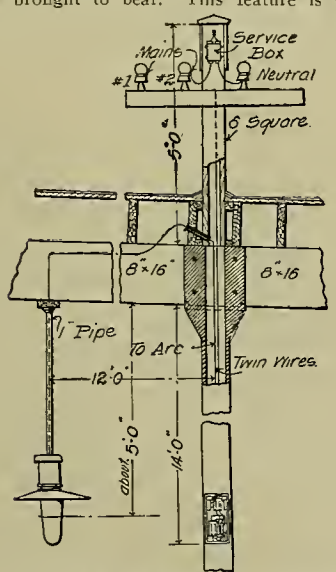


FIG. 6. ARC-LIGHTING SCHEME FOR ROUNDHOUSE AT DANVILLE SHOPS.

A complete telephone system is installed connecting all shops in the plant. The Automatic Electric Company of Chicago furnished this equipment. The automatic exchange is located in the power house, where it is under the eye of the engineer, who will be notified by suitable signal lamp of any failure in the operation of the system and who can at once rectify the difficulty. Additional telephones are added to the system by simply connecting the two wires leading from them to the exchange, as the banks in the exchange come wired to be used in sets of 100.

The Arnold Electric Power Station Company of Chicago did the engineering work for the plant.

Barclay's Printing Telegraph System.

Many will remember, no doubt, the paper read by Mr. J. C. Barclay, the assistant general manager of the Western Union Telegraph Company, on "Modern High-speed Printing Telegraph Systems," at the International Electrical Congress in St. Louis [Western Electrician, October 1, 1904]. In the paper the author mentioned the fact that he had then nearly finished certain improvements to the well-known Buckingham system, which would make it a practical commercial apparatus. It is, therefore, of interest to hear that a system of Mr. Barclay's has recently been tried and has operated with apparent success. The messages are sent by means of ordinary typewriter keys and are printed out at the receiving end in the form of letters. All that the sender needs to understand is the operation of a typewriter. It is said that the mechanism is simple and inexpensive and that the most expert typewriter cannot operate the keys fast enough to disconcert the telegraphing.

Electric Resistance Furnace for Laboratory and Dental Purposes.

Illustrated herewith is a simple, cheap and efficient electric resistance furnace, adapted for laboratory, dental and other uses, such as determining melting points of metals, calibrating thermo-electric couples by means of the melting point of copper, determining the cooling curves of steel, or for use for any chemical or physical operation when it is desired to reach quickly and accurately a desired temperature or to hold an object for a long time at a given temperature, and especially when it is desirable to do so in an atmosphere free from the products of combustion of any fuel or in any special atmosphere.

The furnace itself, as described in a patent recently issued to Mr. Henry M. Howe of New York, consists of two semi-cylinders of magnesia (A) (A'), hollowed to form the heating chamber and provided with a cover of magnesia (B) (B') and a stopper (C), also of magnesia, which is perforated to admit the leads (x) (y) of a thermo-electric couple. The furnace is heated by the spiral of platinum or other suitable wire (D) (D), entering and departing by the openings (I) and (K), through which a current of any desired strength is passed, bringing it to incandescence and to any desired temperature not above the melting point of the heating wire. The crucible (E), which is surrounded by the heating coil, is also preferably of magnesia.

It is not necessary that the magnesia of which the furnace is made should be absolutely pure. That used has the following composition: Silica, two per cent (determined accurately); ferric oxide and alumina, one per cent. (determined approximately); lime, two per cent. (determined approximately); magnesia, 95 per cent. (by difference).

Magnesia may be diluted with a certain amount of lime; but the amount should not be very great, because of the tendency of the lime to slake, and the less lime the better. The presence of any large amount of silica is objectionable.

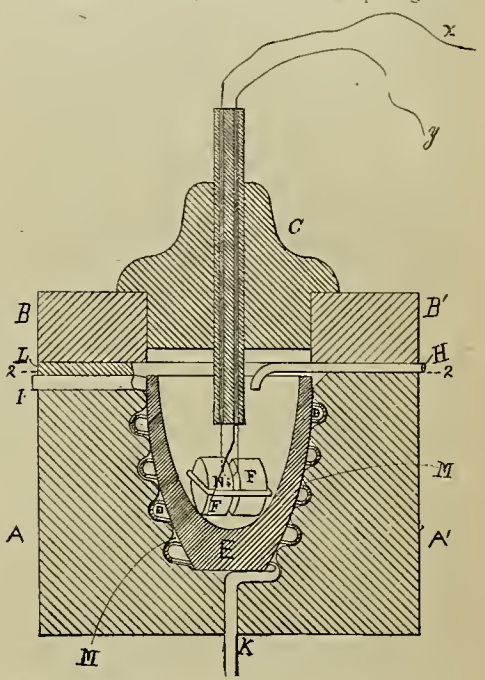
Unsuccessful attempts with furnaces of this general class have been made and the failures are attributed to the use of sileceous materials for the furnace walls. Of course, such a result might be expected, since the silica would readily be electrolyzed by the current and the resultant silicon would alloy with platinum and destroy it. But the magnesia furnace here described is said to be free from this objection. It has been used successfully in laboratory work, and temperatures up to 1,100° C. have been developed in it over considerable periods of time. Indeed, it has been held near 1,400° C. for about two hours without indication of any deterioration of the platinum.

Great care should be taken not to turn on an excessive amount of current, because this is liable to melt the platinum. The current should be controlled carefully with an ammeter and a differential rheostat. When beginning to use the furnace, the operator should first turn on the current slowly till the wire begins to glow. Then setting the thermoelectric junction of the pyrometer in place and closing the furnace, he should increase the current very slowly and cautiously, so as to learn just what current is required to produce within the furnace the temperature which he needs.

In the illustration (F) (F) are a pair of steel disks bound together, but separated by the inverted thermo-junction (N) of the thermo-electric pyrometer. This arrangement permits the observation and record of retardations in the heating and cooling of (F) (F)—in other words, the determinations of the cooling curves of steel—a purpose for which the furnace is well adapted, as well as for the determination of melting points. In calibrating thermo-electric couples by means of the melting point of copper, this apparatus permits the crucible to be filled with an atmosphere composed of equal volumes of carbonic acid and carbonic oxide, a gaseous mixture which does not oxidize copper and at the same time is unlikely to cause deposition of carbon. In such an operation the mixture of carbonic acid and oxide, or any other desired atmosphere, is introduced through a pipe (H), which, as well as the openings (I) and (K), may be tightly packed, while the cover (C) is luted on. Absolutely air-tight closure, however, is not required, since the gas pressure through (H) sufficient to maintain a plenum in the crucible and to offset small leakages will be a sufficient prevention of change of the interior atmosphere.

In order to increase its radiating surface, the spiral (D) may be made of flattened wire, and preferably of the special U-shaped section shown, so that it may be the better adapted to the groove, while giving a large heating surface.

To facilitate placing the spiral (D) in its groove molded within the furnace walls, a mandrel has been devised. The mandrel, with the wire wound upon it, is set approximately in place in the furnace. The mandrel is then withdrawn by screwing it to the left. The two halves of the furnace are at the same time pushed together, and the wire is thus fitted into the spiral groove made for that purpose in the inner faces of the furnace walls. The metallic conductor thus laid in the spiral groove in the chamber constitutes a large part of the interior wall of the heating chamber instead of being on the outside of the wall, as is common, so that the heat generated by the passage of an electric current through the wire is transmitted directly into the heating chamber by radiation instead of by conduction through the walls of the chamber.



ELECTRIC RESISTANCE FURNACE FOR LABORATORY AND DENTAL PURPOSES.

Chicago Street-railway Situation.

Judge Grosscup last week refused the application of the Chicago Union Traction Company to issue receiver certificates with which to meet various obligations. The court said: "What I shall do now is, to continue this hearing until December 31st. If at that time the Union Traction Company shall not have put into the hands of the receivers the sum needed January 1st, for interest and rentals; and by January 18th the sum needed for rentals January 20th; and by February 1st, the remainder of the sums immediately needed for the purposes named, and for adjusting the accounts between the underlying companies and the Union Traction Company—taking therefor the interest-bearing obligation of the receivers, resting on the property, but not cutting under the mortgages—the court will consider that the Union Traction Company's obligation, in that respect, has been defaulted, and steps accordingly will be taken."

Just how much money the eastern interests must raise to fulfill the terms of this order is a question. Unquestionably they will have to bring forth for interest payments about $180,000 by December 31st, $130,000 more by January 20th, and an additional $45,000 by February 1st—a total of something more than $350,000. But how much money is meant by the words "remainder of the sums immediately needed for the purposes named" will have to be determined at later hearings.

The financiers interested in the proposition to merge the Chicago City railway with the North and West Side companies agree that the decision has cleared the atmosphere considerably and put the traction problem in a way to be settled soon. The points gained by the underlying interests will, it is declared, give them more patience to await the outcome of the efforts of Marshall Field, John J. Mitchell and others to buy the South Side system. Then they will be able to treat with the capitalist for fair and square terms of effecting the merger.

WESTERN ELECTRICIAN

EVERY SATURDAY.

PUBLICATION OFFICES:
510 Marquette Building, - CHICAGO.
TELEPHONE, MAIN 1746.

Eastern Office, 193 Times Building, New York.
Telephone, 3806J Cortlandt.

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted. This paper is entered at the Chicago postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the old address as well as the new should be given.

CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—the only general electrical paper published in the West—thoroughly covers a territory *exclusively its own.* THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be furnished on application.

REMITTANCES.—All checks, drafts and other remittances should be made payable to the order of the publishers, the Electrician Publishing Company, and addressed to the offices of publication, Suite 510, Marquette Building (204 Dearborn Street), Chicago, Illinois, U. S. A.

CONTENTS OF THIS NUMBER.

Hydro-electric Plant for Small Industries at Hagneck, Switzerland. By Franz Koester. Illustrated. 517, 518, 519
Proposed Power Development for Chattanooga. 519
Electric Power in Railroad Shops at Danville, Ill. Illustrated 519, 520, 521
Barclay's Printing Telegraph System. 521
Electric Resistance Furnace for Laboratory and Dental Purposes. Illustrated 521
Chicago Street-railway Situation. 521
Editorial 522
Extensive Traction Project in Ohio. 523
More Long-distance Wireless. 523
Electrical Industry in Chemnitz. 523
W. Forman Collins. Portrait. 523
Electric Fans to Increase Efficiency of Radiators and Registers 523
Directors for Chicago Freight-tunnel System. 523
The Maximum Distance to Which Power Can be Economically Transmitted. By Ralph D. Mershon. Illustrated. With discussion. (American Institute of Electrical Engineers.) 524, 525, 526
Novelties in Special Decorative Incandescent Lamps. Illustrated 526, 527
Transformer for Thawing Ice in Water Pipes. Illustrated 527
Motors for Cranes and Hoists. Illustrated. 527
American Association in Session. 527
Ohio Telephone Notes. 528
Telephone News from the Northwest. 528
Southeastern Telephone Developments. 528
Indiana Telephone Items. 528
Michigan Telephone Matters. 528
Northwestern Cedarmen's Association. 528
New Companies. 528
Hygienic Resonator for Telephones. 528
General Telephone News. 528

DEPARTMENTS.

Correspondence 529, 530, 531
Great Britain 529
New York 529
Dominion of Canada. 529
New England 529
Southeastern States 529, 530
Texas 530
Mexico 530
Ohio 530
Indiana 530
Michigan 530, 531
Northwestern States 531
Pacific Slope 531
Personal 531, 532
Electric Lighting 532
Electric Railways 532
Automobiles 532
Societies and Schools 532
Power Transmission 532
Publications 532
Telegraph 532
Space Telegraphy 532, 533
Miscellaneous 533
Trade News 533
Business 533
Illustrated Electrical Patent Record. 533, 534

DATES AHEAD.

Northwestern Cedarmen's Association (annual meeting), Hotel Pfister, Milwaukee, Wis., January 18th and 19th.

Northwestern Electrical Association (annual convention), Hotel Pfister, Milwaukee, Wis., January 18th and 19th.

Independent Telephone Association of Wisconsin (annual convention), Hotel Pfister, Milwaukee, January 25th and 26th.

Ohio Independent Telephone Association, Columbus, Ohio, March, 1905.

National Electric Light Association (annual convention), Denver, June 6th, 7th and 8th, and Colorado Springs, June 9th, 10th and 11th.

MR. W. FORMAN COLLINS, vice-president of the Western Electrician, was a man of high character, benevolent disposition and untarnished integrity. While his health had not been satisfactory for many years, his sudden death was nevertheless absolutely unexpected and very shocking. Mr. Collins was kind and considerate to his associates, very charitable to those less well provided with this world's goods than himself and thoroughly upright in his dealings with all men. He had a wide and comprehensive grasp of business affairs, and although of late years he had paid less attention to the routine of office affairs, by his physician's advice, yet his counsel and his active supervision of business matters, so far as he was able to give the latter, were highly prized. Mr. Collins' domestic life, too, was a notably beautiful one; he was ideally united to a wife who was his almost constant companion and closest friend—the confidant and trusted counselor of a high-spirited, retiring man who had few intimates. To the widow who is entering the New Year in the shadow of a great bereavement the Western Electrician offers its earnest sympathy.

ONE of the possible electrical benefits of the building of the Panama Canal by the United States is the laying of a submarine cable from Florida to the Isthmus of Panama, perhaps from Tampa to Colon. Such a cable would be of much usefulness, and is likely to be installed at some future date—just how soon no one can tell. The government of the United States has laid more cable within the last few years than most people are aware of. Already there is 2,000 miles of cable in the Philippines, laid by the Signal Service; and from 1,500 to 1,700 miles more connect the land-telegraph system of this country with that of Alaska. In fact, though several European powers anticipated the United States in the adoption of the policy, only one of them has a greater aggregate of cable under the control of the national authorities. France is credited with more than 5,000 miles, Germany with 2,600, and Great Britain and Japan with something like 2,000 miles each. Of course, the Panama cable may be laid and owned by a private company, as in the case of the American Pacific cable, but it will need government sanction and encouragement, and these should not be lacking.

COAL STORAGE on a considerable scale is now a feature of nearly all large central-station plants, and it is therefore of some importance to consider the possibility of spontaneous ignition. Such ignition is stated by a recent writer to be due to slow oxidation of the fuel, and the fact that the heat produced by this oxidation cannot escape, but seems to raise the temperature of the mass of fuel, only accelerates the rate of oxidation and increases the danger of spontaneous ignition. Anthracite coal does not heat in this way, but semi-bituminous and bituminous fuels are both liable to do so, and as a rule the danger increases with the increase in the percentage of moisture, volatile matter and sulphur. The customary method of minimizing the risk by placing air tubes or passages in the mass of fuel intensifies the danger, since it insures a supply of oxygen to continue the oxidation, but does not produce a sufficient current of air to carry off the heat generated, which therefore gradually rises. The amount of moisture present in a bituminous fuel after air-drying is stated to be a measure of the risk of spontaneous ignition when stored. Coals of this character containing above 4.75 per cent. of water are dangerous. Coal bins should be constructed of iron or steel protected by concrete, and should be roofed over; the depth of coal stored in them should never exceed 12 feet. No steam pipe or smoke flue should pass near the bin, and every effort should be made, by free air passages around its walls and below it, to keep it cool. Bins above boilers are dangerous as store places for coals liable to heat. For testing the temperature of a heap of fuel five-eighths-inch iron rods, made in sections which screw together, are very useful. These are simply pushed down into the coal heap to the required depth, left until they have arrived at the temperature of the fuel, and then withdrawn and tested by hand, or with a thermometer. An experienced man can easily tell by mere feeling when the temperature exceeds 140° F. (the danger limit). When the interior of a heap of fuel has ignited, it is not easy to quench it by playing water on the outside of the heap, since a ring of coked fuel is formed around the combustion area. A two-inch pipe with its lower end perforated with three-eighths-inch holes must be employed, and this must be pushed down into the fuel until the perforated portion has passed through the upper portion of the coked protective ring. The better plan is, however, to guard against ignition, by turning over the fuel when heating is observed.

SWITZERLAND is a country abundantly provided with waterpower, and the remark has frequently been made that the power thus obtainable would be sufficient to operate all the railways of the country. Though such a condition of affairs is, of course, far from being realized at the present time, the Swiss engineers are not backward in taking advantage of natural facilities at their hand, and in many quarters hydro-electric power developments are taking place for furnishing power to various industries. The leading article in this issue is devoted to the hydro-electric development at Hagneck, which has been worked out with the thoroughness as to detail characteristic of the European engineers. Power developed at the Hagneck plant is used to supply numerous small industries in and near that city. The generators furnish three-phase alternating current at 40 cycles per second, which is carried by high-tension transmission lines to numerous points of distribution, where, in transformer stations of unique appearance, as shown by a picture accompanying the article, the pressure is stepped down to the required voltage for distribution. The pole-line construction is noticeably substantial, as shown in the illustrations, especially the lattice-work poles, which are used where any considerable distance is to be spanned. As a whole the system is well worthy of study and embodies many points in the construction which vary widely from methods followed in this country.

SOME of the newspapers are wondering why none of the Nobel prizes has been awarded to an American scientist. Probably the reason is that comparatively little of the class of original work honored by these awards has been done in the United States. The quantity of research work in this country is, it must be admitted, small when compared with that of European nations. For instance, England has been granted two of this year's prizes, that for physics to Lord Rayleigh and the one in chemistry going to Sir William Ramsay. No one in the United States can quarrel with these names surely. Lord Rayleigh was senior wrangler at Cambridge in 1865, since when, by experimental and mathematical research, he has been a constant contributor to scientific progress. As one of our English contemporaries remarks, he is one of the greatest living authorities on acoustics, his "Theory of Sound" [1877] being still a standard work. His best known and perhaps most valuable discovery was the finding of argon in the atmosphere a decade ago. By a most refined chemical investigation, in the later stages of which he was associated with the other Nobel prize-winner, Sir William Ramsay, he demonstrated the existence of an inert gas, which was added to the list of elements under the name of argon. It is announced that Lord Rayleigh will present the value of the Nobel prize (about $39,000) to his alma mater. Sir William Ramsay has been the recipient of almost every medal and honor conferred by scientific bodies. Educated at Glasgow and Tübingen, he became successively principal of University College, Bristol, and professor of chemistry at University College, London. He followed up the discovery of argon first by the detection of helium in the mineral clevite, and then his skilful investigations, assisted by Dr. Travers, resulted in the detection of three new gases in our atmosphere—krypton, meon and xenon—the experimental work leading to these results ranking with the most refined ever carried out. Recently Sir William and Mr. Soddy have demonstrated that the ultimate residue of the disintegration of radium is helium.

This is the kind of work the world can well afford to honor. More of it is being done in this country, year by year, at the great universities and through the agency of such bodies as that most promising foundation, the Carnegie Institution. It will not be long, we confidently predict, before a greater proportion of the discoveries in pure science will be credited to the United States.

Extensive Traction Project in Ohio.

The Cleveland correspondent of the Western Electrician writes that, from present prospects, Ohio will shortly have an extensive traction system which may also connect with the systems operating out of Indianapolis. A few days ago the Northern Traction Company was incorporated with a capital stock of $500,000 by the interests back of the Cincinnati, Dayton and Toledo Traction Company, and the general understanding is that this is a holding company that will lease the latter. It is further said that the Elkins-Widener syndicate of Philadelphia is the controlling interest in the new company, and that its plan includes the connection of Cincinnati, Cleveland, Toledo and Indianapolis with traction lines. Following the supposition further, the western Ohio lines will become a portion of the system, either by purchase, lease or traffic arrangement, and the Dayton and Piqua will be acquired in a similar manner. This would give the company a line from Cincinnati to Lima, with a branch to St. Marys. Arrangements have been made by the Western Ohio to extend its line north to Findlay. The Toledo, Bowling Green and Southern has a line in operation from Findlay into Toledo, which would give a through line from Cincinnati to Toledo. From Lima to Findlay, the distance is 31 miles, and it is said that so much has been done that the additional cost will not exceed $15,000 a mile.

It is said that W. Kelsey Schoepf of Cincinnati and Hugh J. McGowan of Indianapolis are looking after the interests of the eastern capitalists in the deal. The terms of the lease of the Cincinnati, Dayton and Toledo have been given out and the proposition is satisfactory, considering the fact that the company has not yet paid dividends. The company is also to turn over $1,500,000 treasury stock and the same amount in bonds, and in return the new company agrees to spend not less than $1,500,000 in improvements and extensions the first two years. This will give the required power and the additional facilities that are needed.

More Long-distance Wireless.

The following interesting notes are sent from St. Louis by the American De Forest Wireless Telegraph Company:

"Some very remarkable distances have recently been covered by some of the De Forest wireless-telegraph installations. The operators at Buffalo and also at Cleveland, Ohio, have read a large number of messages sent from the two-kilowatt station mounted upon the roof at 42 Broadway, New York city. This station is equipped with only a 100-foot mast, and this distance of 700 miles overland from a two-kilowatt station is considered very remarkable. From this same station messages have been read on board the Mallory Line boats, Denver and San Jacinto, when less than 200 miles from Key West, Fla., or in the neighborhood of 900 miles from New York city. These two ships are each equipped with one-kilowatt apparatus, but they have been able to communicate over 350 miles. The De Forest Cape Hatteras station has in fact read messages from the Denver when she was only 50 miles out from New York city.

"In the work from 42 Broadway to Buffalo and Cleveland it was noticed that signals were much more distant at night than during the day. This is another evidence of the impairing effect on the transmission which the daylight exerts and which has only been noticed in one or two instances heretofore.

"In explanation of the extreme distances which have been attained from the two-kilowatt station at New York, it is suggested that the location of this station, some 350 feet above earth on the top of a steel building, plays an important part in this unexpected phenomenon. The source of the electrical waves here is at an unprecedented height from the earth and at the same time an excellent ground is afforded through the steel frame of the building."

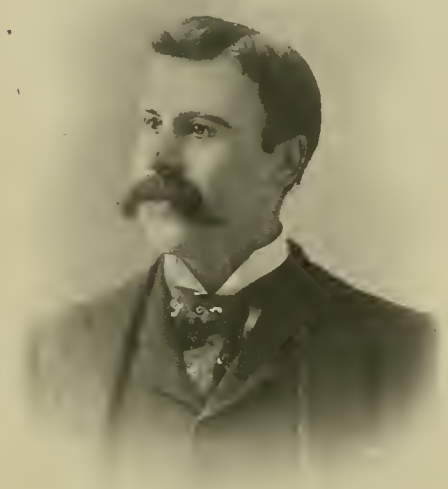
Electrical Industry in Chemnitz.

The first half of the year ended June 30, 1904, left the electrical machine manufacturing industry in Chemnitz, Germany, but moderately employed, but during the last six months conditions have improved steadily, so that at the present time this industry is fully employed. The Saxon electrical industry is especially highly developed, and Saxon motors, generators and transformers have acquired an excellent reputation for durability and cheapness. The Saxon government placed a number of heavy orders for electrical machinery that contributed much toward the improvement of conditions. Foreign markets also expanded satisfactorily. The heaviest foreign buyers were Holland, Belgium, Spain, South Africa, Russia, Austria-Hungary and the Balkan States. Though prices were kept down by severe competition, the demand continued good to the close of the year. Wage conditions are reported good in this branch. These facts are from a report of United States Consul Monaghan.

W. Forman Collins.

It is a trying task to set forth in cold type a brief chronicle of the characteristics and career of a friend and associate who but yesterday was in the harness of active work at one's side and who passed away as suddenly as the flame of a candle is snuffed out. It is the sad duty of the Western Electrician to attempt to do this in the case of Mr. W. Forman Collins, its vice-president and business manager, whose very sudden and unexpected death was briefly announced last week.

Mr. Collins' death was due to apoplexy, and it happened about 8 a. m. on December 21st. For many years—in fact from boyhood—he was subject to an unusual nervous ailment which manifested itself periodically in severe attacks resembling vertigo. In the intervals between these attacks (which of late years had been somewhat less frequent) Mr. Collins enjoyed apparent good health and pursued his vocations. He was at the office as usual the day before he died and conversed cheerfully with



W. FORMAN COLLINS.

his associates. He passed the evening at home and retired at his accustomed hour. In the morning he remarked to Mrs. Collins before arising that he had enjoyed a good night's sleep. He chatted pleasantly with his wife and was sitting in bed preparing to get up, when suddenly, with a slight noise in the throat, he pitched forward into his wife's arms—dead. Physicians were hurriedly summoned, but they could do nothing. Death had been instantaneous.

W. Forman Collins was born on September 14, 1867, and was therefore but 37 years of age. He was a native of Suffolk, England, and sprang from well-connected and well-to-do people. His father was a prominent lawyer who had attained the distinction of a Q. C., but he died while the subject of this sketch was but a child. Mr. Collins' mother died after he came to America. Quite early in life "Wilkie," as he was known to intimate friends—although the W. in his name really stood for William—was destined for a physician, and he was sent to Edinburgh to study for that profession. But the bent of his mind was toward electrical and mechanical problems, and accordingly the plan was changed and he was given a thorough technical training at an engineering school.

Mr. Collins was a bright, precocious young man, and he was still far from having attained his majority, when, in 1885, he came to the United States, which country was afterward his home. He immediately engaged in electrical pursuits, generally in New York, but for a while in Boston. For some time he represented the Callender underground cable interests, but later he did work in the line of electrical engineering and machine design. He designed several direct-current motors, and the Waddell-Entz and Crocker-Wheeler machines of the late '80's and early '90's bore evidence of his work.

About 1889 Mr. Collins became interested in electrical journalism, first on the editorial and then on the business side. He was connected with the Electrical World and later with the Electrical Engineer. In 1890 he came to Chicago to represent the latter journal in a business capacity. In this work he was successful, and two years later he purchased a large interest in the Western Electrician, becoming vice-president and business manager of the Electrician Publishing Company—a position he held until the time of his death.

In 1889 Mr. Collins married Mrs. Jessica Bill, a lady of great strength and beauty of character, who survives him. There are no children. He and his wife were devoted to each other, and their home life was ideal. In 1896-97 they spent a year in foreign travel for the benefit of the husband's health, visiting at that time relatives of Mr. Collins in London, where he is survived by three brothers and a sister.

Mr. Collins was a man of high character and lofty aims. He was a consistent churchman, charitable to the unfortunate, both in speech and in purse; he was kind and considerate to all men—a thoroughly good man. In business his judgment was sound, and he stood only for the best and cleanest methods; his integrity was unassailable. He was very domestic in his tastes and the inseparable companion of his beloved wife. He delighted in music and greatly enjoyed outdoor life, particularly yachting and driving. His great liking for machinery and mechanical processes of magnitude was always a characteristic. In early life he had been, too, something of an athlete. Mr. Collins had all of an Englishman's reserve, and seldom discussed his own affairs or the deeper feelings of his nature. But all who came to know him intimately recognized the sterling worth of his character, and, like his associates on the Western Electrician, feel an abiding grief at his untimely death.

The funeral took place on December 23d. Brief services were held at the house, 5344 Greenwood Avenue, and then the procession took its way to Trinity Reformed Episcopal Church, of which Mr. Collins was a member. The Rev. B. R. Thornbury, the dead man's pastor, officiated and made a brief address. Among the musical selections was one by Mr. Holmes Cowper, the well-known tenor, who arose from a sick bed to sing at the funeral of his friend. There were a number of floral remembrances, and among the people in the church were not a few electrical men. The bearers were Charles R. Mack, S. Arnold, A. Grossmith, E. J. Bardwell, Fred J. Lee, Frank L. Perry, C. W. Forbrich and N. F. Obright. The remains were taken to Albany, N. Y., for burial.

Since Mr. Collins' death a number of letters of condolence have been received, and these are much appreciated, both by Mrs. Collins and by the Western Electrician.

Electric Fans to Increase Efficiency of Radiators and Registers.

A new use for the electric fan, which serves as a cooling agent in the summer, is to bring about a diametrically opposite effect in the winter, that is, to increase the efficiency of a steam radiator. As described in The Electric City, this is done by setting the fan where it can blow against the radiator. By forcing a draft against the radiator much more heat is conducted away from the surface than if the radiator were surrounded by a layer of still air. The condensation of the steam in the radiator, being more rapid, the pressure need not be so high.

Another way the fan may be used is in distributing the air more quickly from a furnace register. Where the pipes are long and there are many bends there is often difficulty in getting the hot air from the furnace to pass to the upper floors before its heat is dissipated. A plan proposed is to build a sort of hood over the register which will contain the fan and direct the flow of air out into the room. When the fan is set in motion the increased draft soon draws sufficient air up the pipes to make the room warm.

Directors for Chicago Freight-tunnel System.

Announcement has been made that the following-named men will be among the directors of the Illinois Tunnel Company, which will operate the underground-freight project of the recently organized Chicago Subway Company: A. J. Earling, president St. Paul railway; E. P. Ripley, president Santa Fe railway; George H. Harris, president Burlington railway; S. M. Felton, president Chicago and Alton railway; J. Kruttschnitt, director of maintenance of ways, Southern Pacific and Union Pacific railways; B. L. Winchell, president Rock Island railway; A. C. Bird, vice-president Gould lines; F. D. Underwood, president Erie railway; Benjamin Thomas, president Chicago and Western Indiana railway; P. A. Valentine, vice-president Armour & Co.; Albert G. Wheeler, president Illinois Tunnel Company. Besides these there will be included in the directorate representatives of the Vanderbilt lines, the Pennsylvania and the Northwestern railways.

The Maximum Distance to Which Power Can Be Economically Transmitted.[1]

By Ralph D. Mershon.

It appears that all the elements in the annual cost per kilowatt for transmitting power, except those dependent upon the line conductors, may be continually reduced by increasing the amount of power to be transmitted. The annual cost per kilowatt due to the line conductors cannot be so reduced. It can be diminished only by such other means as will reduce the first cost of the conductors. As the first cost of the line conductors can be reduced only by increasing the voltage of transmission and as there is a limit to which such increase can be carried, it follows that the limiting distance to which power can be economically transmitted will depend, finally, upon the cost of the line conductors and upon this alone.

It will somewhat simplify the treatment of the subject if the interest charge be included as a part of the cost of transmission and profits be represented by a percentage on the investment. This course will, therefore, be pursued. That is, it will be assumed that in the cost of transmission is included the interest on the investment (bond interest) and that over and above this cost there must be earned a certain percentage, which percentage will represent profits (stock dividends). In addition the following assumptions will be made:

Power purchased at low-tension bus bars of step-up transformers and sold at outgoing bus bars of the step-down station.

Frequency of transmission not less than 25 cycles nor more than 30 cycles.

Idle synchronous motors at stepdown station to correct for power-factor, the average power-factor of the line being held as near unity as possible.

That no matter what the capacity of the plant, there will be three transmission lines, each capable of carrying one-third the load.

That the power-factor of the load supplied will be 0.8.

That no matter what the size of the plant the number of transforming units at each end of the line be 18, each transformer being normally worked at five-sixths of its rated capacity, so that one bank of three may be cut out, if need be.

That no matter what the size of the plant the number of corrective synchronous motors will be six, each being worked at five-sixths of its rated capacity. The kilovolt-ampere capacity of these synchronous motors must, for a load power-factor of 0.8, be equal to three-quarters of the kilowatt capacity of the load carried by the plant.

It is evident that the number of units must be considered as the same for plants of all capacities in order to take full advantage of the decrease of cost per kilowatt, due to increase of capacity.

The pole lines will be assumed as constructed with 12 steel towers to the mile.

Ideal conditions will be assumed throughout consistent with delivering reliable and cheap power. Since the object is to determine the maximum distance, the factors fixing commercial costs of apparatus will be taken at the lowest values likely to obtain.

Later on in this paper general equations are

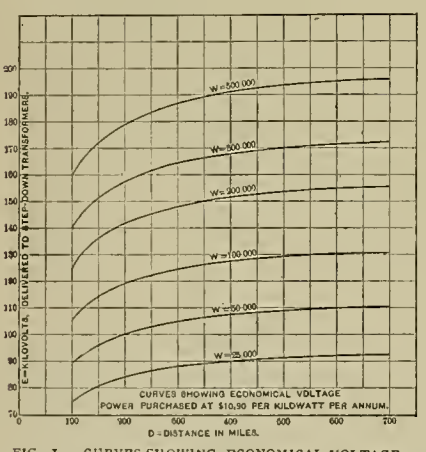


FIG. 1. CURVES SHOWING ECONOMICAL VOLTAGE.

derived expressing the relations between the distance of transmission and the qualities which govern it. By making assumptions, in addition to those mentioned above, as to the values of the various coefficients in the general equations and as to the purchase price and selling price of power, the curves of Figs. 1, 2, 3, 4 and 5 have been obtained, which are given and discussed here instead of at the end of the paper.

Fig. 1 shows the relation between the distances of transmission (D) and the economical voltage (E) for different kilowatt outputs (W); that is, it shows the voltage which it is most economical to use for any given output and distance of transmission.

1. Abstract of a paper presented at the meeting of the American Institute of Electrical Engineers, New York, December 23, 1904. Mr. Mershon is a well-known consulting engineer of New York.

Fig. 2 shows, in a corresponding manner, the economical drop.

Fig. 3 shows the diameter of the conductors corresponding to the conditions of Figs. 1 and 2.

Fig. 4 shows the relation between (D) the distance of transmission and (p) a percentage net profit on the investment for different values of output (W) and for selling price of $34 per kilowatt per annum.

Fig. 5 is a curve obtained from Fig. 4 and shows the relation between the distance of transmission and the output for a net profit of 12 per cent.

In obtaining these curves the constants have all been given values favorable to long-transmission distances. The costs have been taken lower than those ordinarily current in the endeavor to anticipate somewhat possible future prices. Also, the cost of power purchased at the step-up station has been fixed at the very low figure of $10.90 per kilowatt per annum.

The maximum amount of power dealt with herein, 500,000 kilowatts, is probably too high to be seriously considered at this time, but from 200,000 to 300,000 kilowatts is believed to be within the range of immediate future possibility. In a plant of this size it is probable that a net return of 12 per cent. would be required, not alone for the purpose of dividends, but also as a protection to the bonds. Under these conditions Fig. 5 shows the distance of transmission to vary from 512 miles for 200,000 kilowatts to 623 miles for 300,000 kilowatts. For the present outlook, therefore, the limiting distance may be taken as about 550 miles.

It appears from the preceding matter that under the conditions assumed the limiting distance of transmission will, for some time at least, be in the neighborhood of 550 miles.

It also appears that voltage limits will be fixed

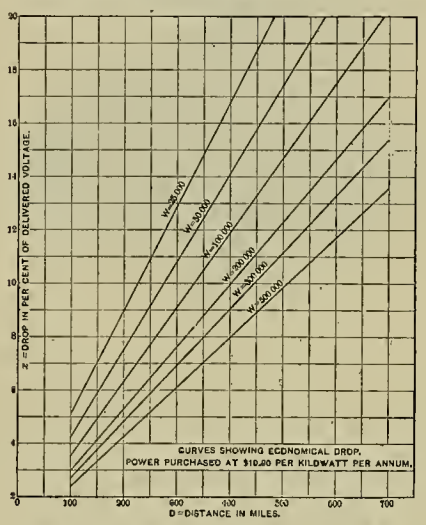


FIG. 2. CURVES SHOWING ECONOMICAL DROP.

not by conditions depending upon atmospheric losses, but by economic conditions.

The latter conclusion, while recognized as a possibility when this paper was begun, was unexpected. It is, perhaps, of greater present importance than the original object of the paper as conveyed in the title.

The analysis on which depends the general equations from which the preceding curves were obtained will now be taken up.

Let E = voltage, in kilovolts, delivered to step-down transformers.
D = distance of transmission in miles.
x = percentage of power lost in the line in terms of delivered power.
e = efficiency of the whole system.
e_1 = combined efficiency of step-up and step-down transformers and synchronous motors.
d = diameter of line conductors in inches.
W = power, in kilowatts, delivered at low-voltage bus bars of step-down station.
c = cost, in dollars per kilowatt per annum of power purchased at the low-voltage bus bars of the step-up transformers.
Let s = price, in dollars, received for power per kilowatt per annum at the low-voltage bus bars of the step-down station.
h = a quantity which, multiplied by c, will give the cost at the high-voltage terminals of step-up transformers.
R = total interest maintenance and depreciation charge per annum.
L = cost of labor for operating transformer stations and for executive and clerical services.
M = total investment.
C = total cost per annum of power delivered, inclusive of interest.
p = a percentage covering profit.

$\therefore e = \frac{e_1}{1+x}$, since $\frac{1}{1+x}$ is the efficiency of the line.

$\frac{W c}{e} = \frac{W c (1+x)}{e_1}$ = total amount expended per annum for power purchased.

$\therefore W s$ = total amount received per annum for power.

$\therefore C = \frac{W c}{e} + L + R.$

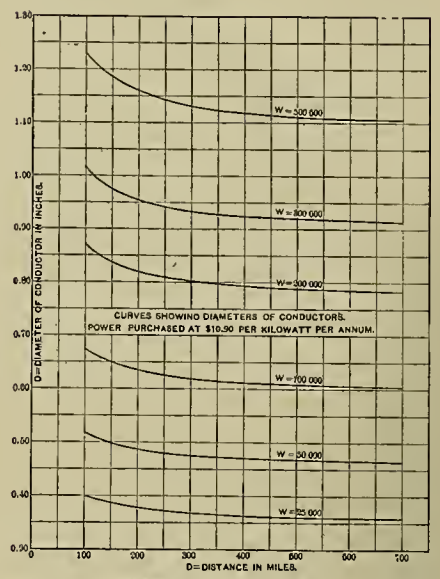


FIG. 3. CURVES SHOWING DIAMETERS OF CONDUCTORS FOR VARIOUS DISTANCES.

$$\therefore p = \frac{W s - C}{M} = \frac{W s - \frac{W c}{e} - L - R}{M} =$$

$$\frac{W s - \frac{W c (1+x)}{e_1} - L - R}{M} = \frac{N}{M} \qquad (1)$$

Now M is made up of
(1) Cost of transformers.
(2) Cost of transformer switchboard apparatus, cables, lightning protection, etc.
(3) Cost of building and real estate.
(4) Cost of insulators.
(5) Cost of pole-line material and construction.
(6) Cost of right-of-way.
(7) Cost of corrective synchronous motors and exciters.
(8) Cost of switchboard apparatus, cables, etc., for synchronous motors.
(9) Cost of line conductors.

Cost of transformers will depend upon voltage and output;
f_1 (E, W).

Cost of transformer cables and controlling apparatus will depend upon same quantities as transformers, but in a different way;
f_2 (E, W).

Cost of building will depend upon output;
f_3 (W).

Cost of insulators will depend upon voltage, diameter of conductors and number required, i. e., voltage, diameter of conductor and distance of transmission;
f_4 (E, d, D).

Cost of pole-line construction will depend upon diameter of the conductors and the distance. But the diameter of the conductors depends upon voltage, drop, output and distance; hence,
f_5 (d, D) = f_5 (E, W, x, D).

Cost of right-of-way will depend upon distance only;
f_6 (D).

Cost of synchronous motors will depend upon output only, since all other elements affecting cost will be fixed;
f_7 (W).

Cost of switchboards and cables for synchronous motors will depend upon output only;
f_8 (W).

Cost of line conductors will depend upon voltage, output, line loss allowed and distance of transmission;
f_9 (E, W, x, D).

The sum of these nine functions constitutes M, the total investment.

Now R, the total interest and depreciation charge, depends upon all of the several quantities making up M.

In what follows the numerical value of the constants are those taken for the specific problem treated herein.

Let p_1 = 0.125, being the percentage of transformer cost for interest, depreciation and repairs.
p_2 = 0.125, being the percentage of transformer switchboards cost, for interest, depreciations and repairs.
p_3 = 0.075, being the percentage of buildings, cost for interest, depreciation and repairs.
p_4 = 0.10, being the percentage of insulator cost for interest, depreciation and repairs.

$p_5 = 0.125$, being the percentage of pole-line cost for interest, depreciation and repairs.
$p_6 = 0.05$, being the percentage of cost of right-of-way, for interest only.
$p_7 = 0.125$, being the percentage of synchronous-motor cost for interest, depreciation and repairs.
$p_8 = 0.125$, being the percentage of cost of synchronous-motor, switchboard, etc., for interest, depreciation and repairs.
$p_9 = 0.05$, being the percentage of cost of conductors, for interest.
R = the sum of these percentages multiplied respectively into the several quantities to which they refer.
L depends only upon output $f_{10}(W)$.

Let q = that portion of the cost per kilowatt at the low-tension bus bars of the step-down station, which is due to line loss and to interest on the value of the conductors; then, anticipating in part the matter further on

$$q = \frac{p_9 K_9 \frac{W D^2}{E^2 x} - hc\,Wx}{W}$$

in which $p_9 K_9 \frac{W D^2}{E^2 x}$ is the interest on the conductors and hc Wx the cost of the power lost in the line.

Setting the first derivative of this with respect to x equal to zero, in order to determine the value of x corresponding to the minimum value of q, we find the well-known expression for economic drop

$$x = \left(\frac{p_9 K_9}{hc}\right)^{\frac{1}{2}} \frac{D}{E} = n\frac{D}{E} = 0.038\frac{D}{E} \qquad (2)$$

From this equation for x we may obtain the equation

$$\frac{D^2}{E^2 x} = \frac{hcx}{p_9 K_9}$$

Let q_1 = that portion of the annual cost per kilowatt of delivered power due to the line loss, conductors, insulators and transformers. It has just been shown that for best economy the line loss and annual-conductor cost must be equal, so that twice the line loss, 2 hc Wx, may be taken as representing the sum of the annual cost due to line loss and to the conductors.

The cost of insulators will vary as the distance of transmission, and as the cube of the voltage. The cost of the transformers may be represented by

$$K_1'(E + K_1'')\,W^{\frac{1}{2}}$$

Hence remembering that p_1 and p_4 are the interest

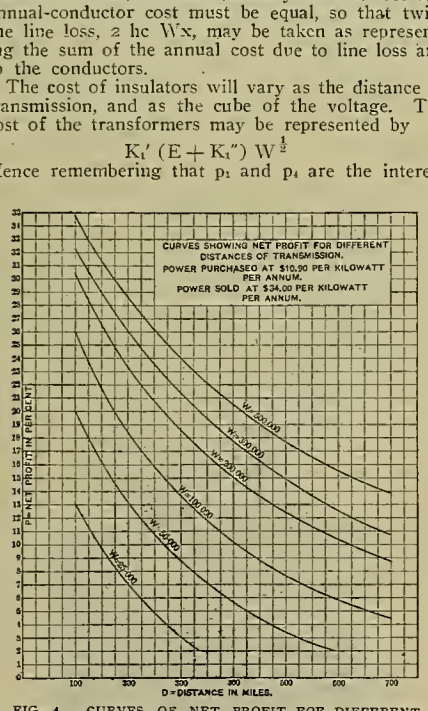


FIG. 4. CURVES OF NET PROFIT FOR DIFFERENT DISTANCES.

and depreciation of transformers and insulators, respectively.

$$q_1 = \frac{2\,hc\,Wx + p_4 K_4 E^2 (1+x)^3 D + p_1 K_1'(E + K_1'')\,W^{\frac{1}{2}}}{W}$$

or, putting in the value of $x = \left(\frac{p_9 K_9}{hc}\right)^{\frac{1}{2}} \frac{D}{E} = n\frac{D}{E}$,

$$q_1 = [\,2\,h\,n\,WDE^{-1} + p_4 K_4 E^2 (1 + n\,D\,E^{-1})^3 D + p_1 K_1'(E + K_1'')\,W^{\frac{1}{2}}\,] \div W$$

It will greatly simplify matters if instead of substituting the value of x in $(1+x)^3$ we substitute for x, x_1, a fixed drop of such value as will correspond to the average cost of insulator between the two extreme values of x which will be met with in practice; the error due to such a course will be small. Hence

$$q_1 = [\,2\,h\,c\,n\,W\,D\,E^{-1} + p_4 K_4 E^2 (1+x_1)^2 D + p_1 K_1'(E + K_1'')\,W^{\frac{1}{2}}\,] \div W$$

Setting the first derivative of this equation equal to zero, solving and substituting the value $n = \left(\frac{p_9 K_9}{hc}\right)^{\frac{1}{2}}$ there results

$$E = \left(\frac{-\,p_1 K_1'\,W^{\frac{1}{2}}}{6\,p_4 K_4 (1+x_1)^3\,D} + \sqrt{\frac{p_1^2 K_1'^2\,W}{36\,p_4^2 K_4^2 (1+x_1)^6 D^2} + \frac{2\,(hcp_9 K_9)^{\frac{1}{2}}\,W}{3\,p_4 K_4 (1+x_1)^3}}\right)^{\frac{1}{2}}$$

$$= \left(-3066\frac{W^{\frac{1}{2}}}{D} + \sqrt{9400356\frac{W}{D^2} + 3438.5\,W}\right)^{\frac{1}{2}} \qquad (3)$$

This shows that the voltage may be increased with increase of output, which was to be expected since those costs which limit the voltage will diminish in their amount per kilowatt as the output increases.

In Fig. 1 are shown curves plotted from equation (3). These curves show the kilovolts (E) for different distances (D), and different outputs (W).

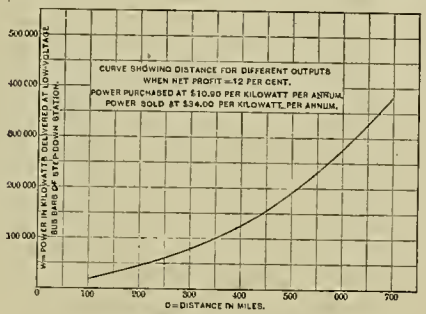


FIG. 5. CURVE OF DISTANCES FOR VARYING OUTPUTS, 12 PER CENT NET PROFIT.

Fig. 2 gives curves plotted from equation (2), using the values obtained from the curves of Fig. 1. The curves of Fig. 2 show the percentage drop (x) for different distances (D) and different outputs (W). In Fig. 3 are curves showing the diameters of the conductors for the conditions of Figs. 1 and 2. These diameters were calculated from the formula

$$d = k_5'\left(\frac{W\,D}{E^2 x}\right)^{\frac{1}{2}} = k_5'\left(\frac{W\,D\,E}{E^2\,n\,D}\right)^{\frac{1}{2}} = \frac{k_5'}{n^{\frac{1}{2}}}\left(\frac{W}{E}\right)^{\frac{1}{2}}$$

$$= 0.0219\left(\frac{W}{E}\right)^{\frac{1}{2}} \qquad (4)$$

which gives the diameter (d), in inches, of a solid conductor.

From a careful consideration of transformer prices it has been determined that for transformers of 1,500 kilowatts and over the cost installed very closely follows the law.

$$f_1(E, W) = K_1'(E + K_1'')\,W^{\frac{1}{2}} =$$
$$13\,(E + K_1'')\,W^{\frac{1}{2}} \therefore p_1 f_1(E, W) =$$
$$p_1 K_1'(E + K_1'')\,W^{\frac{1}{2}} = 1.625\,(E + K_1'')\,W^{\frac{1}{2}}$$

in which K_1' is a constant and K_1'' a "variable constant," a quantity which varies slowly with the output in accordance with the law,

$$K_1'' = k_1 + k_1''\,W = 55 + 0.000227\,W$$

The apparatus for the control of transformers may be considered as depending only upon output. Under this assumption a consideration of costs of transformer-controlling apparatus and cables shows that we may assume with a close degree of accuracy that

$$f_2(E, W) = K_2' + K_2''\,W = 21\,000 + 0.9\,W$$
$$\therefore p_2 f_2(E, W) = p_2 K_2' + p_2 K_2''\,W = 2625 + 0.1125\,W$$

The cost of buildings and the real estate for them will increase very slowly with the output. The variation of this item, due to variation of output, can be expressed closely enough by

$$f_3(W) = K_3' + K_3''\,W^{\frac{1}{2}} = 125\,000 + 125\,W^{\frac{1}{2}}$$
$$\therefore p_3 f_3(W) = p_3 K_3' + p_3 K_3''\,W^{\frac{1}{2}} = 9375 + 9.375\,W^{\frac{1}{2}}$$

The cost of the pole-line material and construction will depend somewhat upon the diameter of the conductors, since, as the diameter of the conductors increases, the wind and sleet stresses will increase. The increase of cost with increase in diameter of conductors will be slow. The law followed will be that of a constant plus a function of the diameter of conductors, since, no matter how small the diameter of conductor, there will be a certain cost representing the minimum-sized pole which would be employed. We may with a fair degree of accuracy, write

$$p_5 f_5(E\,W\,x\,D) = 375\,D + 4.65\left(\frac{W}{E}\right)^{\frac{1}{2}} D$$

which answers for a stranded conductor.

Cost of right-of-way will be directly proportional to distance, hence

$$f_6(D) = K_6 D = 1000\,D$$
$$\therefore p_6 f_6(D) = p_6 K_6 D = 50\,D$$

A consideration of synchronous-motor prices shows that the cost of synchronous motors may be written,

$$f_7(W) = K_7' + K_7''\,W = 12\,000 + 32.4\,W$$
$$\therefore p_7 f_7(W) = p_7 K_7' + p_7 K_7''\,W = 1500 + 4.05\,W$$

The switchboards and cables for the motors will follow the same law as those for the transformers

The cost of labor for the operation of the step-up and step-down transformer stations and for executive and clerical purposes would probably not vary at all We have in each case the same number of units to be looked after, and the size of these units would make little if any difference in the cost of attendance upon them Similarly, the output will make little difference in executive and clerical costs.

The efficiency of the whole system is $\frac{c_1}{1+x}$

Putting in the value of $x = n\frac{D}{E}$

$$e = \frac{e_1}{1 + n\frac{D}{E}} = \frac{0.925}{1 + 0.038\frac{D}{E}}$$

$$\frac{W\,c}{e} = \frac{W\left(1 + n\frac{D}{E}\right)c}{e_1} = \frac{W\,c}{e_1} + \frac{n\,c}{e_1}\cdot\frac{W\,D}{E} = 11.78\,W + 0.448\frac{W\,D}{E}$$

The various functions above arrived at may now be utilized in obtaining N and M of equation (1), $p = \frac{N}{M}$

Remembering that R is the sum of the products of the various functions by the corresponding percentages representing interest, depreciation and repair; that $L = f_{10}(W)$, and representing the various resulting collections of constants as follows:

$a = p_2 K_2'' + p_1 K_7'' + p_8 K_8'' = 4.184$
$b = K_{10}' + p_2 K_2' + p_3 K_3' + p_7 K_7' + p_8 K_8' = 46\,550$
$m = K_{10}'' + p_2 K_2'' = 35.38$
$r = p_5 K_5' + p_6 K_6 = 425$

$$\text{then } N = W\,s - \frac{W\,c\,(1+x)}{e_1} - L - R$$
$$= \left(s - \frac{c}{e_1} - a\right)W - \left(\frac{n\,c}{e_1} + \frac{p_9 K_9}{n}\right)\frac{W\,D}{E} - m\,W^{\frac{1}{2}} - p_1 K_1'(E + K_1'')\,W^{\frac{1}{2}}$$
$$- p_4 K_4 (1+x_1)^3 E^2 D - r\,D - \frac{p_5 K_5'' k_5}{n^{\frac{1}{2}}}\left(\frac{W}{E}\right)^{\frac{1}{2}} D - b.$$

Representing constants as follows:

$\alpha = K_2'' + K_7'' + K_8'' = 33.47$
$\beta = K_2' + K_3' + K_7' + K_8' = 166{,}400$
$\gamma = K_5' + K_6 = 4{,}000$

$$M = \alpha\,W + \frac{K_9\,W\,D}{n\,E} + K_2''\,W^{\frac{1}{2}} + K_1'(E + K_1'')\,W^{\frac{1}{2}} + K_4(1+x_1)^2 E^2 D + \gamma\,D + \frac{K_5'' k_5}{n^{\frac{1}{2}}}\left(\frac{W}{E}\right)^{\frac{1}{2}} D + \beta.$$

These values of N and M, if substituted in equation (1), will give, in its final form, the equation connecting distance, output, voltage, and profit, or, in connection with equation (3), for voltage, the relation between distance, output and profit. Such substitution results in a cumbersome equation, and will not be made here. If the various numerical values, already determined for the specific problem herein treated, be substituted in N and M, there results,

$$N = (s - 15.96)\,W - 0.903\frac{W\,D}{E} - 35.38\,W^{\frac{1}{2}} - 1.625\,(E + K_1'')\,W^{\frac{1}{2}} - 0.0000883\,E^2 D - 425\,D - 4.65\left(\frac{W}{E}\right)^{\frac{1}{2}} D - 46550$$

$$M = 33.47\,W + 9.1\frac{W\,D}{E} + 125\,W^{\frac{1}{2}} + 13\,(E + K_1'')\,W^{\frac{1}{2}} + 0.0000883\,E^2 D + 4000\,D + 37.2\left(\frac{W}{E}\right)^{\frac{1}{2}} D + 166\,400.$$

The value of s in the above equation for N is taken as 34, that is, it is assumed, for the purposes of the specific problem, that power is sold at $34 per kilowatt. Putting in this value of s and calculating the value of p for different outputs, W, and different distances, D, the curves of Fig. 4 have been obtained. These curves show, for different values of W, the relation between p and D. Assuming that the minimum acceptable profit is 12 per cent., and taking from Fig. 4 the values of D and W corresponding to this percentage profit, there has been plotted the final curve, Fig. 5, which shows the relation between distance and output.

Discussion (in Abstract).

H. G. Stott, New York city: This paper deals with figures of 200,000 or 300,000 kilowatts, and the distances mentioned as being possible are 550 miles. The transmission of power from Niagara Falls to New York would come well within the limits defined by Mr. Mershon, as the distance is approximately 450 miles, and the amount of power used by the large plants in this city approximates 175,000 kilowatts, or in that neighborhood. In connection with the load, another point occurs to me—is it the right way to discuss costs in kilowatts per annum? The writer says a kilowatt per annum, 8,760 hours per year, and the greater part of the load is known as peak load. I therefore contend that no formula of expression which does not take into account the load factor fully expresses the situation. The value which Mr. Mershon gives of $34 per kilowatt would mean that,

on a one-hour peak load, it would pay him a little over 11 cents per kilowatt-hour. I do not think any steam plant costs as much as that. Another point, at the other end of the line is the figure of $10.90 per annum per kilowatt. I believe there are very few water plants that can be constructed for less than $100 per kilowatt. I doubt if there are any constructed at that price, and, assuming Mr. Mershon's figures of 12.5 per cent. interest, depreciation and maintenance, that would be $12.50 to be charged against the cost of power. Many endeavors have been made to charge for a kilowatt per annum on that basis, but they have inevitably, it has been my experience, ended in a mutual recognition by the company supplying the power and the company buying it that it was not fair. It is quite a good arrangement for the company selling the power, but not the company buying it, because under this price of $34 per year per kilowatt, it amounts to 11 cents per kilowatt for one hour. There are few plants that can operate with a better load factor than 50 per cent., and I figure for the average plant, railway or lighting, that would bring up the average cost of power to about 0.8 of a cent per kilowatt-hour.

Philip Torchio, New York city: The general problem treated by Mr. Mershon in his valuable paper involves the study of the two main factors which enter into the problem of power transmission, i. e., the transmission voltage and the cross-section of the conductors. The elements which are affected by the voltage are the cost of transformers and insulators, which increase with the voltage, and the cost of line conductors and line losses, which decrease with the voltage. All the other elements are practically not influenced by the change in voltage. Mr. Mershon has treated the subject in detail, and has given a formula for the determination of the most economical transmission voltage. In this formula enters the cost of line losses and interest and depreciation on conductors, both of which are dependent upon the most economical cross-section of conductors; therefore the dominating factor in a study of this character is the determination of the cross-section of conductors for the fixed conditions of each problem.

Mr. Mershon has adopted the Kelvin law for the determination of the cross-section of conductors, and he has obtained the results shown in Fig. 3, giving "the diameter of the conductors for power purchased at $10.90 per kilowatt per annum." I wish to make a criticism in connection with Mr. Mershon's assumption of $10.90 per annum for the line losses, this being the same amount as paid for the main bulk of current. Mr. Mershon in this instance failed to apply the very same principle which is one of the prominent features of the treatment of this paper, i. e., "That the greater the output of a plant the less is the cost per kilowatt of all the equipment." Now, if there is a case where this general principle is unquestionably correct, it is the case of the increment cost of station equipment for amounts not exceeding, say, five or 10 per cent. of the total equipment. That is, if a plant of 100,000 kilowatts will cost say $10,000,000 or $100 per kilowatt, we must certainly be able to increase the capacity of the apparatus say 10 per cent. at an increment cost considerably less than the average of $100 per kilowatt. The fact that in the paper the power is assumed to be purchased at a fixed rate per kilowatt will not alter conditions, as the saving derived from this increment cost of generating equipment will be felt either directly or indirectly by the transmitting company, either by lower fixed charges for the operation of the generating plant, or lower price of power, charged by the generating company. If the transmitting company owns and operates the generating plant as well, nobody will raise any question upon the above reasoning. I therefore do not see any reason why the same should not hold for the two enterprises operated independently; at least in this theoretical discussion such assumption should be made.

In making further criticism, I have in mind that this paper is of a pioneer character, and therefore should only be discussed upon broad lines. We must assume ideal conditions, and we must even allow something that may appear problematical at the present time.

Dr. A. E. Kennelly, Cambridge, Mass.: The limiting distance is stated to be 220 miles in the West at this time for the transmission of power, and even if we assume that 550 miles would be the commercial limit for a large block of power, something like 200,000 kilowatts, it would be found possible, no doubt, to add on another 500 miles, and carry 10 kilowatts, commercially, if some one would pay for it, and in that way the power might be carried 1,000 miles. The problem is so flexible it is necessary to limit it practically to obtaining a clearer definition of what we mean by selling power. It is noticeable that all the curves commence at the 100 miles, which is fortunate, as there are so few circuits extending over a hundred miles that we have not much chance of comparing them with the possibilities laid before us. The paper is interesting as far as it goes in showing that under these conditions which are assumed, certainly not the conditions of today, perhaps conditions never to be realized, but at all events under certain definite conditions, it would be possible to buy power at $10.00 and sell it at $34, at a distance of 500 miles. Curiously enough, that is the distance that telegraphers think that it is worth while to transmit their power, because when they get to distances greater than that they put in repeaters. Mr. Mershon's conclusions fall in nicely with the limiting distances generally acknowledged in telegraphic practice.

Charles F. Scott, Pittsburg, Pa.: This paper of Mr. Mershon's contains something more than simple mathematical gymnastics. The paper is really the outcome of several years of study of this problem in different ways. Mr. Mershon, as you know, did excellent work a number of years ago in determining experimentally in the West the action of high voltage on wires, and making determinations, under the conditions which prevailed in his experiments, of the actual losses taking place between wires. You will remember that the curves that he there found had very decided turning points in the neighborhood of 60,000 volts. As the voltage was slowly raised, the loss on the wire was so small it could hardly be measured, the current being so small at the high voltage. The instrumental and measuring difficulties were very great, but when about 60,000 volts was reached the curve took a decided turn and increased in voltage beyond that point; even a half per cent. would increase the loss considerably between the wires so that there was under these conditions a definite limit of about 60,000 volts. I commented upon this point before the Institute in a paper some six years ago, and the conclusion was drawn that under the present methods of transmitting power by overhead conductors the limit would be somewhere in the neighborhood of 60,000 volts, limits which would settle the limiting distance of transmission at something like 150 miles. The man who was rash enough at that time to set a definite limit in the matter of power transmission, following after the other engineers a few years ago, to whom Dr. Kennelly referred, has been sorry for it ever since, and he stands before you now. There was something overlooked, something that was not thought of, and that was the size and diameter of the wire; the diameter of the wire modifying these losses and causing them to occur only at higher voltages. The lesson, however, is one which we learned, and I think other men can profit from it—that it is pretty dangerous to draw conclusions on matters too far off in the future. Mr. Mershon has attacked the general problem rather from the commercial than the scientific side, and I imagine that the problem was one which enlarged as he worked upon it. The paper takes a good, general, broad view of the subject. At the International Electrical Congress there were many papers presented in the Transmission section by gentlemen in this country and abroad, but all the papers which were presented dealt with some specific and local thing; some detail, the method of operation, or the kind of insulation, or the method of stringing wires, the characteristics of aluminum and copper, etc. There was no broad paper presented. This paper was prepared by Mr. Mershon as a representative of the Institute, to be presented at the Congress, but the equations were too long and he did not get time to present it to the Congress, and he has presented it to us here tonight.

While there are objections to the misuse of data such as are given here, I think the paper would have relatively little interest and value if it simply had the equations and did not give certain definite results. I think the paper is valuable in giving certain results as being the legitimate outcome of certain results which are given. Of course, if these assumptions are varied the distance may go up and down, but it is a satisfaction to know, that under conditions which are fairly commercial, that the distance is about that from Niagara Falls to New York city and that the units of power are as here stated.

In considering this paper, the thought struck me that we are dealing with something outside of the range of things we are dealing with now. I imagine if we look at the wire tables of 10 years ago we would find the units then used for transmitting lights running up to a few hundred, and then a little later running into a few thousand. This problem goes into hundreds of thousands. These curves pay very little attention to units less than 50,000 horsepower, which is about the output of the largest stations which are now in operation. Many of the conditions here do not apply to less than 200,000 horsepower, which is about the amount of electrical power now used in New York city. This means that the field of power work which is here considered is one somewhat in the future—that our future developments, the size of our waterpower plants and the scale on which we may use power in the future, are far beyond that which we now have as our present practice, as the consumption of current at this day is beyond that of the early days of incandescent lighting. Another interesting thing I note are the curves of Fig. 2, which give the drop in per cent. of delivered voltage.

When we thought of high voltages, our thought was of a small wire, and when the voltages got from 1,000 to 2,000 and then to 10,000, the problem used to be to secure the smallest size of wire which would be mechanically strong enough to be put in place and maintain its position; and so with these larger units our size of wire has gotten so very large that we have again gotten into a new order of things, and Mr. Mershon's wires would about reach the present limit of mechanical construction in size. It has been sought to bring out the very remarkable thing that the size of this wire is so great that apparently the atmosphere losses, which awhile ago were thought to be the determining element, no longer determine the maximum voltage of transmission.

Mr. Mershon: In presenting the paper it seemed to me that others might derive, or imagine they derived, some similar benefit. The difference of opinion which has developed here tonight is no greater than I expected it would be. I do not suppose there are ever two engineers who estimate in exactly the same way on everything or whose estimates, if you would examine them in detail, would agree exactly. One would be higher on one item, lower on another, and in one the items would be simply reversed, as far as the cost was concerned. The estimates made by them as a whole might agree very closely, but in details they might be pretty far apart. On any proposition, in order to judge it as a whole you must consider it in detail, but if you consider it in detail you must consider the equalizing factors of those details. If the details agree, so much the better. If they do not, I do not think it is absolutely necessary they should agree, if the general result works out satisfactorily. I think, therefore, in the matter of the paper too much stress should not be paid on particular details, because you will find there will be differences of opinion among different engineers in regard to different items and different assumptions, and I think the average opinion, if you could get it, would come pretty close to the figures that are given in this paper. But suppose they do not; suppose they were far enough off so that the limiting distances given in the paper were even as great as 20 per cent. Even in that case I do not think the value of a general view of the subject would be diminished to a considerable extent. I feel that it would not be, from my standpoint, because I have now a broader grasp of the whole subject before undertaking the work. As Mr. Scott said, the paper presents more of interest if you have some definite figures than if you simply went through an analysis and left it hanging in the air. It was my endeavor to get some figures that would give an idea of the use of these quantities that I used in making the assumptions. What was desired was a general view of the whole subject of transmission in regard to the limits and possibilities, so that we might have a general guide in this matter.

Mr. Stott brought out a number of interesting questions. As to the cost of the generating plant, as represented in the price I assumed in the figure for cost of power, I will admit that is low; but I will not admit that it is not as low as it is done, or could be done. I do not feel free to say much more than that, but there are some waterpowers throughout the country where the price is very low, where the Lord has done a good deal of the work in developing the power, as was suggested here tonight; but aside from that, supposing the development would be along the lines we have had at Niagara Falls, in considering blocks of power as large as this, and as more power plants are installed, and more skill and experience is brought to bear upon them, I think the cost of power at Niagara Falls will be very considerably diminished from what it is now.

Novelties in Special Decorative Incandescent Lamps.

The accompanying cuts illustrate two of the latest novelties in special forms of the incandescent lamp that have just been placed on the market by the Sterling Electrical Manufacturing Company of Warren, Ohio. The Sterling company has for a long time done excellent work along the line of the creation of special miniature and decorative incandescent lamps, and doubtless the two specialties illustrated herewith will be welcomed as novelties by the many interested in decorative lighting work.

STAG'S HEAD NOVELTY INCANDESCENT LAMP.

The stag's head lamp shown is a realistic bit of

glasswork, as is demonstrated by the appearance of the antlers. The lamp is of frosted glass and is a "real burning" incandescent lamp. These stag's head lamps are equipped with either standard Edison base or candelabra base. They are arranged in voltages of 104, 110, 115, or, in fact, any normal voltage lamp may be obtained.

The pig lamp appears as in the picture, and is made in two sizes, one having candelabra socket and another having regular lamp socket; this lamp is made to fit an Edison socket.

To appreciate fully the merits of these little specialties, however, a sample should be inspected and the lamp lighted, as in actual service.

In addition to this and other curious specialties in miniature and decorative incandescent lamps, the Sterling Electrical Manufacturing Company makes a most complete and attractive line of candelabra

PIG NOVELTY INCANDESCENT LAMP.

lamps of various forms suitable for decorative work. The Sterling company also makes a line of automobile lamps particularly suitable for electric automobiles in that they are designed not to be injured by the jarring of the machine and the liability of fluctuations in the voltage, owing to the sudden changes in load and the consequent sudden draught on the battery of the automobile. In addition to the above-mentioned styles, the company likewise produces a line of regular battery lamps, high-efficiency battery lamps, and also telephone lamps for service in switchboards.

Transformer for Thawing Ice in Water Pipes.

A transformer for thawing ice in water pipes has been recently developed by the General Electric Company. This transformer is easily connected to alternating-current circuits, and has proved an immense advance over the old method of opening the frozen ground and applying fire externally, which

TRANSFORMER FOR THAWING ICE IN WATER PIPES.

was both inefficient and expensive. The transformer is shown in the accompanying picture.

The core has three horizontal legs, with a closed magnetic circuit at the ends. Flat pancake coils are threaded on the middle leg and spaced apart, so as to permit an adjustable flux shunt to move up and down between the primary and secondary coils. When the shunt is in the lowest position, it shunts the primary flux from the secondary coil, and in its highest position permits practically all the flux to thread the secondary coil. At intermediate positions, proportionate amounts of flux thread the secondary coil.

Leads from the primary coil are brought out to a suitable connection board on the side of the transformer, on which are mounted primary switches, fuses and ammeter. The terminals of the secondary coil are brought out to heavy lugs, from which cables can be run to the pipes to be thawed.

Complete, the outfit, including the transformer, switches, cover and ammeter, weighs approximately 1,200 pounds. If desired, it will be mounted on four broad flanged wheels to permit its being quickly loaded on a wagon bed or sleigh.

The transformer has the following desirable features deserving of special mention: It is light, compact, easy to handle and operate, is self-contained and free from oil, and readily lends itself to adjustments from zero to maximum secondary capacity without wasting energy in a dead resistance. It is liberally designed for its work. The large radiating surfaces of the core and coils and spacious air ducts insure cool operation under normal conditions.

While the secondary coil is rated at 75 volts and 400 amperes, a very much larger current may be taken from the transformer for temporary operation, especially in winter time. For instance, in starting up with the transformer cold on a winter's day it will be perfectly safe to take out 800 amperes for 10 or 15 minutes. Smaller currents can be taken out for correspondingly longer periods.

The transformer has been especially designed to meet all conditions which may ordinarily arise in practice. It can be successively applied from one operation to another with only sufficient intermission to transfer the connections, and can be used on any pipes of ordinary size and length not requiring an output more than equivalent to a continuous output of 30 kilowatts, or an intermittent output of 60 kilowatts.

The weight is small, considering the capacity of the transformer. The manufacturer offers smaller and lighter outfits where the conditions warrant their use. The General Electric Company has issued an attractive pamphlet describing this transformer, which will be sent on request.

Motor for Cranes and Hoists.

Motors designed for the operation of cranes, hoists and similar apparatus are manufactured extensively by the Westinghouse Electric and Manufacturing Company, and for intermittent service in which heavy starting torques and wide speed variation are required the new type-K is especially adapted. They represent the latest development and include the most recent improvements in machinery of this kind. Many new features of the highest practical value have been incorporated in their construction.

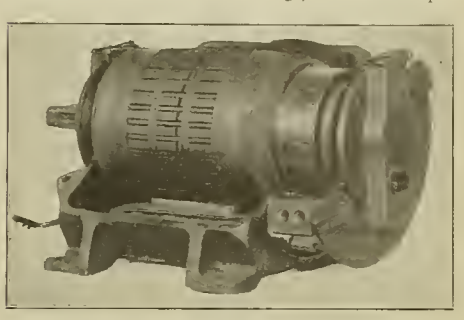
EXTERIOR OF ENCLOSED CRANE MOTOR.

They are strong and compact, convenient to install, adaptable to every practical form of mounting, and are reliable, economical and powerful in operation. Ten sizes are standard, including capacities from two to 40 horsepower. The accompanying illustrations show the motor as a whole and with the upper field removed. The frames are of the wholly enclosed form, to guard against dirt and moisture, but are so designed that the working parts may be exposed for inspection or adjustment without dismantling. If local conditions permit, the cover about the commutator may be removed and the motor operated open, with improved ventilation and increased capacity.

These motors have four inwardly projecting poles, each of which is magnetized by a separate field coil, which is superior to that in which but two poles are directly magnetized. They are series-wound and are designed for operation on direct-current circuits of 220 and 500 volts. Since the current passes successively through armature and field winding, the torque of such a motor increases nearly as the square of the current, up to the point of saturation of the iron. For this reason the series motor is particularly well suited to the starting and acceleration of heavy loads. Governed by change of voltage at the motor terminals, the speed of the motor is carried through a wide range, the change in the resistance of the motor circuit being made by means of a controller.

Cast steel is used for the frames (except in the three smallest sizes, where they are cast iron). They are extremely compact, nearly square in section and require the smallest possible amount of headroom on a crane, or floor space when used with hoists or similar apparatus. Two poles project inwardly in a horizontal and two in a perpendicular plane, this arrangement being the most compact possible with a four-pole motor. The frame is built in two parts, divided in a plane passing through the axis of the armature and at an angle of 34 degrees with the horizontal, an arrangement which allows the upper half of the field to be removed without disturbing the gears or shaft, and makes it easy to take out a pole piece and field coils, or to remove the armature. The lower half of the frame has four feet, with holes for bolting to the support, providing the smallest base consistent with good engineering practice. The lower casting has also two finished faces or pads, to which bearings for a countershaft may be bolted or which may be used for side mounting. The commutator end of the frame is connected to the poles by six ribs, any two of which may carry the brush holders. The opening around the commutator is entirely closed by a three thirty-seconds-inch sheet-steel band, fastened by thumb-screws, an arrangement which permits access to the commutator and brush holders at all points.

The four pole pieces are built up of soft steel punchings, riveted together, between wrought-iron end plates, and are secured to the frame by bolts which pass well into the punchings, but leave the pole



CRANE MOTOR WITH TOP HALF REMOVED.

face smooth and unbroken. The coils of the larger motors are of copper strap, and the terminals are insulated with asbestos ribbon.

Shells lined with bronze or babbitt and mounted in housings which may be removed without separating the motor frame, constitute bearings of particular merit and splendidly adapted to the service for which these motors have been designed.

The armature core is built up of soft steel punchings of high permeability, carefully annealed by a special process. These punchings are, in all except the smallest sizes, assembled on a spider and held from turning by a steel key. The pinion end is provided with a bell-shaped flange, which forms a support and shield for the armature coils. Ducts between the punchings are provided, through which air, drawn in through openings in the spider, is forced out against field coils and core, maintaining a uniform temperature throughout all parts of the motor. The commutator is mounted on the armature web, allowing the shaft to be removed without disturbing the winding or connections. The coils are placed in slots and retained by bands laid in grooves below the surface of the core, except in the case of armatures for the Nos. 9 and 10 motors, which have fish-paper wedges forced in between V-shaped grooves near the top of the slots. Covers of oiled duck adequately protect the ends of the winding. Wiper rings or oil guards are provided at each end of the armature to protect the winding from oil.

The commutator is built up of bars of hard-drawn copper, insulated by prepared mica, and mounted on the armature spider. The commutation is particularly good, in spite of the heavy rushes of current to which a motor of this class is subjected.

Brush holders are of the sliding type and possess many features of peculiar merit. The individual holders may be independently adjusted. Tension is provided by means of a coiled spring, which acts through a short brass strip, so that the spring responds immediately to any movement of the brush, and close contact is maintained at all times. The brush-holder arms are secured by stud bolts to surfaces which are machined on the ribs of the frame, parallel to tangents at the points of contact with the brushes.

With all but the two smaller sizes, a shunt is connected to the tip of the spring, extended back over the spring and securely fastened to the brush holder, thus relieving the spring of the duty of carrying current, insuring good contact, low operating temperature and a permanent and even tension. With every carbon brush five-eighths inch or more in thickness an additional sheet is provided connecting the carbon itself to the carbon holder, improving the contact between carbon and holder and preventing that pitting of the brush which is so annoying and troublesome, besides offering a further protection to the temper of the spring.

Flexible leads are brought out through insulating bushings in the upper frame and are either connected to terminal blocks mounted on the top of the motor, or are arranged for direct connection to the controller lines.

American Associaton in Session.

The American Association for the Advancement of Science and the American Physical Society are holding their annual meetings in Philadelphia, Pa., this week. The sessions are being held in the Morgan Laboratory of Physics of the University of Pennsylvania. The programme includes many papers on scientific subjects. About 1,500 persons were present at the various meetings on the opening day.

Ohio Telephone Notes.

The Village Council of Lakewood, a Cleveland suburb, has contracted with the Cuyahoga Telephone Company to erect at designated points on the streets six telephone instruments for the use of the police and for fire-alarm service. The instruments will be mounted in weatherproof metal boxes, with lock and key. The patrolmen and firemen will be provided with keys, and several keys will be left at neighboring houses, so they can be had in case of fire.

The Farm and City Telephone Company of Van Wert has been incorporated with a capital stock of $20,000. The incorporators are F. W. Purmort, J. A. Wilmore, J. W. Miller, David Counselor and Hugh E. Allen.

For a few days before Christmas the Cuyahoga Telephone Company placed an operator in charge of the "Santa Claus" calls, resulting in much amusement as well as satisfaction on the part of the children. In each case the operator secured the address of the child calling and then sent a list of the things asked for to the parents. In this way the children feel that their requests were granted. This company is becoming more popular all the time because of the little innovations of this kind it introduces.

The stock of the Sugar Grove Telephone Company, Sugar Grove, has nearly all been sold, and the work of erecting poles and stringing wires will begin within a short time.

A suit to recover $3,500 has been brought against the Hotel Euclid Company in Cleveland by the Cuyahoga Telephone Company, the allegation being that the hotel company has taken forcible possession of a complete telephone system placed in the building. Owing to some trouble a few weeks ago the hotel company refused to receive the service of the Cuyahoga Telephone Company and had the Bell company connect its wires with the private exchange which the former had installed in the house.

Checker players of Uniopolis and Waynesfield are conducting a series of games by telephone. A man at each end of the line calls the moves, and it is said the games are played in about the same time as when the players are actually together.

The November statements of all the companies auxiliary to the Federal Telephone Company show a very satisfactory surplus. It is thought that the entire year will show a nice average gain over last year. Each company has striven to make an increase in its business, and most of them have succeeded. C.

Telephone News from the Northwest.

A syndicate of Minneapolis men, headed by S. S. Thorpe, has purchased the Iowa properties of the Mississippi Valley Telephone Company and will proceed to enlarge the system. Thomas Peebles of Minneapolis is secretary and general manager. The company has exchanges at Muscatine, Burlington, Keokuk, Fort Madison and Wapello, Iowa. The old name of the company is to be retained.

A petition has been presented to the Legislature of Canada for authority to form and incorporate the Independent telephone company of Canada, the promoters being Minneapolis men. A local system is to be installed for Winnipeg, with connections to the towns of the province. The capital stock is fixed at $10,000,000.

The telephone exchange at Wadena, Minn., has been rebuilt.

The council of Bismarck, N. D., has granted a new franchise to the Interstate Electric and Telephone Company.

The Twin City Telephone Company gives its subscribers at the Merriam Park exchange, midway between the Twin Cities, a free exchange with Minneapolis, although all the other suburbs of St. Paul have to pay the regular toll.

Citizens of Kerkhoven, Minn., want a local exchange, and propose to buy out the Minnesota Central company, or build a new one.

The Cambridge (Minn.) Telephone Company has been incorporated by local business men with $50,000 capital.

The Farmers' Mutual Telephone Company has been formed to build a rural line from Sunbury to New Liberty, Iowa.

Two new rural telephone lines will be constructed at once at Terril, Iowa.

The Clark Automatic Telephone Company is installing a telephone system at Sergeant Bluff, Iowa.

The new exchange building of the Sioux City (Iowa) Telephone Company has been completed.

The Hamilton County Telephone Company's plant at Webster City, Iowa, has been badly damaged by fire. R.

Southeastern Telephone Developments.

Work has been inaugurated on the handsome new three-story exchange building for the Southern Bell Telephone Company at Greensboro, N. C.

The Bell Telephone Company has applied for the right to enter the town of Chester, S. C., but the local company is said to be opposing the move, together with many of the citizens.

The Southern Bell Telephone Company is installing a new exchange in Fayetteville, Ga.

The long-distance Bell telephone company has nearly completed a line from Charlotte, N. C., to Morganton, a distance of about 100 miles.

A report on the telephones of North Carolina shows that there are 83 exchanges in the state, with 15,632 subscribers, and over 24,000 miles of wire. The total revenues for the year being over $346,000.

The Southern Bell Telephone Company has just completed anbther long-distance line from Lynchburg, Va., to Danville. L.

Indiana Telephone Items.

During a meeting of the Franklin City Council to consider the petition of the Central Union Telephone Company for a local franchise the company asked permission to withdraw the petition, with the view of filing another at an early date. It was discovered that the council and business men generally opposed the ordinance in its present form, and, unless altered, it would never be passed.

There is considerable talk of soon completing an Independent telephone line between Laporte and Chicago, to be operated in conjunction with the automatic system in Chicago. There is a line being constructed from Kendallville to Goshen, and this will connect at Kendallville with the Toledo (Ohio) line. Should such a line be completed, there will be direct telephone connection between Chicago, Toledo, Cleveland, Pittsburg and eastern points.

The commissioners of Gibson County have granted a franchise to a new telephone company to erect poles and string wires in the public highways in Washington, Widner and Vigo townships.

The Blountsville Telephone Company has been absorbed and consolidated with the Cambridge City Telephone Company. R. Lamb is president of the new company and states that many improvements will be installed in the spring.

The Rural Telephone Company is installing a new switchboard at its principal exchange in Milford.

The Princeton Independent Telephone Company is soliciting bids for the installation of a new exchange in Princeton.

James Epperson, state mine inspector, says that telephones are being introduced in the Indiana coal mines and in some instances take the place of the speaking tubes required by law. Mr. Epperson will endeavor to secure a new mining law, leaving it optional with the mine operators to use either speaking tubes or telephones for communication with the miners while at work in the mines. S.

Michigan Telephone Matters.

Within 90 days Detroit will be in telephonic connection with Chicago, Cleveland, Pittsburg, Cincinnati, Indianapolis and other western cities by a new telephone line, according to statements made by J. K. Johnson, manager of the Home Telephone Company. Mr. Johnson is said to voice the intentions of the Independent telephone companies of Michigan, Ohio, Indiana and Illinois. He is trying to make arrangements with the Illinois Tunnel Company, which already operates an extensive telephone service in the downtown district of Chicago, for outside connection.

W. C. McMillan, a director and stockholder of the Michigan State Telephone Company, and W. A. Jackson, president of the company, have just returned from a trip East, where they conferred with interests identified with the company prior to the annual meeting of stockholders to be held in Detroit January 10th. It is understood that some interesting figures as to the progress of the company during the year will be submitted at the meeting. W.

Northwestern Cedarmen's Association.

The ninth annual meeting of the Northwestern Cedarmen's Association will be held at the Hotel Pfister, Milwaukee, Wis., on Tuesday, January 3d, at 2 p. m. All standing committees will meet at 10 o'clock in the forenoon of the same day, as also the board of directors. Any matters for the consideration of the committees or the directors should be in the hands of the secretary before that date. Members of the association who cannot be represented at the meeting are requested to send to the secretary, previous to the meeting, such information regarding the condition of stocks in their hands and their contemplated input this winter as will be of value to the association.

NEW COMPANIES.

The Howardsville Telephone Company of Lena, Ill., has been incorporated to operate a system of telephones. The incorporators are Edward Fisher, G. W. Davis and F. A. Howard.

The Palmyra (Neb.) Telephone Company has been incorporated with a capital stock of $4,000.

The Ridge Farmers' Telephone Company of Hartline, Wash., has been incorporated with a capital stock of $10,000.

The Manila Telephone Company has been organized at Manila, P. I., with a capital stock of $500,000. It is estimated that it will cost $90,000 to install an effective modern system in Manila, and large sums will be spent in extensions.

J. B. Long of the Amity Mutual Telephone Company of Amity, Ore., reports that an Independent mutual telephone company has been organized at Belleview, Ore., and work has already been commenced on the line. The new company will have three lines to Amity.

Hygienic Resonator for Telephones.

The following description relates to the Hoglund hygienic resonator as exhibited at the recent Independent telephone convention in Chicago. This device is not a disinfecting contrivance but an instrument founded on scientific principles, and embodies a number of features that have gained for it much appreciation among telephone men, who have previously been everything but favorable to so-called disinfecting mouthpieces.

The resonator, as described by Mr. G. Hoglund, the inventor, is a "booster" for deteriorating transmitter, inasmuch as its acoustic properties increase the vibrations of the diaphragm without causing any increased packing. A peculiar construction with a convex mirror in front will prevent people from approaching the telephone too closely, serving the double purpose of preventing shouting in the telephone and also preventing the breath from entering the transmitter, and thus preventing contagion by too close approach to the mouthpiece. This hygienic feature without a disinfectant has made the resonator a great favorite with the public whenever applied to public telephones as well as with station managers, who also appreciate the acoustic properties of the resonator in increasing the volume of the voice, thus making their telephone service more satisfactory to the public. The resonator gives a neat and finished appearance to the telephone.

The invention is handled by the Hoglund Hygienic Resonator Company of Chicago, which expects that the device will be popularly received.

GENERAL TELEPHONE NEWS.

A receiver has been applied for to take charge of the Jones County Telephone Company of Anamosa, Iowa.

The telephone companies at Topeka, Kan., are installing private exchanges in the three largest hotels of the city.

The New England Telephone and Telegraph Company has cut its pay-station rates from 10 cents to five cents per call in Boston.

The Pacific States Telephone and Telegraph Company has awarded to Logan & Johnson of Nezperce, Idaho, the contract for the construction of its lines from Dublin to Mohler, Idaho.

Representatives from the Kinloch Telephone Company of St. Louis have been in Kansas City recently looking over the plant of the Home Telephone Company and gathering ideas for the new six-story building for the Kinloch exchange in St. Louis.

The City Council of Palm Beach, Fla., has appointed a committee to investigate the matter of granting a franchise to a new telephone company or encouraging the old company, provided it is reorganized and guarantees good service.

The Royal Trust Company of Chicago has applied to the courts for the appointment of a receiver for the Citizens' Telephone Company of Sioux Falls, S. D. The Chicago company holds $163,000 in bonds on which it is said a year's interest is in default.

It is said that Pleasanton, Iowa, with a population of 300, has an Independent telephone company capitalized at $2,000, operates 60 telephones at $15 for business and $12 for residences, and pays 40 per cent. dividends. It has five toll lines, from which it derives an income.

Independent telephone men of the Northwest—all of South Dakota east of the Missouri River, Southwestern Minnesota and Northwestern Iowa—will hold their annual convention in Sioux Falls, S. D., on January 11th and 12th. An interesting programme will be presented.

The farmers of Chemawa Precinct, Ore., have organized a telephone company for the purpose of putting up a mutual telephone system. William Goodrich of the company will endeavor to arrange with the Pacific States company for connections. The company proposes to connect with Yamhill lines at Wheatland, Ore.

Charles E. Sumner, vice-president and general manager of the Empire State Electric Company of Toledo, Ohio, is preparing to apply to the council of Spokane, Wash., for a franchise for telephones in that city. It is understood that Mr. Sumner has applied for a franchise at Portland, Ore., and, with the system at Spokane, proposes to co-operate with the Independent system at Seattle, Wash., and eventually make long-distance connection throughout the Pacific Coast.

At a recent meeting in Philadelphia of the Eastern Traffic Association of Independent Telephone Companies the matter of long-distance telephone connection with points as far west as Kansas City and St. Louis via the lines of the Keystone Telephone Company was settled. The meeting followed a session of the Pennsylvania State Independent Telephone Association in the offices of the Keystone company. Officers of companies in Pennsylvania, New Jersey, Delaware and Maryland were present. New rates, rules and regulations were fixed by the Traffic association and announcement was made that the new long-distance service will be in operation early next year.

CORRESPONDENCE.

Great Britain.

London, December 14.—Some further particulars of the condition of things as exposed at the recent annual meeting of the British Westinghouse Electric and Manufacturing Company will be of interest as showing what the electrical industry in this country has been passing through. As I have previously pointed out, many people here refuse to believe that foreign competition has had anything to do with the present bad condition of trade, but apparently Mr. W. I. Buchanan, deputy chairman of the British Westinghouse Company, thinks otherwise. He said that it was not the actual amount of business being contracted in Great Britain by foreign firms that was doing harm, but rather the influence which the presence of that foreign competition in all important tenders exerted upon the prices quoted by British manufacturers. Consequently, British manufacturers had to try in advance to discount the unknown outside price, with the net result that much lower prices were made by British companies under such conditions than would be the case were the competition they had to meet limited to British competition alone. Practically speaking, it was difficult to see how we could effect reprisals with the present fiscal policy of this country. The Westinghouse company had now set about reducing expenses and the cost of manufacture and much had been accomplished in that direction.

A trial trip was made upon the electrified portion of the Metropolitan railway this week. Even nowadays it seems to some people quite a feat to propel a train electrically. The leading daily newspaper, the Times, seemed quite surprised and pleased that the train in question should have been propelled over some 25 miles of track without having to call in the aid of a steam locomotive. The opening of the lines of the Metropolitan company beyond the much-discussed "Inner Circle" has been brought about owing to the fact that the company is sole owner and not a partner with another company, as in the case of the Inner Circle. It is satisfactory to learn, however, that a perfect understanding exists between the partners concerning the working of the latter and that electrical working on this line will shortly be in fact accomplished.

At the annual dinner of the Institution of Electrical Engineers last week in considering the toast "Our Transatlantic Kinsmen," some remarks were made which should interest the American engineer. The work of the newer hemisphere in connection with the electrical industry it had been impossible to forecast, but it was not astonishing when it was remembered that this had been capable of accomplishment unhampered by the moss which grew with age in the older countries and with a freedom of action which was impossible here. The speaker believed, however, that in the future things would have to be conducted more and more on the lines of those in the older countries. In conclusion a hearty tribute was paid to the magnificent welcome accorded to the members of the Institution by American electrical engineers during their recent visit to the United States.

A report has been presented to the London County Council advising that in view of the magnitude of the council's electric-tramway undertaking the various parts and details of the rolling stock and plant should be standardized and that standard samples and patterns should be immediately prepared of all the various parts. This was agreed to, the cost of preparing the various patterns and drawings being placed at $1,750.

In connection with the various large power supply schemes for London, which were referred to a few weeks back and which will be put before Parliament this session, a movement is on foot to offer combined opposition against all of them in behalf of the various London Borough Councils. It has been decided to call a conference of the London Borough Councils and the London County Council to consider the steps to be taken to protect the interests of municipal electricity supply undertakings in London.

The question of dealing with goods traffic upon electric tramways has come to the fore during the year. An account has just been issued of the parcels traffic conducted upon the Bradford corporation electric tramways during 1904, from which it is seen that 250,000 parcels were carried at an average rate of two cents per parcel, the gross profit being £1,000. A huge and comprehensive scheme for the carrying on of such traffic has now been submitted to the corporation for approval. Under this scheme the delivery of parcels will be carried on by motor vans in districts where the tramways do not travel. Intercommunication with other tramway systems for the same purpose is proposed.

The English house of J. G. White & Co. has received the contract for the conversion of the whole of the Belfast horse tramways to electric traction. The price is over $2,500,000. G.

New York.

New York City, December 24.—The city will take steps to appeal against the injunction of the Supreme Court forbidding the payment of outstanding lighting accounts. Meanwhile, Comptroller Grout is pushing a preliminary investigation into the subject. The Manhattan and Bronx Electric Company has a plan for a lighting plant and asks permission to use the ducts of the Consolidated Telegraph Company for lighting and power wires. Sundry public associations have endorsed the demand for establishing a municipal lighting plant.

The Metropolitan Street Railway Company foreshadows that it will apply for a modified route for an East Side subway to be constructed by J. B. McDonald. It is now proposed to run up Third Avenue instead of Lenox Avenue, so as to facilitate a physical connection with Mr. McDonald's proposed electric lines in the Bronx.

The Interborough Rapid Transit officials are to replace all the copper-sheathed wooden cars in the subway by steel cars. The wooden cars are to be gradually removed to the Second and Ninth Avenue lines. The lower portion of the subway is to be opened as far south as Fulton Street early in January. The tracks, including the third rail, are already laid, while the tunnel itself has been constructed as far as Battery Place.

The certificate of the franchise for the Sixth Avenue subway was handed to Mr. McAdoo on Wednesday. The franchise provides for 12 stations. There are to be no exits or entrances on public property without special permission. Work must be begun within six months and completed within five years. For the first 10 years the company is to pay a rental of 50 cents per linear foot of track, a lump sum of $9,000, and three per cent. on the gross earnings. After 10 years the rental is to be increased to $1 per foot, and five per cent. of the gross earning. The franchise is for 25 years.

President Orr of the Rapid Transit Commission announced on Thursday that the committee in accepting Mr. Parsons' resignation as chief engineer will nevertheless retain his services as consulting engineer. The commissioners have unanimously decided on the appointment of George S. Rice as acting chief engineer.

The new Grand Central Station, which is to include a side station for a number of electric subway lines, will occupy 19 blocks in place of the five on which the present terminal stands. The total cost of land for the site, even at a low appraisement, will be about $10,000,000. As now arranged, the suburban trains are to arrive at the underground level of the terminal, from which there will be a direct opening to a large subway station adjoining. The express trains are to arrive on the ground level, and the stairway to the subway is to open from within the concourse. It is now hoped that there will be a direct connection between the Grand Central Station and the subway between New York and Jersey City.

The Court of Appeals has given a decision in favor of the New York City Interborough Railroad Company, which proposes to lay six new lines of electric traction in the Bronx. This application had been turned down by the railroad commissioners.

The New York City Railway alleges that it has been losing $1,000 a day through a fraudulent use of transfers.

The Rapid Transit Commission is preparing a bill to be presented at Albany to enable the city to construct pipe galleries as accessories to future subways. It is contended that these pipe galleries would soon pay for themselves.

Great opposition has been shown by the chief of construction of the navy and the bureau chiefs at Washington to the plan advised by civilian experts to consolidate the power plants of the Brooklyn navy Yard. Notwithstanding the opposition of the naval experts, it is intended that the question shall be referred to Congress and an effort will be made to have provision in the annual appropriation bill for carrying out the plan of consolidation.

At Albany, this week, the Jacques Ochs Company, for the manufacture of arc and incandescent lamps, whose plant is situated in Brooklyn, was incorporated with a capital of $5,000. D. W. W.

Dominion of Canada.

Ottawa, Ont., December 24.—The gross returns of the electric street railway of Trinidad, B. W. I., for the month of November last, amount to $17,850 and the net profits to $10,550, making an increase in net profits over November, 1903, of $1,750. This places the company's stock on an earning basis of 8½ per cent.

The Canadian Westinghouse Company's nine new buildings in the city of Hamilton, Ont., have been completed and within a few weeks some 1,000 skilled mechanics will be occupying them. The company has begun to install the new machinery. The sprinkler system will be one of the best in the world.

The County Council of the county of Waterloo, Ont., has passed a resolution indorsing the movement on foot to establish a rural telephone system in the county, and against the granting of exclusive franchises to the Bell Telephone Company by any of the municipalities of the county, which might prevent the rural line from obtaining connection with municipalities. The council also decided to support the proposition to again memoralize the government to enact a law that, until the long-distance lines be taken over by the government, compulsory service be given over long-distance lines at rates approved by the government.

The Montreal Street Railway Company has opened its new electric railway through the town of St. Paul, as well as the new line to the locomotive works at Longue Pointe. The distance between the two points above named is a little over nine miles, which, at certain times in the day, can be covered for a fraction over three cents. The company has also under consideration the extension and completion of its suburban lines, and within another year many points in the vicinity of Montreal, now reached by steam cars, will be served by the electric system.

During the last few years scores of private plants for the lighting and power supply of individual buildings or groups of buildings under one ownership have been erected in the city of Montreal. The most recent of these plants is that of the Central Electric Company, an enterprise controlled by members of Carsley & Co. This is the first independent company formed for supplying electricity in Montreal since the small electric companies were all absorbed by the great power corporations, and it is consequently looked upon as a development of great significance. The new company has already working three engines and dynamos of English manufacture. The great advantage claimed for them is that they are particularly suited for an installation in a closely built district. The capacity of this plant is 700 horsepower, with room for considerable expansion, both of boilers and engines.

The Westinghouse people are completing a fine 150-kilowatt system for the Bank of Montreal, and they have also erected plants in many other large buildings. The Allis-Chalmers Company has also installed a considerable number of private electric-lighting and power plants in the city, as has also the Canadian General Electric Company. A few years ago it was thought that the day of the 500 or 1,000-horsepower steam-generated electric power plant was over. Today, however, private plants are springing up in every direction throughout the city of Montreal. W.

New England.

Boston, December 24.—Justice H. H. Chase, who held the inquest concerning the recent death of Harry B. Masters of Brockton, finds that the Edison Electric Illuminating Company of Brockton is responsible, death having been due to a shock from the electric-light wire, and that the company had been advised of the strong current on the wire several days before the accident.

At a meeting of the Boston transit commissioners this week it was decided to open the East Boston tunnel to public travel on Friday, December 30th.

Gen. William A. Bancroft, president of the Boston Elevated Railway Company, has returned from his observation trip to Europe. He visited five different countries, inspecting the electric-railway systems of many important cities and conferring with railway officials in these centers.

On Saturday last, at Middleboro, Mass., the property of the Middleboro, Wareham and Buzzard's Bay Street Railway Company was sold at auction, the purchasers being John A. Arnold and George H. Newhall of Providence, and Charles F. Choate, Jr., of Boston. Their bid was the only one, and $35,000 was the amount, subject to mortgage bonds of $150,000, a receiver's loan of $20,000 and preferred claims of $50,000 aggregate. The Bristol County Street Railway Company's property was also sold at Middleboro on the same date for $30,000 to the same trio, subject to bonds of $200,000 and other obligations. A merger of the two roads is expected.

Gen. Thomas Sherwin, president of the New England Telephone and Telegraph Company, was the guest at luncheon on Wednesday of the directors of the Boston Merchants' Association, and gave a very interesting address on the subject of telephone service, incidentally answering, in an informing way, numerous questions propounded by his auditors relative to rates, cost of service and improvements in the system.

The annual meeting of the Boston Elevated Railway Company will be held in Boston on January 2, 1905. The West End Street Railway Company (leased) will also hold its annual meeting on that date.

Part of the plant of Osgood, Bradley & Son, car manufacturers at Worcester, was burned December 19th, as the result of a gas explosion. Two workmen were badly scorched. The property loss was about $10,000, it is estimated.

Electrical workers in New England will receive a substantial increase in wages on January 1, 1905. An agreement has been made which stipulates the degree of skill required of the men. A joint committee of employers and employes will examine applicants for work as journeymen and helpers and issue certificates.

The Charles T. McCue Company of Hartford and the Hubbard Motor Company of Middletown are two new companies recently incorporated in Connecticut with a capital of $50,000 each. The concerns will construct motors, engines, machinery, vehicles, etc. B.

Southeastern States.

Charlotte, N. C., December 24.—A movement is on foot, backed by business men of Manning, S. C., and other points, to build an electric railway from Manning, through Summerton, to Wright's Bluff.

The Carolina Water, Light and Power Company, with $250,000 capital stock, proposes to construct

and maintain water, light and power plants in Marion, S. C.

The town of Douglas, Ga., is contemplating the letting of contracts for a lighting system, for which bonds were issued some time ago.

The town of Martinsville, Va., has voted $60,000 for a lighting and power plant in the city. The power will be developed on Smith River.

F. W. Siebert is manager of the new $8,000 electric-light plant at Lexington, N. C. The machinery has been shipped and the work is now well under way on the new plant.

An extension may be built in West Asheville to the electric-railway system of Asheville, N. C.

After much litigation to prevent the sale of the Bay Shore railroad and the Hampton Roads Railway and Electric Company of Virginia, an order has finally been signed for the sale of the two roads, and appointing H. H. Little and R. T. Thorp, respectively, special masters of the roads.

The Raleigh (N. C.) Electric Railway Company has made an offer to sell out to the new Raleigh and Durham Electric Railway Company, which has secured a franchise in Raleigh for 60 years. L.

Texas.

Austin, December 22.—The project of building an interurban electric railway between San Marcos and Luling, Texas, has been taken up by local and outside capitalists. The route will be down the valley of the San Marcos River, passing through the towns of Martindale, Staples, Prairie Lea and other smaller places. The line will be about 14 miles long. Judge B. G. Neighbors of San Marcos is interested in the project.

The Port Arthur Electric Street Railway Company of Port Arthur, Texas, has completed a survey for the proposed extension of its line to the deep-water docks, a distance of about two miles, and thence to the oil refinery and to West Port Arthur.

H. F. McGregor, manager of the Houston Electric Company, and John Tod of Houston have been investigating the situation at Corpus Christi with the view of constructing an electric street-railway system. They are said to represent a syndicate of eastern capitalists, who will undertake the work if the report is favorable.

A syndicate of St. Louis capitalists propose to build an interurban electric railway between Brenham and La Grange, Texas, a distance of about 25 miles. Citizens' committees have been appointed in each of the towns to raise the required bonuses and obtain the right-of-way for the proposed road. G. A. Heilig and J. F. Wolters of La Grange are the active representatives of the St. Louis persons in the enterprise.

The Temple-Belton interurban electric railway has been placed in operation. H.

Mexico.

City of Mexico, December 21.—The American syndicate represented in this city by Captain Charles Holt, who recently purchased Mt. Popocatepetl, is said to be preparing plans for the construction of a monorail railroad from the town of Tlamacos to the crater.

If the plans of a syndicate of New York and Philadelphia capitalists are carried out one of the largest electric power plants in Mexico will be established at the Malinaltenango Falls, in the district of Tenancingo, state of Mexico. Major George B. Burbank of New York city and A. S. Harvey of Leadville, Colo., engineers representing the Americans interested in the project, accompanied by George Stuart Simons of New York and William Mackenzie of San Antonio, Texas, have just finished a thorough examination of the falls with the view of ascertaining the waterpower available. There are three falls, from which it is thought 25,000 electrical horsepower can be developed for transmission to the City of Mexico and other places within easy distance of the falls.

The great Zoquitleco waterfall, situated near Corales, Mexico, which was owned by Andres Solon, has been sold to him by a Belgian syndicate. The purchase price was $400,000. It is announced that the syndicate will establish a large electric power plant for supplying power to its large sawmills and to other industrial concerns in that section.

The Bermejillo interests, which own the street-railway system in the city of Guadalajara, Mexico, have not abandoned their efforts to obtain from the Mexican government a concession for the establishment of an electric street-railway system in that city. In anticipation of securing the concession plans have been prepared for a large electric power plant to be located about two miles north of the Juanacatlan Falls, in the state of Jalisco. The government of the state of Jalisco has granted Francisco Laveaga of Guadalajara, Mexico, a concession to establish an electric power plant on the Ayutla River near Union de Tula, and to use the waters of that stream to operate the plant. The electrical energy to be generated will be used to operate the machinery of the reduction mill and other works at the Casa Blanca mines, of which Mr. Laveaga is manager.

John J. Moylan of the City of Mexico is having plans prepared for a large electric power plant which he will construct on the San Cristobal River, near the town of San Cristobal, state of Guerrero.

The American company represented by Sidney Sprout successfully competed with Oscar Braniff of the City of Mexico for the contract to construct and operate an electric-light and power plant and electric street-railway system in the city of Culiacan, state of Sinaloa. Mr. Sprout has made a deposit in the city treasury of Culiacan as a guaranty that the terms of the franchise which has been granted to him on behalf of his company will be carried out.

The government of the state of Jalisco has granted a concession to Carlos Navarro Mora of Guadalajara, Mexico, to establish an electric-light and power plant at Chapala, Mexico. Mr. Mora will furnish lights for the city of Chapala and the cottages on the shore of Lake Chapala and will also erect a flour mill which will be operaated by electricity from the power plant. H.

Ohio.

Cleveland, December 24.—The annual meeting of the Columbus, Delaware and Marion Railway Company and the Columbus Northern Railway, Power and Equipment Company will be held at the Chittenden Hotel, Columbus, on the afternoon of January 2d, when the plans for taking over the properties of the Columbus, Delaware and Marion and the lighting and power companies will be discussed.

Claims against the Miami and Erie Canal Transportation Company are being settled, and it is believed that everything will be in good shape within a short time.

Mayor Finch of Toledo has decided to sign the ordinance authorizing the lighting committee to enter into a contract for street lighting for from two to five years. The Toledo Railways and Light Company will probably get the contract.

The Bullock Electric Company of Cincinnati has been incorporated with a capital stock of $2,500,000, to take the place of the New Jersey corporation under which the big Bullock plant has been operated. Of the entire amount, $1,000,000 will be common stock and the remainder six per cent. cumulative preferred stock. The articles provide that if dividends are not paid for two years the preferred stockholders may elect new directors. No mortgage is to be placed on the real property except for the acquisition of additional real estate. Neither is the machinery or plant to be mortgaged to the detriment of the stockholders.

A decision of the Circuit Court requires that the City Railway Company of Dayton must thoroughly bond its tracks to prevent the escape of electricity into the earth.

The lighting arches on High Street, Columbus, are again under discussion, but it is believed arrangements will be made to retain them. This is a novel way of lighting a business street, and has attracted much attention.

The new municipal plant at Columbus is almost ready for operation in a portion of the territory it will serve. The plant has been tested and found to be in good shape. The city will have an opportunity to thoroughly demonstrate whether there is anything in municipal ownership.

For the purpose of building a new road between Canton and Akron, the Buckeye Streeet Railway Company has been incorporated with a nominal capital stock of $1,000, by J. H. Van Der Vere, Edward H. Tracey, Davis Hawley, S. D. Reed and J. E. Chadwick, all of Cleveland. These men have not given out much detailed information regarding the company.

An electric plant will be built at the Pennsylvania railroad docks at Ashtabula for the purpose of operating the ore-hoisting machinery.

Reports are still in circulation to the effect that the Toledo, Columbus and Cincinnati Electric Railway Company has been financed and that it is now sure to be built. W. H. Luctenburg, the Columbus contractor, is one of the men now deeply interested in the proposed line from Cincinnati to Toledo.

Fifty convertible cars have been ordered by the Cleveland Electric Railway Company. The Brill Car Company secured the order and the work will be done at the Kuhlman shops in Collinwood, near Cleveland.

President J. M. Morgan of the Cincinnati, Toledo and Detroit Short Line Railroad Company says that the proposed line will be operated by electricity, but will not be a trolley line. It will, he says, be an electric railroad in every sense of the word.

Cleveland bondholders of the Springfield and Xenia Traction Company purchased the property of the company at receiver's sale a few days ago for $225,600, the last appraised value being $200,000. The outstanding bonds amount to $425,000, and $75,000 of bonds have been put up to secure a floating indebtedness of $60,000. The plan is to operate the road in connection with the lines of the Bushnell syndicate.

At a meeting of the stockholders of the Toledo, Bowling Green and Southern a few days ago, it was decided to lease the property to the Toledo Urban and Interurban Railway Company, which is backed by the Kilgour and other interests. The first year dividends of one-half of one per cent. will be paid and the percentage will increase until the stockholders will receive four per cent. on the tenth year, after which it will remain the same.

A mortgage for $1,500,000 has been filed with the Ohio Trust Company by the Springfield, Charleston, Washington and Chillicothe road to secure a bonded indebtedness for the same amount.

Indications are that the committee in charge of the Everett-Moore affairs will retire by the first of the year and the syndicate will be given possession of its securities. It will then complete the work of straightening out its affairs, and, without doubt, will continue the work of promoting and developing electric-railway and telephone properties. O. M. C.

Indiana.

Indianapolis, December 24.—The city of Greencastle has brought suit against Albert Lieber, principal owner of the Indianapolis and Plainfield traction line, and the Federal Surety Company on a $5,000 bond to insure the operation of interurban cars between Indianapolis and Greencastle by September 1, 1904. Much work has been done, but the line lacks many miles of reaching Greencastle.

A move is in prospect to unite the interurban electric companies operating in eastern Indiana and western Ohio, so that from them will be formed a system of electric railways closely connecting Indianapolis, Fort Wayne, Cincinnati, Columbus, Springfield, Cleveland and Toledo. The moving spirit in the undertaking is the Elkins-Widener syndicate, largely interested in Indiana and Ohio lines. Hugh J. McGowan, Indianapolis representative of the syndicate, would neither affirm nor deny the report, but admitted enough to indicate that the plans are so far along that the success of the undertaking cannot longer remain a subject of doubt. They call for through lines from all the large cities reached, and will bring hundreds of miles of electric railways under one management and in one system.

The Seagraves electric line has been developing new life in northeastern Indiana. Butler City has granted the company a new franchise, and the syndicate is working for new franchises in Auburn, Garret, Kendallville and Waterloo. Work is to begin in the spring.

The Indiana Railway Company, operating between South Bend, Mishawaka, Goshen and Elkhart, has been consolidated with the Indiana Western Railway Company, constructing an electric line westward from South Bend through Laporte County. The articles of consolidation authorize the directors of the merged corporation to issue $3,000,000 in bonds.

Ten new cars have been received from the St. Louis Car Company for the Rushville line of the Indianapolis and Cincinnati traction line, to be opened January 1st. The new cars are large and heavy.

A company is organizing in Indianapolis for the construction of an electric railway south from Terre Haute to Vincennes. The company will be capitalized at $1,500,000. J. M. Heath is promoting the road and will superintend the preliminary survey.

The Indianapolis and Ohio Valley Traction Company is a new company to file articles of incorporation during the week. Its capital stock is placed at $50,000. The line will be 150 miles long and connect Indianapolis, Nashville, Bloomington, Bedford, Mitchell, Paoli, West Baden, French Lick, Jasper, Rockport, Troy, Tell City and Cannelton. Joseph H. Larimer, Butler Smith, A. E. and E. J. Fauve of Indianapolis and Peter Baker of Troy are the principal stockholders and incorporators.

The Indiana Shippers' Association is opposed to incorporating in the bill to go before the next Legislature for a state railroad commission the power to deal with the question of protection for grade crossings, as such a provision will endanger the passage of the bill.

The Indiana farmers will attempt to secure legislation that will almost prohibit automobiles or vehicles propelled by steam, electricity or gasoline from the use of the country highways.

The government has directed George F. McGinnis, postmaster at Indianapolis, to make contracts for the transportation of mail on the interurban lines out of Indianapolis. The schedule calls for five mails each way daily. S. S.

Michigan.

Detroit, December 23.—A map has been filed with Railroad Commissioner Atwood at Lansing, showing the complete route of the Detroit and Bay City Traction Company. There are 15 crossings with other railroads which are asked to be allowed at grade.

The Detroit United Railway Company's "Trolley Song" contest for a prize of $200 will close at 6 p. m., Saturday, January 7th, and no manuscripts will be received after that hour. The conditions of the contest were published in the Western Electrician some months ago. Many manuscripts have already been received from various localities, and a set of judges will determine which one will receive the prize.

The through freight and passenger service which will be inaugurated early in January over electric roads between Detroit and Cleveland, by way of Toledo, will be an active competitor of the Detroit and Cleveland Navigation Company and the Cleveland and Toledo line of steamboats, but the White Star Line, between Detroit and Toledo, will feel the effects of the Detroit, Monroe and Toledo Short Line to the greatest extent. General Freight Traffic Manager D. C. McIntyre, of the Detroit and Cleveland lines, discusses the situation freely. He said that, as far as his interests were concerned, the Lake Shore electric road between Cleveland and

Toledo would cut heavily into the freight receipts of the Cleveland and Toledo steamboat line. Where the steamboat companies are at a disadvantage is that they are out of the field for three or four months of the year, when the river is closed by ice, while the electric lines are in operation the whole year. Business diverted from the steamboat lines to the electric lines during the winter is hard to get back, rates being equal.

Detroit's mammoth automobile industry receives a powerful impetus by the reorganization of the Reliance Automobile Manufacturing Company, just consummated under the new corporate name of the Reliance Motor Car Company, for the purpose of continuing the manufacture of the Reliance car. The new corporation begins business with a capital of $400,000 and a splendid executive force, under the presidency of J. M. Mulkey. Frank R. Thrall is the general manager.

An ordinance has been introduced in the council for the reduction in the price of electric lights. It is intended to accomplish this by regulating the rates at present charged by the Edison company. The ordinance provides for a rate of 10 cents per kilowatt-hour for the first 75 hours and five cents thereafter. The ordinance was given its second reading and laid over for one week.

The Grand Rapids-Muskegon Water Power Electric Company was recently organized under the laws of Maine, with a capitalization of $1,000,000, for the purpose of building one or more dams on the Muskegon River, for developing electrical current for commercial purposes in Grand Rapids, Muskegon, Big Rapids and other places. The first dam will be built at Rogers Bridge, about six miles below Big Rapids. Preliminary work upon this is already well under way, and it is hoped to be in a position to deliver the current in this city by August of next year. This dam will be capable of developing 3,000 horsepower for 24 hours at low water. With the transmission line to this city, the cost of this work is estimated at $400,000. C. G. W.

Northwestern States.

Minneapolis, December 24.—The Waterloo and Cedar Falls (Iowa) Gas and Electric Company has been voted a franchise at the latter city.

The new electric-light plant at Shell Lake, Wis., has been completed.

The Pathfinder Electric and Water Power Company has been formed by G. L. Shumway and will erect a power plant at Gering, Neb., at a cost of $85,000.

The public Service Club of St. Cloud, Minn., has been incorporated by E. E. Clark and others for the purpose of constructing an electric-light and power plant. It is capitalized at $300,000.

The Ashland (Wis.) Light, Power and Street Railway Company may build an interurban line from Ashland to Superior, Wis.

The Wisconsin Light and Power Company has been incorporated at La Crosse with a capital of $200,000. J. J. Hogan heads the list of incorporators. The company will apply at once for a franchise at La Crosse, Wis.

A vote will be taken at Gillett, Wis., on January 3d on the proposition to establish an electric-light plant there at a cost of $6,000.

Bids will be received shortly by R. M. Schofield, quartermaster, for an addition to the electric-light plant at Fort Snelling, Minn. The improvement will cost about $10,000.

The R. I. Light and Power Company will put in a new electric-lighting plant at Ludden, N. D.

S. A. Vopatek of New Prague, Minn., will incorporate the Montgomery (Minn.) Electric Light and Power Company. A light plant will be built at Montgomery. R.

Pacific Slope.

San Francisco, December 23.—A. D. Schindler, general manager of the Huntington electric lines in and about Los Angeles, Cal., is in San Francisco on business matters. John A. Cranston, head of a big electric concern at Portland, Ore., is also in the city.

The steamship Minnesota, said to be the largest freight and passenger vessel under the American flag, is in the harbor of San Francisco. The electrical equipment of this huge vessel is wonderfully complete. There is an electric heater and telephone in every stateroom, and at the central telephone office there is always an operator on duty. The handling of the cargo is accomplished by 36 noiseless electric winches. In the galley there are electric broilers, electric dough mixers and electric plates for the making of hot cakes. In the pilot house electricity works the whistle, operates the steering gear and carries messages from the bridge to the engine room and other parts of the ship. Also an electric clock takes charge of the fog signal in thick weather, and another electric device stands guard over the electric lamps which constitute the side lights and other law-required illumination. If one of these lights goes out, a bright lamp glows in the pilot house and a bell rings, and neither ceases until the extinguished light is again in commission.

The California Gas and Electric Corporation, which recently contracted with the United Railroads of San Francisco to supply electric power for the operation of the entire system, has let the contract for the generators of the new plant. The Abner Doble Company, representing the Crocker-Wheeler Company, will supply the set, which will consist of three machines having a capacity of 4,000 kilowatts each. They will be direct connected to 5,500-horsepower gas engines. The generators will deliver 25-cycle, three-phase, alternating current and will feed into the railway system through the present sub-stations. This contract is an important one, both on account of the size of the units and because of the prominent part which the big transmission company evidently intends to play in the local power field.

Capt. W. T. Forsman, projector of the proposed Northern Electric Railway and Navigation Company, has returned to Colusa, Cal., from San Francisco, where he has been engaged in making arrangements for the commencement of initial work on the company's power plant at Butte Creek. E. W. Sutcliffe will superintend the construction of the plant, which will cost about $275,000.

It is announced that Contra Costa County, Cal., will soon be connected with Oakland by a complete electric-railway system that will reach every portion of the county. It is not stated who is behind the enterprise, but the work is actually under way.

The supervisors of Fresno County, Cal., have granted to F. W. Bray a franchise to construct an electric plant and system in Coalinga.

The United Light, Fuel and Power Company has been incorporated at San Diego, Cal., with a capital stock of $500,000. The majority of the stock is owned by John D. Spreckels of San Francisco. The corporation is formed to construct and operate plants for making electric and gas light, fuel and power in the state of California. The principal place of business is San Diego.

The council of San Jose, Cal., has received an application from O. A. Hale, president of the Interurban Railway Company, asking for a franchise for an electric railway from the postoffice on Market Street, San Jose, to Coyote Creek; also for a franchise to extend the line to Evergreen, Berryessa and to the edge of Alum Rock Park.

There are prospects for the establishment of an electric power plant on Rock Creek west of Haines, Ore. Bids for the construction of two reservoirs are being called for, the work to be commenced by June 1st and completed by September 1, 1905. Eilert Eilertson of Haines, Ore., and Senator Walter M. Pierce of Pendleton, Ore., are interested in the project. Water will be conveyed to the power plant by means of a large flume. The plant will be equipped with the latest machinery for furnishing light and power.

An electric railway, 26 miles in length, connecting Portland with Hillsboro, Cornelius and Forest Grove, Ore., will be built and in operation in time for the Lewis and Clark Exposition at Portland, if an agreement can be reached with Hillsboro and Forest Grove regarding a subsidy. The cost of the road is estimated at $600,000. The Oregon Traction Company of Portland is the promoter of the enterprise. A.

PERSONAL.

Robert J. Fleming, city assessment commissioner of Toronto, Ont., has been appointed general manager of the Toronto street railway.

F. F. McGuire of Boston, Mass., has been appointed general manager of the Mexican Telephone Company of the City of Mexico, to succeed Percival Burgess, resigned on account of ill health.

E. F. Phillips, assistant manager for the Edison company and the Peninsular Electric Light Company of Detroit, has gone to Phœnix, Ariz., and Los Angeles, Cal., to spend his first vacation in 14 years.

Alonzo Burt of Kansas City, Mo., president of the Missouri and Kansas Telephone Company, has resigned, it is reported, to take effect January 25th. He will devote his attention to the Wisconsin Telephone Company. Mr. Burt, it is thought, will likely be succeeded in Kansas City by C. E. Yost of Omaha, now acting president.

Gisbert Kapp, the well-known Anglo-German electrical engineer, who left England in 1895 to become secretary of the Verband Deutscher Elektrotechniker, will return to become professor of electrical engineering at Birmingham University. According to the terms of the appointment, Mr. Kapp will be allowed to practice as a consulting engineer.

W. L. Stretlau, who has been superintendent of the Toledo division of the Lake Shore electric road in Ohio for some time, has been appointed superintendent of the Springfield and Xenia electric railway, which was recently purchased by Cleveland men. J. W. Parker, who had been superintendent during the receivership, goes to the Springfield, Troy and Piqua, the Bushnell road.

President F. S. Dickson of the Federal Telephone Company, Cleveland, Ohio, is a great admirer of Thackeray. He has gathered together all the various books and writings of that author, besides the biographies, clippings and everything else he can find relating to him. Many handsome and costly editions of Thackeray's works are on his library shelves, the whole collection containing about 900 volumes. Mr. Dickson became interested in the novelist while at Yale, and has been making a study of him ever since. As a result he has become an international authority on Thackeray and often receives requests for information on points connected with his writings or his life. Mr. Dickson wrote the bibliography of General Wilson's book, "Thackeray in the United States," the story of his lecturing tour here in 1852 and 1853.

Mr. C. W. Whitney has resigned his position as Pacific Coast representative of the McGraw Publishing Company and has become identified with the Abner Doble Company of San Francisco, engineer and manufacturer of tangential waterwheels and needle regulating nozzles. Mr. Whitney, who will have charge of the company's publicity department, is pleasantly remembered in Chicago, where he was associate editor of the Western Electrician.

Mr. Theo. P. Bailey has resigned his position as assistant manager of the Chicago office of the General Electric Company, which position he has held for many years. Mr. Bailey entered the employment of the Vandepoele Electric Light Company in 1882, and soon thereafter was elected secretary of the company, which position he held until 1884, when he engaged his services to the Thomson-Houston Electric Company as selling agent for its electric arc-lighting apparatus in the West. His great success in this work made him easily the choice of his company to assume the direction and management of its railway department in the West, when it took up that work in 1887. In 1892 a consolidation was effected with the Edison General Company, and the General Electric Company was formed. Mr. Bailey was continued in the management of the western railway department of the new company. The company's business had grown so rapidly that in 1893 it was found necessary to divide up the large territory under the control of the Chicago office, and accordingly district offices were established at Denver, San Francisco and Atlanta. In 1888 Mr. Bailey read a paper before the Chicago Electric Club in which he predicted that electricity would in a very few years take precedence over all other forms of power for transporting passengers on street railways. This statement was bitterly attacked at the time by interests controlling the cable railways in fear that, unless mollified, their holdings in cable stocks would suffer a serious depreciation. The wisdom of the prediction has, however, been proved, as is well known. Mr. Bailey has been associated with General Electric interests for just 20 years, and leaves the company with very great reluctance on his own part and with the sincere regret of the officials of the company. He has associated himself with the L. E. Myers Company, contracting engineer, Chicago, and will hold the position of vice-president and general manager. He will enlarge and extend the scope of the company's business at once. Mr. Bailey's long, varied and successful experience in electric-railway and lighting affairs will add great strength to the L. E. Myers Company.

THEODORE P. BAILEY.

A number of important additions have been made to the staff of the Allis-Chalmers Company recently. W. L. Loveland, the newly appointed head of the mining and crushing-machinery department, is widely known among mining men and has at command all the benefits which come from both a technical and practical training. Mr. Loveland graduated from the University of Michigan in the class of 1882 and spent the following eight years as a mining engineer and metallurgist, being actively employed during this time in mining and the erection and operation of mills and smelters. In June, 1897, he was appointed to the position of manager of the mining machinery sales department of the Gates Iron Works, Chicago. He remained with this company until 1901, when there was a consolidation with the present Allis-Chalmers Company, at which time he was appointed head salesman in the mining-machinery department of the Chicago office. H. Schifflin has recently been made assistant manager of the mining and crushing-machinery department, with headquarters in the New York Life Building, Chicago. Mr. Schifflin's connection with the mining and crushing-machinery business began in 1886, when he entered the employment of the old Fraser & Chalmers firm as a draftsman. Mr. Schifflin has therefore been in the employment of the Allis-Chalmers Company or some of its constituent companies continuously during the last 18 years. J. U. Jones of Dallas, Texas, one of the best-known salesmen in the Southwest, has joined the staff of the Allis-Chalmers Company of Milwaukee and will hereafter represent the company and its widely varied products in Texas and its tributary territory. He began his business life as a machinist in the locomotive department of the Texas and Pacific railroad. Then for nine years he was superintendent of the plant of the Paris Gas and Electric Light Company. Leaving that position, he built the Crook-Record plant in Paris, Texas, and operated it as manager for two years in opposition to the older plant. A

combination of the two plants was effected through the efforts of Mr. Jones, who managed the two for a year afterward, as superintendent. The next event in his business career was his joining the Southwestern Electrical and Construction Company of Dallas, Texas, as traveling salesman and superintendent of erection for the plants which the firm installed. Leaving that firm he was for three years in a similar capacity with Collins & Delaney of Paris, Texas, and later with the Murray Compaany, remaining with the latter concern until the time of making his present arrangements.

ELECTRIC LIGHTING.

M. H. Ledford has leased the electric-light plant in Bowling Green, Mo.

Canandaigua, N. Y., is contemplating the establishment of a municipal lighting plant.

The Black Hills Electric Light Company has been granted a franchise by the City Council of Deadwood, S. D.

Bacon, Hays & Wilkey have purchased the business of the Hartzell Light and Milling Company at Poplar Bluff, Mo.

C. H. Dabbs, E. Cahn and others have applied for a franchise to establish a plant for furnishing gas, electric lights and steam heat in Meridian, Miss.

The city of Sturgeon, Mo., has sent out a committee to visit other Missouri cities and investigate the advisability of installing a municipal electric-light plant.

A special city election will be held in Clarinda, Iowa, on January 18th, to vote on the proposition of granting a franchise to the Lee Electric Light Company to erect an electric-lighting plant.

The Georgetown Electric Company, with headquarters in Chicago, has been incorporated with a capital of $15,000. It is proposed to operate a heat, light and power plant. W. F. Brugman, A. M. Searle and C. C. Travis are the incorporators.

The El Paso Gas and Electric Company of El Paso, Texas, recently incorporated with a capital of $500,000, has completed organization by the election of the following-named officers: President, G. F. Goodnow of Waukegan, Ill.; vice-president and treasurer, C. H. Bosworth of Chicago; secretary, W. J. Cook; general manager, Thomas Jones. The company has purchased the plant of the El Paso Gas, Electric Light and Power Company, which it will improve.

First-mortgage gold bonds of the Louisville (Ky.) Lighting Company to the amount of $250,000, are being offered to investors. The bonds are a first and only lien on the entire property of the company now owner or that may be hereafter acquired. The Louisville Lighting Company is a consolidation of the Citizens' Lighting Company and the Louisville Electric Light Company, which owns all of the electric-light franchises in the city of Louisville, Ky., serving a population of about 230,000.

The City Council of Bangor, Maine, is considering the advisability of an effort before the state Legislature to secure the necessary power to enable the city to do a commercial electric-lighting, power and heat business. The city has at the waterworks dam an electric plant of its own, where is generated the current for all municipal lighting, and a great amount of power is running to waste which might be developed. The City Council has also voted to double the capacity of the municipal lighting plant and the waterworks at an expense of $10,000, and this will be done at once.

ELECTRIC RAILWAYS.

The Denver, Cliffside and Boulder electric road will be running cars between Boulder, Colo., and Denver by May 1st.

The Indian Territory Traction Company is now operating its electric railway between South McAlester and Dow, 14 miles.

W. E. Winner of Kansas City and others have been granted a franchise for the Sedalia and Warrensburg interurban electric railroad through Sedalia, Mo. The road will be 30 miles long.

A petition has been filed with the county commissioners at Glendive, Mont., by the Glendive and Lower Valley Rapid Transit Company for a franchise for a trolley line from Glendive to Buford, N. D. The road will be 80 miles in length.

Plans are under consideration for the construction of a new trolley road from the county line near Huntington, Long Island, to Flushing, which will touch the villages of Oyster Bay, East Norwich, Glen Cove, Sea Cliff, Roslyn, Mineola and Great Neck.

A new 56-foot trolley baggage car, equipped with four motors, and purchased by the Utica and Mohawk Valley Railroad Company at a cost of $10,000, was given a trial run between Rome and Ilion, N. Y., recently, and it covered the distance at an average rate of a mile a minute.

W. H. Powell and L. P. Andrews of Sedalia, Mo., and others are directors of the Sedalia Transit Company, which has been organized with a capital stock of $60,000, to absorb the Railway and Electric Company of Sedalia, and erect and operate an electric-lighting and street-railway plant.

Two electric-railway companies are about to petition the City Council of Alton, Ill., for a franchise to build electric lines in Belle Street. The rivals are the Alton, Granite and St. Louis Traction Company and the Central Traction Company of Jerseyville. Both have secured the signatures of many property owners in Alton.

It is announced that Murray Verner of Pittsburg has gone to St. Petersburg to have a special conference with the czar regarding a street-railway proposition which was made to Russia years ago, but which was blocked, it is said, by the late minister of the interior, Von Plehve. It is understood that the Russian government is now willing to talk business to the Pittsburg people.

Charles M. Swift of Detroit, Mich., president of the Manila Electric Railroad and Light Company, returned recently from the Philippines and stated that the electric railway being built by his company, and representing 40 miles of single track, would be completed by March 1st. The enterprise represents an outlay for construction and equipment of $4,000,000. The system lies within the city of Manila, excepting about four miles, which spans the distance to Malabon, a convenient suburb.

It is rumored that the Arkansas Valley Interurban Electric Company and the Kansas and Oklahoma Interurban Electric Company have merged. The foundation for the rumor is that the Arkansas Valley company has filed a $2,100,000 mortgage to secure bonds for construction. The mortgage is given the Equitable Trust Company and covers all the right-of-way, lands and franchises and the special franchises in the cities of Wichita, Wellington, Winfield and Arkansas City. The franchises of Winfield and Arkansas City are owned by the Kansas and Oklahoma company.

AUTOMOBILES.

The Automobile Battery Company has been incorporated at Santa Cruz, Cal., by Henry F. Kron and others, to make electric automobiles.

"The American automobile has come and conquered," says Mr. D. R. Birch, the United States Consul located at Malaga, Spain. "It must be considered a satisfaction for American automobile manufacturers to know that their machines have, in the fifth city of Spain, triumphed over the models of every other nation. There are now about a dozen automobiles in Malaga, half of which are of American build. Three more American cars are now en route and I believe that other orders are about to be placed."

SOCIETIES AND SCHOOLS.

The decision to form a Canadian street-railway association was arrived at recently when a meeting of representatives of the leading railways in Canada took place in Montreal. Up to the present time the leading companies in Canada have belonged to the American Street Railway Association.

S. E. Feddon, manager of the Sheffield Corporation electrical supply department, London, England, reports regarding his recent visit to Canada that he was very much impressed by the excellent planning of the electricity department of McGill University, Montreal. Referring to the Soulanges Canal electrical equipment, Mr. Feddon thinks that one of the best applications of electrical energy he has ever seen is embraced in this plant.

The Italian commissioner-general of the Louisiana Purchase Exposition has presented to the school of electric engineering at Purdue University a fine collection of charts, photographs and paintings that were on exhibition at the Palace of Electricity at the St. Louis Exposition. The collection shows the development of the electric power-transmission plants in Italy, and was presented to Purdue as an act of courtesy to Prof. W. E. Goldsborough.

Mr. Homer E. Niesz, editor of the Question Box for the Denver-Colorado Springs meeting of the National Electric Light Association, has sent out over 7,000 letters to companies and individuals in the electrical field asking them to submit questions, grouped under 27 different headings, relating to central-station plants and their operation. Mr. Niesz not only desires questions from those seeking information, but he appeals to the missionary spirit in those who have solved difficulties for themselves and asks them to send questions to which they have found solutions, together with the replies, for the benefit of others. There is practically no limit to the benefits to be gained through this interchange of knowledge.

POWER TRANSMISSION.

John Boyd will erect and install a 750-horsepower electric plant for the Palmer Mountain Tunnel Company at Loomis, Wash.

The Utah Light and Power Company will soon install another power plant in American Fork Canyon, Utah. John W. Wootton of American Fork, Utah, is manager.

The Spring River Power Company has completed its dam at Galena, Kan., which is to furnish 5,500 horsepower to its electric plant. Power will be furnished the mines, etc.

The Carolina Water, Light and Power Company has been incorporated at Marion, S. C., with a capital of $250,000. J. W. Johnson and W. J. Montgomery are the incorporators. It is proposed to generate electricity by waterpower for lighting and power purposes.

PUBLICATIONS.

A mailing card from the F. Bissell Company of Toledo, Ohio, serves as a reminder that Jandus interchangeable arc lamps are still at the front. More cards of a similar nature are to follow, therefore, preserve this, says the company.

The Automatic Electric Company of Chicago has published in pamphlet form a technical description of its automatic telephone system, written by Mr. Fritz Lubberger, one of the engineers of the company. This pamphlet will be sent to interested persons on inquiry.

The Williams Electric Machine Company of Akron, Ohio, manufacturer of electric clutches and safety devices, clutch pulleys, etc., has issued a new catalogue upon this apparatus which is striking in appearance and well worthy of preservation on account of the tables for every-day use which it contains. The apparatus is illustrated in a pleasing manner and ample descriptive matter accompanies each picture. The catalogue is well prepared.

In looking over the latest catalogue of the Marinette Gas Engine Company of Chicago Heights, Ill., the first thing which claims the attention is the pleasing design of the cover. Upon opening the book it is found that the interior shows the good taste which is characteristic of the outside. Typographically, the whole is well executed, and when it comes to the matter of the descriptions and illustrations of the various types of gas engines which this company manufactures, very little has been left unsaid in the 48 pages which the catalogue contains.

TELEGRAPH.

A destructive fire in Sioux City, Iowa, a few days ago burned two business blocks. The office of the Western Union Telegraph Company was among the buildings burned. The wires of both telegraph companies were lost, cutting off the city from outside communication. The loss is estimated at $2,000,000.

The telegraph lines which have been taken over by the civil government from the military administration in the Philippine Islands, are under the control of the Philippine constabulary. During the year some 20 telegraphers have been appointed by this bureau in the United States and transported to the islands. It is the policy of the Philippine government, however, eventually to employ Filipinos as telegraph operators as soon as they are qualified, and for this purpose telegraphic schools have been established in Manila and some of the larger cities for the purpose of training natives along this line.

SPACE TELEGRAPHY.

The Mallory Line steamships San Jacinto and Denver have been equipped with wireless-telegraph apparatus. The De Forest system is used. The De Forest company is preparing to equip the entire Mallory fleet, it is said.

Experiments with the Artons system of space telegraphy have been made between Rome and Sardinia, resulting, it is said, in an alleged successful demonstration of the inventor's claim that an electromagnetic-wave message transmitted by this system cannot be diverted from the point for which it is intended. King Victor Emmanuel witnessed the test.

A dispatch from Paris says that a 50-word wireless telegram sent over the Alps from Cornwall to Italy recently arrived without a mistake in the wording, despite the fears that the rarefied atmosphere of the higher Alps would affect the message. The message was first received at Lausanne, then at the station on the top of Monterosa, whence it was transmitted direct to Ancona.

A contract has been signed with a United States company at Bocas del Toro, Panama, for the establishment of a system of space telegraphy between

Bocas del Toro and Colon on the one hand and Bocas del Toro and Port Limon, in Costa Rica, on the other, the latter thus affording communication with foreign countries by way of Central America. Also a similar system connecting Colon with Panama, and thence with the republics in South America.

MISCELLANEOUS.

When a fire alarm came to one of the engine companies in Burlington, N. J., at a time when there were only five firemen in the house, two of the resourceful men hitched the horses to the engine, while the other three seized the hose carriage, attached it to the rear of a trolley car which was passing and arrived at the scene of the conflagration in record time.

The Criminal Court of the Seine has convicted the four trainmen who were responsible for the catastrophe on the Metropolitan electric underground railroad in Paris in August, 1903, resulting in the loss of 65 lives. The conductor and station superintendent were sentenced to a month's imprisonment and a $400 fine each, while two motormen, who were permanently injured, were released with fines of $600 and $400, respectively.

The executive committee of local No. 68 of the union of electrical workers, in Denver is arranging for a public entertainment that will be something different from anything ever before attempted in the city. The entertainment in question will consist of a demonstrative lecture on "Electricity; Its Properties, Uses and Powers." There will be shown and illustrated with mechanical appliances the field of electrical research. There will be the entire working apparatus for space telegraphy, wireless telephones, wireless electric lighting, static illuminations, high-frequency currents and wireless exelaphone.

A decision has been rendered by the commissioner of patents to the effect that a specification for a patent should be confined to a description of the structure of the device and the manner of its use, and a discussion of the theoretical result to be attained by the use of the invention. When matter of an advertising nature is incorporated in the specification, yet the description of the mechanical structure and manner of use is clear, it is held that action on the merits should be proceeded with, but that the matter in the specification which is of an advertising nature should be required to be erased before the patent is allowed.

When the gases pass through an economizer containing pipes arranged longitudinally in straight rows with intervening straight free air spaces, they do not come into contact with a large part of each pipe; in other words, they are not sufficiently agitated by the pipes. In fact, there is always a considerable amount of gas which passes quickly through the openings between the rows of pipes without giving up any appreciable heat until it joins with the colder gases at the economizer outlet. The patent arrangement of "staggered pipes" in the Sturtevant economizers, in which the several sections are so arranged that the pipes of any one section stand longitudinally opposite the spaces between the pipes of the adjoining sections, overcomes this loss of heat. With this arrangement the gases are agitated and come into contact with a maximum area of the economizer pipes, utilizing a maximum amount of the waste heat from the boiler.

TRADE NEWS.

The Bureau of Supplies and Accounts, Navy Department, is inviting sealed proposals until January 10th for furnishing the navy yards at Boston, New York, Newport, Norfolk, League Island and elsewhere, with a quantity of motors, arc lamps, panel boards, wire and lamp cord, circuit-breakers, dry-battery cells, battery boxes and miscellaneous electrical supplies. Specifications and blank proposals can be obtained of the bureau or at the navy pay offices in the cities mentioned.

Two suits have been filed entitled Edison Electric Light Company versus Tri-city Electric Company and General Electric Company versus Tri-city Electric Company for infringement, respectively, of patents No. 444,530 to Edison, and No. 532,760 to Branin. The defendant, in business in Davenport, Iowa, is sued for dealing in lamps infringing these patents. The suits were commenced on December 19, 1904.

Leroy W. Stanton, consulting telephone engineer, Electric Building, Cleveland, is enthusiastic over the prospect for business during the coming year. Mr. Stanton is now installing two "open wireless" telephone plants. In each of these plants there will be employed from 100,000 to 200,000 feet of cable. Mr. Stanton reports a number of telephone plants to be commenced as soon as the spring weather opens up. In establishing his staff, Mr. Stanton has availed himself of the services of some of the best engineering talent to be found among the large Bell and fndependent companies.

BUSINESS.

The Pardridge Shade and Reflector Company, Chicago, reports that patents for its "Easy" cord adjuster have just been allowed in Germany. Mr. A. J. Pardridge, president of the company, with Mrs. Pardridge, is leaving for a four-month sojourn in southern California.

Frederick W. Leonard, referee in bankruptcy of the Standard Pole and Tie Company, gives notice that on January 5th, at his office in Newark, N. J., his application will be considered for an order allowing him to sell at public sale all the personal property of the company.

After two years of experimentation, the Cleveland Electric Railway Company has decided upon the individual air-brake compressor system and has just placed what is said to be the largest order ever secured in this country for such apparatus with the National Electric Company of Milwaukee.

The Faries Manufacturing Company of Decatur, Ill., manufacturer of the Faries line of fixtures, states that the business of the company has not failed to show an increase each year over the previous one. This year's business has exceeded any former year's by a good margin and the company feels satisfied that this increase will be maintained the coming year.

James B. Day & Co. have recently completed a new factory in Chicago at No. 57 Illinois Street for the manufacture of shellac varnishes, lacquers, etc. The company is manufacturing a special line of lamp lacquers for which a new department has been established. These lacquers are made in various shades and allow of dipping either hot or cold, producing, it is said, a permanent coloring. The main offices of the company are at No. 49 West Lake Street.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued (United States Patent Office) December 20, 1904.

777,666. Cluster Socket. John H. Dale, New York, N. Y. Original application filed February 18, 1904. Divided and this application filed April 5, 1904.

A cluster socket comprises a finishing cap or casing provided with openings for lamps. Lamp-holding devices and contacts in the cap or casing engage with the lamps.

777,677. Automatic Gas Danger Signal. Preston A. Kettering, Cadiz, Ohio. Application filed February 16, 1904.

Means for indicating the reduction of pressure within a pipe consist of a tube, a weight movable within the tube and supported by the pressure under normal conditions, and an electric alarm circuit adapted to be closed by and through the weight when the pressure falls below that sufficient to support the weight.

777,691. Trolley Head. Edwin V. Newcomb, Kansas City, Mo. Application filed December 15, 1903.

Bearing-recesses in the trolley harp are provided at corresponding ends with entrance slots and with bearing blocks within the other corresponding ends of the recesses, the blocks being capable of adjustment therein across the entrance slots.

777,693. Electric Locomotive. Edward D. Priest, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed May 6, 1904.

An electrically propelled vehicle embodies a control system for the motors of the vehicle which includes resistance sections, a compartment in which the resistance sections are located and a sand-box in the compartment so arranged as to be subjected to the heat from the resistance sections.

777,698. Trolley Head and Wheel. Joseph W. Sharp, Mohawk, N. Y. Application filed March 4, 1904.

Details are described.

777,707. Insulated Joint. George A. Weber and Percy Holbrook, New York, N. Y., assignors to the Weber Railway Joint Manufacturing Company, New York, N. Y. Application filed November 13, 1903.

A shoe at the ends of the rails is made in the form of a channel in which the rails rest, being separated from the channel by insulating material.

777,741. Base for Electric Lamp Bulbs. George P. McDonnell, St. Louis, Mo. Application filed March 12, 1904.

A ring adapted to be passed about the neck of the bulb carries a plug for entering the hollow stem of the bulb.

777,750. Apparatus for Indicating the Magnetic Condition of Heating Metals. George W. Sargent, Reading, Pa., assignor to the Carpenter Steel Company, Reading, Pa. Application filed July 11, 1904.

Combined with a metal-heating apparatus are a magnet arranged to include in its field the metal to be heated, means for indicating the response or non-response of the metal to the magnetic influence and means for protecting the magnet from the heating action.

777,759. Apparatus for Automatically Starting Electromotors and for Regulating Purposes. Johan J. Thoresen, Bygdö, Norway. Application filed December 2, 1902.

In an apparatus for automatically starting electromotors and for regulating purposes are a rotating part and one or more chambers formed in it and containing a powdered or granulated resistance material. Conductors are in contact with separate parts of the material.

777,760. Automatic Signal System. John R. Walsh, Boston, Mass., assignor of one-half to Henry T. Goold, Lexington, Mass. Application filed February 19, 1904.

Several circuits each include a sign in a central station. A circuit-closer and a circuit-opener are combined with a tappet on a car to engage successively the circuit-closer and the circuit-opener in any one circuit.

777,764. Telephone Call Register and Time Indicator. David A. Yoder, Toledo, Ohio. Application filed April 27, 1904.

A call register and indicator for telephones embodies a motor-operated driver, a series of time-indicating mechanisms adapted to be driven thereby, a series of counters, one for each time-indicating mechanism, electromagnets for establishing driving connection between the time-indicating mechanism and driver and a call or operator's circuit controlling each of the magnets.

777,778. System for Controlling Electric Motors. Henry H. Cutler, Milwaukee, Wis., assignor to the Cutler-Hammer Manufacturing Company, Milwaukee, Wis. Application filed July 6, 1903.

Connected in a number of controlling circuits are electromagnetic windings adapted to respond to variations of voltage. A separate source of supply is provided for each of the circuits, and means for simultaneously varying at will the voltage impressed upon each of the circuits.

777,801. Electric Switch. William J. Murray, Leavenworth, Kan., assignor of one-half to Herbert W. Wolcott, Leavenworth, Kan. Application filed May 2, 1904.

Contact-posts, a contact-arm pivoted at a point between the vertical planes containing the axes of the posts, a lift plate to oscillate the arm from one post toward the other and means for yieldingly resisting the first part of the movement of the arm and then for continuing the movement until the arm contacts with the other post are the essential features of the switch.

777,807. Telephone System and Apparatus. Elias E. Ries, New York, N. Y. Application filed June 23, 1899.

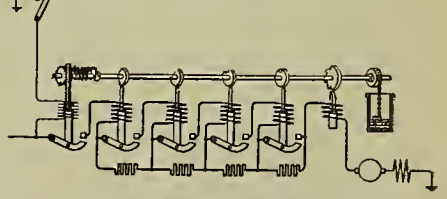
In a telephone-exchange system having a clearing-out drop connected across the cord-circuit are a grounded generator connected to the circuit at the central office and a telephone receiver at the subscriber's station embodying an automatic gravity switch adapted when held to the ear to connect the two sides of the line and to complete a ground connection when the instrument is placed in its normal position.

777,808. Telephone Transmitter. Elias E. Ries, New York, N. Y. Application filed June 23, 1900.

An improved method of producing variations of resistance in an electric circuit corresponding in form to sound-waves, consists in varying the extent of a wetted surface included in an electric circuit with the wetting liquid by the principle of capillary action.

777,833. Static Electrical Machine. Charles F. Birtman, Chicago, Ill. Application filed February 6, 1904.

A static electrical machine comprises two disk-like members mounted for relative movement and having parallel surfaces provided at opposite peripheral sides with devices adapted for reciprocal operation for the generation and collection of electricity.



NO. 777,839 —MOTOR STARTER.

777,839. Motor Starter. Eugene R. Carichoff, East Orange, N. J., assignor to the General Electric Company, Schenectady, N. Y. Application filed May 12, 1904.

Several separately actuated contacts control the motor circuit. Actuating coils for the contacts are successively connected in the controlled circuit, each by the operation of the contact next in advance, to produce an automatic progression of the contacts. Independently operated means regulate the progressive closing of the contact and a switch primarily completes the controlled circuit. (See cut.)

777,844. Meter. Frank P. Cox and William H. Pratt, Lynn, Mass., assignors to the General Electric Company, Schenectady, N. Y. Application filed January 29, 1903.

A movable measuring element is associated with a number of conductors and means responsive to the flow of direct current in one of the conductors for moving the element. Means responsive to the flow of alternating current in another of the conductors also move the element.

777,851. Electric Battery. William H. Gregory, Vallejo, Cal. Application filed May 14, 1904.

Combined with the cell of a dry battery is a breakable liquid-holding tube containing an auxiliary supply of liquid arranged therein for resupplying moisture.

777,857. Dynamo for Train Lighting. James F. McElroy, Albany, N. Y., assignor to the Consolidated Car Heating Company. Original application filed June 6, 1902. Divided and this application filed September 2, 1904.

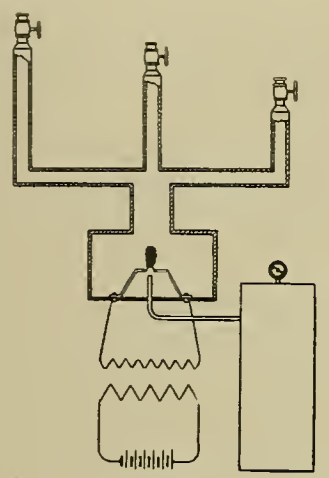
A generator for car-lighting embodies a field-magnet, a casing forming the yoke of the magnet and inclosing the machine, a partition in the casing surrounding the dynamo shaft, an armature on the shaft on one side of the partition, an automatic switch on the opposite side of the partition, and operating devices controlled by the shaft and controlling the switch.

777,866. System of Distribution. John B. Taylor, Schenectady, N. Y., assignor to the General Electric Company, Schenectady, N. Y. Application filed May 21, 1904.

In an electrical system of distribution are sections separately connected to the source or sources, and automatic switches adapted and arranged to connect the sections to each other when the sections are energized.

777,871. System for Lighting Hydrocarbon Lamps. George Washington, New York, N. Y., assignor to Joseph N. Patterson, Devon, Pa. Application filed August 3, 1899.

Electric sparking mechanism is used to ignite the carburetted air.



NO. 777, 988.—ELECTRIC PROCESS OF GENERATING GASES.

777,883. Control System. Eugene R. Carichoff, East Orange, N. J., assignor to the General Electric Company, Schenectady, N. Y. Application filed June 2, 1904.

Normally open switches are provided with means for closing each. A controlling device is arranged to be placed successively under strain by the closing of each switch and adapted by its movement to actuate successively the closing means of the remaining switches, and there are means for retarding the movement of the device.

777,888. Automatic Fire Extinguishing Apparatus. James Fiddes, Aberdeen, Scotland. Application filed February 1, 1904.

An electromagnet is included in an alarm circuit which is automatically closed when the automatic sprinkling system is put into operation.

777,912. Trolley Crossing. Edward R. North, Webster Groves, Mo. Application filed May 6, 1904.

An electromagnet operates the bridge connecting the two branches of a trolley line.

777,954. Telephone Chair. George J. Just, Northbranch, Iowa. Application filed August 15, 1902.

Concealed circuits in the chair arm lead to a telephone mounted conveniently to the ear.

777,971. High-speed Train System and Apparatus Therefor. Thomas H. Patenall, Wilkinsburg, Pa., assignor to the Union Switch and Signal Company, Swissvale, Pa. Application filed April 7, 1902.

A high-speed train-staff system comprises a call-circuit, main and local circuits, locking magnets, an armature and mechanism adapted to lift the armature to the locking magnets, the armature being held up when the magnets are energized so as to act conjointly. A staff lock is controlled by the magnets.

777,972. High-speed Permissive-train System and Apparatus Therefor. Thomas H. Patenall, Wilkinsburg, Pa., assignor to the Union Switch and Signal Company, Swissvale, Pa. Application filed September 19, 1902.

A high-speed train-staff instrument having a permissive staff, an electrically controlled lock for the staff, a tablet-receptacle and lock is arranged so that the permissive staff unlocks the receptacle. The withdrawal and manipulation of the permissive staff is controlled by electric circuits connecting it with a distant instrument.

777,974. Electromotive Device for Clocks. David Perret, Neuchâtel, Switzerland. Application filed May 27, 1904.

In an electric motive device for clocks and similar mechanisms are a ratchet wheel, an electrically connected spring contact, and a double-armed click, the shorter arm of which normally engages the ratchet wheel, while the longer arm engages the spring contact.

777,985. Battery. Nelson M. Watson, Detroit, Mich. Application filed June 13, 1904.

Details are described.

777,987. Apparatus for the Treatment of Gases. Ernest E. Werner, St. Louis, Mo., assignor to the Electrical Purifying Company. Application filed June 13, 1904.

Apparatus for treating gases comprises an inclosed chamber having suitable inlets and outlets, electric terminals in the chamber, means for supplying current to the terminals, means for supplying gas under pressure to the action of the arc between the terminals and means for regulating the escape of gas from the chamber.

777,988. Process of Generating Gases from the Atmosphere. Ernest E. Werner, St. Louis, Mo., assignor to the Electrical Purifying Company, Stafford, Kan. Application filed August 6, 1904.

The process, which consists in generating gases from air by maintaining an arc between two electric terminals in a chamber, allows compressed air to be released and expanded in the gap between the terminals and regulates the volume of compressed air released by varying the outflow of the treated gases. (See cut.)

777,989 and 777,990. Apparatus for the Treatment of Gases. Ernest E. Werner, St. Louis, Mo., assignor to the Electrical Purifying Company, Stafford, Kan. Original application filed June 13, 1904. Divided and these applications filed August 11, 1904.

These two patents refer to apparatus by which gases are treated by submitting them to the action of an electric arc.

777,991. Device for Projecting Air Against Electric Discharges. Ernest E. Werner, St. Louis, Mo., assignor to the Electrical Purifying Company, Stafford, Kan. Application filed August 29, 1904.

Combined with electric arc terminals is a device for projecting compressed air in divided streams against the side of the arc.

778,005. Electric Insulator. Charles Booker, Toronto, Canada. Application filed February 1, 1904.

Combined with a hood of insulating material provided with a cylindrical hole and a pin fitting therein are a spring, means for holding the pin within the hole, and a resilient washer between the top of the pin and the top of the hole, so as to take up any slack in the spring connection.

778,017. Trolley Guard. Mack H. Dorsey, Woodlawn, Ala. Application filed May 24, 1904.

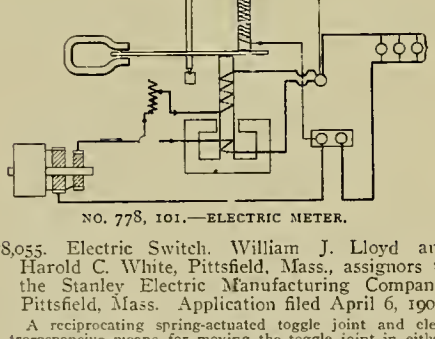
Inwardly turned retaining fingers form the trolley guard.

778,021. Electromagnetic Apparatus for Operating Reciprocating Mechanisms. Joseph Feingold, Frankfort-on-the-Main, Germany. Application filed June 21, 1904.

In an electromagnet driving apparatus for hammers, punching-machines, pumps and the like are movable electromagnet coils provided with cores passing into fixed electromagnet coils with a transverse iron bar connecting the cores.

778,037. Signaling Mechanism. Reinhold Herman, Crafton, Pa. Application filed November 21, 1903.

Electrically-controlled operating mechanism consists of a motor for actuating the mechanism, an inclosing box or casing for the mechanism and motor, and provided with a lens opening, a supporting-post on which the box or casing is mounted, the drive-shaft of the mechanism extending through the box or casing, a signal mounted on the drive-shaft outside the casing, and electrically controlled means for locking the signal in danger position.



NO. 778, 101.—ELECTRIC METER.

778,055. Electric Switch. William J. Lloyd and Harold C. White, Pittsfield, Mass., assignors to the Stanley Electric Manufacturing Company, Pittsfield, Mass. Application filed April 6, 1903.

A reciprocating spring-actuated toggle joint and electroresponsive means for moving the toggle joint in either direction from its dead-center are associated with a switch mechanism adapted to be operated by the movement of the toggle-joint in either direction from its dead center.

778,067. Telegraphic Key. John E. Pearson, Motor, N. C. Application filed November 12, 1903.

Mechanical parts are set forth in the patent.

778,101. Electricity Meter. Arthur Blanchet, Paris, France, assignor to Compagnie pour la Fabrication des Compteurs and Matériel d'Usines a'Gaz, Paris, France. Application filed October 19, 1903.

In a rotary field or induction meter the shunt energized flux is displaced less than a fourth of a period with respect to the active electromotive force. A differential flux produced by two components of the main current, one of which traverses a path of low self-induction and the other a path of high self-induction, produces a resultant flux displaced a fourth of a period with respect to the flux of the shunt current. A rotable armature is acted upon by the fluxes, the speed of the armature being proportional to the current to be recorded. (See cut.)

778,120. Multiplex Telegraphy. Thomas B. Dixon, New York, N. Y. Application filed October 11, 1898. Renewed May 16, 1904.

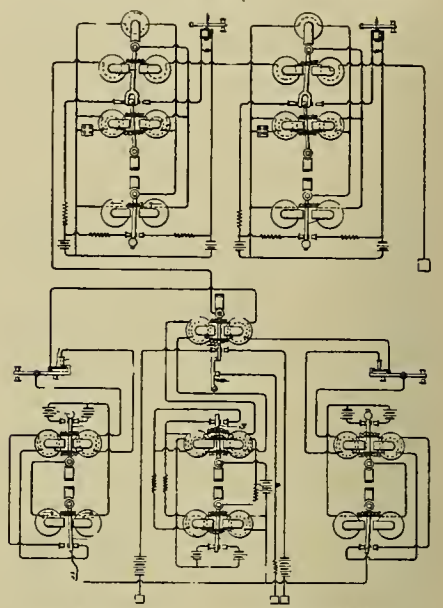
Associated with the line conductor are means for supplying to the line currents of two different directions. Two double-current transmitting instruments are provided, one for each direction of line-current. A selector and two single-direction double-current receiving instruments, one operated only by positive currents, and the other only by negative currents, and each adapted to be changed from, and restored to, normal condition, by alternate current impulses of proper direction in the line complete the apparatus. (See cut.)

778,146. Gas-engine Ignition Dynamo. John Reek, Camden, Mich., assignor to the Alamo Manufacturing Company, Hillsdale, Mich. Application filed March 16, 1903.

A small dynamo for furnishing the spark for gas engine is described.

778,155. Incandescent Electric Lamp and Switch. George Sweetser, Upper Norwood, England, assignor to E. C. L. Syndicate, London, England. Application filed February 2, 1904.

A light-emitting member which is a non-conductor when cold and a heat-emitting member which is a conductor at ordinary atmospheric temperatures and which is in circuit and electrically connected intermediate of its ends to one end of the light-emitting member are the two essentials of the lamp.



NO. 778, 120.—MULTIPLEX TELEGRAPH SYSTEM.

778,177. Telegraphy. Thomas B. Dixon, New York, N. Y. Original application filed October 11, 1898. Divided and this application filed April 22, 1902.

Transmitting apparatus for simultaneously telegraphing messages in the same direction, through a single circuit, allows the transmitting of the signals of each message by current impulses occurring in pairs, one at the beginning and the other at the end of each signal, the signals of one message being transmitted by positive impulses and the signals of the other message by negative impulses.

778,194. Electric Furnace. Henry M. Howe, New York, N. Y., assignor to Eimer & Amend, New York, N. Y. Application filed October 3, 1902.

An electric resistance furnace consists of two internally grooved blocks and a cover in combination with a resistance element in the grooves of the blocks.

778,206. Electric Hammer. William F. Wagner, New York, N. Y. Application filed July 11, 1904.

An electric hammer comprising a suitable casing is arranged to reciprocate within a casing. Electromagnet coils operate the hammer and a demagnetizing coil releases it.

EXPIRING PATENTS.

Following is a list of electrical patents (issued by the United States Patent Office) that expired on December 27, 1904:

375,328. Commutator or Electric Circuit-breaker. C. D. Baker, Chicago, Ill.
375,339. System of Synchronism for Telegraphy. G. A. Cassagnes, Paris, France.
375,346. Electrically Propelled Vehicle. S. D. Field, Yonkers, N. Y.
375,390. Portable Electric Coal-mining Machine. J. B. Sneathen and A. Micheals, Pittsburg, and M. A. Micheals, Allegheny, Pa.
375,392. Electric Meter. W. A. Stern, Allegheny City, Pa.
375,408. Caleletric Generator. E. G. Acheson, Pittsburg, Pa.
375,414. System of Electric Gas Lighting. W. H. Doering, Philadelphia, Pa.
375,441. Galvanic Battery. H. B. Cox, Cincinnati, Ohio.
375,456. Telephone. E. C. Newton, Little Rock, Ark.
375,476. Electrical Cut-out Device. J. Chester Chamberlain, New York, N. Y.
375,542. Electrical Converter, Motor and Generator. R. Eickemeyer, Yonkers, N. Y.
375,543. Electric Circuit-changing and Signaling Apparatus. I. H. Farnham, Malden, Mass.
375,544. Electromagnetic Arresting and Releasing Mechanism. I. H. Farnham, Malden, Mass.
375,559. Galvanic Battery. James F. McLaughlin, Philadelphia, Pa.
375,560. Electric Motor. James F. McLaughlin, Philadelphia, Pa.
375,561. Primary Electric Battery. James F. McLaughlin, Philadelphia, Pa.
375,617. Electric Call Box. L. B. Firman, Chicago, Ill.
375,633. Underground Electric Conductors. De Witt C. James, Warren, Pa.
375,636. Fire Extinguisher and Alarm. C. E. Kells, Jr., New Orleans, La.
375,637. Burglar Alarm. D. H. Kime, Kendallville, Ind.
375,676. Electric Motor. E. Julien, Brussels, Belgium.
375,685. Double Spring Loop Key and Circuit for Multiple Switchboards. C. E. Scribner, Chicago, Ill.
375,697. Tension Device for Winding Electromagnets. J. W. Easton, New York, N. Y.

Western Electrician

Vol. XXXV. $3.00 Per Annum. Copyright, 1903, by Electrician Publishing Company, Chicago. CHICAGO, JULY 2, 1904. Entered at Chicago Postoffice as mail matter of the second class. 10 Cents a Copy. No. 1.

SIMPLEX INSULATED WIRES AND CABLES.
RUBBER COVERED, WEATHERPROOF, UNDERGROUND AND SUBMARINE.
WESTERN SELLING AGENT, H. R. HIXSON, The Simplex Electrical Co., 110 State Street, BOSTON, MASS.

N. I. R.
National India Rubber Co.'s
RUBBER COVERED WIRES AND CABLES.
OFFICE AND FACTORY: BRISTOL, R. I.

OKONITE
TRADE MARK
1889—Paris Exposition, Medal for Rubber Insulation.
1893—World's Fair, Medal for Rubber Insulation.
THE STANDARD FOR RUBBER INSULATION.
Sole Manufacturers of
Okonite Wires, Okonite Tape, Manson Tape, Candee Weather-proof Wires.
THE OKONITE CO., LTD.
Willard L. Candee, H. Ourant Cheever, Managers. 253 Broadway, New York. Geo. T. Manson, Gen'l Supt. W. H. Hodgins, Secy.

TRADE MARK
CRESCENT INSULATED WIRE & CABLE CO. TRENTON, N. J.
CRESCENT RUBBER INSULATED WIRES AND CABLES
National Code Standard.
CRESCENT INSULATED WIRE AND CABLE CO.,
New York Office, 83 BARCLAY STREET. Main Office and Factory, TRENTON, N. J.

RESISTANCE WIRES
"Climax" For High-resistance Work.
"Advance" For Measuring Instruments.
SPECIAL ALLOYS FOR ELECTRICAL MANUFACTURERS.
DRIVER-HARRIS WIRE CO., Harrison (Newark), N. J.

INDIANA RUBBER AND INSULATED WIRE CO.,
MANUFACTURERS OF
Paranite Rubber Covered Wires and Cables,
UNDERGROUND, AERIAL, SUBMARINE AND INSIDE USE.
TELEPHONE, TELEGRAPH AND FIRE ALARM CABLES.
All Wires are tested at Factory. JONESBORO, IND.

"CIRCULAR LOOM" THE FLEXIBLE CONDUIT
AMERICAN CIRCULAR LOOM CO.
TRADE MARK
REGISTERED
CONDUITS FOR INTERIOR WIRING.
American Circular Loom Co.
Chelsea, Mass., New York, Chicago, San Francisco.

M. KLEIN & SON.
Send 2c stamp for new catalogue No. 6 of
KLEIN'S TOOLS
For Electrical Workers and Line Builders.
MATHIAS KLEIN & SONS.
81 W. Van Buren St., Chicago, Ill.

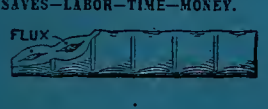
THOUSANDS IN USE.
Motors, ¼ h. p. to 100 h. p.
Dynamos, 1 k. w. to 75 k. w.
Highest Quality. Reasonable Price.
THE HOBART ELECTRIC MFG. CO.
TROY, OHIO.

SINGLE AND POLYPHASE TRANSFORMERS
KUHLMAN ELECTRIC CO., - - Elkhart, Ind.

I-T-E
CIRCUIT BREAKERS
CUTTER ELECTRICAL CO., PHILADELPHIA

THERMOPILES 1½ VOLTS 1½ AMPERES
For Electrolytic analysis, charging storage batteries, and other constant current requirements. $5 Each.
WALSH'S SONS & CO.,
264 Washington Street. Newark, N. J.

The Bossert Electric Construction Co.
—MANUFACTURERS OF—
STEEL OUTLET AND JUNCTION BOXES, SWITCHBOARDS, PANEL BOARDS, SWITCHES, ETC.
UTICA, NEW YORK.

KESTER
SELF FLUXING SOLDER
A Tube of Solder Filled with Flux.
Requires no Acid.
SAVES—LABOR—TIME—MONEY.


ACTUAL SIZE
PATENTED.
Send for Free Samples.
L. F. Mahler Co., R. 1008 Chemical Bldg., St. Louis, Mo., Gen. Western Agent.
KESTER ELECTRIC M'F'G CO.,
46 N. UNION STREET, CHICAGO, ILL.

Edison Battery Fan Outfits
The reputation of all goods bearing the name of Edison makes them desirable lines to handle. Edison Battery Fan Motor outfits are as good as their name and dealers who do not already have a line of them should write us for Catalogue No. 7 F.
EDISON MANUFACTURING CO.,
TRADE Thomas A. Edison MARK
Factory, ORANGE, N. J.
NEW YORK, 83 Chambers St.
CHICAGO, 304 Wabash Ave.

"STAR" INCANDESCENT LAMPS

LONG LIFE
GUARANTEED CANDLEPOWER,
HIGHEST EFFICIENCY.
MADE BY THE MOST SKILLED WORKMEN.
STANDARD ELECTRICAL MFG. COMPANY, : Niles, Ohio.

WESTON Electrical Instrument Co.,
Waverly Park, NEWARK, N. J.

Illuminated Dial Station Instruments.
These instruments are constructed upon the same general principle as our regular Standard Portable Direct Current Voltmeters and Ammeters, but are much larger, and the working parts are inclosed in a neatly designed, dust-proof cast-iron case which effectively shields the instruments from disturbing influences of external magnetic fields.

Weston Standard Illuminated Dial Station Ammeter, Style B.

Weston Standard
Portable Direct Reading Voltmeters and Millivoltmeters. Ammeters and Milliammeters, Wattmeters and Voltmeters, for Alternating and Direct Current Circuits.
Our portable instruments are recognized as standards throughout the civilized world.
Our Semi-Portable Laboratory Standard Voltmeters and Ammeters are still better.
They are the most reliable, absolute standards for Laboratory use.

LONDON—Elliott Bros., Century Works, Lewisham.
BERLIN—European Weston Electrical Instrument Co., Ritterstrasse No. 89
PARIS, FRANCE—E. H. Cadiot, 12 Rue St. Georges.
New York Office—74 Cortlandt St.

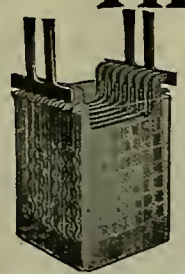
Pagoda Wireless Clusters
Most Efficient and Cheapest Cluster on the Market.
Combines the advantages of the Benjamin, Dale and similar Clusters with the tremendous reflecting powers of the well known
PAGODA SHADES.
Furnished in Ed[illegible] Suitable for lamps ranging from 4 to 24 C. P.
WRITE FOR PRICES
Holophane Glass Co.
15 E. THIRTY-SECOND ST., NEW YORK.
WESTERN HOUSE
V. R. LANSINGH CO.
[illegible] Jackson Boulevard, CHICAGO

Allis-Chalmers Co
CHICAGO

Bullock
Electrical Apparatus
for all purposes.

THE ELECTRIC STORAGE BATTERY CO.

PHILADELPHIA



MANUFACTURER OF THE

"Chloride Accumulator"

For Central Stations, Electric Railways, Isolated Lighting and Power Stations, Fire Alarm, Telegraph, Train Lighting, etc., etc.

PRICE LISTS AND DESCRIPTIVE BULLETINS FORWARDED UPON REQUEST.

SALES OFFICES:

PHILADELPHIA, Allegheny Ave. and 19th St. | NEW YORK, 100 Broadway, | BOSTON, 60 State St. | CHICAGO, Marquette Bldg. | ST. LOUIS, Wainwright Bldg. | SAN FRANCISCO, Rialto Bldg. | CLEVELAND, Citizens Bldg. | CANADA, Canadian General Electric Co., Ltd. Toronto | HAVANA, CUBA, G. F. Greenwood, Manager 34 Empedrado St.

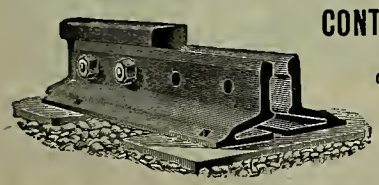
ALLEN-BRADLEY ELECTRIC CRANE CONTROLLERS

PATENTED

Guaranteed for One Year. Three months' Free Trial.
No Sparking. No Repairs. Perfect Control.

AMERICAN ELECTRIC FUSE COMPANY

CHICAGO - - ILLINOIS



CONTINUOUS RAIL JOINT COMPANY OF AMERICA.

GENL. OFFICES: CENTURY BLDG., NEWARK, N. J.

OVER 20,000 MILES IN USE

Highest Award Paris Exposition, 1900, Buffalo, 1901

CARBONS

CONSUMERS CARBON CO.

LANCASTER, OHIO, U. S. A.

Carbons of all kinds and for all purposes.

PLATINUM

PLATINUM RIVETS FOR CONTACT POINTS IN TELEPHONES—SPARK COILS AND OTHER ELECTRICAL APPARATUS. PLATINUM SHEET AND WIRE IN ANY FORM AND DEGREE OF HARDNESS. PLATINUM SCRAP PURCHASED.

BAKER & COMPANY, Inc.

ARTISANS IN PLATINUM

408-410-412-414 N. J. R. R. AVE. - NEWARK, N. J.

New York Office: 120 Liberty St.

ALPHABETICAL INDEX TO ADVERTISEMENTS.

Adams-Bagnall Electric Co...—
Akron Electrical Mfg Co.....13
Allen Company, L. B.....13
Allis-Chalmers Company..... 2
American Battery Co.....14
Amer. Circular Loom Co... 1, 10
American Conduit Co.....15
Amer. District Steam Co.....15
Amer. Elec. Fuse Co..... 3
Amer. Electrical Heater Co.. 9
Amer. El. Telephone Co.....18
American Electrical Works..13
American Stone Conduit Co..18
Arnold Elec. Power Station Co..... 17
Automatic Electric Co..... 19

Babcock & Wilcox Co.....17
Bain, Forée.....13
Baker & Company..... 3
Baker & Co., W. E.....17
Barnett Company, G. & H....24
Beardslee Chandelier Mfg.Co.—
Berthold & Jennings.....20
Big Four Route.....18
Bissell Co., The F..... 4
Bossert Electric Construction Co..... 1
Brooks, Hall L.....20
Bryan-Marsh Co.....—
Bryan, Wm. H.....17
Buckeye Electric Co.....—
Bullock Elec. Mfg. Co..... 4
Bushnell, A.....21
Butterfield, J. F.....17
Byllesby & Co., H. M.....17
Byrne Const. Co., M. P.....17

Central Electric Co..... 5
Cent. Stat. Improvement Co..14
Central Tel. & El. Co.....18
Century Electric Co..... 9
Chicago Die & Electric Co....13
Chicago Edison Co.....4, 14
Chic. Fuse Wire & Mfg. Co...—
Chicago Insulated Wire Co..—
Chicago Mica Co.....12
Columbia Incand. Lamp Co..—
Columbia Mfg. Co.....21
Columbus Storage Batt'ry Co.—
Consumers Carbon Co..... 3
Continuous Rail Joint Company of America..... 3
Coolidge Co.. Marshall H.....—
Cope, T. J.....—
Crawfordsville Electric Co..—
Crescent Co.....—
Crescent Ins. Wire & Cbl. Co. 1
Crocker-Wheeler Company...24
Crouse-Hinds Co.....21
Cutler-Hammer Mfg. Co..... 7
Cutter Elec. & Mfg. Company 1

D. & W. Fuse Company.....—
Dearborn Drug & Chem. Wks.16
Detroit Steel Casting Co..... 5
Diamond Meter Company.... 4
Dielectric Manufacturing Co. 7
Dixon Crucible Co., Joseph..16
Driver-Harris Wire Co..... 1
Duncan Elec. Mfg. Co.....23
Dustin Co., Chas. E.....14

Edison Decorative & Miniature Lamp Departm't.....12
Edison Mfg. Company..... 1
Edwards & Co.....13
Egan, J. J.....14
Electrical Engineer Institute.15
Electric Appliance Co 12
Electrical Recorder & Indicator Co 5
Electric Storage Battery Co.. 3
Electrician Pub. Company...23

Faries Mfg. Co..... 4
"For Sale" Advertisements..14
Ft. Wayne Elec. Works, Inc..23
Fostoria Incand. Lamp Co...—
Fowler, John H.....20
Fowler-Jacobs Company.....20

General Electric Co..... 9
General Engineering Co., The.17
General Incandescent Arc Light Company.....—
General Incand. Lamp Co....—
Gould Storage Battery Co.... 6
Gt. West. Smelt. & Refining Co.—
Green Fuel Economizer Co..17
Gregory Electric Company...14

Hallberg, J. H 17
Haller Machine Co.....—
Hart Mfg. Co..... 7
Hartford Steam Boiler Inspection & Insurance Co....—
Hartford Time Switch Co....15
Hazard Manufacturing Co....—
Hipwell Mfg. Co..... ....—
Hobart Elec. Mfg. Company. 1
Hoffman, G. W.....14
Holmes Fibre-Graph. Co.....—
Holophane Glass Co..... 1
Honaday & Co., J. P.....17
Humphrey, Henry H.....17
Hunt & Co., Robt. W.....17

Illinois Central Ry.....14
Illinois Electric Specialty Co.18
Incandescent Electric Light Manipulator Company.....15
Indiana Rub. & Ins. W. Co.... 1
India Rubber & Gutta Percha Insulating Company..... 3
International Elec. Meter Co.14
International Tel. Mfg. Co....19

Jackson, D. C. & W. B.....17
Jeffrey Manufacturing Co....16
Jewell Electrical Inst. Co....—
Johns-Manville Co., H. W.....23

Kartavert Manufacturing Co.—
Kellogg Switchboard & Supply Company.....19, 21
Kester Elec. Mfg. Co..... 1
Klein & Sons, Mathias..... 1
Kohler Brothers.....17
Kuhlman Electric Co..... 1

Leather Preserv. M. Corp....17
Leffel & Co., James.....16
Lewis Lumber & Mfg Co....21
Lindsley Brothers Company..20
Loud's Sons Co., H. M.....—

Machado & Roller..... 7
Maltby Lumber Company....21
Manhattan El. Supply Co....14
Manross, F. N..... .....—
Marinette Gas Engine Co.....16
Matthews & Bros., W. N.....13
McLennan & Company, K....12
Mechanical Appliance Co....17
Mica Insulator Company.....—
Michigan College of Mines ..15
Miller Electric Co.....—
Minnesota Electric Co.....18
Miscellaneous Advs.....14
Mono Railroad..... ..15
Moon Mfg. Co., The.....—
Morrison Lbr. Co., J. W.....21
Mueller Company, William..21
Munsell & Co., Eugene.....12

National Electric Co..... 8
National Elec. Signalling Co.—
National India Rubber Co.... 1
New England Butt Co.....18
Newgard & Co., Henry..... 24
New York Cent. Ry.....15
New York Ins. Wire Co.....13
Northern Elect'l Mfg. Co....12
Norton Elect'l Instrument Co.—

Ohio Valley Glass Co.....21
Okonite Co., The..... 1
Olds Gasoline Engine Works.16

Pacific Coast Pole Co.....16
Page & Hill Co.....21
Paragon Fan & Motor Co.....—
Pardridge Shade & Refl. Co..—
Pass & Seymour, Inc.....—
Phelan, D. W.....21
Phillips, Eugene F.....13
Phillips Insulated Wire Co...13
Phœnix Glass Co.....—
Phosphor-Bronze S. Co.....16
Pignolet, L. M.....12
Pittsburg & L. S. Iron Co....20
Plume & Atwood Mfg. Co.... 9
Porter Cedar Company.....20
Pratt Institute 15

Reisinger, Hugo..... 7
Reynolds El. Flasher Mfg.Co.13
Roebling's Sons Co., J. A..... 5
Rose Polytechnic Institute...15
Ruebel-Schwedtmann-Wells..17

Safety Ins. Wire & Cable Co.. 1
Sargent & Lundy.....—
Schott, W. H.....11, 17
Seaman, J. H..... 7
Seaman & Co., W. S.....18
Simplex Electrical Co., The.. 1
Simplex Elec. Heating Co....12
Speer Carbon Co.....—
Sprague Electric Company...12
Squire Electric Co.....—
Standard Elec. Mfg. Co..... 1
Standard Underg. Cable Co....—
Standard Vitrified Conduit Co15
Stanley Instrument Co..... 7
Stanton, LeRoy W..... 17
State Univ. of Iowa.....15
Sterling & Son, W. C.....21
Sterling Electrical Mfg.Co... 13
Sterling Varnish Co., The....18
Stow Mfg. Company.....—
Stromberg-Carlson Tel. Mfg. Company.....19
Sturtevant Company, B. F...24

Thompson, S. E.....21
Tod Company, William.....16
Torrey Cedar Company.....20
Trumbull Elec. Co.....—
Turner Brass Works.....—

Union Electric Mfg. Co..... 12

Valentine-Clark Co., The....—
Varley Duplex Magnet Co....18
Vulcanized Fibre Company..24

Wabash R R.....14
Wagner Electric Mfg. Co.....—
Walsh's Sons & Company..... 1
Warren Elec. Mfg. Co.....12
Wesco Supply Co.....12
Western Electric Company... 5
Western El. Supply Co.....—
Western Lumber & Pole Co..20
Westinghouse Electric & Manufacturing Co.....22
Weston Electrical Inst. Co... 1
Wilmerding, C. H.....—
Wisconsin Central Ry.....14
Woolley Fdy. & Mach. Wks..16
Worcester Company, C. H....20
Yesbera Mfg. Co..... ..18
Yost Electric Mfg. Co 24

For Classified Index of Advertisements See Page 6.

64116

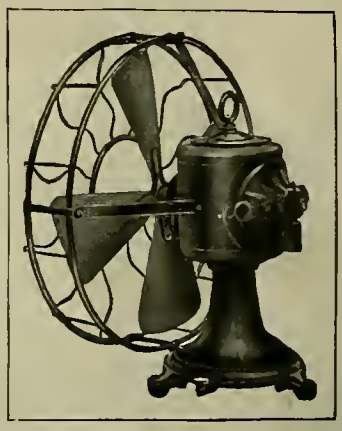
REMEMBER THE NAME AND BUY THE BEST.

PARAGON FAN MOTORS

NEW STYLES NEW PRICES
EASY RUNNING RIGID CONSTRUCTION NOISELESS

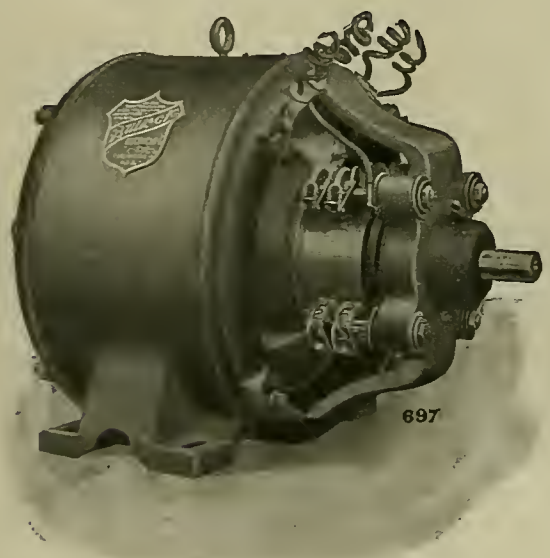
CALL AND SEE THEM OR WRITE FOR PRICES

CHICAGO EDISON COMPANY,
139 ADAMS ST., CHICAGO.



Bullock Electric Manufacturing Co.

CINCINNATI, OHIO, U. S. A.



Type N Bullock Open Motor

Especially adapted for driving machinery requiring variable speeds using the BULLOCK Multiple Voltage System.

FARIES FIXTURES

Shades
Brackets
Clusters
Portables
Canopies
Chandeliers
Nozzles
Fittings
Castings

are UNIVERSALLY USED

Catalog Mailed on Application

FARIES MFG. CO.
DECATUR, ILL.

(See Western Electrician, June 18, 1904.)

"SECURITY"

AUTOMATIC TIME SWITCH

Prices $7.00 to $9.50

Show Window Lighting is one of the advertiser's opportunities. A "Security" Switch automatically cuts out the current at the proper time and stops expense.

These features appeal to consumer. Dealers and Central Stations will do well to get our folder 119 W. E.

THE F. BISSELL COMPANY
Manufacturers and Jobbers of
ELECTRICAL GOODS
226-228-230 HURON STREET
TOLEDO, O.

TYPE E.

ALTERNATING CURRENT.

SCHEEFFER INTEGRATING WATTMETER

Type E for Alternating Current Type F for Direct Current Circuits

DUST AND BUG PROOF
IMPROVED CONSTRUCTION

MOVING PARTS ARE EXTREMELY LIGHT, INSURING A HIGHLY SENSITIVE AND ACCURATE METER.

WRITE FOR PRICES AND DESCRIPTIVE LITERATURE.

DIAMOND METER COMPANY,
PEORIA, ILL., - - - - U. S. A.

TYPE F.

DIRECT CURRENT.

YOU GET MORE FEET PER 100 LBS.

OF I. X. L. WEATHER-PROOF WIRE than you get of any other, owing to the compact insulation.

SEND FOR SAMPLES AND PRICES.

Central Electric Company, *GENERAL SALES AGENTS.* 264-266-268-270 FIFTH AVENUE, CHICAGO.

JOHN A. ROEBLING'S SONS CO.

Insulated Wire of All Kinds

Bare Copper Wire

MAIN OFFICE AND WORKS **TRENTON, N. J.**

AGENCIES AND BRANCHES

New York Chicago Cleveland San Francisco Philadelphia Atlanta

STEEL CASTINGS

—FOR—

Dynamos and Motors

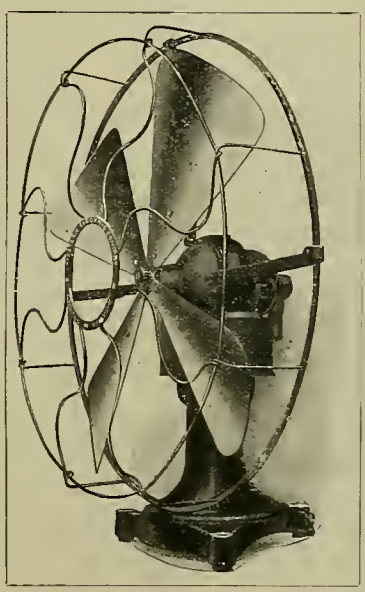
We manufacture a Steel that far excels anything now in the market for Electrical Work

WRITE US FOR CHARTS AND PRICES

DETROIT STEEL CASTING CO.

DETROIT, MICH.

W. E. FAN MOTORS



Catalogue on Request

DESK, BRACKET and CEILING STYLES

ALL VOLTAGES
ALL CIRCUITS

Western Electric Company

Chicago New York
Saint Louis Denver
Philadelphia Kansas City
Pittsburg

San Francisco (California Electrical Works) Cincinnati (Standard Electric Company) Saint Paul (American Electric Company)

THEY ARE ABSOLUTELY

DEAD BEAT

Electrical Recorder & Indicator Company's

VOLTMETERS AND AMMETERS

WATCH FOR THEIR PICTURES — THEY ARE GOOD LOOKING

ELECTRICAL RECORDER & INDICATOR CO., PONTIAC BLDG., CHICAGO, ILL.

Gould Storage Battery Co.

Complete Storage Battery Plants

Railway Line and Regulating
Isolated and Train Lighting
Central Lighting and Power
Electric Vehicle and Telephone

GOULD COUNTER E. M. F. BOOSTER SYSTEMS

Sales Offices { NEW YORK, 1 W. 34th Street. BOSTON, 89 State Street. CHICAGO, The "Rookery." SAN FRANCISCO, Century Electric Co.

WORKS: DEPEW, N. Y.

Bulletins.

CLASSIFIED INDEX OF ADVERTISEMENTS.

Adjusters, Cord.
Crescent Co.
Incandes. El. Lt. Manip. Co.
Seaman, J. H.

Adjusters, Inc. Lamps.
Inc. El. Lt. Manipulator Co.

Anchors (Tel. & Tel.)
Matthews & Bro., W. N.
Crouse-Hinds Co.

Annunciators.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Moeo Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Batteries and Jars.
Bissell Co., The F.
Central Electric Co.
Columbus Storage Battery Co.
Edison Mfg. Co.
Edwards & Company.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Bells, Buzzers, Etc.
Central Electric Co.
Edwards & Co.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Belt Dressing.
Dixon Crucible Co., Jos.
Leather Preserver Mfg. Corp.

Belting.
Leather Preserver Mfg. Corp

Blowers.
Sturtevant Co., B. F.

Blow Pipes.
Turner Brass Works.

Boiler Compounds.
Dearborn Drug & Chem Wks.

Boilers.
Babcock & Wilcox Co.

Books, Electrical.
Electrician Publishing Co.
Drake & Co., F. J.

Booths, Telephone.
Seaman & Co., W. S.
Yesbera Mfg. Co.

Brackets.
Farles Mfg. Co.

Brushes.
Central Electric Co.
Hobart Elec. Mfg. Co.
Holmes Fibre-Graphite Co.
Speer Carbon Co.
Western Electric Company.

Cable Hangers.
National Tel. Supply Co.
Western Electric Co.

Cables (See Wires and Cables)

Canopies.
Farles Mfg. Co.

Carbons, Points and Plates.
Central Electric Co.
Chicago Edison Co.
Consumers Carbon Co.
Electric Appliance Co.
National Carbon Co.
Reisinger, Hugo.
Speer Carbon Co.
Wesco Supply Co.
Western Elec. Supply Co.

Castings.
Detroit Steel Casting Co.
Farles Mfg. Co.
New England Butt Co.
National Electric Co.

Chains.
Jeffrey Mfg. Co.

Chandeliers.
Farles Mfg. Co.

Circuit Breakers.
Cutler-Hammer Mfg. Co.
Cutter Elec. & Mfg. Co.
Ft. Wayne Elec. Wks. Inc.
Union Electric Mfg. Co.
Western Electric Company.
Westinghouse El. & Mfg. Co.

Clusters.
Farles Mfg. Co.

Clutches, Electrical and Mechanical.
Akron Electrical Mfg. Co.

Coal and Ashes Handling Machinery.
Jeffrey Mfg. Co.

Coils and Magnets.
Varley Duplex Maguet Co.
Western Electric Co.

Commutator Compound
Allen Co., L. B.
Egan, J. J.
McLennan & Co., K.

Commutator Truing Device.
Akron Electrical Mfg. Co.

Conduit and Conduits.
American Circular Loom Co.
American Conduit Company.
American Stone Conduit Co.
Central Electric Co.
Electric Appliance Co.
Sprague Electric Co.
Standard Vitrified Cond. Co.
Wesco Supply Co.
Western Electrical Supply Co.

Contractors and Electric Light Plants.
Bullock El. Mfg. Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
National Electric Co.
Northern Electrical Mfg. Co.
Sprague Electric Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Controllers, Crane.
Amer. Elec. Fuse Co.

Cross-Arms, Pins and Brackets.
Berthold & Jennings.
Central Electric Co.
Lewis Lumber & Mfg. Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Company.
Western Elec. Supply Co.

Cut-Outs and Switches.
Bissell Co., The F.
Bossert Elec. Const. Co.
Central Electric Co.
Chicago Edison Co.
Crouse-Hinds Co.
Cutler Elec. & Mfg. Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
General Inc. Arc Light Co.
Hart Manufacturing Co.
Manhattan Elec. Supply Co.
Trumbull Elec. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Dynamos and Motors.
Akron Electrical Mfg. Co.
Bissell Co., The F.
Bullock Elec. Mfg. Co.
Central Electric Co.
Century Electric Co.
Crawfordsville Electric Co.
Crocker-Wheeler Co.
Dustin Co., Chas. E.
Ft. Wayne Elec. Wks. Inc.
General Elec. Co.
General Inc. Arc Light Co.
Gregory Electric Co.
Hobart Elec. Mfg. Co.
Mechanical Appliance Co.
National Electric Co.
Northern Electrical Mfg. Co.
Northwestern Electric Co.
Sprague Electric Co.
Stow Manufacturing Co.
Sturtevant Co., B. F.
Wagner Electric Mfg. Co.
Warren Elec. Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Economizers, Fuel.
Green Fuel Economizer Co.

Electric Heating Appl.
American Elec. Heater Co.
Simplex Elec. Heating Co.
Western Electric Co.

Electric Railways.
Crocker-Wheeler Co.
General Electric Co.
Sprague Electric Co.
Westinghouse El. & Mfg. Co.

Electrical and Mechanical Engineers.
Arnold Elec. Power Stat'n Co.
Baker & Co., W. E.
Bryan, Wm. H.
Butterfield, J. F.
Byllesby & Co., H. M.
Byrne Const. Co., M. P.
General Engineering Co., The.
Hallberg, J. H.
Hornaday, J. P. & Co.
Humphrey, Henry H.
Hunt & Co., Robt. W.
Jackson, D. C. & W. B.
Kohler Brothers.
Newgard & Co., Henry.
Northern Electrical Mfg. Co.
Ruebel, Schwedtman, Wells.
Sargent & Lundy.
Schott, W. H.
Squire Electric Co.
Stanton, LeRoy W.
Wilmerding, C. H.

Electrical Instruments. (Recording and Testing.)
Bissell Co., The F.
Central Electric Co.
Diamond Meter Co.
Duncan Elec. Mfg. Co.
Electric Appliance Co.
Electrical Recorder & Indicator Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
General Inc. Arc Light Co.
Illinois Elec. Specialty Co.
Jewell Electrical Inst. Co.
Machado & Roller.
Norton Elec'l Instrument Co.
Pignolet, L. M.
Stanley Instrument Co.
Wagner Electric Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.
Weston Electrical Inst. Co.

Electro-Plating Mach'y
Crocker-Wheeler Company.
General Electric Co.

Elevators-Conveyors.
Jeffrey Mfg. Co.

Engines, Gas and Gasoline.
Marinette Gas Engine Co.
Olds Gasoline Engine Works.
Woolley Fdy. & Mach. Wks.

Engines, Steam.
Allis-Chalmers Company.
Amer. Diesel Engine Co
Dustin Co., Chas. E.
Sturtevant Co., B. F.
Tod Co., Wm.

Fans and Fan Motors.
Central Electric Co.
Crocker-Wheeler Company.
Edison Mfg. Co.
General Electric Co.
General Inc. Arc Light Co.
Sprague Electric Co.
Sturtevant Co., B. F.
Wesco Supply Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Fibre.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Files.
Barnett Co., G. & H.

Fittings.
Farles Mfg. Co.

Fixtures, Gas and Elec.
Beardslee Chandeller Mfg. Co.

Flashers.
Bissell Co., The F.
Haller Machine Co.
Reynolds El. Flasher Mfg. Co

Flexible Shafts.
Stow Mfg. Co.

Forges.
Sturtevant Co., B. F.

Fuses and Fuse Wire.
Am r. Elec. Fuse Co.
Bissell Co., The F.
Central Electric Co.
Central Tel. & El. Co
Chicago Dle & Electric Co.
Chicago Fuse Wire & Mfg. Co.
D. & W. Fuse Company.
Electric Appliance Co.
Johns-Manville Co., H. W.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Company.
Western Elect. Supply Co.

Globes, Reflectors and Shades.
Fostoria Incan. Lamp Co.
Haller Machine Co.
Holophane Glass Co.
Pardridge Shade & Refl. Co.
Phoenix Glass Co.
Wesco Supply Co.
Western Electric Co.
Western Elect. Supply Co.

Graphite Specialties.
Dixon Crucible Co., Jos.
Holmes Fibre-Graphite Co.

Heating (Exhaust Steam).
Amer. District Steam Co.

Heating and Ventilating Apparatus.
Sturtevant Co., B. F.

Holders, Inc. Lamps.
Incandescent Electric Light Manipulator Co.

Inspection & Insurance
Hartford Steam Boiler Inspection & Insurance Co.

Insulating Machinery.
New England Butt Co.

Insulators and Insulating Materials.
Akron Electrical Mfg. Co.
American Electrical Works.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Inc. Arc Light Co.
Indiana Rub. & Ins. Wire Co.
Johns-Manville Co., H. W.
Kartavert Mfg. Co.
Manhattan Elec. Supply Co.
Mica Insulator Co.
Munsell & Co., Eugene.
National India Rubber Co.
New York Insulated Wire Co.
Ohio Valley Glass Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Standard Vitrified Cond. Co.
Sterling Varnish Co.
Vulcanized Fibre Co.
Wesco Supply Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Junction Boxes.
Bossert Elect. Const. Co.
General Inc. Arc Light Co.

Lamps, Arc.
Bissell Co., The F.
Central Electric Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
General Inc. Arc Lt. Co.
Gregory Electric Co.
Hipwell Manufacturing Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Lamps, Incandescent.
Bissell Co., The F.
Bryan-Marsh Company.
Buckeye Electric Company.
Central Electric Co.
Chicago Edison Co.
Columbia Incan. Lamp Co.
Edison Decorative & Miniature Lamp Dept.
Electric Appliance Co.
Fostoria Incand. Lamp Co.
General Electric Co.
General Inc. Arc Light Co.
Standard Elec'l Mfg. Co.
Sterling Electrical Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Lamps, Incandescent—Replacers & Cleaners.
Inc. El. Lt. Manipulator Co.

Letters, Metal.
Haller Machine Co.

Lightning Arresters.
Central Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
Manhattan Elec. Supply Co.
Minnesota Electric Co.
Western Electric Co.

Linemen's Climbers.
Klein & Sons, Mathias.

Magnet Wires.
(See Wires and Cables.)

Mechanical Draft.
Sturtevant Co., B. F.

Mica.
Chicago Mica Co.
Mica Insulator Co.
Munsell & Co., Eugene.

Mining Apparatus, Elec.
Crocker-Wheeler Company.
General Electric Co.
Jeffrey Mfg. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Motors. (See Dynamos and Motors.)

Nippers and Pliers.
Klein & Sons, Mathias.

Novelties, Glass, Elec.
Ithaca Elect'l Novelty Co.

Nozzles.
Farles Mfg. Co.

Paints.
Dielectric Mfg. Co.

Patent Attorneys.
Bain, Feree.

Phosphor Bronze.
Phosphor Bronze Sm. Co. Ltd.

Platinum, Wire and Sheet.
Baker & Company Inc.

Poles and Ties.
Berthold & Jennings.
Brooks, Hall L.
Bushnell, A.
Columbia Mfg. Co.
Coolidge Co., Marshall H.
Fowler, John H.
Fowler-Jacobs Company.
Kellogg Switch. & Sup. Co.
Lewis Lumber & Mfg. Co.
Lindsley Bros. Co.
Loud's Sons Co., H. M.
Maltby Lumber Co.
Morrison Lbr. Co., J. W.
Mueller Company, William.
Pacific Coast Pole Co.
Page & Hill Company.
Phelan, D. W.
Pittsburg & L. S. Iron Co.
Porter Cedar Company.
Sterling & Son, W. C.
Thompson, S. E.
Torrey Cedar Co.
Valentine-Clark Co., The.
Western Lumber & Pole Co.
Worcester Co., C. H.

Polish (Metal).
Allen Co., Inc., L. B.
Hoffman, Geo. W.

Portables.
Farles Mfg. Co.

Power Transmission Machinery.
Jeffrey Mfg. Co.

Rail Joints.
Continuous Rail Joint Company of America.

Refiners.
Gt. West Smelt. & Refining Co

Re-Winding—Repairs.
Chicago Edison Co.
Gregory Electric Co.
Miller Electric Co.
Northwestern Electric Co.

Rheostats.
Cutler-Hammer Mfg. Co.
General Electric Co.
Gen'l Inc. Arc Lt. Co.
Union Electric Mfg. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Rods, Conduit.
Cope, T. J.

Schools and Colleges.
Electrical Engineer Inst.
Michigan College of Mines.
Pratt Institute.
Rose Polytechnic Institute.
State Univ. of Iowa.

Second-Hand Mach'y.
Bissell Co., The F.
Cent. Stat. Improvement Co.
Dustin Co., Chas. E.
Gregory Electric Co.
Matthews & Bro., W. N.
Northwestern Electric Co.
Walsh's Sons & Co.

Shades, Lamp.
Farles Mfg. Co.

Sheet Brass & Copper.
Plume & Atwood Mfg. Co.

Signs, Electric.
Haller Machine Co.

Sockets & Receptacles.
Pass & Seymour.
Yost Elec. Mfg. Co.

Soldering Sticks, Salts and Paste.
Allen Co., L. B.
Crescent Co.
Kester Elec. Mfg. Co.
Western Electric Co.

Speaking Tubes.
Central Electric Co.
Edwards & Co.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.
Wester Elec. Supply Co.

Specialties, Electrical Mfrs. and Designers.
Haller Machine Co.

Speed Indicators.
Weston Electrical Inst. Co.

Storage Batteries.
American Battery Co.
Electric Storage Battery Co.
Gould Storage Battery Co.

Supplies, General Elec.
Bissell Co., The F.
Central Electric Co.
Century Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Electric Co.
Manhattan Elect'l Supply Co.
Wesco Supply Co.
Western Electric Co.
Western Elect. Supply Co.

Switchboards.
Bissell Co., The F.
Crouse-Hinds Co.
Gen. Incan. Arc Light Co.

Telephones, Telephone Material and Switchboards.
American El. Telephone Co
Automatic Electric Co.
Bissell Co., The F.
Central Electric Co.
Central Tel. & El. Co.
International Tel. Mfg. Co.
Kellogg Switchb. & Sup. Co.
Manhattan Elec. Supply Co.
Moeo Mfg. Co., The.
Murdock & Co., Wm. J.
National Elec. Signalling Co.
Stromberg-Carlson Tel. M. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Time Switches.
Bissell Co., The F.
Hartford Time Switch Co.

Tools.
Klein & Sons, Mathias.
Western Electric Co.

Transformers.
Central Electric Co.
Crawfordsville Electric Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Works, Inc.
General Electric Co.
Gregory Electric Co.
Kuhlman Electric Co.
Manhattan Elec. Supply Co.
National Electric Co.
Wagner Electric Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Trucks, Electric Car.
General Electric Co.
Westinghouse El. & Mfg. Co.

Turbines, Steam.
Allis-Chalmers Co.
General Electric Co.
Westinghouse El. & Mfg. Co

Turbines Water Wheels
Leffel & Co., Jas.

Varnishes.
Dielectric Mfg. Co.
Sterling Varnish Co.

Vulcanized Fibre.
Vulcanized Fibre Co.

Wireless Tel. App'tus.
Clark Wireless Tel. & Tel. Co. T. E
National Elec. Signalling Co

Wires & Cables—Magnet Wires.
American Electrical Works.
Bissell Co., The F.
Central Electric Co.
Chicago Insulated Wire Co.
Crescent Ins. Wire & Cable Co.
Driver-Harris Wire Co.
Electric Appliance Co.
General Electric Co.
Hazard Manufacturing Co.
Indiana Rub. & Ins. Wire Co
India Rubber & Gutta Percha Insulating Co.
Kellogg Switch. & Sup. Co.
Manhattan Elec. Supply Co.
National India Rubber Co
New York Insulated Wire Co.
Okonite Co., The.
Phillips, Eugene F.
Phillips Insulated Wire Co
Roebling's Sons Co., J. A.
Safety Ins. Wire & Cable Co.
Simplex Electrical Co.
Standard Underground C. Co
Wesco Supply Co.
Western Electric Company.
Western Elec. Supply Co.

For Alphabetical Index of Advertisements See Page 3.

"ELECTRA" HIGHEST GRADE NUERNBERG

CARBONS

BEST LIGHT — STEADIEST LIGHT — LONGEST LIFE — LEAST DUST

ELECTRA
TRADE MARK

REMAIN THE STANDARD OF THE WORLD FOR ALL ARC LIGHTING SYSTEMS, BECAUSE they cannot be equaled in QUALITY or EFFICIENCY, producing the highest standard of candlepower in proportion to the current consumed.

HUGO REISINGER, Sole Importer, - - 11 Broadway, NEW YORK.

"Diamond H" Switches

Trade H Mark

This Trade-Mark guarantees quality.

The Hart Mfg. Co., Hartford, Conn.

New York Boston Chicago Toronto, Ont.

W. D. PAINT.

A PERMANENT INSULATING PROTECTION FOR WOOD OR METAL. A quick drying, moisture-proofing, black paint. An elastic anti-rust coating. A jet black finishing paint, efficient and not expensive.

Write for "Data on Insulating Materials."

DIELECTRIC MANUFACTURING CO., SAINT LOUIS.

⅔ Actual Size. Patented.

CROWN CORD ADJUSTER

BEST AND SIMPLEST. MADE OF HARD RUBBER.

No Slip, No Abrasion, No Removing socket, Easily attached

Price $4.00 Per Hundred. Liberal Discount to the Trade.

Sample Free.

J. H. SEAMAN, 175 Dearborn St., Chicago

Diam. of body, 8 in., of base flange 7½ in.

THE "I. P." (ISOLATED PLANT) TYPE DIRECT-CURRENT INSTRUMENTS

Are winners. Scales are equally divided, indications are dead beat, high range ammeters have separate shunts and the cases are of heavy polished brass.

Prices are right, the list figure for the meter illustrated, for instance, being $16.50.

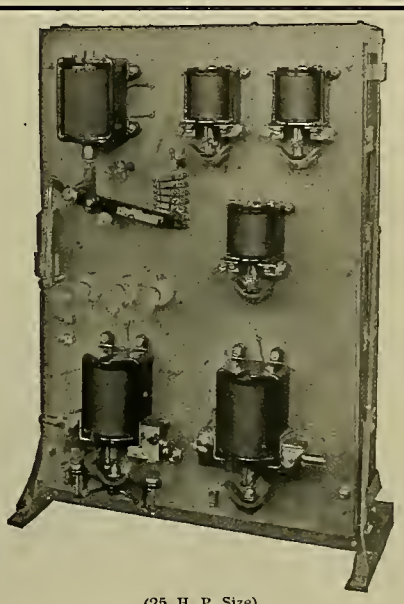
WRITE FOR DISCOUNTS TO

MACHADO & ROLLER,

203 BROADWAY, NEW YORK CITY, N. Y., Or Your Nearest Supply House.

C H

QUALITY QUALITY



(25 H. P. Size)

SELF-STARTERS

FOR

Large Motors

THE CUTLER-HAMMER MFG. CO.

MILWAUKEE WIS.

New York 136 Liberty St. — Boston 176 Federal St.

Pittsburg 322 Frick Building — Chicago 1232 Monadnock Bldg.

STANLEY RECORDING WATTMETERS

FOR ALTERNATING CURRENT CIRCUITS

BALANCED THRUST

NO JEWEL WEAR FROM HAMMER OR SIDE THRUST. GLASS OR METAL COVERS—SECOND ALONE TO THE STANLEY MAGNETIC SUSPENSION WATTMETERS

Send for Bulletins and Information About Meters to

STANLEY INSTRUMENT CO., Great Barrington, Mass., U. S. A.

EUROPEAN OFFICE, 23 BOULEVARD DES ITALIENS, PARIS, FRANCE.

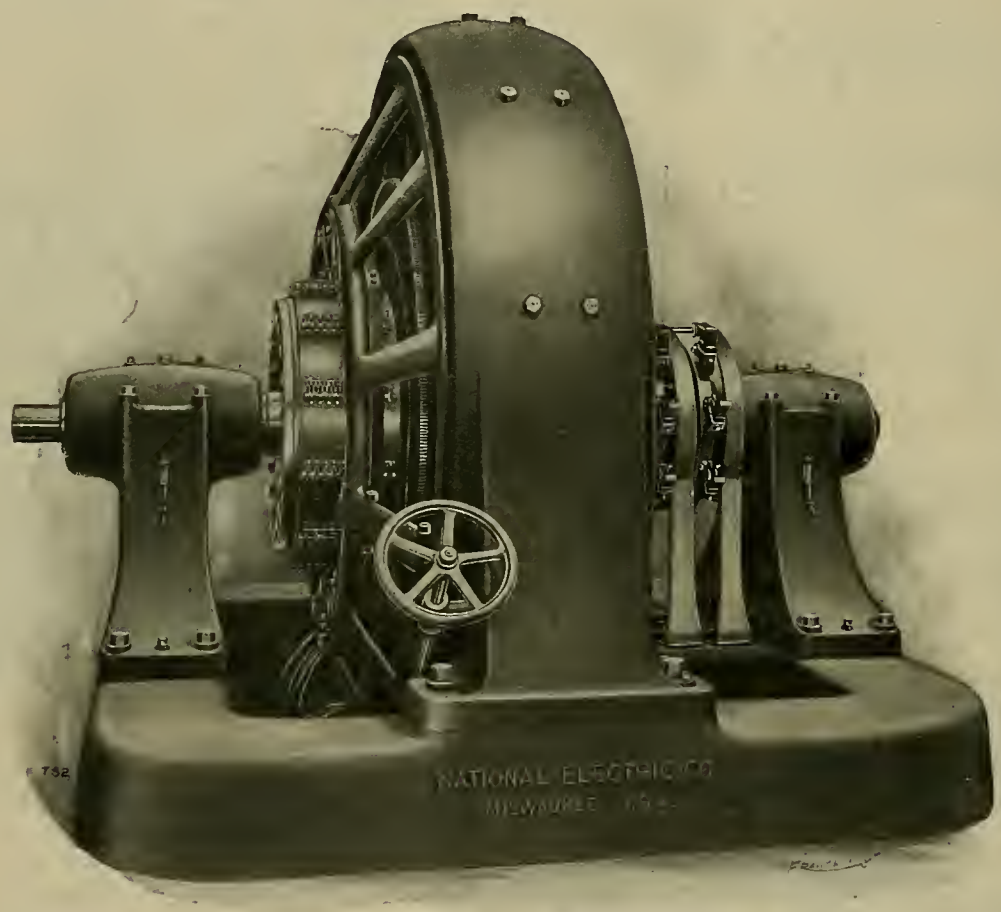
SALES AGENTS:
Missouri, Kansas, Arkansas, FRANK ADAMS ELECTRIC COMPANY, St. Louis.
Colorado, Idaho, Montana, Wyoming, New Mexico, Utah, HENDRIE-BOLTHOFF MFG. AND SUPPLY CO., San Francisco.
California, Oregon, Washington, Nevada, Arizona. BROOKS-FOLLIS ELECTRIC CORP. San Francisco.
Mexico, VICTOR M. BRASCHI & COMPANY, Mexico City.

National Electrical Machinery

Built in Capacities up to

1,500 K. W.

For Lighting, Power and Railway Service



1000 K. W. ROTARY CONVERTER FOR STREET RAILWAY SERVICE.

See our exhibit at the Louisiana Purchase Exposition and the National 1,500 K. W. Alternator in operation.

Write for Catalogues.

National Electric Company

New York: 135 Broadway.
Charleston, W. Va.: Agnew Electric Co.
Philadelphia: 1509 Land Title Bldg.
Pittsburg: Gellatly & Co.

General Sales Office and Works,

MILWAUKEE

Chicago: Old Colony Bldg.

Seattle and San Francisco: { Kilbourne and Clark Co.

DO NOT DELAY placing your order for

Pillsbury A. C. Ceiling Fans

They will stir more air than any other alternating current Ceiling Fan on the market.
THE PRICE IS RIGHT.

MANUFACTURED BY **CENTURY ELECTRIC CO.**

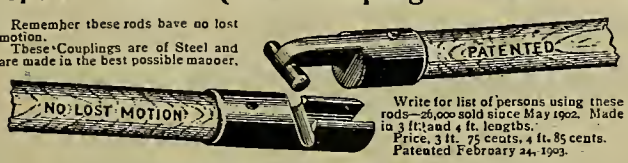
1007-9-11 LOCUST STREET, ST. LOUIS, MO.

BOOKS. BUY YOUR BOOKS FROM THE ELECTRICIAN PUBLISHING COMPANY, 510 Marquette Bldg., CHICAGO.

We Confine Ourselves Strictly to Electric Heating.
DO NOT GO INTO SIDE LINES.
AMERICAN ELECTRICAL HEATER CO.
DETROIT, MICH.

Cope's Patent Quick Coupling Conduit Rod

Remember these rods have no lost motion. These Couplings are of Steel and are made in the best possible manner.



Write for list of persons using these rods—26,000 sold since May 1902. Made in 3 ft. and 4 ft. lengths. Price, 3 ft. 75 cents, 4 ft. 85 cents. Patented February 24, 1903.

T. J. COPE
3244 North Fifteenth Street PHILADELPHIA, PA.

Sheet Brass, *All Tempers*
Brass and Bronze Drill Rods
Brass and Copper Wire
German Silver Sheet and Rod
Brazed and Seamless Tubing

Eagle Brand *Copper Rivets and Burrs, Brass Escutcheon Pins*

Brass Butts, *Desk Narrow, Broad Middle, Ball Tipped and Water Closet*

Brass and Iron Jack Chain, Brass Safety Chain, Etc.
Catalogues on Application

THE PLUME & ATWOOD MFG. CO.
New York Boston San Francisco Chicago

General Electric Company

Edgewise Wound Enclosed Arc Lamps

FOR ONE HUNDRED AND TEN VOLT DIRECT CURRENT SERVICE

Embody the latest features of Arc Lamp manufacture.

INDESTRUCTIBLE.
PERFECT REGULATION.
PERMANENT ADJUSTMENT.
COMPOSED OF FEW PARTS.
SIMPLICITY AND RIGIDITY OF CONNECTIONS.

Write for further information.

GENERAL OFFICES: SCHENECTADY, N. Y.

Chicago Office: Monadnock Block. Sales Offices In All Large Cities.

IMPORTANT NOTICE

AMERICAN CIRCULAR LOOM CO.
TRADE MARK
REGISTERED
MANUFACTURERS OF
FLEXIBLE INTERIOR CONDUIT
CANVAS JACKETS FOR INSULATED WIRE & CABLES
AND
TRADE
—ELECTRODUCT—
MARK

Chelsea, Mass., July 2nd, 1904.

Gentlemen:

Our attention has been called to certain reports that have been recently circulated, evidently with malicious intent with reference to an alleged action of the Underwriters in condemning "Circular Loom." We cannot believe that any of our trade will be misled by these libelous statements. But, may we not ask that you kindly refer to the list of approved appliances published by the Underwriters, April, 1904, in which you will find our material has the full sanction of the Bureau? All appliances included in this little pamphlet are recommended for use by the Underwriters and it will be apparent to you that our name would not be upon its pages unless "Circular Loom" met the requirements.

We have recently taken this matter up with the Bureau and have been assured that our material has not been condemned and that when installed in conformity with the rules laid down by the national code, it is accepted by the various bureaus throughout the United States, and ***in verification of this statement you are at liberty to communicate with the Electrical Bureau of the National Board of Fire Underwriters, 67 East 21st St., Chicago.***

Yours very truly,

AMERICAN CIRCULAR LOOM CO.

SCHOTT

Central Station Heating Plants

THE SCHOTT BALANCED COLUMN HOT WATER SYSTEM

No Back Pressure. No Noise.
Perfect Circulation. Greatest Capacity.
Absolute Regulation

THE SCHOTT REGULATED STEAM SYSTEM

Automatic Vacuum Circulation. Greatest Pipe Line Capacity.
Least Back Pressure. Highest Economy.
Absolute Regulation.

W. H. SCHOTT

Engineer

1218-1221 Marquette Building, - CHICAGO

Designer and Builder of

Central Station Heating, Gas, Electric Light and Power Plants

WATERWORKS SYSTEMS ELECTRIC RAILWAYS

WE HAVE OVER 135,000
ADAMS-BAGNALL ARC LAMPS
IN OPERATION

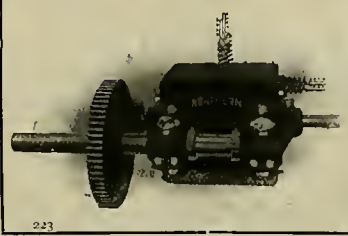
These cost our customers from $1.00 to $2.00 more than they could have bought others for. There must have been a reason why they paid us more. Think it over .·. .·. .·. .·.

Pittsburg, Washington, St. Louis, Baltimore, Kansas City, Grand Rapids, Dayton, and a hundred other towns, are lighted by Adams-Bagnall Arc Lamps. Is yours? .·. .·. .·.

ELECTRIC APPLIANCE CO.
ELECTRICAL SUPPLIES
CHICAGO

Not a Luxury
Fans are a necessity.
We sell
Desk, Wall and Ceiling
styles for all voltages and currents.
Write for our 1904 bulletins.
THE WESCO SUPPLY CO.
"Everything Electrical" ST. LOUIS, U. S. A.

MICA
WE PUT THE MICA POOL OUT OF BUSINESS!
CHICAGO MICA CO.
VALPARAISO, IND.



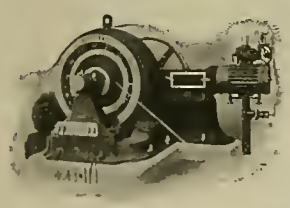
Northern Crane Motors
Best because designed and built for the service. Simple, sturdy, compact, Bulletin No. 2532
Northern Electrical Mfg. Co.
Engineers Manufacturers
Madison, Wis., U. S. A.

MICA
Of all Qualities, in any Form at Lowest Prices
Eugene Munsell and Co.
New York and Chicago
INSULATION That Is.
Micanite, Linotape, M. I. C. Compound, Empire Cloth and Paper. For Years the Standard.
MICA INSULATOR CO., ORIGINATORS,
NEW YORK and CHICAGO.

Motor Starter with Automatic Release. Manufactured under our own patents.

MOTOR STARTERS,
SPEED REGULATORS,
FIELD REGULATORS
And Special Controlling Devices of all kinds. Send for catalogue and discounts.
UNION ELECTRIC MFG. CO.,
Milwaukee, Wis.

Warren
Alternator



Acme of
Electrical Perfection
Mechanical Simplicity
Regulation Efficiency

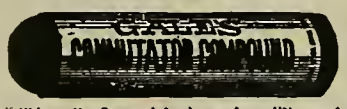
We Guarantee What We Sell
... AND ...
Sell What We Guarantee

WARREN ELECTRIC MFG. CO.
Sandusky, O.

VOLT - AMMETERS,
POCKET SIZE.
For Testing Batteries and Battery Circuits, Locating Faults, Grounds, etc.
RELIABLE. ACCURATE.
Send for Circular.
L. M. PIGNOLET,
78-80 Cortlandt St., NEW YORK, N. Y.

Electric Heating Apparatus
SEND FOR 82-PAGE CATALOGUE.
"UNIT" ENAMELED RHEOSTATS
SIMPLEX ELECTRIC HEATING CO.,
Cambridgeport, Mass.

YOU NEED IT!



Gale's Commutator Compound.
The Only Article That Will Prevent Sparking.
Will keep the Commutator in good condition and prevent cutting. Absolutely will not gum the brushes.
50c. per stick. $5.00 per dozen. Send 50c. for trial stick.
FOR SALE BY ALL SUPPLY HOUSES OR
K. McLENNAN & CO., Sole Manufacturers, Room 411 Inter Ocean Bldg., 130 Dearborn Street . CHICAGO

EDISON MINIATURE LAMPS

Have been for twenty years
The Standard of the World
and are to-day more largely used than all other makes combined.
Serviceable, Economical, Reliable.
Miniature and Candelabra Sockets and Receptacles.
EDISON DECORATIVE & MINIATURE LAMP DEPT.,
General Electric Company, Harrison, N. J.

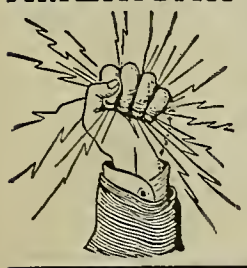
ELECTRIC
FANS

THE POPULARITY
of our fans is due to their superior design and construction. They have been imitated many times, but never equaled.
Write for Catalogue No. 30814
SPRAGUE
ELECTRIC COMPANY
General Offices:
527 West 34th Street, New York.
Chicago Office: Fisher Bldg.

FRANK N. PHILLIPS, PRESIDENT. C. H. WAGENSEIL, TREASURER. EUGENE F. PHILLIPS, GENERAL MANAGER. C. ROWLAND PHILLIPS, VICE-PRES. C. R. REMINGTON, JR., SEC.

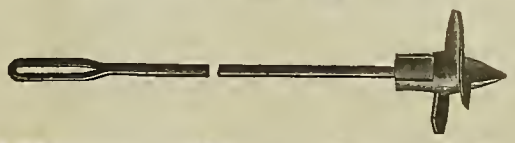
AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.



BARE AND INSULATED ELECTRIC WIRE,
ELECTRIC LIGHT LINE WIRE,
INCANDESCENT AND FLEXIBLE CORDS,
Railway Feeder and Trolley Wire,
AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR WIRES.
CABLES FOR AERIAL AND UNDERGROUND USE.
NEW YORK STORE, W. J. Watson, 26 Cortlandt St.
CHICAGO STORE, F. E. Donohoe, 82 Lake St.
MONTREAL BRANCH, Eugene F. Phillips' Electrical Works.
MAIN OFFICES AND FACTORIES, PHILLIPSDALE, R.I.

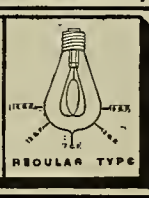
STOMBAUGH
GUY ANCHORS
HOLD
POLES



STRAIGHT, VERTICAL, RIGID, FIRM.
SCREW THEM IN—THAT'S ALL.
W. N. MATTHEWS & BROTHER
DISTRIBUTERS
603 CARLETON BLDG., - - ST. LOUIS, MO.

STERLING SPECIAL

DO YOU?
BUY LAMPS-OR-BUY CANDLE POWER
16 THIS LAMP AVERAGES 12
THE STENLING ELECTRICAL MANUFACTURING CO.
NEW YORK, N. Y. WARREN, O. CHICAGO, ILL.



REGULAR TYPE

EXPERT IN ELECTRICITY MECHANICS PATENT CAUSES
SOLICITOR OF **PATENTS**
U. S. & FOREIGN
FOREE BAIN, 1662-3 Monadnock Blk., CHICAGO

GET ALLEN SOLDERING STICKS
MAKE SOLDER FLOW
FOR ALL ELECTRIC WORK.
My secret's mine until it's told—
Keep your secrets—Get the habit
of telling the man
"ALLEN SOLDERING STICKS OR NOTHING."
A Big Sample Stick for 10c.
Booklet "Soldering Sense" describes.
L. B. ALLEN CO., Inc.,
SOLE MAKERS,
1334 Columbia Ave., CHICAGO.

AKRON
Generators, Motors, Clutches,
Commutator Truing Devices.
AKRON ELECTRICAL MFG. CO.,
AKRON, O.
N. Y. Office: McKay Engineering Co., 149 Broadway

DO YOU WANT THE BEST?
Then ALWAYS buy
THE MAXSTADT PATENT JOINT
Manufactured and sold by the owners of the Maxstadt Patent No. 655,905.
This is the best Joint on the market and gives entire satisfaction wherever used.
No. 882 represents the Joint ready for use.
Patented August 14, 1900, in the United States and Foreign Countries.

No. 882.
No. 884 represents the Joint, twisted, complete on the line.

No. 884.
These Joints are furnished in copper for copper wire and in tinned steel for galvanized iron wire. Samples and prices will be sent, without charge, upon request.
SOLE OWNERS OF THE MAXSTADT PATENT IMPROVED AMERICAN JOINT.
CHICAGO DIE & ELECTRIC COMPANY, 87-91 West Lake Street, CHICAGO, ILL.

EDWARDS AND CO
The R. E.-A. L. Monitor Bell.
(Patented.)

Hammer rod supported in two places and thrown straight out and in by the armature, striking gong on inside, near edge, thus giving a full, clear tone.
All springs made of Phosphor Bronze and so formed that there is least possible strain.
Contacts are platinized, adjustment is made by pressure on the standard which supports one contact. No screws or nuts being used in the adjustment, bell does not get out of order by operation.
Ordinarily the weak point is the pivot, the unreliable one the adjusting screw and nut. As these defects have been eliminated, this bell will stand hard usage and operate under adverse conditions.
The hammer entirely concealed by gong and cannot be tampered with.
It is especially adapted for use on street cars, as in addition to the advantages mentioned, it is dust, insect and moisture proof.
WESTERN ELECTRIC COMPANY,
SELLING AGENTS.
NEW YORK N.Y.

Crimshaw.

Raven White Core.

Raven Black Core.

ALL OUR WIRES pass inspection and carry the above TRADE-MARKS on our tags. We also manufacture Crimshaw and Competition Tapes and Splicing Compounds.

NEW YORK INSULATED WIRE COMPANY,

MAIN OFFICE: 114, 116 & 118 Liberty St., New York.
BRANCHES: CHICAGO: 192 Deaplaines St. BOSTON: 7 Otis St. SAN FRANCISCO: 33 Second St.

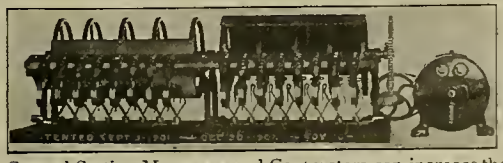
NATIONAL CODE STANDARD

"O. K." Weatherproof Wire.
Slow-Burning Weatherproof and Ideal Wire.
Prices and Samples on Application.

Phillips Insulated Wire Co.
Office and Factory: PAWTUCKET, R. I.

FLASHERS

GENUINE IMPROVED REYNOLDS FLASHER



The most practical and simplest Flasher on earth.

Central Station Managers and Contractors can increase their revenues materially by advocating Flashed Electric Signs among their patrons.
WRITE US NOW for Flasher information and pointers on Electric Signs. We have an interesting proposition for you.

REYNOLDS ELECTRIC FLASHER MFG. CO.
221 FIFTH AVE., CHICAGO, ILL.

WANTED, FOR SALE *and similar* **WANT COLUMN** *advertisements (50 words or less), $1.50 an insertion; additional words 3c each.* **POSITION WANTED** *advertisements (50 words or less), $1.00 an insertion; additional words 2c each.*

WANTED.

50 to 60 K. W. direct-connected unit. Must be standard make in first-class condition and a bargain for spot cash. Address, McGUIRE & COBB, Hotel Warner, 33d St. and Cottage Grove Ave., Chicago.

WANTED.

A man with wide experience and a large acquaintance desires to act as manufacturers agent for several high-class specialties. Must have merit. Highest references. Address BOX 368, care of Western Electrician, 510 Marquette Bldg., Chicago.

WANTED.

To buy or lease an Electric Light Plant by an experienced electrical engineer. Must be in a good town with a chance to grow. Would prefer to take hold of a run-down plant and build it up. Or would take interest in and management of a good plant. Address BOX 373, care Western Electrician, 510 Marquette Bldg., Chicago.

WANTED.

An exceptional opening is offered a practical electrician as superintendent in an established electrical contracting business in Detroit, Mich. Would have to invest $1,000. Steady position, with salary and division of profits. Address BOX 370, care of Western Electrician, 510 Marquette Building, Chicago.

WANTED.

Good all around electrician to take charge of small water power plant in Michigan. Would expect man to trim 45 single carbon arc lamps, look after alternator meters, line work wiring, etc.; have full charge of plant and night man. Give age, experience and salary. Address BOX 371, care of Western Electrician, 510 Marquette Building, Chicago.

WANTED

A competent and experienced salesmao to travel in Ohio and Indiana, and sell electric lighting, telephone and railway supplies. Give age, experience and references, etc. Address, box 369, care of WESTERN ELECTRICIAN, 510 Marquette Bldg., Chicago, Ill.

FOR SALE.

A bargain; I. T. H. 30-light 9.6 Amp. Series open-arc-machine, with wall-controller and ammeter complete, good running order.

Twenty-two 9.6 Amp. double carbon open arc lamps with glass, hoods and spreader complete, good order. Several additional lamps, both single and double, can be put in good order or parts used for repairs. A lot of extra globes and parts and a supply of carbons will be included if taken as a whole.

Two 30-K. W. Edison Bipolar 125-volt D. C. generators in fine running order. Reason for selling, have put in larger machinery.

CARROLL ELECTRIC LIGHT & POWER COMPANY, Carroll, Iowa.

FOR SALE.

A good paying electric light plant in Indiana, in good growing town of 1,200. Plant in first-class shape, cheap fuel and good city contract. Plant runs until 11 p. m. and can be handled by one man. Must be sold on account of sickness and can be bought for $4,200 with $2,400 down, balance long time. Address quick, BOX 372, care Western Electrician, 510 Marquette Bldg., Chicago.

Gas and Electric Light Plants

We act as agents for the sale of gas and electric light plants

If you have a plant to sell write us

J. S. MAURER & CO., MONADNOCK BLDG. CHICAGO

ELECTRICAL BOOKS.

All Kinds.

ELECTRICIAN PUBLISHING COMPANY,

Suite 510 Marquette, CHICAGO.

FOR SALE

Owing to change to 60 cycles we have about 40, 125-cycle, 1000-volt to 100-volt transformers varying in size from 10 to 375 lights. Also 25 Guttman & Westinghouse wattmeters and one 50-light T. H. Series Arc Dynamo, also two 50-K. W. 1000 or 2000 volt Alternators, Stanley and T. H. Above are for sale at a bargain.

MOSCOW ELECTRIC LIGHT & POWER CO., Moscow, Idaho

REPAIRING RECALIBRATING ELECTRIC METERS.

INTERNATIONAL ELECTRIC METER CO.
167 S. CANAL STREET, CHICAGO.

BUY YOUR BOOKS

FROM THE

Electrician Pub. Co., 510 Marquette Bldg., Chicago.

LANDS YOU AT THE GATE

All the most important trains of the Wabash Railroad now run into St. Louis by way of World's Fair Grounds, stopping at Wabash World's Fair Station, located at the Main Entrance. The Wabash is the only line that sells tickets and checks baggage direct to the World's Fair main gate. Excursion tickets on sale daily. Very low rate coach tickets sold twice a week. Write for full particulars, and a copy of folder containing a map of St. Louis and the Fair Grounds.

F. A. PALMER, Ass't Gen. Pass. Agent,
311 Marquette Bldg., CHICAGO, ILL.

INDUSTRIES ARE OFFERED LOCATIONS

WITH

Satisfactory Inducements,
Favorable Freight Rates,
Good Labor Conditions,
Healthful Communities,

ON THE LINES OF

THE ILLINOIS CENTRAL R. R.
AND THE
YAZOO & MISSISSIPPI VALLEY R. R.

For full information and descriptive pamphlet address

J. C. CLAIR,
Industrial Commissioner,
1 Park Row, Chicago, Ill.

Points in Wisconsin and the Northwest

are covered by Wisconsin Central Railway's convenient, solid, wide vestibuled trains, equipped with Pullman sleepers, free reclining chair cars and modern coaches which leave Central Station, 12th Street and Park Row (Lake Front), Chicago for St. Paul, Minneapolis, Ashland and Duluth, connecting with all western lines. Meals in dining and cafe cars served a la carte.

For tickets and further information apply to nearest ticket agent, or write

JAS. C. POND, Gen'l Pass. Agt., Milwaukee, Wis.

All Supply Houses

J. J. EGAN'S "ACME" COMMUTATOR COMPOUND.

J. J. EGAN'S "ACME" COMMUTATOR COMPOUND
Absolutely prevents sparking or cutting. One stick of "Acme" is equal to one gallon of oil for lubricating commutators. Free Sample. AGENTS WANTED.
50c per Stick. $5.00 per doz.
J. J. Egan Sole Mfg., 663 W. Ohio St., Chicago

FOR SALE

220 V. DIRECT CURRENT.

80 H. P. Westinghouse, 400 R. P. M.
20 H. P. Eddy, 1450 R. P. M.
7½ H. P. General Electric, 900 R. P. M.
5 H. P. General Electric, 1820 R. P. M.
5 H. P. Paragon, 900 R. P. M.
3½ H. P. Paragon, 1000 R. P. M.
2 H. P. General Electric, 1025 R. P. M.
2 H. P. Simpson, 2100 R. P. M.
1½ H. P. General Electric, 1800 R. P. M.
1 H. P. Lundell, 1200 R. P. M.
25 H. P. Crocker-Wheeler, 750 R. P. M.
15 H. P. Detroit, 1000 R. P. M.
10 H. P. General Electric, 1350 R. P. M.
10 H. P. Simpson, 2000 R. P. M.
7½ H. P. Crocker-Wheeler, 1575 R. P. M.
7½ H. P. Card, 775 R. P. M.
6 H. P. C. & C., 1030 R. P. M.
5 H. P. Westinghouse, 1050 R. P. M.
5 H. P. C. & C. 1600 R. P. M.
3 H. P. Jenny, 1600 R. P. M.

CENTRAL STATION IMPROVEMENT CO., 938 Monadnock Block, CHICAGO.

WORKS QUICK AND EASY. KEEPS ITS LUSTER. HOLDS OLD TRADE AND MAKES NEW. DOES NOT DETERIORATE. ESTABLISHED 16 YEARS. SOLD BY AGENTS AND DEALERS ALL OVER THE WORLD
U.S. METAL POLISH
3 OUNCE BOX 10 CENTS
SAMPLES SENT FREE
GEO. W. HOFFMAN
POLISHES ALL METALS. BRANCHES NEW YORK, CHICAGO, SAN FRANCISCO. 295 E. WASHINGTON ST. INDIANAPOLIS, IND.

FOR SALE.

ALTERNATORS.

1-360 K. W. General Electric 3-phase.
1-120 " " " "
1-75 " Westinghouse 2-phase.

250-VOLT GENERATORS.

1-250 K. W. Western Electric M. P.
1-200 " Eddy M. P.

125-VOLT GENERATORS.

1-125 K. W. Western Electric M. P.

Immediate shipment.

GREGORY ELECTRIC CO.
54-62 S. CLINTON ST. CHICAGO

NEW PRICES

New net prices on all goods contained in our 550-page catalogue No. 14. Send for it.

MANHATTAN ELECTRICAL SUPPLY CO.
New York Chicago

"AMERICAN" STORAGE CELLS
ARE THE BEST. Send for descriptive Circular.
AMERICAN BATTERY CO.,
ESTD 1893. 171 S. Clinton St., Chicago.

DIRECT CONNECTED RAILWAY UNITS.

850 Kw. with cross-compound Corliss engine.
500 Kw. with cross-compound Corliss engines.
425 Kw. with simple Corliss engine.
425 Kw. with simple Greene engine.
400 Kw. with Russell four-valve engines.
400 Kw. with simple Corliss engine.
325 Kw. with tandem-compound engine.
300 Kw. with tandem-compound engine.
300 Kw. with tandem-compound engines.
250 Kw. with Westinghouse compound engine.
225 Kw. with cross-compound engine.

DIRECT CONNECTED LIGHTING AND POWER UNITS.

300 Kw. 60-cycle two-phase, with simple engine.
300 Kw. 60-cycle three-phase, with simple engine.
200 Kw. 60-cycle three-phase alternator, with simple engine.
200 Kw. 25-cycle three-phase alternator, with simple Buckeye engine.
150 Kw. 60-cycle single-phase alternators with tandem-compound engines.
125 Kw. 125-volt, with simple engines.
75 Kw. 250-volt, with simple engine.
75 Kw. 125-volt, with simple engine.
60 Kw. 125-volt, with simple engine.
50 Kw. 125-volt, with tandem-compound engine.
50 Kw. 125-volt, with simple engine.
42 Kw. 240-volt, with simple engines.
25 Kw. 250-volt, with simple engines.
25 Kw. 125-volt, with simple engine.

BELT DRIVEN ALTERNATORS.

650 Kw., 1,300-2,600 volts, 2-phase, 133 cycles.
300 Kw., 6,000 volts, 3-phase, 25 cycles.
250 Kw., 10,000 volts, 3-phase, 60 cycles.
250 Kw., 2,200 volts, single-phase, 133 cycles.
200 Kw., 1,100 volts, single-phase, 133 cycles.
180 Kw., 2,300 volts, 2-phase, 60 cycles.
180 Kw., 2,300 volts, single-phase, 60 cycles.
180 Kw., 1,080-2,160 volts, single-phase, 133 cycles.
150 Kw., 1,100-2,200 volts, 2-phase, 133 cycles.
150 Kw., 2,200 volts, 3-phase, 60 cycles.
150 Kw., 1,100-2,200 volts, single-phase, 60 cycles.
150 Kw., 1,100 volts, single-phase, 133 cycles.
120 Kw., 1,040-2,080 volts, single-phase, 133 cycles.
120 Kw., 1,040 volts, single-phase, 133 cycles.
100 Kw., 2,300 volts, single-phase, 60 cycles.
100 Kw., 1,100 volts, single-phase, 133 cycles.
100 Kw., 1,040-2,100 volts, 3-phase, 60 cycles.
90 Kw., 2,200 volts, 2-phase, 60 cycles.
90 Kw., 2,200 volts, single-phase, 60 cycles.
75 Kw., 2,200 volts, 2-phase, 60 cycles.
75 Kw., 1,100 volts, single-phase, 133 cycles.
60 Kw., 1,100 volts, single-phase, 133 cycles.

BELT DRIVEN RAILWAY GENERATORS.

Two 500 Kw. 6-pole.
Two 500 Kw. 4-pole.
Four 300 Kw. 4-pole.
Two 250 Kw. 4-pole.
One 250 Kw. 6-pole.
Two 200 Kw. 6-pole.
Three 200 Kw. 4-pole.
Two 200 Kw. bipolar.
Two 187 Kw. 4-pole.
Two 150 Kw. 6-pole.
Two 110 Kw. 4-pole.
One 110 Kw. 6-pole.
Three 100 Kw. 4-pole.
Two 100 Kw. 6-pole.

ENGINES, BOILERS, GENERATORS, MOTORS, ARC LAMPS, TRANSFORMERS.

CHAS. E. DUSTIN CO.,
11 BROADWAY NEW YORK

CHICAGO EDISON COMPANY REPAIR SHOPS

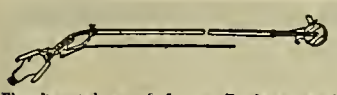
76 MARKET STREET, CHICAGO. TELEPHONE MAIN 1280.

Machine and Carpenter Work of All Kinds Correspondence Solicited.

OPEN DAY AND NIGHT.

FIRST-CLASS EQUIPMENT THROUGHOUT.

Dynamos Armatures, Motors, Arc Lamps, Fans, Instruments.



The Incandescent Lamp Replacer and Cleaner replaces and cleans any c. p. lamp at any height or angle.
Incandescent Electric Light Manipulator Co.,
116 Bedford St., Boston, Mass.

"NEW TRAIN SERVICE TO
French Lick
and
West Baden Springs."

A parlor and dining car now leave Chicago at 12:00 o'clock noon, arrive at the Springs at 8:45 p. m. Leave Springs 9:00 a. m., arrive Chicago 5:55 p. m. Reservations at Monon Route City Office, 232 Clark Street. Telephone Har. 1245.

....BINDERS....
FOR THE
Western Electrician
$1.00 EACH.
ELECTRICIAN PUB. CO.,
CHICAGO.

"Free from the care which wearies and annoys,
Where every hour brings its several joys."

"AMERICA'S SUMMER RESORTS"

This is one of the most complete publications of its kind, and will assist those who are wondering where they will go to spend their vacation this summer.

It contains a valuable map, in addition to much interesting information regarding resorts on or reached by the

NEW YORK CENTRAL LINES

A copy will be sent free, upon receipt of a two-cent stamp, by George H. Daniels, General Passenger Agent New York Central & Hudson River Railroad, Grand Central Station, New York.

Standard Vitrified Conduit Co.

B. S. BARNARD, Manager

39-41 CORTLANDT ST.
NEW YORK

LARGEST FACTORIES IN THE WORLD : STOCK ON HAND
SEND FOR CATALOGUE

BITUMINIZED FIBRE CONDUIT
FOR
ELECTRICAL UNDERGROUND CONSTRUCTION
ELECTROLYSIS PROOF WATER PROOF

A smooth laminated insulator of unchanging durability.
Forms a continuous sealed duct from manhole to manhole, impervious to moisture and through which leaking gas cannot penetrate.
There has never been a gas explosion in our conduits nor the slightest evidence of electrolysis.
Abrasion of the cables is an impossibility.
It saves sixty per centum of freight and handling cost and twenty to thirty-five per centum of construction.
Process of laying is simple, rapid and inexpensive. There is no loss from breakage or fitting. It is self-aligning and cannot settle out of alignment.
All sizes from one inch to ten inches interior diameter. Bends of all angles.
The foremost electrical engineers are recognizing and testifying to the scientific advantages of our system of subway construction over all previous methods.

Send for illustrated book. Ask for prices giving size and quantities required
PROMPT DELIVERIES

FACTORIES: Philadelphia, Chicago, Los Angeles
American Conduit Company
SEVENTH FLOOR, 170 BROADWAY, NEW YORK
336 Macy St., Los Angeles, Cal. Manhattan Bldg., Chicago

The Rose POLYTECHNIC INSTITUTE
Devoted to all branches of Engineering Science, Mechanical, Electrical and Civil. Architecture and Chemistry. Thorough instruction, practical work. Courses under direction of specialists. 23d year. Send for catalog. C. L. MEES, Pres., Box S, Terre Haute, Ind

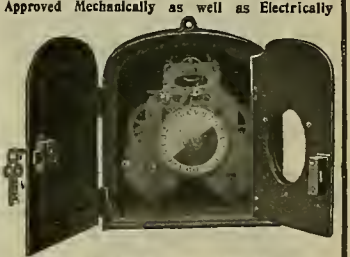
THE STATE UNIVERSITY OF IOWA
SCHOOL OF APPLIED SCIENCE, Iowa City, Iowa
Four year courses of the highest grade in
Civil
Municipal
Sanitary
Electrical
Mechanical
Mining
ENGINEERING
Numerous short practical courses. Special courses in technical chemistry, bacteriology, etc. Adequate equipment in shops and laboratories. Waterpower.
University environment. Expenses low.
Address C. E. MacLEAN, President

TWO YEAR COURSES IN
STEAM AND MACHINE DESIGN
AND IN
APPLIED ELECTRICITY.
PRATT INSTITUTE,
BROOKLYN, N. Y.
Write for Catalogue and Particulars.

MICHIGAN COLLEGE OF MINES.
F. W. McNair, President,
A state institution located in and making use of an active mining district. New Metallurgical Building and Gymnasium completed in the fall of 1904. For Year Book and Record of Graduates apply to President or Secretary, Houghton, Michigan.

Engineering TAUGHT BY CORRESPONDENCE
Our system of training by mail has helped thousands hold down in poor positions to rise to better salaries and situations. Your chance to rise is just as good as others. Write for our free illustrated book, "Can I Become An Electrical Engineer?" We teach by mail, Electrical Engineering, Mechanical Engineering, Steam Engineering, Mechanical Drawing, Electric Lighting, Electric Railways. ELECTRICAL ENGINEER INSTITUTE, Dept. K 240 West 23rd St., New York.

THE
Hartford Time Switch
A mechanically operated switch, which turns lights ON and OFF at such hours as the user desires with no further attention than the weekly winding.
Approved Mechanically as well as Electrically



Showing double doors, Seth Thomas eight-day movement, auxiliary cut-out, auxiliary hand-trip, and switch indicator.
For controlling current used for show window lights, electric sign lights, street lights, apartment house hall lights, motors, batteries, burglar alarms. :: 10, 20, 35 and 50 Amperes. 250 Volts. 1, 2 and 3 Poles.
Consult us regarding any requirements
SEND FOR CATALOGUE
The Hartford Time Switch Co.
440 Asylum St., HARTFORD, CONN., U.S.A.
New York City:
A. Hall Berry, 97-99-101 Warren Street
London, England:
Veritys, Ltd., 31, King Street, Covent Garden, S. W.

CENTRAL STATION HEATING

We are the originators and builders of the underground system of live and exhaust steam heating. Our system is used for the utilization and distribution of exhaust steam from electric and power plants for heating purposes. 250 Plants in successful operation. We have the only Meter System. Also manufacturers of Wooden Water Pipe, Steam Pipe Casing, Steam Traps, Condensation Meters, Valves, Economizing Coils, Separators and full line of Steam Fitters' Supplies.
WRITE FOR PAMPHLET AND PRICE LIST

American District Steam Company
LOCKPORT, N. Y. CHICAGO ILL.
MENTION WESTERN ELECTRICIAN

VEGETABLE FEED-WATER TREATMENT,

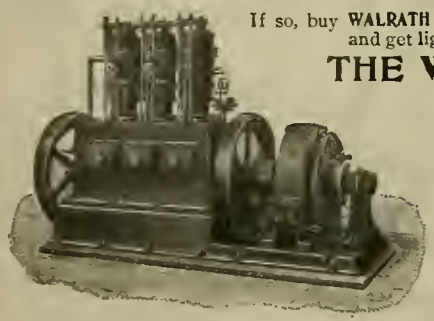
Proportioned to suit the Mineral Analysis of the water, will keep your boilers clean, free from corrosion, and effect great saving in repairs and operating expense.

DEARBORN DRUG & CHEMICAL WORKS,

120 LIBERTY STREET NEW YORK. 15 BRANCH OFFICES IN U. S. 27-34 RIALTO BUILDING, CHICAGO.

ARE YOU LOOKING FOR MONEY?

If so, buy WALRATH GAS OR GASOLINE ENGINES and get light on the subject.



THE WALRATH

Received the Highest Award at the Pan-American Exposition.

It will produce as good a commercial light as that of an automatic steam engine, either belted or direct-connected generator. Simple, Economical and Reliable. Send for Catalogue W.

MARINETTE GAS ENGINE CO.,

CHICAGO HEIGHTS, ILL.

AGENCIES:

301 Fisher Building, Chicago. 619 Stevenson Building, Indianapolis.
703 Bijou Building, Pittsburg.
MacKay Engineering Co., 149 Broadway, New York.
MacKay Engineering Co., 100 Boylston St., Boston.
Strong, Carlisle & Hammond Co., Cleveland.

Dixon's Pure Flake Graphite

As a Cylinder Lubricant

Makes cylinders, valves and rods wonderfully smooth and bright. Reduces friction, saving oil and packing. Booklet 125C and sample upon request.

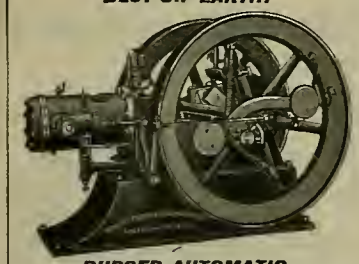
JOSEPH DIXON CRUCIBLE CO., JERSEY CITY, N. J.

REG. TRADE MARKS "Phosphor Bronze" DELTA

THE PHOSPHOR BRONZE SMELTING CO. LIMITED, 2200 WASHINGTON AVE., PHILADELPHIA.
"ELEPHANT BRAND PHOSPHOR-BRONZE"
INGOTS, CASTINGS, WIRE, RODS, SHEETS, ETC.
— DELTA METAL —
CASTINGS, STAMPINGS AND FORGINGS
ORIGINAL AND SOLE MAKERS IN THE U.S.

JEFFREY Elevating, Conveying, Power Transmission, Screening, Crushing Dredging, Rock and Coal Drilling, Coal Cutting, Hauling and Washing Machinery.
OUR CATALOGUES ARE YOURS FOR THE ASKING.
The JEFFREY MANUFACTURING CO., Columbus, O., U. S. A.

BEST ON EARTH.



BURGER AUTOMATIC.

For Electric Work

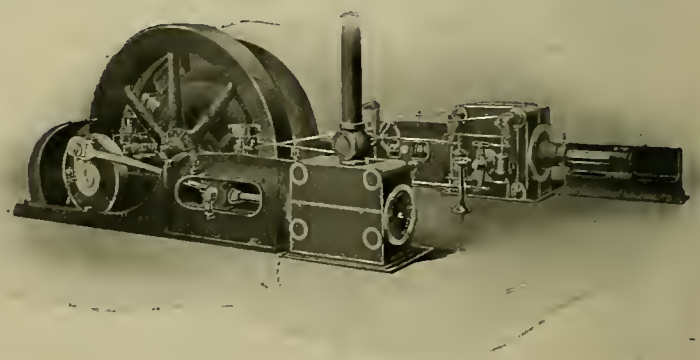
REGULATION AND ECONOMY OF FUEL UNSURPASSED.

WRITE FOR CATALOGUE H

Then compare it with some Gas Engine hand books that cost $1.00.

Woolley
Foundry & Mach. Works
Box 400, Anderson, Ind. U. S. A.

THE WILLIAM TOD CO.



BUILDERS OF

CORLISS AND HIGH-SPEED

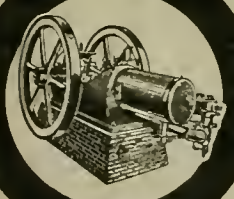
Automatic Engines

FOR ELECTRICAL PURPOSES.

MAIN OFFICE AND WORKS: YOUNGSTOWN, OHIO.

AGENCIES { New York, George F. Woolston, 29 Broadway.
Birmingham, Ala., W. H. Hume & Co., Woodward Bldg.

Olds Gas and Gasoline Engines

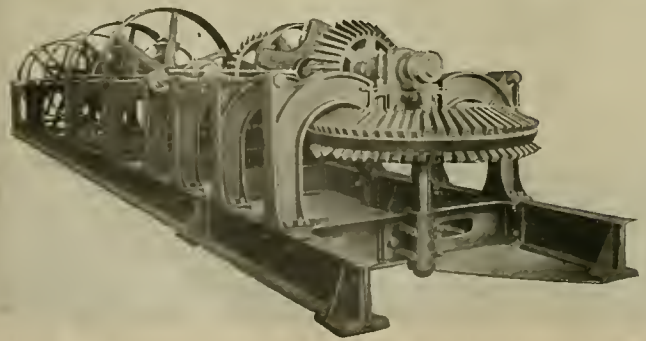


Competitive tests have established the superiority of the Olds in point of economy over any other engine. The maximum of power is obtained from a minimum of fuel, the cost averaging ¼ of a cent an hour for each horsepower.

Stationary Engines - - - 2 to 100 H. P.
Portable Engines - - - 8 to 10 H. P.

Our new illustrated catalog should be in the hands of every power user. Write to-day for a copy.

OLDS GASOLINE ENGINE WORKS
252 River Street - - - Lansing, Mich.
No. 984



SAMSON TURBINE

Almost everyone knows that for a given amount of power, the quicker the speed of a turbine, the better. This is due to the fact that LIGHTER and consequently CHEAPER TRANSMISSION MACHINERY can be used. The SAMSON has a QUICKER SPEED than any other turbine of the same dimensions operating under the same conditions.

WRITE DEPT. D FOR CATALOG

JAMES LEFFEL & CO.

SPRINGFIELD, OHIO U. S. A.

ARNOLD ELECTRIC POWER STATION Co.
Engineers, Constructors for Complete Electric Plants. Results Guaranteed.
SUITE 1539, MARQUETTE BLDG., CHICAGO. NEW YORK OFFICE: 711 TRANSIT BLDG.

BUTTERFIELD, J. F.
ELECTRICAL ENGINEER AND CONTRACTOR.
Complete Telephone Exchanges Built and Material Furnished.
Cable Construction and Underground Conduit Construction a Specialty.
Room 595, 113 Adams Street, CHICAGO, ILL.

J. H. HALLBERG
Consulting Arc Lighting Expert and Practical Electrical Engineer
45 Broadway - NEW YORK
Room 169A

KOHLER BROS.,
Contracting Electrical Engineers, Lighting Power Railways,
1804-1806-1808-1810-1812 Fisher Building, CHICAGO.

W. E BAKER. H. B. BISHOP.
BAKER, W. E. & CO.
ENGINEERS,
ELECTRIC RAILWAYS.
27 William St., NEW YORK.

BYLLESBY, H. M. & Co.
(Incorporated)
ENGINEERS
Design, Construct and Operate Railway, Light, Power and Hydraulic Plants.
Examinations and Reports.
New York Life Building, - CHICAGO, ILL.

HORNADAY, J. P. & Co.
SUITE 1108 TRACTION BUILDING
CINCINNATI, O.
WATERWORKS, ELECTRIC RAILWAY, LIGHT, TRACTION, INDUSTRIAL AND MINERAL PROPERTIES BOUGHT AND SOLD

RUEBEL - SCHWEDTMANN-WELLS,
CONSULTING, MECHANICAL AND ELECTRICAL ENGINEERS,
Suite 801 Chemical Building, ST. LOUIS, U. S. A.

TRY IT. Keep your name and address in this directory where it will be seen by possible clients.

THE M. P. BYRNE CONSTRUCTION CO.
GENERAL CONTRACTORS,
Sewers, Water Works, Conduits and Electric Plants a Specialty.
Room 30, 88 E. Washington St., CHICAGO, ILL.

HUMPHREY, HENRY H.,
CONSULTING ENGINEER.
Central Lighting Stations,
Electric Power Transmission.
SUITE 1305, CHEMICAL BLDG., ST. LOUIS.

Long Distance Phone Central 2448.
SCHOTT, W. H.,
ENGINEER AND CONTRACTOR,
SPECIALTIES—Central Station Heating Plants, Water Works Steam Plants, Electric Light, Gas and Street Railway Plants.
2220-21 MARQUETTE BUILDING, CHICAGO.

BRYAN, WILLIAM H.
M. Am. Soc. M. E.,
Consulting Mechanical and Electrical Engineer.
Lincoln Trust Building, ST. LOUIS.

E. W Hammer, Pres. and Treas. H. J. Minhinnick, Sec. and Gen'l Sup't.
GENERAL ENGINEERING Co., THE
Consulting and Contracting Engineers.
Telephones, Electric Light, Power Transmission
Suite 1112, 135 ADAMS ST., CHICAGO.
Long Distance Telephone Central 478.

ROBERT W. HUNT & Co.,
ENGINEERS
1121 The Rookery, Chicago. 66 Broadway, New York.
Monongahela Bank Bldg., Pittsburg.
Norfolk House, Cannon St., London.

STANTON, LE ROY W.
Consulting Telephone Engineer.
Plans, Specifications and Supervision of Installation of complete telephone plants.
Special Reports on Telephone Properties and Apparatus.
411 Electrical Bldg., Cleveland, Ohio.

DUGALD C. JACKSON, C. E.
WILLIAM B. JACKSON, M. E.
MEMBERS
AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS
AMERICAN SOCIETY OF MECHANICAL ENGINEERS
AMERICAN SOCIETY OF CIVIL ENGINEERS
ENGINEERS. EXPERTS.
MADISON, WIS.

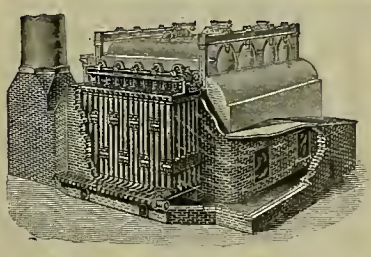
ALL Live men read the WESTERN ELECTRICIAN Each Week. Do You?

WE BUY OLD BELTS
OR SCRAPS, ANY SIZE OR CONDITION.
WE CLEAN, REPAIR AND RENEW OLD BELTS.
LEATHER PRESERVER MFG. CORP.
27 W. MONROE ST., CHICAGO.

READ THE BLUE ELECTRICAL PAPER.

Watson Motors
If you want a small motor for a special purpose. Write us.
Mechanical Appliance Co.
Milwaukee, Wis.

If the Installation of a
GREEN'S ECONOMIZER

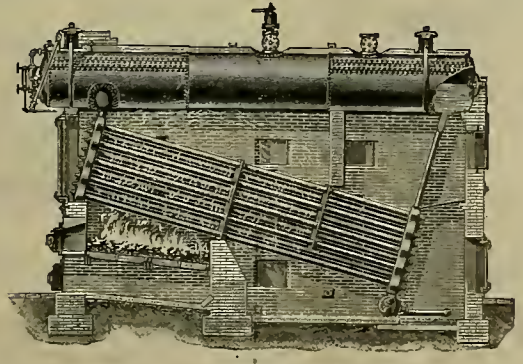


Were long an expense, then you would be justified in deliberating, but under ordinary conditions, depending largely upon coal cost, it soon pays for itself by utilizing waste gases. **Electric light and power plants** find it a paying investment outside of the 10 to 20% saving on coal bill. Ask for explanation through our experts, also for booklet, both free.

The Green Fuel Economizer Co.
Matteawan, N. Y. *Sole Manufacturers in the U. S.*

THE BABCOCK & WILCOX CO., 85 LIBERTY ST., N. Y.

BRANCH OFFICES:
BOSTON, 35 FEDERAL STREET.
PHILADELPHIA, 1110-1112 NORTH AM. BLDG.
SAN FRANCISCO, 63 FIRST STREET.
PITTSBURG, 1218 FRICK BUILDING.
NEW ORLEANS, 339 CARONDELET STREET.
CHICAGO, 1215 MARQUETTE BLDG.
ATLANTA, EMPIRE BLDG.
CLEVELAND, 706 NEW ENGLAND BLDG.
MEXICO CITY, 7 AVENIDA JUAREZ.
HAVANA, CUBA, 116 1-2 CALLE DE LA HABANA



200 Pounds Working Pressure

WATER TUBE STEAM BOILERS

STEAM SUPERHEATERS

Our Book, STEAM, mailed free on application.

We introduced successful 4-party lines

LEICH SELECTIVE SYSTEM

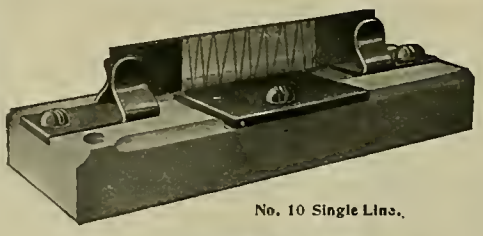
Write for our booklet—"Selective W."

Impedance Coil for Selectives. No Springs.

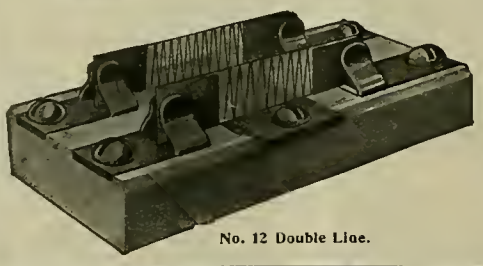
CENTRAL ENERGY OR MAGNETO

AMERICAN ELECTRIC TELEPHONE CO.

CHICAGO, ILLINOIS



No. 10 Single Line.



No. 12 Double Line.

PROTECTORS THAT PROTECT.

Our patent wrapped fuse used in our protectors are an insurance policy against lightning.

Sample free by mail to any Exchange or Toll Line

CENTRAL TELEPHONE AND ELECTRIC CO.,
909 Market St.,
ST. LOUIS, U. S. A.

TELEPHONE BOOTHS

When in want of the Right Kind write us.

Catalogue Free

Yesbera Mfg. Co.
TOLEDO, OHIO.

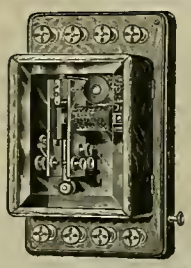
AS SIMPLE AS ITS NAME.

A B C
—OF—
THE TELEPHONE

By J. E. HOMANS, A. M.
352 pages.
Cloth, Price $1.00.

An up-to-date, practical treatise on the construction, theory, installation, care and management of telephones and their appliances.
Sent prepaid on receipt of price.

Electrician Publishing Co.,
510 Marquette Building, Chicago, Ill.



SIMPLE
EFFICIENT
RELIABLE
DURABLE
NOISELESS
ECONOMICAL

THE ILLINOIS POLE CHANGER
THE LATEST RINGING DEVICE
Produces Both Alternating and Pulsating Currents.....
Broadly guaranteed. Write for circulars.
Illinois Electric Specialty Co.
171-173 South Canal Street .... Chicago

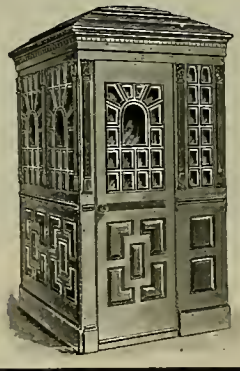
Sterling Black Plastic Insulator.

One hundred days' continuous baking at 180° F. will not make it brittle. Water repellent. Oil proof.

THE STERLING VARNISH CO., - - Pittsburg, Pa.

INCREASED RECEIPTS PAY THE COST OF

TELEPHONE BOOTHS,

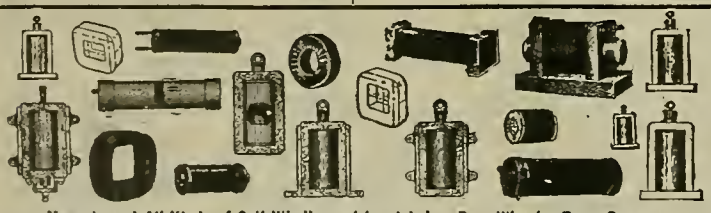


Oftentimes the first thirty days will do it.

TRY ONE.

Write for catalog

W. S. SEAMAN & CO.
218 E. WATER STREET,
MILWAUKEE, WIS.



Magnets and All Kinds of Coil Windings of Insulated or Bare Wire for Every Purpose.
VARLEY DUPLEX MAGNET COMPANY, PROVIDENCE, RHODE ISLAND.

The Electrician Publishing Co., 510 Marquette Bldg., Chicago. Headquarters for all latest Electrical Books. Write for Catalogue.

STONE CONDUIT
For Underground Wires. The Only Conduit that Improves with Age.
AMERICAN STONE CONDUIT CO., Suite 29. 94 La Salle St., Chicago, Ill.

H. N. FENNER, President J. F. BLAUVELT, Agent RUSSELL W. KNIGHT, Treasurer

NEW ENGLAND BUTT COMPANY
MANUFACTURERS OF
Machinery for Insulating Electrical Wires
Braiding, Taping, Winding, Twinning, Cabling, Stranding, Polishing and Measuring Machines. Cable Covering Braiders
FINE CASTINGS A SPECIALTY
304 PEARL STREET, - - - PROVIDENCE, R. I., U. S. A.

KELLOGG

MAGNETO SWITCHBOARDS.

We have been making small switchboards only during the last three years, but in that time we have constructed

Over 1,400 Small Switchboards, Having 75,000 Lines in Actual Use.

Every one of all this list is giving the best satisfaction.

Kellogg Switchboard and Supply Company,

Green and Congress Streets,
CHICAGO.

Seymour Building, LOS ANGELES. Electric Building, CLEVELAND. Keystone Telephone Building, PHILADELPHIA.

WRITE
FOR
BULLETIN
No. 11-E

THIS IS OUR LATEST BULLETIN DESCRIBING
GENERATOR-CALL TELEPHONES

It shows all of our recent improvements in this type of apparatus. If you wish to keep posted on the most modern apparatus you will write for this bulletin.

Stromberg-Carlson Telephone Mfg. Co.

GENERAL AND EASTERN SALES OFFICE
ROCHESTER, N. Y.

SALES DEPT.
CHICAGO, ILL.

Keys for the Practical Electrical Worker

By F. J. ROBINSON.

Electric Light, Power, Street Railway, Telephone, Telegraph and the every-day tables explained almost entirely by drawings and diagrams of connections taken from the very latest practice.

Nearly 200 pages. Price $2.00.

Prepaid to any address in the world.

ELECTRICIAN PUBLISHING CO.

PUBLISHERS OF AND DEALERS IN SCIENTIFIC BOOKS

510 MARQUETTE BUILDING, - - - CHICAGO.

INTERNATIONAL

Mechanical Self-Restoring Drop Switchboard.

A PERFECT APPARATUS.

Made in any desired capacity.
Sample parts and quotations on request.

INTERNATIONAL TELEPHONE MANUFACTURING CO.

CHICAGO, U. S. A.

Automatic Telephones.

Privacy

Promptness

Precision

Profits.

Automatic Electric Co., Chicago, U. S. A.

PRODUCERS AND WHOLESALERS OF WHITE CEDAR PRODUCTS

CEDAR POLES

SPECIAL PRICES ON SMALL POLES.
Write for a copy of our TELEGRAPH CODE FOR CEDAR PRODUCTS

YARDS
KOSS MICH.
L'ANSE "
MUNISING "
ONTONAGON
WAGNER, WIS
PESHTIGO "

C. H. WORCESTER CO.
SUITE 1206 TRIBUNE BLDG. CHICAGO.

POLES. WHITE CEDAR. IDAHO CEDAR up to 80 ft.

BERTHOLD & JENNINGS, ST. LOUIS. Chemical Building.

CROSS ARMS. LONG LEAF PINE AND FIR.

POLES—POSTS—PILING—TIES

Fowler-Jacobs Co.
Elmore-Fowler-Jacobs Co.
John H. Fowler & Co.

The FOWLER Companies
Fisher Building, - - CHICAGO

Cedar Poles.

Pittsburg and Lake Superior Iron Co. Producers and Wholesalers. Escanaba, Mich.

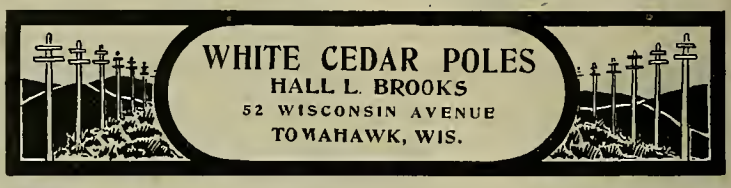
Cedar Poles

TORREY CEDAR CO., CLINTONVILLE, WIS.

Large Stock Constantly on Hand

POLES, TIES, POSTS. THE PORTER CEDAR CO., SAGINAW, MICH.

PRODUCERS. We want your Inquiries always.



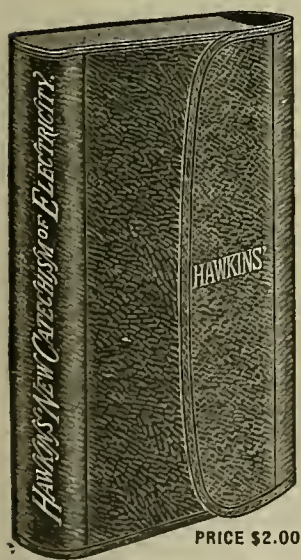
WHITE CEDAR POLES

Don't forget our Minnesota Transfer Yard—midway between St. Paul and Minneapolis, where we load in forty-eight hours from the time we have your order.

PACE & HILL CO. 1003 Lumber Exchange, MINNEAPOLIS, MINN.

HAWKINS' NEW CATECHISM OF ELECTRICITY.

Plan of the Work, Contents, Etc.



PRICE $2.00.

The New Catechism of Electricity will be found to be surprisingly plain, and free from useless and ambiguous terms. The plan upon which it is arranged is unique.

The book is, first of all, intended to be plain and instructive; some 300 illustrations have been introduced, so that the mere pictures will afford almost a knowledge of the subjects.

It is a school book from the manner in which it proceeds from the simple facts to the abstract principles which the facts indicate; it is also a book of reference through the index of seventeen double columns of fine type pages; by means of this index a thousand items of practical importance are at once available.

It is an up-to-date work, which has cost a large outlay of capital and time, and, in short, it is doubtful if any more attractive book has ever been issued—or one more useful.

The subjects treated upon are as follows: Dedication to Thomas A. Edison, with engraving of Mr. Edison; Preface and Introduction; Nature and Source of Electricity and Magnetism.

The Dynamo; Conductors and Non-Conductors; Symbols, abbreviations and definitions relating to electricity; Parts of the Dynamo; The Motor; The Care and Management of the Dynamo and Motor.

Electric Lighting; Wiring; The rules and requirements of the National Board of Underwriters in full; Electrical Measurements.

The Electric Railway; Line Work; Instruction and Cautions for Linemen and the Dynamo Room; Storage Batteries; Care and Management of the Street Car Motor; Electro Plating.

The Telephone and Telegraph; The Electric Elevator; Accidents and Emergencies, etc., etc.

The full one-third part of the whole work has been devoted to the explanation and illustrations of the dynamo, and particular directions relating to its care and management;—all the directions are given in the simplest and most kindly way to assist rather than confuse the learner. The names of the various parts of the machine are also given with pictorial illustrations of the same.

In the Catechism no less than 25 full page illustrations have been given of the various dynamo machines made in different parts of the country, and an equal number of part page illustrations.

ELECTRICIAN PUBLISHING CO., 510 Marquette Bldg., CHICAGO.

The business of the Western Electrician for the year 1903 was the largest in its history of 17 years.

MICHIGAN AND WESTERN CEDAR POLES
ALL LENGTHS AND SIZES
LINDSLEY BROS CO.
TRIBUNE BLDG., CHICAGO

IDAHO CEDAR POLES.

LOW PRICES. LONG LENGTHS A SPECIALTY.

YARDS: IDAHO. MONTANA.

WESTERN LUMBER & POLE CO., - Main Office, DENVER, COLO.

CYPRESS POLES CREOSOTED AND TREATED WITH CHLORIDE OF ZINC.

If you want a telegraph pole *that will outlast any two cedar poles,* get the above. No decay. No dry rot. Nothing to give way. Test poles *sound after thirty years.* Price on long lengths same as cedar. Short lengths about one third higher. Address,

A. BUSHNELL, 903 Broadway, KANSAS CITY, MO.

POLES AND POSTS.

The consumer should write me, I am on the ground and CAN SAVE YOU 10 per cent.

S. E. THOMPSON, TENSTRIKE, MINN.

SPECIAL CROSS ARMS

ALL HEART, long leaf yellow pine, any size or length. Also ALL HEART cross ties, oak and locust pins and brackets. Write us for delivered prices We can furnish 100 or 100,000 promptly. R. R. AKERS, Manager

LEWIS LUMBER & MFG. CO., Hattiesburg, Miss.

Hadn't you better investigate the low prices we are making on our Tie? You don't always get such a combination of low prices and high quality.

Any quantity for prompt shipment as well as any sized pole.

May we not hear from you?

MALTBY LUMBER COMPANY, 509 Phenix Block, Bay City, Michigan.

PITTSBURG AGENTS, Tipper & Patton, 509 Bessemer Bldg.

BRACKETS—X ARMS—PINS

little things it is true, but they cut a big figure in line construction.

OUR MOTTO IS:

Prompt Shipment Quality Satisfaction Right Price

COLUMBIA MFG. CO. ANTIGO, WIS.

OHIO VALLEY GLASS CO.

Manufacturers of Glass Insulators.

SPECIAL PRICES.

1501 MONADNOCK BLDG., CHICAGO.

Idaho Cedar Poles

PACIFIC COAST POLE CO. SPOKANE, WASH.

TELEPHONE POLES

Yards at Red Cliff, Wis., Aitkin, Feeley, Cohasset, Deer River, Tenstrike and Black Duck, Minnesota.
Large stocks. Prompt shipments. Carefully inspected stock at low prices.

J. W. MORRISON LUMBER CO., 918-19 Lumber Exchange MINNEAPOLIS, MINN.

POLES W. C. STERLING & SON, MONROE, MICH. **TIES.**

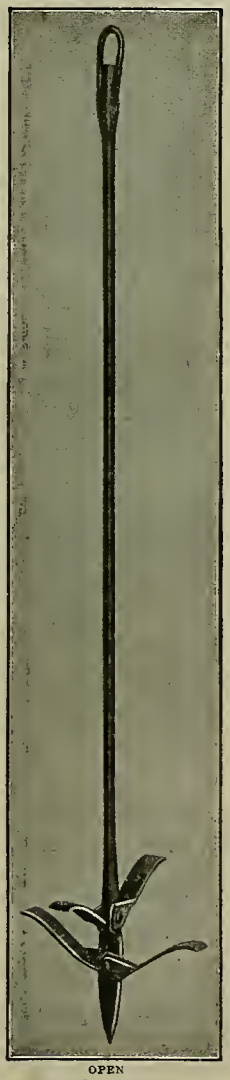
Eleven Pole Yards in Michigan. Wholesale Producers for 20 years.

Southern Cedar POLES Are the Best.

NO ROTTEN BUTTS. D. W. PHELAN, 277 Broadway, New York

POLE DEALERS ADVERTISING IN THE WESTERN ELECTRICIAN OBTAIN MOST EXCELLENT RESULTS BECAUSE IT PLACES THEM IN TOUCH WITH ACTUAL BUYERS OF POLES. TRY A CARD.

NEW GUY ANCHOR



OPEN

A Sledge and A Man To Swing It— All Necessary

CLOSED

"Crouse-Hinds"

133 S. Clinton St.

CHICAGO

CEDAR POLES

ESTABLISHED 1862

WM. MUELLER COMPANY

1211-12-13 MARQUETTE BLDG. CHICAGO.

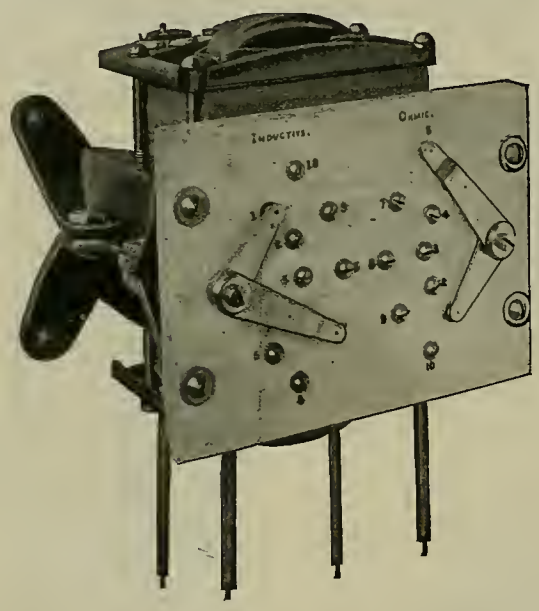
EIGHT DISTRIBUTING YARDS

MICHIGAN WHITE LARGE STOCK.

CEDAR POLES

PROMPT SHIPMENTS. KELLOGG SWITCHBOARD & SUPPLY CO., Chicago.

Westinghouse
Type F Compensator
"Mershon Patent"
For Lighting and Power Circuits



The compensator causes a drop in the reading of the meter corresponding to the drop in the line, and may be used with any standard alternating current voltmeter.

The voltmeter indicates the voltage of the circuit at the point of consumption.

For particulars address nearest office of

Westinghouse Electric & Mfg. Co.

Pittsburg, Pa.

New York, Atlanta, Dallas, Baltimore, Boston, Buffalo, Chicago, Cincinnati, Cleveland, Detroit, Los Angeles, Minneapolis, New Orleans, Philadelphia, Pittsburg, St. Louis, Salt Lake City, San Francisco, Syracuse, Seattle, Denver, Mountain Electric Co.
Canada: Canadian Westinghouse Co., Limited, Hamilton, Ontario. Mexico: G. & O. & Branifi Co., City of Mexico.

DIRECT CURRENT GENERATORS

FORT WAYNE ELECTRIC WORKS
WOOD LIGHTING & POWER SYSTEMS
Fort Wayne, Ind.

BELT-DRIVEN

Here is the list of the large sizes—all have been built and are in satisfactory service:

Poles	K. W.	R. P. M.	Volts
6	100	550	125
6	150	550	250
6	200	550	550
8	250	500	250
8	300	400	550
8	400	400	

Printed matter on above ready to read.

230

"PROFIT & LOSS"

TWO SUMS IN ADDITION

SACHS TRADE NOARK MARK FUSE + SAFETY TO PERSON AND PROPERTY, FREEDOM FROM ACCIDENT, UNINTERRUPTED SERVICE = $$$$$$$ PROFIT

"NOARK" FUSES

DO NOT ARC—BUT INDICATE

Afford absolute safety as Protective Devices, and FREEDOM FROM ALL FIRE HAZARD

SECOND SUM

OPEN FUSE + DANGEROUS FIRES, ACCIDENTS, OBSTRUCTION OF BUSINESS, ETC. = LOSS

WRITE FOR COMPLETE SET "NOARK" FUSE BULLETINS & LINE MATERIAL INSULATION CATALOG

H. W. JOHNS-MANVILLE CO.

100 William St., New York

MILWAUKEE CHICAGO ST LOUIS BOSTON PHILADELPHIA PITTSBURG CLEVELAND NEW ORLEANS LONDON

WATTMETERS FOR DIRECT CURRENTS

The new Duncan has all the up-to-date features that go to make it the best on the market. It will pay you to try one and investigate its merits for yourself.

Its multipoint switch method of compensating for friction and vibration is conceded to be the simplest, quickest and most reliable means yet devised. It is superior in every respect to the old and clumsy methods of adjusting the compensating coil bodily and is not damaged by lightning.

DUNCAN ELECTRIC MFG. CO.

LAFAYETTE, IND.

HENRY NEWGARD & CO.

ELECTRICAL CONSTRUCTION

Power and Light Plants. Switchboards and Panel Boards.

We install Municipal and Isolated Electric Lighting Plants.
We manufacture Switchboards, Table boards, Iron Cut-out Boxes and Electrical Specialties.
We sell Dynamos, Motors and Electrical Supplies.
We wire old as well as new Residences, Factory Buildings, School and College Buildings.

87 Fifth Avenue, Chicago, Illinois

VULCANIZED FIBRE

Highest grades for electrical insulation and mechanical purposes, in sheets, tubes, rods and special shapes. Catalogues and samples on application.

VULCANIZED FIBRE CO., - Wilmington, Del.

USE

"SAFETY" RUBBER COVERED WIRE AND CABLE

FOR EVERY ELECTRICAL SERVICE.

M. B. AUSTIN & CO.,
CHICAGO REPRESENTATIVE.

THE SAFETY INSULATED WIRE & CABLE CO.,
WORKS: Bayonne, N. J. 114-116 LIBERTY STREET, N. Y.

SAVE The Cost of a CHIMNEY

BY USING

Mechanical Draft.

B. F. STURTEVANT COMPANY,

BOSTON, MASS.

New York. Philadelphia. Chicago. London.

123

"Uncle Sam, Printer"

uses over 500 C.-W. Motors in the Government Printing Office

Our bulletin 45 tells of this equipment. Write for it

Electrotyping Saw in Government Printing Office

Crocker-Wheeler Company

Manufacturers of
Generators and Motors
AMPERE, N. J.
Branch Offices in Sixteen Principal Cities

Black Diamond File Works

Est. 1808. Inc. 1895.

Twelve Medals Awarded at International Expositions

Special Prize Gold Medal at Atlanta, 1895.

OUR GOODS ARE ON SALE IN EVERY LEADING HARDWARE STORE IN THE UNITED STATES AND CANADA.

G. & H. BARNETT COMPANY,
PHILADELPHIA, PA.

YOST SPECIALTIES
ELECTRICAL

Do you know the best when you see it? Do you buy the best when you know it? If so, we will mail you samples on request or send you our catalogue (without charge). If you appreciate the best when you see it and want the best when you can get it, we do not hesitate to give you the practical means of obtaining it. Let us hear from you.

THE YOST ELECTRIC MFG. CO.
TOLEDO, OHIO

Western Electrician

Vol. XXXV. $3.00 Per Annum. Copyright, 1903, by Electrician Publishing Company, Chicago. CHICAGO, JULY 9, 1904. Entered at Chicago Postoffice as mail matter of the second class. 10 Cents a Copy. No. 2.

SIMPLEX INSULATED WIRES AND CABLES.

RUBBER COVERED, WEATHERPROOF, UNDERGROUND AND SUBMARINE.

WESTERN SELLING AGENT: H. P. HITSON, Monadnock Block, CHICAGO.

The Simplex Electrical Co., 110 State Street, BOSTON, MASS.

CHICAGO INSULATED WIRE CO.,

152-154 LAKE STREET.

Bare and Insulated Wires and Cables.

Galvanized Steel Strands.

OKONITE

TRADE MARK

1889—Paris Exposition, Medal for Rubber Insulation.

1893—World's Fair, Medal for Rubber Insulation.

THE STANDARD FOR RUBBER INSULATION.

Sole Manufacturers of

Okonite Wires, Okonite Tape, Manson Tape, Candee Weather-proof Wires.

THE OKONITE CO., LTD.

Willard L. Candee, Gorani Cheever, Managers. 253 Broadway, New York. Geo. T. Manson, Gen'l Supt. W. H. Hodgins, Secy.

TRADE MARK

CRESCENT INSULATED WIRE & CABLE CO. TRENTON, N.J.

CRESCENT RUBBER INSULATED WIRES AND CABLES

National Code Standard.

CRESCENT INSULATED WIRE AND CABLE CO.,

New York Office, 63 BARCLAY STREET. Main Office and Factory, TRENTON, N. J.

STANDARD UNDERGROUND CABLE CO.

322 The Rookery, Chicago. Westinghouse Bldg., Pittsburg. 56 Liberty St., New York City. 1225 Betz Bldg., Philadelphia, Pa. Crossley Bldg., San Francisco. 10 Post Office Square, Boston.

BARE AND WEATHERPROOF WIRES AND CABLES.

Rubber Covered Wires and Cables. Underground Cables for all Purposes.

INDIANA RUBBER AND INSULATED WIRE CO.,

MANUFACTURERS OF

Paranite Rubber Covered Wires and Cables,

UNDERGROUND, AERIAL, SUBMARINE AND INSIDE USE.

TELEPHONE, TELEGRAPH AND FIRE ALARM CABLES.

All Wires are tested at Factory. JONESBORO, IND.

THE PHOENIX GLASS CO. Pittsburg, New York, Chicago

Manufacturers of

Electric Globes and Shades, both Arc and Incandescent

Inner and Outer Globes for all enclosed arc systems

CATALOGUES SENT ON REQUEST

"CIRCULAR LOOM" THE FLEXIBLE CONDUIT

AMERICAN CIRCULAR LOOM CO. TRADE MARK REGISTERED

CONDUITS FOR INTERIOR WIRING.

American Circular Loom Co.

Chelsea, Mass., New York, Chicago, San Francisco.

RESISTANCE WIRES

"Climax" For High-resistance Work.

"Advance" For Measuring Instruments.

SPECIAL ALLOYS FOR ELECTRICAL MANUFACTURERS.

DRIVER-HARRIS WIRE CO., Harrison (Newark), N. J.

Send your Book Orders to

ELECTRICIAN PUBLISHING CO.,

510 Marquette Bldg., Chicago.

All Supply Houses

J. J. EGAN'S "ACME" COMMUTATOR COMPOUND.

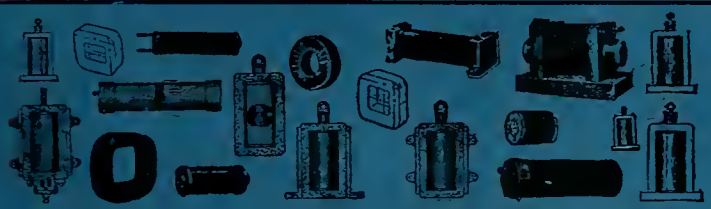
J. J. EGAN'S "ACME" COMMUTATOR COMPOUND absolutely prevents sparking or cutting. One stick of "Acme" is equal to one gallon of oil for lubricating commutators. Free Sample. AGENTS WANTED. 50c per Stick. $5.00 per doz.

J. J. Egan Sole Mfg., 683 W. Ohio St., Chicago

THOUSANDS IN USE.

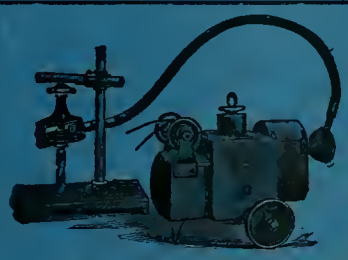
Motors, ¼ h. p. to 100 h. p. Dynamos, 1 k. w. to 75 k. w. Highest Quality. Reasonable Price.

THE HOBART ELECTRIC MFG. CO. TROY, OHIO.



Magnets and All Kinds of Coil Windings of Insulated or Bare Wire for Every Purpose.

VARLEY DUPLEX MAGNET COMPANY, PROVIDENCE, RHODE ISLAND.



ESTABLISHED 1875.

COMBINATION OF

Stow Flexible Shaft

AND

MULTI-SPEED MOTOR

Practically dust and water proof. For Portable Drilling, Tapping, Reaming, Emery Grinding, etc. Write for Catalogue and Prices.

STOW MFG. CO., Binghamton, N. Y.

Gen'l European Agents, Selig, Sonnenthal & Co. 85 Queen Victoria Street, London, England.

H. N. FENNER, President J. F. BLAUVELT, Agent RUSSELL W. KNIGHT, Treasurer

NEW ENGLAND BUTT COMPANY

MANUFACTURERS OF

Machinery for Insulating Electrical Wires

Braiding, Taping, Winding, Twinning, Cabling, Stranding, Polishing and Measuring Machines. Cable Covering Braiders

FINE CASTINGS A SPECIALTY

304 PEARL STREET, - - - PROVIDENCE, R. I., U. S. A.

WESTON Electrical Instrument Co.,

Waverly Park, NEWARK, N. J.

Weston Standard Portable Direct Reading

Voltmeters, Millivoltmeters, Voltammeters, Ammeters, Milammeters, Ground Detectors and Circuit Testers, Ohmmeters, Portable Galvanometers.

Weston Standard Portable Direct Reading Mil-Ammeter.

Our portable Instruments are recognized as **The Standard** the world over. The **Semi-Portable Laboratory Standards** are still better.

Our **Station Voltmeters and Ammeters** are unsurpassed in point of extreme accuracy and lowest consumption of energy.

BERLIN—European Weston Electrical Instrument Co., Ritterstrasse No. 88.

LONDON—Elliott Bros., Century Works, Lewisham.

PARIS, FRANCE—E. H. Cadiot, 12 Rue St. Georges.

New York Office—74 Cortlandt St.

TESTED

FUSE - WIRE - STRIP - LINKS (open)

TELEPHONE-ENCLOSED - (indicating) TUBULAR LINE - **FUSES**

TELEPHONE FUSE BLOCKS, FUSIBLE LINKS (For Fire Doors) OUTLET BOXES, WIRE JOINTS, FUSE SOLDER FLUX

Send for Catalogue No. 15 Illustrating our full line of goods

Exhibit in Electricity Bldg., St. Louis

CHICAGO FUSE WIRE & MFG. CO.

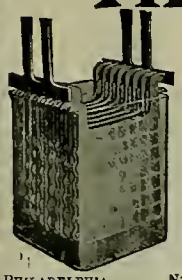
358 Dearborn St., Chicago. 853 Broadway, New York.

Mutual Life Bldg., Buffalo.

Allis-Chalmers Co
CHICAGO

Bullock
Electrical Apparatus
for all purposes.

THE ELECTRIC STORAGE BATTERY CO.



PHILADELPHIA

MANUFACTURER OF THE

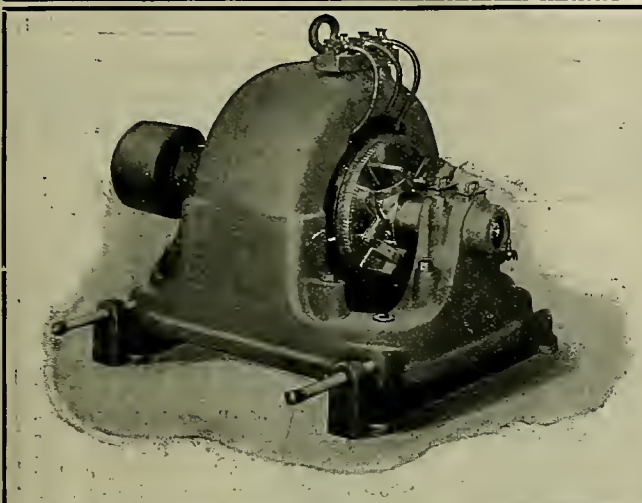
"Chloride Accumulator"

For Central Stations, Electric Railways, Isolated Lighting and Power Stations, Fire Alarm, Telegraph, Train Lighting, etc., etc.

PRICE LISTS AND DESCRIPTIVE BULLETINS FORWARDED UPON REQUEST.

SALES OFFICES:

PHILADELPHIA, Allegheny Ave. and 19th St. | NEW YORK, 100 Broadway, | BOSTON, 60 State St. | CHICAGO, Marquette Bldg. | ST. LOUIS, Wainwright Bldg. | SAN FRANCISCO, Rialto Bldg. | CLEVELAND, Citizens Bldg. | CANADA, Canadian General Electric Co., Ltd. Toronto | HAVANA, CUBA, G. F. Greenwood, Manager 34 Empedrado St.



CENTRAL STATION MANAGERS

Don't Be Afraid

of the Gas Plant

WORK UP A MOTOR LOAD

We can furnish you

SINGLE PHASE MOTORS

that will start under full load in sizes ranging from 1/8 to 35 H. P.

Wagner Electric Mfg. Co.

ST. LOUIS, MO., U. S. A.

W. D. PAINT.

A PERMANENT INSULATING PROTECTION FOR WOOD OR METAL. A quick drying, moisture-proofing, black paint. An elastic anti-rust coating. A jet black finishing paint, efficient and not expensive.

Write for "Data on Insulating Materials."

DIELECTRIC MANUFACTURING CO., SAINT LOUIS.

CARBONS

CONSUMERS CARBON CO.

LANCASTER, OHIO, U. S. A.

Carbons of all kinds and for all purposes.

PLATINUM

PLATINUM RIVETS FOR CONTACT POINTS IN TELEPHONES—SPARK COILS AND OTHER ELECTRICAL APPARATUS. PLATINUM SHEET AND WIRE IN ANY FORM AND DEGREE OF HARDNESS. PLATINUM SCRAP PURCHASED.

BAKER & COMPANY, Inc.

ARTISANS IN PLATINUM

408-410-412-414 N. J. R. R. AVE. - NEWARK, N. J.

New York Office: 120 Liberty St.

ALPHABETICAL INDEX TO ADVERTISEMENTS.

Adams-Bagnall Electric Co.. 7
Akron Electrical Mfg Co.....13
Allen Company, L. B.....11
Allis-Chalmers Company..... 2
American Battery Co.....—
Amer. Circular Loom Co..... 1
American Conduit Co.....14
Amer. District Steam Co.....13
Amer. Elec. Fuse Co..... 6
Amer. Electrical Heater Co..—
Amer. El. Telephone Co.....15
American Electrical Works..11
American Stone Conduit Co..14
Arnold Elec. Power Station Co..... 13
Automatic Electric Co..... 15

Babcock & Wilcox Co.....—
Bain, Forée.....11
Baker & Company..... 3
Baker & Co., W. E.....13
Barnett Company, G. & H....20
Beardslee Chandelier Mfg.Co.10
Berthold & Jennings.....17
Big Four Route.....—
Bissell Co., The F.....11
Bossert Electric Construction Co..... 5
Brooks, Hall L.....17
Bryan-Marsh Co.....—
Bryan, Wm. H.....13
Buckeye Electric Co.....—
Bullock Elec. Mfg. Co.....10
Bushnell, A.....16
Butterfield, J. F.....—
Byllesby & Co., H. M.....13

Central Electric Co..... 5
Cent. Stat. Improvement Co..12
Central Tel. & El. Co.....—
Century Electric Co.....—
Chicago Die & Electric Co....—
Chicago Edison Co.....4, 12
Chic. Fuse Wire & Mfg. Co... 1
Chicago Insulated Wire Co.. 1
Chicago Mica Co.....10
Columbia Incand. Lamp Co..—
Columbia Mfg. Co.....16
Columbus Storage Bat'ry Co.10
Consumers Carbon Co..... 3
Continuous Rail Joint Company of America.....11
Coolidge Co.. Marshall H.....16
Cope, T. J.....12
Crawfordsville Electric Co.. 8
Crescent Co..... 4
Crescent Ins. Wire & Chl. Co. 1
Crocker-Wheeler Company... 8
Crouse-Hinds Co.....—
Cutler-Hammer Mfg. Co..... 5
Cutter Elec. & Mfg. Company—

D. & W. Fuse Company.....—
Dearborn Drug & Chem. Wks.18
Detroit Steel Casting Co 20
Diamond Meter Company....—
Dielectric Manufacturing Co. 3
Dixon Crucible Co., Joseph..18
Driver-Harris Wire Co..... 1
Duncan Elec. Mfg. Co.....19
Dustin Co., Chas. E.....12

Edison Decorative & Miniature Lamp Departm't.....10
Edison Mfg. Company..... 4
Edwards & Co..... 9
Egan, J. J..... 1
Electrical Engineer Institute.—
Electric Appliance Co 10
Electrical Recorder & Indicator Co 13
Electric Storage Battery Co.. 3
Electrician Pub. Company...19
Erie Ry.....14

Faries Mfg. Co..... 9
"For Sale" Advertisements..12
Ft. Wayne Elec. Works, Inc..19
Fostoria Incand. Lamp Co...—
Fowler, John H.....17
Fowler-Jacobs Company.....17

General Electric Co..... 9
General Engineering Co., The 13
General Incandescent Arc Light Company.....—
General Incand. Lamp Co....—
Gould Storage Battery Co....—
Gt. West. Smelt. & Refining Co.12
Green Fuel Economizer Co..—
Gregory Electric Company...12

Hallberg, J. H 13
Baller Machine Co..... 8
Hart Mfg. Co..... 8
Hartford Steam Boiler Inspection & Insurance Co....18
Hartford Time Switch Co....11
Hazard Manufacturing Co...20
Highland Park College. ... 13
Hobart Elec. Mfg. Company. 1
Hoffman, G. W.....12
Holmes Fibre-Graph. Co.....18
Holophane Glass Co.....10
Bornaday & Co., J. P.....13
Humphrey, Henry H.....—
Bunt & Co., Robt. W.....17

Illinois Central Ry.....14
Illinois Electric Specialty Co.—
Incandescent Electric Light Manipulator Company.....—
Indiana Rub. & Ins. W. Co.... 1
India Rubber & Gutta Percha Insulating Company..... 4
International Elec. Meter Co.42
International Tel. Mfg. Co...15

Jackson, D. C. & W. B.....13
Jeffrey Manufacturing Co....18
Jewell Electrical Inst. Co....—
Johns-Manville Co., H. W.....—

Kartavert Manufacturing Co.20
Kellogg Switchboard & Supply Company.....15, 17
Kester Elec. Mfg. Co.....14
Klein & Sons, Mathias..... 10
Kohler Brothers.....13
Kuhlman Electric Co..... 9

Leather Preserv. M. Corp....—
Leffel & Co., James.....18
Lewis Lumber & Mfg Co....17
Lindsley Brothers Company..17
Loud's Sons Co., H. M.....17

Machado & Roller.....—
Maltby Lumber Company....17
Manhattan El. Supply Co....10
Manross, F. N..... 8
Marinette Gas Engine Co.....18
Matthews & Bros., W. N.....11
McLennan & Company, K....10
Mechanical Appliance Co....—
Mica Insulator Company.....—
Michigan College of Mines ...—
Miller Electric Co.....12
Minnesota Electric Co.....14
Miscellaneous Advs.....12
Monon Railroad..... .. ..—
Moon Mfg. Co., The.....14
Morrison Lbr. Co., J. W.....—
Mueller Company, William..17
Munsell & Co., Eugene.....10

National Electric Co.....20
National India Rubber Co....—
New England Butt Co..... 1
Newgard & Co., Henry..... 4
New York Cent. Ry.....14
New York Ins. Wire Co.....11
Northern Elect'l Mfg. Co.... 8
Norton Elect'l Instrument Co.11

Okonite Co., The..... 1
Olds Gasoline Engine Works.18

Pacific Coast Pole Co.....17
Page & Hill Co.....16
Paragon Fan & Motor Co.....—
Pardridge Shade & Refl. Co..—
Pass & Seymour, Inc..... 5
Phelan, D. W.....16
Phillips, Eugene F.....11
Phillips Insulated Wire Co...11
Phœnix Glass Co..... 1
Phosphor-Bronze S. Co.....18
Pignolet, L. M.....10
Pittsburg & L. S. Iron Co....17
Plume & Atwood Mfg. Co....—
Porter Cedar Company.....16
Pratt Institute .....—

Reisinger, Hugo.....—
Reynolds El. Flasher Mfg. Co.12
Roebling's Sons Co., J. A....20
Ruebel-Schwedtmann-Wells..13

Safety Ins. Wire & Cable Co.. 8
Sargent & Lundy.....—
Schott, W. H.....13
Seaman, J. H.....10
Seaman & Co., W. S.....14
Simplex Electrical Co., The.. 1
Simplex Elec. Heating Co....11
Speer Carbon Co..... 8
Sprague Electric Company.. 9
Squire Electric Co.....13
Standard Elec. Mfg. Co.....14
Standard Underg. Cable Co.... 1
Standard Vitrified Conduit Co
Stanley Instrument Co.....
Stanton, LeRoy W..... 13
State Univ. of Iowa.....10
Sterling & Son, W. C.....17
Sterling Electrical Mfg. Co.... 5
Sterling Varnish Co., The....16
Stow Mfg. Company..... 1
Stromberg-Carlson Tel. Mfg. Company.....15
Sturtevant Company, B. F...20

Thompson, S. E.....16
Tod Company, William.....18
Torrey Cedar Company.....17
Trumbull Elec. Co.....—
Turner Brass Works.....11

Union Electric Mfg. Co..... 12

Valentine-Clark Co., The....17
Varley Duplex Magnet Co.... 1
Vulcanized Fibre Company..20

Wagner Electric Mfg. Co.... 3
Walsh's Sons & Company.....12
Warren Elec. Mfg. Co..... 9
Wesco Supply Co.....—
Western Electric Company... 4
Western El. Supply Co.....16
Western Lumber & Pole Co..16
Westinghouse Electric & Manufacturing Co.....—
Weston Electrical Inst. Co.... 1
Wilmerding, C. H.....13
Wisconsin Central Ry.....12
Woolley Fdy. & Mach. Wks.—
Worcester Company, C. H....16

Yesbera Mfg. Co..... .. —
Yost Electric Mfg. Co 8

For Classified Index of Advertisements See Page 6.

REMEMBER THE NAME AND BUY THE BEST.

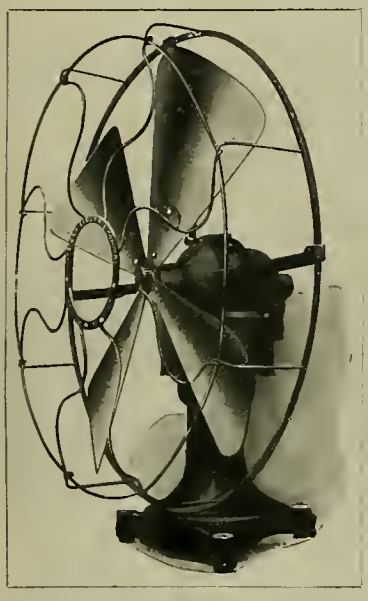
PARAGON FAN MOTORS

NEW STYLES NEW PRICES
EASY RUNNING RIGID CONSTRUCTION NOISELESS

CALL AND SEE THEM OR WRITE FOR PRICES

CHICAGO EDISON COMPANY,
139 ADAMS ST., CHICAGO.

W. E. FAN MOTORS



Catalogue on Request

DESK, BRACKET and CEILING STYLES

ALL VOLTAGES
ALL CIRCUITS

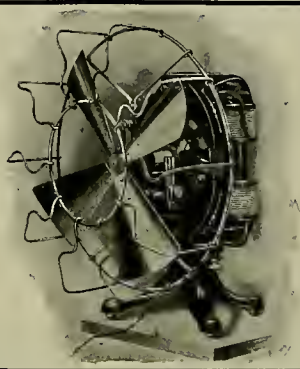
Western Electric Company

Chicago New York
Saint Louis Denver
Philadelphia Kansas City
Pittsburg

San Francisco (California Electrical Works)
Cincinnati (Standard Electric Company)
Saint Paul (American Electric Company)

New Soldering Stick "CRESCENT"

Is Pliable and Plastic, Not Brittle!
Entirely different from any other: no waste; no sputtering; nocorrosion.
CRESCENT CO., 403 OMAHA BLDG., CHICAGO.



Edison Battery Fan Outfits

The reputation of all goods bearing the name of Edison makes them desirable lines to handle. Edison Battery Fan Motor outfits are as good as their name and dealers who do not already have a line of them should write us for Catalogue No. 7 F.

EDISON MANUFACTURING CO.,
Factory, ORANGE, N. J.
NEW YORK, 83 Chambers St.
CHICAGO, 304 Wabash Ave.

HENRY NEWGARD & CO.

ELECTRICAL CONSTRUCTION

Power and Light Plants. Switchboards and Panel Boards.

We install Municipal and Isolated Electric Lighting Plants.
We manufacture Switchboards, Table boards, Iron Cutout Boxes and Electrical Specialties.
We sell Dynamos, Motors and Electrical Supplies.
We wire old as well as new Residences, Factory Buildings, School and College Buildings.

87 Fifth Avenue, Chicago, Illinois.

There is No Higher-Class India-Rubber Insulation For Wires and Cables than

HABIRSHAW.

Authorized Manufacturers of the
ATTIX FLEXIBLE TUBE WIRE.

The India-Rubber and Gutta-Percha Insulating Co.,

MAIN OFFICE, Glenwood Works,
YONKERS, N. Y.

Sales Office,
15 Cortlandt St., New York.

(10828)

YOU GET MORE FEET PER 100 LBS.

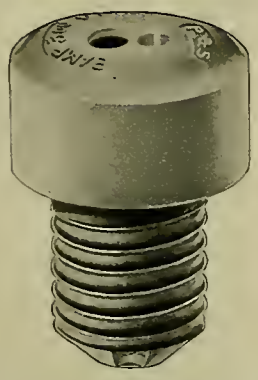
OF I. X. L. WEATHER-PROOF WIRE than you get of any other, owing to the compact insulation.

SEND FOR SAMPLES AND PRICES.

Central Electric Company, *GENERAL SALES AGENTS.* 264-266-268-270 FIFTH AVENUE, CHICAGO.

P. & S.

FUSELESS



ATTACHMENT PLUGS

As made by us conform to Underwriters rules and are in their list of approved fittings.

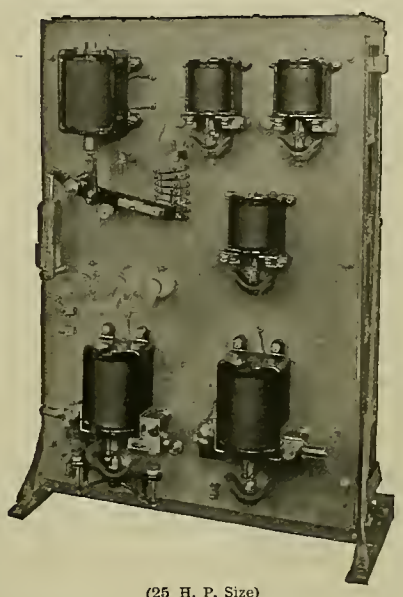
PASS & SEYMOUR, Inc.

SOLVAY, NEW YORK

New York Boston Chicago San Francisco

C H

QUALITY QUALITY



(25 H. P. Size)

SELF-STARTERS

FOR

Large Motors

THE CUTLER-HAMMER MFG. CO.

MILWAUKEE WIS.

New York 136 Liberty St. Boston 176 Federal St.

Pittsburg 322 Frick Building Chicago 1232 Monadnock Bldg.

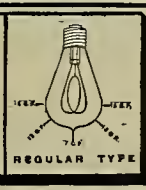
DO YOU?

BUY LAMPS-OR-BUY CANDLE POWER

16 THIS LAMP AVERAGES 12

THE STERLING ELECTRICAL MANUFACTURING CO.

NEW YORK, N. Y. WARREN, O. CHICAGO, ILL.



The Bossert Electric Construction Co.

—MANUFACTURERS OF—

STEEL OUTLET AND JUNCTION BOXES, SWITCHBOARDS, PANEL BOARDS, SWITCHES, ETC.

UTICA, NEW YORK.

STANLEY RECORDING WATTMETERS

FOR ALTERNATING CURRENT CIRCUITS

BALANCED THRUST

NO JEWEL WEAR FROM HAMMER OR SIDE THRUST. GLASS OR METAL COVERS—SECOND ALONE TO THE STANLEY MAGNETIC SUSPENSION WATTMETERS

Send for Bulletins and Information About Meters to

STANLEY INSTRUMENT CO., Great Barrington, Mass., U. S. A.

EUROPEAN OFFICE, 23 BOULEVARD DES ITALIENS, PARIS, FRANCE.

SALES AGENTS:
Missouri, Kansas, Arkansas, FRANK ADAMS ELECTRIC COMPANY, St. Louis.

Colorado, Idaho, Montana, Wyoming, New Mexico, Utah, HENDRIE-BOLTHOFF MFG. AND SUPPLY CO., San Francisco.

California, Oregon, Washington, Nevada, Arizona. BROOKS-FOLLIS ELECTRIC CORP. San Francisco.

Mexico, VICTOR M. BRASCHI & COMPANY, Mexico City.

ALLEN-BRADLEY ELECTRIC CRANE CONTROLLERS

PATENTED

Guaranteed for One Year. Three months' Free Trial.
No Sparking. No Repairs. Perfect Control.

AMERICAN ELECTRIC FUSE COMPANY

CHICAGO - - ILLINOIS

CLASSIFIED INDEX OF ADVERTISEMENTS.

Adjusters, Cord.
Crescent Co.
Incandes. El. Lt. Manip. Co.
Seaman, J. H.

Adjusters, Inc. Lamps.
Inc. El. Lt. Manipulator Co.

Anchors (Tel. & Tel.)
Matthews & Bro., W. N.
Crouse-Hinds Co.

Annunciators.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Moon Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Batteries and Jars.
Bissell Co , The F.
Central Electric Co.
Columbus Storage Battery Co.
Edison Mfg. Co.
Edwards & Company.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Bells, Buzzers, Etc.
Central Electric Co.
Edwards & Co.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Belt Dressing.
Dixon Crucible Co., Jos.
Leather Preserver Mfg. Corp.

Belting.
Leather Preserver Mfg. Corp

Blowers.
Sturtevant Co., B. F.

Blow Pipes.
Turner Brass Works.

Boiler Compounds.
Dearborn Drug & Chem. Wks.

Boilers.
Babcock & Wilcox Co.

Books, Electrical.
Electrician Publishing Co.

Booths, Telephone.
Seaman & Co., W. S.
Yesbera Mfg. Co.

Brackets.
Faries Mfg. Co.

Brushes.
Central Electric Co.
Hobart Elec. Mfg. Co.
Holmes Fibre-Graphite Co.
Speer Carbon Co.
Western Electric Company.

Cable Hangers.
National Tel. Supply Co.
Western Electric Co.

Cables (See Wires and Cables)

Canopies.
Faries Mfg. Co.

Carbons, Points and Plates.
Central Electric Co.
Chicago Edison Co.
Consumers Carbon Co.
Electric Appliance Co.
National Carbon Co.
Reisinger, Hugo.
Speer Carbon Co.
Wesco Supply Co.
Western Elec. Supply Co.

Castings.
Detroit Steel Casting Co.
Faries Mfg. Co.
New England Butt Co.
National Electric Co.

Chains.
Jeffrey Mfg. Co.

Chandeliers.
Faries Mfg. Co.

Circuit Breakers.
Cutler-Hammer Mfg. Co.
Cutter Elec. & Mfg. Co.
Ft. Wayne Elec. Wks. Inc.
Union Electric Mfg. Co.
Western Electric Company.
Westinghouse El. & Mfg. Co.

Clusters.
Faries Mfg. Co.

Clutches, Electrical and Mechanical.
Akron Electrical Mfg. Co.

Coal and Ashes Handling Machinery.
Jeffrey Mfg. Co.

Coils and Magnets.
Varley Duplex Magnet Co.
Western Electric Co.

Commutator Compound
Allen Co., L. B.
Egan, J. J.
McLennan & Co., K.

Commutator Truing Device.
Akron Electrical Mfg. Co.

Conduit and Conduits.
American Circular Loom Co.
American Conduit Company.
American Stone Conduit Co.
Central Electric Co.
Electric Appliance Co.
Sprague Electric Co.
Standard Vitrified Cond. Co.
Wesco Supply Co.
Western Electrical Supply Co.

Contractors and Electric Light Plants.
Bullock El. Mfg. Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
National Electric Co.
Northern Electrical Mfg. Co.
Sprague Electric Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Controllers, Crane.
Amer. Elec. Fuse Co.

Cross-Arms, Pins and Brackets.
Berthold & Jennings.
Central Electric Co.
Lewis Lumber & Mfg. Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Company.
Western Elec. Supply Co.

Cut-Outs and Switches.
Bissell Co., The F.
Bossert Elec. Const. Co.
Central Electric Co.
Chicago Edison Co.
Crouse-Hinds Co.
Cutter Elec. & Mfg. Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
General Inc. Arc Light Co.
Hart Manufacturing Co.
Manhattan Elec. Supply Co.
Trumbull Elec. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Dynamos and Motors.
Akron Electrical Mfg. Co.
Bissell Co., The F.
Bullock Elec. Mfg. Co.
Central Electric Co.
Century Electric Co.
Crawfordsville Electric Co.
Crocker-Wheeler Co.
Dustin Co., Chas. E.
Ft. Wayne Elec. Wks. Inc.
General Elec. Co.
General Inc. Arc Light Co.
Gregory Electric Co.
Hobart Elec. Mfg. Co.
Mechanical Appliance Co.
National Electric Co.
Northern Electrical Mfg. Co.
Sprague Electric Co.
Stow Manufacturing Co.
Sturtevant Co., B. F.
Wagner Electric Mfg. Co.
Warren Elec. Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Economizers, Fuel.
Green Fuel Economizer Co.

Electric Heating Appl.
American Elec. Heater Co.
Simplex Elec. Heating Co.
Western Electric Co.

Electric Railways.
Crocker-Wheeler Co.
General Electric Co.
Sprague Electric Co.
Westinghouse El. & Mfg. Co.

Electrical and Mechanical Engineers.
Arnold Elec. Power Stat'n Co.
Baker & Co., W. E.
Bryan, Wm. H.
Butterfield, J. F.
Bylesby & Co., H. M.
General Engineering Co., The.
Hallberg, J. H.
Hornaday, J. P. & Co.
Humphrey, Henry H.
Hunt & Co., Robt. W.
Jackson, D. C. & W. B.
Kohler Brothers.
Newgard & Co., Henry.
Northern Electrical Mfg. Co.
Ruehel, Schwedtman, Wells, Sargent & Lundy.
Schott, W. H.
Squire Electric Co.
Stanton, LeRoy W.
Wilmerding, C. H.

Electrical Instruments. (Recording and Testing.)
Bissell Co., The F.
Central Electric Co.
Diamond Meter Co.
Duncan Elec. Mfg. Co.
Electric Appliance Co.
Electrical Recorder & Indicator Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
General Inc. Arc Light Co.
Illinois Elec. Specialty Co.
Jewell Electrical Inst. Co.
Machado & Roller.
Nortoo Elec'l Instrument Co.
Pignolet, L. M.
Stanley Instrument Co.
Wagner Electric Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.
Weston Electrical Inst. Co.

Electro-Plating Mach'y
Crocker-Wheeler Company.
General Electric Co.

Elevators-Conveyors.
Jeffrey Mfg. Co.

Engines, Gas and Gasoline.
Marinette Gas Engine Co.
Olds Gasoline Engine Works.
Woolley Fdy. & Mach. Wks.

Engines, Steam.
Allis-Chalmers Company.
Amer. Diesel Engine Co.
Dustin Co., Chas. E.
Sturtevant Co., B. F.
Tod Co., Wm.

Fans and Fan Motors.
Central Electric Co.
Crocker-Wheeler Company.
Edison Mfg. Co.
General Electric Co.
General Inc. Arc Light Co.
Sprague Electric Co.
Sturtevant Co., B. F.
Wesco Supply Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Fibre.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Files.
Barnett Co., G. & H.

Fittings.
Faries Mfg. Co.

Fixtures, Gas and Elec.
Beardslee Chandelier Mfg. Co.

Finishers.
Bissell Co , The F.
Haller Machine Co.
Reynolds El. Flasher Mfg. Co

Flexible Shafts.
Stow Mfg. Co.

Forges.
Sturtevant Co., B. F.

Fuses and Fuse Wire.
Am r. Elec. Fuse Co.
Bissell Co., The F.
Central Electric Co.
Central Tel. & El. Co.
Chicago Die & Electric Co.
Chicago Fuse Wire & Mfg. Co.
D. & W. Fuse Company.
Electric Appliance Co.
Johns-Manville Co., H. W.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Company.
Western Elect. Supply Co.

Globes, Reflectors and Shades.
Fostoria Incan. Lamp Co.
Haller Machine Co.
Holophane Glass Co.
Pardridge Shade & Refl. Co.
Phœnix Glass Co.
Wesco Supply Co.
Western Electric Co.
Western Elect. Supply Co.

Graphite Specialties.
Dixon Crucible Co., Jos.
Holmes Fibre-Graphite Co.

Heating (Exhaust Steam).
Amer. District Steam Co.

Heating and Ventilating Apparatus.
Sturtevant Co., B. F.

Holders, Inc. Lamps.
Incandesent Electric Light Manipulator Co.

Inspection & Insurance
Bartford Steam Boiler Inspection & Insurance Co.

Insulating Machinery.
New England Butt Co.

Insulators and Insulating Materials.
Akron Electrical Mfg. Co.
American Electrical Works.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Inc. Arc Light Co.
Indiana Rub. & Ins. Wire Co.
Johns-Manville Co., H. W.
Kartavert Mfg. Co.
Manhattan Elec. Supply Co.
Mica Insulator Co.
Mundell & Co., Eugene.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Standard Vitrified Cond. Co.
Sterling Varnish Co.
Vulcanized Fibre Co.
Wesco Supply Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Junction Boxes.
Bossert Elect. Const. Co.
General Inc. Arc Light Co.

Lamps, Arc.
Bissell Co., The F.
Central Electric Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
General Inc. Arc Lt. Co.
Gregory Electric Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Lamps, Incandescent.
Bissell Co., The F.
Bryan-Marsh Company.
Buckeye Electric Company.
Central Electric Co.
Chicago Edison Co.
Columbia Incan. Lamp Co.
Edison Decorative & Miniature Lamp Dept.
Electric Appliance Co.
Fostoria Incand. Lamp Co.
General Electric Co.
General Inc. Arc Light Co.
Standard Elec'l Mfg Co.
Sterling Electrical Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Lamps, Incandescent—Reflecers & Cleaners.
Inc. El. Lt. Manipulator Co.

Letters, Metal.
Haller Machine Co.

Lightning Arresters.
Central Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
Manhattan Elec. Supply Co.
Minnesota Electric Co.
Western Electric Co.

Linemen's Climbers.
Klein & Sons, Mathias.

Magnet Wires.
(See Wires and Cables.)

Mechanical Draft.
Sturtevant Co., B. F.

Mica.
Chicago Mica Co.
Mica Insulator Co.
Munsell & Co., Eugene.

Mining Apparatus, Elec.
Crocker-Wheeler Company.
General Electric Co.
Jeffrey Mfg. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Motors. (See Dynamos and Motors.)

Nippers and Pliers.
Klein & Sons, Mathias.

Novelties, Glass, Elec.
Ithaca Elect'l Novelty Co.

Nozzles.
Faries Mfg. Co.

Paints.
Dielectric Mfg. Co.

Patent Attorneys.
Bald, Foree.

Phosphor Bronze.
Phosphor Bronze Sm. Co. Ltd.

Platinum, Wire and Sheet.
Baker & Company Inc.

Poles and Ties.
Berthold & Jennings.
Brooks, Hall L.
Bushnell, A.
Columbia Mfg. Co.
Coolidge Co., Marshall H.
Fowler, John H.
Fowler-Jacobs Company.
Kellogg Switch. & Sup. Co.
Lewis Lumber & Mfg. Co.
Lindsley Bros. Co.
Loud's Sons Co., H. M.
Maltby Lumber Co.
Morriseo Lbr. Co., J. W.
Mueller Company, William.
Pacific Coast Pole Co.
Page & Hill Company.
Phelan, D. W.
Pittsburg & L. S. Iron Co.
Porter Cedar Company.
Sterling & Son, W. C.
Thompson, S. E.
Torrey Cedar Co.
Valentine-Clark Co., The.
Western Lumber & Pole Co.
Worcester Co., C. H.

Polish (Metal).
Allen Co., Inc., L. B.
Hoffman, Geo. W.

Portables.
Faries Mfg. Co.

Power Transmission Machinery.
Jeffrey Mfg. Co.

Rail Joints.
Continuous Rail Joint Company of America.

Refiners.
Gt. West Smelt. & Refining Co

Re-Winding—Repairs.
Chicago Edison Co.
Gregory Electric Co.
Miller Electric Co.

Rheostats.
Cutler-Hammer Mfg. Co.
General Electric Co.
Gen'l Inc. Arc Lt. Co.
Union Electric Mfg. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Rods, Conduit.
Cope, T. J.

Schools and Colleges.
Electrical Engineer Inst.
Highland Park College
Michigan College of Mines.
Pratt Institute.
State Univ. of Iowa.

Second-Hand Mach'y.
Bissell Co , The F.
Cent. Stat. Improvement Co.
Dustin Co., Chas. E.
Gregory Electric Co.
Matthews & Bro., W. N.
Northwestern Electric Co.
Walsh's Sons & Co.

Shades, Lamp.
Faries Mfg. Co.

Sheet Brass & Copper.
Plume & Atwood Mfg. Co.

Signs, Electric.
Haller Machine Co.

Sockets & Receptacles.
Pass & Seymour.
Yost Elec. Mfg. Co.

Soldering Sticks, Salts and Paste.
Allen Co., L. B.
Crescent Co.
Kester Elec. Mfg. Co.
Western Electric Co.

Spunking Tubes.
Central Electric Co.
Edwards & Co.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.
Wester Elec. Supply Co.

Specialties, Electrical Mfrs. and Designers.
Haller Machine Co.

Speed Indicators.
Weston Electrical Inst. Co.

Storage Batteries.
American Battery Co.
Electric Storage Battery Co.
Gould Storage Battery Co.

Supplies, General Elec.
Bissell Co., The F.
Central Electric Co.
Century Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Electric Co.
Manhattan Elect'l Supply Co.
Wesco Supply Co.
Western Electric Co.
Western Elect. Supply Co.

Switchboards.
Bissell Co., The F.
Crouse-Hinds Co.
Gen. Incan. Arc Light Co.

Telephones, Telephone Material and Switchboards.
American El. Telephone Co
Automatic Electric Co.
Bissell Co., The F.
Central Electric Co.
Central Tel. & El. Co.
International Tel. Mfg. Co.
Kellogg Switchb. & Sup. Co.
Manhattan Elec. Supply Co.
Moon Mfg. Co., The.
Murdock & Co., Wm. J.
National Elec. Signalling Co.
Stromberg-Carlson Tel. M.Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Time Switches.
Bissell Co , The F.
Hartford Time Switch Co.

Tools.
Klein & Sons, Mathias.
Western Electric Co.

Transformers.
Central Electric Co.
Crawfordsville Electric Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Works, Inc.
General Electric Co.
Gregory Electric Co.
Kuhlman Electric Co.
Manhattan Elec. Supply Co.
National Electric Co.
Wagner Electric Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Trucks, Electric Car.
General Electric Co.
Westinghouse El. & Mfg. Co.

Turbines, Steam.
Allis-Chalmers Co.
General Electric Co.
Westinghouse El. & Mfg. Co

Turbines Water Wheels
Leffel & Co., Jas.

Varnishes.
Dielectric Mfg. Co.
Sterling Varnish Co.

Vulcanized Fibre.
Vulcanized Fibre Co.

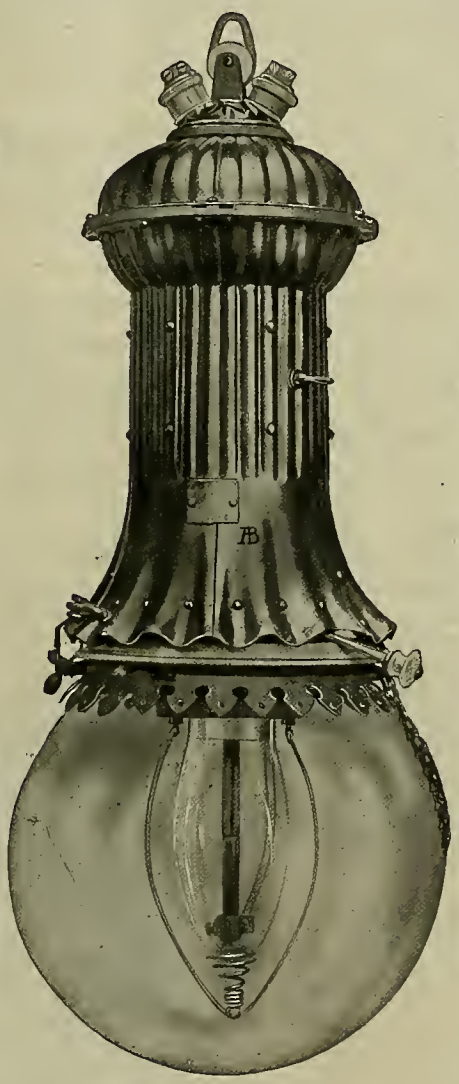
Wireless Tel. App'tus.
Clark Wirel. Tel. & Tel. Co. T. E
National Elec. Signalling Co

Wires & Cables—Magnet Wires.
American Electrical Works.
Bissell Co., The F.
Central Electric Co.
Chicago Insulated Wire Co.
Crescent Ins. Wire & Cble. Co.
Driver-Harris Wire Co.
Electric Appliance Co.
General Electric Co.
Hazard Manufacturing Co.
Indiana Rub. & Ins. Wire Co
India Rubber & Gutta Percha Insulating Co.
Kellogg Switch. & Sup. Co.
Manhattan Elec. Supply Co.
National India Rubber Co
New York Insulated Wire Co.
Okonite Co., The.
Phillips, Eugene F.
Phillips Insulated Wire Co
Roebling's Sons Co., J. A.
Safety Ins. Wire & Cable Co.
Simplex Electrical Co.
Standard Underground C. Co
Wesco Supply Co.
Western Electric Company.
Western Elec. Supply Co.

For Alphabetical Index of Advertisements See Page 3.

A-B ARC LAMPS

FOR ALL CIRCUITS



SPECIAL FEATURES

Accessibility of Mechanism,

Ease of Removing Inner and Outer Globe,

Ease of Trimming,

Weatherproof Construction,

Stamped Copper Cases and Simplicity of Mechanism.

THERE IS

A greater number of Adams-Bagnall Constant Direct Current Series Enclosed Arc Lamps used for street lighting throughout the United States, Canada and Mexico than all other makes of this type of lamp combined.

SEND FOR CATALOGUE

AGENCIES

Doubleday-Hill Electric Co., Pittsburg, Pa.
Electric Appliance Co., Chicago, Ill.
The Wesco Supply Co., St. Louis, Mo.
H. C. Roberts Electric Supply Co., Philadelphia, Pa.
Pettingell-Andrews Co., Boston, Mass.
Cia. Benbow-Dutton, S. A., City of Mexico, Mex.
Geo. F. Rohn, Milwaukee, Wis.

AGENCIES

B-R Electric Co., Kansas City, Mo.
A. J. Michell, Atlanta, Ga.
Interstate Electric Co., New Orleans, La.
Post-Glover Electric Co., Cincinnati, O.
Miller-Seldon Electric Co., Detroit, Mich.
W. G. Nagel Electric Co., Toledo, Ohio.
R. E. T. Pringle Co., Ltd., Montreal Que.

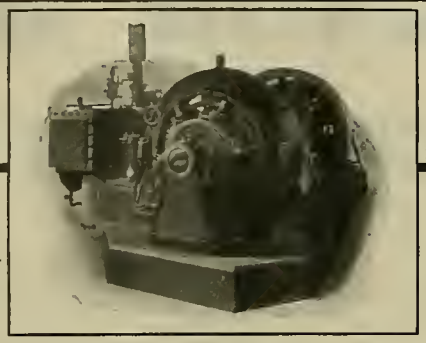
THE ADAMS - BAGNALL ELECTRIC CO.

New York Office: 136 Liberty St. CLEVELAND, OHIO Chicago Office: 309 Dearborn St.

SPEER HIGH GRADE CARBON BRUSHES

MOTOR AND GENERATOR CARBON BRUSHES

SPEER CARBON CO., - St. Marys, Pa.



147

As Good as The Best—"And Then Some."

Ball Compound Engine

—

Northern Dynamos

Northern Direct Current Apparatus possesses all the characteristics of economical, convenient operation common to excellent electric dynamos and motors and

Many exclusive meritorious features that make it worth your while to get acquainted by reading Bulletin No. 2,530.

NORTHERN ELECTRICAL MFG. CO.,

Engineers Manufacturers.

MADISON, WIS., - - - - U. S. A.

"Diamond H" Switches

Trade H Mark

This Trade-Mark guarantees quality.

The Hart Mfg. Co., Hartford, Conn.

New York Boston Chicago Toronto, Ont.

YOST

The Best

WHY?

Because it is serviceable. See Ad. next issue. Catalogue by the asking.

THE YOST ELECTRIC MFG. CO.

Toledo - - Ohio

USE

"SAFETY" RUBBER COVERED WIRE AND CABLE

FOR EVERY ELECTRICAL SERVICE.

M. B. AUSTIN & CO.,

CHICAGO REPRESENTATIVE.

THE SAFETY INSULATED WIRE & CABLE CO.,

WORKS: Bayonne, N. J. 114-116 LIBERTY STREET, N. Y.

"MANROSS"

HAIR SPRINGS

For Electric Indicating and Recording Gauges, Steam Gauges, Etc

LARGEST MANUFACTURER OF HAIR SPRINGS in the United States.

F. N. MANROSS,

FORESTVILLE, CONN.

Crocker-Wheeler. Brown, Boveri.

By arrangement with the celebrated electrical engineers, Brown, Boveri & Cie. of Baden, Switzerland, the Crocker - Wheeler Company has secured their alternating current designs, patents and rights to manufacture in America, and has retained them as consulting engineers.

Crocker-Wheeler Company is now putting on the market alternating current generators, transformers and accessories of the most perfect design and construction, adapted to American practice. Opportunities to bid on this apparatus are invited.

HORNBERGER-IRWIN

Transformers

(LARGE AND SMALL)

½ K. W. to 500 K. W.

This transformer represents the latest improvements in transformer construction; made in three types; multi-coil construction; ventilated cores; built for all commercial voltages and frequencies; **higher efficiencies together with lower temperatures than have heretofore been attained are guaranteed.**

Catalogue just issued explains details.

Manufactured by

Crawfordsville Electric Co.

CRAWFORDSVILLE, INDIANA, U. S. A.

127 FULTON STREET CHICAGO

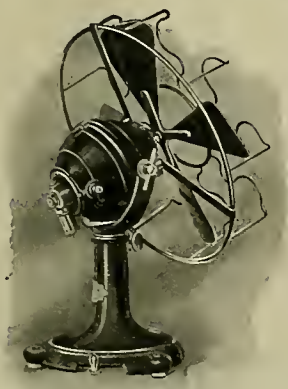
For Signs, Letters, Flashers, Dimmers, Timeswitches, Lamps, Rubberrings and anything pertaining to Signs,

—WRITE TO—

HALLER MACHINE COMPANY

Designers and Manufacturers, of Sheetmetal, Electric and Machinery Specialties

ELECTRIC
FANS



THE POPULARITY

of our fans is due to their superior design and construction. They have been imitated many times, but never equaled.

Write for Catalogue
No. 30814

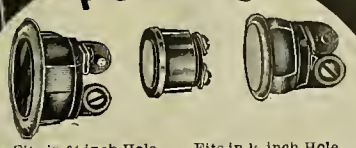
SPRAGUE
ELECTRIC COMPANY

General Offices:
527 West 34th Street, New York.
Chicago Office: Fisher Bldg.

SINGLE AND POLYPHASE
TRANSFORMERS
KUHLMAN ELECTRIC CO., - - Elkhart, Ind.

EDWARDS AND CO.
New York, N.Y. U.S.A.

PUSHES



Fits in ¾-inch Hole. Fits in ⅛-inch Hole
Fits in ⅝-inch Hole.
No screws needed to fasten them as the spring clips hold them securely in place.

WESTERN ELECTRIC CO., SELLING AGENTS

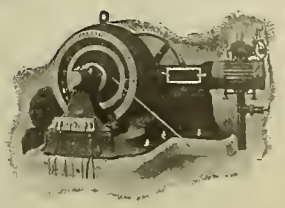
REFLECTIONS ON FARIES REFLECTORS

Fit any socket.
Quickly attached or detached.
Made of aluminum or steel.
Very light and will not rack socket to pieces.
Finish not affected by heat.
Made in many styles and finishes.

Catalogue mailed upon application.

FARIES MFG. CO.
DECATUR, ILL.

Warren Alternator



NINETY-NINE PER CENT.

of thought goes into the making of the Warren Alternator to render it efficient, reliable and easy to care for.

We Guarantee What We Sell

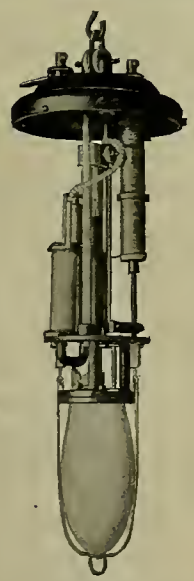
... AND ...

Sell What We Guarantee

WARREN ELECTRIC MFG. CO.

Sandusky, O.

General Electric Company



Edgewise Wound Enclosed Arc Lamps

FOR ONE HUNDRED AND TEN VOLT DIRECT CURRENT SERVICE

Embody the latest features of Arc Lamp manufacture.

INDESTRUCTIBLE.
PERFECT REGULATION.
PERMANENT ADJUSTMENT.
COMPOSED OF FEW PARTS.
SIMPLICITY AND RIGIDITY OF CONNECTIONS.

Write for further information.

GENERAL OFFICES: SCHENECTADY, N. Y.

Chicago Office: Monadnock Block. Sales Offices In All Large Cities.

WE HAVE OVER 135,000
ADAMS-BAGNALL ARC LAMPS
IN OPERATION

These cost our customers from $1.00 to $2.00 more than they could have bought others for. There must have been a reason why they paid us more. Think it over .·. .·. .·. .·.

Pittsburg, Washington, St. Louis, Baltimore, Kansas City, Grand Rapids, Dayton, and a hundred other towns, are lighted by Adams-Bagnall Arc Lamps. Is yours? .·. .·. .·.

ELECTRIC APPLIANCE CO.
ELECTRICAL SUPPLIES
CHICAGO

EDISON MINIATURE LAMPS

Over 400,000 Annually Shipped to Users.

All types—every variety.
Prompt shipment—in any quantity.

Miniature and Candelabra Sockets and Receptacles.

EDISON DECORATIVE & MINIATURE LAMP DEPT.,
General Electric Company, Harrison, N. J.

MICABOND Biggest Stock in the West.
CHICAGO MICA CO., - Valparaiso, Ind.

WANTED
You Who are Troubled with Sparking and Cutting of Commutators to Use

The only article that will PREVENT SPARKING. Will keep the commutator in good condition and PREVENT CUTTING.

Absolutely will Not Gum The Brushes . . .

It will put that high gloss on the commutator you have so long sought after.

50 Cts. per Stick. $5.00 per Dozen.
For Sale by all Supply Houses, or
FREE, Sample Stick.

K. McLENNAN & CO.,
Sole Manufacturers,
Room 411 Inter Ocean Bldg., 130 Dearborn St., CHICAGO, ILL.

MICA Of all Qualities, in any Form at Lowest Prices
EUGENE MUNSELL AND CO.
NEW YORK and CHICAGO

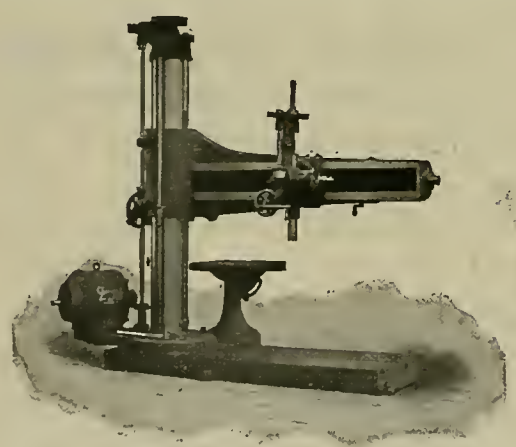
INSULATION That Is.
Micanite, Linotape, M. I. C. Compound, Empire Cloth and Paper. For Years the Standard.
MICA INSULATOR CO., Originators
NEW YORK and CHICAGO

BEARDSLEE CHANDELIER M'F'G CO. 256 and 257 SIXTH CANAL ST. CHICAGO
GAS & ELECTRIC FIXTURES FOR THE TRADE.
CATALOG SENT PREPAID TO DEALERS MENTION THIS PAPER

VOLT - AMMETERS,
POCKET SIZE.
For Testing Batteries and Battery Circuits, Locating Faults, Grounds, etc.
RELIABLE. ACCURATE.
Send for Circular.
L. M. PIGNOLET,
78-80 Cortlandt St., NEW YORK, N. Y.

THE STATE UNIVERSITY OF IOWA
SCHOOL OF APPLIED SCIENCE. Iowa City, Iowa
Four year courses of the highest grade in
Civil
Municipal
Sanitary
Electrical
Mechanical
Mining
ENGINEERING
Numerous short practical courses. Special courses in technical chemistry, bacteriology, etc. Adequate equipment in shops and laboratories. Waterpower.
University environment. Expenses low.
Address C. E. MacLEAN, President

Bullock Electric Manufacturing Company
CINCINNATI, OHIO, U. S. A.



Radial Drill Driven by Bullock Type "N" Motor.

The Bullock Multiple Voltage System provides the only successful means of controlling the speed of motors driving machinery which requires variable speeds

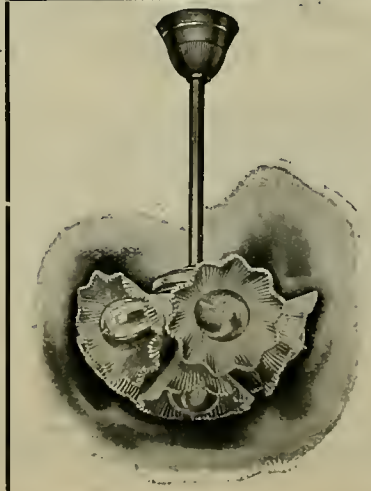
⅔ Actual Size. Patented.

CROWN CORD ADJUSTER
BEST AND SIMPLEST. MADE OF HARD RUBBER.
No Slip, No Abrasion, No Removing socket, Easily attached
Price $4.00 Per Hundred. Liberal Discount to the Trade.
Sample Free.
J. H. SEAMAN, 175 Dearborn St., Chicago

M. KLEIN & SON.
Send 2c stamp for new catalogue No. 6 of
KLEIN'S TOOLS
For Electrical Workers and Line Builders.
MATHIAS KLEIN & SONS.
81 W. Van Buren St., Chicago, Ill.

NEW PRICES
New net prices on all goods contained in our 550-page catalogue No. 14. Send for it.
MANHATTAN ELECTRICAL SUPPLY CO.
New York Chicago

MAILED FREE.
A valuable treatise on
STORAGE BATTERIES
for
Private Lighting Plants
together with our catalogue.
COLUMBUS STORAGE BATTERY CO.,
COLUMBUS, OHIO.
Machado & Roller, New York.
Goltz Engineering Co., Chicago.



Pagoda Wireless Clusters

Most Efficient and Cheapest Cluster on the Market.

Combines the advantages of the Benjamin, Dale and similar Clusters with the tremendous reflecting powers of the well-known
PAGODA SHADES.

Furnished in Edison Base Multiple only.
Suitable for lamps ranging from 4 to 24 C. P.

WRITE FOR PRICES

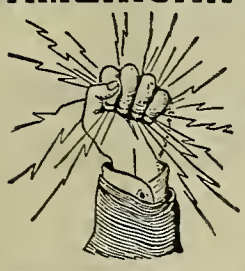
Holophane Glass Co.
15 E. THIRTY-SECOND ST., NEW YORK

WESTERN DISTRIBUTORS
V. R. LANSINGH CO.
207-211 Jackson Boulevard, CHICAGO

FRANK N. PHILLIPS, PRESIDENT. C. H. WADENSEIL, TREASURER. EUGENE F. PHILLIPS, GENERAL MANAGER. E. ROWLAND PHILLIPS, VICE-PRES. C. B. REMINGTON, JR., SEC.

AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.



BARE AND INSULATED ELECTRIC WIRE,
ELECTRIC LIGHT LINE WIRE,
INCANDESCENT AND FLEXIBLE CORDS,
Railway Feeder and Trolley Wire,
AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR WIRES.
CABLES FOR AERIAL AND UNDERGROUND USE.

NEW YORK STORE, W. J. Watson, 26 Cortlandt St.
CHICAGO STORE, F. E. Donohoe, 82 Lake St.
MONTREAL BRANCH, Eugene F. Phillips' Electrical Works.
MAIN OFFICES AND FACTORIES, PHILLIPSDALE, R.I.

NORTON Ammeters and Voltmeters

High-Grade Instruments at Moderate Cost.
Write for Circular and Price List.
The Norton Electrical Instrument Co., Main Office and Factory MANCHESTER, CONN.
Agents.-Kohler Bros., Chicago, Ill.: Interstate Elec. Co., Ltd., New Orleans, La.

STOMBAUGH

GUY ANCHORS
HOLD
POLES

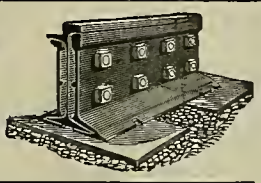
STRAIGHT, VERTICAL, RIGID, FIRM.
SCREW THEM IN—THAT'S ALL.
W. N. MATTHEWS & BROTHER
DISTRIBUTERS
603 CARLETON BLDG., - - ST. LOUIS, MO.

EXPERT IN ELECTRICITY MECHANICS PATENT CAUSES

SOLICITOR OF U. S. & FOREIGN PATENTS

FOREE BAIN, 1662-3 Monadnock Blk., CHICAGO

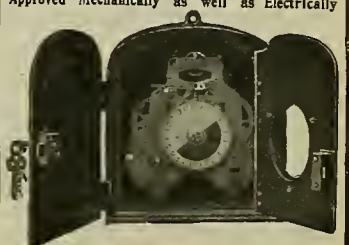
CONTINUOUS RAIL JOINT CO. OF AM.



GENERAL OFFICES: CENTURY BUILDING
NEWARK, N. J.
OVER 20,000 MILES IN USE
Highest Award at Paris Exposition, 1900, Buffalo, 1901

THE Hartford Time Switch

A mechanically operated switch, which turns lights ON and OFF at such hours as the user desires with no further attention than the weekly winding.
Approved Mechanically as well as Electrically



Showing double doors, Seth Thomas eight-day movement, auxiliary cut-out, auxiliary hand-trip, and switch indicator.

For controlling current used for show window lights, electric sign lights, street lights, apartment house hall lights, motors, batteries, burglar alarms. :: 10, 20, 35 and 50 Amperes. 250 Volts. 1, 2 and 3 Poles.
Consult us regarding any requirements
SEND FOR CATALOGUE
The Hartford Time Switch Co.
440 Asylum St., HARTFORD, CONN., U.S.A.
New York City:
A. Hall Berry, 97-99-101 Warren Street
London, England:
Verityn, Ltd., 31, King Street, Covent Garden, S. W.

GET ALLEN SOLDERING STICKS

MAKE SOLDER FLOW
FOR ALL ELECTRIC WORK
An organization's as strong as its membership's loyal—
of telling the man
"ALLEN SOLDERING STICKS OR NOTHING."
A Big Sample Stick for 10c.
Booklet "Soldering Sense" describes.
L. B. ALLEN CO., Inc.,
SOLE MAKERS,
1334 Columbia Ave., CHICAGO.

A "SECURITY" AUTOMATIC TIME SWITCH

(See Western Electrician, June 18, 1904.)

Cuts out the current at the proper time and stops expense

Prices $7.00 to $9.00

Show window lighting is one of the advertisers opportunities

Better get catalogue of complete line of Security Specialties.

THE F. BISSELL COMPANY
Manufacturers and Jobbers of
ELECTRICAL GOODS
226-228-230 HURON STREET
TOLEDO, O.

Electric Heating Apparatus

SEND FOR 32-PAGE CATALOGUE.

"UNIT" ENAMELED RHEOSTATS
SIMPLEX ELECTRIC HEATING CO.,
Cambridgeport, Mass.

Crimshaw.

Raven White Core.

Raven Black Core.

ALL OUR WIRES pass inspection and carry the above TRADE-MARKS on our tags. We also manufacture Crimshaw and Competition Tapes and Splicing Compounds.

NEW YORK INSULATED WIRE COMPANY,

MAIN OFFICE: 114, 116 & 118 Liberty St., New York.
BRANCHES: CHICAGO: 192 Desplaines St. BOSTON: 7 Otis St. SAN FRANCISCO: 33 Second St.

NATIONAL CODE STANDARD

"O. K." Weatherproof Wire.
Slow-Burning Weatherproof and Ideal Wire.
Prices and Samples on Application.

Phillips Insulated Wire Co.

Office and Factory: PAWTUCKET, R. I.

JUST RIGHT FOR THE.. TOOL BAG

No. 10 Double Jet Alcohol Blow Pipe. $4.50 each.

THE TURNER
Double Jet Alcohol
BLOW PIPE No. 10

Produces a non-oxidizing needle flame of over 3,000 degrees. Burns wood alcohol. Burner swiveled so that flame can be turned any direction. Capacity ¾ pint. Shipping weight two pounds. Burns three hours at full blast from one filling. Can be turned low like a lamp when not in use. Size of reservoir 2⅝ x 5 inches. Every electrician should have one in his tool bag. Excellent for

LEAD BURNING,
SOLDERING WIRES, ETC.

THE
Turner Brass Works
23 N. FRANKLIN ST., CHICAGO

Upon receipt of cash we will prepay charges.
DISCOUNT TO DEALERS.

WANTED, FOR SALE *and similar* **WANT COLUMN** *advertisements (50 words or less), $1.50 an insertion; additional words 3c each.* **POSITION WANTED** *advertisements (50 words or less), $1.00 an insertion; additional words 2c each.*

WANTED.

50 to 60 K. W. direct-connected unit. Must be standard make in first-class condition and a bargain for spot cash. Address, McGUIRE & COBB, Hotel Warner, 33d St. and Cottage Grove Ave., Chicago.

WANTED.

An exceptional opening is offered a practical electrician as superintendent in an established electrical contracting business in Detroit, Mich. Would have to invest $1,000. Steady position, with salary and division of profits. Address BOX 370, care of Western Electrician, 510 Marquette Building, Chicago.

WANTED

A competent and experienced salesman to travel in Ohio and Indiana, and sell electric lighting, telephone and railway supplies. Give age, experience and references, etc. Address, box 369, care of WESTERN ELECTRICIAN, 510 Marquette Bldg., Chicago, Ill.

FOR SALE.

A bargain; I. T. H. 30-light 9.6 Amp. Series open arc machine, with wall controller and ammeter complete, good running order.

Twenty-two 9.6 Amp. double carbon open arc lamps with glass, hoods and spreader complete, good order. Several additional lamps, both single and double, can be put in good order or parts used for repairs. A lot of extra globes and parts and a supply of carbons will be included if taken as a whole.

Two 30-K. W. Edison Bipolar 125-volt D. C. generators in line running order. Reason for selling, have put in larger machinery.

CARROLL ELECTRIC LIGHT & POWER COMPANY, Carroll, Iowa.

Gas and Electric Light Plants

We act as agents for the sale of gas and electric light plants

If you have a plant to sell write us

J. S. MAURER & CO., MONADNOCK BLDG. CHICAGO

REPAIRING RECALIBRATING

ELECTRIC METERS.

INTERNATIONAL ELECTRIC METER CO.

167 S. CANAL STREET, CHICAGO.

Dividend Paying Electric Light Plant For Sale.

Electric light plant in Wisconsin city of 3,000 inhabitants, exclusive 17-year franchise and city contract. Plant in operation for seven years paying annually cash dividend. Physical condition of plant is first class.

Company's increasing business demands more attention than can be given to it by present owners, who are local business men. A splendid opportunity for a practical electrician or manager who can control or invest about $20,000. Address BOX 374, care Western Electrician, 510 Marquette Bldg., Chicago, Ill.

FOR SALE.

ALTERNATORS.

1-360 K. W. General Electric 3-phase.
1-120 " " " "
1-75 " Westinghouse 2-phase.

250-VOLT GENERATORS.

1-250 K. W. Western Electric M. P.
1-200 " Eddy M. P.

125-VOLT GENERATORS.

1-125 K. W. Western Electric M. P.

Immediate shipment.

GREGORY ELECTRIC CO.
54-62 S. CLINTON ST. CHICAGO

THERMOPILES

1½ VOLTS
1½ AMPERES

For Electrolytic analysis, charging storage batteries, and other constant current requirements. $3 Each.

WALSH'S SONS & CO.,
264 Washington Street. Newark, N. J.

Points in Wisconsin and the Northwest

are covered by Wisconsin Central Railway's convenient, solid, wide vestibuled trains, equipped with Pullman sleepers, free reclining chair cars and modern coaches which leave Central Station, 12th Street and Park Row (Lake Front), Chicago for St. Paul, Minneapolis, Ashland and Duluth, connecting with all western lines. Meals in dining and cafe cars served a la carte.

For tickets and further information apply to nearest ticket agent, or write

JAS. C. POND, Gen'l Pass. Agt., Milwaukee, Wis.

FOR SALE

220 V. DIRECT CURRENT.

80 H. P. Westinghouse, 400 R. P. M.
20 H. P. Eddy, 1450 R. P. M.
7½ H. P. General Electric, 900 R. P. M.
5 H. P. General Electric, 1820 R. P. M.
5 H. P. Paragon, 900 R. P. M.
3½ R. P. Paragon, 1000 R. P. M.
2 H. P. General Electric, 1025 R. P. M.
2 H. P. Simpson, 2100 R. P. M.
1½ H. P. General Electric, 1800 R. P. M.
1 H. P. Lundell, 1200 R. P. M.
25 H. P. Crocker-Wheeler, 750 R. P. M.
15 H. P. Detroit, 1000 R. P. M.
10 H. P. General Electric, 1350 R. P. M.
10 H. P. Simpson, 2000 R. P. M.
7½ H. P. Crocker-Wheeler, 1575 R. P. M.
7½ H. P. Card, 775 R. P. M.
6 H. P. C. & C., 1080 R. P. M.
5 H. P. Westinghouse, 1050 R. P. M.
5 H. P. C. & C. 1600 R. P. M.
3 H. P. Jenny, 1600 R. P. M.

CENTRAL STATION IMPROVEMENT CO., 938 Monadnock Block, CHICAGO.

Like Finding Money.

Save your scrap copper, brass and platinum, also incandescent lamp bases, etc., and send them to us. We pay the highest market prices for this material. What have you?

We manufacture copper hard babbitt, the best on earth for electrical work, wire solder, pig lead, ingot copper, spelter, etc. It will pay you to get our prices.

GREAT WESTERN SMELTING & REFINING COMPANY, CHICAGO.

FOR ELECTRICAL REPAIR WORK

Of All Kinds, and All Work Guaranteed, Address
MILLER ELECTRIC CO., Davenport, Iowa. Armature and Transformer Rewinding Our Specialty.

Motor Starter with Automatic Release. Manufactured under our own patents.

MOTOR STARTERS, SPEED REGULATORS, FIELD REGULATORS

And Special Controlling Devices of all kinds. Send for catalogue and discounts.

UNION ELECTRIC MFG. CO.,
Milwaukee, Wis.

WORKS QUICK AND EASY. KEEPS ITS LUSTER. HOLDS OLD TRADE AND MAKES NEW. DOES NOT DETERIORATE. ESTABLISHED 16 YEARS. SOLD BY AGENTS AND DEALERS ALL OVER THE WORLD

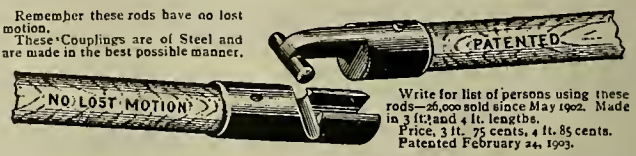
U.S. METAL POLISH

3 OUNCE BOX 10 CENTS
SAMPLES SENT FREE
GEO. W. HOFFMAN

POLISHES ALL METALS. BRANCHES: NEW YORK, CHICAGO, SAN FRANCISCO. 295 E. WASHINGTON ST. INDIANAPOLIS, IND.

Cope's Patent Quick Coupling Conduit Rod

Remember these rods have no lost motion.
These Couplings are of Steel and are made in the best possible manner.



Write for list of persons using these rods—26,000 sold since May 1902. Made in 3 ft. and 4 ft. lengths.
Price, 3 ft. 75 cents, 4 ft. 85 cents.
Patented February 24, 1903.

T. J. COPE
3244 North Fifteenth Street PHILADELPHIA, PA.

ELECTRIC SIGN
FLASHERS

BEST IN THE WORLD
Write for full particulars
Reynolds Elec. Flasher Mfg. Co.
221 Fifth Ave., Chicago.

DIRECT CONNECTED RAILWAY UNITS.

850 Kw. with cross-compound Corliss engine.
500 Kw. with cross-compound Corliss engines.
425 Kw. with simple Corliss engine.
425 Kw. with simple Greene engine.
400 Kw. with Russell four-valve engines.
400 Kw. with simple Corliss engine.
325 Kw. with tandem-compound engine.
300 Kw. with tandem-compound engine.
300 Kw. with tandem-compound engines.
250 Kw. with Westinghouse compound engine.
225 Kw. with cross-compound engine.

DIRECT CONNECTED LIGHTING AND POWER UNITS.

300 Kw. 60-cycle two-phase, with simple engine.
300 Kw. 60-cycle three-phase, with simple engine.
200 Kw. 60-cycle three-phase alternator, with simple engine.
200 Kw. 25-cycle three-phase alternator, with simple Buckeye engine.
150 Kw. 60-cycle single-phase alternators with tandem-compound engines.
125 Kw. 125-volt, with simple engines.
75 Kw. 250-volt, with simple engine.
75 Kw. 125-volt, with simple engine.
60 Kw. 125-volt, with simple engine.
50 Kw. 125-volt, with tandem-compound engine.
50 Kw. 125-volt, with simple engine.
42 Kw. 240-volt, with simple engines.
25 Kw. 250-volt, with simple engines.
25 Kw. 125-volt, with simple engine.

BELT DRIVEN ALTERNATORS.

650 Kw., 1,300-2,600 volts, 2-phase, 133 cycles.
300 Kw., 6,000 volts, 3-phase, 25 cycles.
250 Kw., 10,000 volts, 3-phase, 60 cycles.
250 Kw., 2,200 volts, single-phase, 133 cycles.
200 Kw., 1,100 volts, single-phase, 133 cycles.
180 Kw., 2,300 volts, 2-phase, 60 cycles.
180 Kw., 2,300 volts, single-phase, 60 cycles.
180 Kw., 1,080-2,160 volts, single-phase, 133 cycles.
150 Kw., 1,100-2,200 volts, 2-phase, 133 cycles.
150 Kw., 2,200 volts, 3-phase, 60 cycles.
150 Kw., 1,100-2,200 volts, single-phase, 60 cycles.
150 Kw., 1,100 volts, single-phase, 133 cycles.
120 Kw., 1,040-2,080 volts, single-phase, 133 cycles.
120 Kw., 1,040 volts, single-phase, 133 cycles.
100 Kw., 2,300 volts, single-phase, 60 cycles.
100 Kw., 1,100 volts, single-phase, 133 cycles.
100 Kw., 1,040-2,100 volts, 3-phase, 60 cycles.
90 Kw., 2,200 volts, 2-phase, 60 cycles.
90 Kw., 2,200 volts, single-phase, 60 cycles.
75 Kw., 2,200 volts, 2-phase, 60 cycles.
75 Kw., 1,100 volts, single-phase, 133 cycles.
60 Kw., 1,100 volts, single-phase, 133 cycles.

BELT DRIVEN RAILWAY GENERATORS.

Two 500 Kw. 6-pole.
Two 500 Kw. 4-pole.
Four 300 Kw. 4-pole.
Two 250 Kw. 4-pole.
One 250 Kw. 6-pole.
Two 200 Kw. 6-pole.
Three 200 Kw. 4-pole.
Two 200 Kw. bipolar.
Two 187 Kw. 4-pole.
Two 150 Kw. 6-pole.
Two 110 Kw. 4-pole.
One 110 Kw. 6-pole.
Three 100 Kw. 4-pole.
Two 100 Kw. 6-pole.

ENGINES, BOILERS, GENERATORS, MOTORS, ARC LAMPS, TRANSFORMERS.

CHAS. E. DUSTIN CO.,
11 BROADWAY NEW YORK

CHICAGO EDISON COMPANY REPAIR SHOPS

76 MARKET STREET, CHICAGO. TELEPHONE MAIN 1280.

Machine and Carpenter Work of All Kinds
Correspondence Solicited.

OPEN DAY AND NIGHT.

FIRST-CLASS EQUIPMENT THROUGHOUT.

Dynamos Armatures, Motors, Arc Lamps, Fans, Instruments.

ARNOLD ELECTRIC POWER STATION Co.
Engineers, Constructors for Complete Electric Plants. Results Guaranteed.
SUITE 1539, MARQUETTE BLDG., CHICAGO.
NEW YORK OFFICE: 711 TRANSIT BLDG.

E. W Hammer, Pres. and Treas. H. J. Minhinnick, Sec. and Gen'l Sup't.
GENERAL ENGINEERING Co., THE
Consulting and Contracting Engineers.
Telephones, Electric Light, Power Transmission
Suite 1112, 135 ADAMS ST., CHICAGO.
Long Distance Telephone Central 478.

ROBERT W. HUNT & Co.,
ENGINEERS
1121 The Rookery, Chicago. 66 Broadway, New York.
Monongahela Bank Bldg., Pittsburg.
Norfolk House, Cannon St., London.

SQUIRE ELECTRIC CO.
Engineers and Contractors
113 E. Eighth St., KANSAS CITY, MO.
Consulting, Designing and Supervising Engineers.
Plans and Specifications Furnished.

W. E BAKER. H. B. BISHOP.
BAKER, W. E. & CO.
ENGINEERS,
ELECTRIC RAILWAYS.
27 William St., NEW YORK.

J. H. HALLBERG
Consulting Arc Lighting Expert and Practical Electrical Engineer
45 Broadway - NEW YORK
Room 169A

KOHLER BROS.,
Contracting Electrical Engineers, Lighting Power Railways,
1804-1806-1808-1810-1812 Fisher Building,
CHICAGO.

STANTON, LE ROY W.
Consulting Telephone Engineer.
Plans, Specifications and Supervision of Installation of complete telephone plants.
Special Reports on Telephone Properties and Apparatus.
411 Electrical Bldg., Cleveland, Ohio.

BRYAN, WILLIAM H.
M. Am. Soc. M. E.,
Consulting Mechanical and Electrical Engineer.
Lincoln Trust Building, ST. LOUIS.

ENGINEERS
Represented in this "Directory" are enabled to come in touch with many prospective customers who cannot be reached through any other source.

RUEBEL - SCHWEDTMANN-WELLS,
CONSULTING, MECHANICAL AND ELECTRICAL ENGINEERS,
Suite 801 Chemical Building,
ST. LOUIS, U. S. A.

IT WILL PAY
engineers not represented in this department to carry a card regularly.

BYLLESBY, H. M. & Co.
(Incorporated)
ENGINEERS
Design, Construct and Operate Railway, Light, Power and Hydraulic Plants.
Examinations and Reports.
New York Life Building, - CHICAGO, ILL.

HORNADAY, J. P. & Co.
SUITE 1108 TRACTION BUILDING
CINCINNATI, O.
WATERWORKS, ELECTRIC RAILWAY, LIGHT, TRACTION, INDUSTRIAL AND MINERAL PROPERTIES BOUGHT AND SOLD

Long Distance Phone Central 2448.
SCHOTT, W. H.,
ENGINEER AND CONTRACTOR,
Specialties—Central Station Heating Plants, Water Works Steam Plants, Electric Light, Gas and Street Railway Plants.
1220-21 MARQUETTE BUILDING, CHICAGO.

Telephone Main 3123.
WILMERDING, C. H.
CONSULTING ENGINEER
1100 Old Colony Bldg., CHICAGO.

DUGALD C. JACKSON, C. E.
WILLIAM B. JACKSON, M. E.
MEMBERS
AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS
AMERICAN SOCIETY OF MECHANICAL ENGINEERS
AMERICAN SOCIETY OF CIVIL ENGINEERS
ENGINEERS. EXPERTS.
MADISON, WIS.

Practical Running of Dynamos.
A little booklet on the care and the treating and remedying of troubles in dynamos and motors.
Price, 10 Cents.
Catalogue of mechanical and electrical books free.
ELECTRICIAN PUBLISHING COMPANY,
510 Marquette Bldg., Chicago.

AKRON
Generators, Motors, Clutches, Commutator Truing Devices.
AKRON ELECTRICAL MFG. CO.,
AKRON, O.
N. Y. Office: McKay Engineering Co., 149 Broadway

Engineering MECHANICAL, ELECTRICAL, STEAM, CIVIL.
Complete and short courses. Thoroughly equipped engineering shops. Shop work from the beginning. Short courses in Steam and Electrical Engineering. Expenses low. Accommodations the best. School all year. Students may enter any time. Correspondence steam and electrical courses. Send for catalogue. Mention course in which interested.
HIGHLAND PARK COLLEGE, DES MOINES, IOWA.

READ THE BLUE ELECTRICAL PAPER.

The Electro-Magnet
—BY—
TOWNSEND WOLCOTT, A. E. KENNELLY, RICHARD VARLEY.
PRICE, ONE DOLLAR,
CONTENTS.
General Properties. Magnetic Field of Force. Magnetic Units. Induced Magnet, Reluctance, Permeability. Discovery of Electro-Magnetism. Iron Ring in the Magnetic Field. Calculation of Magnet Windings. Magnetic Circuit. Given Ampere-Turns to Find Proper Current. Relation of Ampere-Turns to Wire Space. Room Occupied by Insulation. Heating and Other Limiting Conditions. Winding a Magnet for a Given Voltage. Hysteresis, Self-Induction. Alternating Currents. Traction.
On the Relative Values of the Windings of Electro-Magnetic Coils. Properties of Fixed Winding Spaces and a Fixed Size of Wire. Properties of Fixed Winding Space and Variable Size of Wire. Fixed Winding Space and Fixed Length of Wire or Number of Turns. Constant Internal Dimensions, but External Diameter of Coil Variable. Fixed Internal Radius and Interflange-Fixed Number of Turns of Same Size of Wire.
The Importance of Details. Actual Calculations. Working Formulæ. Diameter of Wire to Carry Given Current. Diameter of Wire to Have Given Resistance. Thickness of Insulation in a Given Coil. Weight of Copper in a Given Coil. Table of Constants for Insulated Wire. Standard Table of Resistances of Insulated Wires. Table Showing Percentage of Copper and Insulation in Cotton or Silk Covered Wire. Standard Copper Wire Table. 17 Problems (Solved) Illustrated. Cuts of 37 Magnets of Standard Dimensions, Lengths Variable. Logarithms and Anti-Logarithms. Decimal Parts of an Inch. Logarithmic Scale.
—FOR SALE BY—
ELECTRICIAN PUBLISHING CO., 510 MARQUETTE BLDG., CHICAGO.

THEY ARE ABSOLUTELY
DEAD BEAT
Electrical Recorder & Indicator Company's
VOLTMETERS AND AMMETERS
WATCH FOR THEIR PICTURES — THEY ARE GOOD LOOKING
Electrical Recorder & Indicator Co.,
PONTIAC BLDG. - - CHICAGO, ILL.

CENTRAL STATION HEATING
We are the originators and builders of the underground system of live and exhaust steam heating. Our system is used for the utilization and distribution of exhaust steam from electric and power plants for heating purposes. 250 Plants in successful operation. We have the only Meter System. Also manufacturers of Wooden Water Pipe, Steam Pipe Casing, Steam Traps, Condensation Meters, Valves, Economizing Coils, Separators and full line of Steam Fitters' Supplies.
WRITE FOR PAMPHLET AND PRICE LIST
American District Steam Company
MENTION WESTERN ELECTRICIAN.
LOCKPORT, N. Y. CHICAGO, ILL.

KESTER
SELF FLUXING SOLDER

A Tube of Solder Filled with Flux.
Requires no Acid.

SAVES—LABOR—TIME—MONEY.

PATENTED.

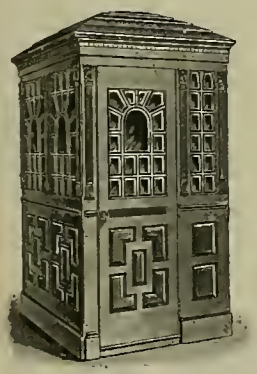
Send for Free Samples.

L. F. Mahler Co., R. 1008 Chemical Bldg., St. Louis, Mo., Gen. Western Agent.

KESTER ELECTRIC M'F'G CO.,
48 N. UNION STREET, CHICAGO, ILL

TELEPHONE BOOTHS

PAY FOR THEMSELVES



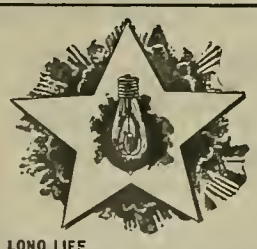
By Increase of Receipts, Oftentimes in one Month

WRITE FOR CATALOGUE

W. S. SEAMAN & CO.
216 E. Water St.
MILWAUKEE, - - WIS.

BUY YOUR BOOKS
FROM THE
Electrician Pub. Co., 510 Marquette Bldg., Chicago.

"STAR" INCANDESCENT LAMPS



LONG LIFE
GUARANTEED CANDLEPOWER,
HIGHEST EFFICIENCY.

MADE BY THE MOST SKILLED WORKMEN.

STANDARD ELECTRICAL MFG. COMPANY, : Niles, Ohio.

STONE CONDUIT

For Underground Wires. The Only Conduit that Improves with Age.
AMERICAN STONE CONDUIT CO., Suite 29. 94 La Salle St., Chicago, Ill.

Standard Vitrified Conduit Co.

B. B. BARNARD, Manager

39-41 CORTLANDT ST.
NEW YORK

LARGEST FACTORIES IN THE WORLD : STOCK ON HAND

SEND FOR CATALOGUE

BITUMINIZED FIBRE CONDUIT

FOR

ELECTRICAL UNDERGROUND CONSTRUCTION
ELECTROLYSIS PROOF WATER PROOF

A smooth laminated insulator of unchanging durability.

Forms a continuous sealed duct from manhole to manhole, impervious to moisture and through which leaking gas cannot penetrate.

There has never been a gas explosion in our conduits nor the slightest evidence of electrolysis.

Abrasion of the cables is an impossibility.

It saves sixty per centum of freight and handling cost and twenty to thirty-five per centum of construction.

Process of laying is simple, rapid and inexpensive. There is no loss from breakage or fitting. It is self-aligning and cannot settle out of alignment.

All sizes from one inch to ten inches interior diameter. Bends of all angles.

The foremost electrical engineers are recognizing and testifying to the scientific advantages of our system of subway construction over all previous methods.

Send for illustrated book. Ask for prices giving size and quantities required

PROMPT DELIVERIES

FACTORIES: Philadelphia, Chicago, Los Angeles

American Conduit Company

SEVENTH FLOOR, 170 BROADWAY, NEW YORK

336 Macy St., Los Angeles, Cal. Manhattan Bldg., Chicago

Locations for Industries

Erie Railroad

Chicago to New York

The Erie Railroad Company's Industrial Department has all the territory traversed by the railroad districted in relation to resources, adaptability, markets and advantages for manufacturing, and can advise with manufacturers in relation to the most suitable locations. For full information address

LUIS JACKSON
Industrial Commissioner, Erie Railroad Company
21 Cortlandt Street, New York

"Free from the care which wearies and annoys.
Where every hour brings its several joys."

"AMERICA'S SUMMER RESORTS"

This is one of the most complete publications of its kind, and will assist those who are wondering where they will go to spend their vacation this summer.

It contains a valuable map, in addition to much interesting information regarding resorts on or reached by the

NEW YORK CENTRAL LINES

A copy will be sent free, upon receipt of a two-cent stamp, by George H. Daniels, General Passenger Agent New York Central & Hudson River Railroad, Grand Central Station, New York.

"Practical and to the Point"

IS ALL THAT NEED BE SAID OF

THE TELEPHONE HAND-BOOK

By HERBERT LAWS WEBB.

160 Pages, 133 Illustrations, Cloth, Price $1.00.

The book for those interested in telephony.

ELECTRICIAN PUBLISHING CO.,
510 Marquette Bldg.,
CHICAGO.

INDUSTRIES ARE OFFERED LOCATIONS

WITH

Satisfactory Inducements,
Favorable Freight Rates,
Good Labor Conditions,
Healthful Communities,

ON THE LINES OF

THE ILLINOIS CENTRAL R. R.
AND THE
YAZOO & MISSISSIPPI VALLEY R. R.

For full information and descriptive pamphlet address

J. C. CLAIR,
Industrial Commissioner,
1 Park Row, Chicago, Ill.

KELLOGG

MAGNETO SWITCHBOARDS.

We have been making small switchboards only during the last three years, but in that time we have constructed

Over 1,400 Small Switchboards, Having 75,000 Lines in Actual Use.

Every one of all this list is giving the best satisfaction.

Kellogg Switchboard and Supply Company,

Green and Congress Streets,
CHICAGO.

Seymour Building, LOS ANGELES. Electric Building, CLEVELAND. Keystone Telephone Building, PHILADELPHIA.

WRITE
FOR
BULLETIN
No. 11-E

THIS IS OUR LATEST BULLETIN DESCRIBING
GENERATOR-CALL TELEPHONES

It shows all of our recent improvements in this type of apparatus. If you wish to keep posted on the most modern apparatus you will write for this bulletin.

Stromberg-Carlson Telephone Mfg. Co.

GENERAL AND EASTERN SALES OFFICE
ROCHESTER, N. Y.

SALES DEPT.
CHICAGO, ILL.

INTERNATIONAL

Mechanical Self-Restoring Drop Switchboard.

A PERFECT APPARATUS.

Made in any desired capacity.
Sample parts and quotations on request.

INTERNATIONAL TELEPHONE MANUFACTURING CO.

CHICAGO, U. S. A.

We introduced successful 4-party lines

LEICH SELECTIVE SYSTEM

Write for our booklet—"Selective W."

CENTRAL ENERGY OR MAGNETO

Impedance Coil for Selectives. No Springs.

AMERICAN ELECTRIC TELEPHONE CO.

CHICAGO, ILLINOIS

Automatic Telephones.

Privacy

Promptness

Precision

Profits.

Automatic Electric Co., Chicago, U. S. A.

PRODUCERS AND WHOLESALERS OF WHITE CEDAR PRODUCTS

CEDAR POLES

SPECIAL PRICES ON SMALL POLES.
Write for a copy of our TELEGRAPH CODE FOR CEDAR PRODUCTS

YARDS
KOSS MICH.
L'ANSE "
MUNISING "
ONTONAGON
WAGNER, WIS
PESHTIGO "

C. H. WORCESTER CO.
SUITE 1206 TRIBUNE BLDG. CHICAGO.

POLES AND POSTS.

The consumer should write me, I am on the ground and CAN SAVE YOU 10 per cent

S. E. THOMPSON, TENSTRIKE, MINN.

BRACKETS—X ARMS—PINS

little things it is true, but they cut a big figure in line construction.

OUR MOTTO IS:
Prompt Shipment Quality Satisfaction Right Price

COLUMBIA MFG. CO. ANTIGO, WIS.

CEDAR POLES

MARSHALL H. COOLIDGE Co. 525 GUARANTY BLDG. MINNEAPOLIS MINN.

YARDS — NEW DULUTH, MINN. - FLOODWOOD, MINN. - WELLERS, MINN.

CYPRESS POLES CREOSOTED AND TREATED WITH CHLORIDE OF ZINC.

If you want a telegraph pole *that will outlast any two cedar poles,* get the above. No decay. No dry rot. Nothing to give way. Test poles *sound after thirty years.* Price on long lengths same as cedar. Short lengths about one third higher. Address,

A. BUSHNELL, 903 Broadway, KANSAS CITY, MO.

IDAHO CEDAR POLES.

LOW PRICES. LONG LENGTHS A SPECIALTY.

YARDS: IDAHO. MONTANA.

WESTERN LUMBER & POLE CO., - Main Office, DENVER, COLO.

POLES, TIES, POSTS.

THE PORTER CEDAR CO., SAGINAW, MICH.

PRODUCERS. We want your Inquiries always.

Southern Cedar POLES Are the Best.

NO ROTTEN BUTTS.

D. W. PHELAN, 277 Broadway, New York

Sterling Black Plastic Insulator.

One hundred days' continuous baking at 180° F. will not make it brittle. Water repellent. Oil proof.

THE STERLING VARNISH CO., - - Pittsburg, Pa.

Telephone Troubles and How to Find Them.

A complete hand-book for telephone inspectors, by Wm. H Hyde and J. A. McManman.

NINTH EDITION. 52 PAGES. PRICE, 25 CENTS.

The large number of telephone exchange managers and employes will find this book a great help in locating telephone troubles and remedies therefor. Considerable new matter has been added in this edition.

Sent prepaid on receipt of price by the

Electrician Publishing Co., 510 Marquette Building, CHICAGO.

POLE DEALERS ADVERTISING IN THE WESTERN ELECTRICIAN OBTAIN MOST EXCELLENT RESULTS BECAUSE IT PLACES THEM IN TOUCH WITH ACTUAL BUYERS OF POLES. TRY A CARD.

WESTERN ELECTRICAL SUPPLY CO.,

ENGINEERS AND BUILDERS

OF

Electric Railways, Lighting and Power Plants.

Western Electrical Supply Co.,

Chemical Building, - - ST. LOUIS, U. S. A.

Estimates Furnished.

WHITE CEDAR POLES

Don't forget our Minnesota Transfer Yard—midway between St. Paul and Minneapolis, where we load in forty-eight hours from the time we have your order.

PAGE & HILL CO. 1003 Lumber Exchange, MINNEAPOLIS, MINN.

SPECIAL CROSS ARMS

ALL HEART, long leaf yellow pine, any size or length. Also ALL HEART cross ties, oak and locust pins and brackets. Write us for delivered prices. We can furnish 100 or 100,000 promptly. R. R. AKERS, Manager.
Sales Office, 519 Main Street, Cincinnati, O.
LEWIS LUMBER & MFG. CO., Hattiesburg, Miss.

If you could see a carload of our low priced Trolley Ties, you would be ready to order.
May we not price you a sample carload?
(We make the same quick delivery on ties that we have always made on poles.)
MALTBY LUMBER COMPANY, 512 Phoenix Block, Bay City, Michigan.
PITTSBURG AGENTS, Tipper & Patton, 509 Bessemer Bldg.

POLES—POSTS—PILING—TIES

Fowler-Jacobs Co.
Elmore-Fowler-Jacobs Co.
John H. Fowler & Co.
The FOWLER Companies
Fisher Building, - - CHICAGO

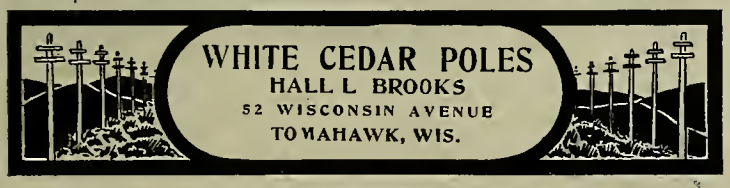
Cedar Poles.
Pittsburg and Lake Superior Iron Co. Producers and Wholesalers. Escanaba, Mich.

MICHIGAN AND WESTERN **CEDAR POLES**
ALL LENGTHS AND SIZES
LINDSLEY BROS CO.
TRIBUNE BLDG., CHICAGO

Idaho Cedar Poles
PACIFIC COAST POLE CO. SPOKANE, WASH.

POLES. WHITE CEDAR. IDAHO CEDAR up to 80 ft.
BERTHOLD & JENNINGS, ST. LOUIS. Chemical Building.
CROSS ARMS. LONG LEAF PINE AND FIR.

CEDAR POLES, POSTS, TIES,
H. M. LOUD'S SONS CO., Au Sable, Mich.



POLES W. C. STERLING & SON, MONROE, MICH. Eleven Pole Yards in Michigan. Wholesale Producers for 20 years. **TIES.**

CEDAR POLES
ESTABLISHED 1862
WM. MUELLER COMPANY
1211-12-13 MARQUETTE BLDG. CHICAGO.
EIGHT DISTRIBUTING YARDS

The business of the Western Electrician for the year 1903 was the largest in its history of 17 years.

Cedar TORREY CEDAR CO., CLINTONVILLE, WIS. **Poles**
Large Stock Constantly on Hand

CEDAR POLES
THE
Valentine-Clark Co.
234 La Salle Street, CHICAGO
YARDS:
Pinconning, Mich. : Green Bay, Wis. : New London, Wis.

MICHIGAN WHITE **CEDAR POLES** LARGE STOCK.
PROMPT SHIPMENTS. KELLOGG SWITCHBOARD & SUPPLY CO., Chicago.

VEGETABLE FEED-WATER TREATMENT,

Proportioned to suit the Mineral Analysis of the water, will keep your boilers clean, free from corrosion, and effect great saving in repairs and operating expense.

DEARBORN DRUG & CHEMICAL WORKS,

120 LIBERTY STREET NEW YORK. 15 BRANCH OFFICES IN U. S. 27-34 RIALTO BUILDING, CHICAGO.

Dixon's Traction Belt Dressing *Has a 27 Years' Record* in restoring and preserving the clinging power of leather belts. Descriptive booklet 125 and sample upon request.

JOSEPH DIXON CRUCIBLE CO., JERSEY CITY, N. J.

JEFFREY CHAIN BUCKET DREDGES FOR CATALOGUE, ADDRESS THE JEFFREY MFG. CO. COLUMBUS, OHIO.

THE WILLIAM TOD CO.

BUILDERS OF

CORLISS AND HIGH SPEED AUTOMATIC ENGINES FOR ELECTRICAL PURPOSES.

Main Office and Works: YOUNGSTOWN, OHIO.

BRANCH OFFICE: PARK BUILDING, PITTSBURG, PA.

AGENCIES { New York, George F. Woolston, 29 Broadway. Birmingham, Ala., W. H. Hume & Co., Woodward, Bldg.

HARTFORD STEAM BOILER INSPECTION AND INSURANCE CO. HARTFORD, CONN.

THE TELEPHONE HAND-BOOK

BY HERBERT LAWS WEBB.

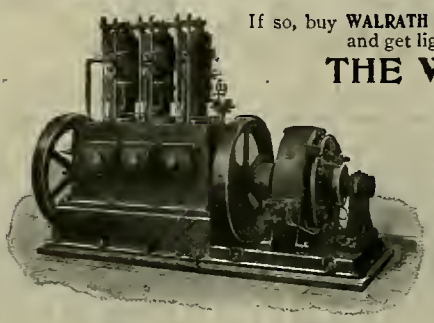
Price $1 00.

A complete and practical work in handy pocket size.

PUBLISHED BY THE ELECTRICIAN PUBLISHING CO., Suite 510 Marquette Building, Chicago.

ARE YOU LOOKING FOR MONEY?

If so, buy WALRATH GAS OR GASOLINE ENGINES and get light on the subject.



THE WALRATH

Received the Highest Award at the Pan-American Exposition.

It will produce as good a commercial light as that of an automatic steam engine, either belted or direct-connected generator. Simple, Economical and Reliable.

Send for Catalogue W.

MARINETTE GAS ENGINE CO.,

CHICAGO HEIGHTS, ILL.

AGENCIES:
301 Fisher Building, Chicago. 619 Stevenson Building, Indianapolis.
703 Bijou Building, Pittsburg.
MacKay Engineering Co., 149 Broadway, New York.
MacKay Engineering Co., 100 Boylston St., Boston.
Strong, Carlisle & Hammond Co., Cleveland.

REG. TRADE MARKS "Phosphor Bronze" DELTA

THE PHOSPHOR BRONZE SMELTING CO. LIMITED. 2200 WASHINGTON AVE., PHILADELPHIA.

"ELEPHANT BRAND PHOSPHOR-BRONZE" INGOTS, CASTINGS, WIRE, RODS, SHEETS, ETC.

— DELTA METAL —

CASTINGS, STAMPINGS AND FORGINGS

ORIGINAL AND SOLE MAKERS IN THE U. S.

BUY Your Electrical Books of the **Electrician Publishing Co., Suite 510 Marquette Bldg., Chicago.** You will save **TIME** and **MONEY** by doing so. . . . . .

Preserve Your Copies

OF THE **WESTERN ELECTRICIAN.**

BINDERS $1.00 EACH.

ELECTRICIAN PUBLISHING CO.,

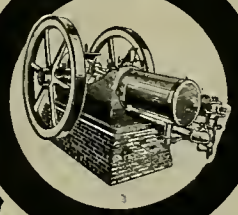
Suite 510 Marquette Building. . . . .

FIBRE-GRAPHITE COMMUTATOR BRUSH SELF-LUBRICATING

There's No Friction

with the Fibre-Graphite Commutator Brush. Being 90 per cent. pure graphite, it insures low resistance, no sparking under a varying load, and longer wear. There is no greasing required. The Fibre-Graphite is therefore the most economic brush on the market. Send for price list.

HOLMES FIBRE-GRAPHITE MFG. CO. 5155 Wakefield St., Germantown, PHILADELPHIA.



Olds Gas and Gasoline Engines

When gasoline is used for fuel it can be pumped up only as fast as it is used. Perfect mechanical appliances make for absolute safety and economy.

STATIONARY ENGINES - - 2 to 100 H. P.
PORTABLE ENGINES - - - 8 to 18 H. P.

We have a new catalog, fully describing and illustrating our line, which will be sent on request.

OLDS GASOLINE ENGINE WORKS

252 River Street - - - Lansing, Mich.

2 No. 983

SAMSON TURBINE

We show below a record of tests made in the official testing flume at Holyoke, of a 35-inch SAMSON TURBINE which was built from the same patterns as those we sell to our customers.

Gateage.	Head.	R. P. M.	Cu. Ft. per Sec.	H. P.	Efficiency.
Full	15.29	194	102	143	81.08%
¾	16.56	188	92	147	84.78%
½	17.33	178	84	138	83.88%
¼	17.54	176	69	110	80.09%

WRITE DEPT. D FOR CATALOG

JAMES LEFFEL & CO.

SPRINGFIELD, OHIO U. S. A.

DIRECT CURRENT GENERATORS

ENGINE DRIVEN

Durable signs of durable strength, electrical and mechanical, are always found in FORT WAYNE apparatus. These 400-kilowatt armatures are good examples.

FORT WAYNE ELECTRIC WORKS · Fort Wayne, Ind. · WOOD LIGHTING & POWER SYSTEMS

The sturdy mechanical construction of armatures of Type M P L generators is the result of symmetrical and economical design, and consistent absence of useless material. :: :: :: :: :: :: :: ::

233

The Inspector AND Trouble Man.

By A. E. DOBBS.

Full of information and diagrams for the operator, exchange owner, exchange manager, inspector, trouble man, lineman.

A complete description of telephones and their troubles. How to find and remedy them, together with working plans for exchange construction, complete with diagrams of all up-to-date telephones and switchboards.

This is a practical book, written in **plain language,** and for **anyone** interested in telephony.

Mailed anywhere on receipt of price . . . **ONE DOLLAR.**

No technicalities. Substantially bound in cloth.

ELECTRICIAN PUBLISHING CO.,
510 MARQUETTE BUILDING, CHICAGO.

WATTMETERS FOR DIRECT CURRENTS

The new Duncan has all the up-to-date features that go to make it the best on the market. It will pay you to try one and investigate its merits for yourself.

Its multipoint switch method of compensating for friction and vibration is conceded to be the simplest, quickest and most reliable means yet devised. It is superior in every respect to the old and clumsy methods of adjusting the compensating coil bodily and is not damaged by lightning.

DUNCAN ELECTRIC MFG. CO.
LAFAYETTE, IND.

STEEL CASTINGS

—FOR—

Dynamos and Motors

We manufacture a Steel that far excels anything now in the market for Electrical Work

WRITE US FOR CHARTS AND PRICES

DETROIT STEEL CASTING CO.

DETROIT, MICH.

KARTAVERT.

HARD AND FLEXIBLE FIBER IN SHEETS, RODS AND TUBING.

For Electrical and Mechanical Purposes, Railway Dust Guards, Washers and Packings. Patent Insulating Cleats.

MANUFACTURED BY

THE KARTAVERT MANUFACTURING CO. Wilmington, Del.

VULCANIZED FIBRE

Highest grades for electrical insulation and mechanical purposes, in sheets, tubes, rods and special shapes. Catalogues and samples on application.

VULCANIZED FIBRE CO., - Wilmington, Del.

WIRES AND CABLES

HIGH-GRADE, RUBBER-COVERED, WEATHER-PROOF

MAGNET, OFFICE, ANNUNCIATOR WIRE.

HAZARD MANUFACTURING CO.,

GENERAL OFFICE AND WORKS, Wilkesbarre, Pa. NEW YORK OFFICE, 50 Dey St. CHICAGO OFFICE, 71 and 73 West Adams St

STURTEVANT ENGINES

BLOWERS FORGES
ELECTRIC MOTORS
GENERATING SETS
ELECTRIC FANS
STEAM HEATING
VENTILATING AND
DRYING APPARATUS
MECHANICAL DRAFT

B. F. STURTEVANT CO.

BOSTON, MASS.

NEW YORK PHILADELPHIA CHICAGO LONDON

National Electric Company

builders of high-grade Electrical Machinery for LIGHTING, POWER and RAILWAY SERVICE

500 K. W. Engine Type Alternator Frame.

General Sales Offices and Works: MILWAUKEE

NEW YORK: 135 Broadway
CHICAGO: Old Colony Building
PHILADELPHIA: 1509 Land Title Bldg.
PITTSBURG: Gellatly & Co.
CHARLESTON, W. VA.: Agnew Electric Co.
SEATTLE & SAN FRANCISCO: Kilbourne & Clark Co.

Black Diamond File Works

Est. 1863. Inc. 1895.

Twelve Medals Awarded at International Expositions

TRADE MARK

Special Prize Gold Medal at Atlanta, 1895.

OUR GOODS ARE ON SALE IN EVERY LEADING HARDWARE STORE IN THE UNITED STATES AND CANADA.

G. & H. BARNETT COMPANY,

PHILADELPHIA, PA.

JOHN A. ROEBLING'S SONS CO.

Insulated Wire of All Kinds

Bare Copper Wire

MAIN OFFICE AND WORKS **TRENTON, N. J.**

AGENCIES AND BRANCHES

New York Chicago Cleveland San Francisco Philadelphia Atlanta

Western Electrician

Vol. XXXV. $3.00 Per Annum. Copyright, 1903, by Electrician Publishing Company, Chicago. CHICAGO, JULY 16, 1904. Entered at Chicago Postoffice as mail matter of the second class. 10 Cents a Copy. No. 3.

SIMPLEX INSULATED WIRES AND CABLES.
RUBBER COVERED, WEATHERPROOF, UNDERGROUND AND SUBMARINE
WESTERN SELLING AGENT, H. B. MASON, [illegible] Monadnock Block, CHICAGO.
The Simplex Electrical Co., 110 State Street, BOSTON, MASS.

N. I. R.
National India Rubber Co.'s
RUBBER COVERED
WIRES AND CABLES.
OFFICE AND FACTORY: BRISTOL, R. I.

OKONITE
TRADE MARK
1889—Paris Exposition, Medal for Rubber Insulation.
1893—World's Fair, Medal for Rubber Insulation.
THE STANDARD FOR RUBBER INSULATION.
Sole Manufacturers of
Okonite Wires, Okonite Tape, Manson Tape, Candee Weather-proof Wires.
THE OKONITE CO., LTD.
Willard L. Candee, N. Durant Cheever, Managers. 253 Broadway, New York. Geo. T. Manson, Gen'l Supt. W. H. Hodgins, Secy.

TRADE MARK. CRESCENT INSULATED WIRE & CABLE CO. TRENTON, N. J.
CRESCENT RUBBER INSULATED WIRES AND CABLES
National Code Standard.
CRESCENT INSULATED WIRE AND CABLE CO.,
New York Office, 93 BARCLAY STREET. Main Office and Factory, TRENTON, N. J.

RESISTANCE WIRES
"Climax" For High-resistance Work.
"Advance" For Measuring Instruments.
SPECIAL ALLOYS FOR ELECTRICAL MANUFACTURERS.
DRIVER-HARRIS WIRE CO., Harrison (Newark), N. J.

INDIANA RUBBER AND INSULATED WIRE CO.,
MANUFACTURERS OF
Paranite Rubber Covered Wires and Cables,
UNDERGROUND, AERIAL, SUBMARINE AND INSIDE USE.
TELEPHONE, TELEGRAPH AND FIRE ALARM CABLES.
All Wires are tested at Factory. JONESBORO, IND.

"CIRCULAR LOOM" THE FLEXIBLE CONDUIT
AMERICAN CIRCULAR LOOM CO. TRADE MARK REGISTERED
CONDUITS FOR INTERIOR WIRING.
American Circular Loom Co.
Chelsea, Mass., New York, Chicago, San Francisco.

TWO YEAR COURSES IN
STEAM AND MACHINE DESIGN
AND IN
APPLIED ELECTRICITY.
PRATT INSTITUTE,
BROOKLYN, N. Y.
Write for Catalogue and Particulars.

W. D. PAINT.
A PERMANENT INSULATING PROTECTION FOR WOOD OR METAL. A quick drying, moisture-proofing, black paint. An elastic anti-rust coating. A jet black finishing paint, efficient and not expensive.
Write for "Data on Insulating Materials."
DIELECTRIC MANUFACTURING CO., SAINT LOUIS.

I-T-E
CIRCUIT BREAKERS
CUTTER ELECTRICAL CO., PHILADELPHIA

THOUSANDS IN USE.
Motors, ⅓ h. p. to 100 h. p.
Dynamos, 1 k. w. to 75 k. w.
Highest Quality. Reasonable Price.
THE NOBART ELECTRIC MFG. CO.
TROY, OHIO.

WE MAKE AND SELL HIGH-GRADE ELECTRIC HEATING DEVICES
AMERICAN ELECTRICAL HEATER COMPANY
DETROIT, MICH.

"STAR" INCANDESCENT LAMPS
LONG LIFE
GUARANTEED CANDLEPOWER,
HIGHEST EFFICIENCY.
MADE BY THE MOST SKILLED WORKMEN.
STANDARD ELECTRICAL MFG. COMPANY, : Niles, Ohio.

Cope's Patent Quick Coupling Conduit Rod
Remember these rods have no lost motion.
These Couplings are of Steel and are made in the best possible manner.
PATENTED
NO LOST MOTION
Write for list of persons using these rods—26,000 sold since May 1902. Made to 3 ft. and 4 ft. lengths.
Price, 3 ft. 75 cents, 4 ft. 85 cents.
Patented February 24, 1903.
T. J. COPE
3244 North Fifteenth Street PHILADELPHIA, PA.

KESTER SELF FLUXING SOLDER
A Tube of Solder Filled with Flux.
Requires no Acid.
SAVES—LABOR—TIME—MONEY.
FLUX
ACTUAL SIZE
PATENTED.
Send for Free Samples.
L. F. Mahler Co., R. 1008 Chemical Bldg., St. Louis, Mo., Gen. Western Agent.
KESTER ELECTRIC M'F'G CO., 46 N. UNION STREET, CHICAGO, ILL.

DO YOU?
BUY LAMPS-OR-BUY CANDLE POWER
16 {THIS LAMP AVERAGES} 12
THE STERLING ELECTRICAL MANUFACTURING CO.
NEW YORK, N. Y. WARREN, O. CHICAGO, ILL.
STERLING SPECIAL
REGULAR TYPE

WESTON Electrical Instrument Co.,
Waverly Park, NEWARK, N. J.

Weston Standard Portable Direct Reading Wattmeter.

The Weston Standard Portable Direct Reading
Voltmeters and Wattmeters
—FOR—
Alternating and Direct Current Circuits
Are the only standard portable instruments of the type deserving this name. Write for circular and price lists.
BERLIN: European Weston Electrical Instrument Co., No. 88 Ritterstrasse.
LONDON: Elliott Bros., Century Works, Lewisham.
PARIS, FRANCE—E. H. Cadiot, 12 Rue St. Georges.
NEW YORK OFFICE—74 Cortlandt St.

SECURITY TROLLEYS
FOR STRINGING CABLES
(PATENTED)

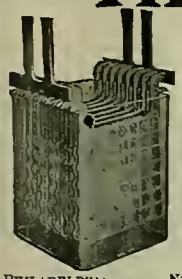
A thousand feet of cable is easily pulled in ten minutes by only two men after trolleys are in position.
The old way cost too much, and of the various new schemes for stringing cables all have been pronounced complicated and defective, except this very natural and sensible way of using trolleys.
Weight, 12 pounds
Price, $1.50 each
Prompt shipments from stock. Write for Catalog W. 118
THE F. BISSELL COMPANY
Manufacturers and Jobbers of
TELEPHONE SUPPLIES
226-228-230 HURON STREET
TOLEDO, O.

Allis-Chalmers Co
CHICAGO

Bullock
Electrical Apparatus
for all purposes.

THE ELECTRIC STORAGE BATTERY CO.

PHILADELPHIA



MANUFACTURER OF THE

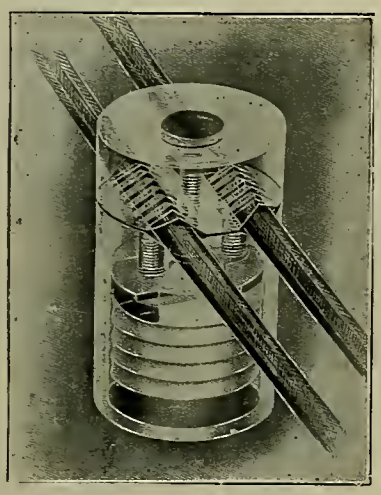
"Chloride Accumulator"

For Central Stations, Electric Railways, Isolated Lighting and Power Stations, Fire Alarm, Telegraph, Train Lighting, etc., etc.

PRICE LISTS AND DESCRIPTIVE BULLETINS FORWARDED UPON REQUEST.

SALES OFFICES:

PHILADELPHIA, Allegheny Ave. and 19th St. | NEW YORK, 100 Broadway, | BOSTON, 60 State St. | CHICAGO, Marquette Bldg. | ST. LOUIS, Wainwright Bldg. | SAN FRANCISCO, Rialto Bldg. | CLEVELAND, Citizens Bldg. | CANADA, Canadian General Electric Co., Ltd. Toronto | HAVANA, CUBA, G. F. Greenwood, Manager 34 Empedrado St.



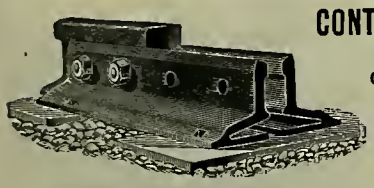
Are You Aware that nearly 30,000 of these

Norbitt Temporary Sockets

are going to be used to illuminate the streets and buildings of Cincinnati during the Elk's Convention to be held in that city, July 18 to 25? It is true.

133 S. Clinton Street
Chicago

Manufactured by
Crouse-Hinds Co.



CONTINUOUS RAIL JOINT COMPANY OF AMERICA.
GENL. OFFICES: CENTURY BLDG., NEWARK, N. J.
OVER 20,000 MILES IN USE
Highest Award Paris Exposition, 1900, Buffalo, 1901

CARBONS
CONSUMERS CARBON CO.
LANCASTER, OHIO, U. S. A.
Carbons of all kinds and for all purposes.

PLATINUM

PLATINUM RIVETS FOR CONTACT POINTS IN TELEPHONES—SPARK COILS AND OTHER ELECTRICAL APPARATUS. PLATINUM SHEET AND WIRE IN ANY FORM AND DEGREE OF HARDNESS. PLATINUM SCRAP PURCHASED.

BAKER & COMPANY, Inc.
ARTISANS IN PLATINUM
408-410-412-414 N. J. R. R. AVE. - NEWARK, N. J.
New York Office: 120 Liberty St.

ALPHABETICAL INDEX TO ADVERTISEMENTS.

Adams-Bagnall Electric Co...—
Akron Electrical Mfg Co.....12
Allen Company, L. B.....13
Allis-Chalmers Company..... 2
American Battery Co..... 4
Amer. Circular Loom Co... 1, 7
American Conduit Co.....16
Amer. District Steam Co.....19
Amer. Elec. Fuse Co..... 4
Amer. Electrical Heater Co.. 1
Amer. El. Telephone Co.....16
American Electrical Works..13
Arnold Elec. Power Station Co..... 15
Automatic Electric Co..... 17

Babcock & Wilcox Co.....—
Bain, Forée.....13
Baker & Company..... 3
Baker & Co., W. E.....15
Barnett Company, G. & H.....22
Beardslee Chandeller Mfg.Co.—
Berthold & Jennings.....19
Big Four Route.....11
Bissell Co., The F..... 1
Bossert Electric Construction Co.....12
Brooks, Hall L.....19
Bryan-Marsh Co.....—
Bryan, Wm. H.....15
Buckeye Electric Co.....—
Bullock Elec. Mfg. Co..... 5
Butterfield, J. F.....15
Byllesby & Co., H. M.....15

Central Electric Co..... 5
Cent. Stat. Improvement Co..14
Central Tel. & El. Co.....16
Century Electric Co.....12
Chicago Die & Electric Co....—
Chicago Edison Co.....4, 14
Chic. Fuse Wire & Mfg. Co....—
Chicago Insulated Wire Co..—
Chicago Mica Co.....12
Columbia Incand. Lamp Co..—
Columbia Mfg. Co.....19
Columbus Storage Bat'ry Co.—
Consumers Carbon Co..... 3
Continuous Rail Joint Company of America..... 3
Coolidge Co.. Marshall H.....—
Cope, T. J..... 1
Crawfordsville Electric Co..—
Crescent Co.....—
Crescent Ins. Wire & Cbl. Co. 1
Crocker-Wheeler Company...14
Crouse-Hinds Co..... 3
Cutler-Hammer Mfg. Co..... 4
Cutter Elec. & Mfg. Company 1

D. & W. Fuse Company.....—
Dearborn Drug & Chem.Wks. 8
Diamond Meter Company....18
Dielectric Manufacturing Co. 1
Directory of Engineers.....15
Dixon Crucible Co., Joseph.. 8
Driver-Harris Wire Co..... 1
Duncan Elec. Mfg. Co.....21

Edison Decorative & Miniature Lamp Departm't.....12
Edison Mfg. Company.....11
Edwards & Co.....11
Egan, J. J..... 4
Electrical Engineer Institute.13
Electric Appliance Co 12
Electrical Recorder & Indicator Co 9
Electric Storage Battery Co.. 3
Electrician Pub. Company...10
Erie Ry.....16

Faries Mfg. Co.....11

"For Sale" Advertisements..14
Ft. Wayne Elec. Works, Inc..21
Fostoria Incand. Lamp Co...—
Fowler, John H.....18
Fowler-Jacobs Company.....18

General Electric Co..... 9
General Engineering Co., The 15
General Incandescent Arc Light Company.....—
General Incand. Lamp Co.....—
Gould Storage Battery Co.... 6
Gt. West. Smelt. & Refining Co.—
Green Fuel Economizer Co.. 8
Gregory Electric Company...14

Hallberg, J. H 15
Haller Machine Co.....—
Hart Mfg. Co..... 9
Hartford Steam Boiler Inspection & Insurance Co....—
Hartford Time Switch Co....11
Hazard Manufacturing Co....—
Highland Park College. .. 13
Hobart Elec. Mfg. Company. 1
Hoffman, G. W.....14
Holmes Fibre-Graph. Co.....—
Holophane Glass Co.....—
Hornaday & Co., J. P.....15
Humphrey, Henry H.....—
Hunt & Co., Robt. W.....15

Illinois Central Ry.....19
Illinois Electric Specialty Co.16
Incandescent Electric Light Manipulator Company.....—
Indiana Rub. & Ins. W. Co.... 1
India Rubber & Gutta Percha Insulating Company.....—
International Elec. Meter Co 14
International Tel. Mfg. Co...16

Jackson, D. C. & W. E.....15
Jeffrey Manufacturing Co.... 8
Jewell Electrical Inst. Co.....—
Johns-Manville Co., H. W.....15

Kartavert Manufacturing Co.—
Kellogg Switchboard & Supply Company..... 17, 19
Kester Elec. Mfg. Co..... 1
Klein & Sons, Mathias..... 13
Kohler Brothers.....15
Kuhlman Electric Co.....12

Leather Preserv. M. Corp....14
Leffel & Co., James..... 8
Lewis Lumber & Mfg Co....19
Lindsley Brothers Company..18
Loud's Sons Co., H. M.....—

Machado & Roller.....11
Malthy Lumber Company....19
Manhattan El. Supply Co....13
Manross, F. N. .....—
Marinette Gas Engine Co..... 8
Matthews & Bros., W. N.....13
McLennan & Company, K....12
Mechanical Appliance Co....15
Mica Insulator Company.....—
Michigan College of Mines..13
Miller Electric Co.....—
Minnesota Electric Co.....16
Miscellaneous Advs.....14
Monon Railroad..... 14
Moon Mfg. Co., The.....—
Morrison Lbr. Co., J. W.....19
Mueller Company, William..19
Munsell & Co., Eugene..... 12

National Electric Co.....11
National India Rubber Co.... 1
New England Butt Co.....18
Newgard & Co., Henry.....22
New York Cent. Ry.....14
New York Ins. Wire Co.....13
Northern Elect'l Mfg. Co....12
Norton Elect'l Instrument Co.—

Okonite Co., The..... 1
Olds Gasoline Engine Works. 8

Pacific Coast Pole Co.....18
Page & Hill Co.....19
Paragon Fan & Motor Co.....—
Pardridge Shade & Refl. Co..—
Pass & Seymour, Inc.....—
Phelan, D. W.....19
Phillips, Eugene F.....13
Phillips Insulated Wire Co...13
Phœnix Glass Co.....—
Phosphor-Bronze S. Co..... 8
Pignolet, L. M.....12
Pittsburg & L. S. Iron Co....18
Plume & Atwood Mfg. Co....13
Porter Cedar Company.....18
Pratt Institute 1

Reisinger, Hugo..... 9
Reynolds El. Flasher Mfg.Co.12
Roebling's Sons Co., J. A.....22
Ruebel-Schwedtmann-Wells..15

Safety Ins. Wire & Cable Co..22
Sargent & Lundy.....—
Schott, W. H.....15
Seaman, J. H.....13
Seaman & Co., W. S.....17
Simplex Electrical Co., The.. 1
Simplex Elec. Heating Co.... 4
Speer Carbon Co.....—
Sprague Electric Company...22
Squire Electric Co.....—
Standard Elec. Mfg. Co..... 1
Standard Underg. Cable Co....—
Standard Vitrified Conduit Co16
Stanley Instrument Co..... 5
Stanton, LeRoy W..... 15
State Univ. of Iowa.....13
Sterling & Son, W. C.....19
Sterling Electrical Mfg.Co... 1
Sterling Varnish Co., The....15
Stow Mfg. Company.....—
Stromberg-Carlson Tel. Mfg. Company.....17
Sturtevant Company, B. F...22

Thompson, S. E.....19
Tod Company, William.....8
Torrey Cedar Company.....18
Trumbull Elec. Co.....—

Union Electric Mfg. Co..... 4

Valentine-Clark Co., The....—
Varley Duplex Magnet Co.... 4
Vulcanized Fibre Company..22

Wagner Electric Mfg. Co.....—
Walsh's Sons & Company.....14
Warren Elec. Mfg. Co.....22
Wesco Supply Co.....12
Western Electric Company... 5
Western El. Supply Co.....—
Western Lumber & Pole Co..18
Westinghouse Electric & Manufacturing Co.....20
Weston Electrical Inst. Co... 1
Wilmerding, C. H.....—
Wisconsin Central Ry.....16
Woolley Fdy. & Mach. Wks.. 8
Worcester Company, C. H....18

Yesbera Mfg. Co..... 17
Yost Electric Mfg. Co 13

For Classified Index of Advertisements See Page 6.

REMEMBER THE NAME AND BUY THE BEST.

PARAGON FAN MOTORS

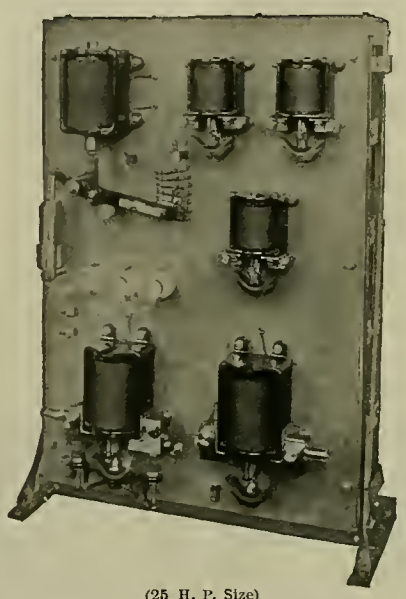
NEW STYLES NEW PRICES
EASY RUNNING RIGID CONSTRUCTION NOISELESS

CALL AND SEE THEM OR WRITE FOR PRICES

CHICAGO EDISON COMPANY,
139 ADAMS ST., CHICAGO.

C H

QUALITY



QUALITY

(25 H. P. Size)

SELF-STARTERS
FOR
Large Motors

THE CUTLER-HAMMER MFG. CO.
MILWAUKEE WIS.
New York 136 Liberty St.
Boston 176 Federal St.
Pittsburg 322 Frick Building
Chicago 1232 Monadnock Bldg.

All Supply Houses

J.J.EGAN'S "ACME" COMMUTATOR COMPOUND.

J. J. EGAN'S "ACME" COMMUTATOR COMPOUND absolutely prevents sparking or cutting. One stick of "Acme" is equal to one gallon of oil for lubricating commutators. Free Sample. AGENTS WANTED. 50c per stick. $5.00 per doz.
J. J. Egan Sole Mfg., 317 Austin Ave., Tel. Polk, 1779 Chicago

Motor Starter with Automatic Release. Manufactured under our own patents.

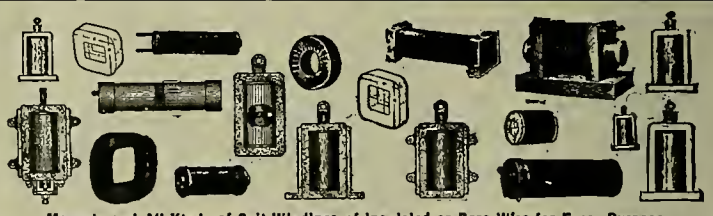
MOTOR STARTERS, SPEED REGULATORS, FIELD REGULATORS

And Special Controlling Devices of all kinds. Send for catalogue and discounts.

UNION ELECTRIC MFG. CO.,
Milwaukee, Wis.

Electric Heating Apparatus
SEND FOR 82-PAGE CATALOGUE.
"UNIT" ENAMELED RHEOSTATS
SIMPLEX ELECTRIC HEATING CO.,
Cambridgeport, Mass.

"AMERICAN" STORAGE CELLS
ARE THE BEST. Send for descriptive Circular.
AMERICAN BATTERY CO.,
EST'D 1882. 171 S. Clinton St., Chicago.



Magnets and All Kinds of Coil Windings of Insulated or Bare Wire for Every Purpose.
VARLEY DUPLEX MAGNET COMPANY, PROVIDENCE, RHODE ISLAND.

BUY Your Electrical Books of the **Electrician Publishing Co., Suite 510 Marquette Bldg., Chicago.** You will save **TIME** and **MONEY** by doing so. . . . . .

ALLEN-BRADLEY ELECTRIC CRANE CONTROLLERS

PATENTED

Guaranteed for One Year. Three months' Free Trial.
No Sparking. No Repairs. Perfect Control.

AMERICAN ELECTRIC FUSE COMPANY
CHICAGO - - ILLINOIS

WE BEG TO ANNOUNCE

That we are General Western Agents for the **Helios Manufacturing Co.**, makers of the well known **Helios-Upton Enclosed Arc Lamps.** Great improvements have been made in these lamps and no expense will be spared to make them the most efficient on the market.

WRITE FOR CATALOGUE AND PRICES

OKONITE IT NEVER DISAPPOINTS

Central Electric Company,

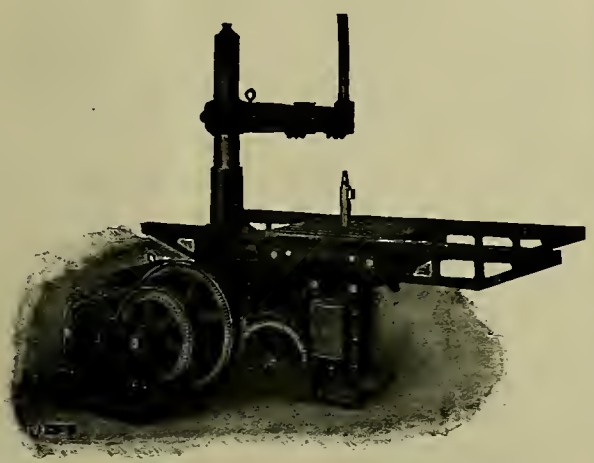
GENERAL WESTERN AGENTS

264-266-268-270 FIFTH AVENUE, CHICAGO

OKONITE IT NEVER DISAPPOINTS

Bullock Electric Mfg. Co.

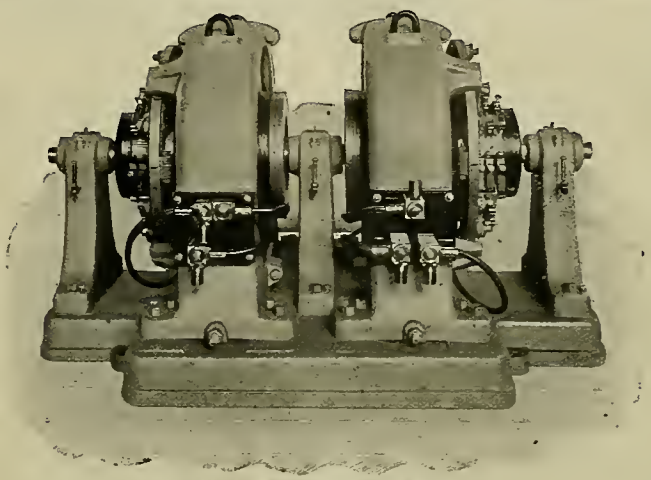
CINCINNATI, OHIO, U. S. A.



Keyseater Driven by Bullock Type "N" Motor.

The Bullock Multiple Voltage System

provides the only successful means of controlling the speed of motors driving machinery which requires variable speeds.



WESTERN ELECTRIC COMPENSATOR

DIRECT CURRENT

Generators and Motors

Bulletins on Request

Western Electric Company

Chicago — New York
Saint Louis — Denver
Philadelphia — Kansas City
Pittsburg

San Francisco (California Electrical Works) — Cincinnati (Standard Electric Company) — Saint Paul (American Electric Company)

Space 17, Electricity Bldg., Louisiana Purchase Exposition.

ELECTRICITY FOR ENGINEERS.

424 PAGES. ILLUSTRATED. PRICE $2.50.

ELECTRICIAN PUBLISHING CO.,
510 Marquette Building, CHICAGO

STANLEY RECORDING WATTMETERS

FOR ALTERNATING CURRENT CIRCUITS

BALANCED THRUST

NO JEWEL WEAR FROM HAMMER OR SIDE THRUST. GLASS OR METAL COVERS—SECOND ALONE TO THE

STANLEY MAGNETIC SUSPENSION WATTMETERS

Send for Bulletins and Information About Meters to

STANLEY INSTRUMENT CO., Great Barrington, Mass., U. S. A.

EUROPEAN OFFICE, 23 BOULEVARD DES ITALIENS, PARIS, FRANCE.

SALES AGENTS:
Missouri, Kansas, Arkansas, FRANK ADAMS ELECTRIC COMPANY, St. Louis.
Colorado, Idaho, Montana, Wyoming, New Mexico, Utah, HENDRIE-BOLTHOFF MFG. AND SUPPLY CO., San Francisco.
California, Oregon, Washington, Nevada, Arizona, BROOKS-FOLLIS ELECTRIC CORP. San Francisco.
Mexico, VICTOR M. BRASCHI & COMPANY, Mexico City.

Gould Storage Battery Co.

Complete Storage Battery Plants

Railway Line and Regulating Isolated and Train Lighting Central Lighting and Power Electric Vehicle and Telephone

GOULD COUNTER E. M. F. BOOSTER SYSTEMS

Sales Offices { NEW YORK, 1 W. 34th Street. BOSTON, 89 State Street. CHICAGO, The "Rookery." SAN FRANCISCO, Century Electric Co.

WORKS: DEPEW, N. Y.

Bulletins.

CLASSIFIED INDEX OF ADVERTISEMENTS.

Adjusters, Cord.
Crescent Co.
Incandes. El. Lt. Manip. Co.
Seaman, J. H.

Adjusters, Inc. Lamps.
Inc. El. Lt. Manipulator Co.

Anchors (Tel. & Tel.)
Matthews & Bro., W. N.
Crouse-Hinds Co.

Annunciators.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Moon Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Batteries and Jars.
Bissell Co., The F.
Central Electric Co.
Columbus Storage Battery Co.
Edison Mfg. Co.
Edwards & Company.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Bells, Buzzers, Etc.
Central Electric Co.
Edwards & Co.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Belt Dressing.
Dixon Crucible Co., Jos.
Leather Preserver Mfg. Corp.

Belting.
Leather Preserver Mfg. Corp

Blowers.
Sturtevant Co., B. F.

Boiler Compounds.
Dearborn Drug & Chem Wks.

Boilers.
Allis-Chalmers Company.
Babcock & Wilcox Co.

Books, Electrical.
Electrician Publishing Co.

Booths, Telephone.
Seaman & Co., W. S.
Yesbera Mfg. Co.

Brackets.
Faries Mfg. Co.

Brushes.
Central Electric Co.
Hobart Elec. Mfg. Co.
Holmes Fibre-Graphite Co.
Speer Carbon Co.
Western Electric Company.

Cable Hangers.
National Tel. Supply Co.
Western Electric Co.

Cables (See Wires and Cables)

Canopies.
Faries Mfg. Co.

Carbons, Points and Plates.
Central Electric Co.
Chicago Edison Co.
Consumers Carbon Co.
Electric Appliance Co.
National Carbon Co.
Reisinger, Hugo.
Speer Carbon Co.
Wesco Supply Co.
Western Elec. Supply Co.

Castings.
Faries Mfg. Co.
New England Butt Co.
National Electric Co.

Chains.
Jeffrey Mfg. Co.

Chandeliers.
Faries Mfg. Co.

Circuit Breakers.
Cutler-Hammer Mfg. Co.
Cutter Elec. & Mfg. Co.
Ft. Wayne Elec. Wks. Inc.
Union Electric Mfg. Co.
Western Electric Company.
Westinghouse El. & Mfg. Co.

Clusters.
Faries Mfg. Co.

Clutches, Electrical and Mechanical.
Akron Electrical Mfg. Co.

Coal and Ashes Handling Machinery.
Jeffrey Mfg. Co.

Coils and Magnets.
Varley Duplex Magnet Co.
Western Electric Co.

Commutator Compound
Allen Co., L. B.
Egan, J. J.
McLennan & Co., K.

Commutator Truing Device.
Akron Electrical Mfg. Co.

Conduit and Conduits.
American Circular Loom Co.
American Conduit Company.
Central Electric Co.
Electric Appliance Co.
Sprague Electric Co.
Standard Vitrified Cond. Co.
Wesco Supply Co.
Western Electrical SupplyCo.

Contractors and Electric Light Plants.
Allis-Chalmers Company.
Bullock El. Mfg. Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
National Electric Co.
Northern Electrical Mfg. Co.
Sprague Electric Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Controllers, Crane.
Amer. Elec. Fuse Co.

Cross-Arms, Pins and Brackets.
Berthold & Jennings.
Central Electric Co.
Lewis Lumber & Mfg. Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Company.
Western Elec. Supply Co.

Cut-Outs and Switches.
Bissell Co., The F.
Bossert Elec. Const. Co.
Central Electric Co.
Chicago Edison Co.
Crouse-Hinds Co.
Cutter Elec. & Mfg. Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
General Inc. Arc Light Co.
Hart Manufacturing Co.
Manhattan Elec. Supply Co.
Trumbull Elec. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Dynamos and Motors.
Akron Electrical Mfg. Co.
Allis-Chalmers Company.
Bissell Co., The F.
Bullock Elec. Mfg. Co.
Central Electric Co.
Century Electric Co.
Crawfordsville Electric Co.
Crocker-Wheeler Co.
Dustin Co., Chas. E.
Ft. Wayne Elec. Wks. Inc.
General Elec. Co.
General Inc. Arc Light Co.
Gregory Electric Co.
Hobart Elec. Mfg. Co.
Mechanical Appliance Co.
National Electric Co.
Northern Electrical Mfg. Co.
Sprague Electric Co.
Stow Manufacturing Co.
Sturtevant Co., B. F.
Wagner Electric Mfg. Co.
Warren Elec. Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Economizers, Fuel.
Green Fuel Economizer Co.

Electric Heating Appl.
American Elec. Heater Co.
Simplex Elec. Heating Co.
Western Electric Co.

Electric Railways.
Crocker-Wheeler Co.
General Electric Co.
Sprague Electric Co.
Westinghouse El. & Mfg. Co.

Electrical and Mechanical Engineers.
Arnold Elec. Power Stat'n Co.
Baker & Co., W. E.
Bryan, Wm. H.
Butterfield, J. F.
Hyllesby & Co., H. M.
General Engineering Co., The.
Hallberg, J. H.
Hornaday, J. P. & Co.
Humphrey, Henry H.
Bunt & Co., Robt. W.
Jackson, D. C. & W. B.
Kohler Brothers.
Newgard & Co., Henry.
Northern Electrical Mfg. Co.
Ruebel, Schwedtman, Wells.
Sargent & Lundy.
Schott, W. H.
Squire Electric Co.
Stanton, LeRoy W.
Wilmerding, C. H.

Electrical Instruments. (Recording and Testing.)
Bissell Co., The F.
Central Electric Co.
Diamond Meter Co.
Duncan Elec. Mfg. Co.
Electric Appliance Co.
Electrical Recorder & Indicator Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
General Inc. Arc Light Co.
Illinois Elec. Specialty Co.
Jewell Electrical Inst. Co.
Machado & Roller.
Norton Elec'l Instrument Co.
Pignolet, L. M.
Stanley Instrument Co.
Wagner Electric Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.
Weston Electrical Inst. Co.

Electro-Plating Mach'y
Crocker-Wheeler Company.
General Electric Co.

Elevators-Conveyors.
Jeffrey Mfg. Co.

Engines, Gas and Gasoline.
Allis-Chalmers Company.
Marinette Gas Engine Co.
Olds Gasoline Engine Works.
Woolley Fdy. & Mach. Wks.

Engines, Steam.
Allis-Chalmers Company.
Amer. Diesel Engine Co
Dustin Co., Chas. E.
Sturtevant Co., B. F.
Tod Co., Wm.

Fans and Fan Motors.
Central Electric Co.
Crocker-Wheeler Company.
Edison Mfg. Co.
General Electric Co.
General Inc. Arc Light Co.
Sprague Electric Co.
Sturtevant Co., B. F.
Wesco Supply Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Fibre.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Files.
Barnett Co., G. & H.

Fittings.
Faries Mfg. Co.

Fixtures, Gas and Elec.
Beardslee Chandelier Mfg. Co.

Flashers.
Bissell Co., The F.
Haller Machine Co.
Reynolds El. Flasher Mfg. Co

Flexible Shafts.
Stow Mfg. Co.

Forges.
Sturtevant Co., B. F.

Fuses and Fuse Wire.
Amer. Elec. Fuse Co.
Bissell Co., The F.
Central Electric Co.
Central Tel. & El. Co
Chicago Die & Electric Co.
Chicago Fuse Wire & Mfg. Co.
D. & W. Fuse Company.
Electric Appliance Co.
Johns-Manville Co., H. W.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Company.
Western Elect. Supply Co.

Globes, Reflectors and Shades.
Fostoria Incan. Lamp Co.
Haller Machine Co.
Holophane Glass Co.
Pardridge Shade & Refl. Co.
Phœnix Glass Co.
Wesco Supply Co.
Western Electric Co.
Western Elect. Supply Co.

Graphite Specialties.
Dixon Crucible Co., Jos.
Holmes Fibre-Graphite Co.

Heating (Exhaust Steam).
Amer. District Steam Co.

Heating and Ventilating Apparatus.
Sturtevant Co., B. F.

Holders, Inc. Lamps.
Incandescent Electric Light Manipulator Co.

Inspection & Insurance
Hartford Steam Boiler Inspection & Insurance Co.

Insulating Machinery.
New England Butt Co.

Insulators and Insulating Materials.
Akron Electrical Mfg. Co.
American Electrical Works.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Inc. Arc Light Co.
Indiana Rub. & Ins. Wire Co.
Johns-Manville Co., H. W.
Kartavert Mfg. Co.
Manhattan Elec. Supply Co.
Mica Insulator Co.
Munsell & Co., Eugene.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Standard Vitrified Cond. Co.
Sterling Varnish Co.
Vulcanized Fibre Co.
Wesco Supply Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Junction Boxes.
Bossert Elect. Const. Co.
General Inc. Arc Light Co.

Lamps, Arc.
Bissell Co., The F.
Central Electric Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
General Inc. Arc Lt. Co.
Gregory Electric Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Lamps, Incandescent.
Bissell Co., The F.
Bryan-Marsh Company.
Buckeye Electric Company.
Central Electric Co.
Chicago Edison Co.
Columbia Incan. Lamp Co.
Edison Decorative & Miniature Lamp Dept.
Electric Appliance Co.
Fostoria Incand. Lamp Co.
General Electric Co.
General Inc. Arc Light Co.
Standard Elec'l Mfg. Co.
Sterling Electrical Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Lamps, Incandescent—Replacers & Cleaners.
Inc. El. Lt. Manipulator Co.

Letters, Metal.
Haller Machine Co.

Lightning Arresters.
Central Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
Manhattan Elec. Supply Co.
Minnesota Electric Co.
Western Electric Co.

Linemen's Climbers.
Klein & Sons, Mathias.

Magnet Wires.
(See Wires and Cables.)

Mechanical Draft.
Sturtevant Co., B. F.

Mica.
Chicago Mica Co.
Mica Insulator Co.
Munsell & Co., Eugene.

Mining Apparatus, Elec.
Allis-Chalmers Company.
Crocker-Wheeler Company.
General Electric Co.
Jeffrey Mfg. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Motors. (See Dynamos and Motors.)

Nippers and Pliers.
Klein & Sons, Mathias.

Novelties, Glass, Elec.
Ithaca Elect'l Novelty Co.

Nozzles.
Faries Mfg. Co.

Paints.
Dielectric Mfg. Co.

Patent Attorneys.
Bain, Foree.

Phosphor Bronze.
Phosphor Bronze Sm. Co. Ltd.

Platinum, Wire and Sheet.
Baker & Company Inc.

Poles and Ties.
Berthold & Jennings.
Brooks, Ball L.
Columbia Mfg. Co.
Coolidge Co., Marshall H.
Fowler, John H.
Fowler-Jacobs Company.
Kellogg Switch. & Sup. Co.
Lewis Lumber & Mfg. Co.
Lindsley Bros. Co.
Loud's Sons Co., H. M.
Maltby Lumber Co.
Morrison Lbr. Co., J. W.
Mueller Company, William.
Pacific Coast Pole Co.
Page & Hill Company.
Phelan, D. W.
Pittsburg & L. S. Iron Co.
Porter Cedar Company.
Sterling & Son, W. C.
Thompson, S. E.
Torrey Cedar Co.
Valentine-Clark Co., The.
Western Lumber & Pole Co.
Worcester Co., C. H.

Polish (Metal).
Allen Co., Inc., L. B.
Hoffman, Geo. W.

Portables.
Faries Mfg. Co.

Power Transmission Machinery.
Jeffrey Mfg. Co.

Rail Joints.
Continuous Rail Joint Company of America.

Refiners.
Gt. West Smelt. & Refining Co

Re-Winding—Repairs.
Chicago Edison Co.
Gregory Electric Co.
Miller Electric Co.

Rheostats.
Cutler-Hammer Mfg. Co.
General Electric Co.
Gen'l Inc. Arc Lt. Co.
Union Electric Mfg. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Rods, Conduit.
Cope, T. J.

Schools and Colleges.
Electrical Engineer Inst.
Highland Park College.
Michigan College of Mines
Pratt Institute.
State Univ. of Iowa.

Second-Hand Mach'y.
Bissell Co., The F.
Cent. Stat. Improvement Co.
Gregory Electric Co.
Matthews & Bro., W. N.
Northwestern Electric Co.
Walsh's Sons & Co.

Shades, Lamp.
Faries Mfg. Co.

Sheet Brass & Copper.
Plume & Atwood Mfg. Co.

Signs, Electric.
Haller Machine Co.

Sockets & Receptacles.
Pass & Seymour.
Yost Elec. Mfg. Co.

Soldering Sticks, Salts and Paste.
Allen Co., L. B.
Crescent Co.
Kester Elec. Mfg. Co.
Western Electric Co.

Speaking Tubes.
Central Electric Co.
Edwards & Co.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.
Wester Elec. Supply Co.

Specialties, Electrical Mfrs. and Designers.
Haller Machine Co.

Speed Indicators.
Weston Electrical Inst. Co.

Storage Batteries.
American Battery Co.
Electric Storage Battery Co.
Gould Storage Battery Co.

Supplies, General Elec.
Bissell Co., The F.
Central Electric Co.
Century Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Electric Co.
Manhattan Elect'l Supply Co.
Wesco Supply Co.
Western Electric Co.
Western Elect. Supply Co.

Switchboards.
Bissell Co., The F.
Crouse-Hinds Co.
Gen. Incan. Arc Light Co.

Telephones, Telephone Material and Switchboards.
American El. Telephone Co
Automatic Electric Co.
Bissell Co., The F.
Central Electric Co.
Central Tel. & El. Co.
International Tel. Mfg. Co.
Kellogg Switchb. & Sup. Co.
Manhattan Elec. Supply Co.
Moon Mfg. Co., The.
Murdock & Co., Wm. J.
National Elec. Signalling Co.
Stromberg-Carlson Tel. M. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Time Switches.
Bissell Co., The F.
Bartford Time Switch Co.

Tools.
Klein & Sons, Mathias.
Western Electric Co.

Transformers.
Central Electric Co.
Crawfordsville Electric Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Works, Inc.
General Electric Co.
Gregory Electric Co.
Kuhlman Electric Co.
Manhattan Elec. Supply Co.
National Electric Co.
Wagner Electric Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Trucks, Electric Car.
General Electric Co.
Westinghouse El. & Mfg. Co.

Turbines, Steam.
Allis-Chalmers Co.
General Electric Co.
Westinghouse El. & Mfg. Co

Turbine Water Wheels
Leffel & Co., Jas.

Varnishes.
Dielectric Mfg. Co.
Sterling Varnish Co.

Vulcanized Fibre.
Vulcanized Fibre Co.

Wireless Tel. App'tus.
Clark Wirel. Tel. & Tel. Co. T. E
National Elec. Signalling Co

Wires & Cables—Magnet Wires.
American Electrical Works.
Bissell Co., The F.
Central Electric Co.
Chicago Insulated Wire Co.
Crescent Ins. Wire & Cble. Co.
Driver-Harris Wire Co.
Electric Appliance Co.
General Electric Co.
Hazard Manufacturing Co.
Indiana Rub. & Ins. Wire Co
India Rubber & Gutta Percha Insulating Co.
Kellogg Switch. & Sup. Co.
Manhattan Elec. Supply Co.
National India Rubber Co
New York Insulated Wire Co.
Okonite Co., The.
Phillips, Eugene F.
Phillips Insulated Wire Co
Roebling's Sons Co., J. A.
Safety Ins. Wire & Cable Co.
Simplex Electrical Co.
Standard Underground C. Co
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

For Alphabetical Index of Advertisements See Page 3.

IMPORTANT NOTICE

AMERICAN CIRCULAR LOOM CO.
TRADE MARK
REGISTERED
MANUFACTURERS OF
FLEXIBLE INTERIOR CONDUIT
CANVAS JACKETS FOR INSULATED WIRE & CABLES
AND
TRADE
ELECTRODUCT
MARK

Chelsea, Mass., July 2nd, 1904.

Gentlemen:

Our attention has been called to certain reports that have been recently circulated, evidently with malicious intent with reference to an alleged action of the Underwriters in condemning "Circular Loom." We cannot believe that any of our trade will be misled by these libelous statements. But, may we not ask that you kindly refer to the list of approved appliances published by the Underwriters, April, 1904, in which you will find our material has the full sanction of the Bureau? All appliances included in this little pamphlet are recommended for use by the Underwriters and it will be apparent to you that our name would not be upon its pages unless "Circular Loom" met the requirements.

We have recently taken this matter up with the Bureau and have been assured that our material has not been condemned and that when installed in conformity with the rules laid down by the national code, it is accepted by the various bureaus throughout the United States, and ***in verification of this statement you are at liberty to communicate with the Electrical Bureau of the National Board of Fire Underwriters, 67 East 21st St., Chicago.***

Yours very truly,

AMERICAN CIRCULAR LOOM CO.

VEGETABLE FEED-WATER TREATMENT,

Proportioned to suit the Mineral Analysis of the water, will keep your boilers clean, free from corrosion, and effect great saving in repairs and operating expense.

DEARBORN DRUG & CHEMICAL WORKS,

120 LIBERTY STREET NEW YORK. 15 BRANCH OFFICES IN U. S. 27-34 RIALTO BUILDING, CHICAGO.

Dixon's Graphite Pipe Joint Compound

Makes the tightest joints that remain free from rust and come apart easily at any time.

Write for Booklet 125D and a sample.

JOSEPH DIXON CRUCIBLE CO., JERSEY CITY, N. J.

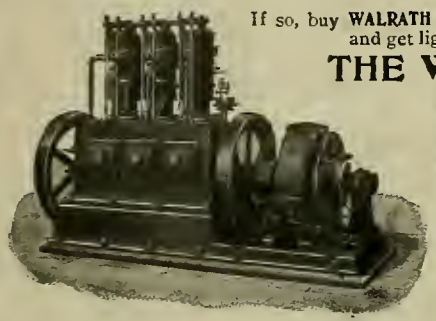
JEFFREY Elevating, Conveying, Power Transmission, Screening, Crushing Dredging, Rock and Coal Drilling, Coal Cutting, Hauling and Washing Machinery.

OUR CATALOGUES ARE YOURS FOR THE ASKING.

The JEFFREY MANUFACTURING CO., Columbus, O., U. S. A.

ARE YOU LOOKING FOR MONEY?

If so, buy WALRATH GAS OR GASOLINE ENGINES and get light on the subject.



THE WALRATH

Received the Highest Award at the Pan-American Exposition.

It will produce as good a commercial light as that of an automatic steam engine, either belted or direct-connected generator. Simple, Economical and Reliable.

Send for Catalogue W.

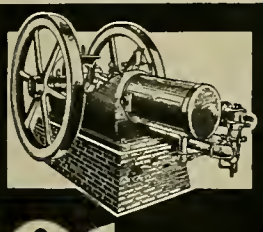
MARINETTE GAS ENGINE CO.,

CHICAGO HEIGHTS, ILL.

AGENCIES:

301 Fisher Building, Chicago. 619 Stevenson Building, Indianapolis.
703 Bijon Building, Pittsburg.
MacKay Engineering Co., 149 Broadway, New York.
MacKay Engineering Co., 100 Boylston St., Boston.
Strong, Carlisle & Hammond Co., Cleveland.

The Electrician Publishing Co., 510 Marquette Bldg., Chicago. Headquarters for all latest Electrical Books. Write for Catalogue.



Olds Gas and Gasoline Engines

Are built on lines of strict originality, and are protected by the Olds patents. The essential parts of our engines combine the highest efficiency with the greatest simplicity of construction and operation. No engine made approaches the Olds for economy and durability.

Stationary Engines - - 2 to 100 H. P.
Portable Engines - - 8 to 18 H. P.

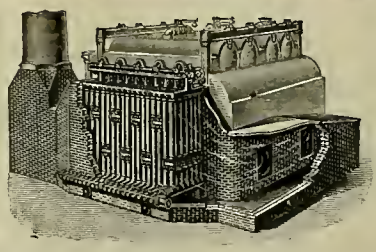
Write to-day for full information and new illustrated catalog.

Olds Gasoline Engine Works
252 River Street, - Lansing, Mich.

3 982

Steam Gained——Fuel Reduced

GREEN'S ECONOMIZER



Installed in any Electric Light and Power Plant produces this result. Its not a long story—simply utilizing waste gases—keeping feed-water heated above the evaporative point—saving 10 to 20% on coal bill. Additional advantages in our free booklet, which your engineer could explain to your satisfaction. Simply address

The Green Fuel Economizer Co.

MATTEAWAN, N. Y. Sole Manufacturers in the U. S.

THE WILLIAM TOD CO.

BUILDERS OF

CORLISS AND HIGH SPEED AUTOMATIC ENGINES FOR ELECTRICAL PURPOSES.

Main Office and Works: YOUNGSTOWN, OHIO.

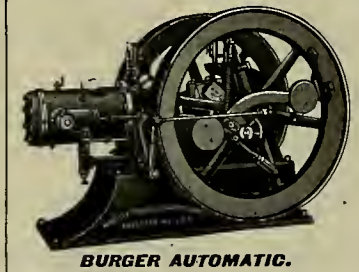
BRANCH OFFICE: PARK BUILDING, PITTSBURG, PA.

AGENCIES { New York, George F. Woolston, 29 Broadway.
Birmingham, Ala., W. H. Hume & Co., Woodward, Bldg.

REG. TRADE MARKS

THE PHOSPHOR BRONZE SMELTING CO. LIMITED.
2200 WASHINGTON AVE., PHILADELPHIA.
"ELEPHANT BRAND PHOSPHOR-BRONZE"
INGOTS, CASTINGS, WIRE, RODS, SHEETS, ETC.
— DELTA METAL —
CASTINGS, STAMPINGS AND FORGINGS
ORIGINAL AND SOLE MAKERS IN THE U.S.

BEST ON EARTH.



BURGER AUTOMATIC.

For Electric Work

REGULATION AND ECONOMY OF FUEL UNSURPASSED.

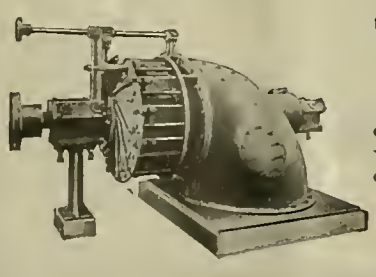
WRITE FOR CATALOGUE H

Then compare it with some Gas Engine hand books that cost $1.00.

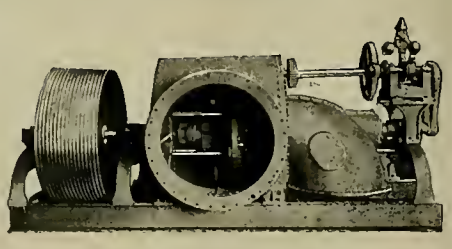
Woolley Foundry & Mach. Works

Box 400, Anderson, Ind. U. S. A.

SAMSON TURBINE



The higher the SPEED of a GENERATOR the LOWER its COST. We can SAVE YOU MONEY if you will use the SAMSON to drive the generator because there is not another turbine built that will attain as quick a SPEED when operating under the same conditions.



WRITE DEPT. D FOR CATALOG

JAMES LEFFEL & CO.

SPRINGFIELD, OHIO U. S. A.

"ELECTRA" HIGHEST GRADE NUERNBERG

CARBONS

BEST LIGHT — LONGEST LIFE

STEADIEST LIGHT — LEAST DUST

•TRADE MARK•

REMAIN THE STANDARD OF THE WORLD FOR ALL ARC LIGHTING SYSTEMS, BECAUSE they cannot be equaled in QUALITY or EFFICIENCY, producing the highest standard of candlepower in proportion to the current consumed.

HUGO REISINGER, Sole Importer, - - 11 Broadway, NEW YORK.

"Diamond H" Switches

Trade H Mark

This Trade-Mark guarantees quality.

The Hart Mfg. Co., Hartford, Conn.

New York - Boston Chicago Toronto, Ont.

THEY ARE ABSOLUTELY

DEAD BEAT

Electrical Recorder & Indicator Company's

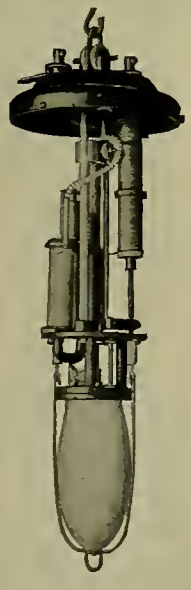
VOLTMETERS AND AMMETERS

WATCH FOR THEIR PICTURES—THEY ARE GOOD LOOKING

Electrical Recorder & Indicator Co.,

PONTIAC BLDG. - - CHICAGO, ILL.

General Electric Company



Edgewise Wound Enclosed Arc Lamps

FOR 110 VOLT DIRECT CURRENT SERVICE

Embody the latest features of Arc Lamp manufacture.

INDESTRUCTIBLE.
PERFECT REGULATION.
PERMANENT ADJUSTMENT.
COMPOSED OF FEW PARTS.
SIMPLICITY AND RIGIDITY OF CONNECTIONS.

Write for further information.

GENERAL OFFICES: SCHENECTADY, N. Y.

Chicago Office: Monadnock Block. Sales Offices In All Large Cities.

Keep Up With the Procession.

Everyone engaged in the electrical business should keep posted on the developments in the art by reading the latest books on the subject. We are headquarters in the West for electrical books and can fill orders for any work published, promptly on receipt of price. We call your special attention to the following standard books:

ALLSOP, F. C.—Electrical Bell Construction; Treatise on the Construction of Electric Bells, Indicators and similar apparatus. 177 illustrations.....$1.25

ATKINSON, PHILIP.—The Elements of Electric Lighting. Seventh edition, fully revised, and new matter added. 104 illustrations. 260 pages.....$1.50

ATKINSON, PHILIP.—The elements of Dynamic Electricity and Magnetism. 406 pages and 117 illustrations. Second edition.....$2.00

AYRTON, W. E.—Practical Electricity; a Laboratory and Lecture Course for First-year Students of Electrical Engineering, Based on the Practical Definitions of the Electrical Units. With numerous illustrations. Sixth edition.....$2.50

BADT, LIEUT F. B.—New Dynamo Tenders' Hand Book. This is, as the name indicates, a NEW BOOK, much more complete than the old one, with all the information, instructions and rules which are required by practical men, as Dynamo Tenders, Linemen, Stationary Engineers and owners and operators of all kinds of Electric Plants. It is the only book of the kind published in the English language. 226 pages, 140 illustrations, flexible cloth binding, size of type page 5½x3 inches.....$1.00

BADT, LIEUT. F. B.—Incandescent Wiring Hand Book. A timely book containing full illustrations for incandescent wiring and complete information concerning methods of running wires, location of safety devices, splices, insulation, testing for faults, wire gauges, general electrical data, calculating sizes of wires, wiring fixtures, elevators, buildings, isolated and central station plants. The only book of the kind published. Type page 5½x3 inches, flexible cloth binding, 66 pages, 35 cuts and 5 tables, 3 of which are 12x18 inches.....$1.00

BADT, LIEUT. F. B.—Bell Hangers' Hand Book. Just the book for people engaged in selling, installing or handling electric batteries, electric bells, elevators, house or hotel annunciators, burglar or fire alarms, electric gas lighting apparatus, electric heat apparatus. 106 pages, 97 illustrations, flexible cloth binding. Type page 5½x3 inches.....$1.00

BADT, LIEUT. F. B.—Electric Transmission Hand Book. First edition, 3,000 copies. 97 pages, 22 illustrations, 27 original tables.....$1.00
Gives more Practical information on the subject than any work published to date. The book contains all necessary information for Power Producers, Capitalists, Agents, Engineers and Motor Inspectors. With this book anybody may make estimates on the cost of Transmission Plants.

REDELL, FRED'K AND ALBERT C. CREHORE.—Alternating Currents; An Analytical and Graphical Treatment for Students and Engineers. Second edition. 112 illustrations.....$2.50

BELL, LOUIS, PH. D.—The Art of Illumination. This is the only book in the language which deals directly with the scientific and artistic use of modern illuminants, electric and other. Cloth, 339 pages, 127 illustrations. Price.....$2.50

BONNEY, G. E.—Electro-Plater's Hand Book. A Manual for Amateurs and Young Students on Electro-Metallurgy. 60 illustrations, 208 pages. 12mo. cloth....$1.25

BOTTONE, S. R.—Electrical Instrument Making for Amateurs. A Practical Hand Book, with 48 illustrations. Fourth edition. Enlarged by a chapter on the Telephone.....$0.50

BOTTONE, S. R.—The Dynamo, How Made and How Used. A Book for Amateurs. Eighth edition, with additional matter and 39 illustrations.....$1.00

BOTTONE, S. R.—Electro-Motors. How Made and How Used. A Hand Book for Amateurs and Practical Men. Reduced to.....$0.50

BUCKLEY, W. J.—Electric Lighting Plants, Their Cost and Operation. 275 pages, many illustrations and diagrams. Paper.....$1.00

CROCKER, F. B. AND WHEELER, S. S.—The Practical Management of Dynamos and Motors. With a special chapter by H. A. Foster. Illustrated. Second edition, revised and enlarged.....$1.00

CUSHING, H. C., JR.—Standard Wiring for Electric Light and Power. A compilation of formulæ, rules and requirements from the most modern practice, and in accordance with the rules and requirements of the Boston Fire Underwriters' Union, the New England Insurance Exchange, and as recommended by the Underwriters' International Electric Association. 12mo, leather.....$1.00

DESMOND, CHAS.—Electricity for Engineers. Part I. Constant Current. A clear and comprehensive treatise on the principles, construction and operation of Dynamos, Motors, Lamps, Indicator and Measuring Instruments; also a full explanation of the electrical terms used in the work. Part II. Alternate Current Apparatus. Containing an explanation of the principles governing the generation of, and a description of the instruments and machinery used in connection with, Alternate Electric Currents. Illustrated. Revised edition.....$2.50

DOBBS, A. E.—The Inspector and Trouble Man. A practical book, written in plain language. Full of information and diagrams for the operator, exchange manager, inspector, trouble man and lineman. A complete description of telephones, how to find and remedy their troubles, together with working plans for exchange construction, complete with diagrams of all up-to-date telephones and switchboards. 106 pages. Price...$1.00

DYER, A.—Induction Coils, How Made and How Used. Third edition. Boards.....$0.50

FLEMING, J. A.—Short Lectures to Electrical Artisans. A course of Experimental Lectures delivered to a Practical Audience. Fourth edition. 74 illustrations..$1.50

FLEMING, J. A.—The Alternate Current Transformer in Theory and Practice. Vol. I. The Induction of Electric Currents. 500 pages, fully illustrated and with copious index. Second edition.....$3.00
Synopsis of contents: Chapter 1. Introductory. 2. Electro-Magnetic Induction. 3. The Theory of Simple Periodic Currents. 4. Mutual and Self Induction. 5. Dynamical Theory of Current Induction.
Vol. II. The Utilization of Induced Currents. 8vo, cloth. London, 1892.....$5.00

GAYETTY, J. W.—Motorman's Guide. A Practical Treatise on Street Railway Motors. Illustrations and diagrams. Cloth.....$0.50

GORDON.—School Electricity. Sources, Currents, Measurement, Telegraphy, Telephony, Lightning, Electrolysis, Induction, etc. 262 pages, with 140 illustrations..$2.00

GORE, G.—The Art of Electro-Metallurgy, including all Known Processes of Electro Deposition. Fourth edition.....$2.00

GRIER, THOS. G.—Wiring for Motor Circuits. A handy little pamphlet containing tables for wiring and for motor service, arranged in convenient form for ready reference.....$1.00

HASKINS, C. C.—Electricity Made Simple. 233 pages, 108 illustrations. Paper covers.....$0.50
A valuable, non-technical work for those whose opportunities for gaining information on the branches treated have been limited.

HASKINS, C. H.—The Galvanometer and Its Uses. A Manual for Electricians and Students. Fourth edition; revised.....$1.50

HASKINS.—Transformers. Their Theory, Construction and Application Simplified. 38 illustrations.....$1.25

HAWKINS, C. C. AND F. WALLIS.—The Dynamo, Its Theory, Design and Manufacture. 190 illustrations.$3.00

HAWKINS, N.—New Catechism of Electricity. A Practical Treatise Relating to the Dynamo and Motor, Wiring, the Electric Railway, Bell Fitting, etc., etc. Red leather, pocketbook form. 95 illustrations....$2.00

HOMANS, J. E., A. M.—A, B, C OF THE TELEPHONE. 352 pages, 269 illustrations. Price.....$1.00
Owing to the demand for a comprehensive book giving a clear, terse idea of the principles governing the construction, installation, care and management of telephones and their appliances, this book has been compiled. It has been the aim of the author to make this the most complete elementary book on this subject for the practical electrician, wireman, lineman and engineer, and it is written in a clear and careful style.

HOPKINS, GEO. M.—Experimental Science. Elementary, Practical and Experimental Physics. 650 illustrations.....$4.00

HOPKINSON.—Original Papers on Dynamo Machinery and Allied Subjects. Illustrated.....$1.00

HOPKINSON, DR. JOHN.—Dynamic Electricity; Its Modern Use and Measurements, Chiefly in Its Application to Electric Lighting and Telegraphy.....$0.50

HORSTMANN, H. C. AND VICTOR H. TOUSLEY.—Modern Wiring Diagrams and Descriptions. A Hand Book of Practical Diagrams and Information for Electrical Workers. 160 pages, over 200 illustrations. Full leather binding, pocket size 4x6.....$1.50

HOSPITALIER, E.—Domestic Electricity for Amateurs; Translated from the French, with additions by G. J. Wharton. With illustrations.....$2.50

HOUSTON, EDWIN J.—A Dictionary of Electrical Words, Terms and Phrases. Fourth edition, greatly enlarged, with over 6,000 additional words and definitions. 2 volumes, 1,000 pages.....$6.00

KAPP, GISBERT.—Electric Transmission of Energy and its Transformation, Subdivision and Distribution. A practical hand book. Fourth edition.....$3.00

KAPP, GISBERT.—Alternate Current Machinery. Illustrated.....$0.50
(Vol. 96. Van Nostrand's Science Series.)

KAPP, GISBERT.—Dynamos, Alternators and Transformers. 138 illustrations.....$4.00

KEMPE, H. R.—A Hand Book of Electrical Testing. Fifth edition. 200 illustrations. 8vo, cloth. London 1892.....$7.25
In this edition there is a considerable amount of new matter; the old matter has been thoroughly revised.

KEMPE, H. R.—The Electrical Engineer's Pocket Book. Modern Rules, Formulæ, Tables, and Data. 32mo, leather.....$1.75

LOCKWOOD, T. D.—Electricity, Magnetism and Electric Telegraphy. A Practical Guide and Hand Book of General Information for Electrical Students, Operators and Inspectors. 376 pages, 152 illustrations.....$2.50

LOCKWOOD, T. D.—Electrical Measurement and the Galvanometer; Its Construction and Use. Second edition.....$1.50

LYNDON, L.—Storage Battery Engineering. A Practical Treatise for Engineers. This is a practical work, intended for the electrical engineer who is called on to design and install storage battery equipments, or who has a battery power plant under his care. Cloth. 360 pages, 178 illustrations and diagrams, 4 large folding plates. Price.....$3.00

MEADOWCROFT, W. H.—The A, B, C of Electricity. 36 illustrations. 12mo, cloth. New York.....$0.50

MAYER AND DAVIS, M. M.—The Quadruplex. With Chapters on the Dynamo-Electric Machine in Relation to the Quadruplex. The Practical Working of the Duplex Telegraph Repeaters and the Wheatstone Automatic Telegraph. 63 illustrations.....$1.50

MEYER, HENRY, C., JR., M. E.—Steam Power Plants. Their Design and Construction. Cloth. 165 pages, 63 illustrations, 15 folding plates. Price.....$2.00

MILLER, KEMPSTER B.—American Telephone Practice. 518 large octavo pages, 379 illustrations.....$3.00
This book treats of the subject in a simple and comprehensive manner from the practical standpoint, and almost entirely without the use of mathematics.

NOLL, AUGUSTUS.—How to Wire Buildings. A manual of the art of interior wiring. Illustrated.....$1.50

POPE, FRANKLIN LEONARD.—Modern Practice of the Electric Telegraph. A technical hand book for Electricians, Managers and Operators. 185 illustrations. Fourteenth edition, rewritten and enlarged.....$1.50

PRINDLE, H. B.—A Popular Treatise on the Electric Railway of To-day. Fully illustrated.....$0.25

REED, LYMAN C.—American Meter Practice. This is the only American book dealing with the theory and practice of current metering. Cloth. About 250 pages. Illustrated. Price.....$2.00

RUSSELL, STUART A.—Electric Light Cables and Distribution of Electricity. 107 illustrations.....$2.25

SALOMONS, SIR DAVID.—Electric Light Installations. Vol. I. The Management of Accumulators. A Practical Hand Book. Seventh edition, revised and enlarged. With illustrations. 12mo, cl. London, 1893.....$1.50

SLOANE, T. O'CONNOR.—Electricity Simplified. The Practice and Theory of Electricity, including a Popular Review of the Theory of Electricity, with Analogies and Examples of Its Practical Application in every day life. Illustrated.....$1.00

SLOANE, T. O'CONNOR.—The Standard Electrical Dictionary. A popular dictionary of words and terms used in the practice of electrical engineering. 350 illustrations.....$3.00

SLOANE, T. O'CONNOR.—Electric Toy Making for Amateurs, including Batteries, Magnets, Motors, Miscellaneous Toys.....$1.00

SLOANE, T. O'CONNOR.—The Arithmetic of Electricity. A Manual of Electrical Calculations by Arithmetical Methods, including numerous rules, examples and tables in the field of practical electrical engineering and experimenting. Third edition, revised.....$1.00

STEVENS, H. G.—Mechanical Catechism. For Stationary and Marine Engineers, Firemen, Electricians, Motormen, Ice Machine Men and Mechanics in General. 336 pages, over 240 illustrations. Cloth.....$1.00

THOMPSON, SYLVANUS P.—Dynamo-Electric Machinery. A series of lectures, with an introduction by Franklin L. Pope. 16mo. Numerous illustrations, fancy boards (Van Nostrand's Science Series, No. 66).....$0.50

THOMPSON, SYLVANUS P.—Polyphase Electric Currents and Alternate-Current Motors. Mailed to any address in the world on receipt of.....$3.50

THOMPSON, SYLVANUS P.—Recent Progress in Dynamo-Electric Machines, being a Supplement to Dynamo-Electric Machinery. 16mo. (Van Nostrand's Science Series, No. 75).....$0.50

THOMPSON, SYLVANUS P.—Dynamo-Electric Machinery. Eighth edition, revised and rewritten. Numerous illustrations and 19 plates. Nearly 1,000 pages.....$6.00

THURSTON, PROF. R. H.—Stationary Steam Engines, Especially Adapted to Electric Lighting Purposes. Treating of the development of Steam Engines, the Principles of Construction and Economy, with description of Moderate and High Speed Engines. With many folding plates.....$2.50

TREVERT.—How to Make Electric Batteries at Home. Illustrated.....$0.25

URQUHART.—Electro-Plating. A Practical Hand Book on the Deposition of Copper, Silver, Nickel, Gold, Aluminum, Brass, Platinum, etc. Second edition; carefully revised, with additions.....$2.00

WALKER, F.—Practical Dynamo Building, for Amateurs. How to wind for any output. With numerous illustrations. 16mo, boards. (Van Nostrand's Science Series, No. 98).....$0.50

WEBB, H. L.—A Practical Guide to the Testing of Insulated Wires and Cables. Illustrated.....$1.00

WEBB, HERBERT LAWS.—Telephone Hand Book. Illustrated. 12mo, cloth. Chicago. 1895.....$1.00
The only complete work on the Telephone. All possible information for any one interested in Telephones and how to make and operate them.

WEBER.—The Handy Vest Pocket Electrical Dictionary.
Cloth.....$0.25
Leather.....$0.50

ELECTRICIAN PUBLISHING CO.,

.....510 Marquette Building, Chicago.....

FARIES

ADJUSTABLE LAMP HOLDERS, SHADES, PORTABLES, ELECTRIC and COMBINATION FIXTURES

CATALOGUE WILL BE SENT ON REQUEST

FARIES MFG. CO., - DECATUR, ILL.

Whitney Instruments

are made in many styles and types. We have a complete line of switchboard and portable

VOLTMETERS, AMMETERS, OHMMETERS, WATTMETERS,

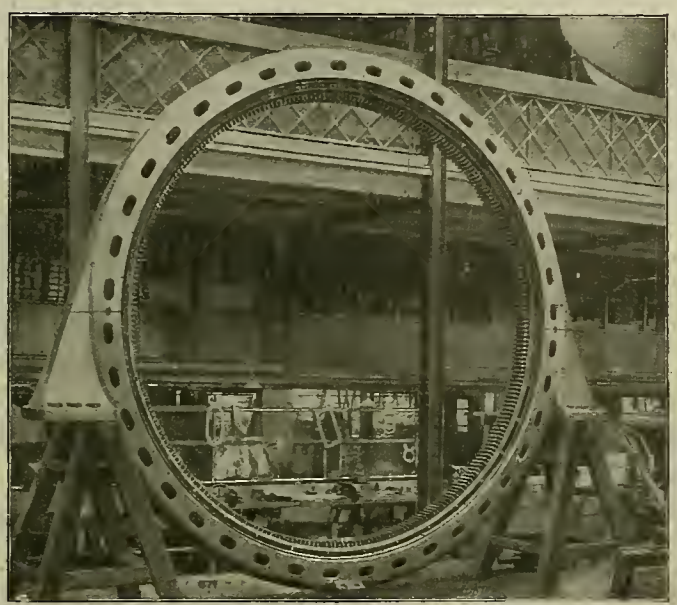
for direct and for alternating current. All of our apparatus is thoroughly guaranteed.

Write for Catalogue and discounts to

Machado & Roller
203 Broadway,
NEW YORK CITY, N. Y.
Or to your nearest SUPPLY HOUSE.

National Electric Company

builders of high-grade Electrical Machinery for LIGHTING, POWER and RAILWAY SERVICE



500 K. W. Engine Type Alternator Frame.

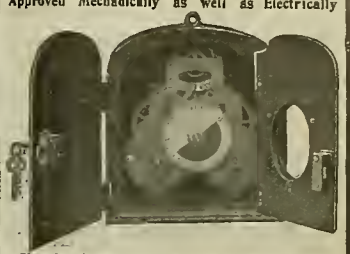
General Sales Offices and Works: MILWAUKEE

NEW YORK: 135 Broadway
CHICAGO: Old Colony Building
PHILADELPHIA: 1509 Land Title Bldg.
PITTSBURG: Gellatly & Co.
CHARLESTON, W. VA.: Agnew Electric Co.
SEATTLE & SAN FRANCISCO: Kilbourne & Clark Co.

THE
Hartford Time Switch

A mechanically operated switch, which turns lights ON and OFF at such hours as the user desires with no further attention than the weekly winding.

Approved Mechanically as well as Electrically



Showing double doors, Seth Thomas eight-day movement, auxiliary cut-out, auxiliary hand-trip, and switch indicator.

For controlling current used for show window lights, electric sign lights, street lights, apartment house hall lights, motors, batteries, burglar alarms. :: 10, 20, 35 and 50 Amperes. 250 Volts. 1, 2 and 3 Poles.

Consult us regarding any requirements

SEND FOR CATALOGUE

The Hartford Time Switch Co.
440 Asylum St., HARTFORD, CONN., U.S.A.
New York City:
A. Hall Berry, 97-99-101 Warren Street
London, England:
Veritys, Ltd., 31, King Street, Covent Garden, S. W.

The WAY of the WORLD to the WORLD'S FAIR. BIG FOUR ROUTE to ST. LOUIS. 1904.

Write for Folders & Booklets

M. E. INGALLS, PRESIDENT, CINCINNATI. WARREN J. LYNCH, G. P. & T. A.

MECHANICAL

Engineers interested in electricity should send for our complete Catalogue (mailed free to any address). Any electrical book published sent prepaid on receipt of price.

ELECTRICIAN PUBLISHING CO., - 510 Marquette Bldg., Chicago.

EDWARDS AND CO

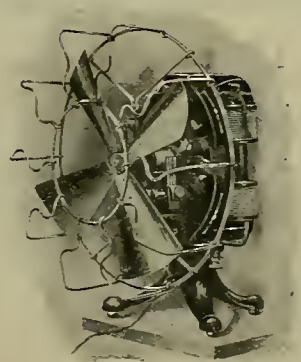
ELECTRO-MECHANICAL GONG.

Is entirely encased in Iron and is weatherproof. The mechanism is very powerful and gives 375 blows to each winding. Continuous ringing or single stroke.

WESTERN ELECTRIC CO.
Selling Agents.

NEW YORK N.Y.

EDISON BATTERY FAN MOTOR OUTFITS



In hot weather it is difficult to eat meals comfortably or to get refreshing sleep at night. These are possible with the use of an Edison Battery Fan Motor outfit, and the cost is small compared with the comfort obtained. Dealers should get our Booklet No. 7F and be in a position to tell their customers more about these Fan Outfits.

TRADE Thomas A. Edison MARK

EDISON MFG. CO., Factory, Orange, N. J.

New York, 83 Chambers St.
Chicago, 304 Wabash Ave.

THE CONTRACT ROAD

The lamp market is a jungle where you are liable to get lost or swamped—and sure to get bit—unless you know the way. These sign boards will set you on the trail:

1st Sign—PACKARD. Turn sharply to the right here.

2nd Sign—CONTRACT. Now the path lies straight before you. It is your individual right of way and will lead you to the best lamp and the best prices.

Lamps bought on contract are "tailor made." Literally fitted to the plant. The far-sighted buyer will avail himself of contract advantages.

ELECTRIC APPLIANCE COMPANY

ELECTRICAL SUPPLIES

CHICAGO and SAN FRANCISCO

Not a Luxury

Fans are a necessity.

We sell

Desk, Wall and Ceiling

styles for all voltages and currents.

Write for our 1904 bulletins.

THE WESCO SUPPLY CO.

"Everything Electrical" ST. LOUIS, U. S. A.

Electric motor drive secures economical operation because power is generated, transmitted and applied by highly efficient devices, and because Northern dynamos and motors are endowed with numerous exclusive features of convenience, excellence and merit, which adapt them particularly well to operating industrial plants.

Get Bulletin No. 2533.

NORTHERN ELECTRICAL MFG. CO., Madison, Wis., U. S. A.

Engineers Manufacturers. 248A.

MICA

Of all Qualities, in any Form at Lowest Prices

EUGENE MUNSELL AND CO.

NEW YORK and CHICAGO

INSULATION That Is.

Micanite, Linotape, M. I. C. Compound, Empire Cloth and Paper. For Years the Standard.

MICA INSULATOR CO., Originators

NEW YORK and CHICAGO

MICA

ONLY WESTERN MICA FACTORY

CHICAGO MICA CO.

VALPARAISO, IND.

P. S. WE PUT THE MICA POOL OUT OF BUSINESS.

VOLT - AMMETERS,

POCKET SIZE.

For Testing Batteries and Battery Circuits, Locating Faults, Grounds, etc.

RELIABLE. ACCURATE.

Send for Circular.

L. M. PIGNOLET,

78-80 Cortlandt St. NEW YORK, N. Y.

The Bossert Electric Construction Co.

—MANUFACTURERS OF—

STEEL OUTLET AND JUNCTION BOXES, SWITCHBOARDS, PANEL BOARDS, SWITCHES, ETC.

UTICA, NEW YORK.

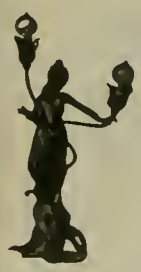
AKRON

Generators, Motors, Clutches, Commutator Truing Devices.

AKRON ELECTRICAL MFG. CO., AKRON, O.

N. Y. Office: McKay Engineering Co., 149 Broadway

EDISON MINIATURE LAMPS



are made in more than 10,000 varieties,

for all classes of work in Candelabra and Decorative Lighting, Multiple and Series Burning and in all types of Battery Lamps.

Miniature Sockets and Receptacles.

EDISON DECORATIVE & MINIATURE LAMP DEPT.,

General Electric Company, Harrison, N. J.

ELECTRIC SIGN

FLASHERS

BEST IN THE WORLD

Write for full particulars

Reynolds Elec. Flasher Mfg. Co.

221 Fifth Ave., Chicago.

SINGLE AND POLYPHASE TRANSFORMERS

KUHLMAN ELECTRIC CO., - - Elkhart, Ind.

SPARKING

Reduces the working capacity of a motor or dynamo, wears out the commutator, wastes power and may cause a fire. All this may be avoided if you use . . . . . .

The only article that will PREVENT SPARKING. Will keep the Commutator in good condition and PREVENT CUTTING.

Absolutely Will Not Gum The Brushes.

It will put that high gloss on the Commutator you have so long sought after.

50 Cents per Stick. $5.00 per Dozen.

SEND FOR FREE SAMPLE STICK.

For sale by all supply houses, or

K. McLENNAN & CO., Sole Mfrs., Room 411 Inter Ocean Bldg., 130 Dearborn St., CHICAGO

DO NOT DELAY placing your order for

Pillsbury A. C. Ceiling Fans

They will stir more air than any other alternating current Ceiling Fan on the market.

THE PRICE IS RIGHT.

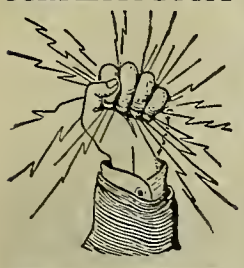
MANUFACTURED BY **CENTURY ELECTRIC CO.**

1007-9-11 LOCUST STREET, ST. LOUIS, MO.

FRANK N. PHILLIPS, PRESIDENT. C. H. WAGENSEIL, TREASURER. EUGENE F. PHILLIPS, GENERAL MANAGER. E. ROWLAND PHILLIPS, VICE-PRES. C. R. REMINGTON, JR., SEC

AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.



BARE AND INSULATED ELECTRIC WIRE,
ELECTRIC LIGHT LINE WIRE,
INCANDESCENT AND FLEXIBLE CORDS,
Railway Feeder and Trolley Wire,
AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR WIRES.
CABLES FOR AERIAL AND UNDERGROUND USE.

NEW YORK STORE, W. J. Watson, 26 Cortlandt St.
CHICAGO STORE, F. E. Donohoe, 82 Lake St.
MONTREAL BRANCH, Eugene F. Phillips' Electrical Works.
MAIN OFFICES AND FACTORIES, PHILLIPSDALE, R. I.

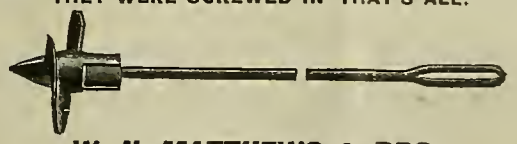
AT THE ST. LOUIS EXPOSITION

STOMBAUGH GUY ANCHORS

ARE **ANCHORING**

POLES ON THE INTRAMURAL RAILWAY, THE MAST OF THE DE FOREST WIRELESS TELEGRAPH CO. AND THE AERODROME BUILT FOR THE AIR SHIPS.

THEY WERE SCREWED IN—THAT'S ALL.



W. N. MATTHEWS & BRO.

603 CARLTON BUILDING *ST. LOUIS*

⅔ Actual Size. Patented.

CROWN CORD ADJUSTER

BEST AND SIMPLEST. MADE OF HARD RUBBER.

No Slip, No Abrasion, No Removing socket, Easily attached

Price $4.00 Per Hundred. Liberal Discount to the Trade.

Sample Free.

J. H. SEAMAN, 175 Dearborn St., Chicago

EXPERT IN ELECTRICITY MECHANICS PATENT CAUSES
SOLICITOR OF **PATENTS**
U. S. & FOREIGN
FOREE BAIN, 1662-3 Monadnock Blk., CHICAGO

Engineering TAUGHT BY CORRESPONDENCE

Our system of training by mail has helped thousands hold down in poor positions to rise to better salaries and situations. Your chance to rise is just as good as others. Write for our free illustrated book, "Can I Become An Electrical Engineer?" We teach by mail, Electrical Engineering, Mechanical Engineering, Steam Engineering, Mechanical Drawing, Electric Lighting, Electric Railways. ELECTRICAL ENGINEER INSTITUTE, Dept. K 240 West 23rd St., New York.

THE STATE UNIVERSITY OF IOWA
SCHOOL OF APPLIED SCIENCE, Iowa City, Iowa
Four year courses of the highest grade in

Civil
Municipal
Sanitary
Electrical
Mechanical
Mining

ENGINEERING

Numerous short practical courses. Special courses in technical chemistry, bacteriology, etc. Adequate equipment in shops and laboratories. Waterpower.

University environment. Expenses low.

Address C. E. MacLEAN, President

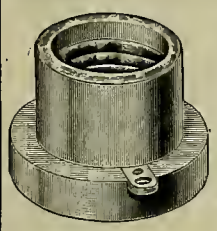
Engineering MECHANICAL, ELECTRICAL, STEAM, CIVIL.

Complete and short courses. Thoroughly equipped engineering shops. **Shop work from the beginning.** Short courses in Steam and Electrical Engineering. Expenses low. Accommodations the best. School all year. Students may enter any time. Correspondence steam and electrical courses. Send for catalogue. Mention course in which interested.

HIGHLAND PARK COLLEGE, DES MOINES, IOWA.

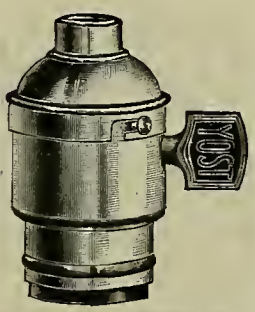
GET ALLEN'S SOLDERING STICKS
MAKE SOLDER FLOW
FOR ALL ELECTRIC WORK.
Be on time—Get the habit.
of telling the man
"ALLEN SOLDERING STICKS OR NOTHING."
A Big Sample Stick for 10c.
Booklet "Soldering Sense" describes.
L. B. ALLEN CO., Inc.,
SOLE MAKERS,
1334 Columbia Ave., CHICAGO.

M. KLEIN & SON.
Send 2c stamp for new catalogue No. 6 of
KLEIN'S TOOLS
For Electrical Workers and Line Builders.
MATHIAS KLEIN & SONS.
81 W. Van Buren St., Chicago, Ill.



YOST SPECIALTIES
ELECTRICAL

Do you know the best when you see it? Do you buy the best when you know it? If so, we will mail you samples on request or send you our catalogue (without charge). If you appreciate the best when you see it and want the best when you can get it, we do not hesitate to give you the practical means of obtaining it. Let us hear from you.



THE YOST ELECTRIC MFG. CO.
TOLEDO, OHIO

DON'T BUY
ELECTRICAL SUPPLIES

Until you have seen our new Catalogue and new Price List.
Free to the trade.

Manhattan Electrical Supply Co.

NEW YORK: 32 Cortlandt St.
CHICAGO: 188 Fifth Ave.

MICHIGAN COLLEGE OF MINES.

F. W. McNair, President,

A state institution located in and making use of an active mining district. New Metallurgical Building and Gymnasium completed in the fall of 1904. For Year Book and Record of Graduates apply to President or Secretary.
Houghton, Michigan.

Crimshaw.

Raven White Core.

Raven Black Core.

ALL OUR WIRES pass inspection and carry the above TRADE-MARKS on our tags. We also manufacture Crimshaw and Competition Tapes and Splicing Compounds.

NEW YORK INSULATED WIRE COMPANY,

MAIN OFFICE: 114 116 & 118 Liberty St., New York.
BRANCHES: CHICAGO: 192 Desplaines St
BOSTON: 7 Otis St.
SAN FRANCISCO: 33 Second St.

NATIONAL CODE STANDARD

WEATHER-PROOF TRADE MARK "O.K." LINE AND HOUSE WIRES

"O. K." Weatherproof Wire.
Slow-Burning Weatherproof and Ideal Wire.
Prices and Samples on Application.

Phillips Insulated Wire Co.
Office and Factory: PAWTUCKET, R. I.

BRASS & BRASS GOODS

ASK FOR CATALOG

THE PLUME & ATWOOD MFG. CO.
New York Boston San Francisco Chicago

WANTED, FOR SALE *and similar* **WANT COLUMN** *advertisements (50 words or less), $1.50 an insertion; additional words 3c each.* **POSITION WANTED** *advertisements (50 words or less), $1.00 an insertion; additional words 2c each.*

POSITION WANTED.

Electrician with fourteen (14) years' practical experience in electric light and power construction work, operating, and capable of making estimates, will be open for position after August first. Or would take interest and management of lighting plant in good town with chance to grow. Address all letters to I. C. ROWELL, Joliet, Ill., care E. T. Hyatt, Wallace Flats.

WANTED.

50 to 60 K. W. direct-connected unit. Must be standard make in first-class condition and a bargain for spot cash. Address, McGUIRE & COBB, Hotel Warner, 33d St. and Cottage Grove Ave., Chicago.

WANTED

A competent and experienced salesman to travel in Ohio and Indiana, and sell electric lighting, telephone and railway supplies. Give age, experience and references, etc. Address, box 369, care of WESTERN ELECTRICIAN, 510 Marquette Bldg., Chicago, Ill.

FOR SALE.

Electrical business (established) in city of 75,000. Reasons for selling, on account of health. Inquire at DAVID B. BUSHONVILLE, 300 W. Huron Street., Chicago, Ill.

FOR SALE.

A bargain; I. T. H. 30-light 9.6 Amp. Series open arc machine, with wall controller and ammeter complete, good running order.

Twenty-two 9.6 Amp. double carbon open arc lamps with glass, hoods and spreader complete, good order. Several additional lamps, both single and double, can be put in good order or parts used for repairs. A lot of extra globes and parts and a supply of carbons will be included if taken as a whole.

Two 30-K. W. Edison Bipolar 125-volt D. C. generators in fine running order. Reason for selling, have put in larger machinery.

CARROLL ELECTRIC LIGHT & POWER COMPANY.
Carroll, Iowa.

THERMOPILES 1½ VOLTS 1½ AMPERES

For Electrolytic analysis, charging storage batteries, and other constant current requirements. $3 Each.

WALSH'S SONS & CO.,
264 Washington Street. Newark, N. J.

Dividend Paying Electric Light Plant For Sale.

Electric light plant in Wisconsin city of 3,000 inhabitants, exclusive 17-year franchise and city contract. Plant in operation for seven years paying annually cash dividend. Physical condition of plant is first class.

Company's increasing business demands more attention than can be given to it by present owners, who are local business men. A splendid opportunity for a practical electrician or manager who can control or invest about $20,000. Address BOX 374, care Western Electrician, 510 Marquette Bldg., Chicago, Ill.

Notice to Contractors.

Bids for the erection of two 35 K. W. Generators and Engines complete, at the Eastern Kentucky Asylum for the Insane, Lexington, Ky., will be received until Aug. 1, 1904, at 12 o'clock noon, by J. S. Redwine, Supt. Eastern Kentucky Asylum for the Insane, Lexington, Ky.

Also one 75 K. W. Generator, with slow speed engine

The Board of Commissioners reserve the right to reject any and all bids.

J. R. MORTON,
Chairman Board of Commissioners,
Eastern Kentucky Asylum for the Insane.

Gas and Electric Light Plants

We act as agents for the sale of gas and electric light plants

If you have a plant to sell write us

J. S. MAURER & CO., MONADNOCK BLDG. CHICAGO

REPAIRING RECALIBRATING ELECTRIC METERS.

INTERNATIONAL ELECTRIC METER CO.
167 S. CANAL STREET, CHICAGO.

FOR SALE.

ALTERNATORS.

1-360 K. W. General Electric 3-phase.
1-120 " " " "
1-75 " Westinghouse 2-phase.

250-VOLT GENERATORS.

1-250 K. W. Western Electric M. P.
1-200 " Eddy M. P.

125-VOLT GENERATORS.

1-125 K. W. Western Electric M. P.

Immediate shipment.

GREGORY ELECTRIC CO.
54-62 S. CLINTON ST. CHICAGO

WE BUY OLD BELTS

OR SCRAPS, ANY SIZE OR CONDITION.
WE CLEAN, REPAIR AND RENEW OLD BELTS.
LEATHER PRESERVER MFG. CORP.
27 W. MONROE ST., CHICAGO.

"Free from the care which wearies and annoys,
Where every hour brings its several joys."

"AMERICA'S SUMMER RESORTS"

This is one of the most complete publications of its kind, and will assist those who are wondering where they will go to spend their vacation this summer.

It contains a valuable map, in addition to much interesting information regarding resorts on or reached by the

NEW YORK CENTRAL LINES

A copy will be sent free, upon receipt of a two-cent stamp, by George H. Daniels, General Passenger Agent New York Central & Hudson River Railroad, Grand Central Station, New York.

BOILERS

One 42-in. x 15 ft. 9-in., 250 H. P. Worthington Water Tube.
One 60-in. x 16 ft., John Mohr Return Tubular Boiler.
One 54-in. x 16 ft., John Mohr Return Tubular Boiler.
One 54-in. x 16 ft., Devine Turbular Boiler.

ENGINES.

One 600 H. P., 21 x 36 x 30, Williams Tandem Horizontal Compound, 140 R. P. M.
Two 600 H. P., 20 x 30 x 24, Porter-Allen Tandem Compound, 200 R. P. M.
One 250 H. P., 12 x 24 x 18 Williams Tandem Compound, 250 R. P. M.
Two 100 H. P., 13 x 12, Dick & Church, High Speed Automatic.

PARTIAL LIST ONLY.

Send for latest Catalogue for bargains in Engines, Boilers, Dynamos and Motors.

CENTRAL STATION IMPROVEMENT CO., 938 Monadnock Block, Chicago

WORKS QUICK AND EASY. KEEPS ITS LUSTER. HOLDS OLD TRADE AND MAKES NEW. DOES NOT DETERIORATE. ESTABLISHED 16 YEARS. SOLD BY AGENTS AND DEALERS ALL OVER THE WORLD

U.S. METAL POLISH 3 OUNCE BOX 10 CENTS. SAMPLES SENT FREE GEO. W. HOFFMAN

POLISHES ALL METALS. BRANCHES NEW YORK, CHICAGO, SAN FRANCISCO. 295 E. WASHINGTON ST. INDIANAPOLIS, IND.

Crocker-Wheeler. Brown, Boveri.

By arrangement with the celebrated electrical engineers, Brown, Boveri & Cie. of Baden, Switzerland, the Crocker - Wheeler Company has secured their alternating current designs, patents and rights to manufacture in America, and has retained them as consulting engineers.

Crocker-Wheeler Company is now putting on the market alternating current generators, transformers and accessories of the most perfect design and construction, adapted to American practice. Opportunities to bid on this apparatus are invited.

On receipt of

10 CENTS

.....We will send you a

Western Electrician Moonlight Schedule

FOR 1904.

Every Lighting man should have one.

ELECTRICIAN PUBLISHING CO.,
Suite 510 Marquette Bldg., CHICAGO

"NEW TRAIN SERVICE TO

French Lick and West Baden Springs."

A parlor and dining car now leave Chicago at 12:00 o'clock noon, arrive at the Springs at 8:45 p. m. Leave Springs 9:00 a. m., arrive Chicago 5:55 p. m. Reservations at Monon Route City Office, 232 Clark Street. Telephone Har. 1245.

CHICAGO EDISON COMPANY REPAIR SHOPS

76 MARKET STREET, CHICAGO. TELEPHONE MAIN 1280.

Machine and Carpenter Work of All Kinds Correspondence Solicited.

OPEN DAY AND NIGHT.

FIRST-CLASS EQUIPMENT THROUGHOUT.

Dynamos Armatures, Motors, Arc Lamps, Fans, Instruments.

ARNOLD ELECTRIC POWER STATION Co.
Engineers, Constructors for Complete Electric Plants. Results Guaranteed.
SUITE 1539, MARQUETTE BLDG., CHICAGO. NEW YORK OFFICE: 711 TRANSIT BLDG.

BUTTERFIELD, J. F.
ELECTRICAL ENGINEER AND CONTRACTOR.
Complete Telephone Exchanges Built and Material Furnished.
Cable Construction and Underground Conduit Construction a Specialty.
Room 595, 113 Adams Street, CHICAGO, ILL.

J. H. HALLBERG
Consulting Arc Lighting Expert and Practical Electrical Engineer
45 Broadway - NEW YORK
Room 169A

KOHLER BROS.,
Contracting Electrical Engineers, Lighting Power Railways,
1804-1806-1808-1810-1812 Fisher Building, CHICAGO.

W. E BAKER. H. B. BISHOP.
BAKER, W. E. & CO.
ENGINEERS,
ELECTRIC RAILWAYS.
27 William St., NEW YORK.

BYLLESBY, H. M. & Co.
(Incorporated)
ENGINEERS
Design, Construct and Operate Railway, Light, Power and Hydraulic Plants.
Examinations and Reports.
New York Life Building, - CHICAGO, ILL.

HORNADAY, J. P. & Co.
SUITE 1108 TRACTION BUILDING
CINCINNATI, O.
WATERWORKS, ELECTRIC RAILWAY, LIGHT, TRACTION, INDUSTRIAL AND MINERAL PROPERTIES BOUGHT AND SOLD

RUEBEL - SCHWEDTMANN-WELLS,
CONSULTING, MECHANICAL AND ELECTRICAL ENGINEERS,
Suite 801 Chemical Building, ST. LOUIS, U. S. A.

TRY IT.
Keep your name and address in this directory where it will be seen by possible clients.

A WEEKLY REPRESENTATION
in this "Directory" enables engineers to keep before all possible customers.

ENGINEERS
Represented in this "Directory" are enabled to come in touch with many prospective customers who cannot be reached through any other source.

Long Distance Phone Central 2148.
SCHOTT, W. H.,
ENGINEER AND CONTRACTOR,
SPECIALTIES—Central Station Heating Plants, Water Works Steam Plants, Electric Light, Gas and Street Railway Plants.
1220-21 MARQUETTE BUILDING, CHICAGO.

BRYAN, WILLIAM H.
M. Am. Soc. M. E.,
Consulting Mechanical and Electrical Engineer.
Lincoln Trust Building, ST. LOUIS.

E. W. Hammer, Pres. and Treas. H. J. Minhinnick, Sec. and Gen'l Sup't.
GENERAL ENGINEERING Co., THE Consulting and Contracting Engineers.
Telephones, Electric Light, Power Transmission
Suite 1112, 135 ADAMS ST., CHICAGO.
Long Distance Telephone Central 478.

ROBERT W. HUNT & Co.,
ENGINEERS
1121 The Rookery, Chicago. 66 Broadway, New York.
Monongahela Bank Bldg., Pittsburg.
Norfolk House, Cannon St., London.

STANTON, LE ROY W.
Consulting Telephone Engineer.
Plans, Specifications and Supervision of Installation of complete telephone plants.
Special Reports on Telephone Properties and Apparatus.
411 Electrical Bldg., Cleveland, Ohio.

DUGALD C. JACKSON, C. E.
WILLIAM B. JACKSON, M. E.
MEMBERS
AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS
AMERICAN SOCIETY OF MECHANICAL ENGINEERS
AMERICAN SOCIETY OF CIVIL ENGINEERS
ENGINEERS. EXPERTS.
MADISON, WIS.

Sterling Black Plastic Insulator.
One hundred days' continuous baking at 180° F. will not make it brittle. Water repellent. Oil proof.
THE STERLING VARNISH CO., - - Pittsburg, Pa.

Practical Running of Dynamos.
A little booklet on the care and the locating and remedying of troubles in dynamos and motors.
Price, 10 Cents.
Catalogue of mechanical and electrical books free.
ELECTRICIAN PUBLISHING COMPANY,
510 Marquette Bldg., Chicago.

READ THE BLUE ELECTRICAL PAPER.

ELECTRICITY MADE SIMPLE.
233 Pages. 108 Illustrations. By CLARK CARYL HASKINS. Paper .50.
A BOOK DEVOID OF TECHNICALITIES—SIMPLE, PLAIN AND UNDERSTANDABLE.
There are many elementary books about electricity upon the market, but this is the first one presenting the matter in such shape that the layman may understand it, and, at the same time, not written in a childish manner.
This little work is not intended for the instruction of experts, nor as a guide for professors. The author has endeavored to bring the matter down to the level of those whose opportunities for gaining information on the branches treated have been limited.
Four chapters are devoted to Static Electricity; three each to Chemical Batteries and Light and Power; two each to Terrestrial Magnetism and Electro-Magnetism; one each to Atmospheric Electricity; Lightning Rods; Electro-Chemistry; Applied Electro-Magnetism; Force, Work and Energy; Practical Application of Ohm's Law; also a chapter upon Methods of Developing Electricity, other than Chemical.
The large number of examples that are given to illustrate the practical application of elementary principles is gaining for it a reputation as a text-book for schools and colleges.
FOR ENGINEERS, DYNAMO MEN, FIREMEN, LINEMEN, WIREMEN AND LEARNERS. FOR STUDY OR REFERENCE.
ELECTRICIAN PUBLISHING CO., 510 MARQUETTE BLDG., CHICAGO.

Watson Motors
If you want a small motor for a special purpose write us
Mechanical Appliance Co.
Milwaukee - Wis.

"PROFIT & LOSS"
TWO SUMS IN ADDITION
SACHS TRADE NOARK MARK FUSE + SAFETY TO PERSON AND PROPERTY, FREEDOM FROM ACCIDENT, UNINTERRUPTED SERVICE = $ $ $ $ $ $ $ PROFIT $ $ $ $ $ $ $
"NOARK" FUSES
DO NOT ARC—BUT INDICATE
Afford absolute safety as Protective Devices, and FREEDOM FROM ALL FIRE HAZARD
SECOND SUM
OPEN FUSE + DANGEROUS FIRES, ACCIDENTS, OBSTRUCTION OF BUSINESS, ETC. = LOSS
WRITE FOR COMPLETE SET "NOARK" FUSE BULLETINS & LINE MATERIAL INSULATION CATALOG
H. W. JOHNS-MANVILLE CO.
100 William St., New York
MILWAUKEE CHICAGO ST. LOUIS BOSTON PHILADELPHIA PITTSBURG CLEVELAND NEW ORLEANS LONDON

We introduced successful 4-party lines

LEICH SELECTIVE SYSTEM

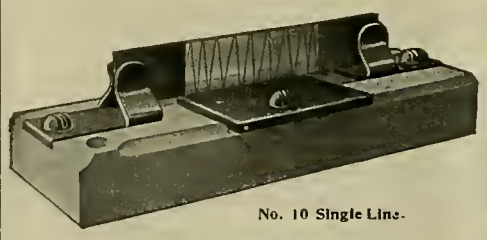
Write for our booklet—"Selective W."

Impedance Coil for Selectives. No Springs.

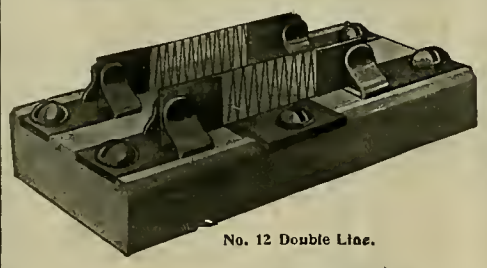
CENTRAL ENERGY OR MAGNETO

AMERICAN ELECTRIC TELEPHONE CO.

CHICAGO, ILLINOIS



No. 10 Single Line.



No. 12 Double Line.

PROTECTORS THAT PROTECT.

Our patent wrapped fuse used in our protectors are an insurance policy against lightning.

Sample free by mail to any Exchange or Toll Line

CENTRAL TELEPHONE AND ELECTRIC CO.,

909 Market St.,
ST. LOUIS, U. S. A.

Locations for Industries

Erie Railroad

Chicago to New York

The Erie Railroad Company's Industrial Department has all the territory traversed by the railroad districted in relation to resources, adaptability, markets and advantages for manufacturing, and can advise with manufacturers in relation to the most suitable locations. For full information address

LUIS JACKSON

Industrial Commissioner, Erie Railroad Company
21 Cortlandt Street, New York

SIMPLE
EFFICIENT
RELIABLE
DURABLE
NOISELESS
ECONOMICAL

THE

ILLINOIS POLE CHANGER

THE LATEST RINGING DEVICE

Produces Both Alternating and Pulsating Currents.....

Broadly guaranteed. Write for circulars.

Illinois Electric Specialty Co.

171-173 South Canal Street .... Chicago

Points in Wisconsin and the Northwest

are covered by Wisconsin Central Railway's convenient, solid, wide vestibuled trains, equipped with Pullman sleepers, free reclining chair cars and modern coaches which leave Central Station, 12th Street and Park Row (Lake Front), Chicago for St. Paul, Minneapolis, Ashland and Duluth, connecting with all western lines. Meals in dining and cafe cars served a la carte.

For tickets and further information apply to nearest ticket agent, or write

JAS. C. POND, Gen'l Pass. Agt., Milwaukee, Wis.

BITUMINIZED FIBRE CONDUIT

FOR

ELECTRICAL UNDERGROUND CONSTRUCTION
ELECTROLYSIS PROOF WATER PROOF

A smooth laminated insulator of unchanging durability.

Forms a continuous sealed duct from manhole to manhole, impervious to moisture and through which leaking gas cannot penetrate.

There has never been a gas explosion in our conduits nor the slightest evidence of electrolysis.

Abrasion of the cables is an impossibility.

It saves sixty per centum of freight and handling cost and twenty to thirty-five per centum of construction.

Process of laying is simple, rapid and inexpensive. There is no loss from breakage or fitting. It is self-aligning and cannot settle out of alignment.

All sizes from one inch to ten inches interior diameter. Bends of all angles.

The foremost electrical engineers are recognizing and testifying to the scientific advantages of our system of subway construction over all previous methods.

Send for illustrated book. Ask for prices giving size and quantities required

PROMPT DELIVERIES

FACTORIES: Philadelphia, Chicago, Los Angeles

American Conduit Company

SEVENTH FLOOR, 170 BROADWAY, NEW YORK

336 Macy St., Los Angeles, Cal. *Manhattan Bldg., Chicago*

SOMETHING NEW

A. B. C.

...OF...

ELECTRICAL EXPERIMENTS

BY W. J. CLARKE.

This is a practical, up-to-date, elementary book for the boy or student interested in electricity, and fills a long felt want. It tells in plain language how to make and experiment with Batteries, Magnets, Telegraph, Telephone, Electric Bells, Induction Coils, X Rays, *Wireless Telegraphy*, Dynamos and Motors.

146 Pages. 129 Ills. Cloth.
PRICE, $1.00.

Sent postage paid, on receipt of price.

ELECTRICIAN PUBLISHING CO.,

510 MARQUETTE BLDG., CHICAGO.

Standard Vitrified Conduit Co.

B. B. BARNARD, Manager

39-41 CORTLANDT ST.,
NEW YORK

LARGEST FACTORIES IN THE WORLD : STOCK ON HAND

SEND FOR CATALOGUE

INTERNATIONAL

Mechanical Self-Restoring Drop Switchboard.

A PERFECT APPARATUS.

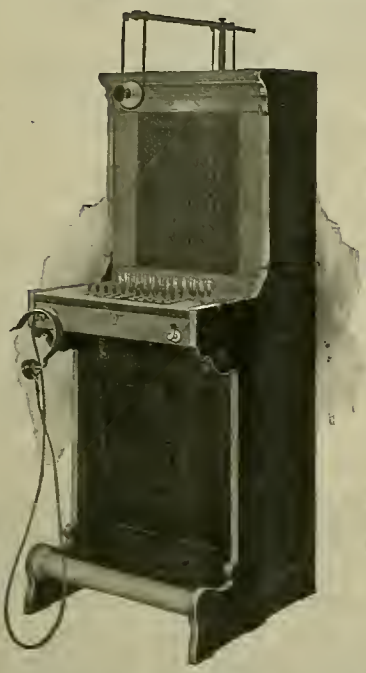
Made in any desired capacity.
Sample parts and quotations on request.

INTERNATIONAL TELEPHONE MANUFACTURING CO.

CHICAGO, U. S. A.

KELLOGG

MAGNETO SWITCHBOARDS.



We have been making small switchboards only during the last three years, but in that time we have constructed

Over 1,400 Small Switchboards, Having 75,000 Lines in Actual Use.

Every one of all this list is giving the best satisfaction.

Kellogg Switchboard and Supply Company,

Green and Congress Streets,
CHICAGO.

Seymour Building, LOS ANGELES. Electric Building, CLEVELAND. Keystone Telephone Building, PHILADELPHIA.

WRITE
FOR
BULLETIN
No. 11-E

THIS IS OUR LATEST BULLETIN DESCRIBING
GENERATOR-CALL TELEPHONES

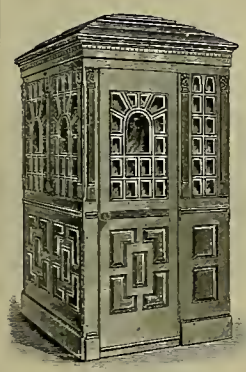
It shows all of our recent improvements in this type of apparatus. If you wish to keep posted on the most modern apparatus you will write for this bulletin.

Stromberg-Carlson Telephone Mfg. Co.

GENERAL AND EASTERN SALES OFFICE
ROCHESTER, N. Y.

SALES DEPT.
CHICAGO, ILL.

DO YOU KNOW that



Telephone Booths

have increased the receipts (where exposed telephones had previously been in use) *sufficiently* to pay the cost of the booths within the first thirty days? SPECIAL PRICES to demonstrate what booths will do for you.

WRITE FOR CATALOG

W. S. SEAMAN & CO.
216 E. WATER ST., MILWAUKEE, WIS.

TELEPHONE BOOTHS

When in want of the Right Kind write us.

Catalogue Free

Yesbera Mfg. Co.
TOLEDO, OHIO.

Automatic Telephones.

Privacy

Promptness

Precision

Profits.

Automatic Electric Co., Chicago, U. S. A.

PRODUCERS AND WHOLESALERS OF WHITE CEDAR PRODUCTS

CEDAR POLES

SPECIAL PRICES ON SMALL POLES.
Write for a copy of our TELEGRAPH CODE FOR CEDAR PRODUCTS

YARDS
KOSS MICH.
L'ANSE "
MUNISING "
ONTONAGON
WAGNER, WIS
PESHTIGO "

C. H. WORCESTER CO.
SUITE 1206 TRIBUNE BLDG. CHICAGO.

Cedar Poles.

Pittsburg and Lake Superior Iron Co. Producers and Wholesalers. Escanaba, Mich.

Cedar Poles

TORREY CEDAR CO., CLINTONVILLE, WIS.
Large Stock Constantly on Hand

POLES—POSTS—PILING—TIES

Fowler-Jacobs Co.
Elmore-Fowler-Jacoba Co.
John H. Fowler & Co.
} The FOWLER Companies
Fisher Building, - - CHICAGO

MICHIGAN AND WESTERN CEDAR POLES
ALL LENGTHS AND SIZES
LINDSLEY BROS CO.
TRIBUNE BLDG., CHICAGO

Idaho Cedar Poles

PACIFIC COAST POLE CO. SPOKANE, WASH.

H. N. FENNER, President J. F. BLAUVELT, Agent RUSSELL W. KNICHT, Treasurer

NEW ENGLAND BUTT COMPANY

MANUFACTURERS OF

Machinery for Insulating Electrical Wires

Braiding, Taping, Winding, Twinning, Cabling, Stranding, Polishing and Measuring Machines. Cable Covering Braiders
FINE CASTINGS A SPECIALTY
304 PEARL STREET, - - - PROVIDENCE, R. I., U. S. A.

POLE DEALERS ADVERTISING IN THE WESTERN ELECTRICIAN OBTAIN MOST EXCELLENT RESULTS BECAUSE IT PLACES THEM IN TOUCH WITH ACTUAL BUYERS OF POLES. TRY A CARD.

POLES, TIES, POSTS.

THE PORTER CEDAR CO., SAGINAW, MICH.
PRODUCERS. We want your inquiries always.

IDAHO CEDAR POLES.

LOW PRICES. LONG LENGTHS A SPECIALTY.
YARDS: IDAHO. MONTANA.
WESTERN LUMBER & POLE CO., - Main Office, DENVER, COLO.

BOOKS.

BUY YOUR BOOKS FROM THE
ELECTRICIAN PUBLISHING COMPANY,
510 Marquette Bldg., CHICAGO.

TYPE E.

ALTERNATING CURRENT.

SCHEEFFER INTEGRATING WATTMETER

Type E for Alternating Current Type F for Direct Current Circuits

DUST AND BUG PROOF IMPROVED CONSTRUCTION

MOVING PARTS ARE EXTREMELY LIGHT, INSURING A HIGHLY SENSITIVE AND ACCURATE METER.

WRITE FOR PRICES AND DESCRIPTIVE LITERATURE.

DIAMOND METER COMPANY,

PEORIA, ILL., - - - - U. S. A.

TYPE F.

DIRECT CURRENT.

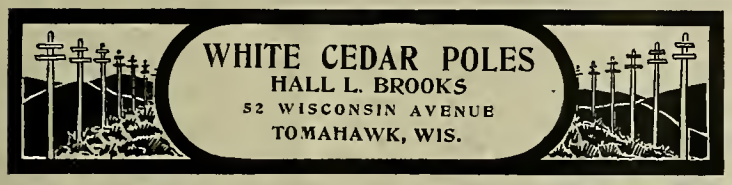
MICHIGAN WHITE LARGE STOCK.
CEDAR POLES
PROMPT SHIPMENTS. KELLOGG SWITCHBOARD & SUPPLY CO., Chicago.

Would'nt you order a carload of 7 or 8 inch 25's or 30's if you could get them Quick and the price was low?
Write us if you're interested.
(That Trolley Tie is still ready for you—any quantity.)
MALTBY LUMBER COMPANY, 512 Phoenix Block, Bay City Michigan.
PITTSBURG AGENTS, TIPPER & PATTON, 509 Bessemer Bldg.

POLES W. C. STERLING & SON, TIES.
MONROE, MICH.
Eleven Pole Yards in Michigan.
Wholesale Producers for 20 years.

Southern Cedar POLES Are the Best.
NO ROTTEN BUTTS. D. W. PHELAN,
277 Broadway, New York

SPECIAL CROSS ARMS
ALL HEART, long leaf yellow pine, any size or length. Also ALL HEART cross ties, oak and locust pins and brackets. Write us for delivered prices. We can furnish 100 or 100,000 promptly. R. K. AKERS, Manager.
Sales Office, 519 Main Street, Cincinnati, O.
LEWIS LUMBER & MFG. CO., Hattiesburg, Miss.



POLES AND POSTS.
The consumer should write me, I am on the ground and CAN SAVE YOU 10 per cent
S. E. THOMPSON, TENSTRIKE, MINN.

BINDERS
FOR THE
Western Electrician
$1.00 Each.
ELECTRICIAN PUB. CO.,
CHICAGO.

TELEPHONE POLES
Yards at Red Cliff, Wis., Altkin, Feeley, Cohasset, Deer River, Tenstrike and Black Duck, Minnesota.
Large stocks. Prompt shipments. Carefully inspected stock at low prices.
J. W. MORRISON LUMBER CO., 918-19 Lumber Exchange MINNEAPOLIS, MINN.

CEDAR POLES
ESTABLISHED 1862
WM. MUELLER COMPANY
1211-12-13 MARQUETTE BLDG. CHICAGO.
EIGHT DISTRIBUTING YARDS

WHITE CEDAR POLES
Don't forget our Minnesota Transfer Yard—midway between St. Paul and Minneapolis, where we load in forty-eight hours from the time we have your order.
PAGE & HILL CO. 1003 Lumber Exchange, MINNEAPOLIS, MINN.

INDUSTRIES ARE OFFERED LOCATIONS WITH
Satisfactory Inducements,
Favorable Freight Rates,
Good Labor Conditions,
Healthful Communities,
ON THE LINES OF
THE ILLINOIS CENTRAL R. R.
AND THE
YAZOO & MISSISSIPPI VALLEY R. R.
For full information and descriptive pamphlet address
J. C. CLAIR,
Industrial Commissioner,
1 Park Row, Chicago, Ill.

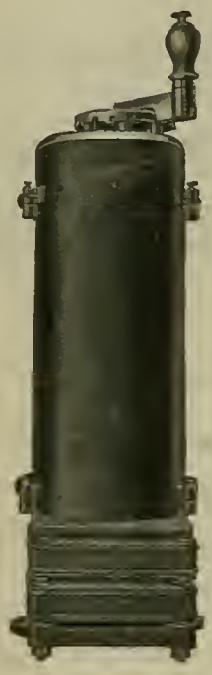
BRACKETS—X ARMS—PINS
little things it is true, but they cut a big figure in line construction.
OUR MOTTO IS:
Prompt Shipment Quality Satisfaction Right Price
COLUMBIA MFG. CO. ANTIGO, WIS.

POLES.
WHITE CEDAR.
IDAHO CEDAR up to 80 ft.
BERTHOLD & JENNINGS,
ST. LOUIS.
Chemical Building.
CROSS ARMS.
LONG LEAF PINE AND FIR.

CENTRAL STATION HEATING
We are the originators and builders of the underground system of live and exhaust steam heating. Our system is used for the utilization and distribution of exhaust steam from electric and power plants for heating purposes. 250 Plants in successful operation. We have the only Meter System. Also manufacturers of Wooden Water Pipe, Steam Pipe Casing, Steam Traps, Condensation Meters, Valves, Economizing Coils, Separators and full line of Steam Fitters' Supplies.
WRITE FOR PAMPHLET AND PRICE LIST
American District Steam Company
MENTION WESTERN ELECTRICIAN. LOCKPORT, N. Y. CHICAGO ILL.

Westinghouse Reversible Controllers

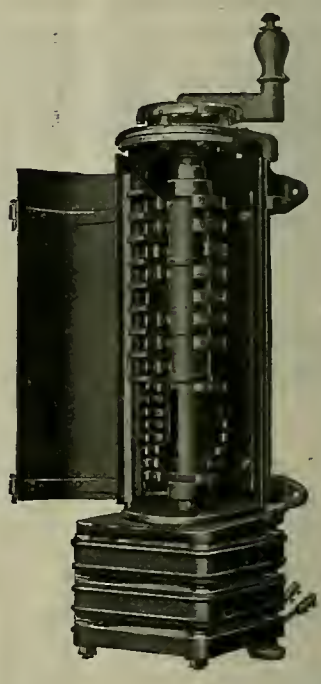
For Direct Current Shunt and Compound Wound Motors Used for Driving Machinery and Machine Tools



Made in two types
Single and Double Voltage

The Single Voltage Type
has 8 Forward and 4 Reverse Speeds

The Double Voltage Type
has 15 Forward and 6 Reverse Speeds



Provided with Renewable Contact Strips
and Adjustable Fingers with Arc Shields

They can be operated from a distance by removing the handle and ratchet, and attaching them to the machine or machine tool, making connection with the controller by means of bevel gears.

For Particulars address nearest office of

Westinghouse Electric & Mfg. Co.

Pittsburg, Pa.

New York, Atlanta, Dallas, Baltimore, Boston, Buffalo, Chicago, Cincinnati, Cleveland, Detroit, Los Angeles, Minneapolis, New Orleans, Philadelphia, Pittsburg, St. Louis, Salt Lake City, San Francisco, Syracuse, Seattle, Denver, Mountain Electric Co.
Canada: Canadian Westinghouse Co., Limited, Hamilton, Ontario. Mexico: G. & O. & Braniff Co., City of Mexico.

PEOPLE WHO BUY GENERATORS

FORT WAYNE ELECTRIC WORKS
WOOD LIGHTING & POWER SYSTEMS
Fort Wayne, Ind.

bearing our name-plate also buy reliable service. It is service that counts, when it is reliable.

Reliable service is continuous—uninterrupted—readiness for hard work and more of it.

That is the chief characteristic of our direct current generators.

It is not obtained by adding weight or by underrating. It is the result of the nicety with which theoretical design and practical construction are combined in these generators.

231

Watch This Space for Further Details

The Inspector AND Trouble Man.

By A. E. DOBBS.

Full of information and diagrams for the operator, exchange owner, exchange manager, inspector, trouble man, lineman.

A complete description of telephones and their troubles. How to find and remedy them, together with working plans for exchange construction, complete with diagrams of all up-to-date telephones and switchboards.

This is a practical book, written in **plain language**, and for **anyone** interested in telephony.

Mailed anywhere on receipt of price . . . ONE DOLLAR.

No technicalities. Substantially bound in cloth.

ELECTRICIAN PUBLISHING CO.,
510 MARQUETTE BUILDING, CHICAGO.

WATTMETERS FOR DIRECT CURRENTS

The new Duncan has all the up-to-date features that go to make it the best on the market. It will pay you to try one and investigate its merits for yourself.

Its multipoint switch method of compensating for friction and vibration is conceded to be the simplest, quickest and most reliable means yet devised. It is superior in every respect to the old and clumsy methods of adjusting the compensating coil bodily and is not damaged by lightning.

DUNCAN ELECTRIC MFG. CO.
LAFAYETTE, IND.

HENRY NEWGARD & CO.

ELECTRICAL CONSTRUCTION

Power and Light Plants. Switchboards and Panel Boards.

We install Municipal and Isolated Electric Lighting Plants.
We manufacture Switchboards, Table boards, Iron Cutout Boxes and Electrical Specialties.
We sell Dynamos, Motors and Electrical Supplies.
We wire old as well as new Residences, Factory Buildings, School and College Buildings.

87 Fifth Avenue, Chicago, Illinois.

VULCANIZED FIBRE

Highest grades for electrical insulation and mechanical purposes, in sheets, tubes, rods and special shapes. Catalogues and samples on application.

VULCANIZED FIBRE CO., - Wilmington, Del.

USE

"SAFETY" RUBBER COVERED WIRE AND CABLE

FOR EVERY ELECTRICAL SERVICE.

M. B. AUSTIN & CO.,
CHICAGO REPRESENTATIVE.

THE SAFETY INSULATED WIRE & CABLE CO.,
WORKS: Bayonne, N. J. 114-116 LIBERTY STREET, N. Y.

ELECTRIC
FANS

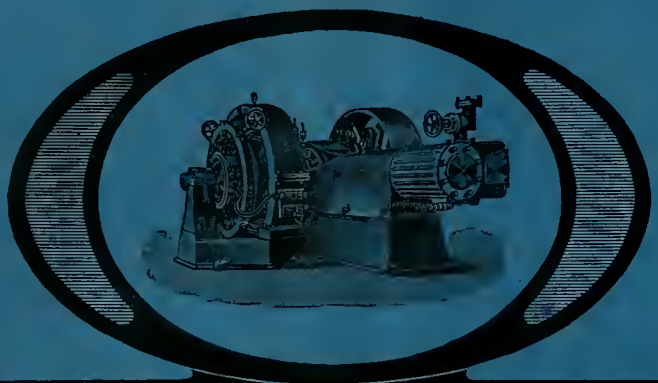
THE POPULARITY

of our fans is due to their superior design and construction. They have been imitated many times, but never equaled.

Write for Catalogue No. 30814

SPRAGUE
ELECTRIC COMPANY

General Offices:
527 West 34th Street, New York.
Chicago Office: Fisher Bldg.



STURTEVANT GENERATING SETS

ENGINES · MOTORS
BLOWERS · FORGES
MECHANICAL DRAFT

B.F. STURTEVANT CO.
BOSTON, MASS. NEW YORK · CHICAGO PHILADELPHIA · LONDON

STEAM HEATING
VENTILATING AND
DRYING APPARATUS

246

Warren Alternator

It's not the
Old-Fashioned
kind that revolves a bundle of copper wire, and a mysterious set of copper rings one or two thousand revolutions a minute — takes brushes and intricate apparatus to collect the current and get it out on the circuit wires.

We Guarantee What We Sell

AND

Sell What We Guarantee

WARREN ELECTRIC MFG. CO.

Sandusky, O.

Black Diamond File Works

Est. 1863. Inc. 1895.

Twelve Medals Awarded at International Expositions

Special Prize Gold Medal at Atlanta, 1895.

OUR GOODS ARE ON SALE IN EVERY LEADING HARDWARE STORE IN THE UNITED STATES AND CANADA.

G. & H. BARNETT COMPANY,
PHILADELPHIA, PA.

JOHN A. ROEBLING'S SONS CO.

Insulated Wire of All Kinds

Bare Copper Wire

MAIN OFFICE AND WORKS **TRENTON, N. J.**

AGENCIES AND BRANCHES

New York Chicago Cleveland San Francisco Philadelphia Atlanta

Western Electrician

Vol. XXXV. $3.00 Per Annum. Copyright, 1904, by Electrician Publishing Company, Chicago. CHICAGO, JULY 23, 1904. Entered at Chicago Postoffice as mail matter of the second class. 10 Cents a Copy. No. 4.

SIMPLEX INSULATED WIRES AND CABLES.

RUBBER COVERED, WEATHERPROOF, UNDERGROUND AND SUBMARINE.

WESTERN SELLING AGENT, H. R. HIXSON, 1154 Monadnock Block, CHICAGO

The Simplex Electrical Co., 110 State Street, BOSTON, MASS.

CHICAGO INSULATED WIRE CO.,

152-154 LAKE STREET.

Bare and Insulated Wires and Cables.

Galvanized Steel Strands.

OKONITE

TRADE MARK.

1889—Paris Exposition, Medal for Rubber Insulation.

1893—World's Fair, Medal for Rubber Insulation.

THE STANDARD FOR RUBBER INSULATION.

Sole Manufacturers of

Okonite Wires, Okonite Tape, Manson Tape, Candee Weather-proof Wires.

THE OKONITE CO., LTD.

Willard L. Candee, N. Durant Cheever, } Managers. 253 Broadway, New York. Geo. T. Manson, Gen'l Supt. W. H. Hodgins, Secy.

TRADE MARK. CRESCENT INSULATED WIRE & CABLE CO. TRENTON, N. J.

CRESCENT RUBBER INSULATED WIRES AND CABLES

National Code Standard.

CRESCENT INSULATED WIRE AND CABLE CO.,

New York Office, 83 BARCLAY STREET. Main Office and Factory, TRENTON, N. J.

INDIANA RUBBER AND INSULATED WIRE CO.,

MANUFACTURERS OF

Paranite Rubber Covered Wires and Cables,

UNDERGROUND, AERIAL, SUBMARINE AND INSIDE USE.

TELEPHONE, TELEGRAPH AND FIRE ALARM CABLES.

All Wires are tested at Factory. JONESBORO, IND.

STANDARD UNDERGROUND CABLE CO.

322 The Rookery, Chicago. Westinghouse Bldg., Pittsburg. 56 Liberty St., New York City. 1225 Betz Bldg., Philadelphia, Pa. Crossley Bldg., San Francisco. 10 Post Office Square, Boston.

BARE AND WEATHERPROOF WIRES AND CABLES.

Rubber Covered Wires and Cables. Underground Cables for all Purposes.

THOUSANDS IN USE.

Motors, ⅛ h. p. to 100 h. p. Dynamos, 1 k. w. to 75 k. w. Highest Quality. Reasonable Price. THE HOBART ELECTRIC MFG. CO. TROY, OHIO.

Electric Heating Apparatus

SEND FOR 32-PAGE CATALOGUE.

"UNIT" ENAMELED RHEOSTATS

SIMPLEX ELECTRIC HEATING CO., Cambridgeport, Mass.

THERMOPILES 1½ VOLTS 1½ AMPERES

For Electrolytic analysis, charging storage batteries, and other constant current requirements. $3 Each.

WALSH'S SONS & CO., 264 Washington Street. Newark, N. J.

The Bossert Electric Construction Co.

—MANUFACTURERS OF—

STEEL OUTLET AND JUNCTION BOXES, SWITCHBOARDS, PANEL BOARDS, SWITCHES, ETC.

UTICA, NEW YORK.

RESISTANCE WIRES

"Climax" For High-resistance Work.

"Advance" For Measuring Instruments.

SPECIAL ALLOYS FOR ELECTRICAL MANUFACTURERS.

DRIVER-HARRIS WIRE CO., Harrison (Newark), N. J.

"CIRCULAR LOOM" THE FLEXIBLE CONDUIT

AMERICAN CIRCULAR LOOM CO. TRADE MARK REGISTERED

CONDUITS FOR INTERIOR WIRING.

American Circular Loom Co.

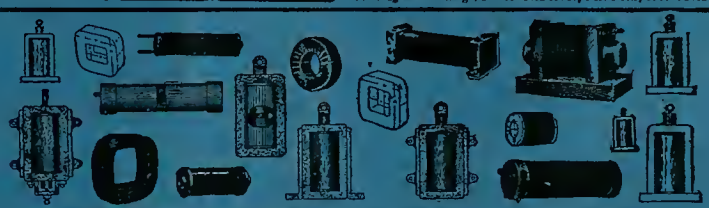
Chelsea, Mass., New York, Chicago, San Francisco.

All Supply Houses

J. J. EGAN'S "ACME" COMMUTATOR COMPOUND.

J. J. EGAN'S "ACME" COMMUTATOR COMPOUND absolutely prevents sparking or cutting. One stick of "Acme" is equal to one gallon of oil for lubricating commutators. Free Sample. AGENTS WANTED. 50c per Stick. $5.00 per doz.

J. J. Egan Sole Mfg., 317 Austin Ave., Tel. Polk, 1779 Chicago



Magnets and All Kinds of Coil Windings of Insulated or Bare Wire for Every Purpose.

VARLEY DUPLEX MAGNET COMPANY, PROVIDENCE, RHODE ISLAND.

THE PHOENIX GLASS CO. Pittsburg, New York, Chicago

Manufacturers of

Electric Globes and Shades, both Arc and Incandescent

Inner and Outer Globes for all enclosed arc systems

CATALOGUES SENT ON REQUEST

H. N. FENNER, President J. F. BLAUVELT, Agent RUSSELL W. KNIGHT, Treasurer

NEW ENGLAND BUTT COMPANY

MANUFACTURERS OF

Machinery for Insulating Electrical Wires

Braiding, Taping, Winding, Twinning, Cabling, Stranding, Polishing and Measuring Machines. Cable Covering Braiders

FINE CASTINGS A SPECIALTY

304 PEARL STREET, - - - PROVIDENCE, R. I., U. S. A.

WESTON Electrical Instrument Co.,

Waverly Park, NEWARK, N. J.

Weston Portable Galvanometer for Bridge Work.

Weston Standard Portable Direct Reading

Voltmeters, Millivoltmeters, Voltammeters, Ammeters, Milammeters,

Ground Detectors and Circuit Testers, Ohmmeters, Portable Galvanometers.

Our Portable Instruments are recognized as The Standard the world over. The Semi-Portable Laboratory Standards are still better.

Our Station Voltmeters and Ammeters are unsurpassed in point of extreme accuracy and lowest consumption of energy.

BERLIN—European Weston Electrical Instrument Co., Ritterstrasse No. 88.

LONDON—Elliott Bros., Century Works, Lewisham.

PARIS, FRANCE—E. H. Cadiot, 12 Rue St. Georges.

New York Office—74 Cortlandt St.

Standard Vitrified Conduit Co.

S. S. BARNARD, Manager

39-41 CORTLANDT ST. NEW YORK

LARGEST FACTORIES IN THE WORLD : STOCK ON HAND

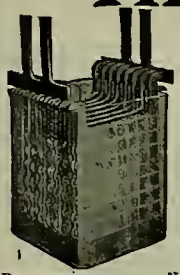
SEND FOR CATALOGUE

Allis-Chalmers Co
CHICAGO

Bullock
Electrical Apparatus
for all purposes.

THE ELECTRIC STORAGE BATTERY CO.

PHILADELPHIA



MANUFACTURER OF THE

"Chloride Accumulator"

For Central Stations, Electric Railways, Isolated Lighting and Power Stations, Fire Alarm, Telegraph, Train Lighting, etc., etc.

PRICE LISTS AND DESCRIPTIVE BULLETINS FORWARDED UPON REQUEST.

SALES OFFICES:

PHILADELPHIA, Allegheny Ave. and 19th St. | NEW YORK, 100 Broadway, | BOSTON, 60 State St. | CHICAGO, Marquette Bldg. | ST. LOUIS, Walnwright Bldg. | SAN FRANCISCO, Rialto Bldg. | CLEVELAND, Citizens Bldg. | CANADA, Canadian General Electric Co., Ltd. Toronto | HAVANA, CUBA, G. F. Greenwood, Manager 34 Empedrado St.

ALLEN-BRADLEY ELECTRIC CRANE CONTROLLERS

PATENTED

Guaranteed for One Year. Three months' Free Trial.
No Sparking. No Repairs. Perfect Control.

AMERICAN ELECTRIC FUSE COMPANY

CHICAGO - - ILLINOIS

Engineering MECHANICAL, ELECTRICAL, STEAM, CIVIL.

Complete and short courses. Thoroughly equipped engineering shops. **Shop work from the beginning.** Short courses in Steam and Electrical Engineering. Expenses low. Accommodations the best. School all year. Students may enter any time. Correspondence steam and electrical courses. Send for catalogue. Mention course in which interested.

HIGHLAND PARK COLLEGE, DES MOINES, IOWA.

CARBONS

CONSUMERS CARBON CO.

LANCASTER, OHIO, U. S. A.

Carbons of all kinds and for all purposes.

THE STATE UNIVERSITY OF IOWA

SCHOOL OF APPLIED SCIENCE. Iowa City, Iowa

Four year courses of the highest grade in

Civil
Municipal
Sanitary
Electrical
Mechanical
Mining

ENGINEERING

Numerous short practical courses. Special courses in technical chemistry, bacteriology, etc. Adequate equipment in shops and laboratories. Waterpower.

University environment. Expenses low.

Address C. E. MacLEAN, President

PLATINUM

PLATINUM RIVETS FOR CONTACT POINTS IN TELEPHONES—SPARK COILS AND OTHER ELECTRICAL APPARATUS. PLATINUM SHEET AND WIRE IN ANY FORM AND DEGREE OF HARDNESS. PLATINUM SCRAP PURCHASED.

BAKER & COMPANY, Inc.

ARTISANS IN PLATINUM

408-410-412-414 N. J. R. R. AVE. - NEWARK, N. J.

New York Office: 120 Liberty St.

ALPHABETICAL INDEX TO ADVERTISEMENTS.

Adams-Bagnall Electric Co.—
Akron Electrical Mfg Co.....11
Allen Company, L. B.....11
Allis-Chalmers Company..... 2
American Battery Co.....—
Amer. Circular Loom Co.....1
American Conduit Co.....14
Amer. District Steam Co.....15
Amer. Elec. Fuse Co..... 3
Amer. Electrical Heater Co.—
Amer. El. Telephone Co.....15
American Electrical Works..11
Arnold Elec. Power Station Co..... 13
Automatic Electric Co..... 14

Babcock & Wilcox Co.....—
Bain, Forée.....11
Baker & Company..... 3
Baker & Co., W. E.....13
Barnett Company, G. & H....20
Beardslee Chandelier Mfg.Co.10
Berthold & Jennings.....17
Big Four Route.....—
Bissell Co., The F..... 4
Bossert Electric Construction Co..... 1
Brooks, Hall L.....16
Bryan-Marsh Co.....—
Bryan, Wm. H.....13
Buckeye Electric Co.....—
Bullock Elec. Mfg. Co..... 9
Burlington Ry.....12
Butterfield, J. F.....—
Byllesby & Co., H. M.....13

Central Electric Co..... 5
Cent. Stat. Improvement Co..12
Central Tel. & El. Co.....—
Century Electric Co.....—
Chicago Die & Electric Co....—
Chicago Edison Co.....4, 12
Chic. Fuse Wire & Mfg. Co...20
Chicago Insulated Wire Co.. 1
Chicago Mica Co.....10
Columbia Incand. Lamp Co..—
Columbia Mfg. Co.....16
Columbus Storage Bat'ry Co.15
Consumers Carbon Co..... 3
Continuous Rail Joint Company of America..... 8
Coolidge Co.. Marshall H.....17
Cope, T. J.....11
Crawfordsville Electric Co..18
Crescent Co.....8
Crescent Ins. Wire & Cbl. Co. 1
Crocker-Wheeler Company...10
Crouse-Hinds Co.....—
Cutler-Hammer Mfg. Co..... 4
Cutter Elec. & Mfg. Company--

D. & W. Fuse Company.....—
Dearborn Drug & Chem. Wks.18
Diamond Meter Company....—
Dielectric Manufacturing Co.11
Directory of Engineers.....13
Dixon Crucible Co., Joseph..18
Driver-Harris Wire Co..... 1
Duncan Elec. Mfg. Co.....19

Edison Decorative & Miniature Lamp Departm't.....10
Edison Mfg. Company..... 5
Edwards & Co.....11
Egan, J. J..... 1
Electrical Engineer Institute.—
Electric Appliance Co 10
Electric Storage Battery Co.. 3
Electrician Pub. Company...13
Erie Ry.....18

Faries Mfg. Co.....11

"For Sale" Advertisements..12
Ft. Wayne Elec. Works, Inc..19
Fostoria Incand. Lamp Co...—
Fowler, John H.....16
Fowler-Jacobs Company.....16

General Electric Co..... 2
General Engineering Co., The 13
General Incandescent Arc Light Company..... 8
General Incand. Lamp Co....—
Gould Storage Battery Co....—
Gt. West. Smelt. & Refining Co.12
Green Fuel Economizer Co..—
Gregory Electric Company...12

Hallberg, J. H 13
Haller Machine Co.....—
Hart Mfg. Co.....16
Hartford Steam Boiler Inspection & Insurance Co....18
Hartford Time Switch Co.... 8
Hazard Manufacturing Co...20
Highland Park College. ... 3
Hobart Elec. Mfg. Company. 1
Hoffman, G. W.....12
Holmes Fibre-Grapb. Co.....18
Holophane Glass Co.....—
Hornaday & Co., J. P.....13
Humphrey, Henry H.....—
Hunt & Co., Robt. W.....13

Illinois Central Ry.....12
Illinois Electric Specialty Co.14
Incandescent Electric Light Manipulator Company.....—
Indiana Rub. & Ins. W. Co.... 1
India Rubber & Gutta Percha Insulating Company..... 6
International Elec. Meter Co 12
International Tel. Mfg. Co...14

Jackson, D. C. & W. B.....13
Jeffrey Manufacturing Co....18
Jewell Electrical Inst. Co....—
Johns-Manville Co., H. W.....—

Kartavert Manufacturing Co.20
Kellogg Switchboard & Supply Company.....15, 16
Kester Elec. Mfg. Co.....12
Klein & Sons, Mathias..... 10
Kohler Brothers.....13
Kuhlman Electric Co.....11

La Roche Co., F. A..... 5
Leather Preserv. M. Corp....—
Leffel & Co., James.....18
Lewis Lumber & Mfg Co....17
Lindsley Brothers Company..16
Loud's Sons Co., H. M.....17

Machado & Roller .....—
Maltby Lumber Company....17
Manhattan El. Supply Co....16
Manross, F. N. 16
Marinette Gas Engine Co.....18
Mattbews & Bros., W. N.....11
McLennan & Company, K....10
Mechanical Appliance Co....—
Mica Insulator Company.....—
Michigan College of Mines ..—
Miller Electric Co.....12
Minnesota Electric Co.....15
Miscellaneous Advs.....12
Mooon Railroad..... .. ..—
Moon Mfg. Co., The.....14
Morrison Lbr. Co., J. W.....—
Mueller Company, William..17
Munsell & Co., Eugene..... 10

National Electric Co.....20
National India Rubber Co....—
New England Rutt Co..... 1
Newgard & Co., Henry..... 4
New York Cent. Ry.....17
New York Ins. Wire Co.....11
Northern Elect'l Mfg. Co.... 5
Norton Elect'l Instrument Co.—

Okonite Co., The..... 1
Olds Gasoline Engine Works.18
Osborn Flexible Conduit Co. 7

Pacific Coast Pole Co.....16
Page & Hill Co.....17
Paragon Fan & Motor Co.....—
Pardridge Shade & Refl. Co..—
Pass & Seymour, Inc..... 8
Phelan, D. W.....16
Phillips, Eugene F.....11
Phillips Insulated Wire Co...11
Phœnix Glass Co..... 1
Phosphor-Bronze S. Co.....18
Pignolet, L. M.....10
Pittsburg & L. S. Iron Co....17
Plume & Atwood Mfg. Co....—
Porter Cedar Company.....17
Pratt Institute .....—

Reisinger, Hugo.....—
Reynolds El. Flasher Mfg. Co. 5
Roebling's Sons Co., J. A.....20
Ruebel-Schwedtmann-Wells..13

Safety Ins. Wire & Cable Co..16
Sargent & Lundy.....13
Schott, W. H.....13
Seaman, J. H..... 5
Seaman & Co., W. S.....14
Simplex Electrical Co., The.. 1
Simplex Elec. Heating Co.... 1
Speer Carbon Co..... 8
Sprague Electric Company...10
Squire Electric Co.....—
Standard Elec. Mfg. Co.....12
Standard Underg. Cable Co.... 1
Standard Vitrified Conduit Co 1
Stanley Instrument Co..... 5
Stanton, LeRoy W..... 13
State Univ. of Iowa..... 3
Sterling & Son, W. C.....17
Sterling Electrical Mfg. Co.... —
Sterling Varnish Co., The....18
Stow Mfg. Company.....11
Stromberg-Carlson Tel. Mfg. Company.....15
Sturtevant Company, B. F...20

Thompson, S. E.....—
Torrey Cedar Company.....16
Trumbull Elec. Co.....—

Union Electric Mfg. Co.....—

Valentine-Clark Co., The....17
Varley Duplex Magnet Co.... 1
Vulcanized Fibre Company..20

Wabash Railroad.....13
Wagner Electric Mfg. Co..... 4
Walsh's Sons & Company..... 1
Warren Elec. Mfg. Co.....10
Wesco Supply Co.....—
Western Electric Company... 9
Western El. Supply Co.....14
Western Lumber & Pole Co..16
Westinghouse Electric & Manufacturing Co.....—
Weston Electrical Inst. Co.... 1
Wilmerding, C. H.....13
Wisconsin Central Ry.....14
Woolley Fdy. & Mach. Wks..—
Worcester Company, C. H....16

Yesbera Mfg. Co..... .. —
Yost Electric Mfg. Co 17

For Classified Index of Advertisements See Page 6.

REMEMBER THE NAME AND BUY THE BEST.

PARAGON FAN MOTORS

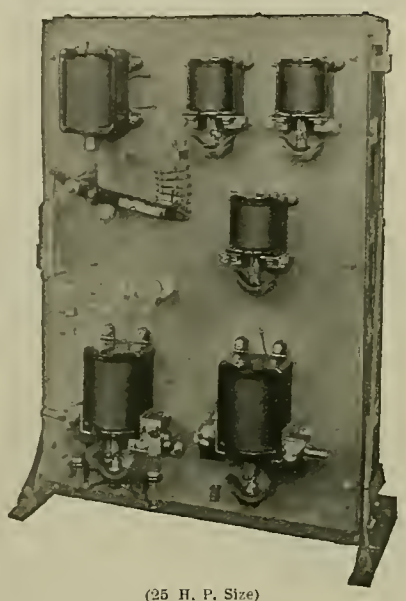
NEW STYLES NEW PRICES
EASY RUNNING RIGID CONSTRUCTION NOISELESS

CALL AND SEE THEM OR WRITE FOR PRICES

CHICAGO EDISON COMPANY,
139 ADAMS ST., CHICAGO.

C H

QUALITY



QUALITY

(25 H. P. Size)

SELF-STARTERS
FOR
Large Motors

THE CUTLER-HAMMER MFG. CO.
MILWAUKEE
WIS.

New York
136 Liberty St.

Boston
176 Federal St.

Pittsborg
322 Frick Building

Chicago
1232 Monadnock Bldg.

HENRY NEWGARD & CO.

ELECTRICAL CONSTRUCTION

Power and Light Plants. Switchboards and Panel Boards.

We install Municipal and Isolated Electric Lighting Plants.
We manufacture Switchboards, Table boards, Iron Cutout Boxes and Electrical Specialties.
We sell Dynamos, Motors and Electrical Supplies.
We wire old as well as new Residences, Factory Buildings, School and College Buildings.

87 Fifth Avenue, Chicago, Illinois.

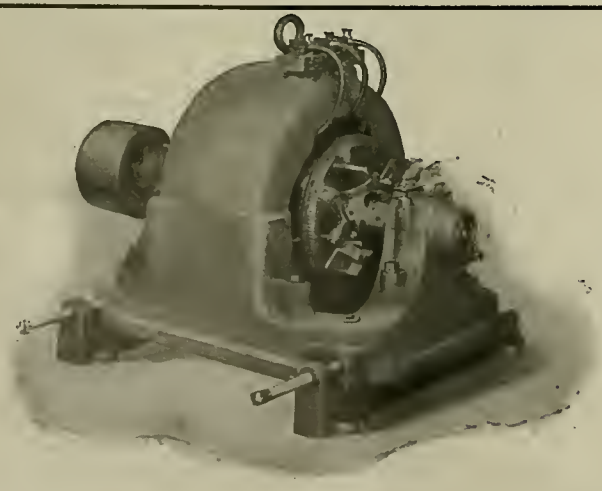
Weatherproof Wire

"ONE OF OUR 61 VARIETIES."

LARGE QUANTITIES CARRIED REGULARLY IN TOLEDO STOCK

We also carry large stocks of other wires for both lighting and telephone work.
Write for Bulletin W 6.

THE F. BISSELL COMPANY
Manufacturers and Jobbers of
ELECTRICAL GOODS
226-228-230 HURON STREET
TOLEDO, O.



CENTRAL STATION MANAGERS

Don't Be Afraid

of the Gas Plant

WORK UP A MOTOR LOAD

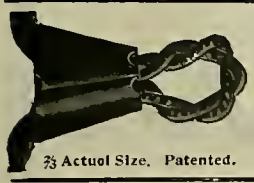
We can furnish you

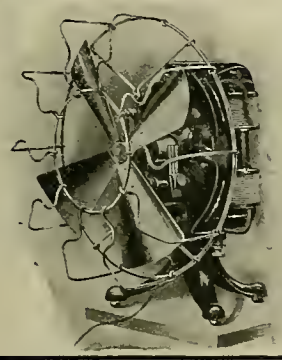
SINGLE PHASE MOTORS

that will start under full load in sizes ranging from 1/8 to 35 H. P.

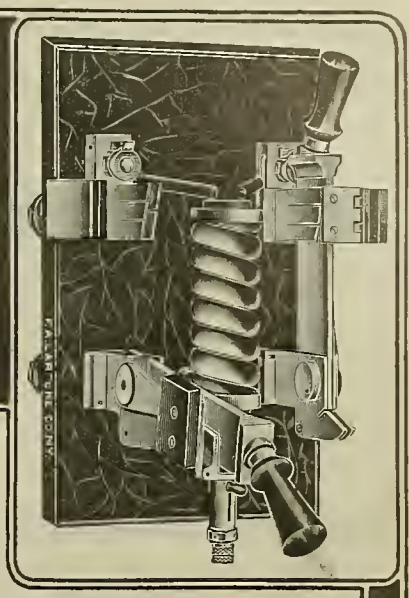
Wagner Electric Mfg. Co.
ST. LOUIS, MO., U. S. A.

ELECTRIC SIGN
FLASHERS
BEST IN THE WORLD
Write for full particulars
Reynolds Elec. Flashar Mfg. Co.
221 Fifth Ave., Chicago.


CROWN CORD ADJUSTER
BEST AND SIMPLEST. MADE OF HARD RUBBER.
No Slip, No Abrasion, No Removing socket, Easily attached
Price $4.00 Per Hundred. Liberal Discount to the Trade.
Sample Free.
⅔ Actual Size. Patented. J. H. SEAMAN, 175 Dearborn St., Chicago


Edison Battery Fan Outfits
"Keep cool while others swelter." Dealers should pass this advice along to customers and tell them that the way to do it is to equip their houses with an Edison Battery Fan Motor. Send for Booklet No. 7 F.
EDISON MANUFACTURING CO.,
TRADE Thomas A. Edison MARK
Factory, ORANGE, N. J.
NEW YORK, 83 Chambers St.
CHICAGO, 304 Wabash Ave.

155
NORTHERN SMALL MOTORS
Compact....Efficient....Superior
High type of construction....susceptible of good speed variation....multipolar....form-wound armatures....simple....hardy....trustworthy.
Booklet No. 3325
NORTHERN ELECTRICAL MFG. CO.
Engineers...Manufacturers Madison, Wis., U. S. A.

THE IDEAL AND VICTOR CIRCUIT — BREAKERS

FOR DIRECT AND ALTERNATING CURRENT
NO CASTINGS
Made of Pure hard drawn copper and case hardened steel. Easily adjusted. Carbon breaks. Automatically locking joints. Large range of adjustment above and below actual rating.
—WESTERN AGENTS—
J. B. McKEAGUE CO.
324 Dearborn Street CHICAGO, ILL.
F. A. LA ROCHE COMPANY
652-664 HUDSON STREET
NEW YORK

The Electrician Publishing Co., 510 Marquette Bldg., Chicago. Headquarters for all latest Electrical Books. Write for Catalogue.

OKONITE
TRADE MARK.
A TRIAL
OKONITE
TRADE MARK
of OKONITE WIRES AND CABLES will do more to convince you of their merits than several years' advertising.
SEND US YOUR ORDER AND BE CONVINCED.
OKONITE IT NEVER DISAPPOINTS
Central Electric Company,
GENERAL SALES AGENTS
264-266-268-270 FIFTH AVENUE, CHICAGO
OKONITE IT NEVER DISAPPOINTS

STANLEY RECORDING WATTMETERS
FOR ALTERNATING CURRENT CIRCUITS
BALANCED THRUST
NO JEWEL WEAR FROM HAMMER OR SIDE THRUST. GLASS OR METAL COVERS—SECOND ALONE TO THE
STANLEY MAGNETIC SUSPENSION WATTMETERS
Send for Bulletins and Information About Meters to
STANLEY INSTRUMENT CO., Great Barrington, Mass., U. S. A.
EUROPEAN OFFICE, 23 BOULEVARD DES ITALIENS, PARIS, FRANCE.
SALES AGENTS:
Missouri, Kansas, Arkansas, FRANK ADAMS ELECTRIC COMPANY, St. Louis.
Colorado, Idaho, Montana, Wyoming, New Mexico, Utah, HENDRIE-BOLTBOFF MFG. AND SUPPLY CO., San Francisco.
California, Oregon, Washington, Nevada, Arizona. BROOKS-FOLLIS ELECTRIC CORP. San Francisco.
Mexico, VICTOR M. BRASCHI & COMPANY, Mexico City.

There is No Higher-Class India-Rubber Insulation
For Wires and Cables than

HABIRSHAW.

Authorized Manufacturers of the
ATTIX FLEXIBLE TUBE WIRE.

The India-Rubber and Gutta-Percha Insulating Co.,
MAIN OFFICE, Glenwood Works,
Sales Office,
15 Cortlandt St., New York.
YONKERS, N. Y.
(10928)

CLASSIFIED INDEX OF ADVERTISEMENTS.

Adjusters, Cord.
Crescent Co.
Incandes. El. Lt. Manip. Co.
Seaman, J. H.

Adjusters, Inc. Lamps.
Inc. El. Lt. Manipulator Co.

Anchors (Tel. & Tel.)
Matthews & Bro., W. N.
Crouse-Hinds Co.

Annunciators.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Moon Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Batteries and Jars.
Bissell Co., The F.
Central Electric Co.
Columbus Storage Battery Co.
Edison Mfg. Co.
Edwards & Company.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Bells, Buzzers, Etc.
Central Electric Co.
Edwards & Co.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Belt Dressing.
Dixon Crucible Co., Jos.
Leather Preserver Mfg. Corp.

Belting.
Leather Preserver Mfg. Corp.

Blowers.
Sturtevant Co., B. F.

Boiler Compounds.
Dearborn Drug & Chem. Wks.

Boilers.
Allis-Chalmers Company.
Babcock & Wilcox Co.

Books, Electrical.
Electrician Publishing Co.

Booths, Telephone.
Seaman & Co., W. S.
Yesbera Mfg. Co.

Brackets.
Faries Mfg. Co.

Brushes.
Central Electric Co.
Hobart Elec. Mfg. Co.
Holmes Fibre-Graphite Co.
Speer Carbon Co.
Western Electric Company.

Cable Hangers.
National Tel. Supply Co.
Western Electric Co.

Cables (See Wires and Cables)

Canopies.
Faries Mfg. Co.

Carbons, Points and Plates.
Central Electric Co.
Chicago Edison Co.
Consumers Carbon Co.
Electric Appliance Co.
National Carbon Co.
Reisinger, Hugo.
Speer Carbon Co.
Wesco Supply Co.
Western Elec. Supply Co.

Castings.
Faries Mfg. Co.
New England Butt Co.
National Electric Co.

Chains.
Jeffrey Mfg. Co.

Chandeliers.
Faries Mfg. Co.

Circuit Breakers.
Cutler-Hammer Mfg. Co.
Cutter Elec. & Mfg. Co.
Ft. Wayne Elec. Wks. Inc.
La Roche Co., F. A.
Union Electric Mfg. Co.
Western Electric Company.
Westinghouse El. & Mfg. Co.

Clusters.
Faries Mfg. Co.

Clutches, Electrical and Mechanical.
Akron Electrical Mfg. Co.

Coal and Ashes Handling Machinery.
Jeffrey Mfg. Co.

Coils and Magnets.
Varley Duplex Magnet Co.
Western Electric Co.

Commutator Compound
Allen Co., L. B.
Egan, J. J.
McLennan & Co., K.

Commutator Truing Device.
Akron Electrical Mfg. Co.

Conduit and Conduits.
American Circular Loom Co.
American Conduit Company
Central Electric Co.
Electric Appliance Co.
Osborn Flexible Conduit Co.
Sprague Electric Co.
Standard Vitrified Cond. Co.
Wesco Supply Co.
Western Electrical Supply Co.

Contractors and Electric Light Plants.
Allis-Chalmers Company.
Bullock El. Mfg. Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
National Electric Co.
Northern Electrical Mfg. Co.
Sprague Electric Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Controllers, Crane.
Amer. Elec. Fuse Co.

Cross-Arms, Pins and Brackets.
Bertheid & Jennings.
Central Electric Co.
Lewis Lumber & Mfg. Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Company.
Western Elec. Supply Co.

Cut-Outs and Switches.
Bissell Co., The F.
Bossert Elec. Const. Co.
Central Electric Co.
Chicago Edison Co.
Crouse-Hinds Co.
Cutter Elec. & Mfg. Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
General Inc. Arc Light Co.
Hart Manufacturing Co.
La Roche Co., F. A.
Manhattan Elec. Supply Co.
Trumbull Elec. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Dynamos and Motors.
Akron Electrical Mfg. Co.
Allis-Chalmers Company.
Bissell Co., The F.
Bullock Elec. Mfg. Co.
Central Electric Co.
Century Electric Co.
Crawfordsville Electric Co.
Crocker-Wheeler Co.
Dustin Co., Chas. E.
Ft. Wayne Elec. Wks. Inc.
General Elec. Co.
General Inc. Arc Light Co.
Gregory Electric Co.
Hobart Elec. Mfg. Co.
Mechanical Appliance Co.
National Electric Co.
Northern Electrical Mfg. Co.
Sprague Electric Co.
Stow Manufacturing Co.
Sturtevant Co., B. F.
Wagner Electric Mfg. Co.
Warren Elec. Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Economizers, Fuel.
Green Fuel Economizer Co.

Electric Heating Appl.
American Elec. Heater Co.
Simplex Elec. Heating Co.
Western Electric Co.

Electric Railways.
Crocker-Wheeler Co.
General Electric Co.
Sprague Electric Co.
Westinghouse El. & Mfg. Co.

Electrical and Mechanical Engineers.
Arnold Elec. Power Stat'n Co.
Baker & Co., W. E.
Bryan, Wm. H.
Butterfield, J. F.
Byllesby & Co., H. M.
General Engineering Co., Tbc.
Hallberg, J. H.
Hornaday, J. P. & Co.
Rumphrey, Benry H.
Hunt & Co., Robt. W.
Jackson, D. C. & W. B.
Kobler Brothers.
Newgard & Co., Henry.
Northern Electrical Mfg. Co.
Ruehel, Schwedtman, Wells.
Sargent & Lundy.
Schott, W. H.
Squire Electric Co.
Stanton, LeRoy W.
Wilmerding, C. H.

Electrical Instruments. (Recording and Testing.)
Bissell Co., The F.
Central Electric Co.
Diamond Meter Co.
Duncan Elec. Mfg. Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
General Inc. Arc Light Co.
Illinois Elec. Specialty Co.
Jewell Electrical Inst. Co.
Machado & Roller.
Norton Elec'l Instrument Co.
Pignolet, L. M.
Stanley Instrument Co.
Wagner Electric Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.
Weston Electrical Inst. Co.

Electro-Plating Mach'y
Crocker-Wheeler Company.
General Electric Co.

Elevators-Conveyors.
Jeffrey Mfg. Co.

Engines, Gas and Gasoline.
Allis-Chalmers Company.
Marinette Gas Engine Co.
Olds Gasoline Engine Works.
Woolley Fdy. & Mach. Wks.

Engines, Steam.
Allis-Chalmers Company.
Amer. Diesel Engine Co.
Dustin Co., Chas. E.
Sturtevant Co., B. F.

Fans and Fan Motors.
Central Electric Co.
Crocker-Wheeler Company.
Edison Mfg. Co.
General Electric Co.
General Inc. Arc Light Co.
Sprague Electric Co.
Sturtevant Co., B. F.
Wesco Supply Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Fibre.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Files.
Barnett Co., G. & H.

Fittings.
Faries Mfg. Co.

Fixtures, Gas and Elec.
Beardslee Chandelier Mfg. Co.

Flashers.
Bissell Co., The F.
Haller Machine Co.
Reynolds El. Flasher Mfg. Co

Flexible Shafts.
Stow Mfg. Co.

Forges.
Sturtevant Co., B. F.

Fuses and Fuse Wire.
Amer. Elec. Fuse Co.
Bissell Co., The F.
Central Electric Co.
Central Tel. & El. Co
Chicago Die & Electric Co.
Chicago Fuse Wire & Mfg. Co.
D. & W. Fuse Company.
Electric Appliance Co.
Johns-Manville Co., H. W.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Company.
Western Elect. Supply Co.

Globes, Reflectors and Shades.
Fostoria Incan. Lamp Co.
Haller Machine Co.
Holophane Glass Co.
Pardridge Shade & Refl. Co.
Phœnix Glass Co.
Wesco Supply Co.
Western Electric Co.
Western Elect. Supply Co.

Graphite Specialties.
Dixon Crucible Co., Jos.
Holmes Fibre-Graphite Co.

Heating (Exhaust Steam).
Amer. District Steam Co.

Heating and Ventilating Apparatus.
Sturtevant Co., B. F.

Holders, Inc. Lamps.
Incandesent Electric Light Manipulator Co.

Inspection & Insurance
Hartford Steam Boiler Inspection & Insurance Co.

Insulating Machinery.
New England Butt Co.

Insulators and Insulating Materials.
Akron Electrical Mfg. Co.
American Electrical Works.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Inc. Arc Light Co.
Indiana Rub. & Ins. Wire Co.
Johns-Manville Co., H. W.
Kartavert Mfg. Co.
Manhattan Elec. Supply Co.
Mica Insulator Co.
Munsell & Co., Eugene.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Standard Vitrified Cond. Co.
Sterling Varnish Co.
Vulcanized Fibre Co.
Wesco Supply Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Junction Boxes.
Bossert Elect. Const. Co.
General Inc. Arc Light Co.

Lamps, Arc.
Bissell Co., The F.
Central Electric Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
General Inc. Arc Lt. Co.
Gregory Electric Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Lamps, Incandescent.
Bissell Co., The F.
Bryan-Marsh Company.
Buckeye Electric Company.
Central Electric Co.
Chicago Edison Co.
Columbia Incan. Lamp Co.
Edison Decorative & Miniature Lamp Dept.
Electric Appliance Co.
Fostoria Incand. Lamp Co.
General Electric Co.
General Inc. Arc Light Co.
Standard Elec'l Mfg. Co.
Sterling Electrical Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Lamps, Incandescent—Replacers & Cleaners.
Inc. El. Lt. Manipulator Co.

Letters, Metal.
Haller Machine Co.

Lightning Arresters.
Central Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
Manhattan Elec. Supply Co.
Minnesota Electric Co.
Western Electric Co.

Linemen's Climbers.
Klein & Sons, Mathias.

Magnet Wires.
(See Wires and Cables.)

Mechanical Draft.
Sturtevant Co., B. F.

Mica.
Chicago Mica Co.
Mica Insulator Co.
Munsell & Co., Eugene.

Mining Apparatus, Elec.
Allis-Chalmers Company.
Crocker-Wheeler Company.
General Electric Co.
Jeffrey Mfg. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Motors. (See Dynamos and Motors.)

Nippers and Pliers.
Klein & Sons, Mathias.

Novelties, Glass, Elec.
Ithaca Elect'l Novelty Co.

Nuzzles.
Faries Mfg. Co.

Paints.
Dielectric Mfg. Co.

Patent Attorneys.
Bain, Foree.

Phosphor Bronze.
Phosphor Bronze Sm. Co. Ltd.

Platinum, Wire and Sheet.
Baker & Company Inc.

Poles and Ties.
Berthold & Jennings.
Brooks, Hall L.
Columbia Mfg. Co.
Coolidge Co., Marshall H.
Fowler, John H.
Fowler-Jacobs Company.
Kellogg Switch. & Sup. Co.
Lewis Lumber & Mfg. Co.
Lindsley Bros. Co.
Loud's Sons Co., H. M.
Maltby Lumber Co.
Morrison Lbr. Co., J. W.
Mueller Company, William.
Pacific Coast Pole Co.
Page & Hill Company.
Phelan, D. W.
Pittsburg & L. S. Iron Co.
Porter Cedar Company.
Sterling & Son, W. C.
Thompson, S. E.
Torrey Cedar Co.
Valentine-Clark Co., The.
Western Lumber & Pole Co.
Worcester Co., C. H.

Polish (Metal).
Allen Co., Inc., L. B.
Koffman, Geo. W.

Portables.
Faries Mfg. Co.

Power Transmission Machinery.
Jeffrey Mfg. Co.

Rail Joints.
Continuous Rail Joint Company of America.

Refiners.
Gt. West Smelt. & Refining Co

Re-Winding—Repairs.
Chicago Edison Co.
Gregory Electric Co.
Miller Electric Co.

Rheostats.
Cutler-Hammer Mfg. Co.
General Electric Co.
Gen'l Inc. Arc Lt. Co.
Union Electric Mfg. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Rods, Conduit.
Cope, T. J.

Schools and Colleges.
Electrical Engineer Inst.
Highland Park College
Michigan College of Mines.
Pratt Institute.
State Univ. of Iowa.

Second-Hand Mach'y.
Bissell Co., The F.
Cent. Stat. Improvement Co.
Gregory Electric Co.
Matthews & Bro., W. N.
Northwestern Electric Co.
Walsh's Sons & Co.

Shades, Lamp.
Faries Mfg. Co.

Sheet Brass & Copper.
Plume & Atwood Mfg. Co.

Signs, Electric.
Haller Machine Co.

Sockets & Receptacles.
Pass & Seymour.
Yost Elec. Mfg. Co.

Soldering Sticks, Salts and Paste.
Allen Co., L. B.
Crescent Co.
Kester Elec. Mfg. Co.
Western Electric Co.

Speaking Tubes.
Central Electric Co.
Edwards & Co.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.
Wester Elec. Supply Co.

Specialties, Electrical Mfrs. and Designers.
Haller Machine Co.

Speed Indicators.
Weston Electrical Inst. Co.

Storage Batteries.
American Battery Co.
Electric Storage Battery Co.
Gould Storage Battery Co.

Supplies, General Elec.
Bissell Co., The F.
Central Electric Co.
Century Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Electric Co.
Manhattan Elect'l Supply Co.
Wesco Supply Co.
Western Electric Co.
Western Elect. Supply Co.

Switchboards.
Bissell Co., The F.
Crouse-Hinds Co.
Gen. Incan. Arc Light Co.

Telephones, Telephone Materials and Switchboards.
American El. Telephone Co
Automatic Electric Co.
Bissell Co., The F.
Central Electric Co.
Central Tel. & El. Co.
International Tel. Mfg. Co.
Kellogg Switchb. & Sup. Co.
Manhattan Elec. Supply Co.
Moon Mfg. Co., The.
Murdock & Co., Wm. J.
National Elec. Signalling Co.
Stromberg-Carlson Tel. M. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Time Switches.
Bissell Co., The F.
Hartford Time Switch Co.

Tools.
Klein & Sons, Mathias.
Western Electric Co.

Transformers.
Central Electric Co.
Crawfordsville Electric Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Works, Inc.
General Electric Co.
Gregory Electric Co.
Kuhlman Electric Co.
Manhattan Elec. Supply Co.
National Electric Co.
Wagner Electric Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Trucks, Electric Car.
General Electric Co.
Westinghouse El. & Mfg. Co.

Turbines, Steam.
Allis-Chalmers Co.
General Electric Co.
Westinghouse El. & Mfg. Co

Turbine Water Wheels
Leffel & Co., Jas.

Varnishes.
Dielectric Mfg. Co.
Sterling Varnish Co.

Vulcanized Fibre.
Vulcanized Fibre Co.

Wireless Tel. App'tus.
Clark Wirel. Tel. & Tel. Co. T. E
National Elec. Signalling Co

Wires & Cables—Magnet Wires.
American Electrical Works.
Bissell Co., The F.
Central Electric Co.
Chicago Insulated Wire Co.
Crescent Ins. Wire & Cble. Co.
Driver-Harris Wire Co.
Electric Appliance Co.
General Electric Co.
Hazard Manufacturing Co.
Indiana Rub. & Ins. Wire Co
India Rubber & Gutta Percha Insulating Co.
Kellogg Switch. & Sup. Co.
Manhattan Elec. Supply Co.
National India Rubber Co
New York Insulated Wire Co.
Okonite Co., The.
Phillips, Eugene F.
Phillips Insulated Wire Co
Reebling's Sons Co., J. A.
Safety Ins. Wire & Cable Co.
Simplex Electrical Co.
Standard Underground C. Co
Wesco Supply Co.
Western Electric Company.
Western Elec. Supply Co.

For Alphabetical Index of Advertisements See Page 3.

The National Electrical Code (Supplement April, 1904)

Says: "The linings (of Flexible Tubing) must be secured in position so that they cannot be readily removed."

"FLEXDUCT"

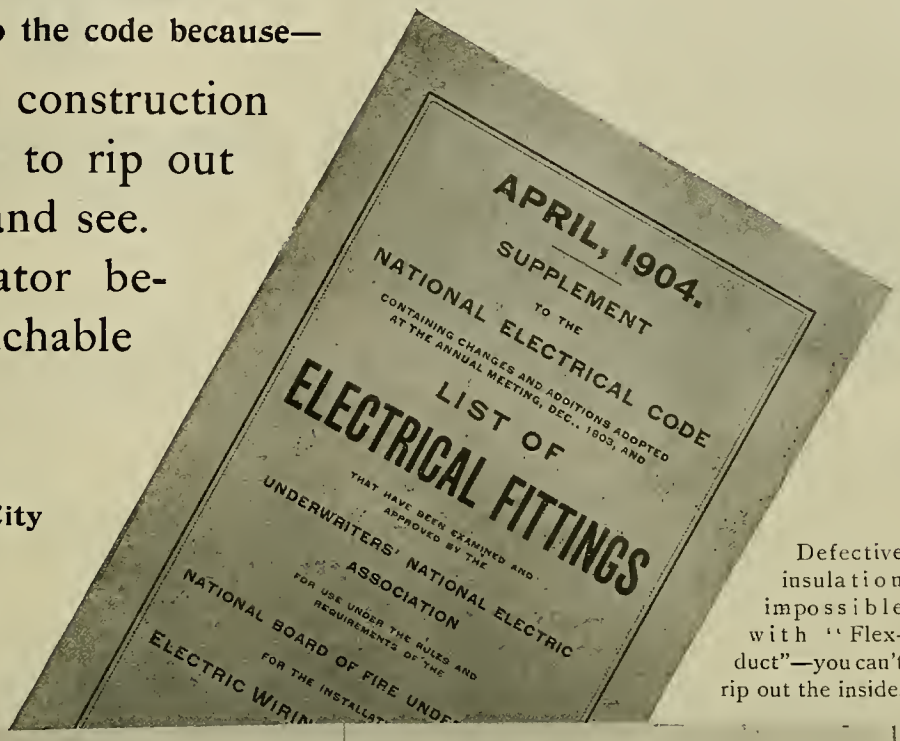
absolutely conforms to the code because—

Its peculiarly woven construction makes it impossible to rip out the inside. Try it and see.

The safest insulator because of its non-detachable interior.

Osburn Flexible Conduit Co.,
General Sales Offices,
19-21 Park Row, New York City

I. A. BENNETT,
General Western Manager
529-30 Monadnock Blk, Chicago.



Defective insulation impossible with "Flexduct"—you can't rip out the inside.

Flexduct is moisture proof, is the best mechanical protector.

Has the smoothest interior.

Is the most flexible.

This is what the Code says. Have you read it?

Write for our interesting booklet giving full particulars about "Flexduct."

6 LIST OF ELECTRICAL FITTINGS.

Also amend by striking out the second paragraph of the fine print note.

Rule 43*a*. Amend to read as follows:

"The insulation must consist of layers of cotton or other thread, all the interstices of which must be filled with the fireproofing compound, or of material having equivalent fire resisting and insulating properties. The outer layer must be braided and specially designed to withstand abrasion. The thickness of insulation must not be less than that required for slow-burning weatherproof wire and the outer surface must be finished smooth and hard."

"The solid constituent of the fireproofing compound must not be susceptible to moisture, and must not burn even when ground in an oxidizable oil, making a compound which, while proof against fire and moisture, at the same time has considerable elasticity, and which when dry will suffer no change at a temperature of 250° F., and which will not burn at even a higher temperature.

Rule 50 C. Flexible Tubing.

The following specifications are designed to cover the construction of flexible tubes for fished work, loop system and for mechanical protection to wires where not exposed to moisture.

Tubes complying with these requirements must not be used for a conduit system of wiring.

a. Must be constructed to meet the following requirements:

Must have a sufficiently smooth interior surface to allow the ready introduction of the wire.

Must be constructed of or treated with materials which will serve as moisture repellants.

Must have a substantial outer covering especially designed to withstand abrasion.

b. The linings must be secured in position so that they cannot be readily removed.

c. The tube must be thoroughly flexible at all temperatures at which it is to be used.

LIST OF ELECTRICAL FITTINGS. 7

d. Must not crack or break when kinked or flattened out.

e. Must be sufficiently tough and tenacious to withstand severe tension without injury; the interior diameter must not be diminished or the tube opened up at any point by the application of a reasonable stretching force.

f. Must not close to prevent the insertion of the wire after the tube has been kinked and straightened out, or flattened.

g. Must not soften injuriously, or cause the wire to stick within the tube when subjected to a temperature of 150° Fahr.

Rule 51*b*. Amend first fine print note by striking out the first two words "on switchboards" and inserting in place thereof the words "for 100 ampere switches and larger."

In the third line of the same note strike out the words "on switchboards."

Change the last fine print note to read as follows:

"For three-wire Edison systems the separations and break distances for plain three-pole knife switches must not be less than those required in the above table for switches designed for the voltage between the neutral and outside wires."

Rule 54 A. New Rule—Rosettes.

Ceiling rosettes, both fused and fuseless, must be constructed in accordance with the following specifications:

a. Base—Current-carrying parts must be mounted on non-combustible, non-absorptive insulating bases. There should be no openings through the rosette base except those for the supporting screws and in the concealed type for the conductors also, and these openings should not be made any larger than necessary.

There must be at least 1/4" space, measured over the surface, between supporting screws and current-carrying parts. The supporting screws

SPEER HIGH GRADE CARBON BRUSHES

MOTOR AND GENERATOR CARBON BRUSHES

SPEER CARBON CO., - St. Marys, Pa.

New Soldering Stick

"CRESCENT"

Is Pliable and Plastic, Not Brittle!

Entirely different from any other: no waste; no sputtering; nocorrosion.

CRESCENT CO., 403 OMAHA BLDG., CHICAGO.

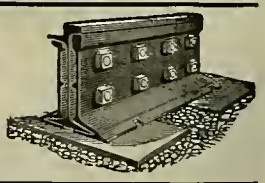
CONTINUOUS RAIL JOINT CO. OF AM.

General Offices: Century Building

NEWARK, N. J.

OVER 20,000 MILES IN USE

Highest Award at Paris Exposition, 1900, Buffalo, 1901



THE

Hartford Time Switch

A mechanically operated switch, which turns lights ON and OFF at such hours as the user desires with no further attention than the weekly winding.

Approved Mechanically as well as Electrically

Showing double doors, Seth Thomas eight-day movement, auxiliary cut-out, auxiliary hand-trip, and switch indicator.

For controlling current used for show window lights, electric sign lights, street lights, apartment house hall lights, motors, batteries, burglar alarms. :: 10, 20, 35 and 50 Amperes. 250 Volts. 1, 2 and 3 Poles.

Consult us regarding any requirements

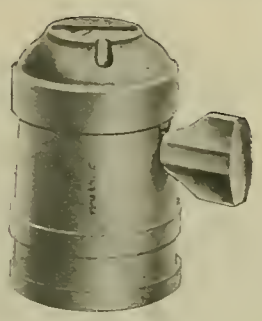
SEND FOR CATALOGUE

The Hartford Time Switch Co.

440 Asylum St., HARTFORD, CONN., U.S.A.

New York City:
A. Hall Berry, 97-99-101 Warren Street

London, England:
Verityn, Ltd., 31, King Street, Covent Garden, S. W.



P. & S. Porcelain Sockets

More of these sockets are now being used than ever before.

Write For Prices

To use with new code card.

PASS & SEYMOUR, Inc.,

SOLVAY, N. Y.

NEW YORK. CHICAGO.
BOSTON. SAN FRANCISCO.

TRADE **G. I.** MARK

WE WILL MAIL YOU ANY OF THE FOLLOWING BULLETINS IF YOU WILL WRITE FOR THEM:

Arc Lamps and Arc Lamp Accessories.	Bulletin No.
D. C. Multiple, 100 to 125 V. Arc Lamps "O"	271
D. C. Series C. P. 200 to 600 V. Arc Lamps "L 3"	174
D. C. Series Constant Current Arc Lamps "L 5"	175
A. C. Multiple, 60 to 133 Cycle Arc Lamps "L 6"	282
Instruction Bulletin "L 6" Arc Lamps	1
A. C. Arc Lamps "L 7" Series Shuntwound	383
A. C. Differential Arc Lamps "L 8" Series	383
D. C. Multiple, 100 to 125 V. Lamps, "L 11" and "L 21"	372
Instruction Bulletin "L 11" and "L 21" Arc Lamps	3
D. C. Multiple, 200 to 250 V. Arc Lamps, "L 12"	273
Instruction Bulletin "L 12" Arc Lamps	4
Arc Lamp Parts, etc., for G. I. Arc Lamps	176
Lightning Arresters, Choke Coils and Line Dischargers	358
Concentric Arc Light Diffuser Outfits	313
Hanger Board for Multiple Arc Lamps	332
Combined Hanger and Absolute Cutout	333
Carbons for Enclosed Arc Lamps	300

Switches and Circuit Breakers.	
Automatic Switches	157
Flush Push-button Switches	254
Knife Switches, Slow and Quick Break	150
Oil Switches and High-tension Apparatus	153
Pendant Push-button Switches	377
Stab Switches, for Series Arc or Incandescent Circuits	327
Volt and Ammeter Switches	255
Circuit Breakers, Under and Overload	252
Circuit Breakers, Special Small Sizes (Type C. B.)	253

Motors and Generators	Bulletin No.
D. C. Motors and Generators	364
A. C. Small Motors	166
Grinding and Buffing Motors	360
Rotary Converters and Motor Generators	264
D. C. and A. C. Sewing Machine Transmitters	165
D. C. Desk Bracket and Trunnion Fan Motors	362
D. C. Ceiling Fans	261

Panels and Switch Boards.	
Automobile Charging Panels	115
Small Plant Switch Panels	309
Plug Panel Boards	107
Switchboards, High and Low Tension	150
"G. I." Panel Boards and Fuse Carriers	51

Boxes, Plugs, Receptacles, Instruments and Meters.	
Primary Fuse Box, Insulator Type	369
Floor Outlet Box (watertight)	194
Underground Apparatus, Junction Boxes	291
Flush Receptacles and Plugs	254
Flush Wall Pocket Receptacle	319
Protective Fuse Devices	324
S. K. C. Instruments	335
Portable and Small Pocket Type Volt and Ammeters	302
Wright Demand (Discount) Meters	193
Round Pattern Voltmeters and Ammeters	363
"G. I." Incandescent Lamps	390

GENERAL INCANDESCENT ARC LIGHT CO.

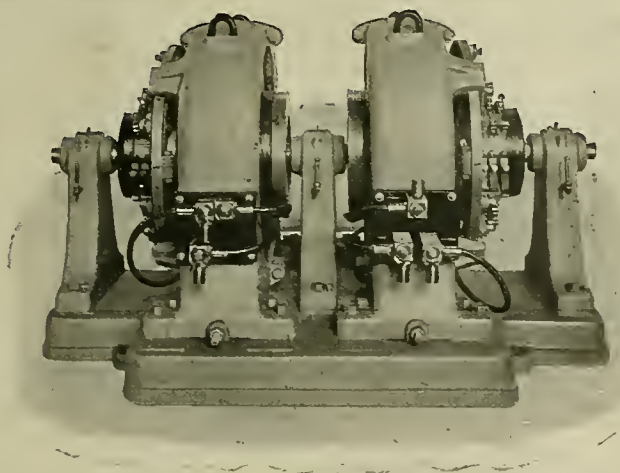
529 W. 34TH STREET, NEW YORK

CHICAGO
BOSTON
PHILADELPHIA

CLEVELAND
CINCINNATI
ST. LOUIS

DENVER
BUTTE
SAN FRANCISCO

LOS ANGELES
SEATTLE



WESTERN ELECTRIC COMPENSATOR

DIRECT CURRENT

Generators and Motors

Bulletins on Request

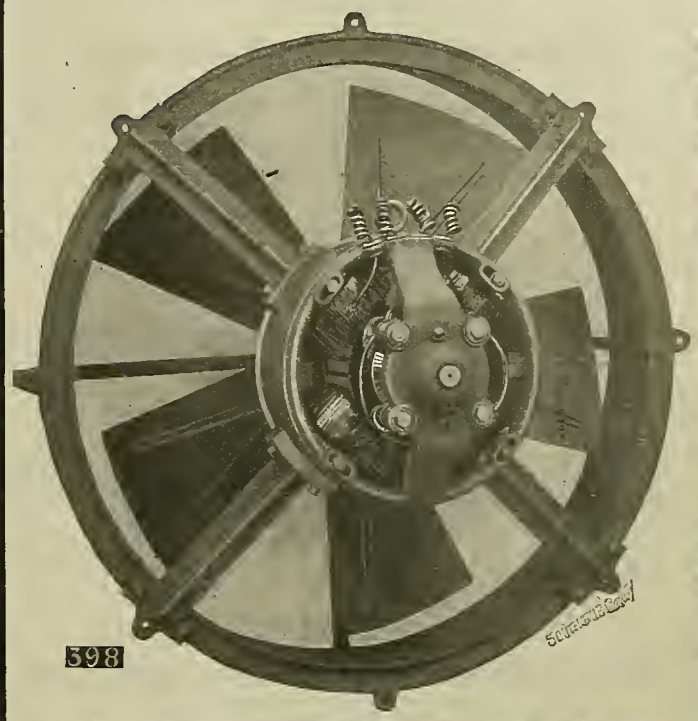
Western Electric Company

Chicago New York
Saint Louis Denver
Philadelphia Kansas City
Pittsburg

San Francisco (California Electrical Works) Cincinnati (Standard Electric Company) Saint Paul (American Electric Company)
Space 17, Electricity Bldg., Louisiana Purchase Exposition.

Bullock Electric Mfg. Co.

CINCINNATI, OHIO, U. S. A.

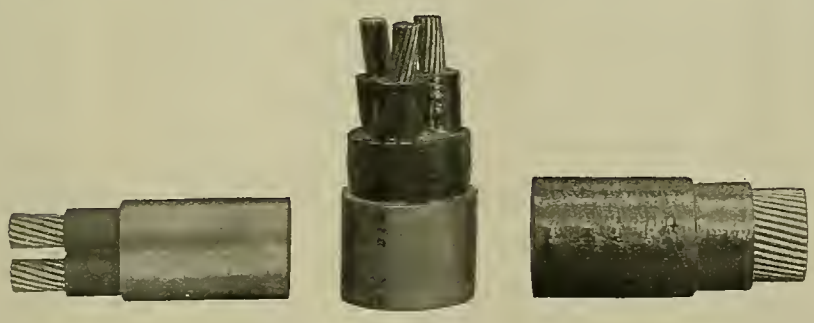


Type "N" Bullock Motor direct connected to exhaust fan.
Modern practice dictates the use of the electric drive.
It is economical—Bullock type "N" Motors are particularly adapted for this purpose.

General Electric Company

Manufacturers all Forms of **Insulated Wires and Cables**

Rubber,
Varnished
Cambric,



Paper,
Asbestos,
Weatherproof

Write for information concerning Wires and Cables insulated with our special form of Varnished Cambric. This insulation is equal and in many respects superior, to high grade rubber insulation and considerably cheaper.

General Office: SCHENECTADY, N. Y.

Chicago Office: Monadnock Block

Sales Offices in all large Cities

THE CONTRACT ROAD

The lamp market is a jungle where you are liable to get lost or swamped—and sure to get bit—unless you know the way. These sign boards will set you on the trail:

1st Sign—PACKARD. Turn sharply to the right here.

2nd Sign—CONTRACT. Now the path lies straight before you. It is your individual right of way and will lead you to the best lamp and the best prices.

Lamps bought on contract are "tailor made." Literally fitted to the plant. The far-sighted buyer will avail himself of contract advantages.

ELECTRIC APPLIANCE COMPANY

ELECTRICAL SUPPLIES

CHICAGO and SAN FRANCISCO

EDISON TELEPHONE LAMPS

ARE

The Standard for Visual Signals.

They save the "Exchange" time and money; because every lamp is perfect. Sure to fit. Sure to burn. The life is extremely long—running into years.

Be sure to get the EDISON.

EDISON DECORATIVE & MINIATURE LAMP DEPT.,

General Electric Company, Harrison, N. J.

CHICAGO OFFICE, MONADNOCK BLOCK.

MICA

Of all Qualities, in any Form at Lowest Prices

EUGENE MUNSELL AND CO.

NEW YORK and CHICAGO

INSULATION That Is.

Micanite, Linotape, M. I. C. Compound, Empire Cloth and Paper. For Years the Standard.

MICA INSULATOR CO., Originators

NEW YORK and CHICAGO

BEARDSLEE CHANDELIER M'F'G CO. 256 AND 257 SO. CANAL ST. CHICAGO

GAS & ELECTRIC FIXTURES FOR THE TRADE.

CATALOG SENT PREPAID TO DEALERS — MENTION THIS PAPER

YOU NEED IT!

Cale's Commutator Compound.

The Only Article That Will Prevent Sparking.

Will keep the Commutator in good condition and prevent cutting. Absolutely will not gum the brushes.

50c. per stick. $5.00 per dozen Send 50c. for trial stick.

FOR SALE BY ALL SUPPLY HOUSES OR

K. McLENNAN & CO., Sole Manufacturers, Room 411 Inter Ocean Bldg., 130 Dearborn Street . CHICAGO

M. KLEIN & SON.

Send 2c stamp for new catalogue No. 6 of

KLEIN'S TOOLS

For Electrical Workers and Line Builders.

MATHIAS KLEIN & SONS,

81 W. Van Buren St., Chicago, Ill.

WE PUT THE MICA-POOL OUT OF BUSINESS.

MICA and MICABOND.

CHICAGO MICA CO., - VALPARAISO, IND.

VOLT - AMMETERS,

POCKET SIZE,

For Testing Batteries and Battery Circuits, Locating Faults, Grounds, etc.

RELIABLE. ACCURATE.

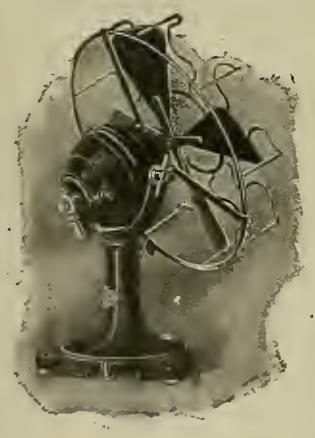
Send for Circular.

L. M. PIGNOLET,

78-80 Cortlandt St., NEW YORK, N. Y.

ELECTRIC

FANS



THE POPULARITY

of our fans is due to their superior design and construction. They have been imitated many times, but never equaled.

Write for Catalogue No. 30614

SPRAGUE

ELECTRIC COMPANY

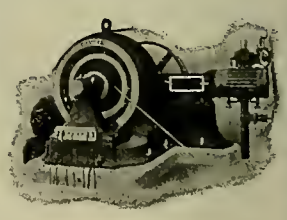
General Offices:
527 West 34th Street, New York.
Chicago Office: Fisher Bldg.

Crocker-Wheeler. Brown, Boveri.

By arrangement with the celebrated electrical engineers, Brown, Boveri & Cie. of Baden, Switzerland, the Crocker - Wheeler Company has secured their alternating current designs, patents and rights to manufacture in America, and has retained them as consulting engineers.

Crocker-Wheeler Company is now putting on the market alternating current generators, transformers and accessories of the most perfect design and construction, adapted to American practice. Opportunities to bid on this apparatus are invited.

Warren Alternator



WARREN ALTERNATORS

are profit producers and surplus swellers.

We Guarantee What We Sell

... AND ...

Sell What We Guarantee

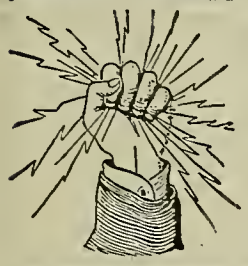
WARREN ELECTRIC MFG. CO.

Sandusky, O.

FRANK N. PHILLIPS, PRESIDENT. C. H. WAGENSEIL, TREASURER. EUGENE F. PHILLIPS, GENERAL MANAGER. E. NOWLAND PHILLIPS, VICE-PRES. S. R. NEMINGTON, JR., SEC.

AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.



BARE AND INSULATED ELECTRIC WIRE,
ELECTRIC LIGHT LINE WIRE,
INCANDESCENT AND FLEXIBLE CORDS,
Railway Feeder and Trolley Wire,
AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR WIRES.
CABLES FOR AERIAL AND UNDERGROUND USE.

NEW YORK STORE, W. J. Watson, 26 Cortlandt St.
CHICAGO STORE, F. E. Donohoe, 82 Lake St.
MONTREAL BRANCH, Eugene F. Phillips' Electrical Works.
MAIN OFFICES AND FACTORIES, PHILLIPSDALE, R.I.

W. D. PAINT.

A PERMANENT INSULATING PROTECTION FOR WOOD OR METAL. A quick drying, moisture-proofing, black paint. An elastic anti-rust coating. A jet black finishing paint, efficient and not expensive.

Write for "Data on Insulating Materials."

DIELECTRIC MANUFACTURING CO., SAINT LOUIS.

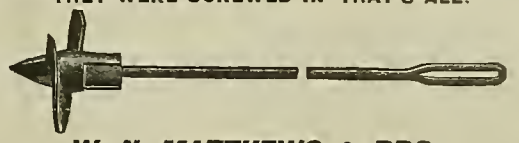
AT THE ST. LOUIS EXPOSITION

STOMBAUGH GUY ANCHORS

ARE ANCHORING

POLES ON THE INTRAMURAL RAILWAY, THE MAST OF THE DE FOREST WIRELESS TELEGRAPH CO. AND THE AERODROME BUILT FOR THE AIR SHIPS.

THEY WERE SCREWED IN—THAT'S ALL.



W. N. MATTHEWS & BRO.

603 CARLTON BUILDING ST. LOUIS

EXPERT IN ELECTRICITY MECHANICS PATENT CAUSES

SOLICITOR OF U. S. & FOREIGN **PATENTS**

FOREE BAIN, 1652-3 Monadnock Blk., CHICAGO

GET ALLEN'S SOLDERING STICKS

MAKE SOLDER FLOW

FOR ALL ELECTRIC WORK

Do it now—Get the habit.

of telling the man "ALLEN SOLDERING STICKS OR NOTHING."

A Big Sample Stick for 10c.

Booklet "Soldering Sense" describes.

L. B. ALLEN CO., Inc., SOLE MAKERS, 1383 Columbia Ave., CHICAGO.

AKRON

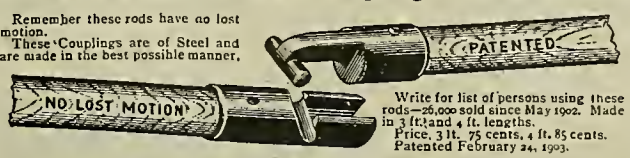
Generators, Motors, Clutches, Commutator Truing Devices.

AKRON ELECTRICAL MFG. CO., AKRON, O.

N. Y. Office: McKay Engineering Co., 149 Broadway

Cope's Patent Quick Coupling Conduit Rod

Remember these rods have no lost motion. These Couplings are of Steel and are made in the best possible manner.



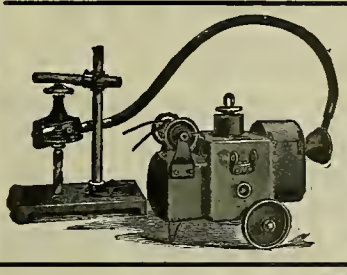
Write for list of persons using these rods—26,000 sold since May 1902. Made in 3 ft. and 4 ft. lengths. Price, 3 ft. 75 cents, 4 ft. 85 cents. Patented February 24, 1903.

T. J. COPE

3244 North Fifteenth Street PHILADELPHIA, PA.

SINGLE AND POLYPHASE TRANSFORMERS

KUHLMAN ELECTRIC CO., - - Elkhart, Ind.



ESTABLISHED 1875.
COMBINATION OF

Stow Flexible Shaft

AND

MULTI-SPEED MOTOR

Practically dust and water proof. For Portable Drilling, Tapping, Reaming, Emery Grinding, etc. Write for Catalogue and Prices.

STOW MFG. CO., Binghamton, N. Y.

Gen'l European Agents, Selig, Sonnenthal & Co. 85 Queen Victoria Street, London, England.

EDWARDS AND CO

Lock Gravity Drop Annunciator.

Extra heavy, well finished case of ornamental design. The drops being fastened to the back-board, the case may be removed without disconnecting wires.

WESTERN ELECTRIC CO., Selling Agents.

NEW YORK N.Y.

Grimshaw.

Raven White Core.

Raven Black Core.

ALL OUR WIRES pass inspection and carry the above TRADE-MARKS on our tags. We also manufacture Grimshaw and Competition Tapes and Splicing Compounds.

NEW YORK INSULATED WIRE COMPANY,

MAIN OFFICE: 114, 116 & 118 Liberty St., New York.
BRANCHES: CHICAGO: 192 Desplaines St. BOSTON: 7 Otis St. SAN FRANCISCO: 33 Second St.

NATIONAL CODE STANDARD

"O. K." Weatherproof Wire.

Slow-Burning Weatherproof and Ideal Wire.

Prices and Samples on Application.

Phillips Insulated Wire Co.

Office and Factory: PAWTUCKET, R. I.

ADJUST YOUR LIGHT

by means of our

Wall, Desk, Floor or Ceiling Adjustable Fixtures

TO ANY DESIRED POSITION INSTANTLY.

Many shapes and styles—plain and ornamental—for shop, factory, store, office, residence—in fact, wherever the incandescent lamp is used.

Catalog mailed upon request.

FARIES MFG. CO.,

DECATUR, ILL.

WANTED, FOR SALE *and similar* **WANT COLUMN** *advertisements (50 words or less), $1.50 an insertion; additional words 3c each.* **POSITION WANTED** *advertisements (50 words or less), $1.00 an insertion; additional words 2c each.*

POSITION WANTED.

As superintendent of electric light or water works plant. Sixteen years' experience with alternating-current and direct-current dynamos, motors, meters, arc lamps, wiring and construction work; eighteen years' experience with steam and water works machinery; results guaranteed. Address BOX 376, care Western Electrician, 510 Marquette Bldg., Chicago.

POSITION WANTED.

By engineer with eleven years' experience with high and low speed engines; have had three years' experience as engineer of electric-light plant; am superintendent and engineer where now located. Desire position as engineer in electric-light plant that operates day and night, where there is a chance for advancement. I am thirty years of age, a steady worker, in good health, and do not drink or use tobacco. Address, BOX 377, care of Western Electrician, 510 Marquette Bldg., Chicago.

POSITION WANTED.

By a successful inventor of Electric Railway and Lighting specialties—patentee of simplest up-to-date enclosed arc lamp. Address BOX 375, care Western Electrician, 610 Marquette Bldg., Chicago.

WANTED.

60 to 60 K. W. direct-connected unit. Must be standard make in first-class condition and a bargain for spot cash. Address, McGUIRE & COBB, Hotel Warner, 33d St. and Cottage Grove Ave., Chicago.

WANTED.

Salesman capable of selling telephone instruments, switchboards and supplies. Territory to be Middle West. JULIUS ANDRAE & SONS CO., Milwaukee, Wis.

WANTED.

Salesman for general line of electrical supplies; experienced lamp salesman preferred. State previous experience, give references. JULIUS ANDRAE & SONS CO., Milwaukee, Wis.

FOR SALE.

A bargain; 1 T. H. 30-light 9.6 Amp. Series open arc machine, with wall controller and ammeter complete, good running order.

Twenty-two 9.6 Amp. double carbon open arc lamps with glass, hoods and spreader complete, good order. Several additional lamps, both single and double, can be put in good order or parts used for repairs. A lot of extra globes and parts and a supply of carbons will be included if taken as a whole.

Two 30-K. W. Edison Bipolar 125-volt D. C. generators in fine running order. Reason for selling, have put in larger machinery.

CARROLL ELECTRIC LIGHT & POWER COMPANY,
Carroll, Iowa.

FOR SALE

Second-hand 300 K. W. A. C. direct connected unit.

OMAHA ELECTRIC LIGHT & POWER CO.
OMAHA, NEB.

Send your Book Orders to
ELECTRICIAN PUBLISHING CO.,
610 Marquette Bldg., Chicago.

FOR SALE.

ALTERNATORS.

1-360 K. W. General Electric 3-phase.
1-120 " " " "
1-75 " Westinghouse 2-phase.

250-VOLT GENERATORS.

1-250 K. W. Western Electric M. P.
1-200 " Eddy M. P.

125-VOLT GENERATORS.

1-125 K. W. Western Electric M. P.

Immediate shipment.

GREGORY ELECTRIC CO.
54-62 S. CLINTON ST. CHICAGO

Notice to Contractors.

Bids for the erection of two 35 K. W. Generators and Engines complete, at the Eastern Kentucky Asylum for the Insane, Lexington, Ky., will be received until Aug. 1, 1904, at 12 o'clock noon, by J. S. Redwine, Supt. Eastern Kentucky Asylum for the Insane, Lexington, Ky.

Also one 75 K. W. Generator, with slow speed engine

The Board of Commissioners reserve the right to reject any and all bids.

J. R. MORTON,
Chairman Board of Commissioners,
Eastern Kentucky Asylum for the Insane.

Dividend Paying Electric Light Plant For Sale.

Electric light plant in Wisconsin city of 3,000 inhabitants, exclusive 17-year franchise and city contract. Plant in operation for seven years paying annually cash dividend. Physical condition of plant is first class.

Company's increasing business demands more attention than can be given to it by present owners, who are local business men. A splendid opportunity for a practical electrician or manager who can control or invest about $20,000. Address BOX 374, care Western Electrician, 510 Marquette Bldg., Chicago, Ill.

KESTER
SELF FLUXING SOLDER

A Tube of Solder Filled with Flux.
Requires no Acid.

SAVES—LABOR—TIME—MONEY.

ACTUAL SIZE

PATENTED.

Send for Free Samples.

L. F. Mahler Co., R. 1008 Chemical Bldg., St. Louis, Mo., Gen. Western Agent.

KESTER ELECTRIC M'F'G CO.,
46 N. UNION STREET, CHICAGO, ILL.

"STAR" INCANDESCENT LAMPS

LONG LIFE
GUARANTEED CANDLEPOWER,
HIGHEST EFFICIENCY.

MADE BY THE MOST SKILLED WORKMEN.

STANDARD ELECTRICAL MFG. COMPANY, : Niles, Ohio.

FOR ELECTRICAL REPAIR WORK
Of All Kinds, and All Work Guaranteed, Address
MILLER ELECTRIC CO., Davenport, Iowa. Armature and Transformer Rewinding Our Specialty.

BOILERS

One 42-in. x 15 ft. 9-in., 250 H. P. Worthington Water Tube.
One 60-in. x 16 ft., John Mohr Return Tubular Boiler.
One 64-in. x 16 ft., John Mohr Return Tubular Boiler.
One 54-in. x 16 ft., Devine Turbular Boiler.

ENGINES.

One 600 H. P., 21 x 36 x 30, Williams Tandem Horizontal Compound, 140 R. P. M.
Two 600 H. P., 20 x 30 x 24, Porter-Allen Tandem Compound, 200 R. P. M.
One 250 H. P., 12 x 24 x 18 Williams Tandem Compound, 250 R. P. M.
Two 100 H. P., 13 x 12, Dick & Church, High Speed Automatic.

PARTIAL LIST ONLY.

Send for latest Catalogue for bargains in Engines, Boilers, Dynamos and Motors.

CENTRAL STATION IMPROVEMENT CO., 938 Monadnock Block, Chicago

WORKS QUICK AND EASY. KEEPS ITS LUSTER. HOLDS OLD TRADE AND MAKES NEW. DOES NOT DETERIORATE. ESTABLISHED 16 YEARS. SOLD BY AGENTS AND DEALERS ALL OVER THE WORLD.
3 OUNCE BOX 10 CENTS
SAMPLES SENT FREE
U.S. METAL POLISH GEO. W. HOFFMAN
POLISHES ALL METALS. BRANCHES NEW YORK CHICAGO SAN FRANCISCO 295 E WASHINGTON ST. INDIANAPOLIS, IND

WE PAY

highest market prices for scrap copper, brass and platinum, also incandescent lamp bases, etc. You can make

BIG MONEY

in scrap of this kind. Save it and send it to the Great Western Smelting and Refining Co., Chicago, headquarters

FOR SCRAP COPPER

REPAIRING
RECALIBRATING
ELECTRIC METERS.
INTERNATIONAL ELECTRIC METER CO.
167 S. CANAL STREET, CHICAGO.

INDUSTRIES

ARE

OFFERED LOCATIONS

WITH

Satisfactory Inducements,
Favorable Freight Rates,
Good Labor Conditions,
Healthful Communities,

ON THE LINES OF

THE ILLINOIS CENTRAL R. R.
AND THE
YAZOO & MISSISSIPPI VALLEY R. R.

For full information and descriptive pamphlet address

J. C. CLAIR,
Industrial Commissioner,
1 Park Row, Chicago, Ill.

Burlington Route

Why not locate your factory near the Raw Material and Market (or the demand for your product)?

FOR INFORMATION
WRITE TO . . . .

W. H. MANSS,
Industrial
Commissioner,
CHICAGO.

CHICAGO EDISON COMPANY REPAIR SHOPS
76 MARKET STREET, CHICAGO. TELEPHONE MAIN 1280.
Machine and Carpenter Work of All Kinds. Correspondence Solicited.
OPEN DAY AND NIGHT.
FIRST-CLASS EQUIPMENT THROUGHOUT.
Dynamos, Armatures, Motors, Arc Lamps, Fans, Instruments.

ARNOLD ELECTRIC POWER STATION Co.
Eogineers, Constructors for Complete Electric Plants. Results Guaranteed.
SUITE 1539, MARQUETTE BLDG., CHICAGO.
NEW YORK OFFICE: 711 TRANSIT BLDG.

E. W Hammer, Pres. and Treas. H. J. Minhinnick, Sec. and Gen'l Sup't.
GENERAL ENGINEERING Co., THE
Consulting and Contracting Engineers.
Telephones, Electric Light, Power Transmission
Suite 1112, 135 ADAMS ST., CHICAGO.
Long Distance Telephone Central 473.

ROBERT W. HUNT & Co., ENGINEERS
1121 The Rookery, Chicago. 66 Broadway, New York.
Monoogahela Bank Bldg., Pittsburg.
Norfolk House, Cannon St., London.

Long Distance Phone Central 2448.
SCHOTT, W. H.,
ENGINEER AND CONTRACTOR,
SPECIALTIES—Central Station Heating Plants, Water Works Steam Plants, Electric Light, Gas and Street Railway Plants.
1220-21 MARQUETTE BUILDING, CHICAGO.

W. E BAKER. H. B. BISHOP.
BAKER, W. E. & CO.
ENGINEERS.
ELECTRIC RAILWAYS.
27 William St., NEW YORK.

J. H. HALLBERG
Consulting Arc Lighting Expert and Practical Electrical Engineer
45 Broadway - NEW YORK
Room 169A

KOHLER BROS.,
Contracting Electrical Engineers, Lighting Power Railways,
1804-1806-1808-1810-1812 Fisher Building, CHICAGO.

STANTON, LE ROY W.
Consulting Telephone Engineer.
Plans, Specifications and Supervision of Installation of complete telephone plants.
Special Reports on Telephone Properties and Apparatus.
411 Electrical Bldg., Cleveland, Ohio.

BRYAN, WILLIAM H.
M. Am. Soc. M. E.,
Consulting Mechanical and Electrical Engineer.
Lincoln Trust Building, ST. LOUIS.

ENGINEERS
Represented in this "Directory" are enabled to come to touch with many prospective customers who cannot be reached through any other source.

RUEBEL · SCHWEDTMANN-WELLS,
CONSULTING, MECHANICAL AND ELECTRICAL ENGINEERS,
Suite 801 Chemical Building, ST. LOUIS, U. S. A.

IT WILL PAY
engineers not represented in this department to carry a card regularly.

BYLLESBY, H. M. & Co.
(Incorporated)
ENGINEERS
Design, Construct and Operate Railway, Light, Power and Hydraulic Plants.
Examinations and Reports.
New York Life Building, - CHICAGO, ILL.

HORNADAY, J. P. & Co.
SUITE 1108 TRACTION BUILDING
CINCINNATI, O.
WATERWORKS, ELECTRIC RAILWAY, LIGHT, TRACTION, INDUSTRIAL AND MINERAL PROPERTIES BOUGHT AND SOLD

SARGENT & LUNDY,
ENGINEERS,
RAILWAY EXCHANGE,
Cor. Jackson and Michigan Boulevards, CHICAGO.
FREDERICK SARGENT. A. D. LUNDY.

Telephone Main 3123.
WILMERDING, C. H.
CONSULTING ENGINEER
1100 Old Colony Bldg., CHICAGO.

DUGALD C. JACKSON, C. E.
WILLIAM B. JACKSON, M. E.
MEMBERS
AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS
AMERICAN SOCIETY OF MECHANICAL ENGINEERS
AMERICAN SOCIETY OF CIVIL ENGINEERS
ENGINEERS. EXPERTS.
MADISON, WIS.

ALL Live men read the WESTERN ELECTRICIAN Each Week. Do You?

G. A. R. EXCURSIONS TO BOSTON VIA THE WABASH
August 12, 13 and 14, the Wabash Railroad will sell excursion tickets from all stations to Boston and return at one cent per mile in each direction. Fare from Chicago, $17.75. Limit may be extended to Sept. 30, by deposit and payment of 50c. Write for illustrated folder giving full details with side trips, etc.
F. A. PALMER, A. G. P. A.
311 Marquette Building, Chicago, Ill

ELECTRICAL BOOKS

Make your book purchases from the only large stock of electrical books carried in the West. Prompt shipments guaranteed. If you do not find what you want in the following list, write for complete and up-to-date book catalogue.

	Price.
Webb's Telephone Hand Book, cloth binding	$1.00
Badt's New Dynamo Tender's Hand Book, cloth binding	1.00
Badt's Incandescent Wiring Hand Book, cloth binding	1.00
Badt's Bell Hanger's Hand Book, cloth binding	1.00
Badt's Electric Transmission Hand Book, cloth binding	1.00
Dobb's The Inspector and Trouble Man, cloth binding	1.00
Steven's Mechanical Catechism, cloth binding	1.00
Hawkins' Catechism of Electricity, leather binding	2.00
Practical Electricity, leather binding	2.00
Thompson's Polyphase Electric Currents, cloth binding	3.50
Varley's Electro-Magnet, cloth binding	1.00
Buckley's Electric Lighting Plants, cloth binding	2.00
Haskins' Electricity Made Simple, cloth binding	1.00
Haskins' Transformer, cloth binding	1.25
Houston's 2-volume Electrical Dictionary, half leather, very cheap, half price	6.00
Watson's Electrician's Handy Book, cloth binding	2.50
Trevert's Armature and Magnet Winding, cloth binding	1.50
Trevert's How to Build Dynamo Electric Machinery, cloth binding	2.50
Trevert's Experimental Electricity, cloth binding	1.00
Trevert's Electricity for Students, cloth binding	1.00
Trevert's Electric Railway Engineering, cloth binding	2.00
Allsop's Bell Construction, cloth binding	1.25

	Price.
Trevert's Electrical Measurements for Amateurs, cloth binding	$1.00
Allsop's Telephones, Their Construction and Fitting, cloth binding	1.25
Allsop's Bell Fitting, cloth binding	1.25
Allsop's Induction Coils, cloth binding	1.25
Bell's Electric Power Transmission, cloth binding	3.00
Bell's Distribution for Electric Railroads, cloth binding	2.50
Cushing's Standard Wiring for Electric Light and Power, leather binding	1.00
Hanchett's Modern Electric Railway Motors, cloth binding	2.00
Houston & Kennelly's Electric Transmission of Intelligence, cloth binding	1.00
Houston & Kennelly's Electrical Measurements, cloth binding	1.00
Houston & Kennelly's Electric Heating, cloth binding	1.00
Houston & Kennelly's Electric Arc Lighting, cloth binding	1.00
Houston & Kennelly's Electric Motor, cloth binding	1.00
Houston & Kennelly's Electric Street Railways, cloth binding	1.00
Houston & Kennelly's Electric Telegraphy, cloth binding	1.00
Houston & Kennelly's Electro Therapeutics, cloth binding	1.00
Houston & Kennelly's Electricity Made Easy, cloth binding	1.50
Merill's Electric Light Specifications, cloth binding	1.50
Wiener's Dynamo Electric Machines, cloth binding	3.00

ANY OF THE ABOVE BOOKS SENT PREPAID ON RECEIPT OF PRICE.

ELECTRICIAN PUBLISHING CO.

SUITE 510 MARQUETTE BUILDING, CHICAGO.

INTERNATIONAL

Mechanical Self-Restoring

Drop Switchboard.

A PERFECT APPARATUS.

Made in any desired capacity.
Sample parts and quotations on request.

INTERNATIONAL
TELEPHONE MANUFACTURING CO.
CHICAGO, U. S. A.

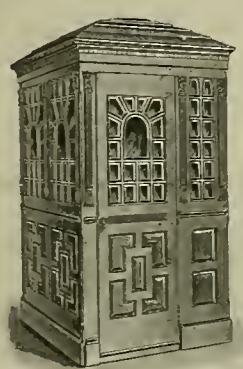
WESTERN ELECTRICAL SUPPLY CO.,

ENGINEERS AND BUILDERS
OF
Electric Railways, Lighting and Power Plants.

Western Electrical Supply Co.,
Chemical Building, - - ST. LOUIS, U. S. A.
Estimates Furnished.

Telephone Booths

—COST NOTHING—



After a few days' service, increase of receipts pay for them. We make booths of all kinds.

WRITE FOR CATALOG.

W. S. SEAMAN & CO.,
218 E. Water Street
MILWAUKEE · WISCONSIN

BITUMINIZED FIBRE CONDUIT

FOR

ELECTRICAL UNDERGROUND CONSTRUCTION
ELECTROLYSIS PROOF WATER PROOF

A smooth laminated insulator of unchanging durability.
Forms a continuous sealed duct from manhole to manhole, impervious to moisture and through which leaking gas cannot penetrate.
There has never been a gas explosion in our conduits nor the slightest evidence of electrolysis.
Abrasion of the cables is an impossibility.
It saves sixty per centum of freight and handling cost and twenty to thirty-five per centum of construction.
Process of laying is simple, rapid and inexpensive. There is no loss from breakage or fitting. It is self-aligning and cannot settle out of alignment.
All sizes from one inch to ten inches interior diameter. Bends of all angles.
The foremost electrical engineers are recognizing and testifying to the scientific advantages of our system of subway construction over all previous methods.

Send for illustrated book. Ask for prices giving size and quantities required

PROMPT DELIVERIES

FACTORIES: Philadelphia, Chicago, Los Angeles

American Conduit Company

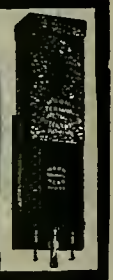
SEVENTH FLOOR, 170 BROADWAY, NEW YORK

336 Macy St., Los Angeles, Cal. *Manhattan Bldg., Chicago*

SIMPLE
EFFICIENT
RELIABLE
DURABLE
NOISELESS
ECONOMICAL

THE
ILLINOIS POLE CHANGER
THE LATEST RINGING DEVICE
Produces Both Alternating and Pulsating Currents.....
Broadly guaranteed. Write for circulars.
Illinois Electric Specialty Co.
171-173 South Canal Street .... Chicago

MOON
TERMINAL HEADS
with Carbon Arresters
METAL STORM BOX
SELF-SOLDERING NOZZLE



MOON MFG. CO.,
43-49 So. Canal St., CHICAGO

Points in Wisconsin and the Northwest

are covered by Wisconsin Central Railway's convenient, solid, wide vestibuled trains, equipped with Pullman sleepers, free reclining chair cars and modern coaches which leave Central Station, 12th Street and Park Row (Lake Front), Chicago for St. Paul, Minneapolis, Ashland and Duluth, connecting with all western lines. Meals in dining and cafe cars served a la carte.
For tickets and further information apply to nearest ticket agent, or write
JAS. C. POND, Gen'l Pass. Agt., Milwaukee, Wis.

Automatic Telephones.

Privacy
Promptness
Precision
Profits.

Automatic Electric Co., Chicago, U. S. A.

"That's A Good Thing"

is the universal opinion of those who have investigated our new party line telephone. Our "Sure-Ring" telephone cuts out much trouble on party lines.
Our new desk set also has some excellent features.

These are all described in Bulletin No. 11-E.
Mailed free upon request.

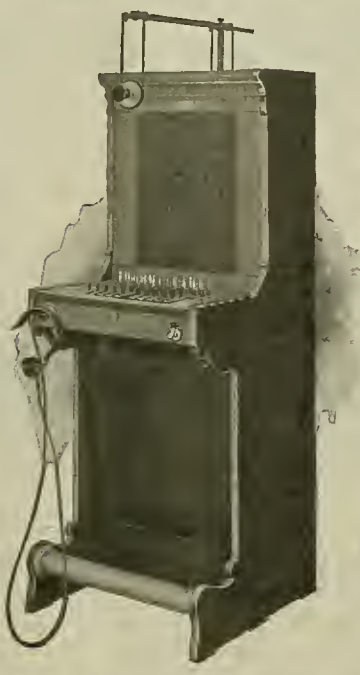
Stromberg-Carlson Telephone Mfg. Co.

GENERAL AND EASTERN SALES OFFICE
ROCHESTER, N. Y.

SALES DEPT.
CHICAGO, ILL.

KELLOGG

MAGNETO SWITCHBOARDS.



We have been making small switchboards only during the last three years, but in that time we have constructed

Over 1,400 Small Switchboards, Having 75,000 Lines in Actual Use.

Every one of all this list is giving the best satisfaction.

Kellogg Switchboard and Supply Company,
Green and Congress Streets,
CHICAGO.

Seymour Building, LOS ANGELES.
Electric Building, CLEVELAND.
Keystone Telephone Building, PHILADELPHIA.

MAILED FREE.
A valuable treatise on
STORAGE BATTERIES
for
Private Lighting Plants
together with our catalogue.
COLUMBUS STORAGE BATTERY CO.,
COLUMBUS, OHIO.
Machado & Rolier, New York.
Coltz Engineering Co., Chicago.

We introduced successful 4-party lines
LEICH SELECTIVE SYSTEM
Write for our booklet—"Selective W."

INDEPENDENT TELEPHONE

Impedance Coil for Selectives. No Springs.

CENTRAL ENERGY OR MAGNETO

AMERICAN ELECTRIC TELEPHONE CO.
CHICAGO, ILLINOIS

INDEPENDENT TELEPHONE

BUY Your Electrical Books of the **Electrician Publishing Co., Suite 510 Marquette Bldg., Chicago.** You will save **TIME** and **MONEY** by doing so. . . . . .

CENTRAL STATION HEATING

We are the originators and builders of the underground system of live and exhaust steam heating. Our system is used for the utilization and distribution of exhaust steam from electric and power plants for heating purposes. 250 Plants in successful operation. We have the only Meter System. Also manufacturers of Wooden Water Pipe, Steam Pipe Casing, Steam Traps, Condensation Meters, Valves, Economizing Coils, Separators and full line of Steam Fitters' Supplies.

WRITE FOR PAMPHLET AND PRICE LIST

American District Steam Company
LOCKPORT, N. Y. CHICAGO ILL.

MENTION WESTERN ELECTRICIAN

PRODUCERS AND WHOLESALERS OF WHITE CEDAR PRODUCTS

CEDAR POLES

SPECIAL PRICES ON SMALL POLES.
Write for a copy of our TELEGRAPH CODE FOR CEDAR PRODUCTS

YARDS
KOSS MICH.
L'ANSE "
MUNISING "
ONTONAGON
WAGNER, WIS
PESHTIGO "

C. H. WORCESTER CO.
SUITE 1206 TRIBUNE BLDG. CHICAGO.

POLES—POSTS—PILING—TIES

Fowler-Jacobs Co.
Elmore-Fowler-Jacobs Co.
John H. Fowler & Co.
} The FOWLER Companies
Fisher Building, - - CHICAGO

IDAHO CEDAR POLES.

LOW PRICES. LONG LENGTHS A SPECIALTY.
YARDS: IDAHO. MONTANA.
WESTERN LUMBER & POLE CO., - Main Office, DENVER, COLO.

USE
"SAFETY" RUBBER COVERED
WIRE AND CABLE
FOR EVERY ELECTRICAL SERVICE.
M. B. AUSTIN & CO.,
CHICAGO REPRESENTATIVE.
THE SAFETY INSULATED WIRE & CABLE CO.,
WORKS: Bayonne, N. J. 114-116 LIBERTY STREET, N. Y.

Idaho Cedar Poles

PACIFIC COAST POLE CO. SPOKANE, WASH.

BOOKS.

BUY YOUR BOOKS FROM THE
ELECTRICIAN PUBLISHING COMPANY,
510 Marquette Bldg., CHICAGO.

"Diamond H" Switches

Trade H Mark

This Trade-Mark guarantees quality.
The Hart Mfg. Co., Hartford, Conn.
New York Boston Chicago Toronto, Ont.

BRACKETS—X ARMS—PINS
little things it is true, but they cut a big figure in line construction.
OUR MOTTO IS:
Prompt Shipment Quality Satisfaction Right Price
COLUMBIA MFG. CO. ANTIGO, WIS.

Cedar TORREY CEDAR CO., CLINTONVILLE, WIS. Poles

Large Stock Constantly on Hand

MICHIGAN AND WESTERN CEDAR POLES
ALL LENGTHS AND SIZES
LINDSLEY BROS CO.
TRIBUNE BLDG., CHICAGO

WHITE CEDAR POLES
HALL L. BROOKS
52 WISCONSIN AVENUE
TOMAHAWK, WIS.

Southern Cedar POLES Are the Best.
NO ROTTEN BUTTS.
D. W. PHELAN,
277 Broadway, New York

DON'T BUY ELECTRICAL SUPPLIES

Until you have seen our new Catalogue and new Price List.
Free to the trade.

Manhattan Electrical Supply Co.
NEW YORK: 32 Cortlandt St.
CHICAGO: 188 Fifth Ave.

"MANROSS"
HAIR SPRINGS
For Electric Indicating and Recording Gauges, Steam Gauges, Etc
LARGEST MANUFACTURER OF HAIR SPRINGS in the United States.
F. N. MANROSS,
FORESTVILLE, CONN.

New Dynamo Tenders' Hand-Book.

By F. B. BADT.

226 Pages, 140 Illustrations. Flexible Cloth Binding. Size of Type Page 5 1-2x3 inches. Price $1.00.

This is, as the name indicates, a NEW BOOK, much more complete than the old one, with all the information, instructions and rules which are required by practical men, as Dynamo Tenders, Linemen, Stationary Engineers and owners and operators of all kinds of Electric Plants. It is the only book of the kind published in the English language. 9,000 copies of the old Dynamo Tenders' Hand-Book sold, and over 13,000 of the new.

Electrician Publishing Co.,
510 Marquette Building, CHICAGO.

MICHIGAN WHITE LARGE STOCK.
CEDAR POLES
PROMPT SHIPMENTS. KELLOGG SWITCHBOARD & SUPPLY CO., Chicago.

SPECIAL CROSS ARMS

ALL HEART, long leaf yellow pine, any size or length. Also ALL HEART cross ties, oak and locust pins and brackets. Write us for delivered prices. We can furnish 100 or 100,000 promptly.
R. R. AKERS, Manager.
Sales Office, 519 Main Street, Cincinnati, O.
LEWIS LUMBER & MFG. CO., Hattiesburg, Miss.

It isn't every one that can guarantee the same prompt shipment on Ties that is demanded on Poles.
We can and do.
May we not quote you on either or both?

MALTBY LUMBER COMPANY, 512 Phoenix Block, Bay City, Michigan
PITTSBURG AGENTS Tipper & Patton, 509 Bessemer Bldg.

POLES. WHITE CEDAR. IDAHO CEDAR up to 80 ft.

BERTHOLD & JENNINGS, ST. LOUIS. Chemical Building.

CROSS ARMS. LONG LEAF PINE AND FIR.

CEDAR POLES MARSHALL H. COOLIDGE Co. 828 GUARANTY BLDG. MINNEAPOLIS MINN.
YARDS – NEW DULUTH, MINN. - FLOODWOOD, MINN. - WELLERS, MINN.

The Electrician Publishing Co., Suite 510 Marquette Building, Chicago. Headquarters for all latest Electrical Books. Write for Catalogue.

YOST SPECIALTIES.

Sockets, Wall Sockets, Weatherproof Sockets, Rosettes, Receptacles, Cord Adjusters.

Catalogue for the asking.

THE YOST ELECTRIC MFG. CO.
TOLEDO, OHIO.

POLES W. C. STERLING & SON, MONROE, MICH. Eleven Pole Yards in Michigan. Wholesale Producers for 20 years. **TIES.**

CEDAR POLES, POSTS, TIES,

H. M. LOUD'S SONS CO., Au Sable, Mich.

CEDAR POLES
ESTABLISHED 1862
WM. MUELLER COMPANY
1211-12-13 MARQUETTE BLDG. CHICAGO.
EIGHT DISTRIBUTING YARDS

"Free from the care which wearies and annoys,
Where every hour brings its several joys."

"AMERICA'S SUMMER RESORTS"

This is one of the most complete publications of its kind, and will assist those who are wondering where they will go to spend their vacation this summer.

It contains a valuable map, in addition to much interesting information regarding resorts on or reached by the

NEW YORK CENTRAL LINES

A copy will be sent free, upon receipt of a two-cent stamp, by George H. Daniels, General Passenger Agent New York Central & Hudson River Railroad, Grand Central Station, New York

Cedar Poles.
Pittsburg and Lake Superior Iron Co. Producers and Wholesalers. Escanaba, Mich.

POLE DEALERS ADVERTISING IN THE WESTERN ELECTRICIAN OBTAIN MOST EXCELLENT RESULTS BECAUSE IT PLACES THEM IN TOUCH WITH ACTUAL BUYERS OF POLES. TRY A CARD.

POLES, TIES, POSTS. THE PORTER CEDAR CO., SAGINAW, MICH.
PRODUCERS. We want your inquiries always.

Telephone Troubles and How to Find Them.

A complete hand-book for telephone inspectors, by Wm. H Hyde and J. A. McManman.

NINTH EDITION. 52 PAGES. PRICE, 25 CENTS.

The large number of telephone exchange managers and employes will find this book a great help in locating telephone troubles and remedies therefor. Considerable new matter has been added in this edition.

Sent prepaid on receipt of price by the

Electrician Publishing Co., 510 Marquette Building, CHICAGO.

CEDAR POLES
THE
Valentine-Clark Co.
234 La Salle Street, CHICAGO
YARDS:
Pinconning, Mich. : Green Bay, Wis. : New London, Wis.

WHITE CEDAR POLES
Don't forget our Minnesota Transfer Yard—midway between St. Paul and Minneapolis, where we load in forty-eight hours from the time we have your order.
PAGE & HILL CO. 1003 Lumber Exchange, MINNEAPOLIS, MINN.

BOILER WATERS CORRECTED

to remove and prevent scale and to stop corrosion. DEARBORN TREATMENT does the work. Send gallon sample for analysis. Booklet "R" now ready.

DEARBORN DRUG & CHEMICAL WORKS,

27-34 RIALTO BUILDING, CHICAGO, ILL. WM. H EDGAR, President Telephone: Harrison 3930 and 3931.

Dixon's Solid Belt Dressing

In Handy 1-lb. Bars

ends all slipping, without hardening or otherwise injuring the leather. Circular 125O and free samples upon request.

JOSEPH DIXON CRUCIBLE CO., JERSEY CITY, N. J.

Sterling Black Plastic Insulator.

One hundred days' continuous baking at 180° F. will not make it brittle. Water repellent. Oil proof.

THE STERLING VARNISH CO., - - Pittsburg, Pa.

JEFFREY CHAIN BUCKET DREDGES FOR CATALOGUE, ADDRESS THE JEFFREY MFG. CO. COLUMBUS, OHIO.

HORNBERGER-IRWIN Transformers

(LARGE AND SMALL)

½ K. W. to 500 K. W.

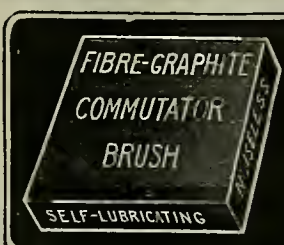
This transformer represents the latest improvements in transformer construction; made in three types; multi-coil construction; ventilated cores; built for all commercial voltages and frequencies; **higher efficiencies together with lower temperatures than have heretofore been attained are guaranteed.**

Catalogue just issued explains details.

Manufactured by

Crawfordsville Electric Co.

CRAWFORDSVILLE, INDIANA, U. S. A.



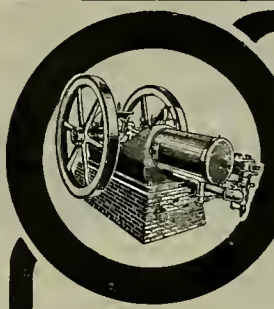
There's No Friction

with the Fibre-Graphite Commutator Brush. Being 90 per cent. pure graphite, it insures low resistance, no sparking under a varying load, and longer wear. There is no greasing required. The Fibre-Graphite is therefore the most economic brush on the market. Send for price list.

HOLMES FIBRE-GRAPHITE MFG. CO.
5155 Wakefield St., Germantown, PHILADELPHIA.

REG. TRADE MARKS "Phosphor Bronze" DELTA

THE PHOSPHOR BRONZE SMELTING CO. LIMITED,
2200 WASHINGTON AVE., PHILADELPHIA.
"ELEPHANT BRAND PHOSPHOR-BRONZE"
INGOTS, CASTINGS, WIRE, RODS, SHEETS, ETC.
— DELTA METAL —
CASTINGS, STAMPINGS AND FORGINGS
ORIGINAL AND SOLE MAKERS IN THE U.S.



Olds Gas and Gasoline Engines

are backed by a broad guarantee that absolutely protects the purchaser against faults or breakage due to construction or material used. Its liberal terms are made possible by the experience of years which have established the success of the Olds' patents.

STATIONARY ENGINES - - 2 to 100 H. P.
PORTABLE ENGINES - - - 8 to 18 H. P.

Our new illustrated catalog will be sent on request

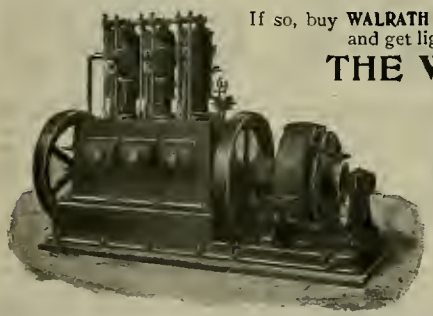
OLDS GASOLINE ENGINE WORKS

252 River Street - - - Lansing, Mich.

No. 970

ARE YOU LOOKING FOR MONEY?

If so, buy WALRATH GAS OR GASOLINE ENGINES and get light on the subject.



THE WALRATH

Received the Highest Award at the Pan-American Exposition.

It will produce as good a commercial light as that of an automatic steam engine, either belted or direct-connected generator. Simple, Economical and Reliable.

Send for Catalogue W.

MARINETTE GAS ENGINE CO.,

CHICAGO HEIGHTS, ILL.

AGENCIES:
301 Fisher Building, Chicago. 619 Stevenson Building, Indianapolis.
703 Bijou Building, Pittsburg.
MacKay Engineering Co., 149 Broadway, New York.
MacKay Engineering Co., 100 Boylston St., Boston.
Stroog, Carlisle & Hammond Co., Cleveland.

BUY YOUR BOOKS

FROM THE

Electrician Pub. Co., 510 Marquette Bldg., Chicago.

HARTFORD STEAM BOILER INSPECTION AND INSURANCE CO. HARTFORD, CONN.

Locations for Industries

Erie Railroad

Chicago to New York

The Erie Railroad Company's Industrial Department has all the territory traversed by the railroad districted in relation to resources, adaptability, markets and advantages for manufacturing, and can advise with manufacturers in relation to the most suitable locations. For full information address

LUIS JACKSON

Industrial Commissioner, Erie Railroad Company,
21 Cortlandt Street, New York

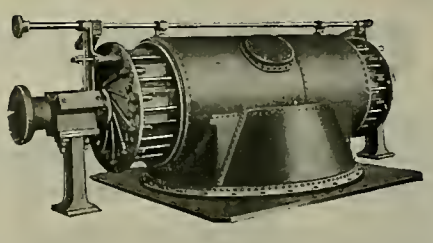
SAMSON TURBINE

The gates on the SAMSON are so constructed that all movable parts have a maximum wearing surface; furthermore, the material used in their construction is of the finest. These two points assure a long life to the gate and consequently prevent leakage.

WRITE DEPT. D FOR CATALOG

JAMES LEFFEL & CO.

SPRINGFIELD, OHIO U. S. A.



Fort Wayne engine driven direct current generators are on a par with the balance of our "Wood" lighting and power system apparatus.

FORT WAYNE ELECTRIC WORKS
WOOD LIGHTING & POWER SYSTEMS
Fort Wayne, Ind.

For continuous performance under severe conditions of operation or for every day service Type MPL generators of all sizes from 20 to 800 kilowatts give unfailing satisfaction.

237

The Inspector AND Trouble Man.

By A. E. DOBBS.

Full of information and diagrams for the operator, exchange owner, exchange manager, inspector, trouble man, lineman.

A complete description of telephones and their troubles. How to find and remedy them, together with working plans for exchange construction, complete with diagrams of all up-to-date telephones and switchboards.

This is a practical book, written in **plain language**, and for **anyone** interested in telephony.

Mailed anywhere on receipt of price . . . **ONE DOLLAR.**

No technicalities. Substantially bound in cloth.

ELECTRICIAN PUBLISHING CO.,
510 MARQUETTE BUILDING, CHICAGO.

Good Advice

No. 1

If you want a Direct Current Wattmeter that can be depended upon to measure low loads accurately and also maintain an absolutely straight line characteristic throughout its entire capacity, try the latest high torque Duncan meter. It is also correct on overloads.

—Good Advice No. 2 Next Week—

Write for Bulletin and Prices

Duncan Electric Mfg. Company
LAFAYETTE, IND.

TESTED
FUSE - WIRE
- STRIP
- LINKS (open)
TELEPHONE-ENCLOSED - FUSES
TUBULAR LINE -
TELEPHONE FUSE BLOCKS, FUSIBLE LINKS (For Fire Doors) OUTLET BOXES, WIRE JOINTS, FUSE SOLDER FLUX

Send for Catalogue No. 15 Illustrating our full line of goods
Exhibit in Electricity Bldg., St. Louis

CHICAGO FUSE WIRE & MFG. CO.
358 Dearborn St., Chicago. 853 Broadway, New York.
Mutual Life Bldg., Buffalo.

KARTAVERT.

HARD AND FLEXIBLE FIBER IN SHEETS, RODS AND TUBING.
For Electrical and Mechanical Purposes, Railway Dust Guards, Washers and Packings. Patent Insulating Cleats.
MANUFACTURED BY
THE KARTAVERT MANUFACTURING CO. Wilmington, Del.

VULCANIZED FIBRE

Highest grades for electrical insulation and mechanical purposes, in sheets, tubes, rods and special shapes. Catalogues and samples on application.
VULCANIZED FIBRE CO., - Wilmington, Del.

WIRES AND CABLES

HIGH-GRADE, RUBBER-COVERED, WEATHER-PROOF
MAGNET, OFFICE, ANNUNCIATOR WIRE.
HAZARD MANUFACTURING CO.,
GENERAL OFFICE AND WORKS, Wilkesbarre, Pa. NEW YORK OFFICE, 50 Dey St. CHICAGO OFFICE, 71 and 73 West Adams St.

STURTEVANT

Fans, Blowers, Engines, Motors, Generating Sets, Economizers, Exhaust Heads, Mechanical Draft Apparatus, Forges, Heating, Ventilating and Drying Apparatus, Industrial Equipments

B. F. STURTEVANT CO.
Boston, Massachusetts
General Office and Works, Hyde Park, Mass.
New York Philadelphia Chicago London 351

National Electric Company

builders of high-grade Electrical Machinery for LIGHTING, POWER and RAILWAY SERVICE

500 K. W. Engine Type Alternator Frame.

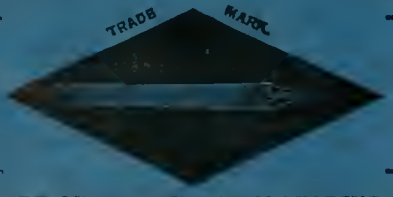
General Sales Offices and Works: MILWAUKEE

NEW YORK: 135 Broadway
CHICAGO: Old Colony Building
PHILADELPHIA: 1509 Land Title Bldg.
PITTSBURG: Gellatly & Co.
CHARLESTON, W. VA.: Agnew Electric Co.
SEATTLE & SAN FRANCISCO: Kilbourne & Clark Co.

Black Diamond File Works

Est. 1863. Inc. 1895.

Twelve Medals Awarded at International Expositions



Special Prize Gold Medal at Atlanta, 1895.

OUR GOODS ARE ON SALE IN EVERY LEADING HARDWARE STORE IN THE UNITED STATES AND CANADA.

G. & H. BARNETT COMPANY,
PHILADELPHIA, PA.

JOHN A. ROEBLING'S SONS CO.

Insulated Wire of All Kinds

Bare Copper Wire

MAIN OFFICE AND WORKS **TRENTON, N. J.**

AGENCIES AND BRANCHES
New York Chicago Cleveland San Francisco Philadelphia Allegh

Western Electrician

Vol. XXXV. $3.00 Per Annum. Copyright, 1904, by Electrician Publishing Company, Chicago. CHICAGO, JULY 30, 1904. Entered at Chicago Postoffice as mail matter of the second class. 10 Cents a Copy. No. 5

SIMPLEX INSULATED WIRES AND CABLES.
RUBBER COVERED, WEATHERPROOF, UNDERGROUND AND SUBMARINE.
WESTERN SELLING AGENT: H. R. HIXSON, [illegible] Monadnock Block, CHICAGO
The Simplex Electrical Co., 110 State Street, BOSTON, MASS.

N. I. R.
National India Rubber Co.'s
RUBBER COVERED WIRES AND CABLES.
OFFICE AND FACTORY: BRISTOL, R. I.

OKONITE
TRADE MARK
1889—Paris Exposition, Medal for Rubber Insulation.
1893—World's Fair, Medal for Rubber Insulation.
THE STANDARD FOR RUBBER INSULATION.
Sole Manufacturers of
Okonite Wires, Okonite Tape, Manson Tape, Candee Weather-proof Wires.
THE OKONITE CO., LTD.
Willard L. Candee, } Managers. H. Durant Cheever, } 253 Broadway, New York. Geo. T. Manson, Gen'l Supt. W. H. Hodgins, Secy.

TRADE MARK — CRESCENT INSULATED WIRE & CABLE CO. TRENTON, N. J.
CRESCENT RUBBER INSULATED WIRES AND CABLES
National Code Standard.
CRESCENT INSULATED WIRE AND CABLE CO.,
New York Office, 83 BARCLAY STREET. Main Office and Factory, TRENTON, N. J.

RESISTANCE WIRES
"Climax" For High-resistance Work.
"Advance" For Measuring Instruments.
SPECIAL ALLOYS FOR ELECTRICAL MANUFACTURERS.
DRIVER-HARRIS WIRE CO., Harrison (Newark), N. J.

INDIANA RUBBER AND INSULATED WIRE CO.,
MANUFACTURERS OF
Paranite Rubber Covered Wires and Cables,
UNDERGROUND, AERIAL, SUBMARINE AND INSIDE USE.
TELEPHONE, TELEGRAPH AND FIRE ALARM CABLES.
All Wires are tested at Factory. JONESBORO, IND.

I-T-E
CIRCUIT BREAKERS
CUTTER ELECTRICAL CO., PHILADELPHIA

TWO YEAR COURSES IN
STEAM AND MACHINE DESIGN
AND IN
APPLIED ELECTRICITY.
PRATT INSTITUTE,
BROOKLYN, N. Y.
Write for Catalogue and Particulars.

"CIRCULAR LOOM" THE FLEXIBLE CONDUIT
AMERICAN CIRCULAR LOOM CO. TRADE MARK REGISTERED
CONDUITS FOR INTERIOR WIRING.
American Circular Loom Co.
Chelsea, Mass., New York, Chicago, San Francisco.

ELECTRIC SIGN FLASHERS
BEST IN THE WORLD
Write for full particulars
Reynolds Elec. Flasher Mfg. Co.
221 Fifth Ave., Chicago.

Sterling Black Plastic Insulator.
One hundred days' continuous baking at 180° F. will not make it brittle. Water repellent. Oil proof.
THE STERLING VARNISH CO., - - Pittsburg, Pa.

THOUSANDS IN USE.
Motors, ¼ h. p. to 100 h. p.
Dynamos, 1 k. w. to 75 k. w.
Highest Quality. Reasonable Price.
THE HOBART ELECTRIC MFG. CO.
TROY, OHIO.

USE
"SAFETY" RUBBER COVERED WIRE AND CABLE
FOR EVERY ELECTRICAL SERVICE.
M. B. AUSTIN & CO.,
CHICAGO REPRESENTATIVE.
THE SAFETY INSULATED WIRE & CABLE CO.,
WORKS: Bayonne, N. J. 114-116 LIBERTY STREET, N. Y.

THE Hartford Time Switch
A mechanically operated switch, which turns lights ON and OFF at such hours as the user desires with no further attention than the weekly winding.
Approved Mechanically as well as Electrically

Showing double doors, Seth Thomas eight-day movement, auxiliary cut-out, auxiliary hand-trip, and switch indicator.
For controlling current used for show window lights, electric sign lights, street lights, apartment house hall lights, motors, batteries, burglar alarms. :: 10, 20, 35 and 50 Amperes. 250 Volts. 1, 2 and 3 Poles.
Consult us regarding any requirements
SEND FOR CATALOGUE
The Hartford Time Switch Co.
440 Asylum St., HARTFORD, CONN., U.S.A.
New York City: A. Hall Berry, 97-99-101 Warren Street
London, England: Verity & Ltd., 31, King Street, Covent Garden, S. W.

DON'T BUY ELECTRICAL SUPPLIES
Until you have seen our new Catalogue and new Price List.
Free to the trade.
Manhattan Electrical Supply Co.
NEW YORK: 32 Cortlandt St. CHICAGO: 188 Fifth Ave.

SINGLE AND POLYPHASE
TRANSFORMERS
KUHLMAN ELECTRIC CO., - - Elkhart, Ind.

WESTON Electrical Instrument Co.,
Waverly Park, NEWARK, N. J.
THE WESTON STANDARD PORTABLE
DIRECT READING
Voltmeters and Wattmeters
—FOR—
Alternating and Direct Current Circuits
Are the only standard portable instruments of the type deserving this name.
Write for Circular and Price List.
BERLIN—European Weston Electrical Instrument Co. Ritterstrasse No. 88.
LONDON—Elliott Bros., Century Works, Lawisham.
PARIS, FRANCE—E. H. Cadiot, 12 Rue St. Georges.
NEW YORK OFFICE—74 Cortlandt St.

Weston Standard Portable Direct-Reading Voltmeter for Alternating and Direct-Current Circuits.

JOHN A. ROEBLING'S SONS CO.
Insulated Wire of All Kinds
Bare Copper Wire
MAIN OFFICE AND WORKS TRENTON, N. J.
AGENCIES AND BRANCHES
New York Chicago Cleveland San Francisco Philadelphia Atlanta

Bullock Electric Mfg Co
Cincinnati

100 K. W. Bullock Generator with Direct-Connected Exciter

Direct and Alternating Current Apparatus

Alternators in Units up to 10,000 k. w.

Complete Electric Equipment
for
Street Railway and Power Plants

Bullock Motors for Machine Tools

Allis-Chalmers Corliss Engines

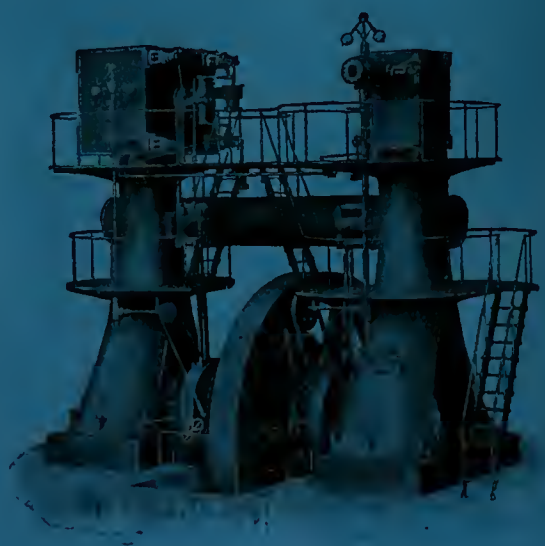
For All Power Purposes
Built in Sizes from 25 h. p. up

Engines for Lighting and Power

Hydraulic Turbines

Don't fail to see our three Exhibits at St. Louis

They are the talk of the Exposition



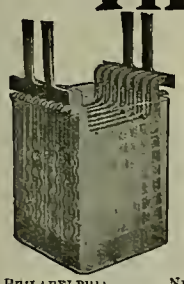
Allis-Chalmers Vertical Cross Compound Direct-Coupled Engine

Allis-Chalmers Co
CHICAGO

Canadian Representatives: Allis-Chalmers-Bullock, Ltd., Montreal

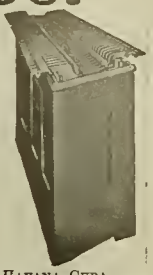
THE ELECTRIC STORAGE BATTERY CO.

PHILADELPHIA



MANUFACTURER OF THE

"Chloride Accumulator"



For Central Stations, Electric Railways, Isolated Lighting and Power Stations, Fire Alarm, Telegraph, Train Lighting, etc., etc.

PRICE LISTS AND DESCRIPTIVE BULLETINS FORWARDED UPON REQUEST.

SALES OFFICES:

PHILADELPHIA, Allegheny Ave. and 19th St. | NEW YORK, 100 Broadway, | BOSTON, 60 State St. | CHICAGO, Marquette Bldg. | ST. LOUIS, Wainwright Bldg. | SAN FRANCISCO, Rialto Bldg. | CLEVELAND, Citizens Bldg. | CANADA, Canadian General Electric Co., Ltd. Toronto | HAVANA, CUBA, G. F. Greenwood, Manager 34 Empedrado St.

TYPE E.

ALTERNATING CURRENT.

SCHEEFFER INTEGRATING WATTMETER

Type E for Alternating Current — Type F for Direct Current Circuits

DUST AND BUG PROOF IMPROVED CONSTRUCTION

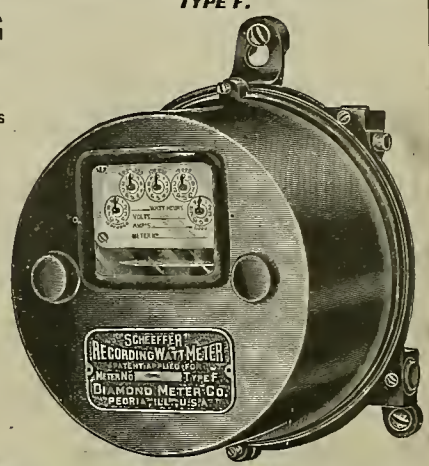
MOVING PARTS ARE EXTREMELY LIGHT, INSURING A HIGHLY SENSITIVE AND ACCURATE METER.

WRITE FOR PRICES AND DESCRIPTIVE LITERATURE.

DIAMOND METER COMPANY,

PEORIA, ILL., U. S. A.

TYPE F.



DIRECT CURRENT.

The Bossert Electric Construction Co.

—MANUFACTURERS OF—

STEEL OUTLET AND JUNCTION BOXES, SWITCHBOARDS, PANEL BOARDS, SWITCHES, ETC.

UTICA, NEW YORK.

CARBONS

CONSUMERS CARBON CO.

LANCASTER, OHIO, U. S. A.

Carbons of all kinds and for all purposes.

PLATINUM

PLATINUM RIVETS FOR CONTACT POINTS IN TELEPHONES—SPARK COILS AND OTHER ELECTRICAL APPARATUS. PLATINUM SHEET AND WIRE IN ANY FORM AND DEGREE OF HARDNESS. PLATINUM SCRAP PURCHASED.

BAKER & COMPANY, Inc.

ARTISANS IN PLATINUM

408-410-412-414 N. J. R. R. AVE. - NEWARK, N. J.

New York Office: 120 Liberty St.

ALPHABETICAL INDEX TO ADVERTISEMENTS.

Adams-Bagnall Electric Co..—
Akron Electrical Mfg Co.....13
Allen Company, L. B.....11
Allis-Chalmers Company..... 2
American Battery Co.....10
Amer. Circular Loom Co.... ...1
American Condnit Co..... 9
Amer. District Steam Co.....14
Amer. Elec. Fuse Co.....20
Amer. Electrical Heater Co..11
Amer. El. Telephone Co.....14
American Electrical Works..11
Arnold Elec. Power Station Co..... 13
Automatic Electric Co..... 15

Babcock & Wilcox Co.....—
Bain, Forée.....11
Baker & Company..... 3
Baker & Co., W. E.....13
Barnett Company, G. & B....20
Beardslee Chandelier Mfg.Co.—
Berthold & Jennings.....16
Big Four Route.....—
Bissell Co., The F..... 5
Bossert Electric Construction Co..... 3
Brooks, Hall L.....16
Bryan-Marsh Co.....—
Bryan, Wm. H.....13
Buckeye Electric Co.....—
Bullock Elec. Mfg. Co..... 5
Butterfield, J. F.....13
Byllesby & Co., H. M.....13

Central Electric Co.....—
Cent. Stat. Improvement Co..12
Central Tel. & El. Co.....14
Century Electric Co..... 7
Chicago Die & Electric Co.... 5
Chicago Edison Co.....4, 12
Chic. Fuse Wire & Mfg. Co...—
Chicago Insulated Wire Co...—
Chicago Mica Co.....10
Columbia Incand. Lamp Co..—
Columbia Mfg. Co.....17
Columbus Storage Bat'ry Co.—
Consumers Carbon Co..... 3
Continuous Rail Joint Company of America.....12
Coolidge Co.. Marshall H.....—
Cope, T. J..... 7
Crawfordsville Electric Co...—
Crescent Co.....—
Crescent Ins. Wire & Cbl. Co. 1
Crocker-Wheeler Company.. 4
Crouse-Hinds Co.....10
Cutler-Hammer Mfg. Co..... 5
Cutter Elec. & Mfg. Company 1

D. & W. Fuse Company.....—
Dearborn Drug & Chem. Wks. 8
Diamond Meter Company.... 3
Dielectric Manufacturing Co. 7
Directory of Engineers.....13
Dixon Crucible Co., Joseph.. 8
Driver-Barris Wire Co..... 1
Duncan Elec. Mfg. Co.....19

Edison Decorative & Miniature Lamp Deparim't.....10
Edison Mfg. Company.....20
Edwards & Co.....—
Egan, J. J..... 7
Electrical Engineer Institute.—
Electric Appliance Co 10
Electric Storage Battery Co.. 3
Electrician Pub. Company...19
Erie Ry..... 8

Faries Mfg. Co..... 4
"For Sale" Advertisements..12
Ft. Wayne Elec. Works, Inc..19
Fostoria Incand. Lamp Co...—
Fowler, John H.....17
Fowler-Jacobs Company.....17

General Electric Co..... 9
General Engineering Co., The 13
General Incandescent Arc Light Company.....—
General Incand. Lamp Co.....—
Gould Storage Battery Co.... 6
Gt. West. Smelt. & Refining Co.-
Green Fuel Economizer Co.. 8
Gregory Electric Company...12

Hallberg, J. H 13
Haller Machine Co.....—
Hart Mfg. Co.....11
Hartford Steam Boiler Inspection & Insurance Co....—
Hartford Time Switch Co.... 1
Hazard Manufacturing Co....—
Highland Park College. ... 11
Hobart Elec. Mfg. Company. 1
Hoffman, G. W.....12
Holmes Fibre-Graph. Co.....—
Holophane Glass Co.....—
Hornaday & Co., J. P.....13
Humphrey, Henry H.....13
Hunt & Co., Robt. W.....13

Illinois Central Ry.....12
Incandescent Electric Light Manipulator Company.....—
Indiana Rub. & Ins. W. Co.... 1
India Rubber & Gutta Percha Insulating Company.....—
International Elec. Meter Co 12
International Tel. Mfg. Co...14

Jackson, D. C. & W. B.....13
Jeffrey Manufacturing Co.... 8
Jewell Electrical Inst. Co....—
Johns-Manville Co., H. W..... 7

Kartavert Manufacturing Co.—
Kellogg Switchboard & Supply Company.....15, 17
Kester Elec. Mfg. Co.....12
Klein & Sons, Mathias..... . 11
Kohler Brothers.....13
Kuhlman Electric Co..... 1

La Roche Co., F. A.....—
Leather Preserv. M. Corp.... 8
Leffel & Co., James..... 8
Lindsley Brothers Company..17
Lond's Sons Co., B. M.....—

Machado & Roller .....—
Malthy Lumber Company....17
Manhattan El. Supply Co.... 1
Manross, F. N..... .....—
Marinette Gas Engine Co..... 8
Matthews & Bros., W. N.....11
McLennan & Company, K....10
Mechanical Appliance Co.... 7
Mica Insulator Company.....—
Michigan College of Mines ..11
Minnesota Electric Co.....15
Miscellaneous Advs.....12
Monon Railroad..... 12
Moon Mfg. Co., The.....—
Morrison Lbr. Co., J. W.....16
Mueller Company, William..16
Munsell & Co., Eugene..... 10

National Electric Co..... ... 9
National India Rubber Co.... 1
New England Butt Co.....17
Newgard & Co., Henry.....11
New York Cent. Ry.....17
New York Ins. Wire Co.....11
Northern Elect'l Mfg. Co....10
Northern Pacific Ry.....16
Norton Elect'l Instrument Co.—

Okonite Co., The..... 1
Olds Gasoline Engine Works. 8

Pacific Coast Pole Co.....17
Page & Hill Co.....16
Paragon Fan & Motor Co.....—
Pardridge Shade & Refl. Co..—
Pass & Seymour, Inc.....—
Pennsylvania Railroad.....13
Phelan, D. W.....16
Phillips, Eugene F.....11
Phillips Insulated Wire Co...11
Phœnix Glass Co.....—
Phosphor-Bronze S. Co..... 8
Pignolet, L. M.....10
Pittsburg & L. S. Iron Co....17
Plume & Atwood Mfg. Co.... 4
Porter Cedar Company.....16
Pratt Institute 1

Reisinger, Hugo..... 7
Reynolds El. Flasher Mfg.Co. 1
Roebling's Sons Co., J. A..... 1
Ruebel-Schwedtmaon-Wells..13

Safety Ins. Wire & Cable Co.. 1
Sargent & Lundy.....—
Schott, W. H.....13
Seaman, J. H..... 5
Seaman & Co., W. S.....14
Simplex Electrical Co., The.. 1
Simplex Elec. Heating Co....10
Speer Carbon Co.....—
Sprague Electric Company...20
Squire Electric Co.....—
Standard Elec. Mfg. Co.....10
Standard Underg. Cable Co....—
Standard Vitrified Conduit Co14
Stanley Instrument Co..... 5
Stanton, LeRoy W..... 13
State Univ. of Iowa.....11
Sterling & Son, W. C.....16
Sterling Electrical Mfg.Co... —
Sterling Varnish Co., The.... 1
Stow Mfg. Company.....—
Stromberg-Carlson Tel. Mfg. Company.....15
Sturtevant Company, B. F...20

Thompson, S. E.....—
Torrey Cedar Company.....16
Trumbull Elec. Co.....—

Union Electric Mfg. Co.....—

Valentine-Clark Co., The....—
Vulcanized Fibre Company..20

Wabash Railroad.....15
Wagner Electric Mfg. Co.....—
Walsh's Sons & Company.....12
Warren Elec. Mfg. Co.....20
Wesco Supply Co.....10
Western Electric Company... 4
Western El. Supply Co.....—
Western Lumber & Pole Co..16
Westinghouse Electric & Manufacturing Co.....18
Westoo Electrical Inst. Co... 1
Wilmerding, C. H.....—
Wisconsin Central Ry.....17
Woolley Fdy. & Mach. Wks.. 8
Worcester Company, C. H....16

Yesbera Mfg. Co..... .. 15
Yost Electric Mfg. Co 11

For Classified Index of Advertisements See Page 6.

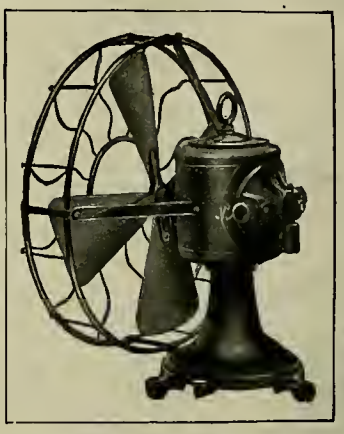
REMEMBER THE NAME AND BUY THE BEST.

PARAGON FAN MOTORS

NEW STYLES NEW PRICES
EASY RUNNING RIGID CONSTRUCTION NOISELESS

CALL AND SEE THEM OR WRITE FOR PRICES

CHICAGO EDISON COMPANY,
139 ADAMS ST., CHICAGO.



Sheet Brass, All Tempers
Brass and Bronze Drill Rods
Brass and Copper Wire
German Silver Sheet and Rod
Brazed and Seamless Tubing

Eagle Brand Copper Rivets and Burrs, Brass Escutcheon Pins

Brass Butts, Desk Narrow, Broad Middle, Ball Tipped and Water Closet

Brass and Iron Jack Chain, Brass Safety Chain, Etc.
Catalogues on Application

THE PLUME & ATWOOD MFG. CO.
New York Boston San Francisco Chicago

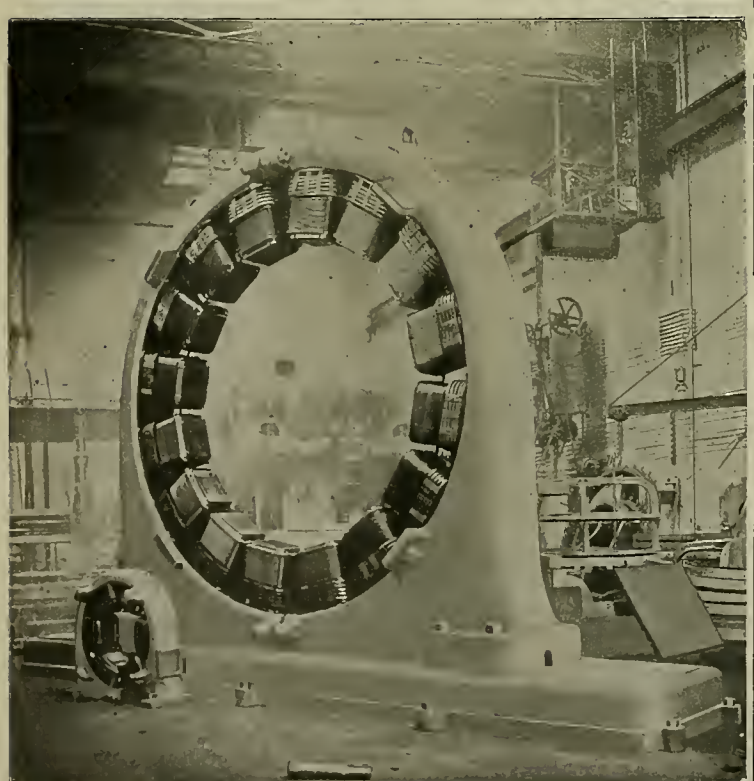
FARIES FIXTURES

Shades
Brackets
Clusters
Portables
Canopies
Chandeliers
Nozzles
Fittings
Castings

are UNIVERSALLY USED

Catalog Mailed on Application

FARIES MFG. CO.
DECATUR, ILL.



Direct Current
Generators and Motors

Western Electric Company
CHICAGO NEW YORK
Other Large Cities

Space 17 Electricity Building, Louisiana Purchase Exposition

Crocker-Wheeler. Brown, Boveri.

By arrangement with the celebrated electrical engineers, Brown, Boveri & Cie. of Baden, Switzerland, the Crocker-Wheeler Company has secured their alternating current designs, patents and rights to manufacture in America, and has retained them as consulting engineers.

Crocker-Wheeler Company is now putting on the market alternating current generators, transformers and accessories of the most perfect design and construction, adapted to American practice. Opportunities to bid on this apparatus are invited.

⅔ Actual Size. Patented.

CROWN CORD ADJUSTER

BEST AND SIMPLEST. MADE OF HARD RUBBER.

No Slip, No Abrasion, No Removing socket, Easily attached

Price $4.00 Per Hundred. Liberal Discount to the Trade.

Sample Free.

J. H. SEAMAN, 175 Dearborn St., Chicago

Security Conduit Rods

Experience develops that the best coupling is the one jointed the easiest and quickest and which holds the rods firmly together without slack and without danger of separation in the duct, and which easily uncouples when removing

These rods are easily handled in manholes, quickly jointed and unjointed, and will stand abuse. The couplings lock together rigidly, so rods will not buckle under pressure nor bind against conduit walls. There is no slack between rods.

Prices, 36 inches, each $0.50 48 inches, each $0.60 Send for catalogs on Security specialties.

THE F. BISSELL COMPANY

Manufacturers and Jobbers of

ELECTRICAL GOODS

226-228-230 HURON STREET

TOLEDO, O.

DO YOU WANT THE BEST?

Then ALWAYS buy

THE MAXSTADT PATENT JOINT

Manufactured and sold by the owners of the Maxstadt Patent No. 655,905.

This is the best Joint on the market and gives entire satisfaction wherever used.

No. 882 represents the Joint ready for use.

Patented August 14, 1900, in the United States and Foreign Countries.

No. 882.

No. 884 represents the Joint, twisted, complete on the line.

No. 884.

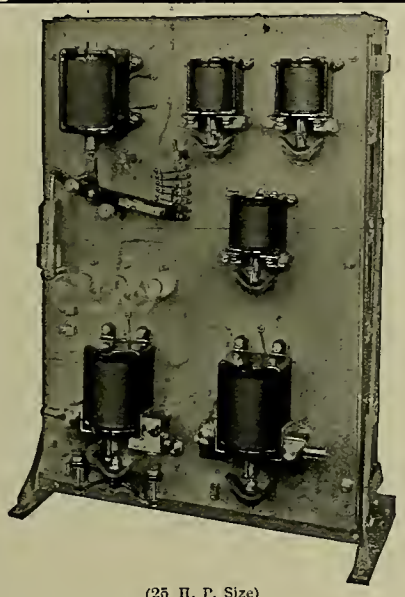
These Joints are furnished in copper for copper wire and in tinned steel for galvanized iron wire. Samples and prices will be sent, without charge, upon request.

SOLE OWNERS OF THE MAXSTADT PATENT IMPROVED AMERICAN JOINT.

CHICAGO DIE & ELECTRIC COMPANY, 87-91 West Lake Street, CHICAGO, ILL.

C H

QUALITY



QUALITY

(25 H. P. Size)

SELF-STARTERS

FOR

Large Motors

THE CUTLER-HAMMER MFG. CO.

MILWAUKEE WIS.

New York 136 Liberty St.

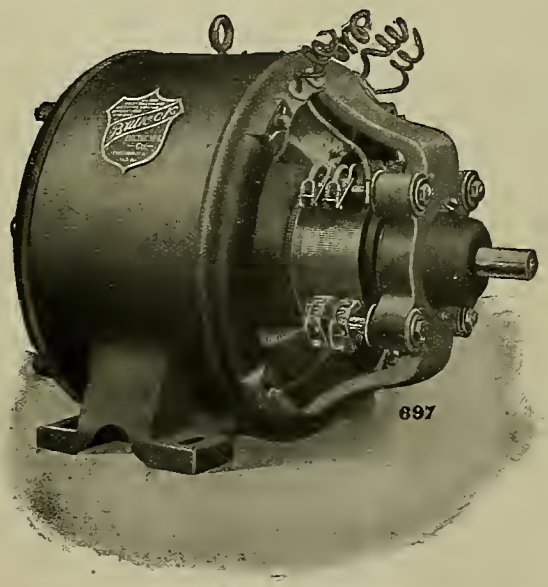
Boston 176 Federal St.

Pittsburg 322 Frick Building

Chicago 1232 Monadnock Bldg.

Bullock Electric Manufacturing Co.

CINCINNATI, OHIO, U. S. A.



Type N Bullock Open Motor

Especially adapted for driving machinery requiring variable speeds using the BULLOCK Multiple Voltage System.

STANLEY RECORDING WATTMETERS

FOR ALTERNATING CURRENT CIRCUITS

BALANCED THRUST

NO JEWEL WEAR FROM HAMMER OR SIDE THRUST. GLASS OR METAL COVERS—SECOND ALONE TO THE

STANLEY MAGNETIC SUSPENSION WATTMETERS

Send for Bulletins and Information About Meters to

STANLEY INSTRUMENT CO., Great Barrington, Mass., U. S. A.

EUROPEAN OFFICE, 23 BOULEVARD DES ITALIENS, PARIS, FRANCE.

SALES AGENTS:

Missouri, Kansas, Arkansas, FRANK ADAMS ELECTRIC COMPANY, St. Louis.

Colorado, Idaho, Montana, Wyoming, New Mexico, Utah, HENDRIE-BOLTHOFF MFG. AND SUPPLY CO., San Francisco.

California, Oregon, Washington, Nevada, Arizona. BROOKS-POLLIS ELECTRIC CORP. San Francisco.

Mexico, VICTOR M. BRASCHI & COMPANY, Mexico City.

Gould Storage Battery Co.

Complete Storage Battery Plants

Railway Line and Regulating Isolated and Train Lighting Central Lighting and Power Electric Vehicle and Telephone

GOULD COUNTER E. M. F. BOOSTER SYSTEMS

Sales Offices { NEW YORK, 1 W. 34th Street. BOSTON, 89 State Street. CHICAGO, The "Rookery." SAN FRANCISCO, Century Electric Co.

WORKS: DEPEW, N. Y.

Bulletins.

CLASSIFIED INDEX OF ADVERTISEMENTS.

Adjusters, Cord.
Crescent Co.
Incandes. El. Lt. Manip. Co.

Adjusters, Inc. Lamps.
Inc. El. Lt. Manipulator Co.

Anchors (Tel. & Tel.)
Matthews & Bro., W. N.
Crouse-Hinds Co.

Annunciators.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Moon Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Batteries and Jars.
Bissell Co., The F.
Central Electric Co.
Columbus Storage Battery Co.
Edison Mfg. Co.
Edwards & Company.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Bells, Buzzers, Etc.
Central Electric Co.
Edwards & Co.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Belt Dressing.
Dixon Crucible Co., Jos.
Leather Preserver Mfg. Corp.

Belting.
Leather Preserver Mfg. Corp

Blowers.
Sturtevant Co., B. F.

Boiler Compounds.
Dearborn Drug & Chem Wks.

Boilers.
Allis-Chalmers Company.
Babcock & Wilcox Co.

Bonks. Electrical.
Electrician Publishing Co.

Booths, Telephone.
Seaman & Co., W. S.
Yesbera Mfg. Co.

Brackets.
Faries Mfg. Co.

Brushes.
Central Electric Co.
Hobart Elec. Mfg. Co.
Holmes Fibre-Graphite Co.
Speer Carbon Co.
Westero Electric Company.

Cable Hangers.
Bissell Co., B. F.
Western Electric Co.

Cables (See Wires and Cables)

Canopies.
Faries Mfg. Co.

Carbons, Points and Plates.
Central Electric Co.
Chicago Edison Co.
Consumers Carbon Co.
Electric Appliance Co.
Reisinger, Hugo.
Speer Carbon Co.
Wesco Supply Co.
Western Elec. Supply Co.

Castings.
Faries Mfg. Co.
New England Butt Co.
National Electric Co.

Chains.
Jeffrey Mfg. Co.

Chandeliers.
Faries Mfg. Co.

Circuit Breakers.
Cutler-Hammer Mfg. Co.
Cutter Elec. & Mfg. Co.
Ft. Wayne Elec. Wks. Inc.
La Roche Co., F. A.
Union Electric Mfg. Co.
Western Electric Company.
Westinghouse El. & Mfg. Co.

Clusters.
Faries Mfg. Co.

Clutches, Electrical and Mechanical.
Akron Electrical Mfg. Co.

Coal and Ashes Handling Machinery.
Jeffrey Mfg. Co.

Coils and Magnets.
Western Electric Co.

Commutator Compound
Allen Co., L. B.
Egan, J. J.
McLennan & Co., K.

Commutator Truing Device.
Akron Electrical Mfg. Co.

Conduit and Conduits.
American Circular Loom Co.
American Conduit Company
Central Electric Co.
Electric Appliance Co.
Sprague Electric Co.
Standard Vitrified Cond. Co.
Wesco Supply Co.
Western Electrical SupplyCo.

Contractors and Electric Light Plants.
Allis-Chalmers Company.
Bullock El. Mfg. Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
National Electric Co.
Northern Electrical Mfg. Co.
Sprague Electric Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Controllers, Crane.
Amer. Elec. Fuse Co.

Cross-Arms, Pins and Brackets.
Berthold & Jennings.
Central Electric Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Company.
Western Elec. Supply Co.

Cut-Outs and Switches.
Bissell Co., The F.
Bossert Elec. Const. Co.
Central Electric Co.
Chicago Edison Co.
Crouse-Binds Co.
Cutter Elec. & Mfg. Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
General Inc. Arc Light Co.
Hart Manufacturing Co.
La Roche Co., F. A.
Manhattan Elec. Supply Co.
Trumbull Elec. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Dynamos and Motors.
Akron Electrical Mfg. Co.
Allis-Chalmers Company.
Bissell Co., The F.
Bullock Elec. Mfg. Co.
Central Electric Co.
Century Electric Co.
Crawfordsville Electric Co.
Crocker-Wheeler Co.
Dustin Co., Chas. E.
Ft. Wayne Elec. Wks. Inc.
General Elec. Co.
General Inc. Arc Light Co.
Gregory Electric Co.
Hobart Elec. Mfg. Co.
Mechanical Appliance Co.
National Electric Co.
Northern Electrical Mfg. Co.
Sprague Electric Co.
Stow Manufacturing Co.
Sturtevant Co., B. F.
Wagner Electric Mfg. Co.
Warren Elec. Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Economizers, Fuel.
Green Fuel Economizer Co.

Electric Heating Appl.
American Elec. Heater Co.
Simplex Elec. Heating Co.
Western Electric Co.

Electric Railways.
Crocker-Wheeler Co.
General Electric Co.
Sprague Electric Co.
Westinghouse El. & Mfg. Co.

Electrical and Mechanical Engineers.
Arnold Elec. Power Stat'n Co.
Baker & Co., W. E.
Bryan, Wm. H.
Butterfield, J. F.
Byllesby & Co., H. M.
General Engineering Co., The.
Hallberg, J. H.
Hornaday, J. P. & Co.
Humphrey, Henry H.
Hunt & Co., Robt. W.
Jackson, D. C. & W. B.
Kohler Brothers.
Newgard & Co., Henry.
Northern Electrical Mfg. Co.
Ruebel, Schwedtman, Wells.
Sargent & Lundy.
Schott, W. H.
Squire Electric Co.
Stanton, LeRoy W.
Wilmerding, C. H.

Electrical Instruments. (Recording and Testing.)
Bissell Co., The F.
Central Electric Co.
Diamond Meter Co.
Duncan Elec. Mfg. Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
General Inc. Arc Light Co.
Jewell Electrical Inst. Co.
Machado & Roller.
Norton Elec'l Instrument Co.
Pignolet, L. M.
Stanley Instrument Co.
Wagner Electric Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.
Weston Electrical Inst. Co.

Electro-Plating Mach'y
Crocker-Wheeler Company.
General Electric Co.

Elevators-Conveyors.
Jeffrey Mfg. Co.

Engines, Gas and Gasoline.
Allis-Chalmers Company.
Marinette Gas Engine Co.
Olds Gasoline Engine Works.
Woolley Fdy. & Mach. Wks.

Engines, Steam.
Allis-Chalmers Company.
Dustin Co., Chas. E.
Sturtevant Co., B. F.

Fans and Fan Motors.
Central Electric Co.
Crocker-Wheeler Company.
Edison Mfg. Co.
General Electric Co.
General Inc. Arc Light Co.
Sprague Electric Co.
Sturtevant Co., B. F.
Wesco Supply Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Fibre.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Files.
Barnett Co., G. & H.

Fittings.
Faries Mfg. Co.

Fixtures, Gas and Elec.
Beardslee Chandelier Mfg. Co.

Flashers.
Bissell Co., The F.
Haller Machine Co.
Reynolds El. Flasher Mfg. Co

Flexible Shafts.
Stow Mfg. Co.

Forges.
Sturtevant Co., B. F.

Fuses and Fuse Wire.
Amer. Elec. Fuse Co.
Bissell Co., The F.
Central Electric Co.
Central Tel. & El. Co.
Chicago Die & Electric Co.
Chicago Fuse Wire & Mfg. Co.
D. & W. Fuse Company.
Electric Appliance Co.
Johns-Manville Co., H. W.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Company.
Western Elect. Supply Co.

Globes, Reflectors and Shades.
Fostoria Incan. Lamp Co.
Haller Machine Co.
Holophane Glass Co.
Pardridge Shade & Refl. Co.
Phœnix Glass Co.
Wesco Supply Co.
Western Electric Co.
Western Elect. Supply Co.

Graphite Specialties.
Dixon Crucible Co., Jos.
Holmes Fibre-Graphite Co.

Heating (Exhaust Steam).
Amer. District Steam Co.

Heating and Ventilating Apparatus.
Sturtevant Co., B. F.

Holders, Inc. Lamps.
Incandesent Electric Light Manipulator Co.

Inspection & Insurance
Hartford Steam Boiler Inspection & Insurance Co.

Insulating Machinery.
New England Butt Co.

Insulators and Insulating Materials.
Akron Electrical Mfg. Co.
American Electrical Works.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Inc. Arc Light Co.
Indiana Rub. & Ins. Wire Co.
Johns-Manville Co., H. W.
Kartavert Mfg. Co.
Manhattan Elec. Supply Co.
Mica Insulator Co.
Munsell & Co., Eugene.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Standard Vitrified Cond. Co.
Sterling Varnish Co.
Vulcanized Fibre Co.
Wesco Supply Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Junction Boxes.
Bossert Elect. Const. Co.
General Inc. Arc Light Co.

Lamps, Arc.
Bissell Co., The F.
Central Electric Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
General Inc. Arc Lt. Co.
Gregory Electric Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Lamps, Incandescent.
Bissell Co., The F.
Bryan-Marsh Company.
Buckeye Electric Company.
Central Electric Co.
Chicago Edison Co.
Columbia Incan. Lamp Co.
Edison Decorative & Miniature Lamp Dept.
Electric Appliance Co.
Fostoria Incand. Lamp Co.
General Electric Co.
General Inc. Arc Light Co.
Standard Elec'l Mfg. Co.
Sterling Electrical Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Lamps, Incandescent—Replacers & Cleaners.
Inc. El. Lt. Manipulator Co.

Letters, Metal.
Haller Machine Co.

Lightning Arresters.
Central Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
Manhattan Elec. Supply Co.
Minnesota Electric Co.
Western Electric Co.

Linemen's Climbers.
Klein & Sons, Mathias.

Magnet Wires.
(See Wires and Cables.)

Mechanical Draft.
Sturtevant Co., B. F.

Mica.
Chicago Mica Co.
Mica Insulator Co.
Munsell & Co., Eugene.

Mining Apparatus. Elec.
Allis-Chalmers Company.
Crocker-Wheeler Company.
General Electric Co.
Jeffrey Mfg. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Motors. (See Dynamos and Motors.)

Nippers and Pliers.
Klein & Sons, Mathias.

Nozzles.
Faries Mfg. Co.

Paints.
Dielectric Mfg. Co.

Patent Attorneys.
Bain, Foree.

Phosphor Bronze.
Phosphor Bronze Sm. Co. Ltd.

Platinum, Wire and Sheet.
Baker & Company Inc.

Poles and Ties.
Berthold & Jennings.
Brooks, Hall L.
Columbia Mfg. Co.
Coolidge Co., Marshall H.
Fowler, John H.
Fowler-Jacobs Company.
Kellogg Switch. & Sup. Co.
Lindsley Bros. Co.
Loud's Sons Co., B. M.
Maltby Lumber Co.
Morrison Lbr. Co., J. W.
Mueller Company, William.
Pacific Coast Pole Co.
Page & Hill Company.
Phelan, D. W.
Pittsburg & L. S. Iron Co.
Porter Cedar Company.
Sterling & Son, W. C.
Thompson, S. E.
Torrey Cedar Co.
Valentine-Clark Co., The.
Western Lumber & Pole Co.
Worcester Co., C. B.

Polish (Metal).
Allen Co., Inc., L. B.
Hoffman, Geo. W.

Portables.
Faries Mfg. Co.

Power Transmission Machinery.
Jeffrey Mfg. Co.

Rail Joints.
Continuous Rail Joint Company of America.

Refiners.
Gt. West Smelt. & Refining Co

Re-Winding—Repairs.
Chicago Edison Co.
Gregory Electric Co.

Rheostats.
Cutler-Hammer Mfg. Co.
General Electric Co.
Gen'l Inc. Arc Lt. Co.
Union Electric Mfg. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Rods, Conduit.
Cope, T. J.

Schools and Colleges.
Electrical Engineer Inst.
Highland Park College
Michigan College of Mines.
Pratt Institute.
State Univ. of Iowa.

Second-Hand Mach'y.
Bissell Co., The F.
Cent. Stat. Improvement Co.
Gregory Electric Co.
Matthews & Bro., W. N.
Walsh's Sons & Co.

Shades, Lamp.
Faries Mfg. Co.

Sheet Brass & Copper.
Plume & Atwood Mfg. Co.

Signs, Electric.
Haller Machine Co.

Sockets & Receptacles.
Pass & Seymour.
Yost Elec. Mfg. Co.

Soldering Sticks, Salts and Paste.
Allen Co., L. B.
Crescent Co.
Kester Elec. Mfg. Co.
Western Electric Co.

Speaking Tubes.
Central Electric Co.
Edwards & Co.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.
Wester Elec. Supply Co.

Specialties, Electrical Mfrs. and Designers.
Haller Machine Co.

Speed Indicators.
Weston Electrical Inst. Co.

Storage Batteries.
American Battery Co.
Electric Storage Battery Co.
Gould Storage Battery Co.

Supplies, General Elec.
Bissell Co., The F.
Central Electric Co.
Century Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Electric Co.
Manhattan Elec'l Supply Co.
Wesco Supply Co.
Western Electric Co.
Western Elect. Supply Co.

Switchboards.
Bissell Co., The F.
Crouse-Hinds Co.
Gen. Incan. Arc Light Co.

Telephones, Telephone Material and Switchboards.
American El. Telephone Co
Automatic Electric Co.
Bissell Co., The F.
Central Electric Co.
Central Tel. & El. Co.
International Tel. Mfg. Co.
Kellogg Switchb. & Sup. Co.
Manhattan Elec. Supply Co.
Moon Mfg. Co., The.
Stromberg-Carlson Tel. M.Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Time Switches.
Bissell Co., The F.
Hartford Time Switch Co.

Tools.
Klein & Sons, Mathias.
Western Electric Co.

Transformers.
Central Electric Co.
Crawfordsville Electric Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Works, Inc.
General Electric Co.
Gregory Electric Co.
Kuhlman Electric Co.
Manhattan Elec. Supply Co.
National Electric Co.
Wagner Electric Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Trucks, Electric Car.
General Electric Co.
Westinghouse El. & Mfg. Co.

Turbines, Steam.
Allis-Chalmers Co.
General Electric Co.
Westinghouse El. & Mfg. Co

Turbine Water Wheels
Leffel & Co., Jas.

Varnishes.
Dielectric Mfg. Co.
Sterling Varnish Co.

Vulcanized Fibre.
Vulcanized Fibre Co.

Wires & Cables—Magnet Wires.
American Electrical Works.
Bissell Co., The F.
Central Electric Co.
Chicago Insulated Wire Co.
Crescent Ins. Wire & Cble. Co.
Driver-Harris Wire Co.
Electric Appliance Co.
General Electric Co.
Hazard Manufacturing Co.
Indiana Rub. & Ins. Wire Co
India Rubber & Gutta Percha Insulating Co.
Kellogg Switch. & Sup. Co.
Manhattan Elec. Supply Co.
National India Rubber Co
New York Insulated Wire Co.
Okonite Co., The.
Phillips, Eugene F.
Phillips Insulated Wire Co
Roebling's Sons Co., J. A.
Safety Ins. Wire & Cable Co.
Simplex Electrical Co.
Standard Underground C. Co
Wesco Supply Co.
Western Electric Company.
Western Elec. Supply Co.

For Alphabetical Index of Advertisements See Page 3.

"ELECTRA" HIGHEST GRADE NUERNBERG

CARBONS

BEST LIGHT

STEADIEST LIGHT

LONGEST LIFE

LEAST DUST

REMAIN THE STANDARD OF THE WORLD FOR ALL ARC LIGHTING SYSTEMS, BECAUSE they cannot be equaled in QUALITY or EFFICIENCY, producing the highest standard of candlepower in proportion to the current consumed.

HUGO REISINGER, Sole Importer, - - 11 Broadway, NEW YORK.

All Supply Houses

J. J. EGAN'S "ACME" COMMUTATOR COMPOUND absolutely prevents sparking or cutting. One stick of "Acme" is equal to one gallon of oil for lubricating commutators. Free Sample. AGENTS WANTED. 50c per Stick. $5 00 per doz.

J. J. Egan Sole Mfg., 317 Austin Ave., Tel. Polk, 1779 Chicago

Cope's Patent Quick Coupling Conduit Rod

Remember these rods have no lost motion. These Couplings are of Steel and are made in the best possible manner.

Write for list of persons using these rods—26,000 sold since May 1902. Made in 3 ft. and 4 ft. lengths. Price, 3 ft. 75 cents, 4 ft. 85 cents. Patented February 24, 1903.

T. J. COPE

3244 North Fifteenth Street PHILADELPHIA, PA.

Watson Motors

If you want a small motor for a special purpose. Write us. Mechanical appliance Co. Milwaukee, Wis.

W. D. PAINT.

A PERMANENT INSULATING PROTECTION FOR WOOD OR METAL. A quick drying, moisture-proofing, black paint. An elastic anti-rust coating. A jet black finishing paint, efficient and not expensive.

Write for "Data on Insulating Materials."

DIELECTRIC MANUFACTURING CO., SAINT LOUIS.

"PROFIT & LOSS"

TWO SUMS IN ADDITION

+ SAFETY TO PERSON AND PROPERTY, FREEDOM FROM ACCIDENT, UNINTERRUPTED SERVICE = PROFIT

$ $ $ $ $ $ $

"NOARK" FUSES

DO NOT ARC—BUT INDICATE

Afford absolute safety as Protective Devices, and FREEDOM FROM ALL FIRE HAZARD

SECOND SUM

+ DANGEROUS FIRES, ACCIDENTS, OBSTRUCTION OF BUSINESS, ETC. = LOSS

WRITE FOR COMPLETE SET "NOARK" FUSE BULLETINS & LINE MATERIAL INSULATION CATALOG

H. W. JOHNS-MANVILLE CO.

100 William St., New York

MILWAUKEE, CHICAGO, ST. LOUIS, BOSTON, PHILADELPHIA, PITTSBURG, CLEVELAND, NEW ORLEANS, LONDON

DO NOT DELAY

placing your order for

Pillsbury A. C. Ceiling Fans

They will stir more air than any other alternating current Ceiling Fan on the market. THE PRICE IS RIGHT.

MANUFACTURED BY **CENTURY ELECTRIC CO.**

1007-9-11 LOCUST STREET, ST. LOUIS, MO.

BOILER WATERS CORRECTED

to remove and prevent scale and to stop corrosion. DEARBORN TREATMENT does the work. Send gallon sample for analysis. Booklet "R" now ready.

DEARBORN DRUG & CHEMICAL WORKS,

27-34 RIALTO BUILDING, CHICAGO, ILL. WM. H EDGAR, President Telephone: Harrison 3930 and 3931.

Dixon's Pure Flake Graphite

"The Perfect Solid Lubricant," saves shut-downs and repairs due to imperfect lubrication. Booklet 125C and sample upon request.

JOSEPH DIXON CRUCIBLE CO., JERSEY CITY, N. J.

JEFFREY ELEVATING, CONVEYING, POWER TRANSMISSION **MACHINERY** FOR CATALOGUE, ADDRESS THE JEFFREY MFG. CO. COLUMBUS, O.

BEST ON EARTH.

BURGER AUTOMATIC.

For Electric Work

REGULATION AND ECONOMY OF FUEL UNSURPASSED.

WRITE FOR CATALOGUE H

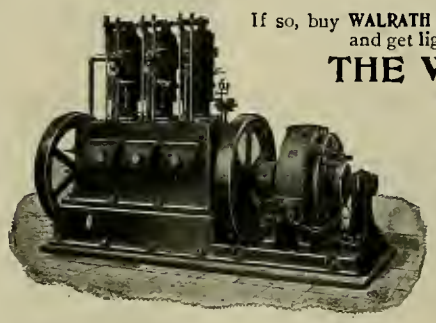
Then compare it with some Gas Engine hand books that cost $1.00.

Woolley

Foundry & Mach. Works

Box 400, Anderson, Ind. U. S. A.

ARE YOU LOOKING FOR MONEY?



If so, buy WALRATH GAS OR GASOLINE ENGINES and get light on the subject.

THE WALRATH

Received the Highest Award at the Pan-American Exposition.

It will produce as good a commercial light as that of an automatic steam engine, either belted or direct-connected generator. Simple, Economical and Reliable. Send for Catalogue W.

MARINETTE GAS ENGINE CO.,

CHICAGO HEIGHTS, ILL.

AGENCIES:

Keystone Engineering Co., Farmer's Bank Bldg., Pittsburg, Pa.
Strong, Carlisle & Hammond Co., 61-67 Frankfort St., Cleveland, Ohio
Mackay Engineering Co., 149 Broadway, N. Y.
C. H. Seidenglanz, 52 Wheo Bldg., Indianapolis, Ind.

REG. TRADE MARKS

"Phosphor Bronze"

DELTA

THE PHOSPHOR BRONZE SMELTING CO. LIMITED, 2200 WASHINGTON AVE., PHILADELPHIA.

"ELEPHANT BRAND PHOSPHOR-BRONZE" INGOTS, CASTINGS, WIRE, RODS, SHEETS, ETC.

— DELTA METAL —

CASTINGS, STAMPINGS AND FORGINGS

ORIGINAL AND SOLE MAKERS IN THE U.S.

WE BUY OLD BELTS

OR SCRAPS, ANY SIZE OR CONDITION.

WE CLEAN, REPAIR AND RENEW OLD BELTS.

LEATHER PRESERVER MFG. CORP.

27 W. MONROE ST., CHICAGO.

Locations for Industries

Erie Railroad

Chicago to New York

The Erie Railroad Company's Industrial Department has all the territory traversed by the railroad districted in relation to resources, adaptability, markets and advantages for manufacturing, and can advise with manufacturers in relation to the most suitable locations. For full information address

LUIS JACKSON

Industrial Commissioner, Erie Railroad Company

21 Cortlandt Street, New York

The Electrician Publishing Co., 510 Marquette Bldg., Chicago. Headquarters for all latest Electrical Books. Write for Catalogue.

THE TELEPHONE HAND-BOOK

BY HERBERT LAWS WEBB.

Price $1 00.

A complete and practical work in handy pocket size.

PUBLISHED BY

THE ELECTRICIAN PUBLISHING CO.,

Suite 510 Marquette Building, Chicago.

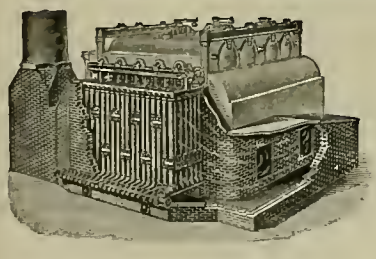
Send your Book Orders to

ELECTRICIAN PUBLISHING CO.,

510 Marquette Bldg., Chicago.

If the Installation of a

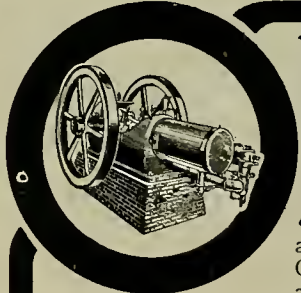
GREEN'S ECONOMIZER



Were long an expense, then you would be justified in deliberating, but under ordinary conditions, depending largely upon coal cost, it soon pays for itself by utilizing waste gases. **Electric light and power plants** find it a paying investment outside of the 10 to 20% saving on coal bill. Ask for explanation through our experts, also for booklet, both free.

***The* Green Fuel Economizer Co.**

Matteawan, N. Y. *Sole Manufacturers in the U. S.*



Olds Gas and Gasoline Engines

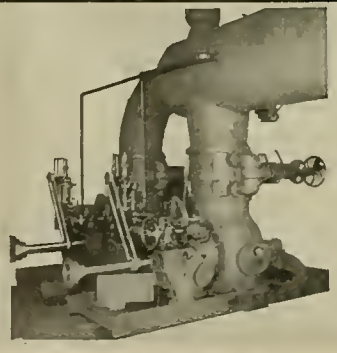
are strong and simple in construction. Parts are few and easily understood. Olds engines can be readily operated by any man of ordinary intelligence without previous experience. Repairs, though seldom necessary, can be quickly and economically made.

Stationary Engines - - 2 to 100 H. P.
Portable Engines - - 8 to 18 H. P.

For complete information and new illustrated catalog write

OLDS GASOLINE ENGINE WORKS,

252 River Street, - - Lansing, Mich.



SAMSON TURBINE

If the SPEED of the turbine is to be controlled by a GOVERNOR, the turbine should be of such capacity that it will develop the MAXIMUM POWER required, when operating at ¾ to ⅞ gate, then when an overload is thrown on, the governor can open the gates wider and allow an increase in power. The EFFICIENCY of the SAMSON between ¾ and ⅞ gate is over 84%.

WRITE DEPT. D FOR CATALOG

JAMES LEFFEL & CO.

SPRINGFIELD, OHIO U. S. A.

BITUMINIZED FIBRE CONDUIT

FOR

ELECTRICAL UNDERGROUND CONSTRUCTION
ELECTROLYSIS PROOF WATER PROOF

A smooth laminated insulator of unchanging durability.

Forms a continuous sealed duct from manhole to manhole, impervious to moisture and through which leaking gas cannot penetrate.

There has never been a gas explosion in our conduits nor the slightest evidence of electrolysis.

Abrasion of the cables is an impossibility.

It saves sixty per centum of freight and handling cost and twenty to thirty-five per centum of construction.

Process of laying is simple, rapid and inexpensive. There is no loss from breakage or fitting. It is self-aligning and cannot settle out of alignment.

All sizes from one inch to ten inches interior diameter. Bends of all angles.

The foremost electrical engineers are recognizing and testifying to the scientific advantages of our system of subway construction over all previous methods.

Send for illustrated book. Ask for prices giving size and quantities required

PROMPT DELIVERIES

FACTORIES: Philadelphia, Chicago, Los Angeles

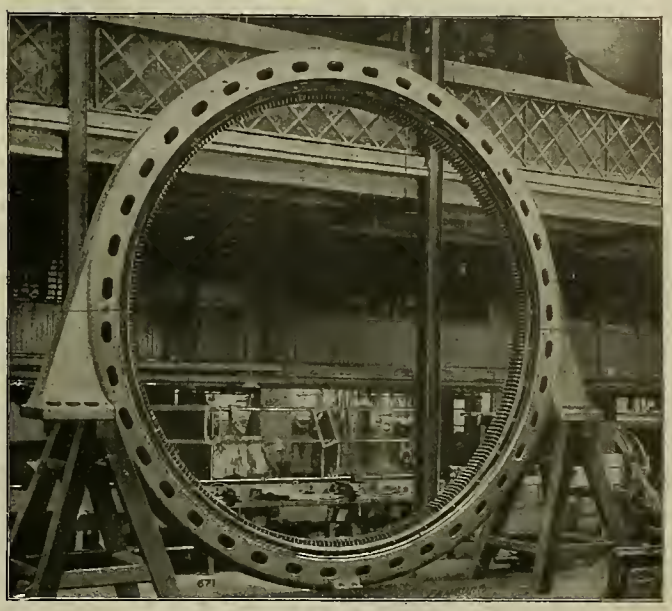
American Conduit Company

SEVENTH FLOOR, 170 BROADWAY, NEW YORK

336 Macy St., Los Angeles, Cal. *Manhattan Bldg., Chicago*

National Electric Company

builders of high-grade Electrical Machinery for LIGHTING, POWER and RAILWAY SERVICE



500 K. W. Engine Type Alternator Frame.

General Sales Offices and Works: MILWAUKEE

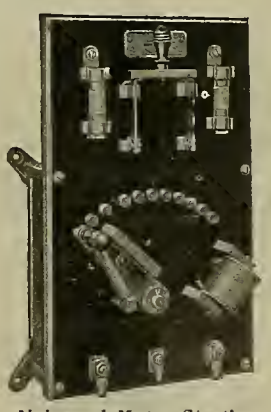
NEW YORK: 135 Broadway
CHICAGO: Old Colony Building
PHILADELPHIA: 1509 Land Title Bldg.
PITTSBURG: Gellatly & Co.
CHARLESTON, W. VA.: Agnew Electric Co.
SEATTLE & SAN FRANCISCO: Kilbourne & Clark Co.

General Electric Company

RHEOSTATS

Field Rheostat Front Connected.

The General Electric Company can furnish Rheostats to meet every condition of service.



Universal Motor Starting Rheostat.

Write for further information.

General Office: SCHENECTADY, N. Y.

Chicago Office: Monadnock Block. **Sales offices in all large cities.**

THE CONTRACT ROAD

The lamp market is a jungle where you are liable to get lost or swamped—and sure to get bit—unless you know the way. These sign boards will set you on the trail:

1st Sign—PACKARD. Turn sharply to the right here.

2nd Sign—CONTRACT. Now the path lies straight before you. It is your individual right of way and will lead you to the best lamp and the best prices.

Lamps bought on contract are "tailor made." Literally fitted to the plant. The far-sighted buyer will avail himself of contract advantages.

ELECTRIC APPLIANCE COMPANY

ELECTRICAL SUPPLIES

CHICAGO and SAN FRANCISCO

Northern variable speed motors operate on the two-wire single voltage system and can be driven from the same circuit as supplies current for the constant speed motors and lighting current.

Get Bulletin No. 2535.

NORTHERN ELECTRICAL MFG. CO., Madison, Wis., U. S. A.

Engineers, Manufacturers. 248A.

WANTED

You Who are Troubled with Sparking and Cutting of Commutators In Use

The only article that will PREVENT SPARKING. Will keep the commutator in good condition and PREVENT CUTTING.

Absolutely will Not Gum The Brushes . . .

It will put that high gloss on the commutator you have so long sought after.

50 Cts. per Stick. $5.00 per Dozen.

For Sale by all Supply Houses, or

FREE, Sample Stick.

K. McLENNAN & CO.,

Sole Manufacturers,

Room 411 Inter Ocean Bldg., 130 Dearborn St., CHICAGO, ILL.

Not a Luxury

Fans are a necessity.

We sell

Desk, Wall and Ceiling

styles for all voltages and currents.

Write for our 1904 bulletins.

THE WESCO SUPPLY CO.

"Everything Electrical" ST. LOUIS, U. S. A.

MICA

Of all Qualities, in any Form at Lowest Prices

EUGENE MUNSELL AND CO.

NEW YORK and CHICAGO

INSULATION That Is.

Micanite, Linotape, M. I. C. Compound, Empire Cloth and Paper. For Years the Standard.

MICA INSULATOR CO., Originators

NEW YORK and CHICAGO

MICA

WE PUT THE MICA POOL OUT OF BUSINESS!

CHICAGO MICA CO.

VALPARAISO, IND.

"STAR" INCANDESCENT LAMPS

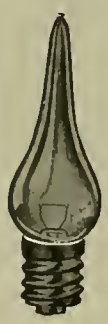
LONG LIFE
GUARANTEED CANDLEPOWER,
HIGHEST EFFICIENCY.

MADE BY THE MOST SKILLED WORKMEN.

STANDARD ELECTRICAL MFG. COMPANY, : Niles, Ohio.

EDISON MINIATURE LAMPS

Dry Battery Lamps



For use in portable lighting devices—electric candle sticks, pocket lanterns, carriage and bicycle lamps, clock lights for bed rooms, ruby lanterns for photography and for optical, dental and surgical instruments.

All types supplied—
Accurately rated—
Carefully selected.

EDISON DECORATIVE & MINIATURE LAMP DEPT.,

General Electric Company, Harrison, N. J.

Chicago Office: Monadnock Block. Sales Office all large cities.

VOLT - AMMETERS,

POCKET SIZE.

For Testing Batteries and Battery Circuits, Locating Faults, Grounds, etc.
RELIABLE. ACCURATE.
Send for Circular.

L. M. PIGNOLET,

78-80 Cortlandt St., NEW YORK, N. Y.

"AMERICAN" STORAGE CELLS

ARE THE BEST. Send for descriptive Circular.

AMERICAN BATTERY CO.,

EST'D 1899. 171 S. Clinton St., Chicago.

Electric Heating Apparatus

SEND FOR 62-PAGE CATALOGUE.

"UNIT" ENAMELED RHEOSTATS

SIMPLEX ELECTRIC HEATING CO.,

Cambridgeport, Mass.

WHY WAS IT

THAT **SEVEN-EIGHTHS** OF THE DECORATING IN CINCINNATI,
ALL OF THE DECORATING IN NEWPORT,
ALL OF THE DECORATING IN COVINGTON, DURING THE ELK'S CONVENTION, JULY 18 TO 25, WAS DONE WITH NORBITT TEMPORARY SOCKETS?

BECAUSE

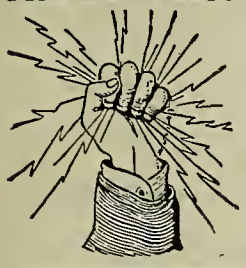
THESE SOCKETS ARE EASY, INEXPENSIVE AND QUICK TO INSTALL. THEY CAN BE INSTALLED AFTER THE WIRE IS UP WITHOUT REMOVING THE INSULATION FROM THE WIRE.

MANUFACTURED BY **CROUSE-HINDS CO., 133 S. Clinton Street, CHICAGO.**

FRANK N. PHILLIPS, PRESIDENT. G. N. WAGENSEIL, TREASURER. EUGENE F. PHILLIPS, GENERAL MANAGER. E. ROWLAND PHILLIPS, VICE-PRES. G. R. REMINGTON, JR., SEC.

AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.



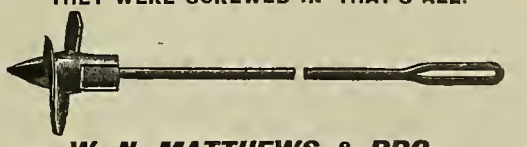
BARE AND INSULATED ELECTRIC WIRE,
ELECTRIC LIGHT LINE WIRE,
INCANDESCENT AND FLEXIBLE CORDS,
Railway Feeder and Trolley Wire,
AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR WIRES.
CABLES FOR AERIAL AND UNDERGROUND USE.

NEW YORK STORE, W. J. Watson, 26 Cortlandt St.
CHICAGO STORE, F. E. Donohoe, 82 Lake St.
MONTREAL BRANCH, Eugene F. Phillips' Electrical Works.
MAIN OFFICES AND FACTORIES, PHILLIPSDALE, R.I.

MICHIGAN COLLEGE OF MINES.
F. W. McNair, President,
A state institution located in and making use of an active mining district. New Metallurgical Building and Gymnasium completed in the fall of 1904. For Year Book and Record of Graduates apply to President or Secretary,
Houghton, Michigan.

Engineering MECHANICAL, ELECTRICAL, STEAM, CIVIL.
Complete and short courses. Thoroughly equipped engineering shops. Shop work from the beginning. Short courses in Steam and Electrical Engineering. Expenses low. Accommodations the best. School all year. Students may enter any time. Correspondence steam and electrical courses. Send for catalogue. Mention course in which interested.
HIGHLAND PARK COLLEGE, DES MOINES, IOWA.

AT THE ST. LOUIS EXPOSITION
STOMBAUGH GUY ANCHORS
ARE **ANCHORING**
POLES ON THE INTRAMURAL RAILWAY, THE MAST OF THE DE FOREST WIRELESS TELEGRAPH CO. AND THE AERODROME BUILT FOR THE AIR SHIPS.
THEY WERE SCREWED IN—THAT'S ALL.



W. N. MATTHEWS & BRO.
603 CARLTON BUILDING *ST. LOUIS*

EXPERT IN ELECTRICITY MECHANICS PATENT CAUSES
SOLICITOR OF **PATENTS**
U. S. & FOREIGN
FORÉE BAIN, 1652-3 Monadnock Blk., CHICAGO

ELECTRIC
SOLDERING IRONS
And Other Devices.
AMERICAN ELECTRICAL HEATER CO., DETROIT, MICH.

THE STATE UNIVERSITY OF IOWA
SCHOOL OF APPLIED SCIENCE, Iowa City, Iowa
Four year courses of the highest grade in
Civil, Municipal, Sanitary, Electrical, Mechanical, Mining **ENGINEERING**
Numerous short practical courses. Special courses in technical chemistry, bacteriology, etc. Adequate equipment in shops and laboratories. Waterpower.
University environment. Expenses low.
Address C. E. MacLEAN, President

GET ALLEN'S SOLDERING TICKS
MAKE SOLDER FLOW
FOR ALL ELECTRIC WORK
Be sure you're right—Get the habit.
Telling the man
"ALLEN SOLDERING STICKS OR NOTHING."
A Big Sample Stick for 10c.
Booklet "Soldering Sense" describes.
L. B. ALLEN CO., Inc.,
SOLE MAKERS,
1334 Columbia Ave., CHICAGO.

"Diamond H" Switches

Trade H Mark

This Trade-Mark guarantees quality.
The Hart Mfg. Co., Hartford, Conn.
New York Boston Chicago Toronto, Ont.

YOST SPECIALTIES.

Sockets, Wall Sockets, Weatherproof Sockets, Rosettes, Receptacles, Cord Adjusters.
Catalogue for the asking.
THE YOST ELECTRIC MFG. CO.
TOLEDO, OHIO.

M. KLEIN & SON.
Send 2c stamp for new catalogue No. 6 of
KLEIN'S TOOLS
For Electrical Workers and Line Builders.
MATHIAS KLEIN & SONS.
81 W. Van Buren St., Chicago, Ill.

Crimshaw

Raven White Core

Raven Black Core

ALL OUR WIRES pass Inspection and carry the above TRADE-MARKS on our tags. We also manufacture Crimshaw and Competition Tapes and Splicing Compounds.

NEW YORK INSULATED WIRE COMPANY,

MAIN OFFICE: 114, 116 & 118 Liberty St., New York.
BRANCHES: CHICAGO: 192 Desplaines St. BOSTON: 7 Otis St. SAN FRANCISCO: 33 Second St.

NATIONAL CODE STANDARD

"O. K." Weatherproof Wire.
Slow-Burning Weatherproof and Ideal Wire.
Prices and Samples on Application.

Phillips Insulated Wire Co.
Office and Factory: PAWTUCKET, R. I.

HENRY NEWGARD & CO.

ELECTRICAL CONSTRUCTION

Power and Light Plants. Switchboards and Panel Boards.

We install Municipal and Isolated Electric Lighting Plants.
We manufacture Switchboards, Table boards, Iron Cutout Boxes and Electrical Specialties.
We sell Dynamos, Motors and Electrical Supplies.
We wire old as well as new Residences, Factory Buildings, School and College Buildings.

87 Fifth Avenue, Chicago, Illinois.

WANTED, FOR SALE *and similar* **WANT COLUMN** *advertisements (50 words or less), $1.50 an insertion; additional words 3c each.* **POSITION WANTED** *advertisements (50 words or less), $1.00 an insertion; additional words 2c each.*

POSITION WANTED.

By a successful inventor of Electric Railway and Lighting specialties—patentee of simplest up-to-date enclosed arc lamp. Address BOX 375, care Western Electrician, 510 Marquette Bldg., Chicago.

POSITION WANTED.

By an electrician, four years' experience in wiring and line work installing, care and repair of generators, motors, meters, arc lamps, both A. C. and D. C. Best of references. Address, BOX 378, care Western Electrician, 510 Marquette Building, Chicago, Ill.

POSITION WANTED.

By practical superintendent and all around electrical and steam engineer, fifteen years' experience, strictly sober and reliable; age thirty-six. Have served as central station man, erecting engineer and superintendent, understand all practical conditions of light and power. Would accept traveling position or superintendent. Address BOX 380, care Western Electrician, 510 Marquette Building, Chicago, Ill.

POSITION WANTED.

Salesman located in the West desires position with reliable electrical manufacturing company. Three years' experience. Address BOX 379, care Western Electrician, 510 Marquette Building, Chicago, Ill.

POSITION WANTED.

As general manager, superintendent or electrician of medium sized plant. Prefer the lake regions. Twenty-five, with no bad habits. At present and for last five years as general manager of lighting and power plant operating 24 hours daily. Am familiar with every detail of the work and also telephone and telephone switchboard work. Can leave present position about August 20. Reason for leaving present position is desire change of climate. Address BOX 381, care of Western Electrician, 510 Marquette Bldg., Chicago.

FOR SALE.

A bargain; I. T. H. 30-light 9.6 Amp. Series open arc machine, with wall controller and ammeter complete, good running order.

Twenty-two 9.6 Amp. double carbon open arc lamps with glass, hoods and spreader complete, good order. Several additional lamps, both single and double, can be put in good order or parts used for repairs. A lot of extra globes and parts and a supply of carbons will be included if taken as a whole.

Two 30-K. W. Edison Bipolar 125-volt D. C. generators in fine running order. Reason for selling, have put in larger machinery.

CARROLL ELECTRIC LIGHT & POWER COMPANY,
Carroll, Iowa.

THERMOPILES 1½ VOLTS 1½ AMPERES
For Electrolytic analysis, charging storage batteries, and other constant current requirements. $3 Each.
WALSH'S SONS & CO.,
264 Washington Street. Newark, N. J.

Dividend Paying Electric Light Plant For Sale.

Electric light plant in Wisconsin city of 3,000 inhabitants, exclusive 17-year franchise and city contract. Plant in operation for seven years paying annually cash dividend. Physical condition of plant is first class.

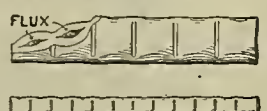
Company's increasing business demands more attention than can be given to it by present owners, who are local business men. A splendid opportunity for a practical electrician or manager who can control or invest about $20,000. Address BOX 374, care Western Electrician, 510 Marquette Bldg., Chicago, Ill.

REPAIRING RECALIBRATING

ELECTRIC METERS.
INTERNATIONAL ELECTRIC METER CO.
167 S. CANAL STREET, CHICAGO.

KESTER SELF FLUXING SOLDER

A Tube of Solder Filled with Flux.
Requires no Acid.
SAVES—LABOR—TIME—MONEY.



PATENTED.

Send for Free Samples.

L. F. Mahler Co., R. 1008 Chemical Bldg., St. Louis, Mo., Gen. Western Agent.

KESTER ELECTRIC M'F'G CO.,
46 N. UNION STREET, CHICAGO, ILL

INDUSTRIES ARE OFFERED LOCATIONS

WITH

Satisfactory Inducements,
Favorable Freight Rates,
Good Labor Conditions,
Healthful Communities,

ON THE LINES OF

THE ILLINOIS CENTRAL R. R.
AND THE
YAZOO & MISSISSIPPI VALLEY R. R.

For full information and descriptive pamphlet address

J. C. CLAIR,
Industrial Commissioner,
1 Park Row, Chicago, Ill.

HELP

Secured quickly through Western Electrician "Help Wanted" ads.

"Practical and to the Point"

IS ALL THAT NEED BE SAID OF

THE TELEPHONE HAND-BOOK

By Herbert Laws Webb.

160 Pages, 133 Illustrations, Cloth, Price $1.00.

The book for those interested in telephony.

ELECTRICIAN PUBLISHING CO.,
510 Marquette Bldg.,
CHICAGO.

WORKS QUICK AND EASY. KEEPS ITS LUSTER. HOLDS OLD TRADE AND MAKES NEW. DOES NOT DETERIORATE. ESTABLISHED 16 YEARS. SOLD BY AGENTS AND DEALERS ALL OVER THE WORLD

U.S. METAL POLISH

3 OUNCE BOX 10 CENTS
SAMPLES SENT FREE
GEO. W. HOFFMAN
POLISHES ALL METALS. BRANCHES: NEW YORK, CHICAGO, SAN FRANCISCO. 295 E. WASHINGTON ST. INDIANAPOLIS, IND.

FOR SALE.

ALTERNATORS.

1-360 K. W. General Electric 3-phase.
1-120 " " " "
1-75 " Westinghouse 2-phase.

250-VOLT GENERATORS.

1-250 K. W. Western Electric M. P.
1-200 " Eddy M. P.

125-VOLT GENERATORS.

1-125 K. W. Western Electric M. P.

Immediate shipment.

GREGORY ELECTRIC CO.
54-62 S. CLINTON ST. CHICAGO

BUY YOUR BOOKS

FROM THE

Electrician Pub. Co., 510 Marquette Bldg., Chicago.

"NEW TRAIN SERVICE TO

French Lick and West Baden Springs."

A parlor and dining car now leave Chicago at 12:00 o'clock noon, arrive at the Springs at 8:45 p. m. Leave Springs 9:00 a. m., arrive Chicago 5:55 p. m. Reservations at Monon Route City Office, 232 Clark Street. Telephone Har. 1245.

BOILERS

One 42-in. x 15 ft. 9-in., 250 H. P. Worthington Water Tube.
One 60-in. x 16 ft., John Mohr Return Tubular Boiler.
One 54-in. x 16 ft., John Mohr Return Tubular Boiler.
One 54-in. x 16 ft., Devine Turbular Boiler.

ENGINES.

One 600 H. P., 21 x 36 x 30, Williams Tandem Horizontal Compound, 140 R. P. M.
Two 600 H. P., 20 x 30 x 24, Porter-Allen Tandem Compound, 200 R. P. M.
One 250 H. P., 12 x 24 x 18 Williams Tandem Compound, 250 R. P. M.
Two 100 H. P., 13 x 12, Dick & Church, High Speed Automatic.

PARTIAL LIST ONLY.

Send for latest Catalogue for bargains in Engines, Boilers, Dynamos and Motors.

CENTRAL STATION IMPROVEMENT CO., 938 Monadnock Block, Chicago

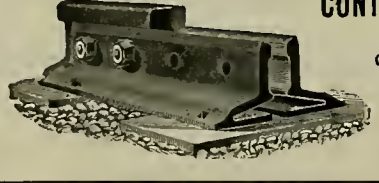
OFFICE OF— Town Clerk — A. R. KAUFMAN, CLERK
BOARD OF TRUSTEES — GEO. A. PAINTER, A. T. TAMBORINES, J. J. KERBY, F. VAN HOUTE, ATTY.

Summitville Ind. Nov. 23 1903.

Western Electrician
Chicago Ill.

Gentlemen: You may discontinue our Want Advertisement with the One issue. as I have already received about 40 answers to same. Send me your bill and I will remit same to you Thanking you very Kindly for your promptness
I am Yours Resp.

A. R. Kaufman
Clerk.



CONTINUOUS RAIL JOINT COMPANY OF AMERICA.

GENL. OFFICES: CENTURY BLDG., NEWARK, N. J.

OVER 20,000 MILES IN USE

Highest Award Paris Exposition, 1900, Buffalo, 1901

CHICAGO EDISON COMPANY REPAIR SHOPS

76 MARKET STREET, CHICAGO. TELEPHONE MAIN 1280.

Machine and Carpenter Work of All Kinds
Correspondence Solicited.

OPEN DAY AND NIGHT.

FIRST-CLASS EQUIPMENT THROUGHOUT.

Dynamos Armatures, Motors, Arc Lamps, Fans, Instruments.

ARNOLD ELECTRIC POWER STATION Co.
Engineers, Constructors for Complete Electric Plants. Results Guaranteed.
SUITE 1539, MARQUETTE BLDG., CHICAGO. NEW YORK OFFICE: 711 TRANSIT BLDG.

BUTTERFIELD, J. F.
ELECTRICAL ENGINEER AND CONTRACTOR.
Complete Telephone Exchanges Built and Material Furnished.
Cable Construction and Underground Conduit Construction a Specialty.
Room 595, 113 Adams Street, CHICAGO, ILL.

J. H. HALLBERG
Consulting Arc Lighting Expert and Practical Electrical Engineer
45 Broadway - NEW YORK
Room 169A

KOHLER BROS.,
Contracting Electrical Engineers, Lighting Power Railways,
1804-1806-1808-1810-1812 Fisher Building, CHICAGO.

W. E BAKER. H. B. BISHOP.
BAKER, W. E. & CO.
ENGINEERS,
ELECTRIC RAILWAYS.
27 William St., NEW YORK.

BYLLESBY, H. M. & Co.
(Incorporated)
ENGINEERS
Design, Construct and Operate Railway, Light, Power and Hydraulic Plants.
Examinations and Reports.
New York Life Building, - CHICAGO, ILL.

HORNADAY, J. P. & Co.
SUITE 1108 TRACTION BUILDING
CINCINNATI, O.
WATERWORKS, ELECTRIC RAILWAY, LIGHT, TRACTION, INDUSTRIAL AND MINERAL PROPERTIES BOUGHT AND SOLD

RUEBEL · SCHWEDTMANN-WELLS,
CONSULTING, MECHANICAL AND ELECTRICAL ENGINEERS,
Suite 801 Chemical Building, ST. LOUIS, U. S. A.

TRY IT.
Keep your name and address in this directory where it will be seen by possible clients.

A WEEKLY REPRESENTATION
in this "Directory" enables engineers to keep before all possible customers.

HUMPHREY, HENRY H.,
CONSULTING ENGINEER.
Central Lighting Stations, Electric Power Transmission.
SUITE 1305, CHEMICAL BLDG., ST. LOUIS.

Long Distance Phone Central 2448.
SCHOTT, W. H.,
ENGINEER AND CONTRACTOR,
SPECIALTIES—Central Station Heating Plants, Water Works Steam Plants, Electric Light, Gas and Street Railway Plants.
1220-21 MARQUETTE BUILDING, CHICAGO.

BRYAN, WILLIAM H.
M. Am. Soc. M. E.,
Consulting Mechanical and Electrical Engineer.
Lincoln Trust Building, ST. LOUIS.

E. W Hammer, Pres. and Treas. H. J. Minhinnick, Sec. and Gen'l Sup't.
GENERAL ENGINEERING Co., THE Consulting and Contracting Engineers.
Telephones, Electric Light, Power Transmission
Suite 1112, 135 ADAMS ST., CHICAGO.
Long Distance Telephone Central 478.

ROBERT W. HUNT & Co.,
ENGINEERS
1121 The Rookery, Chicago. 66 Broadway, New York.
Monongahela Bank Bldg., Pittsburg.
Norfolk House, Cannon St., London.

STANTON, LE ROY W.
Consulting Telephone Engineer.
Plans, Specifications and Supervision of Installation of complete telephone plants.
Special Reports on Telephone Properties and Apparatus.
411 Electrical Bldg., Cleveland, Ohio.

DUGALD C. JACKSON, C. E.
WILLIAM B. JACKSON, M. E.
MEMBERS
AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS
AMERICAN SOCIETY OF MECHANICAL ENGINEERS
AMERICAN SOCIETY OF CIVIL ENGINEERS
ENGINEERS. EXPERTS.
MADISON, WIS.

ALL Live men read the WESTERN ELECTRICIAN Each Week. Do You?

AKRON
Generators, Motors, Clutches, Commutator Truing Devices.
AKRON ELECTRICAL MFG. CO., AKRON, O.
N. Y. Office: McKay Engineering Co., 149 Broadway

TRAINS AT CONVENIENT HOURS

Chicago to { Pittsburg, Baltimore, Washington, Philadelphia and New York

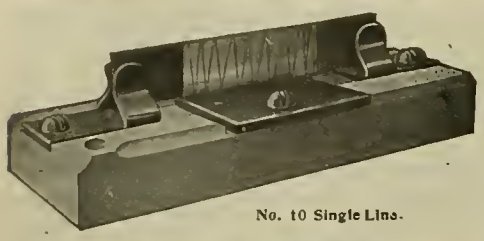
Over the PENNSYLVANIA SHORT LINES

CHOICE OF SEVEN DAILY TRAINS

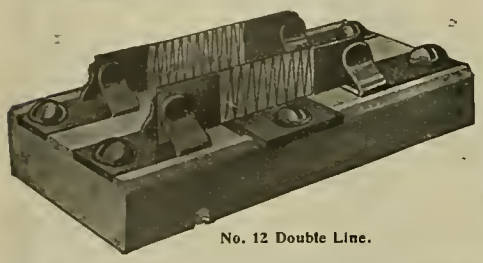
Among them are
No. 20, The Keystone Express leaves at 10:05 a. m.
No. 22, The Manhattan Limited leaves at 1:00 p. m.
No. 8, The Atlantic Express leaves at 3:00 p. m.
No. 2, The Pennsylvania Limited leaves at 6:00 p. m.
No. 24, The Pittsburg Special leaves at 7:30 p. m.

FOR FURTHER PARTICULARS CALL UPON OR ADDRESS

C. L. KIMBALL, Ass't Gen'l Passenger Agent, No. 2 Sherman Street, Chicago



No. 10 Single Line.



No. 12 Double Line.

PROTECTORS THAT PROTECT.

Our patent wrapped fuse used in our protectors are an insurance policy against lightning.

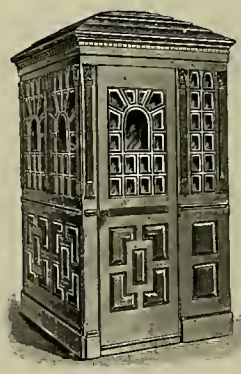
Sample free by mail to any Exchange or Toll Line

CENTRAL TELEPHONE AND ELECTRIC CO.,
909 Market St.,
ST. LOUIS, U. S. A.

INCREASED RECEIPTS PAY THE COST OF TELEPHONE BOOTHS,

Oftentimes the first thirty days will do it.

TRY ONE.



Write for catalog

W. S. SEAMAN & CO.
218 E. WATER STREET,
MILWAUKEE, WIS.

We introduced successful 4-party lines

LEICH SELECTIVE SYSTEM

Write for our booklet—"Selective W."

Impedence Coil for Selectives. No Springs.

CENTRAL ENERGY OR MAGNETO

AMERICAN ELECTRIC TELEPHONE CO.
CHICAGO, ILLINOIS

Standard Vitrified Conduit Co.

G. G. BARNARD, Manager

39-41 CORTLANDT ST.
NEW YORK

LARGEST FACTORIES IN THE WORLD : STOCK ON HAND
SEND FOR CATALOGUE

INTERNATIONAL Mechanical Self-Restoring Drop Switchboard.

A PERFECT APPARATUS.

Made in any desired capacity.
Sample parts and quotations on request.

INTERNATIONAL TELEPHONE MANUFACTURING CO.
CHICAGO, U. S. A.

PRACTICAL FEATURES OF TELEPHONE WORK.

By A. E. DOBBS.

Cloth, 7 by 5 1-4 inches. Illustrated. 134 pages. Appendix. 75 Cents.

THIS work is designed as a simple, plain-speaking handbook for the practical telephone man. Its author, Mr. Dobbs, has been eminently fitted by fourteen years' experience in telephony to deal with the subject in a thoroughly competent manner. This he has done, and the result is a mine of information, clearly and concisely presented, and invaluable to the manager, operator and lineman alike. The appendix contains reliable data regarding wires, resistance, inductive capacity, etc.

This or any other book on telephony or electricity sent to any address, postpaid, on receipt of price.

ELECTRICIAN PUBLISHING CO.,
510 MARQUETTE BUILDING, CHICAGO.

CENTRAL STATION HEATING

We are the originators and builders of the underground system of live and exhaust steam heating. Our system is used for the utilization and distribution of exhaust steam from electric and power plants for heating purposes. 250 Plants in successful operation. We have the only Meter System. Also manufacturers of Wooden Water Pipe, Steam Pipe Casing, Steam Traps, Condensation Meters, Valves, Economizing Coils, Separators and full line of Steam Fitters' Supplies.

WRITE FOR PAMPHLET AND PRICE LIST

AMERICAN DISTRICT STEAM COMPANY
MENTION WESTERN ELECTRICIAN. LOCKPORT, N.Y. CHICAGO, ILL.

"That's A Good Thing"

is the universal opinion of those who have investigated our new party line telephone. Our "Sure-Ring" telephone cuts out much trouble on party lines.
Our new desk set also has some excellent features.

These are all described in Bulletin No. 11-E.
Mailed free upon request.

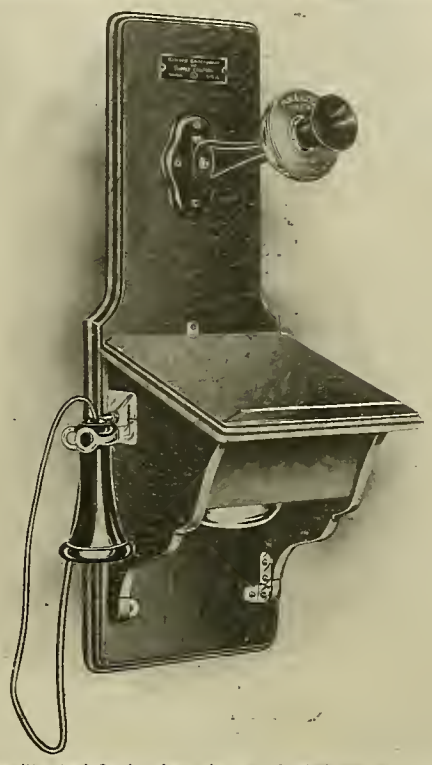
Stromberg-Carlson Telephone Mfg. Co.

GENERAL AND EASTERN SALES OFFICE
ROCHESTER, N. Y.

SALES DEPT.
CHICAGO, ILL.

KELLOGG SWITCHBOARD & SUPPLY CO.

Manufacturers of the Largest and Busiest Telephone Exchanges in the United States



The Kellogg Transmitter stands first in volume, clearness of articulation and in carrying power. Our prices are low when cost of maintenance and quality of apparatus are considered. Do not fail to visit our exhibit in the Electricity Building at the St. Louis Exposition.

Kellogg Switchboard & Supply Co., Green and Congress Streets - CHICAGO

Seymour Bldg., Los Angeles Electric Bldg., Cleveland Keystone Telephone Bldg., Philadelphia

AS SIMPLE AS ITS NAME.

A B C
—OF—
THE TELEPHONE

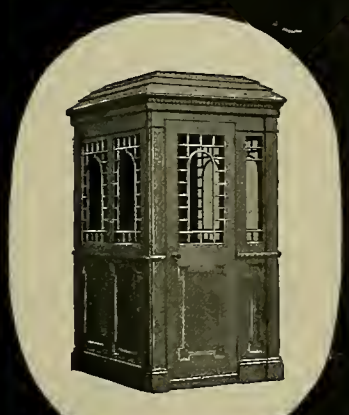
By J. E. HOMANS, A. M.

352 pages.

Cloth, Price $1.00.

An up-to-date, practical treatise on the construction, theory, installation, care and management of telephones and their appliances.
Sent prepaid on receipt of price.

Electrician Publishing Co.,
510 Marquette Building, Chicago, Ill.

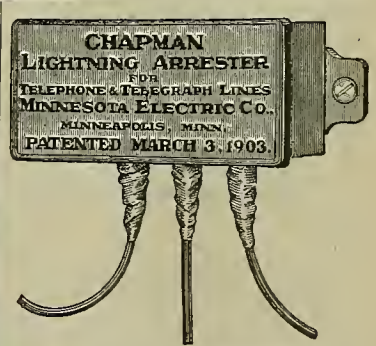


TELEPHONE BOOTHS

When in want of the Right Kind write us.

Catalogue Free

Yesbera Mfg. Co.
TOLEDO, OHIO.



G. A. R. EXCURSIONS TO BOSTON VIA THE WABASH

August 12, 13 and 14, the Wabash Railroad will sell excursion tickets from all stations to Boston and return at one cent per mile in each direction. Fare from Chicago, $17.75. Limit may be extended to Sept. 30, by deposit and payment of 50c. Write for illustrated folder giving full details with side trips, etc.

F. A. PALMER, A. G. P. A.
311 Marquette Building, Chicago, Ill

Automatic Telephones.

Privacy

Promptness

Precision

Profits.

Automatic Electric Co., Chicago, U. S. A.

PRODUCERS AND WHOLESALERS OF WHITE CEDAR PRODUCTS

CEDAR POLES

SPECIAL PRICES ON SMALL POLES.
Write for a copy of our TELEGRAPH CODE FOR CEDAR PRODUCTS

C. H. WORCESTER CO.
SUITE 1206 TRIBUNE BLDG. CHICAGO.

YARDS
KOSS MICH.
L'ANSE "
MUNISING "
ONTONAGON
WAGNER, WIS
PESHTIGO "

POLES, TIES, POSTS. THE PORTER CEDAR CO., SAGINAW, MICH.
PRODUCERS. We want your inquiries always.

Southern Cedar POLES Are the Best.
NO ROTTEN BUTTS. D. W. PHELAN, 277 Broadway, New York

TELEPHONE POLES
Yards at Red Cliff, Wis., Aitkin, Feeley, Cohasset, Deer River, Tenstrike and Black Duck, Minnesota.
Large stocks. Prompt shipments. Carefully inspected stock at low prices.
J. W. MORRISON LUMBER CO., 918-19 Lumber Exchange MINNEAPOLIS, MINN.

IDAHO CEDAR POLES.
LOW PRICES. LONG LENGTHS A SPECIALTY.
YARDS: IDAHO. MONTANA.
WESTERN LUMBER & POLE CO., - Main Office, DENVER, COLO.

POLES. WHITE CEDAR. IDAHO CEDAR up to 80 ft.
BERTHOLD & JENNINGS, ST. LOUIS. Chemical Building.
CROSS ARMS. LONG LEAF PINE AND FIR.

POLES W. C. STERLING & SON, MONROE, MICH. TIES.
Eleven Pole Yards in Michigan.
Wholesale Producers for 20 years

Cedar TORREY CEDAR CO., CLINTONVILLE, WIS. Poles
Large Stock Constantly on Hand

CEDAR POLES
ESTABLISHED 1862
WM. MUELLER COMPANY
1211-12-13 MARQUETTE BLDG. CHICAGO.
EIGHT DISTRIBUTING YARDS

THE TRAIL OF LEWIS AND CLARK

was the pioneer American trail west of the Missouri river and the results of that exploration of 1804-6 were of tremendous importance to the United States and they were never more apparent than now.

A publication relating to the Lewis and Clark expedition, just issued by **G. P. Putnam's Sons, New York**, stands peculiarly alone. This edition is a two-volume, 8 vo one, called "**The Trail of Lewis and Clark, 1804-1904.**" The author, Mr. Olin D. Wheeler, is the well known writer of the popular **Wonderland** series of the Northern Pacific Railway, in connection with which he made his studies and researches for this work.

Mr. Wheeler has traveled several thousand miles over the route of Louis and Clark. He has camped out, climbed mountains, followed old Indian trails, and visited remote points made memorable by those explorers. Their route across the Bitterroot mountains has been followed, identified and mapped.

"**The Trail of Lewis and Clark**" is illustrated in color and half tone from **paintings, drawings, and maps**, by Paxson, De Camp and Russell, made under Mr. Wheeler's direction and from photographs taken especially for the purpose. The writer tells his own story and supplements it with pertinent extracts from Lewis and Clark, and a host of other historical and narrative writers that connect the past with the present. Exact excerpts and photographic reproductions, in half tone from the ORIGINAL MANUSCRIPT JOURNALS of Lewis and Clark are given. A chapter is devoted to the Louisiana Purchase, another to the preparatory measures for the exploration, and another to the history of each man of the expedition so far as known, including a discussion of the death of Captain Lewis.

The Louisiana Purchase Exposition at St. Louis, and the **Lewis and Clark Centenoial** to be held at Portland, Oregon, in 1905, make this work peculiarly timely, because written from the standpoint of actual knowledge of past and present conditions of the old trail and country.

"**The Trail of Lewis and Clark**" should be found in every public and private library in the land and the general reader will find in reading through its pages of large clear type that truth is, indeed, stranger than fiction.

The book can be ordered through any bookseller or news stand or direct from the publishers

The business of the Western Electrician for the year 1903 was the largest in its history of 17 years.

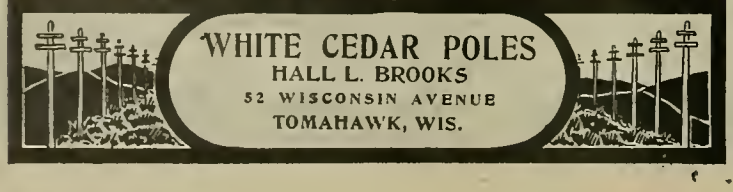
New Dynamo Tenders' Hand-Book.

By F. B. BADT.

226 Pages, 140 Illustrations. Flexible Cloth Binding. Size of Type Page 5 1-2x3 inches. Price $1.00.

This is, as the name indicates, a NEW BOOK, much more complete than the old one, with all the information, instructions and rules which are required by practical men, as Dynamo Tenders, Linemen, Stationary Engineers and owners and operators of all kinds of Electric Plants. It is the only book of the kind published in the English language. 9,000 copies of the old Dynamo Tenders' Hand-Book sold, and over 13,000 of the new.

Electrician Publishing Co.,
510 Marquette Building, CHICAGO.



WHITE CEDAR POLES
Don't forget our Minnesota Transfer Yard—midway between St. Paul and Minneapolis, where we load in forty-eight hours from the time we have your order.
PAGE & HILL CO. 1003 Lumber Exchange, MINNEAPOLIS, MINN.

Cedar Poles.

Pittsburg and Lake Superior Iron Co. Producers and Wholesalers. Escanaba, Mich.

We can't ship you Poles and Ties by Express, but our complete system of tracing orders and cars insures the Promptest Delivery Possible.

May we not quote you?

MALTBY LUMBER COMPANY, 509 Phoenix Block, Bay City, Michigan

PITTSBURG AGENTS: Tipper & Patton, 509 Bessemer Bldg.

POLES—POSTS—PILING—TIES

Fowler-Jacoba Co.
Elmore-Fowler-Jacobs Co.
John H. Fowler & Co.

The FOWLER Companies
Fisher Building, - - CHICAGO

Idaho Cedar Poles

PACIFIC COAST POLE CO. SPOKANE, WASH.

MICHIGAN AND WESTERN **CEDAR POLES**
ALL LENGTHS AND SIZES
LINDSLEY BROS CO.
TRIBUNE BLDG., CHICAGO

H. N. FENNER, President J. F. BLAUVELT, Agent RUSSELL W. KNIGHT, Treasurer

NEW ENGLAND BUTT COMPANY

MANUFACTURERS OF

Machinery for Insulating Electrical Wires

Braiding, Taping, Winding, Twinning, Cabling, Stranding, Polishing and Measuring Machines. Cable Covering Braiders

FINE CASTINGS A SPECIALTY

304 PEARL STREET, - - - PROVIDENCE, R. I., U. S. A.

POLE DEALERS ADVERTISING IN THE WESTERN ELECTRICIAN OBTAIN MOST EXCELLENT RESULTS BECAUSE IT PLACES THEM IN TOUCH WITH ACTUAL BUYERS OF POLES TRY A CARD.

Points in Wisconsin and the Northwest

are covered by Wisconsin Central Railway's convenient, solid, wide vestibuled trains, equipped with Pullman sleepers, free reclining chair cars and modern coaches which leave Central Station, 12th Street and Park Row (Lake Front), Chicago for St. Paul, Minneapolis, Ashland and Duluth, connecting with all western lines. Meals in dining and cafe cars served a la carte.

For tickets and further information apply to nearest ticket agent, or write

JAS. C. POND, Gen'l Pass. Agt., Milwaukee, Wis.

Have YOU read the

NEW DYNAMO TENDERS' HAND-BOOK

By F. B. BADT?

IF NOT, WHY NOT?

Dynamo tenders cannot get along without it.

Sent prepaid on receipt of price, $1.00.

ELECTRICIAN PUBLISHING CO.,
510 Marquette Building, - CHICAGO

"Free from the care which wearies and annoys,
Where every hour brings its several joys."

"AMERICA'S SUMMER RESORTS"

This is one of the most complete publications of its kind, and will assist those who are wondering where they will go to spend their vacation this summer.

It contains a valuable map, in addition to much interesting information regarding resorts on or reached by the

NEW YORK CENTRAL LINES

A copy will be sent free, upon receipt of a two-cent stamp, by George H. Daniels, General Passenger Agent New York Central & Hudson River Railroad, Grand Central Station, New York

READ THE BLUE ELECTRICAL PAPER.

BUY Your Electrical Books of the **Electrician Publishing Co., Suite 510 Marquette Bldg., Chicago.** You will save **TIME** and **MONEY** by doing so. . . . . .

BRACKETS—X ARMS—PINS

little things it is true, but they cut a big figure in line construction.

OUR MOTTO IS:
Prompt Shipment Quality Satisfaction Right Price

COLUMBIA MFG. CO. ANTIGO, WIS.

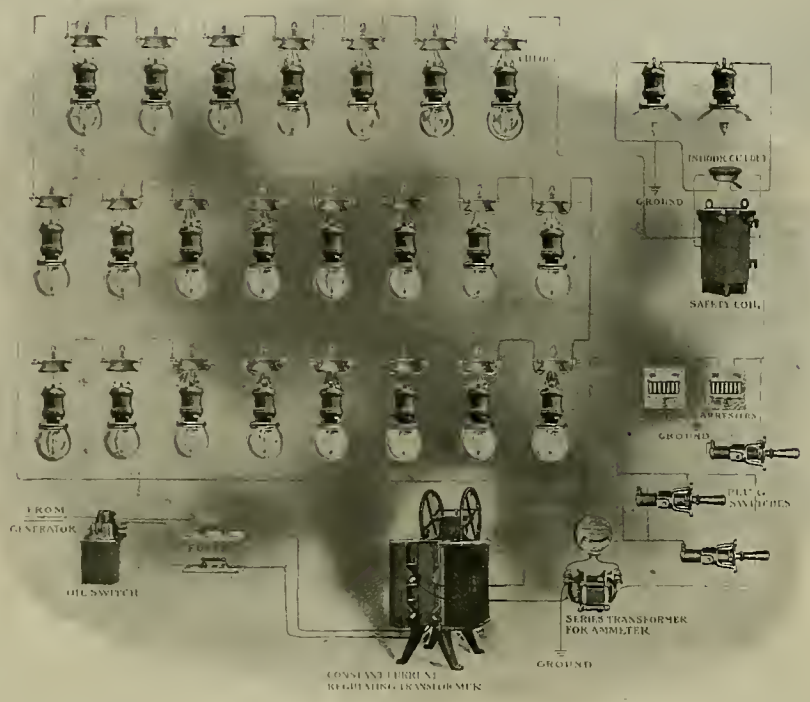
MICHIGAN WHITE LARGE STOCK.

CEDAR POLES

PROMPT SHIPMENTS. KELLOGG SWITCHBOARD & SUPPLY CO., Chicago.

Westinghouse

Series = Alternating Arc Light System



Gives maximum result for amount of energy used.

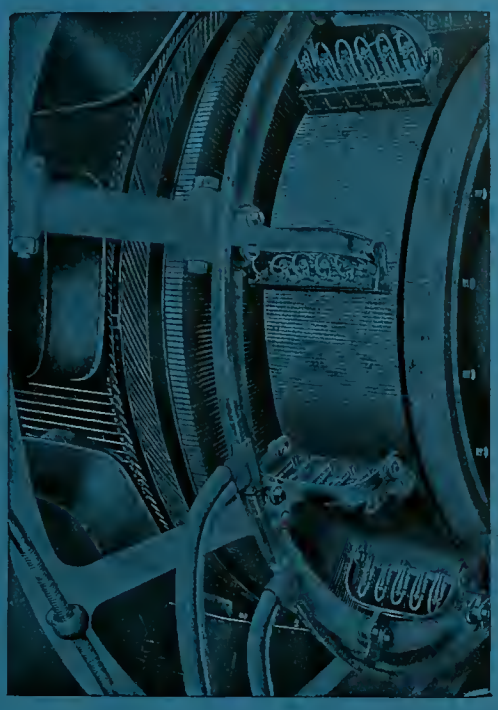
Design and workmanship such as to make the maintenance and operating costs exceptionally low.

Write nearest office for circular 1084 giving particulars

Westinghouse Electric & Mfg. Co.

Pittsburg, Pa.

New York, Atlanta, Dallas, Baltimore, Boston, Buffalo, Chicago, Cincinnati, Cleveland, Detroit, Los Angeles, Minneapolis, New Orleans, Philadelphia, Pittsburg, St. Louis, Salt Lake City, San Francisco, Syracuse, Seattle, Denver, Mountain Electric Co.
Canada: Canadian Westinghouse Co., Limited, Hamilton, Ontario. Mexico: O. & O. & Braniff Co., City of Mexico.



A few of the details of construction of Type MPL generators shown above are: 1st, Outer ends of core ventilating spaces on core surface; 2d, Tapering pole tips; 3d, Wooden Slot Wedges; 4th, Solid strip conductor bands; 5th, Equalizer ring connections to commutator leads; 6th, Brush holder details showing flexible connection to holder, holder clamped to bracket, bracket bolted to yoke in contact with bus ring; 7th, Sectional commutator clamps

FORT WAYNE ELECTRIC WORKS
WOOD LIGHTING & POWER SYSTEMS
Fort Wayne, Ind.

A Bird's-eye View of Details

reveals a harmonious union of little points of excellence that enables our direct-current generators to perform their work with unvarying reliability—with ease, but with enduring regularity.

An extended and elaborate illustrated description of these generators is given in our Bulletin No. 1050, which will be sent free to anyone interested in high-grade, direct-current, engine-driven generators of any size between 20 and 800 kilowatts. Ask for it.

238

The Inspector AND Trouble Man.

By A. E. DOBBS.

Full of information and diagrams for the operator, exchange owner, exchange manager, inspector, trouble man, lineman.

A complete description of telephones and their troubles. How to find and remedy them, together with working plans for exchange construction, complete with diagrams of all up-to-date telephones and switchboards.

This is a practical book, written in **plain language,** and for **anyone** interested in telephony.

Mailed anywhere on receipt of price . . . **ONE DOLLAR.**

No technicalities. Substantially bound in cloth.

ELECTRICIAN PUBLISHING CO.,
510 MARQUETTE BUILDING, CHICAGO.

Good Advice

No. 2.

Every central station manager fully appreciates that when he uses the Type A Duncan Direct Current Wattmeter he is supplying energy to his customers through an instrument that is guaranteed to be permanently accurate on all loads; one that measures the exact amount consumed; no more, no less. It is his best means of securing the absolute confidence of his patrons and fortifying his ability to pay dividends to the stockholders of his company.

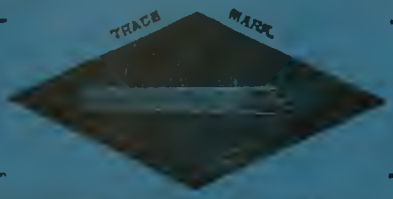
Good Advice No. 3 Next Week.

Write for Bulletin and Prices.

DUNCAN ELECTRIC MFG. CO.
LAFAYETTE, IND.

Black Diamond File Works

Est. 1803. Inc. 1895.



Twelve Medals Awarded at International Expositions

Special Prize Gold Medal at Atlanta, 1895.

OUR GOODS ARE ON SALE IN EVERY LEADING HARDWARE STORE IN THE UNITED STATES AND CANADA.

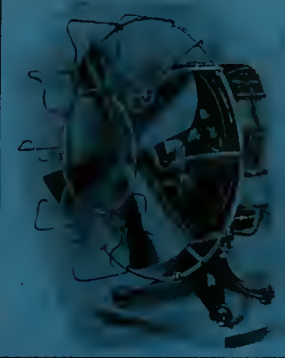
G. & H. BARNETT COMPANY,

PHILADELPHIA, PA.

VULCANIZED FIBRE

Highest grades for electrical insulation and mechanical purposes, in sheets, tubes, rods and special shapes. Catalogues and samples on application.

VULCANIZED FIBRE CO., - Wilmington, Del.



Edison Battery Fan Outfits

"Keep cool while others swelter." Dealers should pass this advice along to customers and tell them that the way to do it is to equip their houses with an Edison Battery Fan Motor. Send for Booklet No. 7 F.

EDISON MANUFACTURING CO.,

TRADE Thomas A. Edison PARIS

Factory, ORANGE, N. J.
NEW YORK, 83 Chambers St.
CHICAGO, 304 Wabash Ave.

DIRECT CURRENT

MOTORS

THE ADAPTATION of our motors to mechanical drive is practically universal, and their service is unequalled.

Write for Bulletin No. 404

SPRAGUE ELECTRIC COMPANY

General Offices:
527 West 34th Street, New York.

Chicago Office: Fisher Building.

CUT YOUR COAL BILL

By using the

STURTEVANT SYSTEM OF MECHANICAL DRAFT

Costs only 20 to 40 per cent. as much as a chimney.
Increases steaming capacity of boilers.
Is independent of the wind and weather.

B. F. STURTEVANT CO.

BOSTON, MASSACHUSETTS

New York Philadelphia Chicago London

334

Warren Alternator

Very little attention has been paid to decorating the machine with fancy ornaments and a great deal of thought has been put into making the machine durable; it impresses one with its simplicity and capacity for severe acting service. No commutator, no moving wire, no trouble. As an investment, they are gilt edged securities. They are "seven leagued boots" in the chase for the almighty dollar.

WARREN ELECTRIC MFG. CO.

Sandusky, O.

ALLEN-BRADLEY ELECTRIC CRANE CONTROLLERS

PATENTED

Guaranteed for One Year. Three months' Free Trial.
No Sparking. No Repairs. Perfect Control.

AMERICAN ELECTRIC FUSE COMPANY

CHICAGO - - ILLINOIS

Western Electrician

Vol. XXXV. $3.00 Per Annum. Copyright, 1904, by Electrician Publishing Company, Chicago. CHICAGO, AUGUST 6, 1904. Entered at Chicago Postoffice as mail matter of the second class. 10 Cents a Copy. No. 6.

SIMPLEX INSULATED WIRES AND CABLES.
RUBBER COVERED, WEATHERPROOF, UNDERGROUND AND SUBMARINE.
WESTERN SELLING AGENT: H. R. HIXSON, 1144 Monadnock Block, CHICAGO.
The Simplex Electrical Co., 110 State Street, BOSTON, MASS.

CHICAGO INSULATED WIRE CO.,
152-154 LAKE STREET.
Bare and Insulated Wires and Cables.
Galvanized Steel Strands.

OKONITE TRADE MARK
1889—Paris Exposition, Medal for Rubber Insulation.
1893—World's Fair, Medal for Rubber Insulation.
THE STANDARD FOR RUBBER INSULATION.
Sole Manufacturers of
Okonite Wires, Okonite Tape, Manson Tape, Candee Weather-proof Wires.
THE OKONITE CO., LTD.
Willard L. Candee, Durant Cheever, Managers. 253 Broadway, New York. Geo. T. Manson, Gan'l Supt. W. H. Hodgins, Secy.

TRADE MARK. CRESCENT INSULATED WIRE & CABLE CO. TRENTON, N. J.
CRESCENT RUBBER INSULATED WIRES AND CABLES
National Code Standard.
CRESCENT INSULATED WIRE AND CABLE CO.,
New York Office, 83 BARCLAY STREET. Main Office and Factory, TRENTON, N. J.

"STANDARD"
STANDARD UNDERGROUND CABLE CO.
322 The Rookery, Chicago. Westinghouse Bldg., Pittsburg. 56 Liberty St., New York City. 1225 Betz Bldg., Philadelphia, Pa.
Crossley Bldg., San Francisco. 10 Post Office Square, Boston.
BARE AND WEATHERPROOF WIRES AND CABLES.
Rubber Covered Wires and Cables. Underground Cables for all Purposes.

JAR RITE
INDIANA RUBBER AND INSULATED WIRE CO.,
MANUFACTURERS OF
Paranite Rubber Covered Wires and Cables,
UNDERGROUND, AERIAL, SUBMARINE AND INSIDE USE;
TELEPHONE, TELEGRAPH AND FIRE ALARM CABLES.
All Wires are tested at Factory. JONESBORO, IND.

"CIRCULAR LOOM" THE FLEXIBLE CONDUIT
AMERICAN CIRCULAR LOOM CO. TRADE MARK REGISTERED
CONDUITS FOR INTERIOR WIRING.
American Circular Loom Co.
Chelsea, Mass., New York, Chicago, San Francisco.

THE PHOENIX GLASS CO. Pittsburg, New York, Chicago
Manufacturers of
Electric Globes and Shades, both Arc and Incandescent
Inner and Outer Globes for all enclosed arc systems
CATALOGUES SENT ON REQUEST

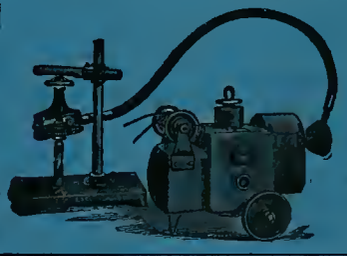
DRIVER-HARRIS WIRE CO.
HARRISON (NEWARK), N. J.
Manufacturers of Fine Sizes Wire of Every Description.
Resistance Wires a Specialty.

THERMOPILES 1½ VOLTS 1½ AMPERES
For Electrolytic analysis, charging storage batteries, and other constant current requirements. $3 Each.
WALSH'S SONS & CO., 264 Washington Street, Newark, N. J.

All Supply Houses
J. J. EGAN'S "ACME" COMMUTATOR COMPOUND.
J. J. EGAN'S "ACME" COMMUTATOR COMPOUND absolutely prevents sparking or cutting. One stick of "Acme" is equal to one gallon of oil for lubricating commutators. Free Sample. AGENTS WANTED.
50c per Stick. $5.00 per doz.
J. J. Egan Sale Mfr., 317 Austin Ave. Tel. Polk, 1779 Chicago

THOUSANDS IN USE.
Motors, ½ h. p. to 100 h. p.
Dynamos, 1 k. w. to 75 k. w.
Highest Quality. Reasonable Price.
THE HOBART ELECTRIC MFG. CO.
TROY, OHIO.

Cope's Patent Quick Coupling Conduit Rod
Remember these rods have no lost motion.
These Couplings are of Steel and are made in the best possible manner.
PATENTED
NO LOST MOTION
Write for list of persons using these rods—26,000 sold since May 1902. Made in 3 ft. and 4 ft. lengths.
Price, 3 ft. 75 cents, 4 ft. 85 cents.
Patented February 24, 1903.
T. J. COPE
3246 North Fifteenth Street PHILADELPHIA, PA.



ESTABLISHED 1875.
COMBINATION OF
Stow Flexible Shaft
—AND—
MULTI-SPEED MOTOR
Practically dust and water proof. For Portable Drilling, Tapping, Reaming, Emery Grinding, etc. Write for Catalogue and Prices.
STOW MFG. CO., Binghamton, N. Y.
Gen'l European Agents, Selig, Sonnenthal & Co. 85 Queen Victoria Street, London, England.

H. N. FENNER, President J. F. BLAUVELT, Agent RUSSELL W. KNIGHT, Treasurer
NEW ENGLAND BUTT COMPANY
MANUFACTURERS OF
Machinery for Insulating Electrical Wires
Braiding, Taping, Winding, Twinning, Cabling, Stranding, Polishing and Measuring Machines. Cable Covering Braiders
FINE CASTINGS A SPECIALTY
304 PEARL STREET, - - - PROVIDENCE, R. I., U. S. A.

WESTON Electrical Instrument Co.,
114-120 William St., NEWARK, N. J., U. S. A.
We are now offering our
New Model Low Priced Portable Instruments, Model E,
for use where the extreme accuracy peculiar to our Portable Standard Instruments is not necessary or desired.
VOLTMETERS
in ranges from 3 to 300 Volts.
AMMETERS
in ranges from 1 to 25 Amperes.
Self contained and for any capacity desired in connection with external shunts, within practical limit.
Send for Bulletin No. 1 describing these instruments.
BERLIN—European Weston Electrical Instrument Co., Bitterstrasse, No. 88.
LONDON—Elliott Bros., Century Works, Lewisham, S. E.
FRANCE—F. H. Cadiot, 12 Rue St. Georges.
NEW YORK OFFICE—74 Cortlandt St.
Weston Portable Type E Voltmeter.

HORNBERGER-IRWIN
Transformers
(LARGE AND SMALL)
½ K. W. to 500 K. W.
This transformer represents the latest improvements in transformer construction; made in three types; multi-coil construction; ventilated cores; built for all commercial voltages and frequencies; higher efficiencies together with lower temperatures than have heretofore been attained are guaranteed.
Catalogue just issued explains details.
Manufactured by
Crawfordsville Electric Co.
CRAWFORDSVILLE, INDIANA, U. S. A.

Bullock Electric Mfg Co
Cincinnati

100 K. W. Bullock Generator with Direct-Connected Exciter

Direct and Alternating Current Apparatus

Alternators in Units up to 10,000 k. w.

Complete Electric Equipment
for
Street Railway and Power Plants

Bullock Motors for Machine Tools

Allis-Chalmers Corliss Engines

For All Power Purposes
Built in Sizes from 25 h. p. up

Engines for Lighting and Power

Hydraulic Turbines

Don't fail to see our three Exhibits at St. Louis

They are the talk of the Exposition

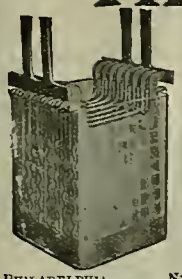
Allis-Chalmers Vertical Cross Compound Direct-Coupled Engine

Allis-Chalmers Co
CHICAGO

Canadian Representatives: Allis-Chalmers-Bullock, Ltd., Montreal

THE ELECTRIC STORAGE BATTERY CO.

PHILADELPHIA



MANUFACTURER OF THE

"Chloride Accumulator"

For Central Stations, Electric Railways, Isolated Lighting and Power Stations, Fire Alarm, Telegraph, Train Lighting, etc., etc.

PRICE LISTS AND DESCRIPTIVE BULLETINS FORWARDED UPON REQUEST.

SALES OFFICES:

PHILADELPHIA, Allegheny Ave. and 19th St. | NEW YORK, 100 Broadway, | BOSTON, 60 State St. | CHICAGO, Marquette Bldg. | ST. LOUIS, Wainwright Bldg. | SAN FRANCISCO, Rialto Bldg. | CLEVELAND, Citizens Bldg. | CANADA, Canadian General Electric Co., Ltd. Toronto | HAVANA, CUBA, G. F. Greenwood, Manager 34 Empedrado St.

"C & H on a controller means highest quality."

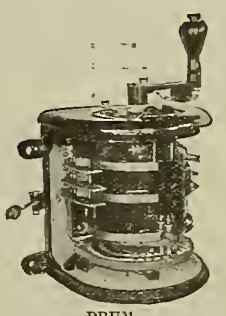
SLATE FRONT

NEW TYPES OF C & H MACHINE TOOL CONTROLLERS

Speed varied entirely through the shunt field of the motor.

Full reverse and non-reverse in each type.

Can be easily attached to machine and be operated without operator leaving his tool post.



DRUM

New York 136 Liberty St. | Chicago Monadnock Bldg.

THE CUTLER-HAMMER MFG. CO.

MILWAUKEE, WIS.

Boston 176 Federal St. | Pittsburg 322 Frick Bldg.

W. D. PAINT.

A PERMANENT INSULATING PROTECTION FOR WOOD OR METAL. A quick drying, moisture-proofing, black paint. An elastic anti-rust coating. A jet black finishing paint, efficient and not expensive.

Write for "Data on Insulating Materials."

DIELECTRIC MANUFACTURING CO., SAINT LOUIS.

CARBONS

CONSUMERS CARBON CO.

LANCASTER, OHIO, U. S. A.

Carbons of all kinds and for all purposes.

PLATINUM

PLATINUM RIVETS FOR CONTACT POINTS IN TELEPHONES—SPARK COILS AND OTHER ELECTRICAL APPARATUS. PLATINUM SHEET AND WIRE IN ANY FORM AND DEGREE OF HARDNESS. PLATINUM SCRAP PURCHASED.

BAKER & COMPANY, Inc.

ARTISANS IN PLATINUM

408-410-412-414 N. J. R. R. AVE. - NEWARK, N. J.

New York Office: 120 Liberty St.

ALPHABETICAL INDEX TO ADVERTISEMENTS.

Adams-Bagnall Electric Co..—
Akron Electrical Mfg Co.....11
Allen Company, L. B.....11
Allis-Chalmers Company..... 2
American Battery Co.....—
Amer. Circula Loom Co..... 1
American Conduit Co.....14
Amer. District Steam Co.....16
Amer. Elec. Fuse Co..... 9
Amer. Electrical Heater Co..—
Amer. El. Telephone Co.....15
American Electrical Works..11
Arnold Elec. Power Station Co..... 13
Automatic Electric Co..... 14

Babcock & Wilcox Co.....17
Bain, Forée.....11
Baker & Company..... 3
Baker & Co., W. E.....13
Barnett Company, G. & H....20
Beardslee Chandelier Mfg. Co.10
Berthold & Jennings.....17
Big Four Route.....17
Bissell Co., The F..... 15
Bossert Electric Constructio. Co.. 11
Brooks, Hall L.....16
Bryan-Marsh Co.....—
Bryan, Wm. H.....13
Buckeye Electric Co.....—
Bullock Elec. Mfg. Co..... 2
Butterfield, J. F.....— 1
Byllesby & Co., H. M.....13

Central Electric Co.....—
Cent. Stat. Improvement Co..12
Central Tel. & El. Co.....—
Century Electric Co.....—
Chicago Dle & Electric Co....—
Chicago Edison Co.....4. 12
Chic. Fuse Wire & Mfg. Co....—
Chicago Insulated Wire Co.. 1
Chicago Mica Co.....10
Columbia Incand. Lamp Co..—
Columbia Mfg. Co.....17
Columbus Storage Bat'ry Co.12
Consumers Carbon Co..... 3
Continuous Rail Joint Company of America..... 9
Coolidge Co.. Marshall H....17
Cope, T. J..... 1
Crawfordsville Electric Co.. 1
Crescent Co..... 6
Crescent Ins. Wire & Cbl. Co. 1
Crocker-Wheeler Company...20
Crouse-Hinds Co.....—
Cutler-Hammer Mfg. Co..... 3
Cutter Elec. & Mfg. Company—

D. & W. Fuse Company.....—
Dearborn Drug & Chem. Wks. 8
Diamond Meter Company....—
Dielectric Manufacturing Co. 3
Directory of Engineers.....13
Dixon Crucible Co., Joseph..8
Driver-Harris Wire Co..... 1
Duncan Elec. Mfg. Co.....19

Edison Decorative & Miniature Lamp Deparim't.....10
Edison Mfg. Company.....10
Edwards & Co.....—
Egan, J. J..... 1
Electrical Engineer Institute.11
Electric Appliance Co 10
Electric Storage Battery Co.. 3
Electrician Pub. Company...15
Erie Ry..... 8

Faries Mfg. Co.....10
"For Sale" Advertisements..12
Ft. Wayne Elec. Works, Inc..19
Fostoria Incand. Lamp Co....—
Fowler, John H.....16
Fowler-Jacobs Company.....16

Gay Chemical Co., The R.... 9
General Electric Co..... 9
General Engineering Co., The 13
General Incandescent Arc Light Company..... 5
General Incand. Lamp Co....—
Gould Storage Battery Co....—
Gt. West. Smelt. & Refining Co.12
Green Fuel Economizer Co..—
Gregory Electric Company...12

Hallberg, J. H 13
Haller Machine Co.....20
Hart Mfg. Co..... 8
Hartford Steam Boiler Inspection & Insurance Co.... 8
Hartford Time Switch Co....14
Hazard Manufacturing Co...20
Highland Park College. ... 9
Hobart Elec. Mfg. Company. 1
Hoffman, G. W..... 9
Holmes Fibre-Graph. Co..... 8
Holophane Glass Co.....—
Hornaday & Co., J. P.....13
Humphrey, Henry H.....—
Hunt & Co., Robt. W.....13

Illinois Central Ry.....12
Incandescent Electric Light Manipulator Company.....10
Indiana Rub. & Ins. W. Co.... 1
India Rubber & Gutta Percha Insulating Company.....14
International Elec. Meter Co 12
International Tel. Mfg. Co...15

Jackson, D. C. & W. B.....13
Jeffrey Manufacturing Co.... 8
Jewell Electrical Inst. Co....—
Johns-Manville Co., H. W.....—

Kartavert Manufacturing Co.20
Kellogg Switchboard & Supply Company.....15, 17
Kester Elec. Mfg. Co.....11
Klein & Sons, Mathias..... 9
Kohler Brothers.....13
Kuhlman Electric Co.....11

La Roche Co., F. A.....—
Leather Preserv. M. Corp....—
Leffel & Co., James..... 8
Lindsley Brothers Company..17
Loud's Sons Co., H. M.....17

Machado & Roller 6
Malthy Lumber Company....17
Manhattan El. Supply Co.... 9
Manross, F. N. 12
Marinette Gas Engine Co..... 8
Matthews & Bros., W. N.....11
McLennan & Company, K....10
Mechanical Appliance Co....—
Mica Insulator Company.....—
Michigan College of Mines ..—
Minnesota Electric Co.....—
Miscellaneous Advs.....12
Monon Railroad.....—
Moon Mfg. Co., The.....14
Morrison Lbr. Co., J. W.....—
Mueller Company, William..16
Munsell & Co., Eugene.....10

National Electric Co..... 4
National India Rubber Co....—
New England Butt Co..... 1
Newgard & Co., Henry..... 5
New York Cent. Ry.....17
New York Ins. Wire Co.....11
Northern Elect'l Mfg. Co.... 5
Northern Pacific Ry.....16
Norton Elect'l Instrument Co. 5

Okonite Co., The..... 1
Olds Gasoline Engine Works. 8

Pacific Coast Pole Co.....17
Page & Hill Co.....16
Paragon Fan & Motor Co.....—
Pardridge Shade & Refl. Co..—
Pass & Seymour, Inc.....—
Pennsylvania Railroad.....13
Phelan, D. W.....17
Phillips, Eugene F.....11
Phillips Insulated Wire Co...11
Phœnix Glass Co.....1
Phosphor-Bronze S. Co..... 8
Pignolet, L. M.....10
Pittsburg & L. S. Iron Co....16
Plume & Atwood Mfg. Co....—
Porter Cedar Company.....16
Pratt Institute .....—

Reisinger, Hugo.....—
Reynolds El. Flasher Mfg. Co.10
Roebling's Sons Co., J. A.....20
Ruebel-Schwedtmann-Wells..13

Safety Ins. Wire & Cable Co..11
Sargent & Lundy.....—
Schott, W. H.....13
Seaman, J. H.....11
Seaman & Co., W. S.....14
Simplex Electrical Co., The.. 1
Simplex Elec. Heating Co....15
Speer Carbon Co..... 9
Sprague Electric Company...10
Squire Electric Co.....—
Standard Elec. Mfg. Co.....12
Standard Underg. Cable Co.... 1
Standard Vitrified Conduit Co11
Stanley Instrument Co..... 5
Stanton, LeRoy W..... 13
State Univ. of Iowa.....13
Sterling & Son, W. C.....16
Sterling Electrical Mfg. Co... —
Sterling Varnish Co., The.... 8
Stow Mfg. Company..... 1
Stromberg-Carlson Tel. Mfg. Company.....15
Sturtevant Company, B. F...20

Thompson, S. E.....—
Torrey Cedar Company.....17
Trumbull Elec. Co.....—

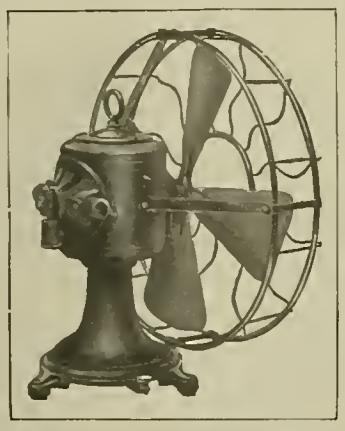
Union Electric Mfg. Co.....—

Valentine-Clark Co., The....16
Vulcanized Fibre Company..20

Wagner Electric Mfg. Co..... 4
Walsh's Sons & Company..... 1
Warren Elec. Mfg. Co.....10
Wesco Supply Co.....—
Western Electric Company...19
Western El. Supply Co.....12
Westinghouse Electric & Manufacturing Co.....18
Weston Electrical Inst. Co. 1, 7
Wilmerding, C. H.....13
Wisconsin Central Ry.....15
Woolley Fdy. & Mach. Wks..—
Worcester Company, C. H....16

Yesbera Mfg. Co.....
Yost Electric Mfg. Co 12

For Classified Index of Advertisements See Page 6.



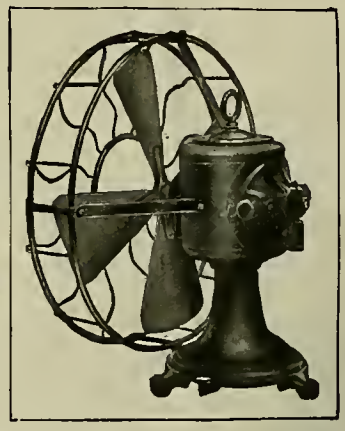
REMEMBER THE NAME AND BUY THE BEST.

PARAGON FAN MOTORS

NEW STYLES NEW PRICES
EASY RUNNING RIGID CONSTRUCTION NOISELESS

CALL AND SEE THEM OR WRITE FOR PRICES

CHICAGO EDISON COMPANY,
139 ADAMS ST., CHICAGO.



National Electrical Machinery

1000 K. W. Rotary Converter for Street Railway Service

BUILT IN ALL CAPACITIES

NATIONAL APPARATUS is *high grade* in every respect. Modern in design and superior in performance. We solicit specifications covering Generating Equipment for Lighting, Power or Railway Service.

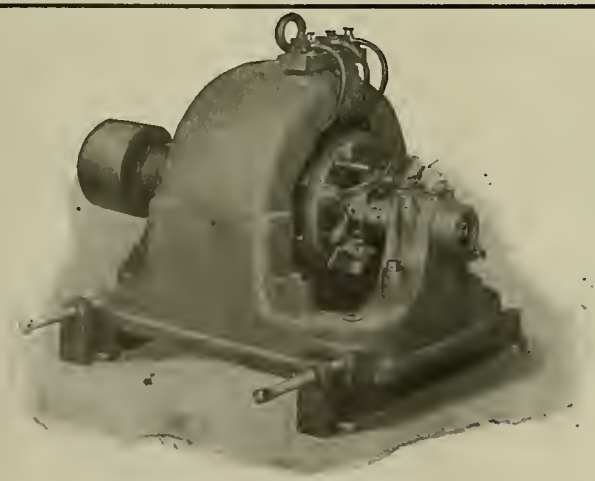
Write for Catalogue No. 27

National Electric Company

New York: 135 Broadway
Philadelphia: 1509 Land Title Bldg.
Charleston, W. Va.: Agnew Electric Co.

Main Office and Works
Milwaukee

Pittsburg: Gellatly & Co.
Chicago: Old Colony Bldg.
Seattle and San Francisco: Kilbourne & Clark Co.



CENTRAL STATION MANAGERS

Don't Be Afraid

of the Gas Plant

WORK UP A MOTOR LOAD

We can furnish you

SINGLE PHASE MOTORS

that will start under full load in sizes ranging from 1/8 to 35 H. P.

Wagner Electric Mfg. Co.
ST. LOUIS, MO., U. S. A.

NORTON Ammeters and Voltmeters

High-Grade Instruments at Moderate Cost.
Write for Circular and Price List.

The Norton Electrical Instrument Co., Main Office and Factory MANCHESTER, CONN.

Agents.-Kohler Bros., Chicago, Ill.: Interstate Elec. Co., Ltd., New Orleans, La.

Expo.

Within the Exposition

See the Northern Exhibit at St. Louis, Section 14, Palace of Electricity, and view the congress of modern machines and machine tools driven by Northern Motors, both constant speed and variable speed.

VARIABLE SPEED MOTORS DRIVEN FROM THE CONSTANT SPEED MOTOR POWER CIRCUIT, GIVING VARIATIONS OF

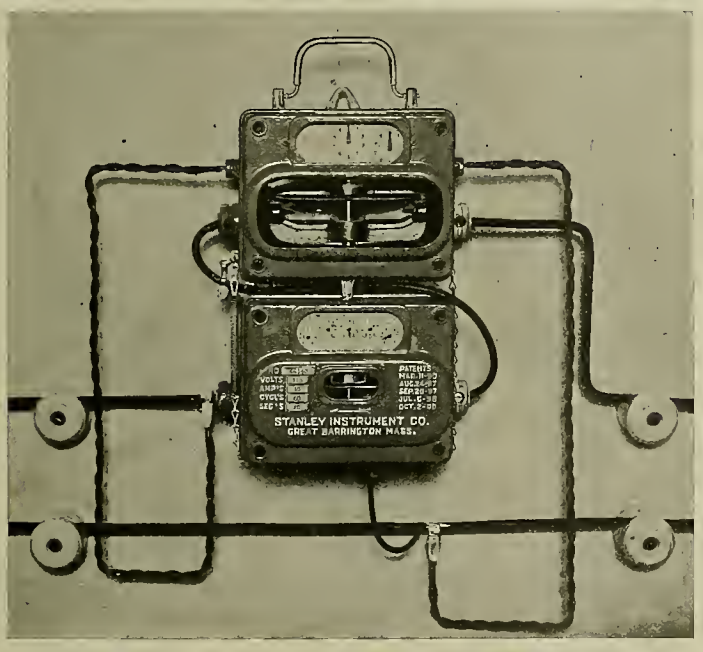
2 TO 1 3 TO 1 4 TO 1 5 TO 1

Northern Variable Speed Motors operate on the two-wire, single voltage system.

Bulletin No. 2535

NORTHERN ELECTRICAL MFG. CO., MADISON, WIS.

ENGINEERS MANUFACTURERS 272



TESTING WATTMETER

ACCURATE TESTS

in a few minutes, anywhere, by one man alone without regulation of VOLTAGE, LOAD OR FREQUENCY

STANLEY INSTRUMENT CO.

GREAT BARRINGTON, MASS.

HENRY NEWGARD & CO.

ELECTRICAL CONSTRUCTION

Power and Light Plants. Switchboards and Panel Boards.

We install Municipal and Isolated Electric Lighting Plants.
We manufacture Switchboards, Table boards, Iron Cutout Boxes and Electrical Specialties.
We sell Dynamos, Motors and Electrical Supplies.
We wire old as well as new Residences, Factory Buildings, School and College Buildings.

87 Fifth Avenue, Chicago, Illinois.

You will admit there is

a doubt about the decision -- from these votes until the Bulletin is in--

no doubt about the decision -- on G. I. goods as soon as the first Bulletin is in--

States	Democratic	Electoral Votes	Republican
Ala.	11		
Ark.	9		
Cal.	10		
Colo.	5		
Conn.	7		
Del.	3		
Fla.	5		
Ga.	13		
Idaho	3		
Ill.	27		
Ind.	15		
Iowa	13		
Kan.	10		
Ky.	13		
La.	9		
Me.	6		
Md.	8		
Mass.	16		
Mich.	14		
Minn.	11		
Miss.	10		
Mo.	18		
Mont.	3		
Neb.	8		
Nev.	3		
N. H.	4		
N. J.	12		
N. Y.	39		
N. C.	12		
N. D.	4		
Ohio	23		
Ore.	4		
Pa.	34		
R. I.	4		
S. C.	9		
S. D.	4		
Tenn.	12		
Tex.	18		
Utah	3		
Vt.	4		
Va.	12		
Wash.	6		
W. Va.	7		
Wis.	13		
Wyo.	3		

G. I.

Write for

Arc Lamps and Arc Lamp Accessories	G. I. Bulletin No.
D. C. Series to 600 V. Arc L.	174
D. C. Series Constant Cur. Arc L.	175
A. C. Multiple, to 133 C. Arc L.	382
A. C. Diff. Arc L. "L 8" Series	383
D. C. Mul. to 125 V. L. "L 11"-"L 21"	372
D. D. Mul. to 250 V. Arc L. "L 12"	273
Lightning Arresters, Choke Coils and Line Discharges	358
Switches and Circuit Breakers	
Automatic Switches	157
Flush Push Button Switches.	254
Knife Switches Slow and Quick Bk.	150
Oil Switches and High Tension Ap.	153
Volt and Ammeter Switches	255
Circuit Breakers	
Motors and Generators	
D. C. Motors and Generators	364
A. C. Small Motors.	166
D.C.—A.C. Sewing Machine Trans.	165
D. C. Fans	161
Panels and Sw. Boards	
Automobile Charging Panels	115
Small Plant Switch Panels	369
Plug Panel Boards	107
Switch Bds. High and Low Tension	150
"G. I." Panel Boards and Fuse Carriers	51
Boxes, Plugs, Receptacles, Instruments and Meters	
Primary Fuse Box, Insulator Type	369
Floor Outlet Boxes (water tight)	194
Protective Fuse Devices	324
Round Pattern Voltmeters and Ammeters	363
"G. I." Incandescent Lamps	390

General Incandescent Arc Light Co.

GENERAL OFFICES: 529 W. 34th STREET

NEW YORK

BRANCH OFFICES:

Boston
Denver
San Francisco
Chicago
Cleveland
Cincinnati
St. Louis
Butte
Los Angeles
Seattle

Diam. of body, 6 in., of base flange 7¾ in.

THE

"I. P." (ISOLATED PLANT) TYPE

DIRECT-CURRENT INSTRUMENTS

Are winners. Scales are eqnally divided, indications are dead beat, high range ammeters have separate shnnts and the cases are of heavy polished brass.

Prices are right, the list figure for the meter illustrated, for instance, being $16.50.

WRITE FOR DISCOUNTS TO

MACHADO & ROLLER,

203 BROADWAY, NEW YORK CITY, N. Y., Or Your Nearest Supply House.

THE KIND THAT WON'T COME OFF

CRESCENT

LAMP COLORING and FROSTING

Economical. A given quantity of Crescent Coloring will color more lamps than the same amount of other solutions.

Put up in all colors and quantities from quarter pint bottles to five-gallon cans.

Write for particulars and prices.

COLORS GUARANTEED BY

CRESCENT COMPANY, Chicago

CLASSIFIED INDEX OF ADVERTISEMENTS.

Adjusters, Cord.
Crescent Co.
Incandes. El. Lt. Manip. Co.

Adjusters, Inc. Lamps.
Inc. El. Lt. Manipulator Co.

Anchors (Tel. & Tel.)
Matthews & Bro., W. N.
Crouse-Hinds Co.

Annunciators.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Moon Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Batteries and Jars.
Bissell Co., The F.
Central Electric Co.
Columbus Storage Battery Co.
Edison Mfg. Co.
Edwards & Company.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Bells, Buzzers, Etc.
Central Electric Co.
Edwards & Co.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Belt Dressing.
Dixon Crucible Co., Jos.
Leather Preserver Mfg. Corp.

Belting.
Leather Preserver Mfg. Corp

Blowers.
Sturtevant Co., B. F.

Boiler Compounds.
Dearborn Drug & Chem Wks.

Boilers.
Allis-Chalmers Company.
Babcock & Wilcox Co.

Books, Electrical.
Electrician Publishing Co.

Booths, Telephone.
Seaman & Co., W. S.
Yesbera Mfg. Co.

Brackets.
Faries Mfg. Co.

Brushes.
Central Electric Co.
Hobart Elec. Mfg. Co.
Holmes Fibre-Graphite Co.
Speer Carbon Co.
Western Electric Company.

Cable Hangers.
Bissell Co., B. F.
Western Electric Co.

Cables (See Wires and Cables)

Canopies.
Faries Mfg. Co.

Carbons, Points and Plates.
Central Electric Co.
Chicago Edison Co.
Consumers Carbon Co.
Electric Appliance Co.
Reisinger, Hugo.
Speer Carbon Co.
Wesco Supply Co.
Western Elec. Supply Co.

Castings.
Faries Mfg. Co.
New England Butt Co.
National Electric Co.

Chains.
Jeffrey Mfg. Co.

Chandeliers.
Faries Mfg. Co.

Circuit Breakers.
Cutler-Hammer Mfg. Co.
Cutter Elec. & Mfg. Co.
Ft. Wayne Elec. Wks. Inc.
La Roche Co., F. A.
Union Electric Mfg. Co.
Western Electric Company.
Westinghouse El. & Mfg. Co.

Clusters.
Faries Mfg. Co.

Cinches, Electrical and Mechanical.
Akron Electrical Mfg. Co.

Coal and Ashes Handling Machinery.
Jeffrey Mfg. Co.

Coils and Magnets, Western Electric Co.

Coloring, Lamp
Gay Chemical Co., The R.
Crescent Co.

Commutator Compound
Allen Co., L. B.
Egan, J. J.
McLennan & Co., K.

Commutator Truing Device.
Akron Electrical Mfg. Co.

Conduit and Conduits.
American Circular Loom Co.
American Conduit Company
Central Electric Co.
Electric Appliance Co.
Sprague Electric Co.
Standard Vitrified Cond. Co.
Wesco Supply Co.
Western Electrical SupplyCo.

Contractors and Electric Light Plants.
Allis-Chalmers Company.
Bullock El. Mfg. Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
National Electric Co.
Northern Electrical Mfg. Co.
Sprague Electric Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Controllers, Crane.
Amer. Elec. Fuse Co.

Cross-Arms, Pins and Brackets.
Berthold & Jennings.
Central Electric Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Company.
Western Elec. Supply Co.

Cut-Outs and Switches.
Bissell Co., The F.
Hossert Elec. Const. Co.
Central Electric Co.
Chicago Edison Co.
Crouse-Hinds Co.
Cutter Elec. & Mfg. Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
General Inc. Arc Light Co.
Hart Manufacturing Co.
La Roche Co., F. A.
Manhattan Elec. Supply Co.
Trumbull Elec. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Dynamos and Motors.
Akron Electrical Mfg. Co.
Allis-Chalmers Company.
Bissell Co., The F.
Bullock Elec. Mfg. Co.
Central Electric Co.
Century Electric Co.
Crawfordsville Electric Co.
Crocker-Wheeler Co.
Dustin Co., Chas. E.
Ft. Wayne Elec. Wks. Inc.
General Elec. Co.
General Inc. Arc Light Co.
Gregory Electric Co.
Hobart Elec. Mfg. Co.
Mechanical Appliance Co.
National Electric Co.
Northern Electrical Mfg. Co.
Sprague Electric Co.
Stow Manufacturing Co.
Sturtevant Co., B. F.
Wagner Electric Mfg. Co.
Warren Elec. Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Economizers, Fuel.
Green Fuel Economizer Co.

Electric Heating Appl.
American Elec. Heater Co.
Simplex Elec. Heating Co.
Western Electric Co.

Electric Railways.
Crocker-Wheeler Co.
General Electric Co.
Sprague Electric Co.
Westinghouse El. & Mfg. Co.

Electrical and Mechanical Engineers.
Arnold Elec. Power Stat'n Co.
Baker & Co., W. E.
Bryan, Wm. H.
Butterfield, J. F.
Byllesby & Co., B. M.
General Engineering Co., The.
Hallberg, J. H.
Hornaday, J. P. & Co.
Humphrey, Henry B.
Hunt & Co., Robt. W.
Jackson, D. C. & W. B.
Köhler Brothers.
Newgard & Co., Henry.
Northern Electrical Mfg. Co.
Ruebel, Schwedtman, Wells.
Sargent & Lundy.
Schott, W. H.
Squire Electric Co.
Stanton, LeRoy W.
Wilmerding, C. H.

Electrical Instruments. (Recording and Testing.)
Bissell Co., The F.
Central Electric Co.
Diamond Meter Co.
Duncan Elec. Mfg. Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
General Inc. Arc Light Co.
Jewell Electrical Inst. Co.
Machado & Roller.
Norton Elec'l Instrument Co.
Pignolet, L. M.
Stanley Instrument Co.
Wagner Electric Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.
Weston Electrical Inst. Co.

Electro-Plating Mach'y
Crocker-Wheeler Company.
General Electric Co.

Elevators-Conveyors.
Jeffrey Mfg. Co.

Engines, Gas and Gasoline.
Allis-Chalmers Company.
Marinette Gas Engine Co.
Olds Gasoline Engine Works.
Woolley Fdy. & Mach. Wks.

Engines, Steam.
Allis-Chalmers Company.
Dustin Co., Chas. E.
Sturtevant Co., B. F.

Fans and Fan Motors.
Central Electric Co.
Crocker-Wheeler Company.
Edison Mfg. Co.
General Electric Co.
General Inc. Arc Light Co.
Sprague Electric Co.
Sturtevant Co., B. F.
Wesco Supply Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Fibre.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Files.
Barnett Co., G. & H.

Fittings.
Faries Mfg. Co.

Fixtures, Gas and Elec.
Beardslee Chandelier Mfg. Co.

Finishers.
Bissell Co., The F.
Haller Machine Co.
Reynolds El. Flasher Mfg. Co

Flexible Shafts.
Stow Mfg. Co.

Forges.
Sturtevant Co., B. F.

Fuses and Fuse Wire.
Amer. Elec. Fuse Co.
Bissell Co., The F.
Central Electric Co.
Central Tel. & El. Co.
Chicago Die & Electric Co.
Chicago Fuse Wire & Mfg. Co.
D. & W. Fuse Company.
Electric Appliance Co.
Johns-Manville Co., H. W.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Company.
Western Elect. Supply Co.

Globes, Reflectors and Shades.
Fostoria Incan. Lamp Co.
Haller Machine Co.
Holophane Glass Co.
Pardridge Shade & Refl. Co.
Phœnix Glass Co.
Wesco Supply Co.
Western Electric Co.
Western Elect. Supply Co.

Graphite Specialties.
Dixon Crucible Co., Jos.
Holmes Fibre-Graphite Co.

Heating (Exhaust Steam).
Amer. District Steam Co.

Heating and Ventilating Apparatus.
Sturtevant Co., B. F.

Holders, Inc. Lamps.
Incandesent Electric Light Manipulator Co.

Inspection & Insurance
Hartford Steam Boiler Inspection & Insurance Co.

Insulating Machinery.
New England Butt Co.

Insulators and Insulating Materials.
Akron Electrical Mfg. Co.
American Electrical Works.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Inc. Arc Light Co.
Indiana Rub. & Ins. Wire Co.
Johns-Manville Co., H. W.
Kartavert Mfg. Co.
Manhattan Elec. Supply Co.
Mica Insulator Co.
Munsell & Co., Eugene.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Standard Vitrified Cond. Co.
Sterling Varnish Co.
Vulcanized Fibre Co.
Wesco Supply Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Junction Boxes.
Bossert Elect. Const. Co.
General Inc. Arc Light Co.

Lamps, Arc.
Bissell Co., The F.
Central Electric Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
General Inc. Arc Lt. Co.
Gregory Electric Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Lamps, Incandescent.
Bissell Co., The F.
Bryan-Marsh Company.
Buckeye Electric Company.
Central Electric Co.
Chicago Edison Co.
Columbia Incan. Lamp Co.
Edison Decorative & Miniature Lamp Dept.
Electric Appliance Co.
Fostoria Incand. Lamp Co.
General Electric Co.
General Inc. Arc Light Co.
Standard Elec'l Mfg Co.
Sterling Electrical Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Lamps, Incandescent—Reinecers & Cleaners.
Inc. El. Lt. Manipulator Co.

Letters, Metal.
Haller Machine Co.

Lightning Arresters.
Central Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
Manhattan Elec. Supply Co.
Minnesota Electric Co.
Western Electric Co.

Linemen's Climbers.
Klein & Sons, Mathias.

Magnet Wires.
(See Wires and Cables.)

Mechanical Draft.
Sturtevant Co., B. F.

Mica.
Chicago Mica Co.
Mica Insulator Co.
Munsell & Co., Eugene.

Mining Apparatus, Elec.
Allis-Chalmers Company.
Crocker-Wheeler Company.
General Electric Co.
Jeffrey Mfg. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Motors. (See Dynamos and Motors.)

Nippers and Pliers.
Klein & Sons, Mathias.

Nozzles.
Faries Mfg. Co.

Paints.
Dielectric Mfg. Co.

Patent Attorneys.
Bain, Foree.

Phosphor Bronze.
Phosphor Bronze Sm. Co. Ltd.

Platinum, Wire and Sheet.
Baker & Company Inc.

Poles and Ties.
Berthold & Jennings.
Brooks, Hall L.
Columbia Mfg. Co.
Coolidge Co., Marshall H.
Fowler, John H.
Fowler-Jacobs Company.
Kellogg Switch. & Sup. Co.
Lindsley Bros. Co.
Loud's Sons Co., H. M.
Maltby Lumber Co.
Morrison Lbr. Co., J. W.
Mueller Company, William.
Pacific Coast Pole Co.
Page & Hill Company.
Phelan, D. W.
Pittsburg & L. S. Iron Co.
Porter Cedar Company.
Sterling & Son, W. C.
Thompson, S. E.
Torrey Cedar Co.
Valentine-Clark Co., The.
Worcester Co., C. H.

Polish (Metal).
Allen Co., Inc., L. B.
Hoffman, Geo. W.

Portables.
Faries Mfg. Co.

Power Transmission Machinery.
Jeffrey Mfg. Co.

Rail Joints.
Continuous Rail Joint Company of America.

Refiners.
Gt. West Smelt. & Refining Co

Re-Winding—Repairs.
Chicago Edison Co.
Gregory Electric Co.

Rheostats.
Cutler-Hammer Mfg. Co.
General Electric Co.
Gen'l Inc. Arc Lt. Co.
Union Electric Mfg. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Rods, Conduit.
Cope, T. J.

Schools and Colleges.
Electrical Engineer Inst.
Highland Park College
Michigan College of Mines.
Pratt Institute.
State Univ. of Iowa.

Second-Hand Mach'y.
Bissell Co., The F.
Cent. Stat. Improvement Co.
Gregory Electric Co.
Matthews & Bro., W. N.
Walsh's Sons & Co.

Shades, Lamp.
Faries Mfg. Co.

Sheet Brass & Copper.
Plume & Atwood Mfg. Co.

Signs, Electric.
Haller Machine Co.

Sockets & Receptacles.
Pass & Seymour.
Yost Elec. Mfg. Co.

Soldering Sticks, Salts and Paste.
Allen Co., L. B.
Crescent Co.
Kester Elec. Mfg. Co.
Western Electric Co.

Speaking Tubes.
Central Electric Co.
Edwards & Co.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.
Wester Elec. Supply Co.

Specialties, Electrical Mfrs. and Designers.
Haller Machine Co.

Speed Indicators.
Weston Electrical Inst. Co.

Storage Batteries.
American Battery Co.
Electric Storage Battery Co.
Gould Storage Battery Co.

Supplies, General Elec.
Bissell Co., The F.
Central Electric Co.
Century Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Electric Co.
Manhattan Elect'l Supply Co.
Wesco Supply Co.
Western Electric Co.
Western Elect. Supply Co.

Switchboards.
Bissell Co., The F.
Crouse-Hinds Co.
Gen. Incan. Arc Light Co.

Telephones, Telephone Material and Switchboards.
American El. Telephone Co
Automatic Electric Co.
Bissell Co., The F.
Central Electric Co.
Central Tel. & El. Co.
International Tel. Mfg. Co.
Kellogg Switchb. & Sup. Co.
Manhattan Elec. Supply Co.
Moon Mfg. Co., The.
Stromberg-Carlson Tel. M. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Time Switches.
Bissell Co., The F.
Hartford Time Switch Co.

Tools.
Klein & Sons, Mathias.
Western Electric Co.

Transformers.
Central Electric Co.
Crawfordsville Electric Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Works, Inc.
General Electric Co.
Gregory Electric Co.
Kuhlman Electric Co.
Manhattan Elec. Supply Co.
National Electric Co.
Wagner Electric Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Trucks, Electric Car.
General Electric Co.
Westinghouse El. & Mfg. Co.

Turbines, Steam.
Allis-Chalmers Co.
General Electric Co.
Westinghouse El. & Mfg. Co

Turbine Water Wheels
Leffel & Co., Jas.

Varnishes.
Dielectric Mfg. Co.
Sterling Varnish Co.

Vulcanized Fibre.
Vulcanized Fibre Co.

Wires & Cables—Magnet Wires.
American Electrical Works.
Bissell Co., The F.
Central Electric Co.
Chicago Insulated Wire Co.
Crescent Ins. Wire & Cble. Co.
Driver-Harris Wire Co.
Electric Appliance Co.
General Electric Co.
Hazard Manufacturing Co.
Indiana Rub. & Ins. Wire Co
India Rubber & Gutta Percha Insulating Co.
Kellogg Switch. & Sup. Co.
Manhattan Elec. Supply Co.
National India Rubber Co
New York Insulated Wire Co.
Okonite Co., The.
Phillips, Eugene F.
Phillips Insulated Wire Co
Roebling's Sons Co., J. A.
Safety Ins. Wire & Cable Co.
Simplex Electrical Co.
Standard Underground C. Co
Wesco Supply Co.
Western Electric Company.
Western Elec. Supply Co.

For Alphabetical Index of Advertisements See Page 3.

WHITNEY INSTRUMENTS ENJOINED

Full opinion of His Honor Judge Wheeler, concurred in by His Honor Judge Lacombe in the case of the

WESTON ELECTRICAL INSTRUMENT CO., Complainant

VS.

WHITNEY ELECTRICAL INSTRUMENT CO., Defendant

This suit is brought upon patent No. 392387 dated November 6, 1888, and granted to Edward Weston for an Electrical Measuring Apparatus, which was adjudged to be valid in Weston Electrical Instrument Co. *vs.* Jewell Electrical Instrument Co. et al in this court in March, 1904. It has now been heard upon a motion for a preliminary injunction.

The principal question made now is as to infringement. **The parts of the defendant's instrument look quite differently from the corresponding parts of the instrument of the patent, but notwithstanding these differences in form they are there in the instrument and do the same things in substantially the same way.** This appears quite well from the description of the two instruments in parallel columns in the affidavit of Frank W. Roller, defendant's record on this motion, page 3. The great thing to be done appears to have been to get the movable coil in its diamagnetic frame into a permanent magnetic field, compactly, and to carry the current to be measured from side to side through the coil, and move the coil against steady resistance to measure the current, and record the measurement. Weston seems to have accomplished this by mounting the frame by pivots on non-conducting bridge-pieces, and carrying the current to be measured to and from the movable coil through springs connected with the frame furnishing steady resistance, and a pointer connected with the frame and moving over a scale to show the movement and the measurement of the current.

Any electrical mechanic could provide the permanent magnetic field, and the form of it would not be material except to permit the movement of the frame carrying the coil. The mounting of the frame on the bridge-pieces by pivots with its arrangement and connections was the important part of Weston's patented invention.

The defendant's instruments have the permanent magnetic field provided by a magnet and core of different and perhaps better shapes in some respects, but permitting movement of the frame in an arc of a circle to carry a pointer moving over a scale to indicate the measurement of the current. **If these changes of forms are even patentable improvements the defendants have taken and used the invention of the patent in making and using those improvements.**

The difference in the form of the parts carrying the frame on pivots supported by the bridge-pieces is of the same sort. It does not vary the mechanical operation of the parts. **These differences do not, any or all of them, amount to doing the same thing in different ways, but leave the operative parts doing the same thing in the same way.**

According to these views the motion should be granted.

HOYT H. WHEELER,
Judge.

FOR PLAINTIFF:
WILLIAM HOUSTON KENYON.

FOR DEFENDANTS:
CLIFTON V. EDWARDS.

Upon re-examination of the record, I concur in the opinion above expressed by Judge Wheeler.

July 18, 1904.

E. HENRY LACOMBE,
U. S. C. J.

(ENDORSED) Circuit Court of the United States, for the Southern District of New York—Weston Electrical Instrument Company *vs.* Whitney Electrical Instrument Company *et al.*—Opinion, WHEELER, J.—United States Circuit Court, Southern District of New York. Filed July 20, 1904. John A. Shields, Clerk.

Weston Electrical Instrument Co.

Waverly Park, NEWARK, N. J.

BOILER WATERS CORRECTED

to remove and prevent scale and to stop corrosion. DEARBORN TREATMENT does the work. Send gallon sample for analysis. Booklet "R" now ready.

DEARBORN DRUG & CHEMICAL WORKS,

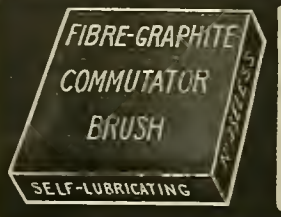
27-34 RIALTO BUILDING, CHICAGO, ILL. WM. H EDGAR, President Telephone: Harrison 3930 and 3931.

Dixon's Pure Flake Graphite

As a Cylinder Lubricant

Makes cylinders, valves and rods wonderfully smooth and bright. Reduces friction, saving oil and packing. Booklet 125C and sample upon request.

JOSEPH DIXON CRUCIBLE CO., JERSEY CITY, N. J.

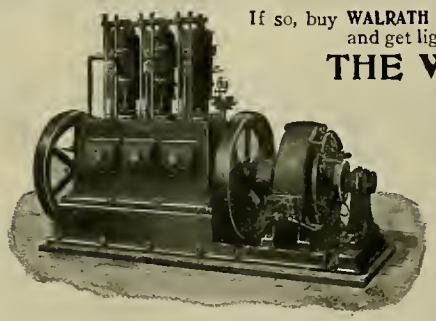


There's No Friction

with the Fibre-Graphite Commutator Brush. Being 90 per cent. pure graphite, it insures low resistance, no sparking under a varying load, and longer wear. There is no greasing required. The Fibre-Graphite is therefore the most economic brush on the market. Send for price list.

HOLMES FIBRE-GRAPHITE MFG. CO.
5155 Wakefield St., Germantown, PHILADELPHIA.

ARE YOU LOOKING FOR MONEY?



If so, buy WALRATH GAS OR GASOLINE ENGINES and get light on the subject.

THE WALRATH

Received the Highest Award at the Pan-American Exposition.

It will produce as good a commercial light as that of an automatic steam engine, either belted or direct-connected generator. Simple, Economical and Reliable. Send for Catalogue W.

MARINETTE GAS ENGINE CO.,
CHICAGO HEIGHTS, ILL.

AGENCIES:
Keystone Engineering Co., Farmer's Bank Bldg., Pittsburg, Pa.
Strong, Carlisle & Hammond Co., 61-67 Frankfort St., Cleveland, Ohio
Mackay Engineering Co., 149 Broadway, N. Y.
C. H. Seidenglanz., 52 Wheu Bldg., Indianapolis, Ind.

"Diamond H" Switches

Trade ◇H◇ Mark

This Trade-Mark guarantees quality.

The Hart Mfg. Co., Hartford, Conn.

New York Boston Chicago Toronto, Ont.

JEFFREY DETACHABLE STEEL ROLLER SPECIAL **CHAINS** FOR CATALOGUE, ADDRESS THE JEFFREY MFG. CO COLUMBUS, OHIO.

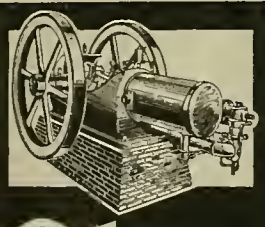
Sterling Black Plastic Insulator.

One hundred days' continuous baking at 180° F. will not make it brittle. Water repellent. Oil proof.

THE STERLING VARNISH CO., - - Pittsburg, Pa.

The Electrician Publishing Co., 510 Marquette Bldg., Chicago. Headquarters for all latest Electrical Books. Write for Catalogue.

THE PHOSPHOR BRONZE SMELTING CO. LIMITED, 2200 WASHINGTON AVE., PHILADELPHIA. "ELEPHANT BRAND PHOSPHOR-BRONZE" INGOTS, CASTINGS, WIRE, RODS, SHEETS, ETC. — DELTA METAL — CASTINGS, STAMPINGS AND FORGINGS ORIGINAL AND SOLE MAKERS IN THE U.S.



Olds Gas and Gasoline Engines

Each engine is fully tested before it leaves our factory to its full indicated horsepower. Its simplicity of construction and perfection of mechanical principles have been amply demonstrated during the past 23 years. Olds engines are standard the world over.

Stationary Engines - 2 to 100 H. P.
Portable Engines - 8 to 18 H. P.

We will send full information and new illustrated catalog upon request

Olds Gasoline Engine Works

252 River Street, - Lansing, Mich.

6

Locations for Industries

Erie Railroad

Chicago to New York

The Erie Railroad Company's Industrial Department has all the territory traversed by the railroad districted in relation to resources, adaptability, markets and advantages for manufacturing, and can advise with manufacturers in relation to the most suitable locations. For full information address

LUIS JACKSON

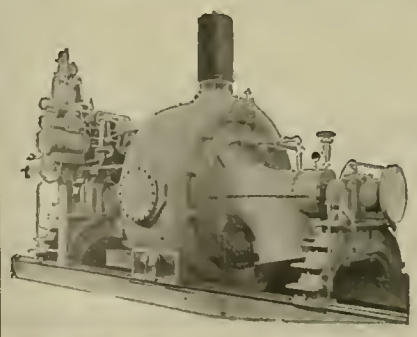
Industrial Commissioner, Erie Railroad Company

21 Cortlandt Street, New York

BUY YOUR BOOKS

FROM THE

Electrician Pub. Co., 510 Marquette Bldg., Chicago.



SAMSON TURBINE

The illustration shows the large NIAGARA design, HORIZONTAL SHAFT TURBINES recently installed by us for the NIAGARA FALLS HYDRAULIC POWER & MANUFACTURING CO., Niagara Falls, N. Y. Tests conducted by competent engineers developed as follows:

Head	Gateage	Speed	H-P	Generator Efficiency	Turbine Efficiency
213 ft.	1-2	257 r. p. m.	1750	95 per cent	.730 per cent
213 "	3-4	257 " "	3000	95 " "	.856 " "
213 "	Full	257 " "	3500	95 " "	.815 " "

These results have never been equaled by any turbine of the Horizontal Shaft Design, operating under equally HIGH HEADS. The test was made **AFTER TURBINES WERE INSTALLED,** direct coupled to Generators. Francis' weirs and formulæ for discharge was used. The original test reports on file at our offices. These turbines are all fitted with our SAMSON BALANCED GATES. Write Department D for catalogue.

Note especially the UNIFORM SPEED at ALL GATEAGES

JAMES LEFFEL & CO., **Springfield, Ohio, U. S. A.**

SPEER HIGH GRADE CARBON BRUSHES

MOTOR AND GENERATOR CARBON BRUSHES

SPEER CARBON CO., - St. Marys, Pa.

Engineering MECHANICAL, ELECTRICAL, STEAM, CIVIL.

Complete and short courses. Thoroughly equipped engineering shops. **Shop work from the beginning.** Short courses in Steam and Electrical Engineering. Expenses low. Accommodations the best. School all year. Students may enter any time. Correspondence steam and electrical courses. Send for catalogue. Mention course in which interested.

HIGHLAND PARK COLLEGE, DES MOINES, IOWA.

M. KLEIN & SON.

Send 2c stamp for new catalogue No. 6 of

KLEIN'S TOOLS

For Electrical Workers and Line Builders.

MATHIAS KLEIN & SONS.

81 W. Van Buren St., Chicago, Ill.

FOR 50 CENTS we will send you a new Formula for making a lamp frosting which will save you money. Inexpensive to manufacture. Every Electrician should have this formula. Send at once, stamps or coin.

THE R. GAY CHEMICAL CO., Box 336, La Crosse, Wis.

CONTINUOUS RAIL JOINT CO. OF AM.

GENERAL OFFICES: CENTURY BUILDING

NEWARK, N. J.

OVER 20,000 MILES IN USE

Highest Award at Paris Exposition, 1900, Buffalo, 1901

WORKS QUICK AND EASY. KEEPS ITS LUSTER. HOLDS OLD TRADE AND MAKES NEW. DOES NOT DETERIORATE. ESTABLISHED 16 YEARS. SOLD BY AGENTS AND DEALERS ALL OVER THE WORLD.

U.S. METAL POLISH 3 OUNCE BOX 10 CENTS SAMPLES SENT FREE GEO. W. HOFFMAN

POLISHES ALL METALS. BRANCHES: NEW YORK, CHICAGO, SAN FRANCISCO, 295 E. WASHINGTON ST. INDIANAPOLIS

DON'T BUY ELECTRICAL SUPPLIES

Until you have seen our new Catalogue and new Price List.

Free to the trade.

Manhattan Electrical Supply Co.

NEW YORK: 32 Cortlandt St.

CHICAGO: 188 Fifth Ave.

ALLEN-BRADLEY ELECTRIC CRANE CONTROLLERS

PATENTED

Guaranteed for One Year. Three months' Free Trial.
No Sparking. No Repairs. Perfect Control.

AMERICAN ELECTRIC FUSE COMPANY

CHICAGO - - ILLINOIS

General Electric Company

Manufactures all Forms of **Insulated Wires and Cables**

Rubber, Varnished Cambric,

Paper, Asbestos, Weatherproof

Write for information concerning Wires and Cables insulated with our special form of Varnished Cambric. This insulation is equal and in many respects superior, to high grade rubber insulation and considerably cheaper.

General Office: SCHENECTADY, N. Y.

Chicago Office: Monadnock Block

Sales Offices in all large Cities

HAVE YOU SEEN
OUR NEW
PRICE LIST
ON
PORCELAIN
KNOBS TUBES CLEATS
Don't Overlook It
ELECTRIC APPLIANCE COMPANY
CHICAGO AND SAN FRANCISCO

EDISON MINIATURE LAMPS

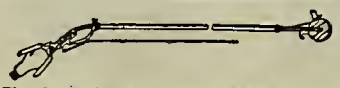
Over 400,000 Annually Shipped to Users.

All types—every variety.
Prompt shipment—in any quantity.

Miniature and Candelabra Sockets and Receptacles.

EDISON DECORATIVE & MINIATURE LAMP DEPT.,
General Electric Company, Harrison, N. J.

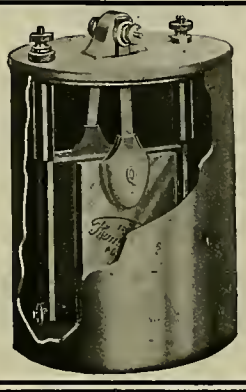
ELECTRIC SIGN
FLASHERS
BEST IN THE WORLD
Write for full particulars
Reynolds Elec. Flasher Mfg. Co.
221 Fifth Ave., Chicago.



The Incandescent Lamp Replacer and Cleaner replaces and cleans any c. p. lamp at any height or angle.
Incandescent Electric Light Manipulator Co.,
116 Bedford St., Boston, Mass.

VOLT - AMMETERS,
POCKET SIZE,
For Testing Batteries and Battery Circuits, Locating Faults, Grounds, etc.
RELIABLE. ACCURATE.
Send for Circular.
L. M. PIGNOLET,
78-80 Cortlandt St., NEW YORK, N. Y.

MICA Of all Qualities, in any Form at Lowest Prices
EUGENE MUNSELL AND CO.
NEW YORK and CHICAGO
INSULATION That Is.
Micanite, Linotape, M. I. C. Compound, Empire Cloth and Paper. For Years the Standard.
MICA INSULATOR CO., Originators
NEW YORK and CHICAGO

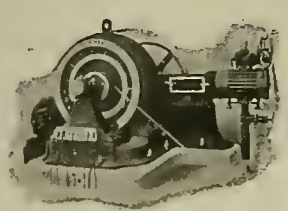


EDISON PRIMARY BATTERIES FORMERLY EDISON LA LANDE

These batteries are simple in construction and can be easily and quickly renewed. The renewal parts and supplies are inexpensive and readily obtained. You would appreciate this if you could read the description of Battery Renewals in our catalogue No. 7. May we not send it?

EDISON MANUFACTURING CO.,
TRADE Thomas A Edison MARK
Factory, ORANGE, N. J.
NEW YORK, 83 Chambers St.
CHICAGO, 304 Wabash Ave.

Warren Alternator



EXPERIENCE
sheds new light on the
WARREN ALTERNATORS
Discovering their attributes for safe, economical and efficient operation. If you are to replace a machine that is too small, or one that you have found inefficient, investigate the
WARREN ALTERNATOR.
WARREN ELECTRIC MFG. CO.
Sandusky, O.

MICABOND Biggest Stock in the West.
CHICAGO MICA CO., - Valparaiso, Ind.

SPARKING Reduces the working capacity of a motor or dynamo, wears out the commutator, wastes power and may cause a fire. All this may be avoided if you use . . . . . .

The only article that will PREVENT SPARKING. Will keep the Commutator in good condition and PREVENT CUTTING.
Absolutely Will Not Gum The Brushes.
It will put that high gloss on the Commutator you have so long sought after.
50 Cents per Stick. $5.00 per Dozen.
SEND FOR FREE SAMPLE STICK.
For sale by all supply houses, or
K. McLENNAN & CO., Sole Mfrs., Room 411 Inter Ocean Bldg., 130 Dearborn St., CHICAGO

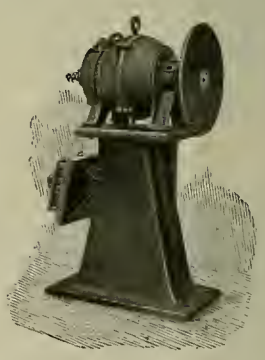
BEARDSLEE CHANDELIER MFG CO. 256 AND 257 SO CANAL ST. CHICAGO
GAS & ELECTRIC FIXTURES FOR THE TRADE.
CATALOG SENT PREPAID TO DEALERS MENTION THIS PAPER

REFLECTIONS ON FARIES REFLECTORS

Fit any socket.
Quickly attached or detached.
Made of aluminum or steel.
Very light and will not rack socket to pieces.
Finish not affected by heat.
Made in many styles and finishes.

Catalogue mailed upon application.
FARIES MFG. CO.
DECATUR, ILL.

DIRECT CURRENT
MOTORS



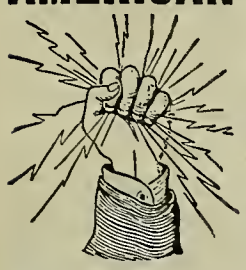
THE ADAPTATION of our motors to mechanical drive is practically universal, and their service is unequalled.
Write for Bulletin No. 21014.

SPRAGUE
ELECTRIC COMPANY
General Offices:
527 West 34th Street, New York.
Chicago Office: Fisher Building.

FRANK N. PHILLIPS, PRESIDENT. C. H. WAGENSEIL, TREASURER. EUGENE F. PHILLIPS, GENERAL MANAGER. E. ROWLAND PHILLIPS, VICE-PRES. C. R. REMINGTON, JR., SEC.

AMERICAN ELECTRICAL WORKS,

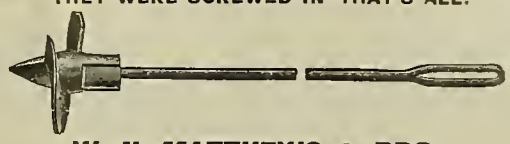
PROVIDENCE, R. I.



BARE AND INSULATED ELECTRIC WIRE,
ELECTRIC LIGHT LINE WIRE,
INCANDESCENT AND FLEXIBLE CORDS,
Railway Feeder and Trolley Wire,
AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR WIRES.
CABLES FOR AERIAL AND UNDERGROUND USE.
NEW YORK STORE, W. J. Watson, 26 Cortlandt St.
CHICAGO STORE, F. E. Donohoe, 82 Lake St.
MONTREAL BRANCH, Eugene F. Phillips' Electrical Works.
MAIN OFFICES AND FACTORIES, PHILLIPSDALE, R. I.

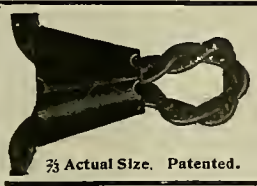
The Bossert Electric Construction Co.
—MANUFACTURERS OF—
STEEL OUTLET AND JUNCTION BOXES,
SWITCHBOARDS, PANEL BOARDS, SWITCHES, ETC.
UTICA, NEW YORK.

AT THE ST. LOUIS EXPOSITION
STOMBAUGH GUY ANCHORS
ARE **ANCHORING**
POLES ON THE INTRAMURAL RAILWAY, THE MAST OF THE DE FOREST WIRELESS TELEGRAPH CO. AND THE AERODROME BUILT FOR THE AIR SHIPS.
THEY WERE SCREWED IN—THAT'S ALL.



W. N. MATTHEWS & BRO.
603 CARLTON BUILDING *ST. LOUIS*

EXPERT IN ELECTRICITY MECHANICS PATENT CAUSES
SOLICITOR OF U. S. & FOREIGN **PATENTS**
FORÉE BAIN, 1652-3 Monadnock Blk., CHICAGO



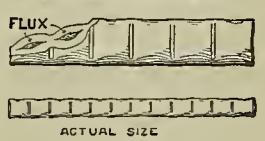
⅔ Actual Size. Patented.

CROWN CORD ADJUSTER
BEST AND SIMPLEST. MADE OF HARD RUBBER.
No Slip, No Abrasion, No Removing socket, Easily attached
Price $4.00 Per Hundred. Liberal Discount to the Trade.
Sample Free.
J. H. SEAMAN, 175 Dearborn St., Chicago

Engineering TAUGHT BY CORRESPONDENCE
Our system of training by mail has helped thousands held down in poor positions to rise to better salaries and situations. Your chances to rise is just as good as others. Write for our free illustrated book, "Can I Become An Electrical Engineer?" We teach by mail, Electrical Engineering, Mechanical Engineering, Steam Engineering, Mechanical Drawing, Electric Lighting, Electric Railways.
ELECTRICAL ENGINEER INSTITUTE, Dept. R 240 West 23rd St., New York.

USE
"SAFETY" RUBBER COVERED WIRE AND CABLE
FOR EVERY ELECTRICAL SERVICE.
M. B. AUSTIN & CO.,
CHICAGO REPRESENTATIVE.
THE SAFETY INSULATED WIRE & CABLE CO.,
WORKS: Bayonne, N. J. 114-116 LIBERTY STREET, N. Y.

KESTER SELF FLUXING SOLDER
A Tube of Solder Filled with Flux.
Requires no Acid.
SAVES—LABOR—TIME—MONEY.



PATENTED.
Send for Free Samples.
L. F. Mahler Co., R. 1008 Chemical Bldg., St. Louis, Mo., Gen. Western Agent.
KESTER ELECTRIC M'F'G CO.,
46 N. UNION STREET, CHICAGO, ILL.

AKRON
Generators, Motors, Clutches, Commutator Truing Devices.
AKRON ELECTRICAL MFG. CO., AKRON, O.
N. Y. Office: McKay Engineering Co., 149 Broadway

SINGLE AND POLYPHASE
TRANSFORMERS
KUHLMAN ELECTRIC CO., - - Elkhart, Ind.

Crimshaw

Raven White Core

Raven Black Core

ALL OUR WIRES pass Inspection and carry the above TRADE-MARKS on our tags. We also manufacture Crimshaw and Competition Tapes and Splicing Compounds.

NEW YORK INSULATED WIRE COMPANY,

MAIN OFFICE: 114, 116 & 118 Liberty St., New York.
BRANCHES: CHICAGO: 192 Desplaines St. BOSTON: 7 Otis St. SAN FRANCISCO: 33 Second St.

NATIONAL CODE STANDARD

"O. K." Weatherproof Wire.
Slow-Burning Weatherproof and Ideal Wire.
Prices and Samples on Application.

Phillips Insulated Wire Co.
Office and Factory: PAWTUCKET, R. I.

Standard Vitrified Conduit Co.

B. B. BARNARD, Manager
39-41 CORTLANDT ST.
NEW YORK
LARGEST FACTORIES IN THE WORLD : STOCK ON HAND
SEND FOR CATALOGUE

WANTED, FOR SALE *and similar* **WANT COLUMN** *advertisements (50 words or less), $1.50 an insertion; additional words 3c each.* **POSITION WANTED** *advertisements (50 words or less), $1.00 an insertion; additional words 2c each.*

POSITION WANTED.

By practical superintendent and all around electrical and steam engineer, fifteen years' experience, strictly sober and reliable; age thirty-six. Have served as central station man, erecting engineer and superintendent. Understand all practical conditions of light and power. Would accept traveling position or superintendent. Address BOX 380, care Western Electrician, 510 Marquette Building, Chicago, Ill.

WANTED.

Superintendent for city water and electric-light plant, must be competent electrical and mechanical engineer. Give experience and references. State salary expected. Address BOX 382, care of Western Electrician, 510 Marquette Bldg., Chicago.

FOR SALE.

Electric-light plant in good Northwest Missouri town of about 1,000 inhabitants. Flat rate system: alternating current, 400 incandescents and other appurtenances. City contract at a bargain. For information address, CITY CLERK, Lawson, Mo.

WANTED.

Operating engineer for electric-light and railway plant. Address BOX 383, care of Western Electrician, 510 Marquette Bldg., Chicago.

FOR SALE.

A bargain: 1 T. H. 30-light 9.6 Amp. Series open arc machine, with wall controller and ammeter complete, good running order.

Twenty-two 9.6 Amp. double carbon open arc lamps with glass, hoods and spreader complete, good order. Several additional lamps, both single and double, can be put in good order or parts used for repairs. A lot of extra globes and parts and a supply of carbons will be included if taken as a whole.

Two 30-K. W. Edison Bipolar 125-volt D. C. generators in fine running order. Reason for selling, have put in larger machinery.

CARROLL ELECTRIC LIGHT & POWER COMPANY,
Carroll, Iowa.

FOR SALE.

Two 250 K.W., 10,000-volt generators.

General Electric, three-phase, 60-cycle, revolving field type, belted machines with exciters and marble switchboard.

Portland Lighting & Power Co.,
Portland, Maine

Dividend Paying Electric Light Plant For Sale.

Electric light plant in Wisconsin city of 3,000 inhabitants, exclusive 17-year franchise and city contract. Plant in operation for seven years paying annually cash dividend. Physical condition of plant is first class.

Company's increasing business demands more attention than can be given to it by present owners, who are local business men. A splendid opportunity for a practical electrician or manager who can control or invest about $20,000. Address BOX 374, care Western Electrician, 510 Marquette Bldg., Chicago, Ill.

PROPOSITION FOR PROPOSALS.

Sealed proposals will be received until 4:30 o'clock p. m. on the 31st day of August, 1904, addressed to the Clerk of Kendallville, Indiana, for furnishing and installing one 150 K. W. alternating current generator, and two 50-light series alternating current regulators and eighty enclosed arc lamps, also switchboard and instruments. It being an addition to the present lighting plant of said city.

Copies of specifications will be sent on application to F. E. Johnson, Electric Light Superintendent of said city.

The Common Council reserves the right to reject any and all bids.

D. O. BRILLHART,
Clerk of Kendallville.

REPAIRING RECALIBRATING
ELECTRIC METERS.
INTERNATIONAL ELECTRIC METER CO.
167 S. CANAL STREET, CHICAGO.

FOR SALE.

ALTERNATORS.

1-360 K. W. General Electric 3-phase.
1-120 " " " "
1-75 " Westinghouse 2-phase.

250-VOLT GENERATORS.

1-250 K. W. Western Electric M. P.
1-200 " Eddy M. P.

125-VOLT GENERATORS.

1-125 K. W. Western Electric M. P.

Immediate shipment.

GREGORY ELECTRIC CO.
54-62 S. CLINTON ST. CHICAGO

We are in position to sell electric-light plants with good franchise and contract and on good paying basis. None too small, none too large. Address,

J. S. MAURER & CO.
804 Monadnock Bldg., Chicago, Ill.

INDUSTRIES ARE OFFERED LOCATIONS

WITH

Satisfactory Inducements,
Favorable Freight Rates,
Good Labor Conditions,
Healthful Communities,

ON THE LINES OF

THE ILLINOIS CENTRAL R. R.
AND THE
YAZOO & MISSISSIPPI VALLEY R. R.

For full information and descriptive pamphlet address

J. C. CLAIR,
Industrial Commissioner,
1 Park Row, Chicago, Ill.

Like Finding Money.

Save your scrap copper, brass and platinum, also incandescent lamp bases, etc., and send them to us. We pay the highest market prices for this material. What have you? We manufacture copper hard babbitt, the best on earth for electrical work, wire solder, pig lead, ingot copper, spelter, etc. It will pay you to get our prices.

GREAT WESTERN SMELTING & REFINING COMPANY, CHICAGO.

MAILED FREE.

A valuable treatise on

STORAGE BATTERIES

for

Private Lighting Plants

together with our catalogue.

COLUMBUS STORAGE BATTERY CO.,
COLUMBUS, OHIO.

Machado & Roller, New York.
Coltz Engineering Co., Chicago.

"MANROSS" HAIR SPRINGS

For Electric Indicating and Recording Gauges, Steam Gauges, Etc

LARGEST MANUFACTURER OF HAIR SPRINGS in the United States.

F. N. MANROSS,
FORESTVILLE, CONN.

BOILERS

One 42-in. x 15 ft. 9-in., 250 H. P. Worthington Water Tube.
One 60-in. x 16 ft., John Mohr Return Tubular Boiler.
One 54-in. x 16 ft., John Mohr Return Tubular Boiler.
One 54-in. x 16 ft., Devine Turbular Boiler.

ENGINES.

One 600 H. P., 21 x 36 x 30, Williams Tandem Horizontal Compound, 140 R. P. M.
Two 600 H. P., 20 x 30 x 24, Porter-Allen Tandem Compound, 200 R. P. M.
One 250 H. P., 12 x 24 x 18 Williams Tandem Compound, 250 R. P. M.
Two 100 H. P., 13 x 12, Dick & Church, High Speed Automatic.

PARTIAL LIST ONLY.

Send for latest Catalogue for bargains in Engines, Boilers, Dynamos and Motors.

CENTRAL STATION IMPROVEMENT CO., 938 Monadnock Block, Chicago

WESTERN ELECTRICAL SUPPLY CO.,

ENGINEERS AND BUILDERS
OF
Electric Railways, Lighting and Power Plants.

Western Electrical Supply Co.,
Chemical Building, - - ST. LOUIS, U. S. A.
Estimates Furnished.

YOST SPECIALTIES.

Sockets, Wall Sockets, Weatherproof Sockets, Rosettes, Receptacles, Cord Adjusters.

Catalogue for the asking.

THE YOST ELECTRIC MFG. CO.
TOLEDO, OHIO.

"STAR" INCANDESCENT LAMPS

LONG LIFE
GUARANTEED CANDLEPOWER,
HIGHEST EFFICIENCY.

MADE BY THE MOST SKILLED WORKMEN.

STANDARD ELECTRICAL MFG. COMPANY, : Niles, Ohio.

CHICAGO EDISON COMPANY REPAIR SHOPS

76 MARKET STREET, CHICAGO. TELEPHONE MAIN 1280.

Machine and Carpenter Work of All Kinds
Correspondence Solicited.

OPEN DAY AND NIGHT.

FIRST-CLASS EQUIPMENT THROUGHOUT.

Dynamos Armatures, Motors, Arc Lamps, Fans, Instruments.

ARNOLD ELECTRIC POWER STATION Co.
Engineers, Constructors for Complete Electric Plants. Results Guaranteed.
SUITE 1539, MARQUETTE BLDG., CHICAGO.
NEW YORK OFFICE: 711 TRANSIT BLDG.

BYLLESBY, H. M. & Co.
(Incorporated)
ENGINEERS
Design, Construct and Operate Railway, Light, Power and Hydraulic Plants.
Examinations and Reports.
New York Life Building, - CHICAGO, ILL.

HORNADAY, J. P. & Co.
SUITE 1108 TRACTION BUILDING
CINCINNATI, O.
WATERWORKS, ELECTRIC RAILWAY, LIGHT, TRACTION, INDUSTRIAL AND MINERAL PROPERTIES BOUGHT AND SOLD

Long Distance Phone Central 2148.
SCHOTT, W. H.,
ENGINEER AND CONTRACTOR,
SPECIALTIES—Central Station Heating Plants, Water Works Steam Plants, Electric Light, Gas and Street Railway Plants.
1220-21 MARQUETTE BUILDING, CHICAGO.

W. E BAKER. H. B. BISHOP.
BAKER, W. E. & CO.
ENGINEERS,
ELECTRIC RAILWAYS.
27 William St., NEW YORK.

E. W Hammer, Pres. and Treas. H. J. Minhinnick, Sec. and Gen'l Sup't.
GENERAL ENGINEERING Co., THE Consulting and Contracting Engineers.
Telephones, Electric Light, Power Transmission
Suite 1112, 135 ADAMS ST., CHICAGO.
Long Distance Telephone Central 478.

ROBERT W. HUNT & Co.,
ENGINEERS
1121 The Rookery, Chicago. 66 Broadway, New York.
Monongahela Bank Bldg., Pittsburg.
Norfolk House, Cannon St., London.

STANTON, LE ROY W.
Consulting Telephone Engineer.
Plans, Specifications and Supervision of Installation of complete telephone plants.
Special Reports on Telephone Properties and Apparatus.
411 Electrical Bldg., Cleveland, Ohio.

TRY IT.
Keep your name and address in this directory where it will be seen by possible clients.

ENGINEERS
Represented in this "Directory" are enabled to come in touch with many prospective customers who cannot be reached through any other source.

KOHLER BROS.,
Contracting Electrical Engineers,
Lighting Power Railways,
1804-1806-1808-1810-1812 Fisher Building,
CHICAGO.

IT WILL PAY
engineers not represented in this department to carry a card regularly.

BRYAN, WILLIAM H.
M. Am. Soc. M. E.,
Consulting Mechanical and Electrical Engineer.
Lincoln Trust Building, ST. LOUIS.

J. H. HALLBERG
Consulting Arc Lighting Expert and Practical Electrical Engineer
45 Broadway - NEW YORK
Room 169A

RUEBEL - SCHWEDTMANN - WELLS,
CONSULTING, MECHANICAL AND ELECTRICAL ENGINEERS,
Suite 801 Chemical Building,
ST. LOUIS, U. S. A.

Telephone Main 3123.
WILMERDING, C. H.
CONSULTING ENGINEER
1100 Old Colony Bldg., CHICAGO.

DUGALD C. JACKSON, C. E.
WILLIAM B. JACKSON, M. E.
MEMBERS
AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS
AMERICAN SOCIETY OF MECHANICAL ENGINEERS
AMERICAN SOCIETY OF CIVIL ENGINEERS
ENGINEERS. EXPERTS.
MADISON, WIS.

ALL Live men read the WESTERN ELECTRICIAN Each Week. Do You?

THE STATE UNIVERSITY OF IOWA
SCHOOL OF APPLIED SCIENCE, Iowa City, Iowa
Four year courses of the highest grade in
Civil
Municipal
Sanitary
Electrical
Mechanical
Mining
ENGINEERING
Numerous short practical courses. Special courses in technical chemistry, bacteriology, etc. Adequate equipment in shops and laboratories. Waterpower.
University environment. Expenses low.
Address C. E. MacLEAN, President

READ THE BLUE ELECTRICAL PAPER.

If You Will Look at the Map You Will See
THAT
The Pennsylvania Line
is the direct route
Chicago to INDIANAPOLIS, IND.
LOUISVILLE, KY.
Columbus, O. Cincinnati, O.
AND ALL POINTS SOUTH

Service and equipment strictly first class. For time of trains and full details call on agents or address

C. L. KIMBALL, Ass't Gen'l Passenger Agent
No. 2 SHERMAN STREET, CHICAGO

There is No Higher-Class India-Rubber Insulation
For Wires and Cables than

HABIRSHAW.

Authorized Manufacturers of the
ATTIX FLEXIBLE TUBE WIRE.

The India-Rubber and Gutta-Percha Insulating Co.,

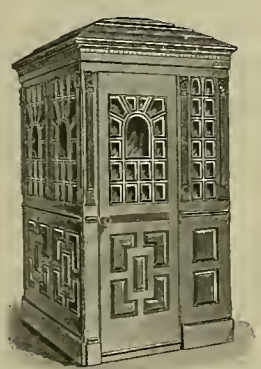
MAIN OFFICE, Glenwood Works,
YONKERS, N. Y.

Sales Office,
15 Cortlandt St., New York.

(10828)

TELEPHONE BOOTHS

PAY FOR THEMSELVES



By Increase of Receipts, Oftentimes in one Month

WRITE FOR CATALOGUE

W. S. SEAMAN & CO.
216 E. Water St.
MILWAUKEE, - - WIS.

BITUMINIZED FIBRE CONDUIT

FOR

ELECTRICAL UNDERGROUND CONSTRUCTION
ELECTROLYSIS PROOF WATER PROOF

A smooth laminated insulator of unchanging durability.

Forms a continuous sealed duct from manhole to manhole, impervious to moisture and through which leaking gas cannot penetrate.

There has uever been a gas explosion in our conduits nor the slightest evidence of electrolysis.

Abrasion of the cables is an impossibility.

It saves sixty per centum of freight and handling cost and twenty to thirty-five per centum of construction.

Process of laying is simple, rapid and inexpensive. There is no loss from breakage or fitting. It is self-aligning and cannot settle out of alignment.

All sizes from one inch to ten inches interior diameter. Bends of all angles.

The foremost electrical engineers are recognizing and testifying to the scientific advantages of our system of subway construction over all previous methods.

Send for illustrated book. Ask for prices giving size and quantities required

PROMPT DELIVERIES

FACTORIES: Philadelphia, Chicago, Los Angeles

American Conduit Company

SEVENTH FLOOR, 170 BROADWAY, NEW YORK

336 Macy St., Los Angeles, Cal. *Manhattan Bldg., Chicago*

THE
Hartford Time Switch

A mechanically operated switch, which turns lights ON and OFF at such hours as the user desires with no further attention than the weekly winding.

Approved Mechanically as well as Electrically

Showing double doors, Seth Thomas eight-day movement, auxiliary cut-out, auxiliary hand-trip, and switch indicator.

For controlling current used for show window lights, electric sign lights, street lights, apartment house hall lights, motors, batteries, burglar alarms. :: 10, 20, 35 and 50 Amperes. 250 Volts. 1, 2 and 3 Poles.

Consult us regarding any requirements

SEND FOR CATALOGUE

The Hartford Time Switch Co.
440 Asylum St., HARTFORD, CONN., U.S.A.
New York City:
A. Hall Berry, 97-99-101 Warren Street
London, England:
Verityn, Ltd., 31, King Street, Covent Garden, S. W.

Automatic Telephones.

Privacy
Promptness
Precision
Profits.

Automatic Electric Co., Chicago, U. S. A.

"That's A Good Thing"

is the universal opinion of those who have investigated our new party line telephone. Our "Sure-Ring" telephone cuts out much trouble on party lines.
Our new desk set also has some excellent features.

These are all described in Bulletin No. 11-E.
Mailed free upon request.

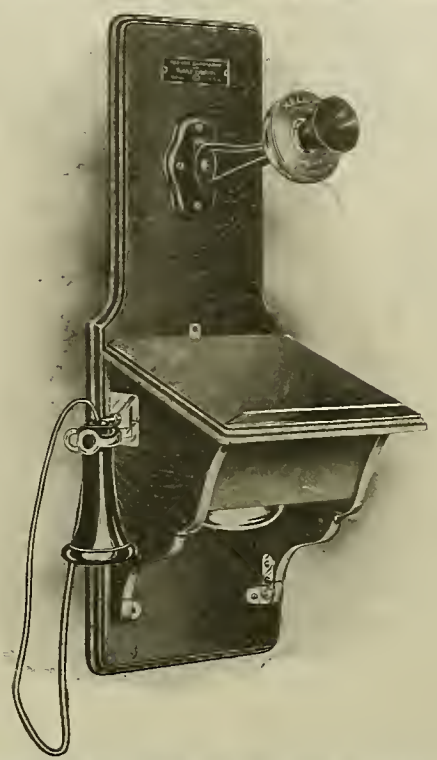
Stromberg-Carlson Telephone Mfg. Co.

GENERAL AND EASTERN SALES OFFICE
ROCHESTER, N. Y.

SALES DEPT.
CHICAGO, ILL.

KELLOGG SWITCHBOARD & SUPPLY CO.

Manufacturers of the Largest and Busiest Telephone Exchanges in the United States



The Kellogg Transmitter stands first in volume, clearness of articulation and in carrying power. Our prices are low when cost of maintenance and quality of apparatus are considered. Do not fail to visit our exhibit in the Electricity Building at the St. Louis Exposition.

Kellogg Switchboard & Supply Co., Green and Congress Streets - CHICAGO

Seymour Bldg., Los Angeles Electric Bldg., Cleveland Keystone Telephone Bldg., Philadelphia

AS SIMPLE AS ITS NAME.

A B C
—OF—
THE TELEPHONE

By J. E. HOMANS, A. M.

352 pages.

Cloth, Price $1.00.

An up-to-date, practical treatise on the construction, theory, installation, care and management of telephones and their appliances.
Sent prepaid on receipt of price.

Electrician Publishing Co.,
510 Marquette Building, Chicago, Ill.

SECURITY TROLLEYS

FOR STRINGING CABLES

(PATENTED)

A thousand feet of cable is easily pulled **in ten minutes** by only two men after trolleys are in position.

The old way cost too much, and of the various new schemes for stringing cables all have been pronounced complicated and defective, except this very natural and sensible way of using trolleys.

Weight, 12 Pounds ***Price, $1.50 each***

Prompt shipments from stock *Write for Catalog W. 118*

THE F. BISSELL COMPANY
Manufacturers and Jobbers of
ELECTRICAL GOODS
226-228-230 HURON STREET
TOLEDO, O.

Electric Heating Apparatus

SEND FOR 32-PAGE CATALOGUE.

"UNIT" ENAMELED RHEOSTATS
SIMPLEX ELECTRIC HEATING CO.,
Cambridgeport, Mass.

Points in Wisconsin and the Northwest

are covered by Wisconsin Central Railway's convenient, solid, widevestibuled trains, equipped with Pullman sleepers, free reclining chair cars and modern coaches which leave Central Station, 12th Street and Park Row (Lake Front), Chicago for St. Paul, Minneapolis, Ashland and Duluth, connecting with all western lines. Meals in dining and cafe cars served a la carte.
For tickets and further information apply to nearest ticket agent, or write
JAS. C. POND, Gen'l Pass. Agt., Milwaukee, Wis.

Send your Book Orders to
ELECTRICIAN PUBLISHING CO.,
510 Marquette Bldg., Chicago.

We introduced successful 4-party lines

LEICH SELECTIVE SYSTEM

Write for our booklet—"Selective W."

CENTRAL ENERGY OR MAGNETO

Impedance Coil for Selectives. No Springs.

AMERICAN ELECTRIC TELEPHONE CO.
CHICAGO, ILLINOIS

INTERNATIONAL

Mechanical Self-Restoring Drop Switchboard.

A PERFECT APPARATUS.

Made in any desired capacity.
Sample parts and quotations on request.

INTERNATIONAL TELEPHONE MANUFACTURING CO.
CHICAGO, U. S. A.

PRODUCERS AND WHOLESALERS OF WHITE CEDAR PRODUCTS

CEDAR POLES

SPECIAL PRICES ON SMALL POLES.
Write for a copy of our TELEGRAPH CODE FOR CEDAR PRODUCTS

C. H. WORCESTER CO.
SUITE 1206 TRIBUNE BLDG. CHICAGO.

YARDS
KOSS MICH.
L'ANSE "
MUNISING "
ONTONAGON
WAGNER, WIS
PESHTIGO "

POLES, TIES, POSTS. THE PORTER CEDAR CO., SAGINAW, MICH.
PRODUCERS. We want your inquiries always.

POLES W. C. STERLING & SON, MONROE, MICH. TIES.
Eleven Pole Yards in Michigan.
Wholesale Producers for 20 years.

Cedar Poles.
Pittsburg and Lake Superior Iron Co. Producers and Wholesalers. Escanaba, Mich.

CEDAR POLES
ESTABLISHED 1862
WM. MUELLER COMPANY
1211-12-13 MARQUETTE BLDG. CHICAGO.
EIGHT DISTRIBUTING YARDS

WHITE CEDAR POLES
HALL L BROOKS
52 WISCONSIN AVENUE
TOMAHAWK, WIS.

POLES—POSTS—PILING—TIES
Fowler-Jacobs Co.
Elmore-Fowler-Jacobs Co.
John H. Fowler & Co.
The FOWLER Companies
Fisher Building, - - CHICAGO

WHITE CEDAR POLES
Don't forget our Minnesota Transfer Yard—midway between St. Paul and Minneapolis, where we load in forty-eight hours from the time we have your order.
PACE & HILL CO. 1003 Lumber Exchange, MINNEAPOLIS, MINN.

CEDAR POLES
THE
Valentine-Clark Co.
234 La Salle Street, CHICAGO
YARDS:
Pinconning, Mich. : Green Bay, Wis. : New London, Wis.

THE TRAIL OF LEWIS AND CLARK

was the pioneer American trail west of the Missouri river and the results of that exploration of 1804-6 were of tremendous importance to the United States and they were never more apparent than now.

A publication relating to the Lewis and Clark expedition, just issued by **G. P. Putnam's Sons, New York**, stands peculiarly alone. This edition is a two-volume, 8 vo one, called "**The Trail of Lewis and Clark, 1804-1904.**" The author, Mr. Olin D. Wheeler, is the well known writer of the popular **Wonderland** series of the Northern Pacific Railway, in connection with which he made his studies and researches for this work.

Mr. Wheeler has traveled several thousand miles over the route of Louis and Clark. He has camped out, climbed mountains, followed old Indian trails, and visited remote points made memorable by those explorers. Their route across the Bitterroot mountains has been followed, identified and mapped.

"**The Trail of Lewis and Clark**" is illustrated in color and half tone from **paintings, drawings, and maps**, by Paxson. De Camp and Russell, made under Mr. Wheeler's direction and from photographs taken especially for the purpose. The writer tells his own story and supplements it with pertinent extracts from Lewis and Clark, and a host of other historical and narrative writers that connect the past with the present. Exact excerpts and photographic reproductions, in half tone from the ORIGINAL MANUSCRIPT JOURNALS of Lewis and Clark are given. A chapter is devoted to the Louisiana Purchase, another to the preparatory measures for the exploration, and another to the history of each man of the expedition so far as known, including a discussion of the death of Captain Lewis.

The Louisiana Purchase Exposition at St Louis, and the **Lewis and Clark Centennial** to be held at Portland, Oregon, in 1905, make this work peculiarly timely, because written from the standpoint of actual knowledge of past and present conditions of the old trail and country.

"**The Trail of Lewis and Clark**" should be found in every public and private library in the land and the general reader will find in reading through its pages of large clear type that truth is, indeed, stranger than fiction.

The book can be ordered through any bookseller or news stand or direct from the publishers

BOOKS. BUY YOUR BOOKS FROM THE ELECTRICIAN PUBLISHING COMPANY, 510 Marquette Bldg., CHICAGO.

CENTRAL STATION HEATING

We are the originators and builders of the underground system of live and exhaust steam heating. Our system is used for the utilization and distribution of exhaust steam from electric and power plants for heating purposes. 250 Plants in successful operation. We have the only Meter System. Also manufacturers of Wooden Water Pipe, Steam Pipe Casing, Steam Traps, Condensation Meters, Valves, Economizing Coils. Separators and full line of Steam Fitters' Supplies.

WRITE FOR PAMPHLET AND PRICE LIST

AMERICAN DISTRICT STEAM COMPANY
LOCKPORT, N.Y. CHICAGO, ILL.
MENTION WESTERN ELECTRICIAN.

MICHIGAN WHITE
CEDAR POLES
LARGE STOCK.
PROMPT SHIPMENTS.
KELLOGG SWITCHBOARD & SUPPLY CO., Chicago.

"Seeing" will be "Believing" if you will only let us ship you a sample car of the "Trolley" ties we are making those low prices on.

May we ship?

MALTBY LUMBER COMPANY, 509 Phoenix Block, Bay City, Michigan.
TIPPER & PATTON, Pittsburg Agents, 509 Bessemer Bldg.

BRACKETS—X ARMS—PINS
little things it is true, but they cut a big figure in line construction.
OUR MOTTO IS:
Prompt Shipment Quality Satisfaction Right Price
COLUMBIA MFG. CO. ANTIGO, WIS.

CEDAR POLES MARSHALL-H.COOLIDGE Co 826 GUARANTY BLDG. MINNEAPOLIS MINN.
YARDS — NEW DULUTH, MINN. - FLOODWOOD, MINN. - WELLERS, MINN.

"By two or three witnesses shall a matter be established."

FIVE POINTS OF EXCELLENCE.

Leaving the center of the city from which you start; reaching the center of the city of your destination, over smooth and level tracks: giving rest and comfort: riding beside running waters most of the way, through the centers of population to the gateways of commerce: when you travel by the

NEW YORK CENTRAL LINES.

A copy of the Illustrated Catalogue of the "Four Track Series" will be sent free upon receipt of a two-cent stamp by George H. Daniels, General Passenger Agent, Grand Central Station, New York.

Idaho Cedar Poles
PACIFIC COAST POLE CO. SPOKANE, WASH.

Cedar TORREY CEDAR CO., CLINTONVILLE, WIS. Poles
Large Stock Constantly on Hand

MICHIGAN AND WESTERN CEDAR POLES
ALL LENGTHS AND SIZES
LINDSLEY BROS CO.
TRIBUNE BLDG., CHICAGO

The "WAY of the WORLD" to the WORLD'S FAIR.
BIG FOUR ROUTE to ST. LOUIS.
1904
Write for Folders & Booklets
M. E. INGALLS, PRESIDENT CINCINNATI WARREN J. LYNCH, G. P. & T. A.

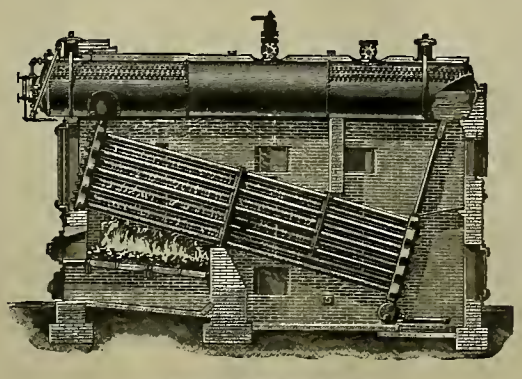
CEDAR POLES, POSTS, TIES,
H. M. LOUD'S SONS CO., Au Sable, Mich.

Southern Cedar POLES Are the Best.
NO ROTTEN BUTTS.
D. W. PHELAN, 277 Broadway, New York

POLES. WHITE CEDAR. IDAHO CEDAR up to 80 ft.
BERTHOLD & JENNINGS, ST. LOUIS. Chemical Building.
CROSS ARMS. LONG LEAF PINE AND FIR.

THE BABCOCK & WILCOX CO., 85 LIBERTY ST., N. Y.

BRANCH OFFICES:
BOSTON, 35 FEDERAL STREET.
PHILADELPHIA, 1110-1112 NORTH AM. BLDG.
SAN FRANCISCO, 63 FIRST STREET.
PITTSBURG, 1216 FRICK BUILDING.
NEW ORLEANS, 339 CARONDELET STREET.
CHICAGO, 1215 MARQUETTE BLDG.
ATLANTA, EMPIRE BLDG.
CLEVELAND, 706 NEW ENGLAND BLDG.
MEXICO CITY, 7 AVENIDA JUAREZ.
HAVANA, CUBA, 116 1-2 CALLE DE LA HABANA


200 Pounds Working Pressure

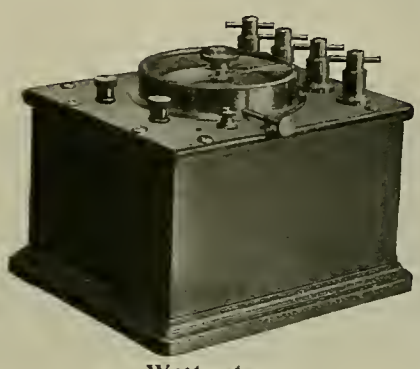
WATER TUBE STEAM BOILERS
STEAM SUPERHEATERS
Our Book, STEAM, mailed free on application.

Announcement

New Standard Instruments

With Free Calibration Service

Voltmeter



Wattmeter

Ammeter

For Direct and Alternating Currents

We Announce the development of Semi-Portable Instruments of Precision of a new type, greatly superior to all others now in use. Their introduction marks the beginning of a new era in electrical measurements.

We Further Announce that the Westinghouse Department of Standards will recalibrate these instruments free of charge upon request at any time within five years of date of purchase. This service will eliminate all the present troubles due to inaccurate standards, and is an important innovation in electrical practice.

One Westinghouse Instrument of Precision has the range of several standard instruments of different capacities of any other manufacture. Free calibration ensures the preservation of their initial accuracy.

——Made Only By——

Westinghouse Electric & Mfg. Co.

Pittsburg, Pa.

For full particulars address nearest District Office

New York, Atlanta, Dallas, Baltimore, Boston, Buffalo, Chicago, Cincinnati, Cleveland, Detroit, Los Angeles, Minneapolis, New Orleans, Philadelphia, Pittsburg, St. Louis, Salt Lake City, San Francisco, Syracuse, Seattle, Denver, Mountain Electric Co.
Canada: Canadian Westinghouse Co., Limited, Hamilton, Ontario. Mexico: G. & O. & Braniff Co., City of Mexico.

FORT WAYNE ELECTRIC WORKS
WOOD LIGHTING & POWER SYSTEMS
Fort Wayne, Ind.

Telephone Booth Fan Motors

The only place where silence is really golden is in a telephone booth—that is, after the talk begins.

The door must be closed to keep outside noise outside, and inside talk inside. Inside air becomes heated and the talker wishes for a fan motor. If he had the ordinary kind he would be unable to use it because of the rumble and roar of vibration of booth and wind in his ears.

The telephone booth "Wood" fan motor is a specialty that has been given special study and fulfills every requirement.

In telephone booths or cabinets these motors are practically without a rival. There is not another motor on the market that so fully meets the requirements of this service.

"Wood" telephone booth fan motors are small, light and slower in speed than any other "Wood" fan motors. The motor is suspended on three spiral springs of calculated resiliency which deaden all vibration.

It is small enough to be mounted on the side of the cabinet and give just the proper amount of breeze in just the right direction.

Special windings permit the use of these motors in series with an incandescent lamp lighting the booth and at the same time cooling it. The circuit can be so arranged that closing the door starts the motor and lights the lamp and opening it turns off the current.

The total energy consumption for series operation is practically the same as for lamp alone.

The suspended revolving type attached to a lamp socket is also a necessary comfort these days

242

Good Advice

No. 3

Nothing exasperates the manager of a central station more, than having complaints come to him from his customers, charging that their meters are "running too fast," or from his meter reading department, that many of the readings are certainly "too slow." The conditions are experienced daily in many plants and many meters are productive of just such results. The present Duncan Direct Current Wattmeter is a guaranteed proof against such erratic departures from straight line accuracy.

Good Advice No. 4 Next Week

Write for Bulletin and Prices

DUNCAN ELECTRIC MFG. CO.
LAFAYETTE, IND.

DIRECT CURRENT

Generators and Motors

Western Electric Company

CHICAGO NEW YORK

Other Principal Cities

Space 17 Louisiana Purchase Exposition

127 FULTON STREET CHICAGO

SIGNS

For Signs, Letters, Flashers, Dimmers, Timeswitches, Lamps, Rubberrings and anything pertaining to Signs,

—WRITE TO—

HALLER MACHINE COMPANY

Designers and Manufacturers, of Sheetmetal, Electric and Machinery Specialties

WIRES AND CABLES

HIGH-GRADE, RUBBER-COVERED, WEATHER-PROOF

MAGNET, OFFICE, ANNUNCIATOR WIRE.

HAZARD MANUFACTURING CO.,

GENERAL OFFICE AND WORKS, Wilkesbarre, Pa. NEW YORK OFFICE, 50 Dey St. CHICAGO OFFICE, 71 and 73 West Adams St.

VULCANIZED FIBRE

Highest grades for electrical insulation and mechanical purposes, in sheets, tubes, rods and special shapes. Catalogues and samples on application.

VULCANIZED FIBRE CO., - Wilmington, Del.

KARTAVERT.

HARD AND FLEXIBLE FIBER IN SHEETS, RODS AND TUBING.

For Electrical and Mechanical Purposes, Railway Dust Guards, Washers and Packings. Patent Insulating Cleats.

MANUFACTURED BY

THE KARTAVERT MANUFACTURING CO. Wilmington, Del.

Crocker-Wheeler. Brown, Boveri.

By arrangement with the celebrated electrical engineers, Brown, Boveri & Cie. of Baden, Switzerland, the Crocker-Wheeler Company has secured their alternating current designs, patents and rights to manufacture in America, and has retained them as consulting engineers.

Crocker-Wheeler Company is now putting on the market alternating current generators, transformers and accessories of the most perfect design and construction, adapted to American practice. Opportunities to bid on this apparatus are invited.

ECONOMIZE

IN YOUR BOILER PLANT. INSTALL A

STURTEVANT ECONOMIZER

Boiler capacity increased 20 to 40 per cent. Patent system of "staggered pipes" give increased saving over straight pipe economizers.

For high or low pressures. No leaky joints. Easily accessible. Send for catalogue.

B. F. STURTEVANT CO.

BOSTON, MASS.

General Office and Works, Hyde Park, Mass.

New York Philadelphia Chicago London

Black Diamond File Works

Est. 1863. Inc. 1895.

Twelve Medals Awarded at International Expositions

Special Prize Gold Medal at Atlanta, 1895.

OUR GOODS ARE ON SALE IN EVERY LEADING HARDWARE STORE IN THE UNITED STATES AND CANADA.

G. & H. BARNETT COMPANY,

PHILADELPHIA, PA.

JOHN A. ROEBLING'S SONS CO.

Insulated Wire of All Kinds

Bare Copper Wire

MAIN OFFICE AND WORKS **TRENTON, N. J.**

AGENCIES AND BRANCHES

New York Chicago Cleveland San Francisco Philadelphia Atlanta

Western Electrician

Vol. XXXV. $3.00 Per Annum. Copyright, 1903, by Electrician Publishing Company, Chicago. CHICAGO, AUGUST 13, 1904, Entered at Chicago Postoffice as mail matter of the second class. 10 Cents a Copy. No. 7.

SIMPLEX INSULATED WIRES AND CABLES.

RUBBER COVERED, WEATHERPROOF, UNDERGROUND AND SUBMARINE.

WESTERN SELLING AGENT, H. A. WILSON, 114 Manhattan Block, CHICAGO.

The Simplex Electrical Co., 110 State Street, BOSTON, MASS.

National India Rubber Co.'s

RUBBER COVERED WIRES AND CABLES.

OFFICE AND FACTORY: BRISTOL, R. I.

OKONITE

TRADE MARK

1889—Paris Exposition, Medal for Rubber Insulation.

1893—World's Fair, Medal for Rubber Insulation.

THE STANDARD FOR RUBBER INSULATION.

Sole Manufacturers of

Okonite Wires, Okonite Tape, Manson Tape, Candee Weather-proof Wires.

THE OKONITE CO., LTD.

Willard L. Candee, H. Durant Chesver, } Managers. 253 Broadway, New York. Geo. T. Manson, Gen'l Supt. W. H. Hodgins, Secy.

TRADE MARK. CRESCENT INSULATED WIRE & CABLE CO. TRENTON N.J.

CRESCENT RUBBER INSULATED WIRES AND CABLES

National Code Standard.

CRESCENT INSULATED WIRE AND CABLE CO.,

New York Office, 83 BARCLAY STREET. Main Office and Factory, TRENTON, N. J.

DRIVER-HARRIS WIRE CO.

HARRISON (NEWARK), N. J.

Manufacturers of Fine Sizes Wire of Every Description.

Resistance Wires a Specialty.

INDIANA RUBBER AND INSULATED WIRE CO.,

MANUFACTURERS OF

Paranite Rubber Covered Wires and Cables,

UNDERGROUND, AERIAL, SUBMARINE AND INSIDE USE:

TELEPHONE, TELEGRAPH AND FIRE ALARM CABLES.

All Wires are tested at Factory. JONESBORO, IND.

"CIRCULAR LOOM" THE FLEXIBLE CONDUIT

AMERICAN CIRCULAR LOOM CO. TRADE MARK REGISTERED

CONDUITS FOR INTERIOR WIRING.

American Circular Loom Co.

Chelsea, Mass., New York, Chicago, San Francisco.

THOUSANDS IN USE.

Motors, ¼ h. p. to 100 h. p. Dynamos, 1 k. w. to 75 k. w.

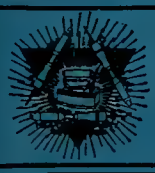
Highest Quality. Reasonable Price.

THE HOBART ELECTRIC MFG. CO. TROY, OHIO.

I-T-E

CIRCUIT BREAKERS

CUTTER ELECTRICAL CO., PHILADELPHIA



They hold YOU responsible

SO GIVE THEM THE BEST.

MANUFACTURED BY

AMERICAN ELECTRICAL HEATER CO., DETROIT, MICH.

THERMOPILES 1¼ VOLTS ½ AMPERES

For Electrolytic analysis, charging storage batteries, and other constant current requirements. $3 Each.

WALSH'S SONS & CO., 264 Washington Street. Newark, N. J.

W. D. PAINT.

A PERMANENT INSULATING PROTECTION FOR WOOD OR METAL. A quick drying, moisture-proofing, black paint. An elastic anti-rust coating. A jet black finishing paint, efficient and not expensive.

Write for "Data on Insulating Materials."

DIELECTRIC MANUFACTURING CO., SAINT LOUIS.

Controlling Devices

OF ALL KINDS

MOTOR STARTERS

SPEED REGULATORS

FIELD REGULATORS

Motor Starter with Automatic Release. Manufactured under our own patents.

SEND FOR CATALOG

Union Electric Mfg. Co.

Milwaukee, Wis.

YOST SPECIALTIES.

Sockets, Wall Sockets, Weatherproof Sockets, Rosettes, Receptacles, Cord Adjusters.

Catalogue for the asking.

THE YOST ELECTRIC MFG. CO.

TOLEDO, OHIO.

EDISON PRIMARY BATTERIES FORMERLY EDISON LA LANDE

These batteries require no attention or inspection until all the energy of their elements is exhausted. This makes them ideal batteries for heavy current work. Catalogue No. 7 will tell you more about them.

EDISON MANUFACTURING CO.,

TRADE Thomas A. Edison PARIS

Factory, ORANGE, N. J.

NEW YORK, 83 Chambers St.

CHICAGO, 304 Wabash Ave.

WESTON Electrical Instrument Co.,

Waverly Park, NEWARK, N. J.

Weston "Round Pattern" Voltmeter, Type K.

We desire to call attention to a line of low priced but excellent Switchboard Instruments for Direct-Current Circuits, which we designate as

"Round Pattern," Type K.

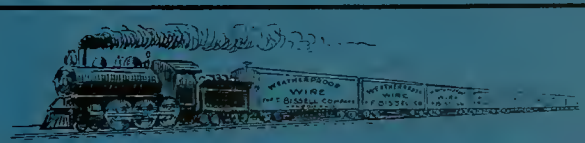
These instruments are particularly suitable for Isolated Plants and Feeder Circuits in Railway and Power Plants. All Weston Instruments are unsurpassed in excellence of workmanship, in accuracy and economy of operation.

BERLIN—European Weston Electrical Instrument Co., Ritterstrasse No. 88.

LONDON—Elliott Bros., Century Works, Lewisham.

PARIS, FRANCE—E. H. Cadiot, 12 Rue St. Georges.

New York Office—74 Cortlandt St.



WEATHERPROOF WIRE

"ONE OF OUR 61 VARIETIES."

Large Quantities Carried Regularly in Toledo Stock

We also carry large stocks of other wires for both lighting and telephone work. Write for Bulletin W 6.

OUR BULL FROG FLAMEPROOF WIRE

for telephone switchboard work positively will not carry flame.

THE F. BISSELL COMPANY

Manufacturers and Jobbers of

ELECTRICAL GOODS

226-228-230 HURON STREET

TOLEDO, O.

Allis-Chalmers Co
CHICAGO

"Big Reliable" Engine
at the
St. Louis Exposition

Largest Single Engine Ever Placed On Exhibition

Popularly Known At Exposition As "Big Reliable"

Allis-Chalmers 5,000 h. p. Engine and Bullock 3,500 k. w. Electric Generator, which furnishes current for Decorative Lighting of Exposition Grounds and Buildings.

From the time steam was first turned on, this Engine has worked perfectly. It furnishes daily, in addition to the lighting work at night, 3,000 h. p. to the St. Louis Transit Company.

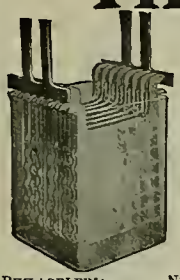
We build smaller Engines in sizes from 25 h. p. upward.

Bullock
Electric Mfg Co
Cincinnati

Canadian representatives, Allis-Chalmers-Bullock, Ltd., Montreal.

THE ELECTRIC STORAGE BATTERY CO.

PHILADELPHIA



MANUFACTURER OF THE

"Chloride Accumulator"

For Central Stations, Electric Railways, Isolated Lighting and Power Stations, Fire Alarm, Telegraph, Train Lighting, etc., etc.

PRICE LISTS AND DESCRIPTIVE BULLETINS FORWARDED UPON REQUEST.

SALES OFFICES:

PHILADELPHIA, Allegheny Ave. and 19th St. | NEW YORK, 100 Broadway, | BOSTON, 60 State St. | CHICAGO, Marquette Bldg. | ST. LOUIS, Wainwright Bldg. | SAN FRANCISCO, Rialto Bldg. | CLEVELAND, Citizens Bldg. | CANADA, Canadian General Electric Co., Ltd. Toronto | HAVANA, CUBA, G. F. Greenwood, Manager 34 Empedrado St.

Announcement

— BY THE —

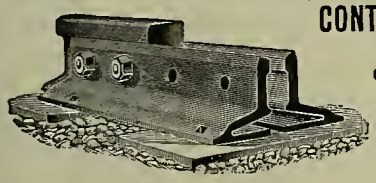
WHITNEY ELECTRICAL INSTRUMENT COMPANY

The Whitney Electrical Instrument Company announces that, being firmly convinced that the direct-current measuring instruments made and sold by it infringe on no patents or rights whatsoever and, having the opinion of eminent counsel that such is the case, it has taken an appeal from the opinion recently handed down by Judge Wheeler. The Whitney Electrical Instrument Company is and will remain ready to supply its full line of admittedly superior measuring instruments for direct current and for alternating current but, pending its appeal, the direct-current instruments will, for the further reassurance of our customers be of a type containing no moving wire and hence entirely removed from any possibility of question or dispute. The instruments referred to are dead beat, have equally divided scales and the ammeters can be used interchangeably on the same shunts as our old type.

In conclusion, the Whitney Electrical Instrument Company reiterates its assurance of readiness to undertake the defense of any suits brought against its customers for alleged infringement. August 1, 1904

WHITNEY ELECTRICAL INSTRUMENT COMPANY

MACHADO & ROLLER, 203 Broadway, New York, General Selling Office



CONTINUOUS RAIL JOINT COMPANY OF AMERICA.

GENL. OFFICES: CENTURY BLDG., NEWARK, N. J.

OVER 20,000 MILES IN USE

Highest Award Paris Exposition, 1900, Buffalo, 1901

CARBONS

CONSUMERS CARBON CO.

LANCASTER, OHIO, U. S. A.

Carbons of all kinds and for all purposes.

PLATINUM

PLATINUM RIVETS FOR CONTACT POINTS IN TELEPHONES—SPARK COILS AND OTHER ELECTRICAL APPARATUS. PLATINUM SHEET AND WIRE IN ANY FORM AND DEGREE OF HARDNESS. PLATINUM SCRAP PURCHASED.

BAKER & COMPANY, Inc.

ARTISANS IN PLATINUM

408-410-412-414 N. J. R. R. AVE. - NEWARK, N. J.

New York Office: 120 Liberty St.

ALPHABETICAL INDEX TO ADVERTISEMENTS.

Adams-Bagnall Electric Co..—
Akron Electrical Mfg Co..... 5
Allen Company, L. B.....—
Allis-Chalmers Company..... 2
American Battery Co.....13
Amer. Circular Loom Co.... 1
American Conduit Co.....12
Amer. District Steam Co.....14
Amer. Elec. Fuse Co.....10
Amer. Electrical Heater Co.. 1
Amer. El. Telephone Co.....14
American Electrical Works..11
Arnold Elec. Power Station Co..... 13
Automatic Electric Co..... 15

Babcock & Wilcox Co.....—
Bain, Forée.....11
Baker & Company..... 3
Baker & Co., W. E.....13
Barnett Company, G. & H....20
Beardslee Chandelier Mfg.Co.—
Berthold & Jennings.....16
Big Four Route.....—
Bissell Co., The F..... 1
Bossert Electric Construction Co.....10
Brooks, Hall L.....16
Bryan-Marsh Co.....—
Bryan, Wm. H.....13
Buckeye Electric Co.....—
Bullock Elec. Mfg. Co..... 2
Butterfield, J. F.....13
Byllesby & Co., H. M.....13

Central Electric Co.....—
Cent. Stat. Improvement Co..12
Central Tel. & El. Co.....14
Century Electric Co..... 8
Chicago Die & Electric Co....—
Chicago Edison Co.....4, 12
Chic. Fuse Wire & Mfg. Co... 5
Chicago Insulated Wire Co..—
Chicago Mica Co.....10
Columbia Incand. Lamp Co.. 7
Columbia Mfg. Co.....16
Columbus Storage Bat'ry Co.--
Consumers Carbon Co..... 3
Continuous Rail Joint Company of America..... 3
Cope, T. J.....11
Crawfordsville Electric Co..—
Crescent Co..... 5
Crescent Ins. Wire & Cbl. Co. 1
Crocker-Wheeler Company... 4
Crouse-Hinds Co.....17
Cutler-Hammer Mfg. Co..... 4
Cutter Elec. & Mfg. Company 1

D. & W. Fuse Company.....—
Dearborn Drug & Chem. Wks.18
Diamond Meter Company....13
Dielectric Manufacturing Co. 1
Directory of Engineers.....13
Dixon Crucible Co., Joseph..18
Driver-Harris Wire Co..... 1
Duncan Elec. Mfg. Co.....19

Edison Decorative & Miniature Lamp Departm't.....10
Edison Mfg. Company..... 1
Edwards & Co.....—
Egan, J. J.....11
Electrical Engineer Institute.—
Electric Appliance Co 10
Electric Storage Battery Co.. 3
Electrician Pub. Company...19
Erie Ry.....16

Faries Mfg. Co.....13
"For Sale" Advertisements..12
Ft. Wayne Elec. Works, Inc..19
Fostoria Incand. Lamp Co....—
Fowler, John H.....17
Fowler-Jacobs Company.....17

Gay Chemical Co.. The R....—
General Electric Co..... 9
General Engineering Co., The 13
General Incandescent Arc Light Company.....—
General Incand. Lamp Co....—
Gould Storage Battery Co.... 6
Gt. West. Smelt. & Refining Co.—
Green Fuel Economizer Co..18
Gregory Electric Company...12

Hallberg, J. H.....13
Haller Machine Co.....—
Hart Mfg. Co.....12
Hartford Steam Boiler Inspection & Insurance Co....—
Hartford Time Switch Co....11
Hazard Manufacturing Co....—
Highland Park College. . 10
Hobart Elec. Mfg. Company. 1
Hoffman, G. W.....12
Holmes Fibre-Graph. Co.....—
Holophane Glass Co.....—
Holtzer-Cabot Electric Co...11
Hornaday & Co., J. P.....13
Humphrey, Henry H.....—
Hunt & Co., Robt. W.....13

Illinois Central Ry.....12
Incandescent Electric Light Manipulator Company.....—
Indiana Rub. & Ins. W. Co.... 1
India Rubber & Gutta Percha Insulating Company.....—
International Elec. Meter Co 12
International Tel. Mfg. Co...14

Jackson, D. C. & W. B.....13
Jeffrey Manufacturing Co....18
Jewell Electrical Inst. Co....—
Johns-Manville Co., H. W..... 8

Kartavert Manufacturing Co.—
Kellogg Switchboard & Supply Company.....15, 17
Kester Elec. Mfg. Co..... 9
Klein & Sons, Mathias..... 10
Kohler Brothers.....13
Kuhlman Electric Co..... 5

La Roche Co., F. A.....—
Leather Preserv. M. Corp....18
Leffel & Co., James.....18
Lindsley Brothers Company..16
Loud's Sons Co., H. M.....-

Machado & Roller 3
Maltby Cedar Company.....17
Manhattan El. Supply Co....11
Manross, F. N. ....—
Marinette Gas Engine Co....18
Matthews & Bros., W. N.....11
McLennan & Company, K....10
Mechanical Appliance Co....16
Mica Insulator Company.....—
Michigan College of Mines ..13
Minnesota Electric Co.....14
Miscellaneous Advs.....12
Monon Railroad..... 14
Moon Mfg. Co., The.....—
Morrison Lbr. Co., J. W.....17
Mueller Company, William..17
Munsell & Co., Eugene..... 10

National Electric Co..... 4
National India Rubber Co.... 1
New England Butt Co.....13
Newgard & Co., Henry.....17
New York Cent. Ry.....16
New York Ins. Wire Co.....11
Northern Elect'l Mfg. Co....10
Northern Pacific Ry.....16
Norton Elect'l Instrument Co.—

Okonite Co., The..... 1
Olds Gasoline Engine Works.18

Pacific Coast Pole Co.....17
Page & Hill Co.....17
Paragon Fan & Motor Co.....—
Pardridge Shade & Refl. Co..—
Pass & Seymour, Inc..... 5
Phelan, D. W.....16
Phillips, Eugene F.....11
Phillips Insulated Wire Co...11
Phœnix Glass Co.....—
Phosphor-Bronze S. Co.....18
Pigeolet, L. M.....10
Pittsburg & L. S. Iron Co....17
Plume & Atwood Mfg. Co....20
Porter Cedar Company.....17
Pratt Institute 18

Reisinger, Hugo..... 5
Reynolds El. Flasher Mfg. Co.11
Roehling's Sons Co., J. A....20
Ruebel-Schwedtman-Wells..13

Safety Ins. Wire & Cable Co..20
Sargent & Lundy.....—
Schott, W. H.....13
Seaman, J. H.....—
Seaman & Co., W. S.....14
Sears, Roebuck & Co..... 5
Simplex Electrical Co., The.. 1
Simplex Elec. Heating Co....11
Speer Carbon Co..... .—
Sprague Electric Company...20
Squire Electric Co.....13
Standard Elec. Mfg. Co..... 9
Standard Underg. Cable Co....—
Standard Vitrified Conduit Co16
Stanley Elec. Mfg. Co., The 8
Stanley Instrument Co..... 5
Stanton, LeRoy W..... 13
State Univ. of Iowa.....13
Sterling & Son, W. C.....17
Sterling Electrical Mfg. Co... —
Sterling Varnish Co., The....18
Stow Mfg. Company.....—
Stromberg-Carlson Tel. Mfg. Company.....15
Sturtevant Company, B. F...20

Torrey Cedar Company.....
Trumbull Elec. Mfg. Co.... 9
Turner Brass Works.....19

Union Electric Mfg. Co..... 1

Valentine-Clark Co., The....—
Vulcanized Fibre Company..20

Wagner Electric Mfg. Co.....—
Walsh's Sons & Company..... 1
Warren Elec. Mfg. Co.....20
Wesco Supply Co.....10
Western Electric Company... 8
Western El. Supply Co.....—
Westinghouse Electric & Manufacturing Co.....—
Weston Electrical Inst. Co... 1
Wilmerding, C. H.....—
Wisconsin Central Ry.....17
Woolley Fdy. & Mach. Wks..18
Worcester Company, C. H....16

Yesbera Mfg. Co..... .. 14
Yost Electric Mfg. Co 1

For Classified Index of Advertisements See Page 6.

REMEMBER THE NAME AND BUY THE BEST.

PARAGON FAN MOTORS

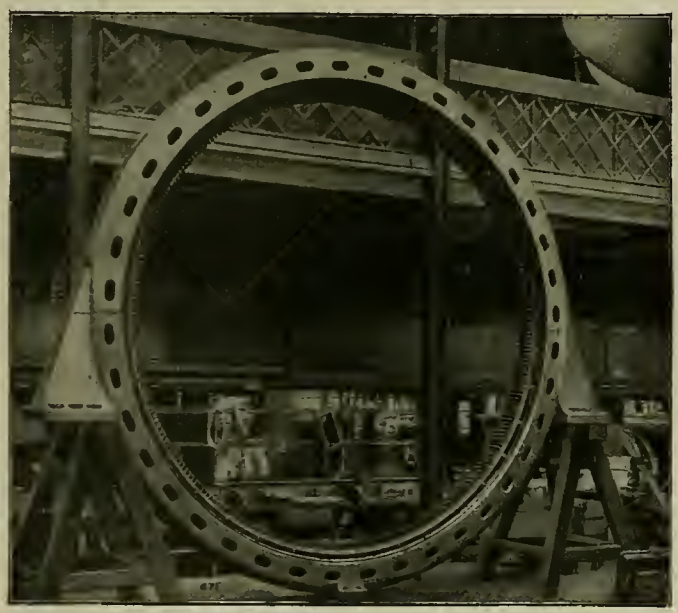
NEW STYLES NEW PRICES
EASY RUNNING RIGID CONSTRUCTION NOISELESS

CALL AND SEE THEM OR WRITE FOR PRICES

CHICAGO EDISON COMPANY,
139 ADAMS ST., CHICAGO.

National Electric Company

builders of high-grade Electrical Machinery for LIGHTING, POWER and RAILWAY SERVICE



500 K. W. Engine Type Alternator Frame.

General Sales Offices and Works: MILWAUKEE

NEW YORK: 135 Broadway
CHICAGO: Old Colony Building
PHILADELPHIA: 1509 Land Title Bldg.
PITTSBURG: Gellatly & Co.
CHARLESTON, W. VA.: Agnew Electric Co.
SEATTLE & SAN FRANCISCO: Kilbourne & Clark Co.

Crocker-Wheeler. Brown, Boveri.

By arrangement with the celebrated electrical engineers, Brown, Boveri & Cie. of Baden, Switzerland, the Crocker - Wheeler Company has secured their alternating current designs, patents and rights to manufacture in America, and has retained them as consulting engineers.

Crocker-Wheeler Company is now putting on the market alternating current generators, transformers and accessories of the most perfect design and construction, adapted to American practice. Opportunities to bid on this apparatus are invited.

"C & H on a controller means highest quality."

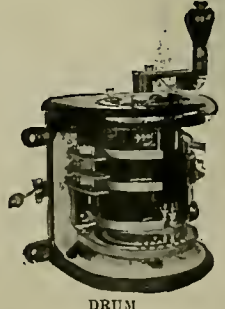
SLATE FRONT

NEW TYPES OF C & H MACHINE TOOL CONTROLLERS

Speed varied entirely through the shunt field of the motor.

Full reverse and non-reverse in each type.

Can be easily attached to machine and be operated without operator leaving his tool post.



DRUM

New York 136 Liberty St. Chicago Monadnock Bldg.

THE CUTLER-HAMMER MFG. CO.
MILWAUKEE, WIS.

Boston 176 Federal St. Pittsburg 322 Feick Bldg.

"ELECTRA" HIGHEST GRADE NUERNBERG
CARBONS

BEST LIGHT
STEADIEST LIGHT

LONGEST LIFE
LEAST DUST

REMAIN THE STANDARD OF THE WORLD FOR ALL ARC LIGHTING SYSTEMS, BECAUSE they cannot be equaled in QUALITY or EFFICIENCY, producing the highest standard of candlepower in proportion to the current consumed.

HUGO REISINGER, Sole Importer, - - 11 Broadway, NEW YORK.

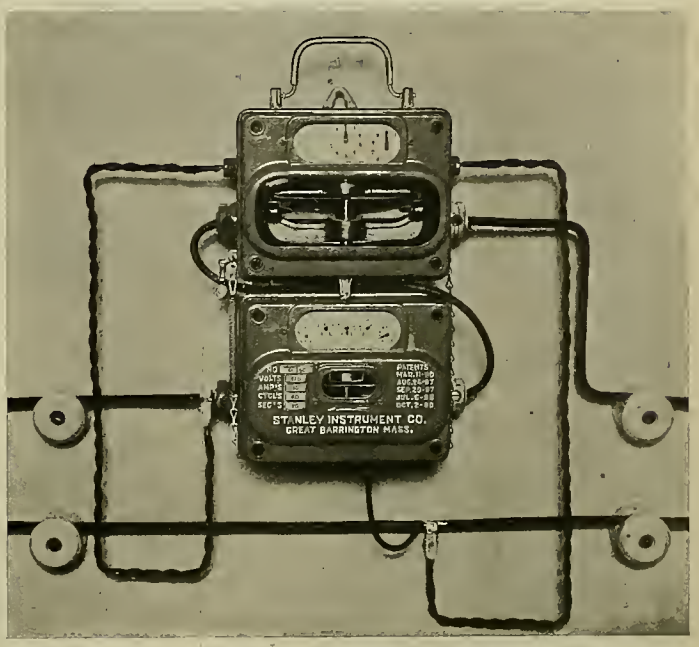
THE KIND THAT WON'T COME OFF
CRESCENT
LAMP COLORING and FROSTING

Economical. A given quantity of Crescent Coloring will color more lamps than the same amount of other solutions.

Put up in all colors and quantities from quarter pint bottles to five-gallon cans.

Write for particulars and prices.

COLORS GUARANTEED BY
CRESCENT COMPANY, Chicago



TESTING WATTMETER

ACCURATE TESTS
in a few minutes, anywhere, by one man alone without regulation of VOLTAGE, LOAD OR FREQUENCY

STANLEY INSTRUMENT CO.
GREAT BARRINGTON, MASS.

TESTED FUSE WIRE AND STRIP
OPEN FUSE LINKS
ENCLOSED FUSE LINKS
TELEPHONE FUSES
TUBULAR LINE FUSES

SWITCH
OUTLET
BOXES.

WIRE JOINTS
TEST
CONNECTORS

CHICAGO FUSE WIRE & MFG. CO.,
CHICAGO. BUFFALO. NEW YORK.

SINGLE AND POLYPHASE
TRANSFORMERS
KUHLMAN ELECTRIC CO., - - Elkhart, Ind.

"TAKE YOUR BASE"

They fit all makes of snap switches, single or double pole, five and ten amperes

WRITE FOR PRICES

PASS & SEYMOUR, INC.,
SOLVAY, N. Y.
NEW YORK CHICAGO SAN FRANCISCO

Gould Storage Battery Co.

Complete Storage Battery Plants

Railway Line and Regulating Isolated and Train Lighting Central Lighting and Power Electric Vehicle and Telephone

GOULD COUNTER E. M. F. BOOSTER SYSTEMS

Sales Offices { NEW YORK, 1 W. 34th Street. BOSTON, 89 State Street. CHICAGO, The "Rookery." SAN FRANCISCO, Century Electric Co.

WORKS: DEPEW, N. Y.

Bulletins.

CLASSIFIED INDEX OF ADVERTISEMENTS.

Adjusters, Cord.
Crescent Co.
Incandes. El. Lt. Manip. Co.

Adjusters, Inc. Lamps.
Inc. El. Lt. Manipulator Co.

Anchors (Tel. & Tel.)
Matthews & Bro., W. N.
Crouse-Hinds Co.

Annunciators.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Moon Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Batteries and Jars.
Bissell Co., The F.
Central Electric Co.
Columbus Storage Battery Co.
Edison Mfg. Co.
Edwards & Company.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Bells, Buzzers, Etc.
Central Electric Co.
Edwards & Co.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Belt Dressing.
Dixon Crucible Co., Jos.
Leather Preserver Mfg. Corp.

Belting.
Leather Preserver Mfg. Corp

Blow Pipes.
Turner Brass Works

Blowers.
Sturtevant Co., B. F.

Boiler Compounds.
Dearborn Drug & Chem. Wks.

Boilers.
Allis-Chalmers Company.
Babcock & Wilcox Co.

Books, Electrical.
Electrician Publishing Co.

Booths, Telephone.
Seaman & Co., W. S.
Yesbera Mfg. Co.

Brackets.
Faries Mfg. Co.

Brushes.
Central Electric Co.
Hobart Elec. Mfg. Co.
Holmes Fibre-Graphite Co.
Speer Carbon Co.
Western Electric Company.

Cable Hangers.
Bissell Co., B. F.
Western Electric Co.

Cables (See Wires and Cables)

Canopies.
Faries Mfg. Co.

Carbons, Points and Plates.
Central Electric Co.
Chicago Edison Co.
Consumers Carbon Co.
Electric Appliance Co.
Reisinger, Hugo.
Speer Carbon Co.
Wesco Supply Co.
Western Elec. Supply Co.

Castings.
Faries Mfg. Co.
New England Butt Co.
National Electric Co.

Chains.
Jeffrey Mfg. Co.

Chandeliers.
Faries Mfg. Co.

Circuit Breakers.
Cutler-Hammer Mfg. Co.
Cutter Elec. & Mfg. Co.
Ft. Wayne Elec. Wks. Inc.
La Roche Co., F. A.
Union Electric Mfg. Co.
Western Electric Company.
Westinghouse El. & Mfg. Co.

Clusters.
Faries Mfg. Co.

Clutches, Electrical and Mechanical.
Akron Electrical Mfg. Co.

Coal and Ashes Handling Machinery.
Jeffrey Mfg. Co.

Coils and Magnets.
Western Electric Co.

Coloring, Lamp
Crescent Co.
Gay Chemical Co., The R.

Commutator Compound
Allen Co., L. B.
Egan, J. J.
McLennan & Co., K.

Commutator Truing Device.
Akron Electrical Mfg. Co.

Condensers, Electric.
Stanley Elec. Mfg. Co.

Conduit and Conduits.
American Circular Loom Co.
American Conduit Company
Central Electric Co.
Electric Appliance Co.
Sprague Electric Co.
Standard Vitrified Cond. Co.
Wesco Supply Co.
Western Electrical Supply Co.

Contractors and Electric Light Plants.
Allis-Chalmers Company.
Bullock El. Mfg. Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
National Electric Co.
Northern Electrical Mfg. Co.
Sprague Electric Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Controllers, Crane.
Amer. Elec. Fuse Co.

Cross-Arms, Pins and Brackets.
Berthold & Jennings.
Central Electric Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Company.
Western Elec. Supply Co.

Cut-Outs and Switches.
Bissell Co., The F.
Bossert Elec. Const. Co.
Central Electric Co.
Chicago Edison Co.
Crouse-Hinds Co.
Cutter Elec. & Mfg. Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
General Inc. Arc Light Co.
Hart Manufacturing Co.
La Roche Co., F. A.
Manhattan Elec. Supply Co.
Trumbull Elec. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Dynamos and Motors.
Akron Electrical Mfg. Co.
Allis-Chalmers Company.
Bissell Co., The F.
Bullock Elec. Mfg. Co.
Central Electric Co.
Century Electric Co.
Crawfordsville Electric Co.
Crocker-Wheeler Co.
Dustin Co., Chas. E.
Ft. Wayne Elec. Wks. Inc.
General Elec. Co.
General Inc. Arc Light Co.
Gregory Electric Co.
Hobart Elec. Mfg. Co.
Holtzer-Cabot Electric Co
Mechanical Appliance Co.
National Electric Co.
Northern Electrical Mfg. Co.
Sprague Electric Co.
Stanley Elec. Mfg. Co.
Stow Manufacturing Co.
Sturtevant Co., B. F.
Wagner Electric Mfg. Co.
Warren Elec. Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Economizers, Fuel.
Green Fuel Economizer Co.

Electric Heating Appl.
American Elec. Heater Co.
Simplex Elec. Heating Co.
Western Electric Co.

Electric Railways.
Crocker-Wheeler Co.
General Electric Co.
Sprague Electric Co.
Westinghouse El. & Mfg. Co.

Electrical and Mechanical Engineers.
Arnold Elec. Power Stat'n Co.
Baker & Co., W. E.
Bryan, Wm. H.
Butterfield, J. F.
Bylesby & Co., H. M.
General Engineering Co., The.
Hallberg, J. H.
Hornaday, J. P. & Co.
Humphrey, Henry H.
Hunt & Co., Robt. W.
Jackson, D. C. & W. B.
Kohler Brothers.
Newgard & Co., Henry.
Northern Electrical Mfg. Co.
Ruebel, Schwedtman, Wells.
Sargent & Lundy.
Schott, W. H.
Squire Electric Co.
Stanley Elec. Mfg. Co.
Stanton, LeRoy W.
Wilmerding, C. H.

Electrical Instruments. (Recording and Testing.)
Bissell Co., The F.
Central Electric Co.
Diamond Meter Co.
Duncan Elec. Mfg. Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
General Inc. Arc Light Co.
Jewell Electrical Inst. Co.
Machado & Roller.
Norton Elec'l Instrument Co.
Pignolet, L. M.
Stanley Elec. Mfg. Co.
Stanley Instrument Co.
Wagner Electric Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.
Weston Electrical Inst. Co.

Electro-Plating Mach'y
Crocker-Wheeler Company.
General Electric Co.

Elevators-Conveyors.
Jeffrey Mfg. Co.

Engines, Gas and Gasoline.
Allis-Chalmers Company.
Marinette Gas Engine Co.
Olds Gasoline Engine Works.
Woolley Fdy. & Mach. Wks.

Engines, Steam.
Allis-Chalmers Company.
Dustin Co., Chas. E.
Sturtevant Co., B. F.

Fans and Fan Motors.
Central Electric Co.
Crocker-Wheeler Company.
Edison Mfg. Co.
General Electric Co.
General Inc. Arc Light Co.
Sprague Electric Co.
Sturtevant Co., B. F.
Wesco Supply Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Fibre.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Flies.
Barnett Co., G. & H.

Fittings.
Faries Mfg. Co.

Fixtures, Gas and Elec.
Beardslee Chandelier Mfg. Co.

Flashers.
Bissell Co., The F.
Haller Machine Co.
Reynolds El. Flasher Mfg. Co

Flexible Shafts.
Stow Mfg. Co.

Forges.
Sturtevant Co., B. F.

Fuses and Fuse Wire.
Amer. Elec. Fuse Co.
Bissell Co., The F.
Central Electric Co.
Central Tel. & El. Co
Chicago Die & Electric Co.
Chicago Fuse Wire & Mfg. Co.
D. & W. Fuse Company.
Electric Appliance Co.
Johns-Manville Co., H. W.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Company.
Western Elect. Supply Co.

Globes, Reflectors and Shades.
Fostoria Incan. Lamp Co.
Haller Machine Co.
Holophane Glass Co.
Pardridge Shade & Refl. Co.
Phœnix Glass Co.
Wesco Supply Co.
Western Electric Co.
Western Elect. Supply Co.

Graphite Specialties.
Dixon Crucible Co., Jos.
Holmes Fibre-Graphite Co.

Heating (Exhaust Steam).
Amer. District Steam Co.

Heating and Ventilating Apparatus.
Sturtevant Co., B. F.

Holders, Inc. Lamps.
Incandescent Electric Light Manipulator Co.

Inspection & Insurance
Hartford Steam Boiler Inspection & Insurance Co.

Insulating Machinery.
New England Butt Co.

Insulators and Insulating Materials.
Akron Electrical Mfg. Co.
American Electrical Works.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Inc. Arc Light Co.
Indiana Rub. & Ins. Wire Co.
Johns-Manville Co., H. W.
Kartavert Mfg. Co.
Manhattan Elec. Supply Co.
Mica Insulator Co.
Munsell & Co., Eugene.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Standard Vitrified Cond. Co.
Sterling Varnish Co.
Vulcanized Fibre Co.
Wesco Supply Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Junction Boxes.
Bossert Elect. Const. Co.
General Inc. Arc Light Co.

Lamps, Arc.
Bissell Co., The F.
Central Electric Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
General Inc. Arc Lt. Co.
Gregory Electric Co.
Manhattan Elec. Supply Co.
Stanley Elec. Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Lamps, Incandescent.
Bissell Co., The F.
Bryan-Marsh Company.
Buckeye Electric Company.
Central Electric Co.
Chicago Edison Co.
Columbia Incan. Lamp Co.
Edison Decorative & Miniature Lamp Dept.
Electric Appliance Co.
Fostoria Incand. Lamp Co.
General Electric Co.
General Inc. Arc Light Co.
Standard Elec'l Mfg. Co.
Sterling Electrical Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Lamps, Incandescent—Reflectors & Cleaners.
Inc. El. Lt. Manipulator Co.

Letters, Metal.
Haller Machine Co.

Lightning Arresters.
Central Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
Manhattan Elec. Supply Co.
Minnesota Electric Co.
Stanley Elec. Mfg. Co.
Western Electric Co.

Linemen's Climbers.
Klein & Sons, Mathias.

Magnet Wires.
(See Wires and Cables.)

Mechanical Draft.
Sturtevant Co., B. F.

Mica.
Chicago Mica Co.
Mica Insulator Co.
Munsell & Co., Eugene.

Mining Apparatus, Elec.
Allis-Chalmers Company.
Crocker-Wheeler Company.
General Electric Co.
Jeffrey Mfg. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Motors. (See Dynamos and Motors.)

Nippers and Pliers.
Klein & Sons, Mathias.

Nozzles.
Faries Mfg. Co.

Paints.
Dielectric Mfg. Co.

Patent Attorneys.
Baln, Foree.

Phosphor Bronze.
Phosphor Bronze Sm. Co. Ltd.

Platinum, Wire and Sheet.
Baker & Company Inc.

Poles and Ties.
Berthold & Jenninga.
Brooks, Hall L.
Columbia Mfg. Co.
Fowler, John H.
Fowler-Jacobs Company.
Kellogg Switch. & Sup. Co.
Lindsley Bros. Co.
Loud's Sons Co., H. M.
Maltby Cedar Co.
Morrison Lbr. Co., J. W.
Mueller Company, William.
Pacific Coast Pole Co.
Page & Hill Company.
Phelan, D. W.
Pittsburg & L. S. Iron Co.
Porter Cedar Company.
Sterling & Son, W. C.
Torrey Cedar Co.
Valentine-Clark Co., The.
Worcester Co., C. H.

Polish (Metal).
Allen Co., Inc., L. B.
Hoffman, Geo. W.

Portables.
Faries Mfg. Co.

Power Transmission Machinery.
Jeffrey Mfg. Co.

Rail Joints.
Continuous Rail Joint Company of America.

Refiners.
Gt. West Smelt. & Refining Co

Re-Winding—Repairs.
Chicago Edison Co.
Gregory Electric Co.

Rheostats.
Cutler-Hammer Mfg. Co.
General Electric Co.
Gen'l Inc. Arc Lt. Co.
Union Electric Mfg. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Rods, Conduit.
Cope, T. J.

Safes.
Sears, Roebuck & Co.

Schools and Colleges.
Electrical Engineer Inst.
Highland Park College
Michigan College of Mines.
Pratt Institute.
State Univ. of Iowa.

Second-Hand Mach'y.
Bissell Co., The F.
Cent. Stat. Improvement Co.
Gregory Electric Co.
Matthews & Bro., W. N.
Walsh's Sons & Co.

Shades, Lamp.
Faries Mfg. Co.

Sheet Brass & Copper.
Plume & Atwood Mfg. Co.

Signs, Electric.
Haller Machine Co.

Sockets & Receptacles.
Pass & Seymour.
Yost Elec. Mfg. Co.

Soldering Sticks, Salts and Paste.
Allen Co., L. B.
Crescent Co.
Kester Elec. Mfg. Co.
Western Electric Co.

Spunking Tubes.
Central Electric Co.
Edwards & Co.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.
Wester Elec. Supply Co.

Specialties, Electrical Mfrs. and Designers.
Haller Machine Co.

Speed Indicators.
Weston Electrical Inst. Co.

Storage Batteries.
American Battery Co.
Electric Storage Battery Co.
Gould Storage Battery Co.

Supplies, General Elec.
Bissell Co., The F.
Central Electric Co.
Century Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Electric Co.
Manhattan Elect'l Supply Co.
Wesco Supply Co.
Western Electric Co.
Western Elect. Supply Co.

Switchboards.
Bissell Co., The F.
Crouse-Hinds Co.
Gen. Incan. Arc Light Co.

Telephones, Telephone Material and Switchboards.
American El. Telephone Co
Automatic Electric Co.
Bissell Co., The F.
Central Electric Co.
Central Tel. & El. Co.
Holtzer-Cabot Elec. Co.
International Tel. Mfg. Co.
Kellogg Switchb. & Sup. Co.
Manhattan Elec. Supply Co.
Moon Mfg. Co., The.
Stromberg-Carlson Tel. M.Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Time Switches.
Bissell Co, The F.
Hartford Time Switch Co.

Tools.
Klein & Sons, Mathias.
Western Electric Co.

Transformers.
Central Electric Co.
Crawfordsville Electric Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Works, Inc.
General Electric Co.
Gregory Electric Co.
Kuhlman Electric Co.
Manhattan Elec. Supply Co.
National Electric Co.
Stanley Elec. Mfg. Co.
Wagner Electric Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Trucks, Electric Car.
General Electric Co.
Westinghouse El. & Mfg. Co.

Turbines, Steam.
Allis-Chalmers Co.
General Electric Co.
Westinghouse El. & Mfg. Co

Turbine Water Wheels
Leffel & Co., Jas.

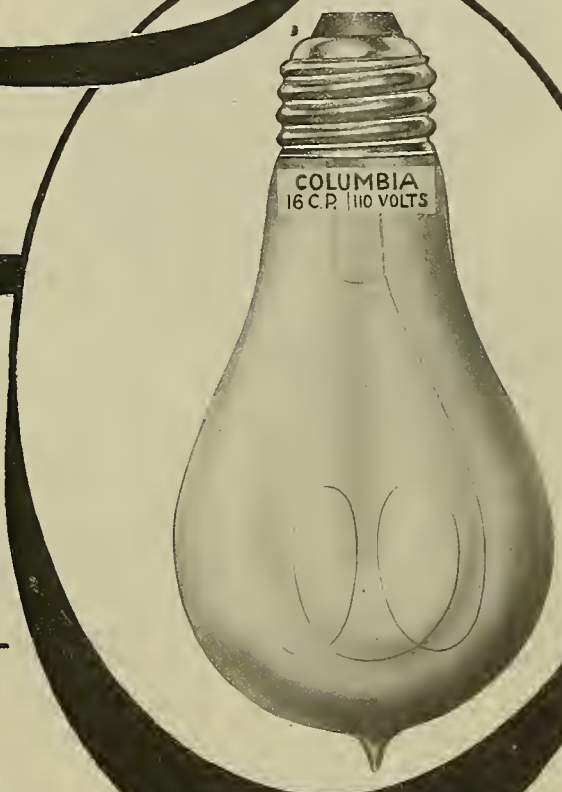
Varnishes.
Dielectric Mfg. Co.
Sterling Varnish Co.

Vulcanized Fibre.
Vulcanized Fibre Co.

Wires & Cables—Magnet Wires.
American Electrical Works.
Bissell Co., The F.
Central Electric Co.
Chicago Insulated Wire Co.
Crescent Ins. Wire & Cble. Co.
Driver-Harris Wire Co.
Electric Appliance Co.
General Electric Co.
Hazard Manufacturing Co.
Indiana Rub. & Ins. Wire Co
India Rubber & Gutta Percha Insulating Co.
Kellogg Switch. & Sup. Co.
Manhattan Elec. Supply Co.
National India Rubber Co
New York Insulated Wire Co.
Okonite Co., The.
Phillips, Eugene F.
Phillips Insulated Wire Co
Roebling's Sons Co., J. A.
Safety Ins. Wire & Cable Co.
Simplex Electrical Co.
Standard Underground C. Co
Wesco Supply Co.
Western Electric Company.
Western Elec. Supply Co.

For Alphabetical Index of Advertisements See Page 3.

Columbia Lamps



GIVE MOST LIGHT

HAVE YOU USED COLUMBIA LAMPS?
IF NOT YOU HAVE NOT USED THE BEST.
NO COMPLAINTS OF "POOR LIGHT" OR "EXCESSIVE BILLS" WHERE COLUMBIA LAMPS ARE USED.

Columbia Lamps are manufactured under a license to use the Chemical Exhaust Process of exhausting lamps. This process is vitally necessary in the production of the highest quality of lamp. Every package of Columbia Lamps carries a label reading

LICENSED UNDER
Patent No. 537,693, April 16, 1895
Patent No. 726,293, April 28, 1903
Patent No. 444,530, Jan. 13, 1891
Patent No. 532,760 Jan. 22, 1895

The Columbia Incandescent Lamp Co.

2115-17-19 Locust St., ST. LOUIS, MO.

NEW YORK OFFICE: 1311 Havemeyer Bldg.
PHILADELPHIA: 1277 Real Estate Trust Bldg.
CHICAGO: Central Electric Co.
MINNEAPOLIS: 638 Boston Block
SAN FRANCISCO: Paul Seiler Electric Works
MEMPHIS: 35 Equitable Building

DO NOT DELAY placing your order for

Pillsbury A. C. Ceiling Fans

They will stir more air than any other alternating current Ceiling Fan on the market.
THE PRICE IS RIGHT.

MANUFACTURED BY **CENTURY ELECTRIC CO.**

1007-9-11 LOCUST STREET, ST. LOUIS, MO.

DIRECT CURRENT

Generators and Motors

Western Electric Company

OFFICES:

CHICAGO NEW YORK

And Other Large Cities

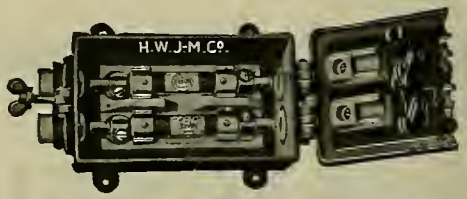
Space 17 Electricity Building, Louisiana Purchase Exposition

SACHS TRADE NOARK MARK "FUSE"

SERVICE BOXES

FOR 500 VOLTS

A fuse box combined for use on services or anywhere else requiring a well protected switch and fuse device. Each fuse individually manipulated from exterior of cover so that it can be pulled with cover or left in its contacts.



COVER: Rubber gasketted and provided with seal hasp.

BUSHING: Heavy Porcelain.

NO BENDING OR TWISTING OF WIRES IN CONNECTING.

Telephone Transite, a fire resisting material for protecting wires in Telephone Exchanges.

New York Milwaukee Chicago St. Louis Boston Philadelphia

H. W. JOHNS-MANVILLE CO.

100 William St., New York.

Pittsburg Cleveland New Orleans London Paris Brussels

The S. K. C. Inductor Alternator

Ability to Start Up
Oil Up
Shut Up
And occasionally Clean Up

is all that is required to operate the Inductor Alternator as built by the Stanley Electric Manufacturing Company.
Does simplicity appeal to you? You have it in the Inductor with no moving wires, brushes, commutator or collector rings.
Do you desire inexpensive operation? The inductor has nothing to renew, and only the bearings require attention.
Are your facilities for handling machinery limited? The Inductor is not difficult to install.
Bulletins Nos. 123 and 128 tell all about it. Send for them.

The Stanley Electric Manufacturing Company

Chicago Office: Monadnock Block Pittsfield, Massachusetts, U. S. A.

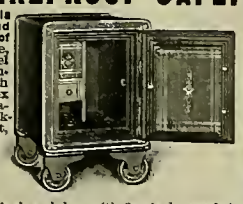
AKRON

Generators, Motors, Clutches, Commutator Truing Devices.

AKRON ELECTRICAL MFG. CO., AKRON, O.

N. Y. Office: McKay Engineering Co., 149 Broadway

$11.95 FIREPROOF SAFE.



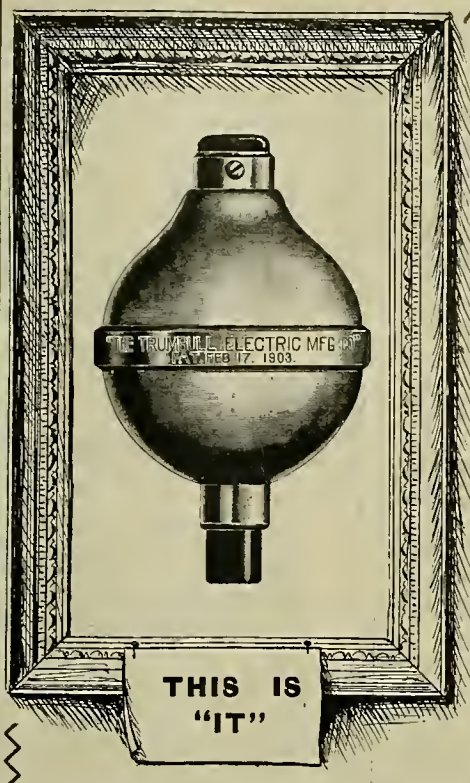
$11.95 buys this 300-pound guaranteed Fireproof Safe, highest grade, heavy wrought steel continuous plate construction, fitted with genuine Yale triplex 8-tumbler combination lock; best workmanship throughout, positively the equal of safes that sell at $20.00 to $25.00. Dimensions: outside, 24x14¾x16¾ inches; inside, 12x8½x9 inches. Has one 5x4-inch cash box with fine lock; one 8x4-inch drawer; one 3½x4-inch pigeonhole; one 12x3½-inch book space. Just the safe for small merchants and offices.

$23.95 BUYS THIS 875-POUND HIGHEST GRADE FIREPROOF SAFE (guaranteed). Equipped with genuine Yale unpickable, triplex, combination lock; finest construction throughout. **Dimensions:** Outside measure, 37¾ x 24 x 22¾ inches. Inside measure, 20¾ x15x13 inches. Arrangement of cabinet work: One 6x4¾-inch iron cash box with high grade lock, with two flat keys; one 8x4¾-inch drawer with knob, two 2¾x4¾-inch pigeonholes; one 3x4¾-inch pigeonhole; one large book space, 14¾x9¾ inches; one small book space, 14¾x4¾ inches. **A BIG BARGAIN FOR ANY STORE, OFFICE, FACTORY, SHOP OR HOTEL.**

We will letter your name or firm name in gold over door free of charge if requested. You can send us your order for either one of these safes with the understanding that we will return your money and pay freight charges both ways if you are not pleased or do not consider you have received a wonderful bargain and saved about one-half in price.

For large illustrations and descriptions of our complete line of safes, including our massive heavy wall single and double door safes at $15.60 up to $102.00, for detailed explanation of our method of fireproofing, heavy construction, how we make our safes heavier, stronger and better than others, how we can sell the highest grade safes it is possible to build for about one-half the prices all other dealers ask, **for our great 30-day free trial offer,** explanation of our binding guarantee, our money refund offer, for freight rates, for our liberal terms of shipment, **write for our Free Safe Catalogue.** Cut this ad. out and mail to us and the complete **SAFE CATALOGUE and our WONDERFUL MONEY SAVING SAFE PROPOSITION WILL BE SENT BY RETURN MAIL.** Address,

SEARS, ROEBUCK & CO., Chicago, Ill.



A NEW PENDANT SWITCH.

We now have ready for delivery in any quantity our NEW PENDANT SWITCH. The following are some of its noteworthy features:

CHEAP, DURABLE, EFFICIENT.

Has only one button to operate. Neat in appearance.

Guaranteed to operate successfully at its rated capacity (10-ampere, 125 volts) 10,000 times without injury. Any switch failing to come up to this standard will be replaced free of charge.

The switch is a 10-ampere snap switch of a special design, positive in action, easy to operate.

Standard finish, nickel plated or polished brass. Made in one size only

IT WILL PAY YOU TO LOOK INTO THIS SWITCH.

THE TRUMBULL ELECTRIC MFG. CO.
PLAINVILLE, CONN.
HIGH GRADE — ELECTRICAL SPECIALTIES

Manufacturers of Electrical Supplies. New York Office, 136 Liberty St.

KESTER SELF FLUXING SOLDER

A Tube of Solder Filled with Flux. Requires no Acid.

SAVES—LABOR—TIME—MONEY.

ACTUAL SIZE

PATENTED.

Send for Free Samples.

L. F. Mahler Co., R. 1008 Chemical Bldg., St. Louis, Mo., Gen. Western Agent.

KESTER ELECTRIC M'F'G CO.,
48 N. UNION STREET, CHICAGO, ILL

"STAR" INCANDESCENT LAMPS

LONG LIFE
GUARANTEED CANDLEPOWER,
HIGHEST EFFICIENCY.

MADE BY THE MOST SKILLED WORKMEN.

STANDARD ELECTRICAL MFG. COMPANY, : Niles, Ohio.

General Electric Company

Manufactures all Forms of **Insulated Wires and Cables**

Rubber, Varnished Cambric,

Paper, Asbestos, Weatherproof

Write for information concerning Wires and Cables insulated with our special form of Varnished Cambric. This insulation is equal and in many respects superior, to high grade rubber insulation and considerably cheaper.

General Office: SCHENECTADY, N. Y.

Chicago Office: Monadnock Block **Sales Offices in all large Cities**

HAVE YOU SEEN
OUR NEW
PRICE LIST
ON
PORCELAIN
KNOBS TUBES CLEATS
Don't Overlook It
ELECTRIC APPLIANCE COMPANY
CHICAGO AND SAN FRANCISCO

YOUR BATTERY TROUBLES
can be obviated by installing an
ADAMS SECONDARY GENERATOR
on the secondaries of your alternating circuit. It will operate
BELLS, ANNUNCIATORS, GAS LIGHTERS, ETC.
without any expense. They are practical and never get out of order. Write for prices
EVERYTHING ELECTRICAL.
THE WESCO SUPPLY CO., ST. LOUIS MO.

248 C
The simplicity of Northern dynamos and motors renders our apparatus especially suited to the operation of industrial shops because Northern apparatus is readily comprehended by all.
Get Bulletin No. 2533.
NORTHERN ELECTRICAL MFG. CO., - Madison, Wis., U. S. A.
Chicago Sales Office, Suite 425 Monadnock Block.
ENGINEERS, MANUFACTURERS.

MICA Of all Qualities, in any Form at Lowest Prices
EUGENE MUNSELL AND CO.
NEW YORK and CHICAGO
INSULATION That Is.
Micanite, Linotape, M. I. C. Compound, Empire Cloth and Paper. For Years the Standard.
MICA INSULATOR CO., Originators
NEW YORK and CHICAGO

YOU NEED IT!
GALE'S COMMUTATOR COMPOUND
Gale's Commutator Compound.
The Only Article That Will Prevent Sparking.
Will keep the Commutator in good condition and prevent cutting. Absolutely will not gum the brushes.
50c. per stick. $5.00 per dozen. Send 50c. for trial stick.
FOR SALE BY ALL SUPPLY HOUSES OR
Sole Manufacturers,
K. McLENNAN & CO., Room 411 Inter Ocean Bldg., 130 Dearborn Street . CHICAGO

MICA ONLY WESTERN MICA FACTORY
CHICAGO MICA CO.
VALPARAISO, IND.
P. S. WE PUT THE MICA POOL OUT OF BUSINESS.

Monitor Bushings
Greatest efficiency at least cost. Absolute protection to wires drawn over conduit ends. Made of one piece of sheet steel and cannot be broken. Enameled insulation. No special tools required to attach. Approved by fire underwriters. Write for bulletin 1002.
BOSSERT
Electric Construction Company
UTICA, N. Y.

EDISON MINIATURE LAMPS

are made in more than 10,000 varieties,
for all classes of work in Candelabra and Decorative Lighting, Multiple and Series Burning and in all types of Battery Lamps.
Miniature Sockets and Receptacles,
EDISON DECORATIVE & MINIATURE LAMP DEPT.,
General Electric Company, Harrison, N. J.

M. KLEIN & SON.
Send 2c stamp for new catalogue No. 6 of
KLEIN'S TOOLS
For Electrical Workers and Line Builders.
MATHIAS KLEIN & SONS.
81 W. Van Buren St., Chicago, Ill.

Engineering MECHANICAL, ELECTRICAL, STEAM, CIVIL.
Complete and short courses. Thoroughly equipped engineering shops. Shop work from the beginning. Short courses in Steam and Electrical Engineering. Expenses low. Accommodations the best. School all year. Students may enter any time. Correspondence steam and electrical courses. Send for catalogue. Mention course in which interested.
HIGHLAND PARK COLLEGE, DES MOINES, IOWA.

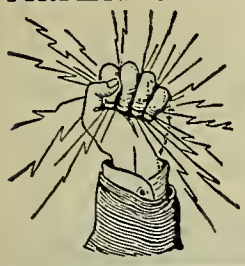
VOLT - AMMETERS,
POCKET SIZE.
For Testing Batteries and Battery Circuits, Locating Faults, Grounds, etc.
RELIABLE. ACCURATE.
Send for Circular.
L. M. PIGNOLET,
78-80 Cortlandt St., NEW YORK, N. Y.

ALLEN-BRADLEY ELECTRIC CRANE CONTROLLERS
PATENTED
Guaranteed for One Year. Three months' Free Trial.
No Sparking. No Repairs. Perfect Control.
AMERICAN ELECTRIC FUSE COMPANY
CHICAGO - - ILLINOIS

FRANK N. PHILLIPS, PRESIDENT. O. H. WAGENBEIL, TREASURER. EUGENE F. PHILLIPS, GENERAL MANAGER. E. HOWLAND PHILLIPS, VICE-PRES. C. R. REMINGTON, JR., SEC

AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.



BARE AND INSULATED ELECTRIC WIRE,
ELECTRIC LIGHT LINE WIRE,
INCANDESCENT AND FLEXIBLE CORDS,
Railway Feeder and Trolley Wire,
AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR WIRES.
CABLES FOR AERIAL AND UNDERGROUND USE.

NEW YORK STORE, W. J. Watson, 26 Cortlandt St.
CHICAGO STORE, F. E. Donohoe, 82 Lake St.
MONTREAL BRANCH, Eugene F. Phillips' Electrical Works.
MAIN OFFICES AND FACTORIES, PHILLIPSDALE, R.I.

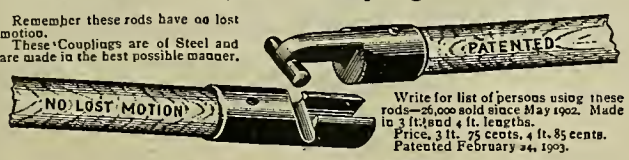
All Supply Houses

J.J.EGAN'S "ACME" COMMUTATOR COMPOUND.

J. J. EGAN'S "ACME" COMMUTATOR COMPOUND absolutely prevents sparking or cutting. One stick of "Acme" is equal to one gallon of oil for lubricating commutators. Free Sample. AGENTS WANTED. 50c per Stick. $5.00 per doz.
J. J. Egan Sole Mfg., 317 Austin Ave., Tel. Polk, 1779 Chicago

Cope's Patent Quick Coupling Conduit Rod

Remember these rods have no lost motion.
These Couplings are of Steel and are made in the best possible manner.



Write for list of persons using these rods—26,000 sold since May 1902. Made in 3 ft. and 4 ft. lengths.
Price, 3 ft. 75 cents, 4 ft. 85 cents.
Patented February 24, 1903.

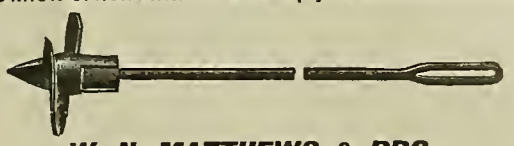
T. J. COPE
3244 North Fifteenth Street PHILADELPHIA, PA.

FIVE YEARS AGO

WE SAID:

"STOMBAUGH GUY ANCHORS NEVER PULL UP,"

And we know of none that have. Simply screw them in—that's all.



W. N. MATTHEWS & BRO.
Distributers
603 CARLETON BUILDING ST. LOUIS

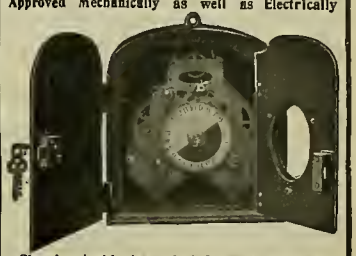
Electric Heating Apparatus

SEND FOR 82-PAGE CATALOGUE.

"UNIT" ENAMELED RHEOSTATS
SIMPLEX ELECTRIC HEATING CO.,
Cambridgeport, Mass.

THE Hartford Time Switch

A mechanically operated switch, which turns lights ON and OFF at such hours as the user desires with no further attention than the weekly winding.
Approved Mechanically as well as Electrically



Showing double doors, Seth Thomas eight-day movement, auxiliary cut-out, auxiliary hand-trip, and switch indicator.

For controlling current used for show window lights, electric sign lights, street lights, apartment house hall lights, motors, batteries, burglar alarms. :: 10, 20, 35 and 50 Amperes. 250 Volts. 1, 2 and 3 Poles.
Consult us regarding any requirements
SEND FOR CATALOGUE
The Hartford Time Switch Co.
440 Asylum St., HARTFORD, CONN., U.S.A.
New York City:
A. Hall Berry, 97-99-101 Warren Street
London, England:
Veritye, Ltd., 31, King Street, Covent Garden, S. W.

EXPERT IN ELECTRICITY MECHANICS PATENT CAUSES

SOLICITOR OF U. S. & FOREIGN PATENTS
FOREE BAIN, 1652-3 Monadnock Blk., CHICAGO

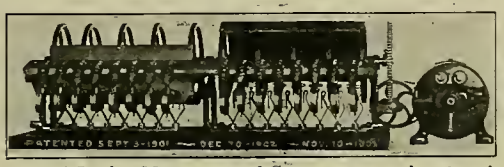
DON'T BUY ELECTRICAL SUPPLIES

Until you have seen our new Catalogue and new Price List.
Free to the trade.

Manhattan Electrical Supply Co.
NEW YORK: 32 Cortlandt St. CHICAGO: 188 Fifth Ave.

FLASHERS

GENUINE IMPROVED REYNOLDS FLASHER



The most practical and simplest Flasher on earth.

Central Station Managers and Contractors can increase their revenues materially by advocating Flashed Electric Signs among their patrons.
WRITE US NOW for Flasher information and pointers on Electric Signs.
We have an interesting proposition for you.

REYNOLDS ELECTRIC FLASHER MFG. CO.
221 FIFTH AVE., CHICAGO, ILL.

Grimshaw

Raven White Core

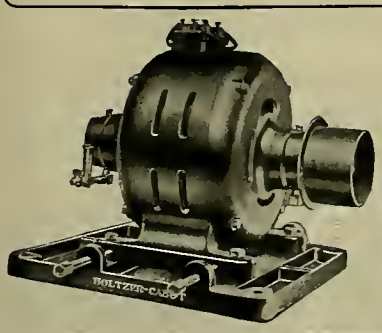
Raven Black Core

ALL OUR WIRES pass inspection and carry the above TRADE-MARKS on our tags. We also manufacture Grimshaw and Competition Tapes and Splicing Compounds.

NEW YORK INSULATED WIRE COMPANY,

MAIN OFFICE: 114, 116 & 118 Liberty St., New York.
BRANCHES: CHICAGO: 192 Desplaines St. BOSTON: 7 Otis St. SAN FRANCISCO: 33 Second St.

Do You Know It?



WHAT!

¶ That we make single phase alternating current motors from 1-8 to 2 H. P.

¶ Are they good and what is the price?

¶ Well, just send for Bulletin 0304. It tells all about it.

THE HOLTZER-CABOT ELECTRIC COMPANY
BROOKLINE, MASS. NEW YORK CHICAGO

NATIONAL CODE STANDARD

"O. K." Weatherproof Wire.
Slow-Burning Weatherproof and Ideal Wire.
Prices and Samples on Application.

Phillips Insulated Wire Co.

Office and Factory: PAWTUCKET, R. I.

WANTED, FOR SALE *and similar* **WANT COLUMN** *advertisements (50 words or less), $1.50 an insertion; additional words 3c each.* **POSITION WANTED** *advertisements (50 words or less), $1.00 an insertion; additional words 2c each.*

POSITION WANTED.

By young man with practical and technical education position as wireman, fixture man, light trimmer, meter reader, dynamo tender or switchboard attendant. Would like to have charge of small plant. Can give references. Would accept any electrical work that I could do. Address BOX 385, care Western Electrician, 510 Marquette Bldg., Chicago.

POSITION WANTED.

By graduate of high school, age 27; six years in shop manufacturing light brass work and plumbing supplies; want chance to start in a power station; will go as oiler or in any capacity where there is a chance to advance; pay small to start; habits steady. Address BOX 3757, Boston, Mass.

WANTED.

Superintendent for city water and electric-light plant, must be competent electrical and mechanical engineer. Give experience and references. State salary expected. Address BOX 382, care of Western Electrician, 510 Marquette Bldg., Chicago.

WANTED.

A first-class up-to-date and energetic man, capable of taking foremanship in repair shop; must be familiar with all branches of armature and field windings and machine work in connection with electrical repair work in general. Only those qualified to fill the above position need apply. Address stating full particulars, GRAHAM BROS. CO., 662 Hudson St., New York City.

WANTED.

To lease or purchase an Electric Lighting Plant in a town of not less than 5,000 and preferably much larger. Have had 15 years' experience as an electrical engineer and as manager, and can improve a plant and increase its business. Address BOX 335, Hamilton, Ohio.

WANTED.

Electrical supply salesmen with experience, to travel in Missouri; also man for Tennessee and south. Address BOX 384, Western Electrician, 510 Marquette Bldg., Chicago.

FOR SALE.

Two 60-inch by 16 feet Tubular boilers, as good as new. Guaranteed 100 lbs. pressure, Hartford inspection; complete with fronts and safety valves, $350.00 each. Can be delivered Oct. 1st. WATERTOWN ELECTRIC CO., Watertown, Wis.

FOR SALE.

One 90-kilowatt single-phase General Electric Co. alternator, speed 900 revolutions per minute, with exciter, also two 14 inch x 56 inch return tubular boilers; also one feed water heater closed type, shafting and condenser all in first-class operating condition. Apply to F. E. EVANS, recorder, Two Harbors, Minn., or O. CLAUSSEN, consulting engineer, National German American Bank Bldg., St. Paul, Minn.

FOR SALE.

A bargain; I. T. H. 30-light 9.6 Amp. Series open arc machine, with wall controller and ammeter complete, good running order.

Twenty-two 9.6 Amp. double carbon open arc lamps with glass, hoods and spreader complete, good order. Several additional lamps, both single and double, can be put in good order or parts used for repairs. A lot of extra globes and parts and a supply of carbons will be included if taken as a whole.

Two 30-K. W. Edison Bipolar 125-volt D. C. generators in fine running order. Reason for selling, have put in larger machinery.

CARROLL ELECTRIC LIGHT & POWER COMPANY,
Carroll, Iowa.

FOR SALE.

ALTERNATORS.

1-360 K. W. General Electric 3-phase.
1-120 " " " "
1-75 " Westinghouse 2-phase.

250-VOLT GENERATORS.

1-250 K. W. Western Electric M. P.
1-200 " Eddy M. P.

125-VOLT GENERATORS.

1-125 K. W. Western Electric M. P.

Immediate shipment.

GREGORY ELECTRIC CO.
54-62 S. CLINTON ST. CHICAGO

We are in position to sell electric-light plants with good franchise and contract and on good paying basis. None too small, none too large. Address,

J. S. MAURER & CO.
804 Monadnock Bldg., Chicago, Ill.

MUST SELL!

Owing to the dissolution of the partnership of The Camden Electric Light Co., of Camden, Ohio, the

ELECTRIC LIGHT PLANT

will positively be sold without limit or reserve to the highest bidder on September 15th next, at 3 o'clock p. m.

The plant is complete with good machinery of all kinds and is running every day.

A thorough investigation is solicited by all parties interested.

CAMDEN ELECTRIC LIGHT CO.,
W. C. HALL, Sec'y.

REPAIRING RECALIBRATING

ELECTRIC METERS.
INTERNATIONAL ELECTRIC METER CO.
167 S. CANAL STREET, CHICAGO.

"Practical and to the Point"

IS ALL THAT NEED BE SAID OF

THE TELEPHONE HAND-BOOK

By HERBERT LAWS WEBB.

160 Pages, 133 Illustrations,
Cloth, Price $1.00.

The book for those interested in telephony.

ELECTRICIAN PUBLISHING CO.,
510 Marquette Bldg.,
CHICAGO.

INDUSTRIES

ARE

OFFERED LOCATIONS

WITH

Satisfactory Inducements,
Favorable Freight Rates,
Good Labor Conditions,
Healthful Communities,

ON THE LINES OF

THE ILLINOIS CENTRAL R. R.
AND THE
YAZOO & MISSISSIPPI VALLEY R. R.

For full information and descriptive pamphlet address

J. C. CLAIR,
Industrial Commissioner,
1 Park Row, Chicago, Ill.

BOILERS

One 42-in. x 15 ft. 9-in., 250 H. P. Worthington Water Tube.
One 60-in. x 16 ft., John Mohr Return Tubular Boiler.
One 54-in. x 16 ft., John Mohr Return Tubular Boiler.
One 54-in. x 16 ft., Devine Turbular Boiler.

ENGINES.

One 600 H. P., 21 x 36 x 30, Williams Tandem Horizontal Compound, 140 R. P. M.
Two 600 H. P., 20 x 30 x 24, Porter-Allen Tandem Compound, 200 R. P. M.
One 250 H. P., 12 x 24 x 18 Williams Tandem Compound, 250 R. P. M.
Two 100 H. P., 13 x 12, Dick & Church, High Speed Automatic.

PARTIAL LIST ONLY.

Send for latest Catalogue for bargains in Engines, Boilers, Dynamos and Motors.

CENTRAL STATION IMPROVEMENT CO., 938 Monadnock Block, Chicago

WORKS QUICK AND EASY. KEEPS ITS LUSTER. HOLDS OLD TRADE AND MAKES NEW. DOES NOT DETERIORATE. ESTABLISHED 15 YEARS. SOLD BY AGENTS AND DEALERS ALL OVER THE WORLD

U.S. METAL POLISH

3 OUNCE BOX 10 CENTS
SAMPLES SENT FREE
GEO. W. HOFFMAN

POLISHES ALL METALS. BRANCHES NEW YORK, CHICAGO, SAN FRANCISCO. 295 E. WASHINGTON ST. INDIANAPOLIS, IND.

"Diamond H" Switches

Trade H Mark

This Trade-Mark guarantees quality.

The Hart Mfg. Co., Hartford, Conn.

New York Boston Chicago Toronto, Ont.

BITUMINIZED FIBRE CONDUIT

FOR

ELECTRICAL UNDERGROUND CONSTRUCTION
ELECTROLYSIS PROOF WATER PROOF

A smooth laminated insulator of unchanging durability.

Forms a continuous sealed duct from manhole to manhole, impervious to moisture and through which leaking gas cannot penetrate.

There has never been a gas explosion in our conduits nor the slightest evidence of electrolysis.

Abrasion of the cables is an impossibility.

It saves sixty per centum of freight and handling cost and twenty to thirty-five per centum of construction.

Process of laying is simple, rapid and inexpensive. There is no loss from breakage or fitting. It is self-aligning and cannot settle out of alignment.

All sizes from one inch to ten inches interior diameter. Bends of all angles.

The foremost electrical engineers are recognizing and testifying to the scientific advantages of our system of subway construction over all previous methods.

Send for illustrated book. Ask for prices giving size and quantities required

PROMPT DELIVERIES

FACTORIES: Philadelphia, Chicago, Los Angeles

American Conduit Company

SEVENTH FLOOR, 170 BROADWAY, NEW YORK

336 Macy St., Los Angeles, Cal. *Manhattan Bldg., Chicago*

CHICAGO EDISON COMPANY REPAIR SHOPS

76 MARKET STREET, CHICAGO. TELEPHONE MAIN 1280.

Machine and Carpenter Work of All Kinds. Correspondence Solicited.

OPEN DAY AND NIGHT.

FIRST-CLASS EQUIPMENT THROUGHOUT.

Dynamos, Armatures, Motors, Arc Lamps, Fans, Instruments.

ARNOLD ELECTRIC POWER STATION Co.
Engineers, Constructors for Complete Electric Plants. Results Guaranteed.
SUITE 1539, MARQUETTE BLDG., CHICAGO. NEW YORK OFFICE: 711 TRANSIT BLDG.

BUTTERFIELD, J. F.
ELECTRICAL ENGINEER AND CONTRACTOR.
Complete Telephone Exchanges Built and Material Furnished.
Cable Construction and Underground Conduit Construction a Specialty.
Room 695, 113 Adams Street. CHICAGO, ILL.

J. H. HALLBERG
Consulting Arc Lighting Expert and Practical Electrical Engineer
45 Broadway - NEW YORK
Room 169A

RUEBEL - SCHWEDTMANN-WELLS,
CONSULTING, MECHANICAL AND ELECTRICAL ENGINEERS,
Suite 801 Chemical Building, ST. LOUIS, U. S. A.

W. E BAKER. H. B. BISHOP.
BAKER, W. E. & CO.
ENGINEERS,
ELECTRIC RAILWAYS.
27 William St., NEW YORK.

BYLLESBY, H. M. & Co.
(Incorporated)
ENGINEERS
Design, Construct and Operate Railway, Light, Power and Hydraulic Plants.
Examinations and Reports.
New York Life Building, - CHICAGO, ILL.

HORNADAY, J. P. & Co.
SUITE 1108 TRACTION BUILDING
CINCINNATI, O.
WATERWORKS, ELECTRIC RAILWAY, LIGHT, TRACTION, INDUSTRIAL AND MINERAL PROPERTIES BOUGHT AND SOLD

Long Distance Phone Central 2148.
SCHOTT, W. H.,
ENGINEER AND CONTRACTOR,
SPECIALTIES—Central Station Heating Plants, Water Works Steam Plants, Electric Light, Gas and Street Railway Plants.
1220-21 MARQUETTE BUILDING, CHICAGO.

TRY IT.
Keep your name and address in this directory where it will be seen by possible clients.

A WEEKLY REPRESENTATION
in this "Directory" enables engineers to keep before all possible customers.

ROBERT W. HUNT & Co.,
ENGINEERS
1121 The Rookery, Chicago. 66 Broadway, New York.
Monongahela Bank Bldg., Pittsburg.
Norfolk House, Cannon St., London.

SQUIRE ELECTRIC CO.
Engineers and Contractors
113 E. Eighth St., KANSAS CITY, MO.
Consulting, Designing and Supervising Engineers.
Plans and Specifications Furnished.

BRYAN, WILLIAM H.
M. Am. Soc. M. E.,
Consulting Mechanical and Electrical Engineer.
Lincoln Trust Building, ST. LOUIS.

E. W Hammer, Pres. and Treas. H. J. Minhinnick, Sec. and Gen'l Sup't.
GENERAL ENGINEERING Co., THE
Consulting and Contracting Engineers.
Telephones, Electric Light, Power Transmission
Suite 1112, 135 ADAMS ST., CHICAGO.
Long Distance Telephone Central 478.

KOHLER BROS.,
Contracting Electrical Engineers, Lighting Power Railways,
1804-1806-1808-1810-1812 Fisher Building, CHICAGO.

STANTON, LE ROY W.
Consulting Telephone Engineer.
Plans, Specifications and Supervision of Installation of complete telephone plants.
Special Reports on Telephone Properties and Apparatus.
411 Electrical Bldg., Cleveland, Ohio.

DUGALD C. JACKSON, C. E.
WILLIAM B. JACKSON, M. E.
MEMBERS
AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS
AMERICAN SOCIETY OF MECHANICAL ENGINEERS
AMERICAN SOCIETY OF CIVIL ENGINEERS
ENGINEERS. EXPERTS.
MADISON, WIS.

"AMERICAN" STORAGE CELLS
ARE THE BEST. Send for descriptive Circular.
AMERICAN BATTERY CO.,
EST'D 1889. 171 S. Clinton St., Chicago.

MICHIGAN COLLEGE OF MINES.
F. W. McNair, President,
A state institution located in and making use of an active mining district. New Metallurgical Building and Gymnasium completed in the fall of 1904. For Year Book and Record of Graduates apply to President or Secretary, Houghton, Michigan.

THE STATE UNIVERSITY OF IOWA
SCHOOL OF APPLIED SCIENCE, Iowa City, Iowa
Four year courses of the highest grade in
Civil
Municipal
Sanitary
Electrical
Mechanical
Mining
ENGINEERING
Numerous short practical courses. Special courses in technical chemistry, bacteriology, etc. Adequate equipment in shops and laboratories. Waterpower.
University environment. Expenses low.
Address C. E. MacLEAN, President

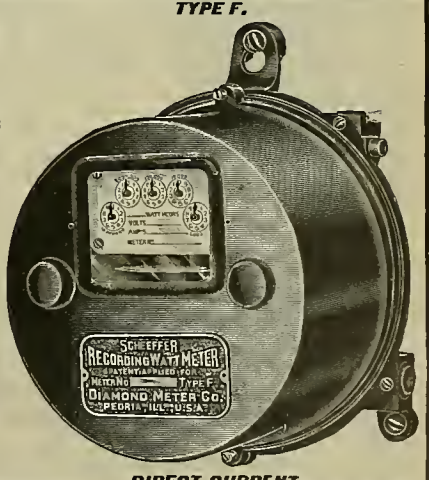
H. N. FENNER, President J. F. BLAUVELT, Agent RUSSELL W. KNIGHT, Treasurer
NEW ENGLAND BUTT COMPANY
MANUFACTURERS OF
Machinery for Insulating Electrical Wires
Braiding, Taping, Winding, Twinning, Cabling, Stranding, Polishing and Measuring Machines. Cable Covering Braiders
FINE CASTINGS A SPECIALTY
304 PEARL STREET, - - - PROVIDENCE, R. I., U. S. A.

READ THE BLUE ELECTRICAL PAPER.

TYPE E.

ALTERNATING CURRENT.

SCHEEFFER INTEGRATING WATTMETER
Type E for Alternating Current Type F for Direct Current Circuits
DUST AND BUG PROOF
IMPROVED CONSTRUCTION
MOVING PARTS ARE EXTREMELY LIGHT, INSURING A HIGHLY SENSITIVE AND ACCURATE METER.
WRITE FOR PRICES AND DESCRIPTIVE LITERATURE.
DIAMOND METER COMPANY,
PEORIA, ILL., - - - - U. S. A.

TYPE F.


DIRECT CURRENT.

FARIES
ADJUSTABLE LAMP HOLDERS, SHADES, PORTABLES, ELECTRIC and COMBINATION FIXTURES
CATALOGUE WILL BE SENT ON REQUEST
FARIES MFG. CO., - DECATUR, ILL.

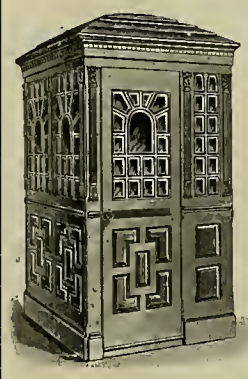
TELEPHONE BOOTHS

When in want of the Right Kind write us.

Catalogue Free

Yesbera Mfg. Co.
TOLEDO, OHIO.

DO YOU KNOW that



Telephone Booths

have increased the receipts (where exposed telephones had previously been in use) *sufficiently* to pay the cost of the booths within the first thirty days? SPECIAL PRICES to demonstrate what booths will do for you.

WRITE FOR CATALOG

W. S. SEAMAN & CO.
216 E. WATER ST., MILWAUKEE, WIS.

KILL TWO BIRDS WITH ONE STONE

Protect the Pole Line and you protect the Service

Minnesota Electric Co.
MINNEAPOLIS, MINN.

We introduced successful 4-party lines

LEICH SELECTIVE SYSTEM

Write for our booklet—"Selective W."

Impedance Coil for Selectives. No Springs.

CENTRAL ENERGY OR MAGNETO

AMERICAN ELECTRIC TELEPHONE CO.
CHICAGO, ILLINOIS

"NEW TRAIN SERVICE TO

French Lick and West Baden Springs."

A parlor and dining car now leave Chicago at 12:00 o'clock noon, arrive at the Springs at 8:45 p. m. Leave Springs 9:00 a. m., arrive Chicago 5:55 p. m. Reservations at Monon Route City Office, 232 Clark Street. Telephone Har. 1245.

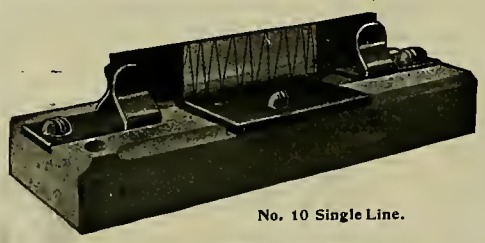
INTERNATIONAL

Mechanical Self-Restoring Drop Switchboard.

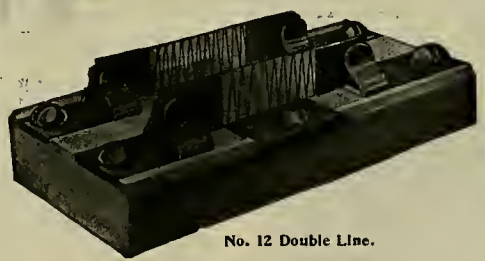
A PERFECT APPARATUS.

Made in any desired capacity.
Sample parts and quotations on request.

INTERNATIONAL TELEPHONE MANUFACTURING CO.
CHICAGO, U. S. A.



No. 10 Single Line.



No. 12 Double Line.

PROTECTORS THAT PROTECT.

Our patent wrapped fuse used in our protectors are an insurance policy against lightning.

Sample free by mail to any Exchange or Toll Line

CENTRAL TELEPHONE AND ELECTRIC CO.,
909 Market St.,
ST. LOUIS, U. S. A.

CENTRAL STATION HEATING

We are the originators and builders of the underground system of live and exhaust steam heating. Our system is used for the utilization and distribution of exhaust steam from electric and power plants for heating purposes. 250 Plants in successful operation. We have the only Meter System. Also manufacturers of Wooden Water Pipe, Steam Pipe Casing, Steam Traps, Condensation Meters, Valves, Economizing Coils, Separators and full line of Steam Fitters' Supplies.

WRITE FOR PAMPHLET AND PRICE LIST

AMERICAN DISTRICT STEAM COMPANY
MENTION WESTERN ELECTRICIAN. LOCKPORT, N.Y. CHICAGO, ILL.

"That's A Good Thing"

is the universal opinion of those who have investigated our new party line telephone. Our "Sure-Ring" telephone cuts out much trouble on party lines.
Our new desk set also has some excellent features.

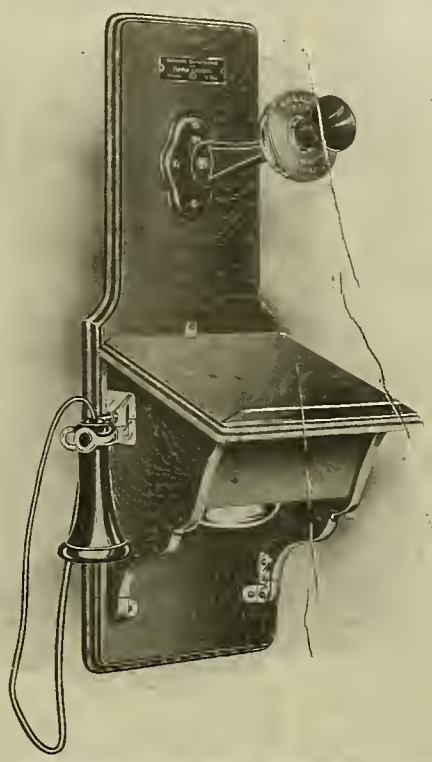
These are all described in Bulletin No. 11-E.
Mailed free upon request.

Stromberg-Carlson Telephone Mfg. Co.

GENERAL AND EASTERN SALES OFFICE
ROCHESTER, N. Y.

SALES DEPT.
CHICAGO, ILL.

KELLOGG SWITCHBOARD & SUPPLY CO.
Manufacturers of the Largest and Busiest Telephone Exchanges in the United States



The Kellogg Transmitter stands first in volume, clearness of articulation and in carrying power. Our prices are low when cost of maintenance and quality of apparatus are considered. Do not fail to visit our exhibit in the Electricity Building at the St. Louis Exposition.

Kellogg Switchboard & Supply Co., Green and Congress Streets - CHICAGO

Seymour Bldg., Los Angeles Electric Bldg., Cleveland Keystone Telephone Bldg., Philadelphia

MAKE YOUR TELEPHONE SECURITIES VALUABLE

in the same way that the values of other public utility securities are enhanced
By using the latest, best and most economically operated equipment;
By giving the best of service and
By making the public your friends.

Our Automatic Telephone System

Meets all these requirements;
It can make your telephone securities worth more to you; it can make them good, substantial, permanent dividend-payers.

When you re-equip, look to the future and replace Manual disadvantages by Automatic advantages.

AUTOMATIC ELECTRIC COMPANY

Van Buren and Morgan Streets - - - CHICAGO

PRODUCERS AND WHOLESALERS OF WHITE CEDAR PRODUCTS

CEDAR POLES

SPECIAL PRICES ON SMALL POLES.
Write for a copy of our TELEGRAPH CODE FOR CEDAR PRODUCTS

C. H. WORCESTER CO.
SUITE 1206 TRIBUNE BLDG. CHICAGO.

YARDS
KOSS MICH.
L'ANSE "
MUNISING "
ONTONAGON
WAGNER, WIS
PESHTIGO "

POLES.
WHITE CEDAR.
IDAHO CEDAR up to 80 ft.

BERTHOLD & JENNINGS,
ST. LOUIS.
Chemical Building.

CROSS ARMS.
LONG LEAF PINE AND FIR.

BRACKETS—X ARMS—PINS
little things it is true, but they cut a big figure in line construction.
OUR MOTTO IS:
Prompt Shipment Quality Satisfaction Right Price
COLUMBIA MFG. CO. ANTIGO, WIS.

MICHIGAN AND WESTERN CEDARPOLES
ALL LENGTHS AND SIZES
LINDSLEY BROS CO.
TRIBUNE BLDG., CHICAGO

Cedar TORREY CEDAR CO., CLINTONVILLE, WIS. Poles
Large Stock Constantly on Hand

WHITE CEDAR POLES
HALL L. BROOKS
52 WISCONSIN AVENUE
TOMAHAWK, WIS.

Southern Cedar POLES Are the Best.
NO ROTTEN BUTTS.
D. W. PHELAN,
277 Broadway, New York

"By two or three witnesses shall a matter be established."

FIVE POINTS OF EXCELLENCE.

Leaving the center of the city from which you start; reaching the center of the city of your destination, over smooth and level tracks; giving rest and comfort; riding beside running waters most of the way, through the centers of population to the gateways of commerce; when you travel by the

NEW YORK CENTRAL LINES.

A copy of the illustrated Catalogue of the "Four Track Series" will be sent free upon receipt of a two-cent stamp by George H. Daniels, General Passenger Agent, Grand Central Station, New York.

A Trip Through Yellowstone Park

is what everyone hopes to have—**some day.** It is the most wonderful trip in the world. There are more than 3,000 square miles of weird, marvelous, unimaginable things that can be seen nowhere else, therefore if one ever sees them one **must** go to the Park, in the heart of the magnificent Rockies with snow tipped peaks all around. If Old Faithful geyser, a Paint Pot, Mud Volcano, or Emerald Pool were to be found in Lincoln Park, Chicago; Central Park, New York; or Fairmount Park, Philadelphia; the people would flock to see it or them by tens of thousands. For a very small sum, comparatively, all these and hundreds more of nature's unduplicated marvels can be seen between June 1 and September 30, of each year, and one will enjoy, to boot, the best coaching trip in the country.

The **Northern Pacific** folder on Yellowstone Park, just issued, is a new, right up to date, finely illustrated dessertation on this Yellowstone Park trip. It is not descriptive, but deals with the detailed, technical matters everyone needs to know about such a trip. It tells all about the hotels, the stage coaches, the roads, the cost of the tour; where the geysers, the waterfalls, the bears, the canyons are, and where the trout fishing is found. We have printed thousands of this beautiful leaflet and want everybody interested to have a copy, and it can be obtained by sending A. M. Cleland, General Passenger Agent, St. Paul, Minn., **two cents** with proper address.

"Wonderland 1904" which is a very fine pamphlet of 116 pages, descriptive of the Northwest, including the Park, will be sent for **six cents.**

Locations for Industries.
Erie Railroad
Chicago to New York

The Erie Railroad Company's Industrial Department has all the territory traversed by the railroad districted in relation to resources, adaptability, markets and advantages for manufacturing, and can advise with manufacturers in relation to the most suitable locations. For full information address

LUIS JACKSON
Industrial Commissioner, Erie Railroad Company
21 Cortlandt Street, New York

ROBT. FERRIS' BOOK ON METERS

IS SO SIMPLE THAT ONE WONDERS AT THE COURAGE OF THE AUTHOR:

IT TELLS JUST WHAT SOME PEOPLE THINK THEY KNOW.

Written expressly for the men who handle the pliers.
Sent prepaid on receipt of $1.00. Address

ELECTRICIAN PUB. CO.,
510 Marquette Bldg., CHICAGO.

Watson Motors

If you want a small motor for a special purpose—Write us—
Mechanical Appliance Co.
Milwaukee, Wis.

Standard Vitrified Conduit Co.

B. S. BARNARD, Manager

39-41 CORTLANDT ST.
NEW YORK

LARGEST FACTORIES IN THE WORLD : STOCK ON HAND
SEND FOR CATALOGUE

Cedar Poles.

Pittsburg and Lake Superior Iron Co. Producers and Wholesalers. Escanaba, Mich.

There's considerable in the Cedar business besides quoting prices on Ties and Poles.

Buying of us is one way to find out.

Buying of a man who don't satisfy you in every particular is another.

MALTBY CEDAR COMPANY, 509 Phoenix Block, Bay City, Michigan

Tipper & Patton, Pittsburg Agents, 509 Bessemer Bldg.

TELEPHONE POLES

Yards at Red Cliff, Wis., Aitkin, Feeley, Cohasset, Deer River, Tenstrike and Black Duck, Minnesota.
Large stocks. Prompt shipments. Carefully inspected stock at low prices.

J. W. MORRISON LUMBER CO., 918-19 Lumber Exchange MINNEAPOLIS, MINN.

POLES, TIES, POSTS.

THE PORTER CEDAR CO., SAGINAW, MICH.

PRODUCERS. We want your Inquiries always.

WHITE CEDAR POLES

Don't forget our Minnesota Transfer Yard—midway between St. Paul and Minneapolis, where we load in forty-eight hours from the time we have your order.

PACE & HILL CO. 1003 Lumber Exchange, MINNEAPOLIS, MINN.

Points in Wisconsin and the Northwest

are covered by Wisconsin Central Railway's convenient, solid, wide vestibuled trains, equipped with Pullman sleepers, free reclining chair cars and modern coaches which leave Central Station, 12th Street and Park Row (Lake Front), Chicago for St. Paul, Minneapolis, Ashland and Duluth, connecting with all western lines. Meals in dining and cafe cars served a la carte.

For tickets and further information apply to nearest ticket agent, or write

JAS. C. POND, Gen'l Pass. Agt., Milwaukee, Wis.

POLE DEALERS ADVERTISING IN THE WESTERN ELECTRICIAN OBTAIN MOST EXCELLENT RESULTS BECAUSE IT PLACES THEM IN TOUCH WITH ACTUAL BUYERS OF POLES. TRY A CARD.

Idaho Cedar Poles

PACIFIC COAST POLE CO. SPOKANE, WASH.

HENRY NEWGARD & CO.

ELECTRICAL CONSTRUCTION

Power and Light Plants. Switchboards and Panel Boards.

We install Municipal and Isolated Electric Lighting Plants.
We manufacture Switchboards, Table boards, Iron Cutout Boxes and Electrical Specialties.
We sell Dynamos, Motors and Electrical Supplies.
We wire old as well as new Residences, Factory Buildings, School and College Buildings.

87 Fifth Avenue, Chicago, Illinois.

POLES—POSTS—PILING—TIES

Fowler-Jacobs Co.
Elmore-Fowler-Jacobs Co.
John H. Fowler & Co.

The FOWLER Companies
Fisher Building, - - CHICAGO

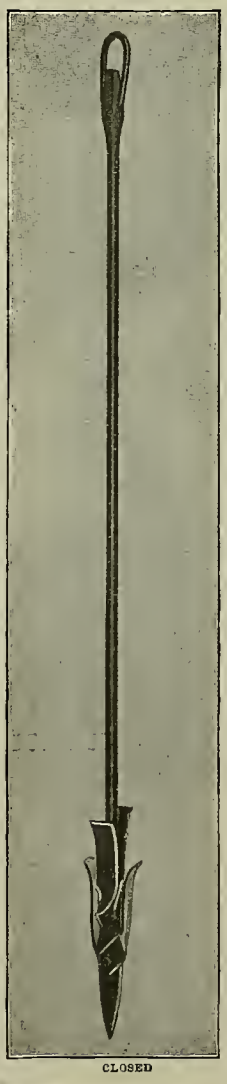
POLES

W. C. STERLING & SON, MONROE, MICH.
Eleven Pole Yards in Michigan.
Wholesale Producers for 20 years

TIES.

CEDAR POLES

ESTABLISHED 1862
WM. MUELLER COMPANY
1211-12-13 MARQUETTE BLDG. CHICAGO.
EIGHT DISTRIBUTING YARDS



CLOSED

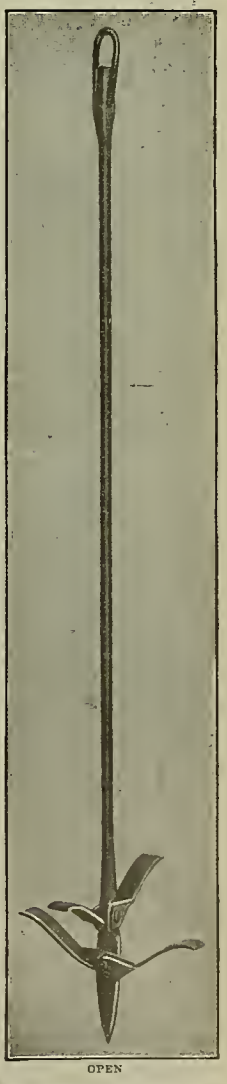
THE

CROUSE-HINDS Harpoon Guy Anchor

can be installed in fifteen or twenty minutes with no other tools than a sledge hammer. Once in the ground it will never pull up.

Write for Circular and Prices

Crouse-Hinds Co.
133 S. Clinton St.
CHICAGO, ILL.



OPEN

MICHIGAN WHITE LARGE STOCK.

CEDAR POLES

PROMPT SHIPMENTS. KELLOGG SWITCHBOARD & SUPPLY CO., Chicago.

BOILER WATERS CORRECTED

to remove and prevent scale and to stop corrosion. DEARBORN TREATMENT does the work. Send gallon sample for analysis. Booklet "R" now ready.

DEARBORN DRUG & CHEMICAL WORKS,

27-34 RIALTO BUILDING, CHICAGO, ILL. WM. H EDGAR, President Telephone: Harrison 3930 and 3931.

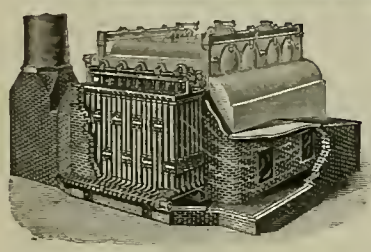
Dixon's Traction Belt Dressing

Has a 27 Years' Record in restoring and preserving the clinging power of leather belts. Descriptive booklet 125E and sample upon request.

JOSEPH DIXON CRUCIBLE CO., JERSEY CITY, N. J.

Steam Gained——Fuel Reduced

GREEN'S ECONOMIZER



Installed in any Electric Light and Power Plant produces this result Its not a long story—simply utilizing waste gases—keeping feed-water heated above the evaporative point—saving 10 to 20% on coal bill. Additional advantages in our free booklet, which your engineer could explain to your satisfaction. Simply address

The Green Fuel Economizer Co.

MATTEAWAN, N. Y. *Sole Manufacturers in the U. S.*

REG. TRADE MARKS

"Phosphor Bronze" DELTA

THE PHOSPHOR BRONZE SMELTING CO. LIMITED, 2200 WASHINGTON AVE., PHILADELPHIA.

"ELEPHANT BRAND PHOSPHOR-BRONZE" INGOTS, CASTINGS, WIRE, RODS, SHEETS, ETC.

— DELTA METAL —

CASTINGS, STAMPINGS AND FORGINGS

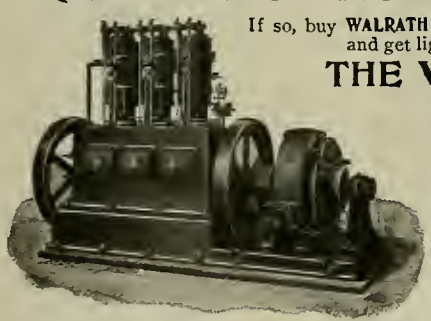
ORIGINAL AND SOLE MAKERS IN THE U.S.

ARE YOU LOOKING FOR MONEY?

If so, buy WALRATH GAS OR GASOLINE ENGINES and get light on the subject.

THE WALRATH

Received the Highest Award at the Pan-American Exposition.



It will produce as good a commercial light as that of an automatic steam engine, either belted or direct-connected generator. Simple, Economical and Reliable. Send for Catalogue W.

MARINETTE GAS ENGINE CO.,

CHICAGO HEIGHTS, ILL.

AGENCIES:

Keystone Engineering Co., Farmer's Bank Bldg., Pittsburg, Pa.
Strong, Carlisle & Hammond Co., 61-67 Frankfort St., Cleveland, Ohio
Mackay Engineering Co., 149 Broadway, N. Y.
C. H. Seidenglanz., 52 When Bldg., Indianapolis, Ind.

BEST ON EARTH.

BURGER AUTOMATIC.

For Electric Work

REGULATION AND ECONOMY OF FUEL UNSURPASSED.

WRITE FOR CATALOGUE H.

Then compare it with some Gas Engine hand books that cost $1.00.

Woolley Foundry & Mach. Works

Box 400, Anderson, Ind. U. S. A.

JEFFREY CHAIN BUCKET DREDGES FOR CATALOGUE, ADDRESS THE JEFFREY MFG. CO. COLUMBUS, OHIO.

Sterling Black Plastic Insulator.

One hundred days' continuous baking at 180° F. will not make it brittle. Water repellent. Oil proof.

THE STERLING VARNISH CO., - - Pittsburg, Pa.

WE BUY OLD BELTS

OR SCRAPS, ANY SIZE OR CONDITION.

WE CLEAN, REPAIR AND RENEW OLD BELTS.

LEATHER PRESERVER MFG. CORP.

27 W. MONROE ST., CHICAGO.

BUY YOUR BOOKS

FROM THE

Electrician Pub. Co., 510 Marquette Bldg., Chicago.

TWO YEAR COURSES IN

STEAM AND MACHINE DESIGN

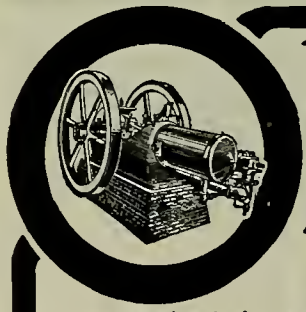
AND IN

APPLIED ELECTRICITY.

PRATT INSTITUTE,

BROOKLYN, N. Y.

Write for Catalogue and Particulars.



Olds Gas and Gasoline Engines

Competitive tests have established the superiority of the Olds in point of economy over any other engine. The maximum of power is obtained from a minimum of fuel, the cost averaging ¼ of a cent an hour for each horsepower.

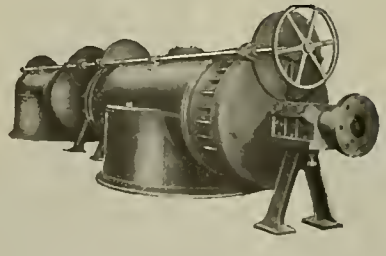
Stationary Engines - - - 2 to 100 H. P.
Portable Engines - - - - 8 to 10 H. P.

Our new illustrated catalog should be in the hands of every power user. Write to-day for a copy.

OLDS GASOLINE ENGINE WORKS,

252 River Street - - - Lansing, Mich.

No. 984



SAMSON TURBINE

HIGH EFFICIENCY at ANY GATEAGE, QUICK SPEED and GREAT POWER are the three essential points demanded of a turbine driving generator. No other turbine maintains these three points to such a high degree of perfection, as the SAMSON.

Write Dept. D for Catalogue

JAMES LEFFEL & CO.

SPRINGFIELD, OHIO U. S. A.

FORT WAYNE ELECTRIC WORKS
WOOD LIGHTING & POWER SYSTEMS
Fort Wayne, Ind.

Multiphase Revolving Field Alternators

We are now in the market with a complete line of belted and engine driven two and three phase alternators

Descriptive Literature
Now Ready

The Electro-Magnet

—BY—

TOWNSEND WOLCOTT, A. E. KENNELLY, RICHARD VARLEY.

PRICE, ONE DOLLAR,

CONTENTS.

General Properties. Magnetic Field of Force. Magnetic Units. Induced Magnet. Reluctance. Permeability. Discovery of Electro-Magnetism. Iron Ring in the Magnetic Field. Calculation of Magnet Windings. Magnetic Circuit. Given Ampere-Turns to Find Proper Current. Relation of Ampere-Turns to Wire Space. Room Occupied by Insulation. Heating and Other Limiting Conditions. Winding a Magnet for a Given Voltage. Hysteresis, Self-Induction. Alternating Currents. Traction.

On the Relative Values of the Windings of Electro-Magnetic Coils. Properties of Fixed Winding Spaces and a Fixed Size of Wire. Properties of Fixed Winding Space and Variable Size of Wire. Fixed Winding Space and Fixed Length of Wire or Number of Turns. Constant Internal Dimensions, but External Diameter of Coil Variable. Fixed Internal Radius and Interflange-Fixed Number of Turns of Same Size of Wire.

The Importance of Details. Actual Calculations. Working Formulæ. Diameter of Wire to Carry Given Current. Diameter of Wire to Have Given Resistance. Thickness of Insulation in a Given Coil. Weight of Copper in a Given Coil. Table of Constants for Insulated Wire. Standard Table of Resistances of Insulated Wires. Table Showing Percentage of Copper and Insulation in Cotton or Silk Covered Wire. Standard Copper Wire Table. 17 Problems (Solved) Illustrated. Cuts of 37 Magnets of Standard Dimensions. Lengths Variable. Logarithms and Anti-Logarithms. Decimal Parts of an Inch. Logarithmic Scale.

—FOR SALE BY—

ELECTRICIAN PUBLISHING CO., 510 MARQUETTE BLDG., CHICAGO.

JUST RIGHT FOR THE.. TOOL BAG

No. 10 Double Jet Alcohol Blow Pipe. $4.50 each.

THE TURNER
Double Jet Alcohol
BLOW PIPE No. 10

Produces a non-oxidizing needle flame of over 3,000 degrees. Burns wood alcohol. Burner swiveled so that flame can be turned any direction. Capacity ⅔ pint. Shipping weight two pounds. Burns three hours at full blast from one filling. Can be turned low like a lamp when not in use. Size of reservoir 2½ x 5 inches. Every electrician should have one in his tool bag. Excellent for

LEAD BURNING, SOLDERING WIRES, ETC.

THE
Turner Brass Works
23 N. FRANKLIN ST., CHICAGO

Upon receipt of cash we will prepay charges.
DISCOUNT TO DEALERS.

Good Advice

No. 4

When a meter operates too fast the central station manager is cheating his customer by having him pay for energy he did not use, and when a meter operates too slow the manager is cheating himself. Mr. Manager, are you guilty? If you are, try a Duncan Direct Current Wattmeter; if you are not guilty, then you are already one of our customers.

Good Advice No. 5 Next Week

Bulletin and Prices Sent Upon Request

DUNCAN ELECTRIC MFG. CO.
LAFAYETTE, IND.

JOHN A. ROEBLING'S SONS CO.

Insulated Wire of All Kinds

Bare Copper Wire

MAIN OFFICE AND WORKS TRENTON, N. J.

AGENCIES AND BRANCHES

New York Chicago Cleveland San Francisco Philadelphia Atlanta

VULCANIZED FIBRE

Highest grades for electrical insulation and mechanical purposes, in sheets, tubes, rods and special shapes. Catalogues and samples on application.

VULCANIZED FIBRE CO., - Wilmington, Del.

USE

"SAFETY" RUBBER COVERED WIRE AND CABLE

FOR EVERY ELECTRICAL SERVICE.

M. B. AUSTIN & CO.,

CHICAGO REPRESENTATIVE.

THE SAFETY INSULATED WIRE & CABLE CO.,

WORKS: Bayonne, N. J. 114-116 LIBERTY STREET, N. Y.

Warren Alternator

OVER 600

WARREN CENTRAL STATIONS

running to-day in the

UNITED STATES

WARREN ELECTRIC MFG. CO.

Sandusky, O.

CUT YOUR COAL BILL

By using the

STURTEVANT SYSTEM OF MECHANICAL DRAFT

Costs only 20 to 40 per cent. as much as a chimney.
Increases steaming capacity of boilers.
Is independent of the wind and weather.

B. F. STURTEVANT CO.

BOSTON, MASSACHUSETTS

New York Philadelphia Chicago London

334

DIRECT CURRENT

MOTORS

THE ADAPTATION of our motors to mechanical drive is practically universal, and their service is unequalled.

Write for Bulletin No. 204

SPRAGUE ELECTRIC COMPANY

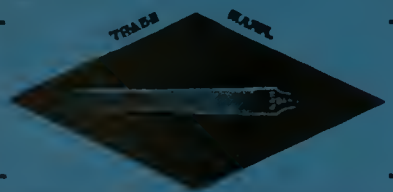
General Offices:
527 West 34th Street, New York.

Chicago Office. Fisher Building

Black Diamond File Works

Est. 1803. Inc. 1895.

Twelve Medals Awarded at International Expositions



Special Prize Gold Medal at Atlanta, 1895.

OUR GOODS ARE ON SALE IN EVERY LEADING HARDWARE STORE IN THE UNITED STATES AND CANADA.

G. & H. BARNETT COMPANY,

PHILADELPHIA, PA.

BRASS & BRASS GOODS

ASK FOR CATALOG

THE PLUME & ATWOOD MFG. CO.

New York Boston San Francisco Chicago

Western Electrician

Vol. XXXV. $3.00 Per Annum. Copyright, 1903, by Electrician Publishing Company, Chicago. CHICAGO, AUGUST 20, 1904. Entered at Chicago Postoffice as mail matter of the second class. 10 Cents a Copy. No. 8.

SIMPLEX INSULATED WIRES AND CABLES.
RUBBER COVERED, WEATHERPROOF, UNDERGROUND AND SUBMARINE.
WESTERN SELLING AGENT, H. R. HUNTON, 1148 Monadnock Block, CHICAGO.
The Simplex Electrical Co., 110 State Street, BOSTON, MASS.

CHICAGO INSULATED WIRE CO.,
152-154 LAKE STREET.
Bare and Insulated Wires and Cables.
Galvanized Steel Strands.

OKONITE
TRADE MARK
1889—Paris Exposition, Medal for Rubber Insulation.
1893—World's Fair, Medal for Rubber Insulation.
THE STANDARD FOR RUBBER INSULATION.
Sole Manufacturers of
Okonite Wires, Okonite Tape, Manson Tape, Candee Weather-proof Wires.
THE OKONITE CO., LTD.
Willard L. Candee, M. Durant Cheever, Managers. 253 Broadway, New York. Geo. T. Manson, Gen'l Supt. W. H. Hodgins, Secy.

TRADE MARK
CRESCENT INSULATED WIRE & CABLE CO. TRENTON, N. J.
CRESCENT RUBBER INSULATED WIRES AND CABLES
National Code Standard.
CRESCENT INSULATED WIRE AND CABLE CO.,
New York Office, 83 BARCLAY STREET. Main Office and Factory, TRENTON, N. J.

STANDARD UNDERGROUND CABLE CO.
322 The Rookery, Chicago. Westinghouse Bldg., Pittsburg. 56 Liberty St., New York City. 1225 Betz Bldg., Philadelphia, Pa.
Crossley Bldg., San Francisco. 10 Post Office Square, Boston.
BARE AND WEATHERPROOF WIRES AND CABLES.
Rubber Covered Wires and Cables. Underground Cables for all Purposes.

INDIANA RUBBER AND INSULATED WIRE CO.,
MANUFACTURERS OF
Paranite Rubber Covered Wires and Cables,
UNDERGROUND, AERIAL, SUBMARINE AND INSIDE USE;
TELEPHONE, TELEGRAPH AND FIRE ALARM CABLES.
All Wires are tested at Factory. JONESBORO, IND.

THE PHOENIX GLASS CO. Pittsburg, New York, Chicago
Manufacturers of
Electric Globes and Shades, both Arc and Incandescent
Inner and Outer Globes for all enclosed arc systems
CATALOGUES SENT ON REQUEST

"CIRCULAR LOOM" THE FLEXIBLE CONDUIT
AMERICAN CIRCULAR LOOM CO.
TRADE MARK
REGISTERED
CONDUITS FOR INTERIOR WIRING.
American Circular Loom Co.
Chelsea, Mass., New York, Chicago, San Francisco.

DRIVER-HARRIS WIRE CO.
HARRISON (NEWARK), N. J.
Manufacturers of Fine Sizes Wire of Every Description.
Resistance Wires a Specialty.

THERMOPILES 1½ VOLTS 1½ AMPERES
For Electrolytic analysis, charging storage batteries, and other constant current requirements. $3 Each.
WALSH'S SONS & CO.,
264 Washington Street. Newark, N. J.

All Supply Houses
J. J. EGAN'S "ACME" COMMUTATOR COMPOUND.
J. J. EGAN'S "ACME" COMMUTATOR COMPOUND absolutely prevents sparking or cutting. One stick of "Acme" is equal to one gallon of oil for lubricating commutators. Free Sample. AGENTS WANTED.
50c per Stick. $5.00 per doz.
J. J. Egan Sole Mfg., 317 Austin Ave., Tel. Polk, 1779 Chicago

MAILED FREE.
A valuable treatise on
STORAGE BATTERIES
for
Private Lighting Plants
together with our catalogue.
COLUMBUS STORAGE BATTERY CO.,
COLUMBUS, OHIO.
Machado & Roller, New York.
Coltz Engineering Co., Chicago.

AKRON
Generators, Motors, Clutches, Commutator Truing Devices.
AKRON ELECTRICAL MFG. CO.,
AKRON, O.
N. Y. Office: McKay Engineering Co., 149 Broadway

THOUSANDS IN USE.
Motors, ¼ h. p. to 100 h. p.
Dynamos, 1 k. w. to 75 k. w.
Highest Quality. Reasonable Price.
THE HOBART ELECTRIC MFG. CO.
TROY, OHIO.

ESTABLISHED 1875.
COMBINATION OF
Stow Flexible Shaft
—AND—
MULTI-SPEED MOTOR
Practically dust and water proof. For Portable Drilling, Tapping, Reaming, Emery Grinding, etc. Write for Catalogue and Prices.
STOW MFG. CO., Binghamton, N. Y.
Gen'l European Agents, Selig, Sonnenthal & Co., 85 Queen Victoria Street, London, England

H. N. FENNER, President J. F. BLAUVELT, Agent RUSSELL W. KNIGHT, Treasurer
NEW ENGLAND BUTT COMPANY
MANUFACTURERS OF
Machinery for Insulating Electrical Wires
Braiding, Taping, Winding, Twinning, Cabling, Stranding, Polishing and Measuring Machines. Cable Covering Braiders
FINE CASTINGS A SPECIALTY
304 PEARL STREET, - - - PROVIDENCE, R. I., U. S. A.

WESTON Electrical Instrument Co.,
Waverly Park, NEWARK, N. J.
Weston Standard Portable Direct Reading
Voltmeters,
Millivoltmeters,
Voltammeters,
Ammeters,
Milammeters,
Ground Detectors and Circuit Testers.
Ohmmeters,
Portable Galvanometers.
Our Portable Instruments are recognized as The Standard the world over. The Semi-Portable Laboratory Standards are still better.
Our Station Voltmeters and Ammeters are unsurpassed in point of extreme accuracy and lowest consumption of energy.
BERLIN—European Weston Electrical Instrument Co., Ritterstrasse No. 85.
LONDON—Elliott Bros., Century Works, Lewisham.
PARIS, FRANCE—E. H. Cadiot, 12 Rue St. Georges
New York Office—74 Cortlandt St.
Weston Ground Detector and Circuit Tester.

HENRY NEWGARD & CO.
ELECTRICAL CONSTRUCTION
Power and Light Plants. Switchboards and Panel Boards.
We install Municipal and Isolated Electric Lighting Plants.
We manufacture Switchboards, Table boards, Iron Cutout Boxes and Electrical Specialties.
We sell Dynamos, Motors and Electrical Supplies.
We wire old as well as new Residences, Factory Buildings, School and College Buildings.
87 Fifth Avenue, Chicago, Illinois.

Allis-Chalmers Co
CHICAGO

"Big Reliable" Engine
at the
St. Louis Exposition

Largest Singie Engine Ever Placed On Exhibition

Popularly Known At Exposition As "Big Reliable"

Allis-Chalmers 5,000 h. p. Engine and Bullock 3,500 k. w. Electric Generator, which furnish current for Decorative Lighting of Exposition Grounds and Buildings.

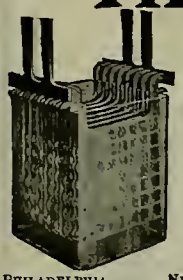
From the time steam was first turned on, this Engine has worked perfectly. It furnishes daily, in addition to the lighting work at night, 3,000 h. p. to the St. Louis Transit Company.

We build smaller Engines in sizes from 25 h. p. upward.

Bullock
Electric Mfg Co
Cincinnati

Canadian representatives, Allis-Chalmers-Bullock, Ltd., Montreal.

THE ELECTRIC STORAGE BATTERY CO.



PHILADELPHIA

MANUFACTURER OF THE

"Chloride Accumulator"

For Central Stations, Electric Railways, Isolated Lighting and Power Stations, Fire Alarm, Telegraph, Train Lighting, etc., etc.

PRICE LISTS AND DESCRIPTIVE BULLETINS FORWARDED UPON REQUEST.

SALES OFFICES:

PHILADELPHIA, Allegheny Ave. and 19th St. | NEW YORK, 100 Broadway, | BOSTON, 60 State St. | CHICAGO, Marquette Bldg. | ST. LOUIS, Wainwright Bldg. | SAN FRANCISCO, Rialto Bldg. | CLEVELAND, Citizens Bldg. | CANADA, Canadian General Electric Co., Ltd. Toronto | HAVANA, CUBA, G. F. Greenwood, Manager 34 Empedrado St.

"STAR" INCANDESCENT LAMPS

LONG LIFE
GUARANTEED CANDLEPOWER,
HIGHEST EFFICIENCY.

MADE BY THE MOST SKILLED WORKMEN.

STANDARD ELECTRICAL MFG. COMPANY, : Niles, Ohio.

NORTHERN Vertical Motors

Built in a wide range of sizes for operation where a vertical shaft is required, enabling operation of machine without the use of bevel gears, etc.

WE SHOW A NORTHERN VERTICAL MOTOR AS APPLIED TO A DEEP WELL PUMP.

Leaflet No. 10125 shows a novel application of the Northern Vertical Motor.

Meet us at Section 14, Palace of Electricity, World's Fair, St. Louis

136

NORTHERN ELECTRICAL MFG. CO.
Engineers, Manufacturers MADISON, WIS., U. S. A.

Monitor Bushings

Greatest efficiency at least cost. Absolute protection to wires drawn over conduit ends. Made of one piece of sheet steel and cannot be broken. Enameled insulation. No special tools required to attach. Approved by fire underwriters. Write for bulletin 1002.

BOSSERT
Electric Construction Company
UTICA, N. Y.

M. KLEIN & SON.
Send 2c stamp for new catalogue No. 6 of
KLEIN'S TOOLS
For Electrical Workers and Line Builders.
MATHIAS KLEIN & SONS.
31 W. Van Buren St., Chicago, Ill.

CARBONS
CONSUMERS CARBON CO.
LANCASTER, OHIO, U. S. A.
Carbons of all kinds and for all purposes.

Engineering
MECHANICAL, ELECTRICAL, STEAM, CIVIL.

Complete and short courses. Thoroughly equipped engineering shops. Shop work from the beginning. Short courses in Steam and Electrical Engineering. Expenses low. Accommodations the best. School all year. Students may enter any time. Correspondence steam and electrical courses. Send for catalogue. Mention course in which interested.
HIGHLAND PARK COLLEGE, DES MOINES, IOWA.

PLATINUM

PLATINUM RIVETS FOR CONTACT POINTS IN TELEPHONES—SPARK COILS AND OTHER ELECTRICAL APPARATUS. PLATINUM SHEET AND WIRE IN ANY FORM AND DEGREE OF HARDNESS. PLATINUM SCRAP PURCHASED.

BAKER & COMPANY, Inc.
ARTISANS IN PLATINUM
408-410-412-414 N. J. R. R. AVE. - NEWARK, N. J.
New York Office: 120 Liberty St.

ALPHABETICAL INDEX TO ADVERTISEMENTS.

Adams-Hagnall Electric Co.. 7
Akron Electrical Mfg Co..... 1
Allen Company, L. B.....—
Allis-Chalmers Company..... 2
American Battery Co.....—
Amer. Circular Loom Co..... 1
American Conduit Co.....14
Amer. District Steam Co.....15
Amer. Elec. Fuse Co..... 5
Amer. Electrical Heater Co..—
Amer. El. Telephone Co.....15
American Electrical Works..11
Arnold Elec. Power Station Co.....13
Automatic Electric Co..... 14

Babcock & Wilcox Co.....—
Bain, Forée.....11
Baker & Company..... 3
Baker & Co., W. E.....13
Barnett Company, G. & H....20
Beardslee Chandelier Mfg.Co.10
Berthold & Jennings.....17
Big Four Route.....17
Bissell Co., The F.....12
Bossert Electric Construction Co..... 3
Brooks, Hall L.....16
Bryan-Marsh Co.....—
Bryan, Wm. H.....13
Buckeye Electric Co.....—
Bullock Elec. Mfg. Co..... 2
Butterfield, J. F.....—
Byllesby & Co., H. M.....13

Central Electric Co.....—
Cent. Stat. Improvement Co..12
Central Tel. & El. Co.....—
Century Electric Co.....—
Chicago Die & Electric Co....—
Chicago Edison Co.....4, 12
Chic. Fuse Wire & Mfg. Co...—
Chicago Insulated Wire Co.. 1
Chicago Mica Co.....10
Columbia Incand. Lamp Co..—
Columbia Mfg. Co.....17
Columbus Storage Bat'ry Co. 1
Consumers Carbon Co..... 3
Continuous Rail Joint Company of America.....11
Cope, T. J.....17
Crawfordsville Electric Co..11
Crescent Co.....—
Crescent Ins. Wire & Cbl. Co. 1
Crocker-Wheeler Company...20
Crouse-Hinds Co.....—
Cutler-Hammer Mfg. Co..... 4
Cutter Elec. & Mfg. Company—

D. & W. Fuse Company..... 5
Dearborn Drug & Chem. Wks. 8
Diamond Meter Company....—
Dielectric Manufacturing Co.10
Directory of Engineers.....13
Dixon Crucible Co., Joseph.. 8
Driver-Harris Wire Co..... 1
Duncan Elec. Mfg. Co.....19

Edison Decorative & Miniature Lamp Departm't.....10
Edison Mfg. Company..... 4
Edwards & Co.....—
Egan, J. J..... 1
Electrical Engineer Institute.10
Electric Appliance Co 10
Electric Storage Battery Co.. 3
Electrician Pub. Company... 9
Erie Ry.....16

Faries Mfg. Co.....11
"For Sale" Advertisements..12
Ft. Wayne Elec. Works, Inc..19
Fostoria Incand. Lamp Co...—
Fowler, John H.....16
Fowler-Jacobs Company.....16

Gay Chemical Co., The R....—
General Electric Co..... 9
General Engineering Co., The 13
General Incandescent Arc Light Company.....—
General Incand. Lamp Co....—
Gould Storage Battery Co....—
Gt. West. Smelt. & Refining Co.12
Green Fuel Economizer Co..—
Gregory Electric Company...12

Hallberg, J. H.....13
Haller Machine Co.....10
Hart Mfg. Co.....20
Hartford Steam Boiler Inspection & Insurance Co.... 8
Hartford Time Switch Co....—
Hazard Manufacturing Co...20
Highland Park College. ... 3
Hobart Elec. Mfg. Company. 1
Hoffman, G. W.....16
Holmes Fibre-Graph. Co..... 8
Holophane Glass Co.....—
Holtzer-Cabot Electric Co...—
Hornaday & Co., J. P.....13
Humphrey, Henry H.....—
Hunt & Co., Robt. W.....13

Illinois Central Ry.....12
Incandescent Electric Light Manipulator Company.....—
Indiana Rub. & Ins. W. Co.... 1
India Rubber & Gutta Percha Insulating Company.....17
International Elec. Meter Co 12
International Tel. Mfg. Co...14

Jackson, D. C. & W. B.....13
Jeffrey Manufacturing Co.... 8
Jewell Electrical Inst. Co....—
Johns-Manville Co., H. W.....—

Kartavert Manufacturing Co.20
Kellogg Switchboard & Supply Company.....15, 17
Kemp, R. W.....13
Kester Elec. Mfg. Co.....11
Klein & Sons, Mathias..... 3
Kohler Brothers.....13
Kuhlman Electric Co.....11

La Roche Co., F. A.....—
Leather Preserv. M. Corp....—
Leffel & Co., James..... 8
Lindsley Brothers Company..17
Loud's Sons Co., H. M.....17

Machado & Roller.....—
Maltby Cedar Company.....17
Manhattan El. Supply Co.... 8
Manross, F. N. 11
Marinette Gas Engine Co..... 8
Matthews & Bros., W. N.....11
McLennan & Company, K....10
Mechanical Appliance Co....—
Mica Insulator Company.....—
Michigan College of Mines ..—
Minnesota Electric Co.....15
Miscellaneous Advs.....12
Monon Railroad..... .. ..—
Moon Mfg. Co., The.....14
Morrison Lbr. Co., J. W.....—
Mueller Company, William..16
Munsell & Co., Eugene..... 10

National Electric Co.....12
National India Rubber Co....—
New England Butt Co..... 1
Newgard & Co., Henry..... 1
New York Cent. Ry.....17
New Ynrk Ins. Wire Co.....11
Northern Elect'l Mfg. Co.... 3
Northern Pacific Ry.....16
Norton Elect'l Instrument Co.—

Okonite Co., The..... 1
Olds Gasoline Engine Works. 8

Pacific Coast Pole Co.....17
Page & Hill Co.....16
Paragon Fan & Motor Co.....—
Pardridge Shade & Refl. Co..—
Pass & Seymour, Inc.....—
Phelan, D. W.....16
Phillips, Eugene F.....11
Phillips Insulated Wire Co...11
Phœnix Glass Co..... 1
Phosphor-Bronze S. Co..... 8
Pignolet, L. M.....10
Pittsburg & L. S. Iron Co....16
Plume & Atwood Mfg. Co.....--
Porter Cedar Company.....17
Pratt Institute .....—

Reisinger, Hugo.....—
Reynolds El. Flasher Mfg.Co.12
Roehling's Sons Co., J. A.....20
Ruebel-Schwedtmann-Wells..13

Safety Ins. Wire & Cable Co..10
Sargent & Lundy.....13
Schott, W. H.....13
Seaman, J. H.....—
Seaman & Co., W. S.....14
Sears, Roebuck & Co.....—
Simplex Electrical Co., The.. 1
Simplex Elec. Heating Co....11
Speer Carbon Co..... . 8
Sprague Electric Company... 5
Squire Electric Co.....—
Standard Elec. Mfg. Co..... 3
Standard Underg. Cable Co.... 1
Standard Vitrified Conduit Co14
Stanley Elec. Mfg. Co., The 6
Stanley Instrument Co..... 4
Stanton, LeRoy W..... 13
State Univ. of Iowa.....11
Sterling & Son, W. C.....17
Sterling Electrical Mfg.Co... —
Sterling Varnish Co., The.... 4
Stow Mfg. Company..... 1
Stromberg-Carlson Tel. Mfg. Company.....15
Sturtevant Company, B. F...20

Torrey Cedar Company.....17
Trumbull Elec. Mnfg. Co.....10
Turner Brass Works.....—

Union Electric Mfg. Co.....—

Valentine-Clark Co., The....16
Vulcanized Fibre Company..20

Wagner Electric Mfg. Co.....13
Walsh's Sons & Company..... 1
Warren Elec. Mfg. Co..... 5
Wesco Supply Co.....—
Western Electric Company... 5
Western El. Supply Co.....13
Westinghouse Electric & Manufacturing Co.....18
Weston Electrical Inst. Co... 1
Wilmerding, C. H.....13
Wisconsin Central Ry.....16
Woolley Fdy. & Mach. Wks..—
Worcester Company, C. H....16

Yesbera Mfg. Co..... .. --
Yost Electric Mfg. Co 12

For Classified Index of Advertisements See Page 6.

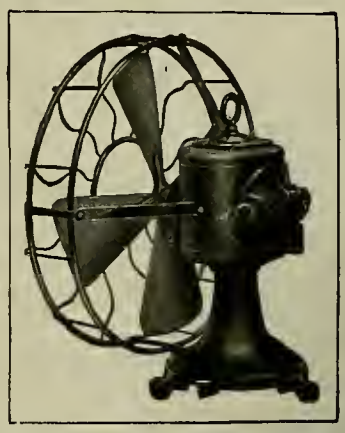
REMEMBER THE NAME AND BUY THE BEST.

PARAGON FAN MOTORS

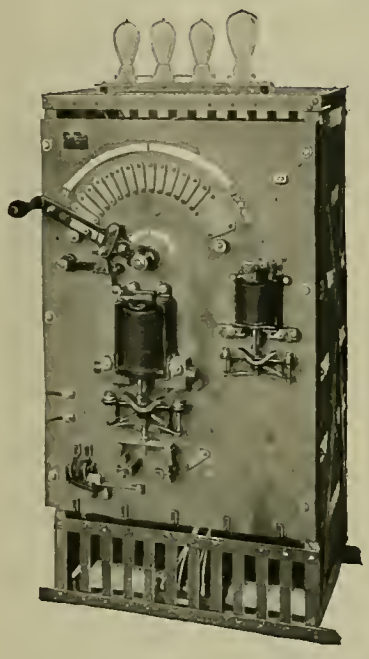
NEW STYLES NEW PRICES
EASY RUNNING RIGID CONSTRUCTION NOISELESS

CALL AND SEE THEM OR WRITE FOR PRICES

CHICAGO EDISON COMPANY,
139 ADAMS ST., CHICAGO.



"C & H on a controller means highest quality"



The C&H Rotary Press Controller

Gives any speed desired.

It starts the press gradually and gives a steady motion at all speeds.

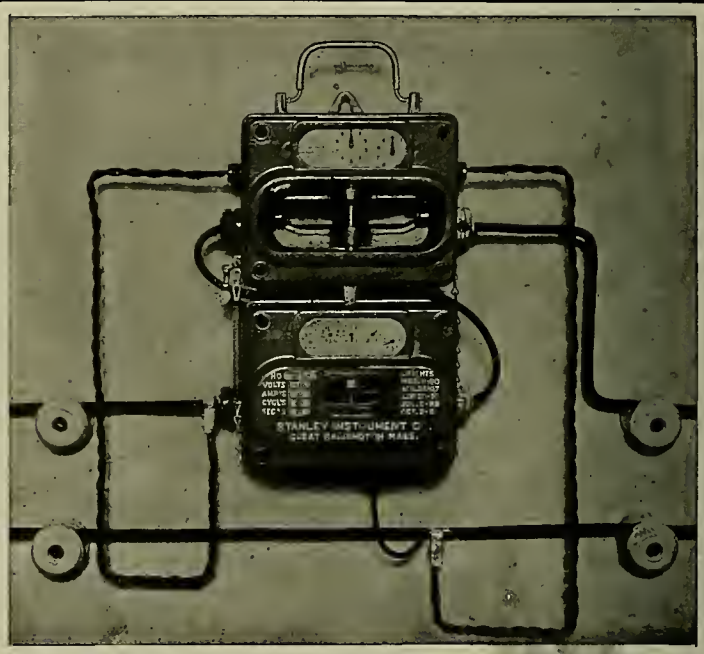
Perfect and immediate control from any part of press by means of a series of push buttons.

The Cutler-Hammer Mfg. Co.
MILWAUKEE, WIS.
New York Boston Chicago Pittsburg

Sterling Black Plastic Insulator.

One hundred days' continuous baking at 180° F. will not make it brittle. Water repellent. Oil proof.

THE STERLING VARNISH CO., - - Pittsburg, Pa.



TESTING WATTMETER

ACCURATE TESTS
in a few minutes, anywhere, by one man alone without regulation of VOLTAGE, LOAD OR FREQUENCY

STANLEY INSTRUMENT CO.
GREAT BARRINGTON, MASS.

EDISON PRIMARY BATTERIES

FORMERLY EDISON LALANDE

These batteries are free from objection on the score of either polarization or local action, and can be conveniently applied to sewing machine motors, fan motors, electric cauteries, gas engine igniters, small electric lamps, and other purposes calling for moderate supplies of electrical power, in addition to the needs of telegraphy, telephony and railroad semaphore signals and crossing bells. Send for catalogue No. 7.

TRADE Thomas A. Edison MARK **EDISON MFG. CO.,** Factory, Orange, N. J.

New York, 83 Chambers St.
Chicago, 304 Wabash Ave.

DIRECT CURRENT

MOTORS

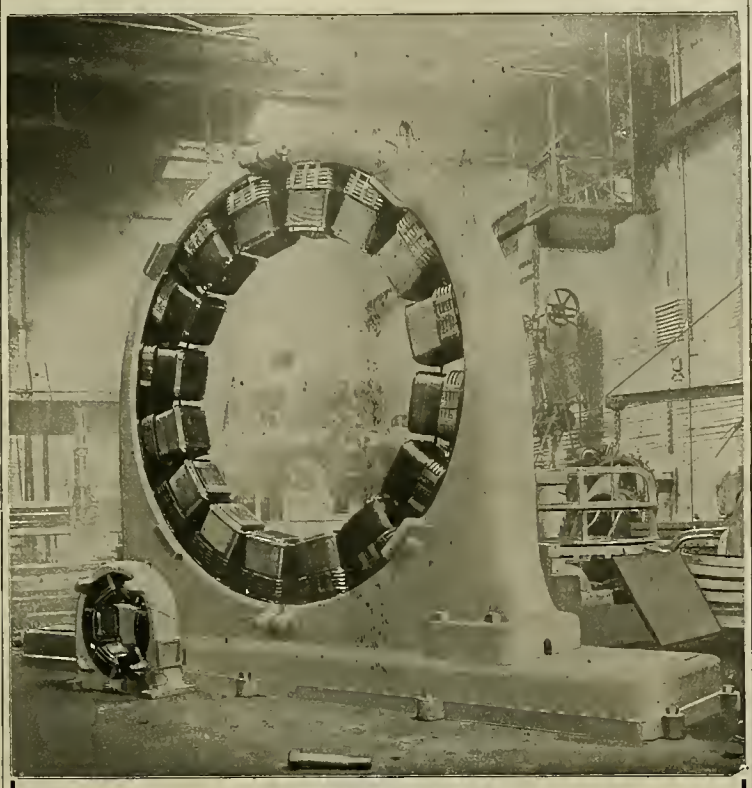
THE ADAPTATION of our motors to mechanical drive is practically universal, and their service is unequalled.

Write for Bulletin No. 21014.

SPRAGUE ELECTRIC COMPANY

General Offices:
527 West 34th Street, New York.

Chicago Office: Fisher Building.



Direct Current

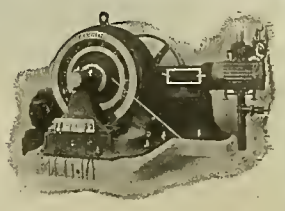
Generators and Motors

Western Electric Company

CHICAGO NEW YORK
And Other Large Cities

Space 17 Electricity Building, Louisiana Purchase Exposition

Warren Alternator



A DOZEN CITIES IN JAPAN ARE LIGHTED FROM THE

WARREN ALTERNATOR

WARREN ELECTRIC MFG. CO.

Sandusky, O.

Allen-Bradley Electric Crane Controllers

Patented

Manufactured by AMERICAN ELECTRIC FUSE CO., Chicago

Front View—before starting

Rear View

Front View—all resistance out

A New Controller. Positively No Sparking. No Repairs. Guaranteed for One Year. Three Months' Free Trial. Perfect Control.

OUR GUARANTEE: Ask any Other Manufacturer to Duplicate It.

THE AMERICAN ELECTRIC FUSE COMPANY hereby guarantees to..... that it will at any time within three months from this date upon demand repay to said..... the sum of..... .....Dollars, being the full purchase price paid (or agreed to be paid) by said..... to the American Electric Fuse Company for one..... horsepower Allen-Bradley Crane Controller, number.....upon delivery within three months after this date of said controller, freight prepaid and in good condition, ordinary wear and tear from use excepted, at the office of the American Electric Fuse Company, Chicago, Illinois, together with a written statement that said controller has proved unsatisfactory to said .....

FURTHERMORE, the said American Electric Fuse Company agrees that it will at any time within one year from this date replace, without charge, any part of said controller which may prove defective or wear out during the ordinary use of said controller, provided that it is a condition of this guarantee that said..... hereby agrees to use ordinary care in the operation of said controller, and that said controller will be operated by some person, or persons, familiar with the use of crane controllers, and further that said controller will not be wilfully or maliciously injured while in the possession of said.....

"SURVIVAL OF THE FITTEST"

THIS IS THE FUSE ADAPTED BY INTERBOROUGH RAPID TRANSIT CO. OF NEW YORK.

FOR ENTIRE FUSE EQUIPMENT OF THE MANHATTAN ELEVATED AND SUBWAY DIVISIONS.

After competitive tests in which the *"D & W"* was THE ONLY FUSE capable of fulfilling all of the conditions imposed upon it.

D. & W. FUSE COMPANY, PROVIDENCE, R. I.

A. HALL BERRY, New York Representative, 97 Warren Street.

AGENCIES:

BOSTON, Pettingell-Andrews Co.
CHICAGO, Central Electric Co.
CINCINNATI, Standard Electric Co.
NEW YORK, Western Electric Co.
PITTSBURG, Western Electric Co.
DENVER, Western Electric Co.
SAN FRANCISCO, California Electrical Works.
KANSAS CITY, Western Electric Co.
PHILADELPHIA, Western Electric Co.
ST. PAUL, American Electric Co.
ST. LOUIS, Western Electric Co.

Separate Phase Regulation.

In connection with S. K. C. INDUCTOR ALTERNATORS and S. K. C. REVOLVING FIELD TYPE GENERATORS, we recommend the use of our separate phase regulating device.

This device when desired, is furnished as a part of the generator. No additional transformers or boosters are required and the regulating head or terminal board may be mounted on the machine or on the switchboard, as desired.

By this means the voltage of one phase may be varied irrespective of the other.

The potential of one phase even may be raised while that of the other is lowered without any inconvenience resulting.

This can be done only on the S. K. C. INDUCTOR and the S. K. C. REVOLVING FIELD TYPE GENERATOR.

Do you realize the advantages derived from such even regulation?

Will you let us send you Bulletin No. 112 showing how we do it?

The Stanley Electric Manufacturing Co.,

Pittsfield, Massachusetts.

Atlanta, Ga., Empire Building.
Boston, Mass., Oliver Building.
Chicago, Ill., Monadnock Block.
Cincinnati, O., No. 61 Perin Building.
Denver, Colo., Headrie & Bolthoff Mfg. & Supply Co.
Los Angeles, Cal., Douglas Block.
New York, N. Y., No. 29 Broadway.
Philadelphia, Pa., North American Building.
St. Louis, Mo., Century Building.
San Francisco, Cal., 69-75 Montgomery St.
Seattle, Wash., Pioneer Building.

Representative for the Dominion of Canada, The Canadian General Electric Co. of Toronto.

"THE S. K. C. SYSTEM."

CLASSIFIED INDEX OF ADVERTISEMENTS.

Adjusters, Cord.
Crescent Co.
Incandes. El. Lt. Manip. Co.

Adjusters, Inc. Lamps.
Inc. El. Lt. Manipulator Co.

Anchors (Tel. & Tel.)
Matthews & Bro., W. N.
Crouse-Hinds Co.

Annunciators.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Moon Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Batteries and Jars.
Bissell Co., The F.
Central Electric Co.
Columbus Storage Battery Co.
Edison Mfg. Co.
Edwards & Company.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Bells, Buzzers, Etc.
Central Electric Co.
Edwards & Co.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Belt Dressing.
Dixon Crucible Co., Jos.
Leather Preserver Mfg. Corp.

Belting.
Leather Preserver Mfg. Corp

Blow Pipes.
Turner Brass Works

Blowers.
Sturtevant Co., B. F.

Boiler Compounds.
Dearborn Drug & Chem. Wks.

Boilers.
Allis-Chalmers Company.
Babcock & Wilcox Co.

Books, Electrical.
Electrician Publishing Co.

Booths, Telephone.
Seaman & Co., W. S.
Yesbera Mfg. Co.

Brackets.
Faries Mfg. Co.

Brushes.
Central Electric Co.
Hobart Elec. Mfg. Co.
Holmes Fibre-Graphite Co.
Speer Carbon Co.
Western Electric Company.

Cable Hangers.
Bissell Co., B. F.
Western Electric Co.

Cables (See Wires and Cables)

Canopies.
Faries Mfg. Co.

Carbons, Points and Plates.
Central Electric Co.
Chicago Edison Co.
Consumers Carbon Co.
Electric Appliance Co.
Reisinger, Hugo.
Speer Carbon Co.
Wesco Supply Co.
Western Elec. Supply Co.

Castings.
Faries Mfg. Co.
New England Butt Co.
National Electric Co.

Chains.
Jeffrey Mfg. Co.

Chandeliers.
Faries Mfg. Co.

Circuit Breakers.
Cutler-Hammer Mfg. Co.
Cutter Elec. & Mfg. Co.
Ft. Wayne Elec. Wks. Inc.
La Roche Co., F. A.
Union Electric Mfg. Co.
Western Electric Company.
Westinghouse El. & Mfg. Co.

Clusters.
Faries Mfg. Co.

Clutches, Electrical and Mechanical.
Akron Electrical Mfg. Co.

Coal and Ashes Handling Machinery.
Jeffrey Mfg. Co.

Coils and Magnets.
Western Electric Co.

Coloring, Lamp
Crescent Co.
Gay Chemical Co., The R.

Commutator Compound
Allen Co., L. B.
Egan, J. J.
McLennan & Co., K.

Commutator Truing Device.
Akron Electrical Mfg. Co.

Condensers, Electric.
Stanley Elec. Mfg. Co.

Conduit and Conduits.
American Circular Loom Co.
American Conduit Company
Central Electric Co.
Electric Appliance Co.
Sprague Electric Co.
Standard Vitrified Cond. Co.
Wesco Supply Co.
Western Electrical SupplyCo.

Contractors and Electric Light Plants.
Allis-Chalmers Company.
Bullock El. Mfg. Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
National Electric Co.
Northern Electrical Mfg. Co.
Sprague Electric Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Controllers, Crane.
Amer. Elec. Fuse Co.

Cross-Arms, Pins and Brackets.
Berthold & Jennings.
Central Electric Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Company.
Western Elec. Supply Co.

Cut-Outs and Switches.
Bissell Co., The F.
Bossert Elec. Const. Co.
Central Electric Co.
Chicago Edison Co.
Crouse-Hinds Co.
Cutter Elec. & Mfg. Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
General Inc. Arc Light Co.
Hart Manufacturing Co.
La Roche Co., F. A.
Manhattan Elec. Supply Co.
Trumbull Elec. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Dynamos and Motors.
Akron Electrical Mfg. Co.
Allis-Chalmers Company.
Bissell Co., The F.
Bullock Elec. Mfg. Co.
Central Electric Co.
Century Electric Co.
Crawfordsville Electric Co.
Crocker-Wheeler Co.
Dustin Co., Chas. E.
Ft. Wayne Elec. Wks. Inc.
General Elec. Co.
General Inc. Arc Light Co.
Gregory Electric Co.
Hobart Elec. Mfg. Co.
Holtzer-Cabot Electric Co
Mechanical Appliance Co.
National Electric Co.
Northern Electrical Mfg. Co.
Sprague Electric Co.
Stanley Elec. Mfg. Co.
Stow Manufacturing Co.
Sturtevant Co., B. F.
Wagner Electric Mfg. Co.
Warren Elec. Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Economizers, Fuel.
Green Fuel Economizer Co.

Electric Heating Appl.
American Elec. Heater Co.
Simplex Elec. Heating Co.
Western Electric Co.

Electric Railways.
Crocker-Wheeler Co.
General Electric Co.
Sprague Electric Co.
Westinghouse El. & Mfg. Co.

Electrical and Mechanical Engineers.
Arnold Elec. Power Stat'n Co.
Baker & Co., W. E.
Bryan, Wm. B.
Butterfield, J. F.
Byllesby & Co., H. M.
General Engineering Co., The.
Hallberg, J. H.
Bornaday, J. P. & Co.
Humphrey, Henry H.
Hunt & Co., Robt. W
Jackson, D. C. & W. B.
Kemp, R. W.
Kohler Brothers.
Newgard & Co., Henry.
Northern Electrical Mfg. Co.
Ruebel, Schwedtman, Wells.
Sargent & Lundy.
Schott, W. H.
Squire Electric Co.
Stanley Elec. Mfg. Co.
Stanton, LeRoy W.
Wilmerding, C. H.

Electrical Instruments. (Recording and Testing.)
Bissell Co., The F.
Central Electric Co.
Diamond Meter Co.
Duncan Elec. Mfg. Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
General Inc. Arc Light Co.
Jewell Electrical Inst. Co.
Machado & Roller.
Norton Elec'l Instrument Co.
Pignolet, L. M.
Stanley Elec. Mfg. Co.
Stanley Instrument Co.
Wagner Electric Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.
Weston Electrical Inst. Co.

Electro-Plating Mach'y
Crocker-Wheeler Company.
General Electric Co.

Elevators-Conveyors.
Jeffrey Mfg. Co.

Engines, Gas and Gasoline.
Allis-Chalmers Company.
Marinette Gas Engine Co.
Olds Gasoline Engine Works.
Woolley Fdy. & Mach. Wks.

Engines, Steam.
Allis-Chalmers Company.
Dustin Co., Chas. E.
Sturtevant Co., B. F.

Fans and Fan Motors.
Central Electric Co.
Crocker-Wheeler Company.
Edison Mfg. Co.
General Electric Co.
General Inc. Arc Light Co.
Sprague Electric Co.
Sturtevant Co., B. F.
Wesco Supply Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Fibre.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Files.
Barnett Co., G. & H.

Fittings.
Faries Mfg. Co.

Fixtures, Gas and Elec.
Beardsley Chandelier Mfg. Co.

Flashers.
Bissell Co., The F.
Haller Machine Co.
Reynolds El. Flasher Mfg. Co

Flexible Shafts.
Stow Mfg. Co.

Forges.
Sturtevant Co., B. F.

Fuses and Fuse Wire.
Amer. Elec. Fuse Co.
Bissell Co., The F.
Central Electric Co.
Central Tel. & El. Co
Chicago Die & Electric Co.
Chicago Fuse Wire & Mfg. Co.
D. & W. Fuse Company.
Electric Appliance Co.
Johns-Manville Co., H. W.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Company.
Western Elect. Supply Co.

Globes, Reflectors and Shades.
Fostoria Incan. Lamp Co.
Haller Machine Co.
Holophane Glass Co.
Pardridge Shade & Refl. Co.
Phœnix Glass Co.
Wesco Supply Co.
Western Electric Co.
Western Elect. Supply Co.

Graphite Specialties.
Dixon Crucible Co., Jos.
Holmes Fibre-Graphite Co.

Heating (Exhaust Steam).
Amer. District Steam Co.

Heating and Ventilating Apparatus.
Sturtevant Co., B. F.

Holders, Inc. Lamps.
Incandesent Electric Light Manipulator Co.

Inspection & Insurance
Hartford Steam Boiler Inspection & Insurance Co.

Insulating Machinery.
New England Butt Co.

Insulators and Insulating Materials.
Akron Electrical Mfg. Co.
American Electrical Works.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Inc. Arc Light Co.
Indiana Rub. & Ins. Wire Co.
Johns-Manville Co., H. W.
Kartavert Mfg. Co.
Manhattan Elec. Supply Co.
Mica Insulator Co.
Munsell & Co., Eugene.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Standard Vitrified Cond. Co.
Sterling Varnish Co.
Vulcanized Fibre Co.
Wesco Supply Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Junction Boxes.
Bossert Elect. Const. Co.
General Inc. Arc Light Co.

Lamps, Arc.
Bissell Co., The F.
Central Electric Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
General Inc. Arc Lt. Co.
Gregory Electric Co.
Manhattan Elec. Supply Co.
Stanley Elec. Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Lamps, Incandescent.
Bissell Co., The F.
Bryan-Marsh Company.
Buckeye Electric Company.
Central Electric Co.
Chicago Edison Co.
Columbia Incan. Lamp Co.
Edison Decorative & Miniature Lamp Dept.
Electric Appliance Co.
Fostoria Incand. Lamp Co.
General Electric Co.
General Inc. Arc Light Co.
Standard Elec'l Mfg Co
Sterling Electrical Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Lamps, Incandescent—Replacers & Cleaners.
Inc. El. Lt. Manipulator Co.

Letters, Metal.
Haller Machine Co.

Lightning Arresters.
Central Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
Manhattan Elec. Supply Co.
Minnesota Electric Co.
Stanley Elec. Mfg. Co.
Western Electric Co.

Linemen's Climbers.
Klein & Sons, Mathias.

Magnet Wires.
(See Wires and Cables.)

Mechanical Draft.
Sturtevant Co., B. F.

Mica.
Chicago Mica Co.
Mica Insulator Co.
Munsell & Co., Eugene.

Mining Apparatus, Elec.
Allis-Chalmers Company.
Crocker-Wheeler Company.
General Electric Co.
Jeffrey Mfg. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Motors. (See Dynamos and Motors.)

Nippers and Pliers.
Klein & Sons, Mathias.

Nozzles.
Faries Mfg. Co.

Paints.
Dielectric Mfg. Co.

Patent Attorneys.
Bain, Foree.

Phosphor Bronze.
Phosphor Bronze Sm. Co. Ltd.

Platinum, Wire and Sheet.
Baker & Company Inc.

Poles and Ties.
Berthold & Jenninga.
Brooks, Ball L.
Columbia Mfg. Co.
Fowler, John H.
Fowler-Jacobs Company.
Kellogg Switch. & Sup. Co.
Lindsley Bros. Co.
Loud's Sons Co., H. M.
Maltby Cedar Co.
Morrison Lbr. Co., J. W.
Mueller Company, William.
Pacific Coast Pole Co.
Page & Hill Company.
Puelan, D. W.
Pittsburg & L. S. Iron Co.
Porter Cedar Company.
Sterling & Son, W. C.
Torrey Cedar Co.
Valentine-Clark Co., The.
Worcester Co., C. H.

Polish (Metal).
Allen Co., Inc., L. B.
Hoffman, Geo. W.

Portables.
Faries Mfg. Co.

Power Transmission Machinery.
Jeffrey Mfg. Co.

Rail Joints.
Continuous Rail Joint Company of America.

Reliners.
Gt. West Smelt. & Refining Co

Re-Winding—Repairs.
Chicago Edison Co.
Gregory Electric Co.

Rheostats.
Cutler-Hammer Mfg. Co.
General Electric Co.
Gen'l Inc. Arc Lt. Co.
Union Electric Mfg. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Rods, Conduit.
Cope, T. J.

Safes.
Sears, Roebuck & Co.

Schools and Colleges.
Electrical Engineer Inst.
Highland Park College.
Michigan College of Mines.
Pratt Institute.
State Univ. of Iowa.

Second-Hand Mach'y.
Bissell Co., The F.
Cent. Stat. Improvement Co.
Gregory Electric Co.
Matthews & Bro., W. N.
Walsh's Sons & Co.

Shades, Lamp.
Faries Mfg. Co.

Sheet Brass & Copper.
Plume & Atwood Mfg. Co.

Signs, Electric.
Haller Machine Co.

Sockets & Receptacles.
Pass & Seymour.
Yost Elec. Mfg. Co.

Soldering Sticks, Salts and Paste.
Allen Co., L. B.
Crescent Co.
Kester Elec. Mfg. Co.
Western Electric Co.

Speaking Tubes.
Central Electric Co.
Edwards & Co.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.
Wester Elec. Supply Co.

Specialties, Electrical Mfrs. and Designers.
Haller Machine Co.

Speed Indicators.
Weston Electrical Inst. Co.

Storage Batteries.
American Battery Co.
Electric Storage Battery Co.
Gould Storage Battery Co.

Supplies, General Elec.
Bissell Co., The F.
Central Electric Co.
Century Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Electric Co.
Manhattan Elect'l Supply Co.
Wesco Supply Co.
Western Electric Co.
Western Elect. Supply Co.

Switchboards.
Bissell Co., The F.
Crouse-Hinds Co.
Gen. Incan. Arc Light Co.

Telephones, Telephone Material and Switchboards.
American El. Telephone Co
Automatic Electric Co.
Bissell Co., The F.
Central Electric Co.
Central Tel. & El. Co.
Holtzer-Cabot Elec. Co.
International Tel. Mfg. Co.
Kellogg Switchb. & Sup. Co.
Manhattan Elec. Supply Co.
Moon Mfg. Co., The.
Stromberg-Carlson Tel. M.Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Time Switches.
Bissell Co., The F.
Hartford Time switch Co.

Tools.
Klein & Sons, Mathias.
Western Electric Co.

Transformers.
Central Electric Co.
Crawfordsville Electric Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Works, Inc.
General Electric Co.
Gregory Electric Co.
Kuhlman Electric Co.
Manhattan Elec. Supply Co.
National Electric Co.
Stanley Elec. Mfg Co.
Wagner Electric Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Trucks, Electric Car.
General Electric Co.
Westinghouse El. & Mfg. Co.

Turbines, Steam.
Allis-Chalmers Co.
General Electric Co.
Westinghouse El. & Mfg. Co

Turbine Water Wheels
Leffel & Co., Jas.

Varnishes.
Dielectric Mfg. Co.
Sterling Varnish Co.

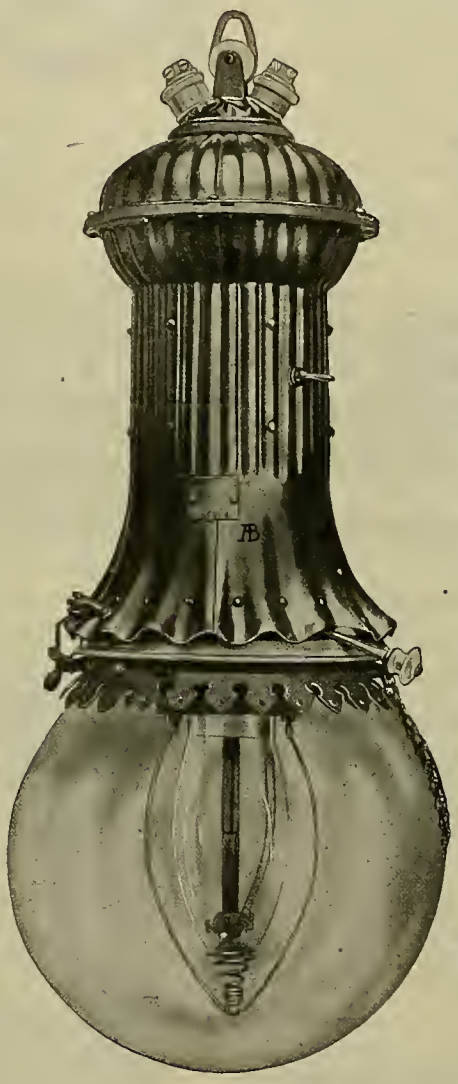
Vulcanized Fibre.
Vulcanized Fibre Co.

Wires & Cables—Magnet Wires.
American Electrical Works.
Bissell Co., The F.
Central Electric Co.
Chicago Insulated Wire Co.
Crescent Ins. Wire & Cble. Co.
Driver-Harris Wire Co.
Electric Appliance Co.
General Electric Co.
Hazard Manufacturing Co.
Indiana Rub. & Ins. Wire Co
India Rubber & Gutta Percha Insulating Co.
Kellogg Switch. & Sup. Co.
Manhattan Elec. Supply Co.
National India Rubber Co
New York Insulated Wire Co.
Okonite Co., The.
Phillips, Eugene F.
Phillips Insulated Wire Co
Roebling's Sons Co., J. A.
Safety Ins. Wire & Cable Co.
Simplex Electrical Co.
Standard Underground C. Co
Wesco Supply Co.
Western Electric Company.
Western Elec. Supply Co.

For Alphabetical Index of Advertisements See Page 3.

A-B ARC LAMPS

FOR ALL CIRCUITS



SPECIAL FEATURES

Accessibllity of Mechanism,

Ease of Removing Inner and Outer Globe,

Ease of Trimming,

Weatherproof Construction,

Stamped Copper Cases and Simplicity of Mechanism.

THERE IS

A greater number of Adams-Bagnall Constant Direct Current Series Enclosed Arc Lamps used for street lighting throughout the United States, Canada and Mexico than all other makes of this type of lamp combined.

SEND FOR CATALOGUE

AGENCIES

Doubleday-Hill Electric Co., Pittsburg, Pa.
Electric Appliance Co., Chicago, Ill.
The Wesco Supply Co., St. Louis, Mo.
H. C. Roberts Electric Supply Co., Philadelphia, Pa.
Pettingell-Andrews Co., Boston, Mass.
Cia. Benbow-Dutton, S. A., City of Mexico, Mex.
Geo. F. Rohn, Milwaukee, Wis.

AGENCIES

B-R Electric Co., Kansas City, Mo.
A. J. Micheli, Atlanta, Ga.
Interstate Electric Co., New Orleans, La.
Post-Glover Electric Co., Cincinnati, O.
Miller-Seldon Electric Co., Detroit, Mich.
W. G. Nagel Electric Co., Toledo, Ohio.
R. E. T. Pringle Co., Ltd., Montreal Que.

THE ADAMS - BAGNALL ELECTRIC CO.

New York Office: 136 Liberty St. CLEVELAND, OHIO Chicago Office: 303 Dearborn St.

BOILER WATERS CORRECTED

to remove and prevent scale and to stop corrosion. DEARBORN TREATMENT does the work. Send gallon sample for analysis. Booklet "R" now ready.

DEARBORN DRUG & CHEMICAL WORKS,

27-34 RIALTO BUILDING, CHICAGO, ILL. WM. H EDGAR, President Telephone: Harrison 3930 and 3931.

Dixon's Graphite Pipe Joint Compound

Makes the tightest joints that remain free from rust and come apart easily at any time. Write for Booklet 125D and a sample.

JOSEPH DIXON CRUCIBLE CO., JERSEY CITY, N. J.

HARTFORD STEAM BOILER INSPECTION AND INSURANCE CO. HARTFORD, CONN.

BUY YOUR BOOKS

FROM THE

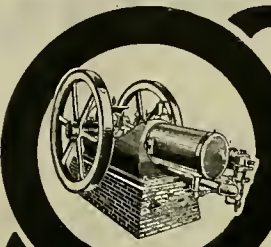
Electrician Pub. Co., 510 Marquette Bldg., Chicago.

DON'T BUY ELECTRICAL SUPPLIES

Until you have seen our new Catalogue and new Price List.
Free to the trade.

Manhattan Electrical Supply Co.

NEW YORK: 32 Cortlandt St.
CHICAGO: 188 Fifth Ave.



Olds Gas and Gasoline Engines

When gasoline is used for fuel it can be pumped up only as fast as it is used. Perfect mechanical appliances make for absolute safety and economy.

STATIONARY ENGINES - - 2 to 100 H. P.
PORTABLE ENGINES - - - 8 to 18 H. P.

We have a new catalog, fully describing and illustrating our line, which will be sent on request.

OLDS GASOLINE ENGINE WORKS.
252 River Street., - - Lansing, Mich.

2 No. 983

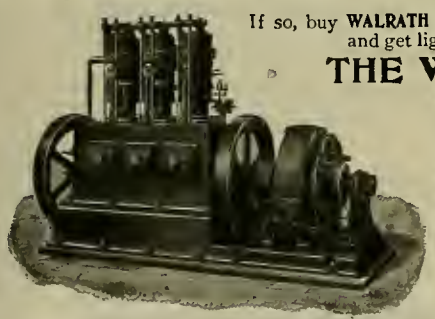
SPEER HIGH GRADE CARBON BRUSHES

MOTOR AND GENERATOR CARBON BRUSHES

SPEER CARBON CO., - St. Marys, Pa.

ARE YOU LOOKING FOR MONEY?

If so, buy WALRATH GAS OR GASOLINE ENGINES and get light on the subject.



THE WALRATH

Received the Highest Award at the Pan-American Exposition.

It will produce as good a commercial light as that of an automatic steam engine, either belted or direct-connected generator. Simple, Economical and Reliable

Send for Catalogue W.

MARINETTE GAS ENGINE CO.,
CHICAGO HEIGHTS, ILL.

AGENCIES:
Keystone Engineering Co., Farmer's Bank Bldg., Pittsburg, Pa.
Strong, Carlisle & Hammond Co., 61-67 Frankfort St., Cleveland, Ohio
Mackay Engineering Co., 149 Broadway, N. Y.
C. H. Seidenglanz., 52 Wheu Bldg., Indianapolis, Ind.

The Electrician Publishing Co., 510 Marquette Bldg., Chicago. Headquarters for all latest Electrical Books. Write for Catalogue.

JEFFREY Elevating, Conveying, Power Transmission, Screening, Crushing Dredging, Rock and Coal Drilling, Coal Cutting, Hauling and Washing Machinery.
OUR CATALOGUES ARE YOURS FOR THE ASKING.
The JEFFREY MANUFACTURING CO., Columbus, O., U. S. A.

BUY Your Electrical Books of the **Electrician Publishing Co., Suite 510 Marquette Bldg., Chicago.** You will save **TIME** and **MONEY** by doing so. . . . . .

REG. TRADE MARKS

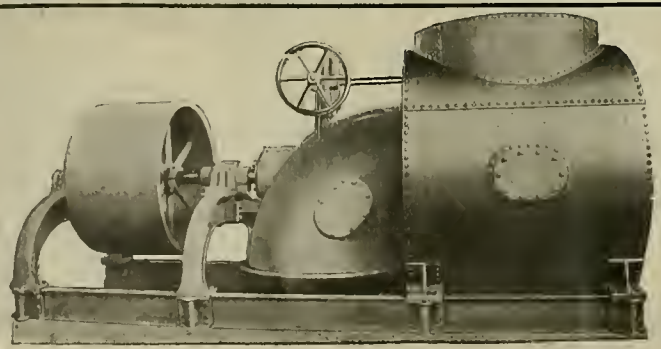
"Phosphor Bronze" DELTA

THE PHOSPHOR BRONZE SMELTING CO. LIMITED,
2200 WASHINGTON AVE., PHILADELPHIA.
"ELEPHANT BRAND PHOSPHOR-BRONZE"
INGOTS, CASTINGS, WIRE, RODS, SHEETS, ETC.
— DELTA METAL —
CASTINGS, STAMPINGS AND FORGINGS
ORIGINAL AND SOLE MAKERS IN THE U.S.

There's No Friction

with the Fibre-Graphite Commutator Brush. Being 90 per cent. pure graphite, it insures low resistance, no sparking under a varying load, and longer wear. There is no greasing required. The Fibre-Graphite is therefore the most economic brush on the market. Send for price list.

HOLMES FIBRE-GRAPHITE MFG. CO.
5155 Wakefield St., Germantown, PHILADELPHIA.



SAMSON TURBINE

The EASE and QUICKNESS with which the gates on the SAMSON are operated make that turbine especially desirable for use where the SPEED of the turbine is to be controlled by a GOVERNOR. CLOSE REGULATION is assured.

WRITE DEPT. D FOR CATALOG

JAMES LEFFEL & CO.

SPRINGFIELD, OHIO U. S. A.

THE MONTH OF SEPTEMBER 1904

will be a memorable one in electrical circles.

The International Electrical Congress,

The American Institute of Electrical Engineers,

The National Electrical Contractors' Association,

The Northwestern Electrical Association,

The International Association of Municipal Electricians,

The American Electrochemical Society,

The American Electrotherapeutic Association.

will all meet in St. Louis during the week beginning September 12th. The Independent Telephone Association of the U. S. will be held in St. Louis beginning September 21. A number of State conventions will also be held during the month.

The September issues of the WESTERN ELECTRICIAN, therefore, will prove unusually interesting to everyone in any way connected with the trade.

Advertisers will find these numbers well worthy of extra space, and it will pay those not regularly represented to begin a standing card now.

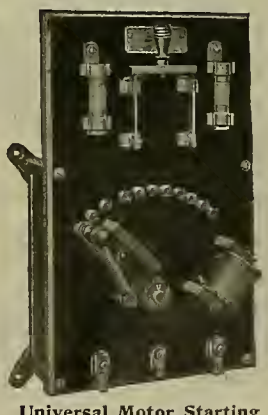
WESTERN ELECTRICIAN, 510 MARQUETTE BLDG., CHICAGO.

General Electric Company

RHEOSTATS

Field Rheostat Front Connected.

The General Electric Company can furnish Rheostats to meet every condition of service.



Universal Motor Starting Rheostat.

Write for further information.

General Office: SCHENECTADY, N. Y.

Chicago Office: Monadnock Block. Sales offices in all large cities.

HAVE YOU SEEN
OUR NEW
PRICE LIST
ON
PORCELAIN
KNOBS TUBES CLEATS
Don't Overlook It
ELECTRIC APPLIANCE COMPANY
CHICAGO AND SAN FRANCISCO

EDISON MINIATURE LAMPS

Have been for twenty years
The Standard of the World
and are to-day more largely used than all other makes combined.
Serviceable, Economical, Reliable.
Miniature and Candelabra Sockets and Receptacles.
EDISON DECORATIVE & MINIATURE LAMP DEPT.,
General Electric Company, Harrison, N. J.

W. D. PAINT.
A PERMANENT INSULATING PROTECTION FOR WOOD OR METAL. A quick drying, moisture-proofing, black paint. An elastic anti-rust coating. A jet black finishing paint, efficient and not expensive.
Write for "Data on Insulating Materials."
DIELECTRIC MANUFACTURING CO., SAINT LOUIS.

VOLT - AMMETERS,
POCKET SIZE.
For Testing Batteries and Battery Circuits, Locating Faults, Grounds, etc.
RELIABLE. ACCURATE.
Send for Circular.
L. M. PIGNOLET,
78-80 Cortlandt St., NEW YORK, N. Y.

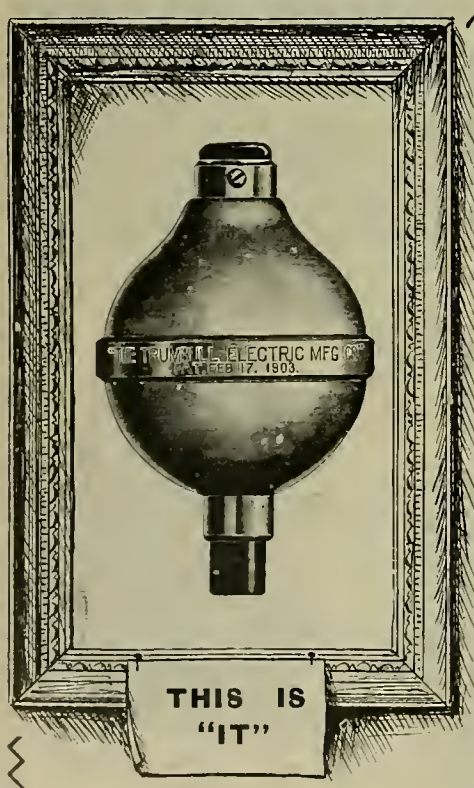
Engineering TAUGHT BY CORRESPONDENCE
Our system of training by mail has helped thousands hold down in poor positions to rise to better salaries and situations. Your chance to rise is just as good as others. Write for our free illustrated book, "Can I Become An Electrical Engineer?" We teach by mail, Electrical Engineering, Mechanical Engineering, Steam Engineering, Mechanical Drawing, Electric Lighting, Electric Railways. ELECTRICAL ENGINEER INSTITUTE, Dept. K 240 West 23rd St., New York.

BEARDSLEE CHANDELIER M'F'G CO. 256 AND 257 SO. CANAL ST. CHICAGO
GAS & ELECTRIC FIXTURES FOR THE TRADE.
CATALOG SENT PREPAID TO DEALERS MENTION THIS PAPER

WANTED
You Who are Troubled with Sparking and Cutting of Commutators to Use

The only article that will PREVENT SPARKING. Will keep the commutator in good condition and PREVENT CUTTING.
Absolutely will Not Gum The Brushes . . .
It will put that high gloss on the commutator you have so long sought after.
50 Cts. per Stick. $5.00 per Dozen.
For Sale by all Supply Houses, or
FREE, Sample Stick. K. McLENNAN & CO., Sole Manufacturers, Room 411 Inter Ocean Bldg., 130 Dearborn St., CHICAGO, ILL.

MICA Of all Qualities, in any Form at Lowest Prices
EUGENE MUNSELL AND CO.
NEW YORK and CHICAGO
INSULATION That Is.
Micanite, Linotape, M. I. C. Compound, Empire Cloth and Paper. For Years the Standard.
MICA INSULATOR CO., Originators
NEW YORK and CHICAGO



THIS IS "IT"

A NEW PENDANT SWITCH.

We now have ready for delivery in any quantity our NEW PENDANT SWITCH. The following are some of its noteworthy features:

CHEAP,
DURABLE,
EFFICIENT.

Has only one button to operate. Neat in appearance.

Guaranteed to operate successfully at its rated capacity (10-ampere, 125 volts) 10,000 times without injury. Any switch failing to come up to this standard will be replaced free of charge.

The switch is a 10-ampere snap switch of a special design, positive in action, easy to operate.

Standard finish, nickel plated or polished brass. Made in one size only
IT WILL PAY YOU TO LOOK INTO THIS SWITCH.

HIGH GRADE
THE TRUMBULL ELECTRIC MFG. CO.
PLAINVILLE, CONN.
ELECTRICAL SPECIALTIES
Manufacturers of Electrical Supplies. New York Office, 136 Liberty St.

MICA and MICABOND.
WE PUT THE MICA-POOL OUT OF BUSINESS.
CHICAGO MICA CO., VALPARAISO, IND.

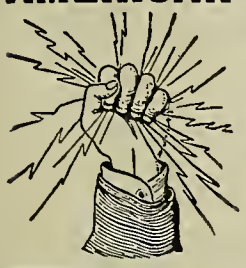
USE
"SAFETY" RUBBER COVERED
WIRE AND CABLE
FOR EVERY ELECTRICAL SERVICE.
M. B. AUSTIN & CO.,
CHICAGO REPRESENTATIVE.
THE SAFETY INSULATED WIRE & CABLE CO.,
WORKS: Bayonne, N. J. 114-116 LIBERTY STREET, N. Y.

127 FULTON STREET CHICAGO
SIGNS
For Signs, Letters, Flashers, Dimmers, Timeswitches, Lamps, Rubberrings and anything pertaining to Signs,
—WRITE TO—
HALLER MACHINE COMPANY
Designers and Manufacturers, of Sheetmetal, Electric and Machinery Specialties

FRANK N. PHILLIPS, PRESIDENT. O. H. WAGENSEIL, TREASURER. EUGENE F. PHILLIPS, GENERAL MANAGER. E. ROWLAND PHILLIPS, VICE-PRES. C. H. REMINGTON, JR., SEC.

AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.

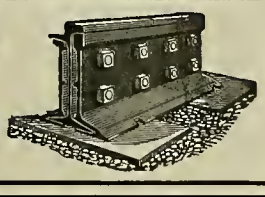


BARE AND INSULATED ELECTRIC WIRE,
ELECTRIC LIGHT LINE WIRE,
INCANDESCENT AND FLEXIBLE CORDS,
Railway Feeder and Trolley Wire,
AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR WIRES.
CABLES FOR AERIAL AND UNDERGROUND USE.

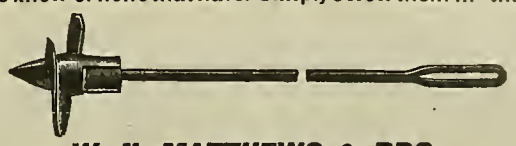
NEW YORK STORE, W. J. Watson, 26 Cortlandt St.
CHICAGO STORE, F. E. Donohoe, 82 Lake St.
MONTREAL BRANCH, Eugene F. Phillips' Electrical Works.
MAIN OFFICES AND FACTORIES, PHILLIPSDALE, R. I.

CONTINUOUS RAIL JOINT CO. OF AM.

GENERAL OFFICES: CENTURY BUILDING
NEWARK, N. J.
OVER 20,000 MILES IN USE
Highest Award at Paris Exposition, 1900, Buffalo, 1901



FIVE YEARS AGO
WE SAID:
"STOMBAUGH GUY ANCHORS NEVER PULL UP,"
And we know of none that have. Simply screw them in—that's all.



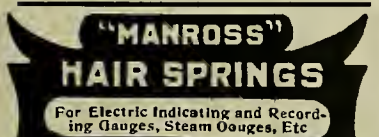
W. N. MATTHEWS & BRO.
Distributers
603 CARLETON BUILDING *ST. LOUIS*

EXPERT IN ELECTRICITY MECHANICS PATENT CAUSES
SOLICITOR OF **PATENTS**
U. S. & FOREIGN
FORÉE BAIN, 1652-3 Monadnock Blk., CHICAGO

SINGLE AND POLYPHASE
TRANSFORMERS
KUHLMAN ELECTRIC CO., - - Elkhart, Ind.

THE STATE UNIVERSITY OF IOWA
SCHOOL OF APPLIED SCIENCE, Iowa City, Iowa
Four year courses of the highest grade in
Civil
Municipal
Sanitary
Electrical
Mechanical
Mining
ENGINEERING
Numerous short practical courses. Special courses in technical chemistry, bacteriology, etc. Adequate equipment in shops and laboratories. Waterpower.
University environment. Expenses low.
Address C. E. MacLEAN, President

"MANROSS"
HAIR SPRINGS
For Electric Indicating and Recording Gauges, Steam Gauges, Etc

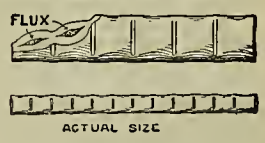


LARGEST MANUFACTURER OF HAIR SPRINGS in the United States.
F. N. MANROSS,
FORESTVILLE, CONN.

ADJUST YOUR LIGHT
by means of our
Wall, Desk, Floor or Ceiling Adjustable Fixtures
TO ANY DESIRED POSITION INSTANTLY.

Many shapes and styles—plain and ornamental—for shop, factory, store, office, residence—in fact, wherever the incandescent lamp is used.
Catalog mailed upon request.
FARIES MFG. CO.,
DECATUR, ILL.

KESTER
SELF FLUXING SOLDER
A Tube of Solder Filled with Flux.
Requires no Acid.
SAVES—LABOR—TIME—MONEY.



PATENTED.
Send for Free Samples.
L. F. Mahler Co., R. 1008 Chemical Bldg., St. Louis, Mo., Gen. Western Agent.
KESTER ELECTRIC M'F'G CO.,
46 N. UNION STREET, CHICAGO, ILL.

Electric Heating Apparatus
SEND FOR 32-PAGE CATALOGUE.
"UNIT" ENAMELED RHEOSTATS
SIMPLEX ELECTRIC HEATING CO.,
Cambridgeport, Mass.

Crimshaw

Raven White Core

Raven Black Core

ALL OUR WIRES pass inspection and carry the above TRADE-MARKS on our tags. We also manufacture Crimshaw and Competition Tapes and Splicing Compounds.

NEW YORK INSULATED WIRE COMPANY.

MAIN OFFICE: 114, 116 & 118 Liberty St., New York.
BRANCHES: CHICAGO: 192 Desplaines St. BOSTON: 7 Otis St. SAN FRANCISCO: 33 Second St.

NATIONAL CODE STANDARD

"O. K." Weatherproof Wire.
Slow-Burning Weatherproof and Ideal Wire.
Prices and Samples on Application.

Phillips Insulated Wire Co.
Office and Factory: PAWTUCKET, R. I.

HORNBERGER-IRWIN
Transformers
(LARGE AND SMALL)
½ K. W. to 500 K. W.
This transformer represents the latest improvements in transformer construction; made in three types; multi-coil construction; ventilated cores; built for all commercial voltages and frequencies; **higher efficiencies together with lower temperatures than have heretofore been attained are guaranteed.**
Catalogue just issued explains details.
Manufactured by
Crawfordsville Electric Co.
CRAWFORDSVILLE, INDIANA, U. S. A.

WANTED, FOR SALE *and similar* **WANT COLUMN** *advertisements (50 words or less), $1.50 an insertion; additional words 3c each.* **POSITION WANTED** *advertisements (50 words or less), $1.00 an insertion; additional words 2c each.*

POSITION WANTED.

Who can use services of man age 31, speaki g English and German, industrious, 10 years' practical experience as all-around electrician on electrical apparatus in D. C. plants? Competent mechanic on dynamos, motors, wind armatures, wiring, arc lamps, telephones, etc. Student International Cor. School. Have good references. Don't want job if services prove unsatisfactory. Address M. SCHMIDT, 288 Belden Ave., Chicago, Ill.

POSITION WANTED.

By a man experienced in central station management and operation. Address BOX 387, care Western Electrician, 510 Marquette Bldg., Chicago, Ill.

WANTED.

Head engineer in electric-light and power station of 500 H. P. steam capacity and 200 H. P. water power. City of 13,000 inhabitants in Southern Wisconsin. Address BOX 386, care of Western Electrician, 510 Marquette Bldg., Chicago.

WANTED.

Young man, correspondence student preferred, to fire, run and operate a 1,500-light A.C. plant in small town in Colorado. $50.00. Also engineer as above for third watch of eight hours in 6,000-light plant. $50.00. Address BOX 119, Grand Island, Neb.

FOR SALE.

A bargain; I. T. H. 30-light 9.6 Amp. Series open arc machine, with wall controller and ammeter complete, good running order.

Twenty-two 9.6 Amp. double carbon open arc lamps with glass, hoods and spreader complete, good order. Several additional lamps, both single and double, can be put in good order or parts used for repairs. A lot of extra globes and parts and a supply of carbons will be included if taken as a whole.

Two 30-K. W. Edison Bipolar 125-volt D. C. generators in fine running order. Reason for selling, have put in larger machinery.

CARROLL ELECTRIC LIGHT & POWER COMPANY, Carroll, Iowa.

We are in position to sell electric-light plants with good franchise and contract and on good paying basis. None too small, none too large. Address,

J. S. MAURER & CO.
804 Monadnock Bldg., Chicago, Ill.

REPAIRING RECALIBRATING

ELECTRIC METERS.
INTERNATIONAL ELECTRIC METER CO.
167 S. CANAL STREET, CHICAGO.

FOR SALE.

ALTERNATORS.

1-360 K. W. General Electric 3-phase.
1-120 " " " "
1-75 " Westinghouse 2-phase.

250-VOLT GENERATORS.

1-250 K. W. Western Electric M. P.
1-200 " Eddy M. P.

125-VOLT GENERATORS.

1-125 K. W. Western Electric M. P.

Immediate shipment.

GREGORY ELECTRIC CO.
54-62 S. CLINTON ST. CHICAGO

Practical Running of Dynamos.

A little booklet on the care and the locating and remedying of troubles in dynamos and motors.

Price, 10 Cents.

Catalogue of mechanical and electrical books free.

ELECTRICIAN PUBLISHING COMPANY,
510 Marquette Bldg., Chicago.

WE PAY

highest market prices for scrap copper, brass and platinum, also incandescent lamp bases, etc. You can make

BIG MONEY

in scrap of this kind. Save it and send it to the Great Western Smelting and Refining Co., Chicago, headquarters

FOR SCRAP COPPER

YOST SPECIALTIES.

Sockets, Wall Sockets, Weatherproof Sockets, Rosettes, Receptacles, Cord Adjusters.

Catalogue for the asking.

THE YOST ELECTRIC MFG. CO.
TOLEDO, OHIO.

HELP

Secured quickly through Western Electrician "Help Wanted" ads.

INDUSTRIES ARE OFFERED LOCATIONS

WITH

Satisfactory Inducements,
Favorable Freight Rates,
Good Labor Conditions,
Healthful Communities,

ON THE LINES OF

THE ILLINOIS CENTRAL R. R.
AND THE
YAZOO & MISSISSIPPI VALLEY R. R.

For full information and descriptive pamphlet address

J. C. CLAIR,
Industrial Commissioner,
1 Park Row, Chicago, Ill.

ELECTRIC SIGN FLASHERS

BEST IN THE WORLD
Write for full particulars
Reynolds Elec. Flasher Mfg. Co.
221 Fifth Ave., Chicago.

BOILERS.

One 42-in. x 15 ft. 9-in., 250 H. P. Worthington Water Tube.
One 60-in. x 16 ft., John Mohr Return Tubular Boiler.
One 54-in. x 16 ft., John Mohr Return Tubular Boiler.
One 54-in. x 16 ft., Devine Tubular Boiler.

ENGINES.

One 600 H. P., 21 x 36 x 30, Williams Tandem Horizontal Compound, 140 R. P. M.
Two 600 H. P., 20 x 30 x 24, Porter-Allen Tandem Compound, 200 R. P. M.
One 250 H. P., 12 x 24 x 18 Williams Tandem Compound, 250 R. P. M.
Two 100 H. P., 13 x 12, Dick & Church, High Speed Automatic.

PARTIAL LIST ONLY.

Send for latest Catalogue for bargains in Engines, Boilers, Dynamos and Motors.

CENTRAL STATION IMPROVEMENT CO., 938 Monadnock Block, Chicago

WEATHERPROOF WIRE

"ONE OF OUR 61 VARIETIES."

Large Quantities Carried Regularly in Toledo Stock

We also carry large stocks of other wires for both lighting and telephone work. Write for Bulletin W 6.

OUR BULL FROG FLAMEPROOF WIRE
for telephone switchboard work positively will not carry flame.

THE F. BISSELL COMPANY
Manufacturers and Jobbers of
ELECTRICAL GOODS
226-228-230 HURON STREET
TOLEDO, O.

National Electric Company

builders of high-grade Electrical Machinery for LIGHTING, POWER and RAILWAY SERVICE

500 K. W. Engine Type Alternator Frame.

General Sales Offices and Works: MILWAUKEE

NEW YORK: 135 Broadway
CHICAGO: Old Colony Building
PHILADELPHIA: 1509 Land Title Bldg.
PITTSBURG: Gellatly & Co.
CHARLESTON, W. VA.: Agnew Electric Co.
SEATTLE & SAN FRANCISCO: Kilbourne & Clark Co.

CHICAGO EDISON COMPANY REPAIR SHOPS

76 MARKET STREET, CHICAGO. TELEPHONE MAIN 1280.

Machine and Carpenter Work of All Kinds Correspondence Solicited.

OPEN DAY AND NIGHT.

FIRST-CLASS EQUIPMENT THROUCHOUT.

Dynamos Armatures, Motors, Arc Lamps, Fans, Instruments.

ARNOLD ELECTRIC POWER STATION Co.
Engineers, Constructors for Complete Electric Plants. Results Guaranteed.
SUITE 1539, MARQUETTE BLDG., CHICAGO. NEW YORK OFFICE: 711 TRANSIT BLDG.

E. W. Hammer, Pres. and Treas. H. J. Minhinnick, Sec. and Gen'l Supt.
GENERAL ENGINEERING Co., THE Consulting and Contracting Engineers.
Telephones, Electric Light, Power Transmission
Suite 1112, 135 ADAMS ST., CHICAGO.
Long Distance Telepho. e Central 478.

ROBERT W. HUNT & Co., ENGINEERS
1121 The Rookery, Chicago. 66 Broadway, New York.
Monongahela Bank Bldg., Pittsburg. Norfolk House, Cannon St., London.

SARGENT & LUNDY, ENGINEERS,
RAILWAY EXCHANGE,
Cor. Jackson and Michigan Boulevards, CHICAGO.
FREDERICK SARGENT. A. D. LUNDY.

W. B BAKER. H. B. BISHOP.
BAKER, W. E. & CO.
ENGINEERS,
ELECTRIC RAILWAYS.
27 William St., NEW YORK.

ENGINEERS
Represented in this "Directory" are enabled to come in touch with many prospective customers who cannot be reached through any other source.

KEMP, R. W.
Consulting and Contracting Telephone Engineer.
Plans and specification for complete plants. Old plants overhauled and placed on paying basis. Territory, Kansas, Oklahoma and Indian Territory.
WELLINGTON, - - - KANSAS.

Long Distance Phone Central 2448.
SCHOTT, W. H.,
ENGINEER AND CONTRACTOR,
SPECIALTIES—Central Station Heating Plants, Water Works Steam Plants, Electric Light, Gas and Street Railway Plants.
1220-21 MARQUETTE BUILDING, CHICAGO.

BRYAN, WILLIAM H.
M. Am. Soc. M. E.,
Consulting Mechanical and Electrical Engineer.
Lincoln Trust Building, ST. LOUIS.

J. H. HALLBERG
Consulting Arc Lighting Expert and Practical Electrical Engineer
45 Broadway - NEW YORK
Room 169A

KOHLER BROS.,
Contracting Electrical Engineers, Lighting Power Railways,
1804-1806-1808-1810-1812 Fisher Building, CHICAGO.

STANTON, LE ROY W.
Consulting Telephone Engineer.
Plans, Specifications and Supervision of Installation of complete telephone plants.
Special Reports on Telephone Properties and Apparatus.
411 Electrical Bldg., Cleveland, Ohio.

BYLLESBY, H. M. & Co.
(Incorporated)
ENGINEERS
Design, Construct and Operate Railway, Light, Power and Hydraulic Plants.
Examinations and Reports.
New York Life Building, - CHICAGO, ILL.

HORNADAY, J. P. & Co.
SUITE 1108 TRACTION BUILDING
CINCINNATI, O.
WATERWORKS, ELECTRIC RAILWAY, LIGHT, TRACTION, INDUSTRIAL AND MINERAL PROPERTIES BOUGHT AND SOLD

RUEBEL - SCHWEDTMANN-WELLS,
CONSULTING, MECHANICAL AND ELECTRICAL ENGINEERS,
Suite 801 Chemical Building, ST. LOUIS, U. S. A.

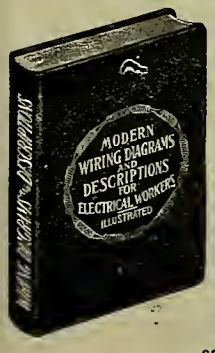
Telephone Main 3123.
WILMERDING, C. H.
CONSULTING ENGINEER
1100 Old Colony Bldg., CHICAGO.

DUGALD C. JACKSON, C. E.
WILLIAM B. JACKSON, M. E.
MEMBERS
AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS
AMERICAN SOCIETY OF MECHANICAL ENGINEERS
AMERICAN SOCIETY OF CIVIL ENGINEERS
ENGINEERS. EXPERTS.
MADISON, WIS.

ALL Live men read the WESTERN ELECTRICIAN Each Week. Do You?

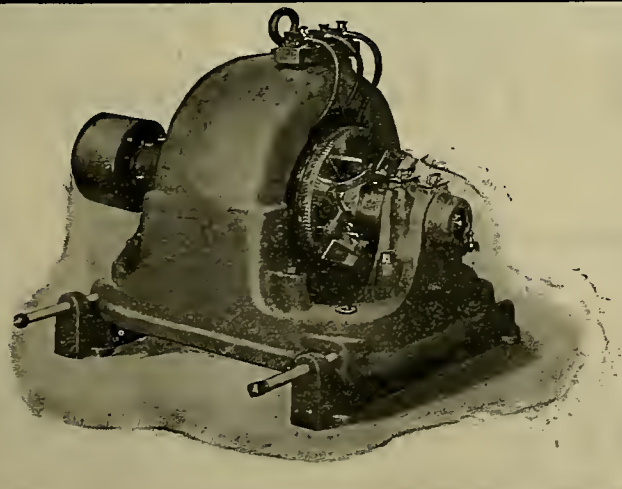
PLACE YOUR "Want" and "For Sale" advertisements in the WESTERN ELECTRICIAN. Immediate Returns.

READ THE BLUE ELECTRICAL PAPER.



A PRACTICAL BOOK
FOR PRACTICAL MEN
"MODERN WIRING DIAGRAMS AND DESCRIPTIONS FOR ELECTRICAL WORKERS."
By Henry C. Horstmann and Victor H. Tousley. 160 pages, over 200 illustrations. Full leather binding, red edges. Pocket size 4 x 6. Price, net, $150.
A work that not only tells you how to do it, but shows you.
THIS BOOK tells how to wire for call and alarm bells. For burglar and fire alarm. How to run bells from dynamo current. How to install and manage batteries. How to test batteries. How to test circuits. How to wire for annunciators; for telegraph and gas lighting. It tells how to locate "trouble" and "ring out" circuits. It tells about meters and transformers. It contains 30 diagrams of electric lighting circuits alone. It explains dynamos and motors; alternating and direct current. It gives 10 diagrams of ground detectors alone. It gives "Compensator" and Storage Battery installation. It gives simple and explicit explanations of the "Wheatstone Bridge," and its uses as well as volt-meter and other testing. It gives a new and simple wiring table, covering all voltages and all losses or distances, etc., etc.
SENT PREPAID ON RECEIPT OF PRICE
ELECTRICIAN PUBLISHING CO.
510 Marquette Building, Chicago

WESTERN ELECTRICAL SUPPLY CO.,
ENGINEERS AND BUILDERS
OF
Electric Railways, Lighting and Power Plants.
Western Electrical Supply Co.,
Chemical Building, - - ST. LOUIS, U. S. A.
Estimates Furnished.



CENTRAL STATION MANAGERS
Don't Be Afraid
of the Gas Plant
WORK UP A MOTOR LOAD
We can furnish you
SINGLE PHASE MOTORS
that will start under full load in sizes ranging from 1/8 to 35 H. P.
Wagner Electric Mfg. Co.
ST. LOUIS, MO., U. S. A.

Telephone Booths

—COST NOTHING—

After a few days' service, increase of receipts pay for them. We make booths of all kinds.

WRITE FOR CATALOG.

W. S. SEAMAN & CO.,
218 E. Water Street
MILWAUKEE · WISCONSIN

BITUMINIZED FIBRE CONDUIT

FOR

ELECTRICAL UNDERGROUND CONSTRUCTION
ELECTROLYSIS PROOF WATER PROOF

A smooth laminated insulator of unchanging durability.
Forms a continuous sealed duct from manhole to manhole, impervious to moisture and through which leaking gas cannot penetrate.
There has never been a gas explosion in our conduits nor the slightest evidence of electrolysis.
Abrasion of the cables is an impossibility.
It saves sixty per centum of freight and handling cost and twenty to thirty-five per centum of construction.
Process of laying is simple, rapid and inexpensive. There is no loss from breakage or fitting. It is self-aligning and cannot settle out of alignment.
All sizes from one inch to ten inches interior diameter. Bends of all angles.
The foremost electrical engineers are recognizing and testifying to the scientific advantages of our system of subway construction over all previous methods.

Send for illustrated book. Ask for prices giving size and quantities required

PROMPT DELIVERIES

FACTORIES: Philadelphia, Chicago, Los Angeles

American Conduit Company

SEVENTH FLOOR, 170 BROADWAY, NEW YORK

336 Macy St., Los Angeles, Cal. *Manhattan Bldg., Chicago*

SOMETHING NEW

A. B. C.

...OF...

ELECTRICAL EXPERIMENTS

BY W. J. CLARKE.

This is a practical, up-to-date, elementary book for the boy or student interested in electricity, and fills a long felt want. It tells in plain language how to make and experiment with Batteries, Magnets, Telegraph, Telephone, Electric Bells, Induction Coils, X Rays, *Wireless Telegraphy*, Dynamos and Motors.

146 Pages. 129 Ills. Cloth.
PRICE, $1.00.

Sent postage paid, on receipt of price.

ELECTRICIAN PUBLISHING CO.,
510 MARQUETTE BLDG., CHICAGO.

Standard Vitrified Conduit Co.

B. B. BARNARD, Manager

39-41 CORTLANDT ST.
NEW YORK

LARGEST FACTORIES IN THE WORLD : STOCK ON HAND
SEND FOR CATALOGUE

INTERNATIONAL

Mechanical Self-Restoring Drop Switchboard.

A PERFECT APPARATUS.

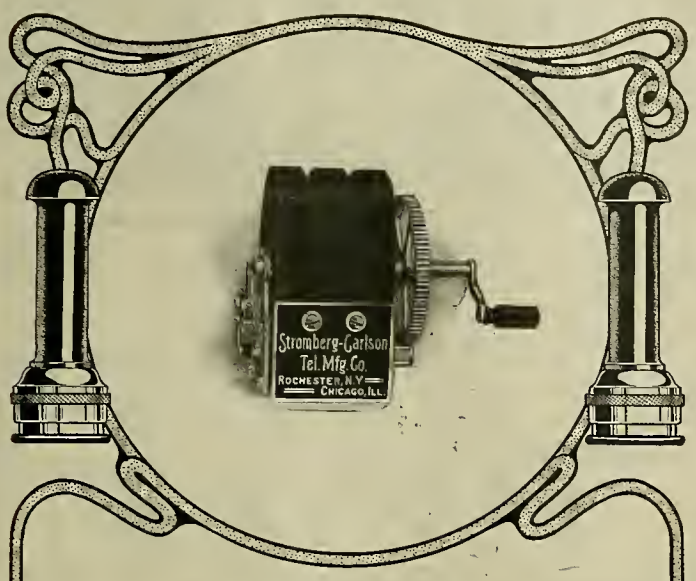
Made in any desired capacity.
Sample parts and quotations on request.

INTERNATIONAL TELEPHONE MANUFACTURING CO.
CHICAGO, U. S. A.

Automatic Telephones.

Privacy
Promptness
Precision
Profits.

Automatic Electric Co., Chicago, U. S. A.



Standard three-bar generator, same as used in our series telephones. We have manufactured generators since we first started in business. What this experience means to you enables us to sell the best generator made at a price slightly above the ordinary. The difference is caused by the better grade of material used and the superior workmanship.

You pay nothing for our experience. Our Bulletin No. 11-E explains fully this apparatus. Mailed free.

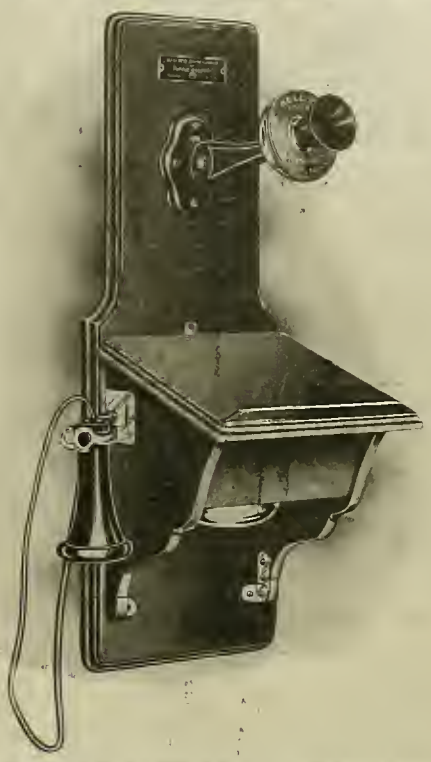
Stromberg-Carlson Telephone Mfg. Co.

GENERAL AND EASTERN OFFICE
ROCHESTER, N. Y.

SALES DEPT.
CHICAGO, ILL.

KELLOGG SWITCHBOARD & SUPPLY CO.

Manufacturers of the Largest and Busiest Telephone Exchanges in the United States



The Kellogg Transmitter stands first in volume, clearness of articulation and in carrying power. Our prices are low when cost of maintenance and quality of apparatus are considered. Do not fail to visit our exhibit in the Electricity Building at the St. Louis Exposition.

Kellogg Switchboard & Supply Co., Green and Congress Streets - CHICAGO

Seymoor Bldg., Los Angeles Electric Bldg., Cleveland Keystone Telephone Bldg., Philadelphia

AS SIMPLE AS ITS NAME.

A B C

—OF—

THE TELEPHONE

By J. E. HOMANS, A. M

352 pages.

Cloth, Price $1.00.

An up-to-date, practical treatise on the construction, theory, installation, care and management of telephones and their appliances.

Sent prepaid on receipt of price.

Electrician Publishing Co.,
510 Marquette Building, Chicago, Ill.

We introduced successful 4-party lines

LEICH SELECTIVE SYSTEM

Write for our booklet—"Selective W."

Impedance Coil for Selectives. No Springs.

CENTRAL ENERGY OR MAGNETO

AMERICAN ELECTRIC TELEPHONE CO.

CHICAGO, ILLINOIS

KILL TWO BIRDS WITH ONE STONE

Protect the Pole Line and you protect the Service

Minnesota Electric Co.
MINNEAPOLIS, MINN.

CENTRAL STATION HEATING

We are the originators and builders of the underground system of live and exhaust steam heating. Our system is used for the utilization and distribution of exhaust steam from electric and power plants for heating purposes. 250 Plants in successful operation. We have the only Meter System. Also manufacturers of Wooden Water Pipe, Steam Pipe Casing, Steam Traps, Condensation Meters, Valves, Economizing Coils, Separators and full line of Steam Fitters' Supplies.

WRITE FOR PAMPHLET AND PRICE LIST

AMERICAN DISTRICT STEAM COMPANY

MENTION WESTERN ELECTRICIAN. LOCKPORT, N.Y. CHICAGO, ILL.

PRODUCERS AND WHOLESALERS OF WHITE CEDAR PRODUCTS

CEDAR POLES

SPECIAL PRICES ON SMALL POLES.
Write for a copy of our TELEGRAPH CODE FOR CEDAR PRODUCTS

C. H. WORCESTER CO.
SUITE 1206 TRIBUNE BLDG. CHICAGO.

YARDS
KOSS MICH.
L'ANSE "
MUNISING "
ONTONAGON
WAGNER, WIS
PESHTIGO "

WHITE CEDAR POLES
Don't forget our Minnesota Transfer Yard—midway between St. Paul and Minneapolis, where we load in forty-eight hours from the time we have your order.
PAGE & HILL CO. 1003 Lumber Exchange, MINNEAPOLIS, MINN.

POLES—POSTS—PILING—TIES
Fowler-Jacobs Co.
Elmore-Fowler-Jacobs Co.
John H. Fowler & Co.
The FOWLER Companies
Fisher Building, - - CHICAGO

Cedar Poles.
Pittsburg and Lake Superior Iron Co. Producers and Wholesalers. Escanaba, Mich.

A Trip Through Yellowstone Park

is what everyone hopes to have—**some day**. It is the most wonderful trip in the world. There are more than 3,000 square miles of weird, marvelous, unimaginable things that can be seen nowhere else, therefore if one ever sees them one **must** go to the Park, in the heart of the magnificent Rockies with snow tipped peaks all around. If Old Faithful geyser, a Paint Pot, Mud Volcano, or Emerald Pool were to be found in Lincoln Park, Chicago; Central Park, New York; or Fairmount Park, Philadelphia; the people would flock to see it or them by tens of thousands. For a very small sum, comparatively, all these and hundreds more of nature's unduplicated marvels can be seen between June 1 and September 30, of each year, and one will enjoy, to boot, the best coaching trip in the country.

The **Northern Pacific** folder on Yellowstone Park, just issued, is a new, right up to date, finely illustrated dessertation on this Yellowstone Park trip. It is not descriptive, but deals with the detailed, technical matters everyone needs to know about such a trip. It tells all about the hotels, the stage coaches, the roads, the cost of the tour; where the geysers, the waterfalls, the bears, the canyons are, and where the trout fishing is found. We have printed thousands of this beautiful leaflet and want everybody interested to have a copy, and it can be obtained by sending A. M. Cleland, General Passenger Agent, St. Paul, Minn., **two cents** with proper address.

"Wonderland 1904" which is a very fine pamphlet of 116 pages, descriptive of the Northwest, including the Park, will be sent for **six cents.**

WORKS QUICK AND EASY. KEEPS ITS LUSTER. HOLDS OLD TRADE AND MAKES NEW. DOES NOT DETERIORATE. ESTABLISHED 16 YEARS. SOLD BY AGENTS AND DEALERS ALL OVER THE WORLD
U.S. METAL POLISH 3 OUNCE BOX 10 CENTS. SAMPLES SENT FREE
POLISHES ALL METALS. BRANCHES: NEW YORK CHICAGO SAN FRANCISCO 295 E. WASHINGTON ST. INDIANAPOLIS, IND. GEO. W. HOFFMAN

WHITE CEDAR POLES
HALL L. BROOKS
52 WISCONSIN AVENUE
TOMAHAWK, WIS.

Southern Cedar POLES Are the Best.
NO ROTTEN BUTTS.
D. W. PHELAN,
277 Broadway, New York

Locations for Industries
Erie Railroad
Chicago to New York

The Erie Railroad Company's Industrial Department has all the territory traversed by the railroad districted in relation to resources, adaptability, markets and advantages for manufacturing, and can advise with manufacturers in relation to the most suitable locations. For full information address

LUIS JACKSON
Industrial Commissioner, Erie Railroad Company
21 Cortlandt Street, New York

Points in Wisconsin and the Northwest

are covered by Wisconsin Central Railway's convenient, solid, wide vestibuled trains, equipped with Pullman sleepers, free reclining chair cars and modern coaches which leave Central Station, 12th Street and Park Row (Lake Front), Chicago for St. Paul, Minneapolis, Ashland and Duluth, connecting with all western lines. Meals in dining and cafe cars served a la carte.
For tickets and further information apply to nearest ticket agent, or write
JAS. C. POND, Gen'l Pass. Agt., Milwaukee, Wis.

Send your Book Orders to
ELECTRICIAN PUBLISHING CO.,
510 Marquette Bldg., Chicago.

POLE DEALERS ADVERTISING IN THE WESTERN ELECTRICIAN OBTAIN MOST EXCELLENT RESULTS BECAUSE IT PLACES THEM IN TOUCH WITH ACTUAL BUYERS OF POLES. TRY A CARD.

CEDAR POLES
ESTABLISHED 1862
WM. MUELLER COMPANY
1211-12-13 MARQUETTE BLDG. CHICAGO.
EIGHT DISTRIBUTING YARDS

CEDAR POLES
THE
Valentine-Clark Co.
234 La Salle Street, CHICAGO
YARDS:
Pinconning, Mich. : Green Bay, Wis. : New London, Wis.

MICHIGAN WHITE LARGE STOCK.
CEDAR POLES
PROMPT SHIPMENTS. KELLOGG SWITCHBOARD & SUPPLY CO., Chicago.

Possibly our promptness in shipping Poles has brought you to expect it of everybody.
Do you understand that we are just as prompt in shipping Ties?
Send us that rush order and we can prove it.
MALTBY CEDAR COMPANY, 509 Phoenix Block, Bay City, Michigan.
Tipper & Patton, Pittsburg Agents, 509 Bessemer Bldg.

POLES. WHITE CEDAR. IDAHO CEDAR up to 80 ft.
BERTHOLD & JENNINGS, ST. LOUIS. Chemical Building.
CROSS ARMS. LONG LEAF PINE AND FIR.

CEDAR POLES, POSTS, TIES,
H. M. LOUD'S SONS CO., Au Sable, Mich.

Idaho Cedar Poles
PACIFIC COAST POLE CO. SPOKANE, WASH.

Cedar TORREY CEDAR CO., CLINTONVILLE, WIS. Poles
Large Stock Constantly on Hand

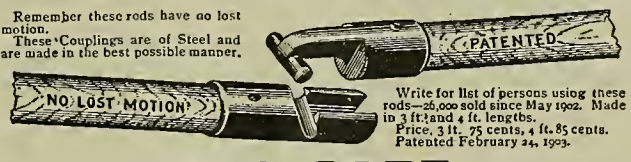
BRACKETS—X ARMS—PINS
little things it is true, but they cut a big figure in line construction.
OUR MOTTO IS:
Prompt Shipment Quality Satisfaction Right Price
COLUMBIA MFG. CO. ANTIGO, WIS.

The "WAY of the WORLD" to the WORLD'S FAIR.
BIG FOUR ROUTE to ST. LOUIS.
·1904·
Write for Folders & Booklets
M. E. INGALLS, PRESIDENT CINCINNATI WARREN J. LYNCH, G. P. & T. A.

POLES, TIES, POSTS. THE PORTER CEDAR CO., SAGINAW, MICH.
PRODUCERS. We want your inquiries always.

MICHIGAN AND WESTERN CEDAR POLES
ALL LENGTHS AND SIZES
LINDSLEY BROS CO.
TRIBUNE BLDG., CHICAGO

POLES W. C. STERLING & SON, MONROE, MICH. TIES.
Eleven Pole Yards in Michigan.
Wholesale Producers for 20 years

Cope's Patent Quick Coupling Conduit Rod
Remember these rods have no lost motion. These Couplings are of Steel and are made in the best possible manner.


Write for list of persons using these rods—26,000 sold since May 1902. Made in 3 ft. and 4 ft. lengths. Price, 3 ft. 75 cents, 4 ft. 85 cents. Patented February 24, 1903.
T. J. COPE
3244 North Fifteenth Street PHILADELPHIA, PA.

"By two or three witnesses shall a matter be established."

FIVE POINTS OF EXCELLENCE.

Leaving the center of the city from which you start; reaching the center of the city of your destination, over smooth and level tracks; giving rest and comfort; riding beside running waters most of the way, through the centers of population to the gateways of commerce; when you travel by the

NEW YORK CENTRAL LINES.

A copy of the illustrated Catalogue of the "Four Track Series" will be sent free upon receipt of a two-cent stamp by George H. Daniels, General Passenger Agent, Grand Central Station, New York.

There is No Higher-Class India-Rubber Insulation For Wires and Cables than
HABIRSHAW.
Authorized Manufacturers of the
ATTIX FLEXIBLE TUBE WIRE.
The India-Rubber and Gutta-Percha Insulating Co.,
MAIN OFFICE, Glenwood Works,
YONKERS, N. Y.
Sales Office, 15 Cortlandt St., New York.
(10923)

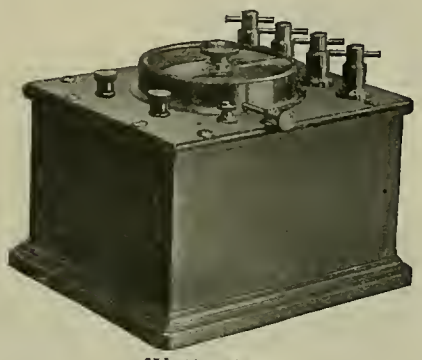
Westinghouse

Semi=Portable

Instruments of Precision

With Free Calibration Service

Voltmeter



Wattmeter

Ammeter

For Direct and Alternating Currents

The Instruments combine the accuracy of the best stationery laboratory instruments, with the convenience of the ordinary portable standards. Large open divisions of scale, equally legible over entire range. Vernier for reading fractional parts of divisions, and slow motion handle for fine adjustment. One of these precision instruments will do the work of several standards of different capacities of any other manufacture, and with an accuracy they cannot attain.

Free Calibration For five years the Westinghouse Department of Standards will check these instruments of precision free of charge, owner paying carriage only. Shipping case provided. Nominal charge for repairs. No delay in returning.

——Sole Manufacturers——

Westinghouse Electric & Mfg. Co.

Pittsburg, Pa.

For full particulars address our nearest District Office

New York, Atlanta, Dallas, Baltimore, Boston, Buffalo, Chicago, Cincinnati, Cleveland, Detroit, Los Angeles, Minneapolis, New Orleans, Philadelphia, Pittsburg, St. Louis, Salt Lake City, San Francisco, Syracuse, Seattle, Denver, Mountain Electric Co.
Canada: Canadian Westinghouse Co., Limited, Hamilton, Ontario. Mexico: G. & O. & Braniff Co., City of Mexico.

FORT WAYNE ELECTRIC WORKS
WOOD LIGHTING & POWER SYSTEMS
Fort Wayne, Ind.

Multiphase Revolving Field Alternators

We are now in the market with a complete line of belted and engine driven two and three phase alternators

Descriptive Literature
Now Ready

The Inspector
AND
Trouble Man.
By A. E. DOBBS.

Full of information and diagrams for the operator, exchange owner, exchange manager, inspector, trouble man, lineman.

A complete description of telephones and their troubles. How to find and remedy them, together with working plans for exchange construction, complete with diagrams of all up-to-date telephones and switchboards.

This is a practical book, written in **plain language**, and for **anyone** interested in telephony.

Mailed anywhere on receipt of price . . . ONE DOLLAR.

No technicalities. Substantially bound in cloth.

ELECTRICIAN PUBLISHING CO.,
510 MARQUETTE BUILDING, CHICAGO.

Good Advice

No. 5.

When you wish to ascertain which meter on the market will fill all of your requirements, viz., extreme accuracy, reliability of operation, freedom from weakening magnets, etc., don't be talked into adopting one because it is cheap or because it has been on the market for a long period. Send for a Duncan Direct Current Wattmeter and test it for yourself. It won't cost you a cent if you do not find it satisfactory in every respect.

Good Advice No. 6 Next Week.

Write for Bulletin and Prices.

DUNCAN ELECTRIC MFG. CO.
LAFAYETTE, IND.

"Diamond H"
Switches
Trade H Mark
This Trade-Mark guarantees quality.
The Hart Mfg. Co., Hartford, Conn.
New York Boston Chicago Toronto, Ont.

WIRES AND CABLES
HIGH-GRADE, RUBBER-COVERED, WEATHER-PROOF
MAGNET, OFFICE, ANNUNCIATOR WIRE.
HAZARD MANUFACTURING CO.,
GENERAL OFFICE AND WORKS, Wilkesbarre, Pa. NEW YORK OFFICE, 50 Dey St. CHICAGO OFFICE, 71 and 73 West Adams St

VULCANIZED FIBRE
Highest grades for electrical insulation and mechanical purposes, in sheets, tubes, rods and special shapes. Catalogues and samples on application.
VULCANIZED FIBRE CO., - Wilmington, Del.

KARTAVERT.
HARD AND FLEXIBLE FIBER IN SHEETS, RODS AND TUBING.
For Electrical and Mechanical Purposes, Railway Dust Guards, Washe and Packings. Patent Insulating Cleats.
MANUFACTURED BY
THE KARTAVERT MANUFACTURING CO. Wilmington, Del.

Crocker-Wheeler. Brown, Boveri.

By arrangement with the celebrated electrical engineers, Brown, Boveri & Cie. of Baden, Switzerland, the Crocker-Wheeler Company has secured their alternating current designs, patents and rights to manufacture in America, and has retained them as consulting engineers.

Crocker-Wheeler Company is now putting on the market alternating current generators, transformers and accessories of the most perfect design and construction, adapted to American practice. Opportunities to bid on this apparatus are invited.

STURTEVANT MOTORS

All Types, Sizes and Capacities to Meet Any Requirements

B. F. STURTEVANT CO.
Boston, Massachusetts
General Office and Works: Hyde Park, Mass.
New York Philadelphia Chicago London
364

Black Diamond File Works
Est. 1863. Inc. 1895.
Twelve Medals Awarded at International Expositions
TRADE MARK
Special Prize Gold Medal at Atlanta, 1895.
OUR GOODS ARE ON SALE IN EVERY LEADING HARDWARE STORE IN THE UNITED STATES AND CANADA.
G. & H. BARNETT COMPANY,
PHILADELPHIA, PA.

JOHN A. ROEBLING'S SONS CO.
Insulated Wire of All Kinds

Bare Copper Wire
MAIN OFFICE AND WORKS TRENTON, N. J.
AGENCIES AND BRANCHES
New York Chicago Cleveland San Francisco Philadelphia Atlanta

Western Electrician

Vol. XXXV. $3.00 Per Annum. Copyright, 1903, by Electrician Publishing Company, Chicago. CHICAGO, AUGUST 27, 1904. Entered at Chicago Postoffice as mail matter of the second class. 10 Cents a Copy. No. 9.

SIMPLEX INSULATED WIRES AND CABLES.
RUBBER COVERED, WEATHERPROOF, UNDERGROUND AND SUBMARINE.
WESTERN SELLING AGENT, H. R. PATTISON, 1144 Monadnock Block, CHICAGO.
The Simplex Electrical Co., 110 State Street, BOSTON, MASS.

N. I. R.
National India Rubber Co.'s
RUBBER COVERED
WIRES AND CABLES.
OFFICE AND FACTORY: BRISTOL, R. I.

OKONITE
TRADE
1889—Paris Exposition, Medal for Rubber Insulation.
1893—World's Fair, Medal for Rubber Insulation.
THE STANDARD FOR RUBBER INSULATION.
Sole Manufacturers of
Okonite Wires, Okonite Tape, Manson Tape, Candee Weather-proof Wires.
THE OKONITE CO., LTD.
Willard L. Candee, W. Durant Cheever, Managers. 253 Broadway, New York. Geo. T. Manson, Gen'l Supt. W. H. Hodgins, Secy.

TRADE MARK
CRESCENT INSULATED WIRE & CABLE CO. TRENTON, N. J.
CRESCENT RUBBER INSULATED WIRES AND CABLES
National Code Standard.
CRESCENT INSULATED WIRE AND CABLE CO.,
New York Office, 83 BARCLAY STREET. Main Office and Factory, TRENTON, N. J.

DRIVER-HARRIS WIRE CO.
HARRISON (NEWARK), N. J.
Manufacturers of Fine Sizes Wire of Every Description.
Resistance Wires a Specialty.

INDIANA RUBBER AND INSULATED WIRE CO.,
MANUFACTURERS OF
Paranite Rubber Covered Wires and Cables,
UNDERGROUND, AERIAL, SUBMARINE AND INSIDE USE:
TELEPHONE, TELEGRAPH AND FIRE ALARM CABLES.
All Wires are tested at Factory. JONESBORO, IND.

"CIRCULAR LOOM" THE FLEXIBLE CONDUIT
AMERICAN CIRCULAR LOOM CO.
TRADE MARK
REGISTERED
CONDUITS FOR INTERIOR WIRING.
American Circular Loom Co.
Chelsea, Mass., New York, Chicago, San Francisco.

THERMOPILES 1½ VOLTS 1½ AMPERES
For Electrolytic analysis, charging storage batteries, and other constant current requirements. $3 Each.
WALSH'S SONS & CO.,
264 Washington Street. Newark, N. J.

M. KLEIN & SON.
Send 2c stamp for new catalogue No. 6 of
KLEIN'S TOOLS
For Electrical Workers and Line Builders.
MATHIAS KLEIN & SONS.
81 W. Van Buren St., Chicago, Ill.

THOUSANDS IN USE.
Motors, ¼ h. p. to 100 h. p.
Dynamos, 1 k. w. to 75 k. w.
Highest Quality. Reasonable Price.
THE HOBART ELECTRIC MFG. CO.
TROY, OHIO.

I-T-E
CIRCUIT BREAKERS
CUTTER ELECTRICAL CO., PHILADELPHIA

YOST SPECIALTIES.

Sockets, Wall Sockets, Weatherproof Sockets, Rosettes, Receptacles, Cord Adjusters.
Catalogue for the asking.
THE YOST ELECTRIC MFG. CO.
TOLEDO, OHIO.

ELECTRIC SIGN FLASHERS
BEST IN THE WORLD
Write for full particulars
Reynolds Elec. Flasher Mfg. Co.
221 Fifth Ave., Chicago.

Sterling Black Plastic Insulator.
One hundred days' continuous baking at 180° F. will not make it brittle. Water repellent. Oil proof.
THE STERLING VARNISH CO., - - Pittsburg, Pa.

KESTER
SELF FLUXING SOLDER
A Tube of Solder Filled with Flux.
Requires no Acid.
SAVES—LABOR—TIME—MONEY.

PATENTED.
Send for Free Samples.
L. F. Mahler Co., R. 1008 Chemical Bldg., St. Louis, Mo., Gen. Western Agent.
KESTER ELECTRIC M'F'G CO.,
48 N. UNION STREET, CHICAGO, ILL.

EDISON PRIMARY BATTERIES FORMERLY EDISON LA LANDE
There is no deterioration in the permanent parts of these batteries. It follows, therefore, that each time a cell is recharged it will last as long a time and deliver as heavy a current as the original charge, when the cell was first put into service. Our catalogue No. 7 will tell you more about this. Let us send it.
EDISON MANUFACTURING CO.,
TRADE Thomas A Edison MARK
Factory, ORANGE, N. J.
NEW YORK, 83 Chambers St.
CHICAGO, 304 Wabash Ave.

Engineering MECHANICAL, ELECTRICAL, STEAM, CIVIL.
Complete and short courses. Thoroughly equipped engineering shops. Shop work from the beginning. Short courses in Steam and Electrical Engineering. Expenses low. Accommodations the best. School all year. Students may enter any time. Correspondence steam and electrical courses. Send for catalogue. Mention course in which interested.
HIGHLAND PARK COLLEGE, DES MOINES, IOWA.

Electric Heating Apparatus
SEND FOR 62-PAGE CATALOGUE.
"UNIT" ENAMELED RHEOSTATS
SIMPLEX ELECTRIC HEATING CO.,
Cambridgeport, Mass.

WESTON Electrical Instrument Co.,
Waverly Park, NEWARK, N. J.

Illuminated Dial Station Instruments.
These instruments are constructed upon the same general principle as our regular Standard Portable Direct Current Voltmeters and Ammeters, but are much larger, and the working parts are inclosed in a neatly designed, dust-proof cast-iron case which effectively shields the instruments from disturbing influences of external magnetic fields.
BERLIN—European Weston Electrical Instrument Co., Ritterstrasse No. 84.
PARIS, FRANCE—E. Hardy, 12 Rue St. Georges.

Weston Standard Illuminated Dial Potential Indicator, Style B.

Weston Standard
Portable Direct Reading Voltmeters and Millivoltmeters. Ammeters and Milliammeters, Wattmeters and Voltmeters, for Alternating and Direct Current Circuits.
Our portable instruments are recognized as standards throughout the civilized world.
Our Semi-Portable Laboratory Standard Voltmeters and Ammeters are still better.
They are the most reliable, absolute standards for Laboratory use.
LONDON—Elliott Bros., Century Works, Lewisham.
New York Office—74 Cortlandt St.

Sheet Brass, All Tempers
Brass and Bronze Drill Rods
Brass and Copper Wire
German Silver Sheet and Rod
Brazed and Seamless Tubing
Eagle Brand Copper Rivets and Burrs, Brass Escutcheon Pins
Brass Butts, Desk Narrow, Broad Middle, Ball Tipped and Water Closet
Brass and Iron Jack Chain, Brass Safety Chain, Etc.
Catalogues on Application
THE PLUME & ATWOOD MFG. CO.
New York Boston San Francisco Chicago

Allis-Chalmers Co
CHICAGO

"Big Reliable" Engine
at the
St. Louis Exposition

Largest Single Engine Ever Placed On Exhibition

Popularly Known At Exposition As "Big Reliable"

Allis-Chalmers 5,000 h. p. Engine and Bullock 3,500 k. w. Electric Generator, which furnish current for Decorative Lighting of Exposition Grounds and Buildings.

From the time steam was first turned on, this Engine has worked perfectly. It furnishes daily, in addition to the lighting work at night, 3,000 h. p. to the St. Louis Transit Company.

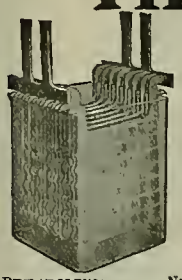
We build smaller Engines in sizes from 25 h. p. upward.

Bullock
Electric Mfg Co
Cincinnati

Canadian representatives, Allis-Chalmers-Bullock, Ltd., Montreal.

THE ELECTRIC STORAGE BATTERY CO.

PHILADELPHIA



MANUFACTURER OF THE

"Chloride Accumulator"

For Central Stations, Electric Railways, Isolated Lighting and Power Stations, Fire Alarm, Telegraph, Train Lighting, etc., etc.

PRICE LISTS AND DESCRIPTIVE BULLETINS FORWARDED UPON REQUEST.

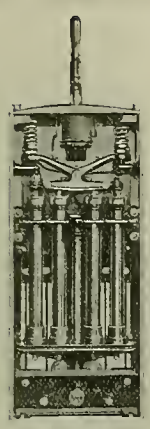
SALES OFFICES:

PHILADELPHIA, Allegheny Ave. and 19th St. | NEW YORK, 100 Broadway, | BOSTON, 60 State St. | CHICAGO, Marquette Bldg. | ST. LOUIS, Walnwright Bldg. | SAN FRANCISCO, Rialto Bldg. | CLEVELAND, Citizens Bldg. | CANADA, Canadian General Electric Co., Ltd. Toronto | HAVANA, CUBA, G. F. Greenwood, Manager 34 Empedrado St.

Allen-Bradley Electric Crane Controllers

Patented

Front View—before starting



Rear View

Front View—all resistance out

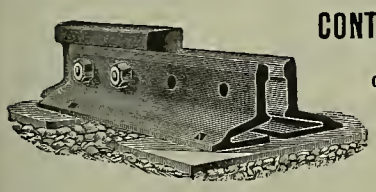
Manufactured by AMERICAN ELECTRIC FUSE CO., Chicago

A New Controller. Positively No Sparking. No Repairs. Guaranteed for One Year. Three Months' Free Trial. Perfect Control.

OUR GUARANTEE: Ask any Other Manufacturer to Duplicate It.

THE AMERICAN ELECTRIC FUSE COMPANY hereby guarantees to..... that it will at any time within three months from this date upon damand repay to said..... the sum of..... .....Dollars, being the full purchase price paid (or agreed to be paid) by said..... to the American Electric Fuse Company for one..... horsepower Allen-Bradley Crane Controller, number.....upon delivery within three months after this date of said controller, freight prapaid and in good condition, ordinary wear and tear from use excepted, at the office of the American Electric Fuse Company, Chicago, Illinois, together with a written statement that said controller has provad unsatisfactory to said .....

FURTHERMORE, the said American Electric Fuse Company agrees that it will at any time within one year from this date replace, without charge, aoy part of said controller which may prove defective or wear out during the ordinary use of said controller, provided that it is a condition of this guarantee that said..... hereby agrees to use ordinary care in the operation of said controller, and that said controller will be operated by some person, or persons, familiar with the use of crane controllers, and further that said controller will not be wilfully or maliciously injured while in the possession of said.....



CONTINUOUS RAIL JOINT COMPANY OF AMERICA.

GENL. OFFICES: CENTURY BLDG., NEWARK, N. J.

OVER 20,000 MILES IN USE

Highest Award Paris Exposition, 1900, Buffalo, 1901

CARBONS

CONSUMERS CARBON CO.

LANCASTER, OHIO, U. S. A.

Carbons of all kinds and for all purposes.

PLATINUM

PLATINUM RIVETS FOR CONTACT POINTS IN TELEPHONES—SPARK COILS AND OTHER ELECTRICAL APPARATUS. PLATINUM SHEET AND WIRE IN ANY FORM AND DEGREE OF HARDNESS. PLATINUM SCRAP PURCHASED.

BAKER & COMPANY, Inc.

ARTISANS IN PLATINUM

408-410-412-414 N. J. R. R. AVE. - NEWARK, N. J.

New York Office: 120 Liberty St.

ALPHABETICAL INDEX TO ADVERTISEMENTS.

Adams-Bagnall Electric Co..— 9
Akron Electrical Mfg Co.... 11
Allen Company, L. B.....— 2
Allis-Chalmers Company..... 2
American Battery Co.....11
Amer. Circular Loom Co.... ...1
American Conduit Co.....14
Amer. District Steam Co.....14
Amer. Elec. Fuse Co..... 3
Amer. El. Telephone Co 14
American Electrical Works..11
Arnold Elec. Power Station Co:..... 8
Automatic Electric Co..... 15

Babcock & Wilcox Co.....—
Balo, Forée.....11
Baker & Company..... 3
Baker & Co., W. E..... 8
Barnett Company, G. & H....20
Beardslee Chandelier Mfg.Co.—
Berthold & Jennings.....17
Big Four Route.....—
Bissell Co., The F.....20
Bossert Electric Coostructioo Co.....10
Brooks, Hall L.....16
Bryan-Marsh Co.....—
Bryan, Wm. H..... 8
Buckeye Electric Co.....—
Bullock Elec. Mfg. Co..... 2
Butterfield, J. F..... 8
Byllesby & Co., H. M.....:.... 8

Central Electric Co.....—
Cent. Stat. Improvement Co..12
Central Tel. & El. Co.....14
Century Electric Co.....—
Chicago Die & Electric Co....10
Chicago Edison Co.....4, 12
Chic. Fuse Wire & Mfg. Co... 9
Chicago Insulated Wire Co..—
Chicago Mica Co.....10
Columbia Incaod. Lamp Co..—
Columbia Mfg. Co.....16
Columbus Storage Battry Co. 1
Consumers Carbon Co..... 3
Continuous Rail Joint Company of America..... 3
Cope, T. J.....10
Crawfordsville Electric Co:.—
Crescent Ins. Wire & Chl. Co. 1
Crocker-Wheeler Company... 4
Crouse-Hinds Co.....17
Cutler-Hammer Mfg. Co..... 9
Cutter Elec. & Mfg. Company 1

D. & W. Fuse Company.....—
Dearborn Drug & Chem. Wks.18
Diamond Meter Company.... 7
Dielectric Manufacturing Co.11
Directory of Engineers..... 8
Dixon Crucible Co., Joseph..18
Driver-Harris Wire Co..... 1
Duncan Elec. Mfg. Co.....19

Edison Decorative & Miniature Lamp Departm't.....10
Edison Mfg. Company..... 1
Edwards & Co.....:—
Egan, J. J..... 4
Electrical Engioeer Institute.—
Electric Appliance Co 10
Electric Storage Battery Co.. 3
Electrician Pub. Company... 8
Erie Ry.....16

Faries Mfg. Co..... 7
"For Sale" Advertisements..12
Ft. Wayne Elec. Works, Inc..19
Fostoria Incand. Lamp Co...—
Fowler, John H.....16
Fowler-Jacobs Company.....16

Gay Chemical Co., The R....—
General Electric Co..... 9
General Engineering Co., The 8
General Incandescent Arc Light Company.....—
General Incand. Lamp Co....—
Gould Storage Battery Co.... 6
Gt. West. Smelt. & Refining Co.—
Green Fuel Economizer Co..18
Gregory Electric Company...12

Hallberg, J. H 8
Haller Machine Co.....—
Hart Mfg. Co..... 5
Hartford Steam Boiler Inspection & Insurance Co....—
Hazard Manufacturing Co....—
Highland Park College. ... 1
Hipwell Mfg. Co..... 9
Hobart Elec. Mfg. Company. 1
Hoffman, G. W.....12
Holmes Fibre-Graph. Co.....—
Holophane Glass Co.....—
Holtzer-Cabot Electric Co...11
Hornaday & Co., J. P..... 8
Humphrey, Henry H..... 8
Hunt & Co., Robt. W..... 8

Illinois Central Ry.....12
Incandescent Electric Light Manipulator Company.....—
Indiana Rub. & Ins. W. Co.... 1
India Rubber & Gutta Percha Insulating Company.....—
International Elec. Meter Co 12
International Tel. Mfg. Co...14

Jackson, D. C. & W. B..... 8
Jeffrey Manufacturing Co....18
Jewell Electrical Inst. Co....—
Johns-Manville Co., H. W..... 5

Kartavert Manufacturing Co.—
Kellogg Switchboard & Supply Company.....15, 17
Kemp, R. W..... 8
Kester Elec. Mfg. Co..... 1
Klein & Sons, Mathias..... 1
Kohler Brothers..... 8
Kuhlman Electric Co..... 4

Leather Preserv. M. Corp.... 8
Leffel & Co., James.....18
Lindsley Brothers Company..17
Loud's Sons Co., H. M.....—

Machado & Roller.....—
Malthy Cedar Company.....17
Manhattan El. Supply Co....12
Manross, F. N..... .....—
Marinette Gas Engine Co.....18
Matthews & Bros., W. N.....11
McLaughlin, James..... 8
McLaughlin & Co., Jas..... 4
McLennan & Company, K....10
Mechanical Appliance Co.... 4
Mica Insulator Company.....—
Michigan College of Mines ..11
Minnesota Electric Co.....14
Miscellaneous Advs.....12
Monon Railroad..... ..12
Moon Mfg. Co., The.....—
Morrison Lbr. Co., J. W.....17
Mueller Company, William..17
Munsell & Co., Eugene.....10

National Electric Co..... 5
National India Rubber Co.... 1
New England Butt Co.....18
Newgard & Co., Henry..... 7
New York Cent. Ry.....16
New York Ins. Wire Co.....11
Northern Elect'l Mfg. Co....10
Northern Pacific Ry.....16
Norton Elect'l Instrument Co.—

Okonite Co., The..... 1
Olds Gasoline Engine Works.18

Pacific Coast Pole Co.....16
Page & Hill Co.....17
Paragon Fan & Motor Co.....—
Pardridge Shade & Refl. Co..—
Pass & Seymour, Inc.....11
Phelan, D. W.....17
Phillips, Eugene F.....11
Phillips Insulated Wire Co...11
Phœnix Glass Co.....—
Phosphor-Bronze S. Co.....18
Pignolet, L. M.....10
Pittsburg & L. S. Iron Co....17
Plume & Atwood Mfg. Co.... 1
Porter Cedar Company.....16

Reisinger, Hugo..... 7
Reynolds El. Flashar Mfg. Co. 1
Roebling's Sons Co., J. A.... 5
Ruebel-Schwedtmann-Wells.. 8

Safety Ins. Wire & Cable Co..20
Sargent & Lundy.....—
Schott, W. H..... 8
Seaman & Co., W. S.....15
Sears, Roebuck & Co.....12
Simplex Electrical Co., The.. 1
Simplex Elec. Heating Co.... 1
Speer Carbon Co..... .—
Sprague Electric Company...20
Squire Electric Co.....—
Standard Elec. Mfg. Co.....10
Standard Underg. Cable Co...—
Standard Vitrified Conduit Co16
Stanley Elec. Mfg. Co., The 5
Stanley Instrument Co..... 4
Stanton, LeRoy W..... 8
State Univ. of Iowa.....10
Sterling & Son, W. C.....16
Sterling Electrical Mfg. Co... —
Sterling Varnish Co., The... 1
Stow Mfg. Company.....—
Stromberg-Carlson Tel. Mfg. Company.....15
Sturtevant Company, B. F...20

Torrey Cedar Company.....16
Trumbull Elec. Mnfg. Co.....—
Turner Brass Works.....20

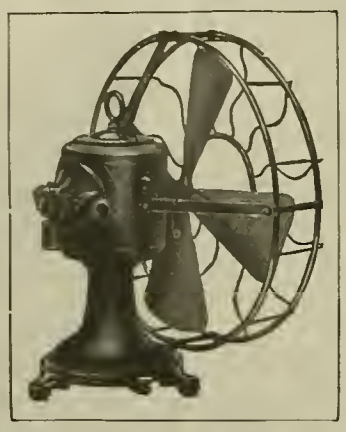
Union Electric Mfg. Co.....—

Valentine-Clark Co., The....—
Vulcanized Fibre Company..20

Wagoer Electric Mfg. Co.....—
Walsh's Sons & Company..... 1
Warren Elec. Mfg. Co.....20
Wesco Supply Co.....10
Western Electric Company... 7
Western El. Supply Co.....—
Westinghouse Electric & Manufacturing Co.....—
Weston Electrical Inst. Co... 1
Wilmerding, C. H.....—
Wisconsin Central Ry.....16
Woolley Fdy. & Mach. Wks..18
Worcester Company, C. H....16

Yesbera Mfg. Co..... .. 15
Yost Electric Mfg. Co 1

For Classified Index of Advertisements See Page 6.



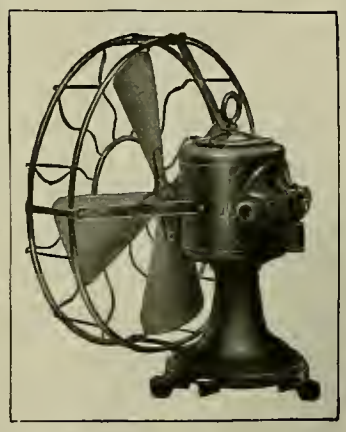
REMEMBER THE NAME AND BUY THE BEST.

PARAGON FAN MOTORS

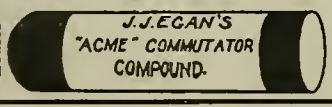
NEW STYLES NEW PRICES
EASY RUNNING RIGID CONSTRUCTION NOISELESS

CALL AND SEE THEM OR WRITE FOR PRICES

CHICAGO EDISON COMPANY,
139 ADAMS ST., CHICAGO.



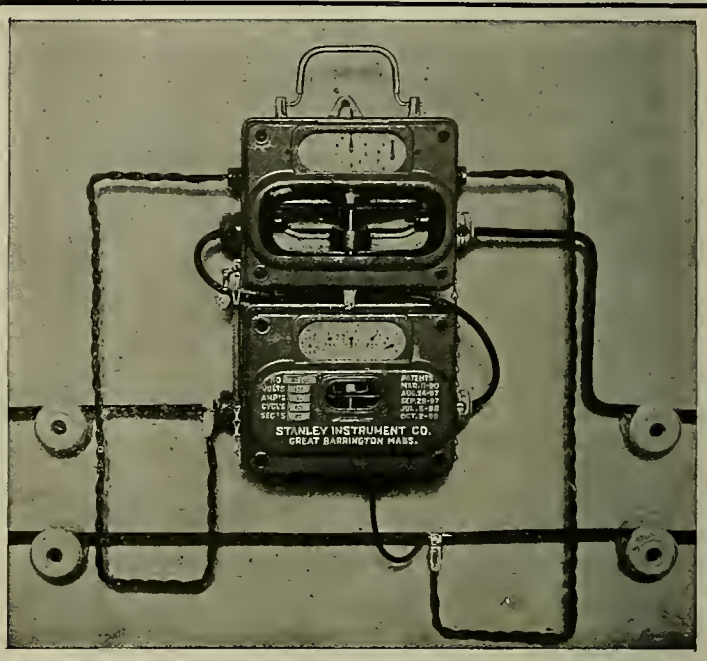
All Supply Houses



J. J. EGAN'S "ACME" COMMUTATOR COMPOUND absolutely prevents sparking or cutting. One stick of "Acme" is equal to one gallon of oil for lubricating commutators. Free Sample. AGENTS WANTED.
50c per Stick. $5 00 per doz.
J. J. Egan Sole Mfg., 317 Austin Ave., Tel. Polk, 1779 Chicago

SINGLE AND POLYPHASE
TRANSFORMERS
KUHLMAN ELECTRIC CO., - - Elkhart, Ind.

Our Compound Stops Sparking and Saves Commutators.
14 Years' Use on Street Ry., Light and Power Commutators Has Proven its Worth. WE GUARANTEE RESULTS
Send Your Address for FREE SAMPLE THAT CONVINCES.
JAS. McLAUGHLIN & CO., ELECTRICAL ENGINEERS
586 Fulton Street, - - Chicago, Ill.



TESTING WATTMETER
ACCURATE TESTS
in a few minutes, anywhere, by one man alone without regulation of VOLTAGE, LOAD OR FREQUENCY
STANLEY INSTRUMENT CO.
GREAT BARRINGTON, MASS.

Crocker-Wheeler. Brown, Boveri.

By arrangement with the celebrated electrical engineers, Brown, Boveri & Cie. of Baden, Switzerland, the Crocker - Wheeler Company has secured their alternating current designs, patents and rights to manufacture in America, and has retained them as consulting engineers.

Crocker-Wheeler Company is now putting on the market alternating current generators, transformers and accessories of the most perfect design and construction, adapted to American practice. Opportunities to bid on this apparatus are invited.

The Electrician Publishing Co., 510 Marquette Bldg., Chicago. Headquarters for all latest Electrical Books. Write for Catalogue.

Watson Motors
If you want a small motor for a special purpose. Write us.
Mechanical Appliance Co.
Milwaukee - Wis.

"Diamond H" Switches

Trade H Mark

This Trade-Mark guarantees quality.

The Hart Mfg. Co., Hartford, Conn.

New York Boston Chicago Toronto, Ont.

JOHN A. ROEBLING'S SONS CO.

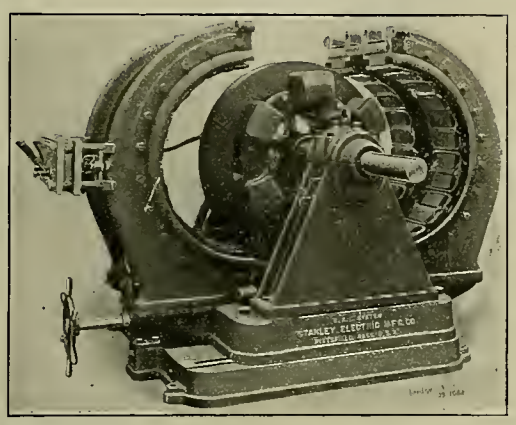
Insulated Wire of All Kinds

Bare Copper Wire

MAIN OFFICE AND WORKS **TRENTON, N. J.**

AGENCIES AND BRANCHES

New York Chicago Cleveland San Francisco Philadelphia Atlanta



The S. K. C. Inductor Alternator

Ability to Start Up
Oil Up
Shut Up
And occasionally Clean Up

is all that is required to operate the Inductor Alternator as built by the Stanley Electric Manufacturing Company.

Does simplicity appeal to you? You have it in the Inductor with no moving wires, brushes, commutator or collector rings.

Do you desire inexpensive operation? The Inductor has nothing to renew, and only the bearings require attention.

Are your facilities for handling machinery limited? The Inductor is not difficult to install.

Bulletins Nos. 123 and 128 tell all about it. Send for them.

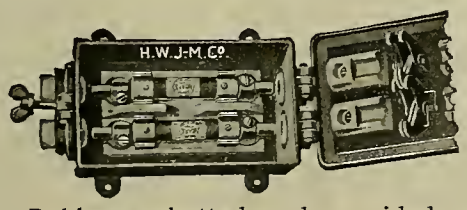
The Stanley Electric Manufacturing Company
Pittsfield, Massachusetts, U. S. A.

SACHS TRADE NOARK MARK FUSE

SERVICE BOXES

FOR 500 VOLTS

A fuse box combined for use on services or anywhere else requiring a well protected switch and fuse device. Each fuse individually manipulated from exterior of cover so that it can be pulled with cover or left in its contacts.



COVER: Rubber gasketted and provided with seal hasp.

BUSHING: Heavy Porcelain.

NO BENDING OR TWISTING OF WIRES IN CONNECTING.

Telephone Transite, a fire resisting material for protecting wires in Telephone Exchanges.

New York Milwaukee Chicago St. Louis Boston Philadelphia

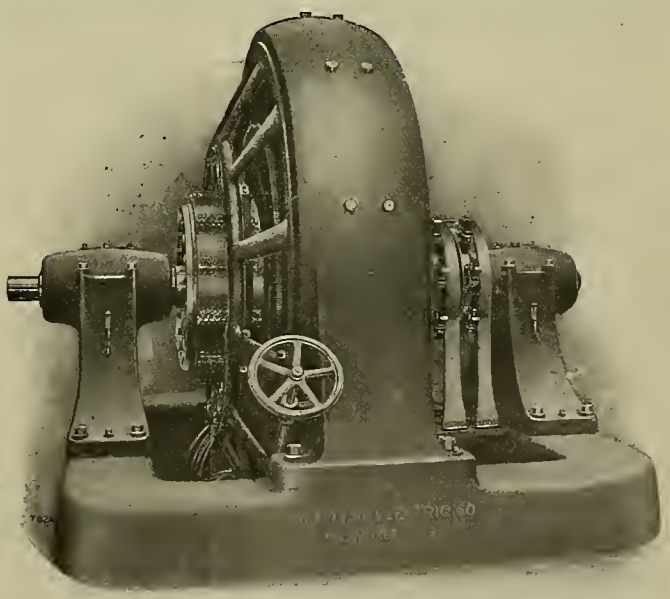
H. W. JOHNS-MANVILLE CO.

100 William St, New York.

Pittsburg Cleveland New Orleans London Paris Brussels

National

Electrical Machinery
built in all capacities
Direct and Alternating
apparatus of the highest grade



1,000 K. W. Rotary Converter

National Electric Company

GENERAL SALES OFFICES & WORKS:

Philadelphia: Land Title Bldg.
New York: 135 Broadway
Chicago: Old Colony Bldg.
Pittsburg: Gellatly & Co
Charleston, W. Va.: Agnew Electric Co.

Milwaukee

Seattle & San Francisco: Kilbourne & Clark Co.

Gould Storage Battery Co.

Complete Storage Battery Plants

Railway Line and Regulating Isolated and Train Lighting Central Lighting and Power Electric Vehicle and Telephone

GOULD COUNTER E. M. F. BOOSTER SYSTEMS

Sales Offices { NEW YORK, 1 W. 34th Street. BOSTON, 89 State Street. CHICAGO, The "Rookery." SAN FRANCISCO, Century Electric Co.

WORKS: DEPEW, N. Y.

Bulletins.

CLASSIFIED INDEX OF ADVERTISEMENTS.

Adjusters, Cord.
Incandes. El. Lt. Manip. Co.

Adjusters, Inc. Lamps.
Inc. El. Lt. Manipulator Co.

Anchors (Tel. & Tel.)
Matthews & Bro., W. N.
Crouse-Hinds Co.

Annunciators.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Moon Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Batteries and Jars.
Bissell Co., The F.
Central Electric Co.
Columbus Storage Battery Co.
Edison Mfg. Co.
Edwards & Company.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Bells, Buzzers, Etc.
Central Electric Co.
Edwards & Co.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Belt Dressing.
Dixon Crucible Co., Jos.
Leather Preserver Mfg. Corp.

Belting.
Leather Preserver Mfg. Corp

Blow Pipes.
Turner Brass Works

Blowers.
Sturtevant Co., B. F.

Boiler Compounds.
Dearborn Drug & Chem. Wks.

Boilers.
Allis-Chalmers Company.
Babcock & Wilcox Co.

Books, Electrical.
Electrician Publishing Co.

Booths, Telephone.
Seaman & Co., W. S.
Yesbera Mfg. Co.

Brackets.
Faries Mfg. Co.

Brushes.
Central Electric Co.
Hobart Elec. Mfg. Co.
Holmes Fibre-Graphite Co.
Speer Carbon Co.
Western Electric Company.

Cable Hangers.
Bissell Co., B. F.
Western Electric Co.

Cables (See Wires and Cables)

Canopies.
Faries Mfg. Co.

Carbons, Points and Plates.
Central Electric Co.
Chicago Edison Co.
Consumers Carbon Co.
Electric Appliance Co.
Reisinger, Hugo.
Speer Carbon Co.
Wesco Supply Co.
Western Elec. Supply Co.

Castings.
Faries Mfg. Co.
New England Butt Co.
National Electric Co.

Chains.
Jeffrey Mfg. Co.

Chandeliers.
Faries Mfg. Co.

Circuit Breakers.
Cutler-Hammer Mfg. Co.
Cutter Elec. & Mfg. Co.
Ft. Wayne Elec. Wks. Inc.
Union Electric Mfg. Co.
Western Electric Company.
Westinghouse El. & Mfg. Co.

Clusters.
Faries Mfg. Co.

Clutches, Electrical and Mechanical.
Akron Electrical Mfg. Co.

Coal and Ashes Handling Machinery.
Jeffrey Mfg. Co.

Coils and Magnets.
Western Electric Co.

Coloring, Lamp
Gay Chemical Co., The R.

Commutator Compound
Allen Co., L. B.
Egan, J. J.
McLaughlin & Co., Jas.
McLennan & Co., K.

Commutator Truing Device.
Akron Electrical Mfg. Co.

Condensers, Electric.
Stanley Elec. Mfg. Co.

Conduit and Conduits.
American Circular Loom Co.
American Conduit Company
Central Electric Co.
Electric Appliance Co.
Sprague Electric Co.
Standard Vitrified Cond. Co.
Wesco Supply Co.
Western Electrical Supply Co.

Contractors and Electric Light Plants.
Allis-Chalmers Company.
Bullock El. Mfg. Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
National Electric Co.
Northern Electrical Mfg. Co.
Sprague Electric Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Controllers, Crane.
Amer. Elec. Fuse Co.

Cross-Arms, Pins and Brackets.
Berthold & Jennings.
Central Electric Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Company.
Western Elec. Supply Co.

Cut-Outs and Switches.
Bissell Co., The F.
Bossert Elec. Const. Co.
Central Electric Co.
Chicago Edison Co.
Crouse-Hinds Co.
Cutter Elec. & Mfg. Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
General Inc. Arc Light Co.
Hart Manufacturing Co.
Manhattan Elec. Supply Co.
Trumbull Elec. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Dynamos and Motors.
Akron Electrical Mfg. Co.
Allis-Chalmers Company.
Bissell Co., The F.
Bullock Elec. Mfg. Co.
Central Electric Co.
Century Electric Co.
Crawfordsville Electric Co.
Crocker-Wheeler Co.
Dustin Co., Chas. E.
Ft. Wayne Elec. Wks. Inc.
General Elec. Co.
General Inc. Arc Light Co.
Gregory Electric Co.
Hobart Elec. Mfg. Co.
Holtzer-Cabot Electric Co
Mechanical Appliance Co.
National Electric Co.
Northern Electrical Mfg. Co.
Sprague Electric Co.
Stanley Elec. Mfg. Co.
Stow Manufacturing Co.
Sturtevant Co., B. F.
Wagner Electric Mfg. Co.
Warren Elec. Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Economizers, Fuel.
Green Fuel Economizer Co.

Electric Heating Appl.
Simplex Elec. Heating Co.
Western Electric Co.

Electric Railways.
Crocker-Wheeler Co.
General Electric Co.
Sprague Electric Co.
Westinghouse El. & Mfg. Co.

Electrical and Mechanical Engineers.
Arnold Elec. Power Stat'n Co.
Baker & Co., W. E.
Bryan, Wm. H.
Butterfield, J. F.
Bylesby & Co., H. M.
General Engineering Co., The.
Hallberg, J. H.
Hornaday, J. P. & Co.
Humphrey, Henry H.
Hunt & Co., Robt. W.
Jackson, D. C. & W. B.
Kemp, R. W.
Kohler Brothers.
McLaughlin, James
Newgard & Co., Henry.
Northern Electrical Mfg. Co.
Ruebel, Schwedtman, Wells.
Sargent & Lundy.
Schott, W. H.
Squire Electric Co.
Stanley Elec. Mfg. Co.
Stanton, LeRoy W.
Wilmerding, C. H.

Electrical Instruments. (Recording and Testing.)
Bissell Co., The F.
Central Electric Co.
Diamond Meter Co.
Duncan Elec. Mfg. Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
General Inc. Arc Light Co.
Jewell Electrical Inst. Co.
Machado & Roller.
Norton Elec'l Instrument Co.
Pignolet, L. M.
Stanley Elec. Mfg. Co.
Stanley Instrument Co.
Wagner Electric Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.
Weston Electrical Inst. Co.

Electro-Plating Mach'y
Crocker-Wheeler Company.
General Electric Co.

Elevators-Conveyors.
Jeffrey Mfg. Co.

Engines, Gas and Gasoline.
Allis-Chalmers Company.
Marinette Gas Engine Co.
Olds Gasoline Engine Works.
Woolley Fdy. & Mach. Wks.

Engines, Steam.
Allis-Chalmers Company.
Dustin Co., Chas. E.
Sturtevant Co., B. F.

Fans and Fan Motors.
Central Electric Co.
Crocker-Wheeler Company.
Edison Mfg. Co.
General Electric Co.
General Inc. Arc Light Co.
Sprague Electric Co.
Sturtevant Co., B. F.
Wesco Supply Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Fibre.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Files.
Barnett Co., G. & B.

Fittings.
Faries Mfg. Co.

Fixtures, Gas and Elec.
Beardslee Chandelier Mfg. Co.

Finishers.
Bissell Co., The F.
Haller Machine Co.
Reynolds El. Flasher Mfg. Co

Flexible Shafts.
Stow Mfg. Co.

Forges.
Sturtevant Co., B. F.

Fuses and Fuse Wire.
Amer. Elec. Fuse Co.
Bissell Co., The F.
Central Electric Co.
Central Tel. & El. Co.
Chicago Die & Electric Co.
Chicago Fuse Wire & Mfg. Co.
D. & W. Fuse Company.
Electric Appliance Co.
Johns-Manville Co., H. W.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Company.
Western Elect. Supply Co.

Globes, Reflectors and Shades.
Fostoria Incan. Lamp Co.
Haller Machine Co.
Holophane Glass Co.
Pardridge Shade & Refl. Co.
Phoenix Glass Co.
Wesco Supply Co.
Western Electric Co.
Western Elect. Supply Co.

Graphite Specialties.
Dixon Crucible Co., Jos.
Holmes Fibre-Graphite Co.

Heating (Exhaust Steam).
Amer. District Steam Co.

Heating and Ventilating Apparatus.
Sturtevant Co., B. F.

Holders, Inc. Lamps.
Incandescent Electric Light Manipulator Co.

Inspection & Insurance
Hartford Steam Boiler Inspection & Insurance Co.

Insulating Machinery.
New England Butt Co.

Insulators and Insulating Materials.
Akron Electrical Mfg. Co.
American Electrical Works.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Inc. Arc Light Co.
Indiana Rub. & Ins. Wire Co.
Johns-Manville Co., H. W.
Kartavert Mfg. Co.
Manhattan Elec. Supply Co.
Mica Insulator Co.
Munsell & Co., Eugene.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Standard Vitrified Cond. Co.
Sterling Varnish Co.
Vulcanized Fibre Co.
Wesco Supply Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Lamps, Incandescent.
Bissell Co., The F.
Bryan-Marsh Company.
Buckeye Electric Company.
Central Electric Co.
Chicago Edison Co.
Columbia Incan. Lamp Co.
Edison Decorative & Miniature Lamp Dept.
Electric Appliance Co.
Fostoria Incand. Lamp Co.
General Electric Co.
General Inc. Arc Light Co.
Standard Elec'l Mfg. Co.
Sterling Electrical Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Lamps, Incandescent—Replacers & Cleaners.
Inc. El. Lt. Manipulator Co.

Letters, Metal.
Haller Machine Co.

Lightning Arresters.
Central Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
Manhattan Elec. Supply Co.
Minnesota Electric Co.
Stanley Elec. Mfg. Co.
Western Electric Co.

Linemen's Climbers.
Klein & Sons, Mathias.

Magnet Wires.
(See Wires and Cables.)

Mechanical Draft.
Sturtevant Co., B. F.

Mica.
Chicago Mica Co.
Mica Insulator Co.
Munsell & Co., Eugene.

Mining Apparatus, Elec.
Allis-Chalmers Company.
Crocker-Wheeler Company.
General Electric Co.
Jeffrey Mfg. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Motors. (See Dynamos and Motors.)

Nippers and Pliers.
Klein & Sons, Mathias.

Nozzles.
Faries Mfg. Co.

Paints.
Dielectric Mfg. Co.

Patent Attorneys.
Hain, Foree.

Phosphor Bronze.
Phosphor Bronze Sm. Co. Ltd.

Platinum, Wire and Sheet.
Baker & Company Inc.

Poles and Ties.
Berthold & Jennings.
Brooks, Hall L.
Columbia Mfg. Co.
Fowler, John H.
Fowler-Jacobs Company.
Kellogg Switch. & Sup. Co.
Lindsley Bros. Co.
Loud's Sons Co., H. M.
Maltby Cedar Co.
Morrison Lbr. Co., J. W.
Mueller Company, William.
Pacific Coast Pole Co.
Page & Hill Company.
Phelan, D. W.
Pittsburg & L. S. Iron Co.
Porter Cedar Company.
Sterling & Son, W. C.
Torrey Cedar Co.
Valentine-Clark Co., The.
Worcester Co., C. H.

Polish (Metal).
Allen Co., Inc., L. B.
Hoffman, Geo. W.

Portables.
Faries Mfg. Co.

Power Transmission Machinery.
Jeffrey Mfg. Co.

Rail Joints.
Continuous Rail Joint Company of America.

Refiners.
Gt. West Smelt. & Refining Co

Re-Winding—Repairs.
Chicago Edison Co.
Gregory Electric Co.

Rheostats.
Cutler-Hammer Mfg. Co.
General Electric Co.
Gen'l Inc. Arc Lt. Co.
Union Electric Mfg. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Rods, Conduit.
Cope, T. J.

Safes.
Sears, Roebuck & Co.

Schools and Colleges.
Electrical Engineer Inst.
Highland Park College
Michigan College of Mines.
State Univ. of Iowa.

Second-Hand Mach'y.
Bissell Co., The F.
Cent. Stat. Improvement Co.
Gregory Electric Co.
Mathews & Bro., W. N.
Walsh's Sons & Co.

Shades, Lamp.
Faries Mfg. Co.

Sheet Brass & Copper.
Plume & Atwood Mfg. Co.

Signs, Electric.
Haller Machine Co.

Sockets & Receptacles.
Pass & Seymour.
Yost Elec. Mfg. Co.

Soldering Sticks, Salts and Paste.
Allen Co., L. B.
Crescent Co.
Kester Elec. Mfg. Co.
Western Electric Co.

Speaking Tubes.
Central Electric Co.
Edwards & Co.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Specialties, Electrical Mfrs. and Designers.
Haller Machine Co.

Speed Indicators.
Weston Electrical Inst. Co.

Storage Batteries.
American Battery Co.
Electric Storage Battery Co.
Gould Storage Battery Co.

Supplies, General Elec.
Bissell Co., The F.
Central Electric Co.
Century Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Electric Co.
Manhattan Elect'l Supply Co
Wesco Supply Co.
Western Electric Co.
Western Elect. Supply Co.

Switchboards.
Bissell Co., The F.
Crouse-Hinds Co.
Gen. Incan. Arc Light Co.

Telephones, Telephone Material and Switchboards.
American El. Telephone Co
Automatic Electric Co.
Bissell Co., The F.
Central Electric Co.
Central Tel. & El. Co.
Holtzer-Cabot Elec. Co.
International Tel. Mfg. Co.
Kellogg Switchb. & Sup. Co.
Manhattan Elec. Supply Co.
Moon Mfg. Co., The.
Stromberg-Carlson Tel. M.Co
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Time Switches.
Bissell Co., The F.

Tools.
Klein & Sons, Mathias.
Western Electric Co.

Transformers.
Central Electric Co.
Crawfordsville Electric Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Works, Inc.
General Electric Co.
Gregory Electric Co.
Kuhlman Electric Co.
Manhattan Elec. Supply Co.
National Electric Co.
Stanley Elec. Mfg. Co.
Wagner Electric Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Trucks, Electric Car.
General Electric Co.
Westinghouse El. & Mfg. Co.

Turbines, Steam.
Allis-Chalmers Co.
General Electric Co.
Westinghouse El. & Mfg. Co

Turbine Water Wheels
Leffel & Co., Jas.

Varnishes.
Dielectric Mfg. Co.
Sterling Varnish Co.

Vulcanized Fibre.
Vulcanized Fibre Co.

Wires & Cables—Magnet Wires.
American Electrical Works.
Bissell Co., The F.
Central Electric Co.
Chicago Insulated Wire Co.
Crescent Ins. Wire & Cble. Co.
Driver-Harris Wire Co.
Electric Appliance Co.
General Electric Co.
Hazard Manufacturing Co.
Indiana Rub. & Ins. Wire Co
India Rubber & Gutta Percha Insulating Co.
Kellogg Switch. & Sup. Co.
Manhattan Elec. Supply Co.
National India Rubber Co
New York Insulated Wire Co.
Okonite Co., The.
Phillips, Eugene F.
Phillips Insulated Wire Co
Roebling's Sons Co., J. A.
Safety Ins. Wire & Cable Co.
Simplex Electrical Co.
Standard Underground C. Co
Wesco Supply Co.
Western Electric Company.
Western Elec. Supply Co.

For Alphabetical Index of Advertisements See Page 3.

"ELECTRA" HIGHEST GRADE NUERNBERG

CARBONS

BEST LIGHT — LONGEST LIFE

STEADIEST LIGHT — LEAST DUST

ELECTRA

TRADE MARK

REMAIN THE STANDARD OF THE WORLD FOR ALL ARC LIGHTING SYSTEMS, BECAUSE they cannot be equaled in QUALITY or EFFICIENCY, producing the highest standard of candlepower in proportion to the current consumed.

HUGO REISINGER, Sole Importer, - - 11 Broadway, NEW YORK.

FARIES FIXTURES

Shades
Brackets
Clusters
Portables
Canopies
Chandeliers
Nozzles
Fittings
Castings

are UNIVERSALLY USED

Catalog Mailed on Application

FARIES MFG. CO.
DECATUR, ILL.

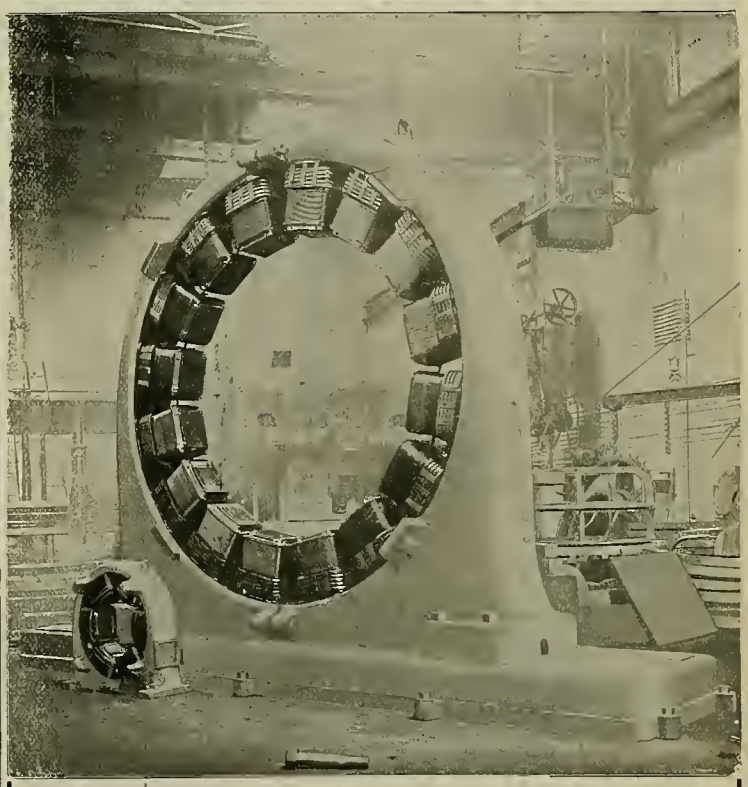
HENRY NEWGARD & CO.

ELECTRICAL CONSTRUCTION

Power and Light Plants. Switchboards and Panel Boards.

We install Municipal and Isolated Electric Lighting Plants.
We manufacture Switchboards, Table boards, Iron Cutout Boxes and Electrical Specialties.
We sell Dynamos, Motors and Electrical Supplies.
We wire old as well as new Residences, Factory Buildings, School and College Buildings.

87 Fifth Avenue, Chicago, Illinois.



Direct Current

Generators and Motors

Western Electric Company

CHICAGO NEW YORK
And Other Large Cities

Space 17 Electricity Building, Louisiana Purchase Exposition

TYPE E.

ALTERNATING CURRENT.

SCHEEFFER INTEGRATING WATTMETER

Type E for Alternating Current — Type F for Direct Current Circuits

DUST AND BUG PROOF
IMPROVED CONSTRUCTION

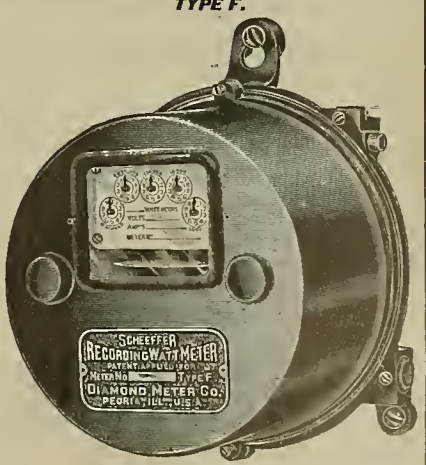
MOVING PARTS ARE EXTREMELY LIGHT, INSURING A HIGHLY SENSITIVE AND ACCURATE METER.

WRITE FOR PRICES AND DESCRIPTIVE LITERATURE.

DIAMOND METER COMPANY,

PEORIA, ILL., - - - - U. S. A.

TYPE F.



DIRECT CURRENT.

ARNOLD ELECTRIC POWER STATION Co.
Engineers, Constructors for Complete Electric Plants. Results Guaranteed.
SUITE 1539, MARQUETTE BLDG., CHICAGO. NEW YORK OFFICE: 711 TRANSIT BLDG.

BYLLESBY, H. M. & Co.
(Incorporated)
ENGINEERS
Design, Construct and Operate Railway, Light, Power and Hydraulic Plants.
Examinations and Reports.
New York Life Building, - CHICAGO, ILL.

HUMPHREY, HENRY H.,
CONSULTING ENGINEER.
Central Lighting Stations,
Electric Power Transmission.
SUITE 1305, CHEMICAL BLDG., ST. LOUIS.

McLAUGHLIN, JAMES
Consulting Arc Lighting Expert.
Practical Electrical and Mechanical Engineer.
53 River Street, - - Chicago, Ill.

W. E. BAKER. H. H. BISHOP.
BAKER, W. E. & CO.
ENGINEERS,
ELECTRIC RAILWAYS.
27 William St., NEW YORK.

E. W. Hammer, Pres. and Treas. H. J. Minhinnick, Sec. and Gen'l Sup't.
GENERAL ENGINEERING Co., THE
Consulting and Contracting Engineers.
Telephones, Electric Light, Power Transmission
Suite 1112, 136 ADAMS ST., CHICAGO.
Long Distance Telephone Central 478.

ROBERT W. HUNT & Co.,
ENGINEERS
1121 The Rookery, Chicago. 66 Broadway, New York.
Monongahela Bank Bldg., Pittsburg.
Norfolk House, Cannon St., London.

RUEBEL · SCHWEDTMANN-WELLS,
CONSULTING, MECHANICAL AND ELECTRICAL ENGINEERS,
Suite 801 Chemical Building, ST. LOUIS, U. S. A.

BRYAN, WILLIAM H.
M. Am. Soc. M. E.,
Consulting Mechanical and Electrical Engineer.
Lincoln Trust Building, ST. LOUIS.

J. H. HALLBERG
Consulting Arc Lighting Expert and Practical Electrical Engineer
45 Broadway - NEW YORK
Room 169A

KEMP, R. W.
Consulting and Contracting Telephone Engineer.
Plans and specification for complete plants. Old plants overhauled and placed on paying basis. Territory, Kansas, Oklahoma and Indian Territory.
WELLINGTON, - - - KANSAS.

Long Distance Phone Central 2448.
SCHOTT, W. H.,
ENGINEER AND CONTRACTOR,
SPECIALTIES—Central Station Heating Plants, Water Works Steam Plants, Electric Light, Gas and Street Railway Plants.
1220-21 MARQUETTE BUILDING, CHICAGO.

BUTTERFIELD, J. F.
ELECTRICAL ENGINEER AND CONTRACTOR.
Complete Telephone Exchanges Built and Material Furnished.
Cable Construction and Underground Conduit Construction a Specialty.
Room 595, 113 Adams Street, CHICAGO, ILL.

HORNADAY, J. P. & Co.
SUITE 1108 TRACTION BUILDING
CINCINNATI, O.
WATERWORKS, ELECTRIC RAILWAY, LIGHT, TRACTION, INDUSTRIAL AND MINERAL PROPERTIES BOUGHT AND SOLD

KOHLER BROS.,
Contracting Electrical Engineers,
Lighting Power Railways,
1804-1806-1808-1810-1812 Fisher Building,
CHICAGO.

STANTON, LE ROY W.
Consulting Telephone Engineer.
Plans, Specifications and Supervision of Installation of complete telephone plants.
Special Reports on Telephone Properties and Apparatus.
411 Electrical Bldg., Cleveland, Ohio.

DUGALD C. JACKSON, C. E.
WILLIAM B. JACKSON, M. E.
MEMBERS
AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS
AMERICAN SOCIETY OF MECHANICAL ENGINEERS
AMERICAN SOCIETY OF CIVIL ENGINEERS
ENGINEERS. EXPERTS.
MADISON, WIS.

ALL Live men read the WESTERN ELECTRICIAN Each Week. Do You?

WE BUY OLD BELTS
OR SCRAPS, ANY SIZE OR CONDITION.
WE CLEAN, REPAIR AND RENEW OLD BELTS.
LEATHER PRESERVER MFG. CORP.
27 W. MONROE ST., CHICAGO.

IT'S ALL RIGHT.

Webb's Telephone Hand-Book. A book for the expert as well as the novice. Price $1.00.
ELECTRICIAN PUBLISHING CO.,
510 Marquette Building, Chicago

THE MONTH OF SEPTEMBER 1904

will be a memorable one in electrical circles.

The International Electrical Congress,

The American Institute of Electrical Engineers,

The National Electrical Contractors' Association,

The Northwestern Electrical Association,

The International Association of Municipal Electricians,

The American Electrochemical Society,

The American Electrotherapeutic Association

will all meet in St. Louis during the week beginning September 12th. The Independent Telephone Association of the U. S. will be held in St. Louis beginning September 21. A number of State conventions will also be held during the month.

The September issues of the WESTERN ELECTRICIAN, therefore, will prove unusually interesting to everyone in any way connected with the trade.

Advertisers will find these numbers well worthy of extra space, and it will pay those not regularly represented to begin a standing card now.

WESTERN ELECTRICIAN, 510 MARQUETTE BLDG., CHICAGO.

TESTED FUSE WIRE AND STRIP
OPEN FUSE LINKS
ENCLOSED FUSE LINKS
TELEPHONE FUSES
TUBULAR LINE FUSES

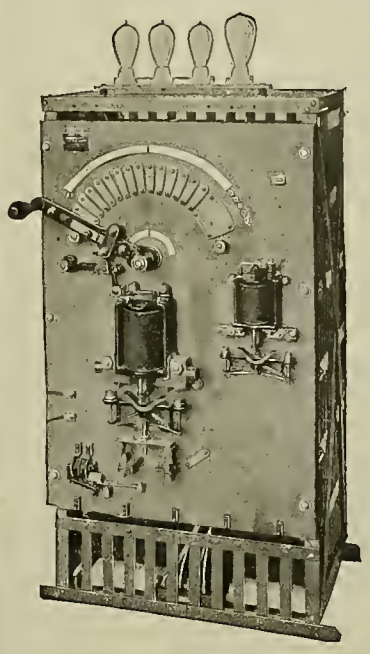
SWITCH OUTLET BOXES.

WIRE JOINTS TEST CONNECTORS

CHICAGO FUSE WIRE & MFG. CO.,
CHICAGO. BUFFALO. NEW YORK.

"HIPWELL"
ENCLOSED
ARC LAMP
"MARVEL OF MECHANICAL SIMPLICITY"
MADE FOR ALL CIRCUITS—DIRECT AND ALTERNATING
SAMPLES SENT ON 30 DAYS' TRIAL—COSTS NOTHING TO TRY THEM.
HIPWELL MNFG. CO.
ALLEGHENY, PA.

"C & H on a controller means highest quality"



The C&H Rotary Press Controller

Gives any speed desired.

It starts the press gradually and gives a steady motion at all speeds.

Perfect and immediate control from any part of press by means of a series of push buttons.

The Cutler-Hammer Mfg. Co.
MILWAUKEE, WIS.
New York Boston Chicago Pittsburg

General Electric Company

Manufactures all Forms of **Insulated Wires and Cables**

Rubber, Varnished Cambric,

Paper, Asbestos, Weatherproof

Write for information concerning Wires and Cables insulated with our special form of Varnished Cambric. This insulation is equal and in many respects superior, to high grade rubber insulation and considerably cheaper.

General Office: SCHENECTADY, N. Y.

Chicago Office: Monadnock Block

Sales Offices in all large Cities

HAVE YOU SEEN
OUR NEW
PRICE LIST
ON
PORCELAIN
KNOBS TUBES CLEATS
Don't Overlook It
ELECTRIC APPLIANCE COMPANY
CHICAGO. AND SAN FRANCISCO

WESCO YOUR BATTERY TROUBLES WESCO
can be obviated by installing an
ADAMS SECONDARY GENERATOR
on the secondaries of your alternating circuit. It will operate
BELLS, ANNUNCIATORS, GAS LIGHTERS, ETC.
without any expense. They are practical and never get out of order. Write for prices
EVERYTHING ELECTRICAL.
THE WESCO SUPPLY CO., ST. LOUIS MO.

SPARKING *Reduces the working capacity of a motor or dynamo, wears out the commutator, wastes power and may cause a fire. All this may be avoided if you use*
GALE'S COMMUTATOR COMPOUND
The only article that will PREVENT SPARKING. Will keep the Commutator in good condition and PREVENT CUTTING.
Absolutely Will Not Gum The Brushes.
50 Cents per Stick. $5.00 per Dozen.
SEND FOR FREE SAMPLE STICK.
For sale by all supply houses, or
It will put that high gloss on the Commutator you have so long sought after.
K. McLENNAN & CO., Sole Mfrs., Room 411 Inter Ocean Bldg., 130 Dearborn St., CHICAGO

248 D
Northern Variable Speed Motors are especially adapted to rejuvenating of belted machine tools because the motors are so compact and readily applied.
Get Bulletin No. 2533.
NORTHERN ELECTRICAL MFG. CO., - Madison, Wis., U. S. A
Chicago Sales Office, Suite 425 Monadnock Block.
ENGINEERS, MANUFACTURERS.

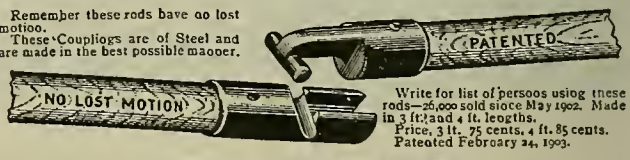
MICA WE PUT THE MICA POOL OUT OF BUSINESS! CHICAGO MICA CO. VALPARAISO, IND.

MICA Of all Qualities, in any Form at Lowest Prices
EUGENE MUNSELL AND CO.
NEW YORK and CHICAGO

EDISON MINIATURE LAMPS

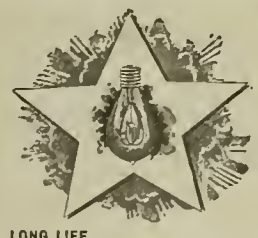
Over 400,000 Annually Shipped to Users.
All types—every variety.
Prompt shipment—in any quantity.
Miniature and Candelabra Sockets and Receptacles.
EDISON DECORATIVE & MINIATURE LAMP DEPT.,
General Electric Company, Harrison, N. J.

INSULATION That Is.
Micanite, Linotape, M. I. C. Compound, Empire Cloth and Paper. For Years the Standard.
MICA INSULATOR CO., Originators
NEW YORK and CHICAGO

Cope's Patent Quick Coupling Conduit Rod
Remember these rods have no lost motion. These Couplings are of Steel and are made in the best possible manner.


Write for list of persons using these rods—26,000 sold since May 1902. Made in 3 ft. and 4 ft. lengths. Price, 3 ft. 75 cents, 4 ft. 85 cents. Patented February 24, 1903.
T. J. COPE
3244 North Fifteenth Street PHILADELPHIA, PA.

VOLT - AMMETERS,
POCKET SIZE.
For Testing Batteries and Battery Circuits, Locating Faults, Grounds, etc.
RELIABLE. ACCURATE.
Send for Circular.
L. M. PIGNOLET,
78-80 Cortlandt St., NEW YORK, N. Y.

"STAR" INCANDESCENT LAMPS

LONG LIFE
GUARANTEED CANDLEPOWER,
HIGHEST EFFICIENCY.
MADE BY THE MOST SKILLED WORKMEN.
STANDARD ELECTRICAL MFG. COMPANY, : Niles, Ohio.

YOU BUY
Maxstadt Patent Mica Fuses,
Maxstadt Patent Copper and Steel Wire Joints,
Maxstadt Patent Fuse Blocks and Lightning Arresters—Fuse Wire, Fuse Links, Etc.
We manufacture and
WE SELL THEM
TO THE WISE BUYER THE ABOVE IS SUFFICIENT.
CHICAGO DIE AND ELECTRIC CO.,
87-89-91 W. LAKE STREET,
CHICAGO, - - - - - ILLINOIS.

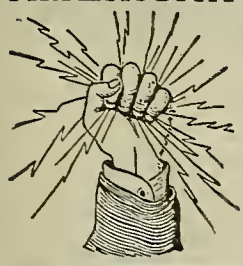
THE STATE UNIVERSITY OF IOWA
SCHOOL OF APPLIED SCIENCE. Iowa City, Iowa
Four year courses of the highest grade in
Civil
Municipal
Sanitary
Electrical
Mechanical
Mining
ENGINEERING
Numerous short practical courses. Special courses in technical chemistry, bacteriology, etc. Adequate equipment in shops and laboratories. Waterpower.
University environment. Expenses low.
Address C. E. MacLEAN. President

Monitor Bushings
Greatest efficiency at least cost. Absolute protection to wires drawn over conduit ends. Made of one piece of sheet steel and cannot be broken. Enameled insulation. No special tools required to attach. Approved by fire underwriters. Write for bulletin 1002.
BOSSERT
Electric Construction Company
UTICA, N. Y.

FRANK N. PHILLIPS, President. G. H. WAGENSEIL, Treasurer. EUGENE F. PHILLIPS, General Manager. E. ROWLAND PHILLIPS, Vice-Pres. C. R. REMINGTON, Jr., Sec

AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.



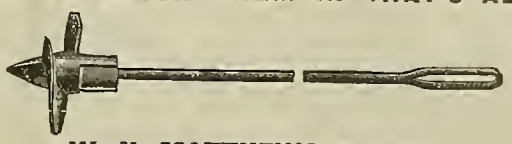
BARE AND INSULATED ELECTRIC WIRE,
ELECTRIC LIGHT LINE WIRE,
INCANDESCENT AND FLEXIBLE CORDS,
Railway Feeder and Trolley Wire,
AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR WIRES.
CABLES FOR AERIAL AND UNDERGROUND USE.

NEW YORK STORE, W. J. Watson, 26 Cortlandt St.
CHICAGO STORE, F. E. Donohoe, 82 Lake St.
MONTREAL BRANCH, Eugene F. Phillips' Electrical Works.
MAIN OFFICES AND FACTORIES, PHILLIPSDALE, R.I.

WE HAVE YET TO HEAR OF AN INSTANCE OF A

STOMBAUGH GUY ANCHOR PULLING UP.

THEY DON'T DO IT.
SIMPLY SCREW THEM IN—THAT'S ALL.



W. N. MATTHEWS & BRO.
Distributers
603 CARLETON BUILDING ST. LOUIS

AKRON
Generators, Motors, Clutches, Commutator Truing Devices.
AKRON ELECTRICAL MFG. CO., AKRON, O.
N. Y. Office: McKay Engineering Co., 149 Broadway

"AMERICAN" STORAGE CELLS
ARE THE BEST. Send for descriptive Circular.
AMERICAN BATTERY CO.,
EST'D 1891. 171 S. Clinton St., Chicago.

EXPERT IN ELECTRICITY MECHANICS PATENT CAUSES
SOLICITOR OF U. S. & FOREIGN PATENTS
FOREE BAIN, 1652-3 Monadnock Blk., CHICAGO

W. D. PAINT.

A PERMANENT INSULATING PROTECTION FOR WOOD OR METAL. A quick drying, moisture-proofing, black paint. An elastic anti-rust coating. A jet black finishing paint, efficient and not expensive.
Write for "Data on Insulating Materials."
DIELECTRIC MANUFACTURING CO., SAINT LOUIS.

MICHIGAN COLLEGE OF MINES.
F. W. McNair, President,
A state institution located in and making use of an active mining district. New Metallurgical Building and Gymnasium completed in the fall of 1904. For Year Book and Record of Graduates apply to President or Secretary, Houghton, Michigan.

Grimshaw

Raven White Core

Raven Black Core

ALL OUR WIRES pass inspection and carry the above TRADE-MARKS on our tags. We also manufacture Grimshaw and Competition Tapes and Splicing Compounds.

NEW YORK INSULATED WIRE COMPANY.

MAIN OFFICE: 114, 116 & 118 Liberty St., New York.
BRANCHES: CHICAGO: 192 Desplaines St. BOSTON: 7 Otis St. SAN FRANCISCO: 33 Second St.

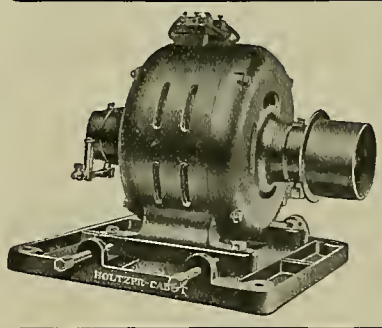
NATIONAL CODE STANDARD

"O. K." Weatherproof Wire.
Slow-Burning Weatherproof and Ideal Wire.
Prices and Samples on Application.

Phillips Insulated Wire Co.

Office and Factory: PAWTUCKET, R. I.

Do You Know It?



WHAT!

¶ That we make single phase alternating current motors from 1-8 to 2 H. P.

¶ Are they good and what is the price?

¶ Well, just send for Bulletin 0304. It tells all about it.

THE HOLTZER-CABOT ELECTRIC COMPANY
BROOKLINE, MASS. NEW YORK CHICAGO

5000 SOCKETS

If you use 5000 Sockets or over per year, write us for our future delivery contract proposition. You contract for lamps; why not for Sockets?

PASS & SEYMOUR, Inc.

SOLVAY, N. Y.

NATIONAL CODE

NEW YORK - CHICAGO
SAN FRANCISCO

WANTED, FOR SALE *and similar* **WANT COLUMN** *advertisements (50 words or less), $1.50 an insertion; additional words 3c each.* **POSITION WANTED** *advertisements (50 words or less), $1.00 an insertion; additional words 2c each.*

POSITION WANTED.

By a man experienced in central station management and operation. Address BOX 387, care Western Electrician, 510 Marquette Bldg., Chicago, Ill.

POSITION WANTED.

As superintendent or chief electrician, by thoroughly practical man. Six years superintendent of light, water and telephone. Can improve your service and increase your revenue. First-class references furnished. Address BOX 388, care of Western Electrician, 510 Marquette Building, Chicago.

POSITION WANTED.

In some electric-light plant as fireman and dynamo tender where there is a chance for advancement. Am first-class dynamo tender. One year experience. Student of I. C. schools. Address BOX 73, Clarion, Iowa.

WANTED.

Head engineer in electric-light and power station of 500 H. P. steam capacity and 200 H. P. water power. City of 13,000 inhabitants in Southern Wisconsin. Address BOX 386, care of Western Electrician, 510 Marquette Bldg., Chicago.

FOR SALE.

About 100 New England Butt Company's double insulating machines for insulating wire, in good order; some almost new. Also a Payne Spooler. NEWTON I. STEERS, 128 Malden Lane, New York City.

FOR SALE.

A bargain: I. T. H. 30-light 9.6 Amp. Series open arc machine, with wall controller and ammeter complete, good running order.

Twenty-two 9.6 Amp. double carboo open arc lamps with glass, hoods and spreader complete, good order. Several additional lamps, both single and double, can be put in good order or parts used for repairs. A lot of extra globes and parts and a supply of carbons will be included if taken as a whole.

Two 30-K. W. Edison Bipolar 125-volt D. C. generators in fine running order. Reason for selling, have put in larger machinery.

CARROLL ELECTRIC LIGHT & POWER COMPANY, Carroll, Iowa.

BUY YOUR BOOKS

FROM THE

Electrician Pub. Co., 510 Marquette Bldg., Chicago.

$11.95 FIREPROOF SAFE.

$11.95 buys this 300-pound guaranteed Fireproof Safe, highest grade, heavy wrought steel continuous plate construction, fitted with genuine Yale triplex 3-tumbler combination lock; best workmanship throughout, positively the equal of safes that sell at $20.00 to $25.00. Dimensions: outside, 24x14¾x16¾ inches; inside, 12x8½x9 inches. Has one 5x4-inch cash box with fine lock; one 3x4-inch drawer; one 3½x4-inch pigeonhole; one 12x3½-inch book space. Just the safe for small merchants and offices.

$23.95 BUYS THIS 675-POUND HIGHEST GRADE FIREPROOF SAFE (guaranteed). Equipped with genuine Yale unpickable, triplex, combination lock; finest construction throughout. Dimensions: Outside measure, 37¾ x 24 x 22¾ inches. Inside measure, 20¾ x16x13 inches. Arrangement of cabinet work: One 6x4¾-inch iron cash box with high grade lock, with two flat keys; one 3x4¾-inch drawer with knob, two 2¾x4¾-inch pigeonholes; one 3x4¾-inch pigeonhole; one large book space, 14¾x9¾ inches; one small book space, 14¾x4¾ inches. A BIG BARGAIN FOR ANY STORE, OFFICE, FACTORY, SHOP OR HOTEL.

We will letter your name or firm name in gold over door free of charge if requested. You can send us your order for either one of these safes with the understanding that we will return your money and pay freight charges both ways if you are not pleased or do not consider you have received a wonderful bargain and saved about one-half in price.

For large illustrations and descriptions of our complete line of safes, including our massive heavy wall single and double door safes at $10.60 up to $102.00, for detailed explanation of our method of fireproofing, heavy construction, how we make our safes heavier, stronger and better than others, how we can sell the highest grade safes it is possible to build for about one-half the prices all other dealers ask, for our great 30-day free trial offer, explanation of our binding guarantee, our money refund offer, for freight rates, for our liberal terms of shipment, write for our Free Safe Catalogue. Cut this ad. out and mail to us and the complete SAFE CATALOGUE and our WONDERFUL MONEY SAVING SAFE PROPOSITION WILL BE SENT BY RETURN MAIL. Address,

SEARS, ROEBUCK & CO., Chicago, Ill.

REPAIRING RECALIBRATING

ELECTRIC METERS.

INTERNATIONAL ELECTRIC METER CO.

167 S. CANAL STREET, CHICAGO.

FOR SALE.

ALTERNATORS.

1-360 K. W. General Electric 3-phase.
1-120 " " " "
1-75 " Westinghouse 2-phase.

250-VOLT GENERATORS.

1-250 K. W. Western Electric M. P.
1-200 " Eddy M. P.

125-VOLT GENERATORS.

1-125 K. W. Western Electric M. P.

Immediate shipment.

GREGORY ELECTRIC CO.
54-62 S. CLINTON ST. CHICAGO

We are in position to sell electric-light plants with good franchise and contract and on good paying basis. None too small, none too large. Address,

J. S. MAURER & CO.
804 Monadnock Bldg., Chicago, Ill.

DON'T BUY ELECTRICAL SUPPLIES

Until you have seen our new Catalogue and new Price List.
Free to the trade.

Manhattan Electrical Supply Co.

NEW YORK: 32 Cortlandt St.
CHICAGO: 188 Fifth Ave.

INDUSTRIES ARE OFFERED LOCATIONS

WITH

Satisfactory Inducements,
Favorable Freight Rates,
Good Labor Conditions,
Healthful Communities,

ON THE LINES OF

THE ILLINOIS CENTRAL R. R.
AND THE
YAZOO & MISSISSIPPI VALLEY R. R.

For full information and descriptive pamphlet address

J. C. CLAIR,
Industrial Commissioner,
1 Park Row, Chicago, Ill.

WORKS QUICK AND EASY. KEEPS ITS LUSTER. HOLDS OLD TRADE AND MAKES NEW. DOES NOT DETERIORATE. ESTABLISHED 16 YEARS. SOLD BY AGENTS AND DEALERS ALL OVER THE WORLD

U.S. METAL POLISH

3 OUNCE BOX 10 CENTS
SAMPLES SENT FREE
GEO. W. HOFFMAN

POLISHES ALL METALS. BRANCHES: NEW YORK, CHICAGO, SAN FRANCISCO. 295 E. WASHINGTON ST. INDIANAPOLIS, IND.

BOILERS.

One 42-in. x 15 ft. 9-in., 250 H. P. Worthington Water Tube.
One 60-in. x 16 ft., John Mohr Return Tubular Boiler.
One 54-in. x 16 ft., John Mohr Return Tubular Boiler.
One 54-in. x 16 ft., Devine Tubular Boiler.

ENGINES.

One 600 H. P., 21 x 36 x 30, Williams Tandem Horizontal Compound, 140 R. P. M.
Two 600 H. P., 20 x 30 x 24, Porter-Allen Tandem Compound, 200 R. P. M.
One 250 H. P., 12 x 24 x 18 Williams Tandem Compound, 250 R. P. M.
Two 100 H. P., 13 x 12, Dick & Church, High Speed Automatic.

PARTIAL LIST ONLY.

Send for latest Catalogue for bargains in Engines, Boilers, Dynamos and Motors.

CENTRAL STATION IMPROVEMENT CO., 938 Monadnock Block, Chicago

Have YOU read the

NEW DYNAMO TENDERS' HAND-BOOK

By F. B. BADT?

IF NOT, WHY NOT?

Dynamo tenders cannot get along without it.

Sent prepaid on receipt of price, $1.00

ELECTRICIAN PUBLISHING CO.,
510 Marquette Building, - CHICAGO

"NEW TRAIN SERVICE TO

French Lick and West Baden Springs."

A parlor and dining car now leave Chicago at 12:00 o'clock noon, arrive at the Springs at 8:45 p. m. Leave Springs 9:00 a. m., arrive Chicago 5:55 p. m. Reservations at Monon Route City Office, 232 Clark Street. Telephone Har. 1245.

OFFICE OF Town Clerk
A. R. KAUFMAN, CLERK

BOARD OF TRUSTEES
GEO. A. PAINTER
AS. V. PANEBOKER
S. J. HERSEN
F. VAN HUYS, ATTY.

Summitville Ind. Nov. 23 1903

Western Electrician
Chicago Ill.

Gentlemen: You may discontinue our Want Advertisement with the one issue. As I have already received about 40 answers to same. Send me your bill and I will remit same to you Thanking you very kindly for your promptness

I am Yours Resp.

A. R. Kaufman
Clerk.

CHICAGO EDISON COMPANY REPAIR SHOPS

76 MARKET STREET, CHICAGO. TELEPHONE MAIN 1280.

Machine and Carpenter Work of All Kinds
Correspondence Solicited.

OPEN DAY AND NIGHT.

FIRST-CLASS EQUIPMENT THROUGHOUT.

Dynamos Armatures, Motors, Arc Lamps, Fans, Instruments.

Keep Up With the Procession.

Everyone engaged in the electrical business should keep posted on the developments in the art by reading the latest books on the subject. We are headquarters in the West for electrical books and can fill orders for any work published, promptly on receipt of price. We call your special attention to the following standard books:

ALLSOP, F. C.—Electrical Bell Construction; Treatise on the Construction of Electric Bells, Indicators and similar apparatus. 177 illustrations.....$1.25

ATKINSON, PHILIP.—The Elements of Electric Lighting. Seventh edition, fully revised, and new matter added. 104 illustrations. 260 pages.....$1.50

ATKINSON, PHILIP.—The elements of Dynamic Electricity and Magnetism. 406 pages and 117 illustrations. Second edition.....$2.00

AYRTON, W. E.—Practical Electricity; a Laboratory and Lecture Course for First-year Students of Electrical Engineering. Based on the Practical Definitions of the Electrical Units. With numerous illustrations. Sixth edition.....$2.50

BADT, LIEUT F. B.—New Dynamo Tenders' Hand Book. This is, as the name indicates, a NEW BOOK, much more complete than the old one, with all the information, instructions and rules which are required by practical men, as Dynamo Tenders, Linemen, Stationary Engineers and owners and operators of all kinds of Electric Plants. It is the only book of the kind published in the English language. 226 pages, 140 illustrations, flexible cloth binding, size of type page 5½x3 inches.....$1.00

BADT, LIEUT. F. B.—Incandescent Wiring Hand Book. A timely book containing full illustrations for incandescent wiring and complete information concerning methods of running wires, location of safety devices, splices, insulation, testing for faults, wire gauges, general electrical data, calculating sizes of wires, wiring fixtures, elevators, buildings, isolated and central station plants. The only book of the kind published. Type page 5½x3 inches, flexible cloth binding, 66 pages, 35 cuts and 5 tables, 3 of which are 12x18 inches.....$1.00

BADT, LIEUT. F. B.—Bell Hangers' Hand Book. Just the book for people engaged in selling, installing or handling electric batteries, electric bells, elevators, house or hotel annunciators, burglar or fire alarms, electric gas lighting apparatus, electric heat apparatus. 106 pages, 97 illustrations, flexible cloth binding. Type page 5½x3 inches.....$1.00

BADT, LIEUT. F. B.—Electric Transmission Hand Book. First edition, 3,000 copies. 97 pages, 22 illustrations, 27 original tables.....$1.00
Gives more Practical information on the subject than any work published to date. The book contains all necessary information for Power Producers, Capitalists, Agents, Engineers and Motor Inspectors. With this book anybody may make estimates on the cost of Transmission Plants.

BEDELL, FRED'K AND ALBERT C. CREHORE.—Alternating Currents; An Analytical and Graphical Treatment for Students and Engineers. Second edition. 112 illustrations.....$2.50

BELL, LOUIS, PH. D.—The Art of Illumination. This is the only book in the language which deals directly with the scientific and artistic use of modern illuminants, electric and other. Cloth, 339 pages, 127 illustrations. Price.....$2.50

BONNEY, G. E.—Electro-Plater's Hand Book. A Manual for Amateurs and Young Students on Electro-Metallurgy. 60 illustrations, 208 pages. 12mo. cloth....$1.25

BOTTONE, S. R.—Electrical Instrument Making for Amateurs. A Practical Hand Book, with 48 illustrations. Fourth edition. Enlarged by a chapter on the Telephone.....$0.50

BOTTONE, S. R.—The Dynamo, How Made and How Used. A Book for Amateurs. Eighth edition, with additional matter and 39 illustrations.....$1.00

BOTTONE, S. R.—Electro-Motors. How Made and How Used. A Hand Book for Amateurs and Practical Men. Reduced to.....$0.50

BUCKLEY, W. J.—Electric Lighting Plants, Their Cost and Operation. 275 pages, many illustrations and diagrams. Paper.....$1.00

CROCKER, F. B. AND WHEELER, S. S.—The Practical Management of Dynamos and Motors. With a special chapter by H. A. Foster. Illustrated. Second edition, revised and enlarged.....$1.00

CUSHING, H. C., JR.—Standard Wiring for Electric Light and Power. A compilation of formulæ, rules and requirements from the most modern practice, and in accordance with the rules and requirements of the Boston Fire Underwriters' Union, the New England Insurance Exchange, and as recommended by the Underwriters' International Electric Association. 12mo, leather.....$1.00

DESMOND, CHAS.—Electricity for Engineers. Part I. Constant Current. A clear and comprehensive treatise on the principles, construction and operation of Dynamos, Motors, Lamps, Indicator and Measuring Instruments; also a full explanation of the electrical terms used in the work. Part II. Alternate Current Apparatus. Containing an explanation of the principles governing the generation of, and a description of the instruments and machinery used in connection with, Alternate Electric Currents. Illustrated. Revised edition.....$2.50

DOBBS, A. E.—The Inspector and Trouble Man. A practical book, written in plain language. Full of information and diagrams for the operator, exchange manager, inspector, trouble man and lineman. A complete description of telephones, how to find and remedy their troubles, together with working plans for exchange construction, complete with diagrams of all up-to-date telephones and switchboards. 108 pages. Price...$1.00

DYER, A.—Induction Coils, How Made and How Used. Third edition. Boards.....$0.50

FLEMING, J. A.—Short Lectures to Electrical Artisans. A course of Experimental Lectures delivered to a Practical Audience. Fourth edition. 74 illustrations..$1.50

FLEMING, J. A.—The Alternate Current Transformer in Theory and Practice. Vol. I. The Induction of Electric Currents. 500 pages, fully illustrated and with copious index. Second edition.....$3.00
Synopsis of contents: Chapter 1. Introductory. 2. Electro-Magnetic Induction. 3. The Theory of Simple Periodic Currents. 4. Mutual and Self Induction. 5. Dynamical Theory of Current Induction.
Vol. II. The Utilization of Induced Currents. 8vo, cloth. London, 1892.....$5.00

GAYETTY, J. W.—Motorman's Guide. A Practical Treatise on Street Railway Motors. Illustrations and diagrams. Cloth.....$0.50

GORDON.—School Electricity. Sources, Currents, Measurement, Telegraphy, Telephony, Lightning, Electrolysis, Induction, etc. 262 pages, with 140 illustrations..$2.00

GORE, G.—The Art of Electro-Metallurgy, including all Known Processes of Electro Deposition. Fourth edition.....$2.00

GRIER, THOS. G.—Wiring for Motor Circuits. A handy little pamphlet containing tables for wiring and for motor service, arranged in convenient form for ready reference.....$1.00

HASKINS, C. C.—Electricity Made Simple. 233 pages, 108 illustrations. Paper covers.....$0.50
A valuable, non-technical work for those whose opportunities for gaining information on the branches treated have been limited.

HASKINS, C. H.—The Galvanometer and Its Uses. A Manual for Electricians and Students. Fourth edition, revised.....$1.50

HASKINS.—Transformers. Their Theory, Construction and Application Simplified. 38 illustrations.....$1.25

HAWKINS, C. C. AND F. WALLIS.—The Dynamo, Its Theory, Design and Manufacture. 190 illustrations.$3.00

HAWKINS, N.—New Catechism of Electricity. A Practical Treatise Relating to the Dynamo and Motor, Wiring, the Electric Railway, Bell Fitting, etc., etc. Red leather, pocketbook form. 95 illustrations....$2.00

HOMANS, J. E., A. M.—A, B, C OF THE TELEPHONE. 352 pages, 269 illustrations. Price.....$1.00
Owing to the demand for a comprehensive book giving a clear, terse idea of the principles governing the construction, installation, care and management of telephones and their appliances, this book has been compiled. It has been the aim of the author to make this the most complete elementary book on this subject for the practical electrician, wireman, lineman and engineer, and it is written in a clear and careful style.

HOPKINS, GEO. M.—Experimental Science. Elementary, Practical and Experimental Physics. 650 illustrations.....$4.00

HOPKINSON.—Original Papers on Dynamo Machinery and Allied Subjects. Illustrated.....$1.00

HOPKINSON, DR. JOHN.—Dynamic Electricity; Its Modern Use and Measurements, Chiefly in Its Application to Electric Lighting and Telegraphy.....$0.50

HORSTMANN, H. C. AND VICTOR H. TOUSLEY.—Modern Wiring Diagrams and Descriptions. A Hand Book of Practical Diagrams and Information for Electrical Workers. 160 pages, over 200 illustrations. Full leather binding, pocket size. 4x6.....$1.50

HOSPITALIER, E.—Domestic Electricity for Amateurs; Translated from the French, with additions by C. J. Wharton. With illustrations.....$2.50

HOUSTON, EDWIN J.—A Dictionary of Electrical Words, Terms and Phrases. Fourth edition, greatly enlarged, with over 6,000 additional words and definitions. 2 volumes, 1,000 pages.....$6.00

KAPP, GISBERT.—Electric Transmission of Energy and its Transformation, Subdivision and Distribution. A practical hand book. Fourth edition.....$3.00

KAPP, GISBERT.—Alternate Current Machinery. Illustrated.....$0.50
(Vol. 96. Van Nostrand's Science Series.)

KAPP, GISBERT.—Dynamos, Alternators and Transformers. 138 illustrations.....$4.00

KEMPE, H. R.—A Hand Book of Electrical Testing. Fifth edition. 200 illustrations. 8vo, cloth. London 1892.....$7.25
In this edition there is a considerable amount of new matter; the old matter has been thoroughly revised.

KEMPE, H. R.—The Electrical Engineer's Pocket Book. Modern Rules, Formulæ, Tables, and Data. 32mo, leather.....$1.75

LOCKWOOD, T. D.—Electricity, Magnetism and Electric Telegraphy. A Practical Guide and Hand Book of General Information for Electrical Students, Operators and Inspectors. 376 pages, 152 illustrations.....$2.50

LOCKWOOD, T. D.—Electrical Measurement and the Galvanometer; Its Construction and Use. Second edition.....$1.50

LYNDON, L.—Storage Battery Engineering. A Practical Treatise for Engineers. This is a practical work, intended for the electrical engineer who is called on to design and install storage battery equipments, or who has a battery power plant under his care. Cloth. 360 pages, 178 illustrations and diagrams, 4 large folding plates. Price.....$3.00

MEADOWCROFT, W. H.—The A, B, C of Electricity. 36 illustrations. 12mo, cloth. New York.....$0.50

MAYER AND DAVIS, M. M.—The Quadruplex. With Chapters on the Dynamo-Electric Machine in Relation to the Quadruplex. The Practical Working of the Duplex Telegraph Repeaters and the Wheatstone Automatic Telegraph. 63 illustrations.....$1.50

MEYER, HENRY, C., JR., M. E.—Steam Power Plants. Their Design and Construction. Cloth. 165 pages, 63 illustrations, 15 folding plates. Price.....$2.00

MILLER, KEMPSTER B.—American Telephone Practice. 518 large octavo pages, 379 illustrations.....$3.00
This book treats of the subject in a simple and comprehensive manner from the practical standpoint, and almost entirely without the use of mathematics.

NOLL, AUGUSTUS.—How to Wire Buildings. A manual of the art of interior wiring. Illustrated.....$1.50

POPE, FRANKLIN LEONARD.—Modern Practice of the Electric Telegraph. A technical hand book for Electricians, Managers and Operators. 185 illustrations. Fourteenth edition, rewritten and enlarged.....$1.50

PRINDLE, H. B.—A Popular Treatise on the Electric Railway of To-day. Fully illustrated.....$0.25

REED, LYMAN C.—American Meter Practice. This is the only American book dealing with the theory and practice of current metering. Cloth. About 250 pages. Illustrated. Price.....$2.00

RUSSELL, STUART A.—Electric Light Cables and Distribution of Electricity. 107 illustrations.....$2.25

SALOMONS, SIR DAVID.—Electric Light Installations. Vol. 1. The Management of Accumulators. A Practical Hand Book. Seventh edition, revised and enlarged. With illustrations. 12mo, cl. London, 1893.....$1.50

SLOANE, T. O'CONNOR.—Electricity Simplified. The Practice and Theory of Electricity, including a Popular Review of the Theory of Electricity, with Analogies and Examples of Its Practical Application in every day life. Illustrated.....$1.00

SLOANE, T. O'CONNOR.—The Standard Electrical Dictionary. A popular dictionary of words and terms used in the practice of electrical engineering. 350 illustrations.....$3.00

SLOANE, T. O'CONNOR.—Electric Toy Making for Amateurs, including Batteries, Magnets, Motors, Miscellaneous Toys.....$1.00

SLOANE, T. O'CONNOR.—The Arithmetic of Electricity. A Manual of Electrical Calculations by Arithmetical Methods, including numerous rules, examples and tables in the field of practical electrical engineering and experimenting. Third edition, revised.....$1.00

STEVENS, H. G.—Mechanical Catechism. For Stationary and Marine Engineers, Firemen, Electricians, Motormen, Ice Machine Men and Mechanics in General. 338 pages, over 240 illustrations. Cloth.....$1.00

THOMPSON, SYLVANUS P.—Dynamo-Electric Machinery. A series of lectures, with an introduction by Franklin L. Pope. 16mo. Numerous illustrations, fancy boards (Van Nostrand's Science Series, No. 66).....$0.50

THOMPSON, SYLVANUS P.—Polyphase Electric Currents and Alternate-Current Motors. Mailed to any address in the world on receipt of.....$3.50

THOMPSON, SYLVANUS P.—Recent Progress in Dynamo-Electric Machines, being a Supplement to Dynamo-Electric Machinery. 16mo. (Van Nostrand's Science Series, No. 75).....$0.60

THOMPSON, SYLVANUS P.—Dynamo-Electric Machinery. Eighth edition, revised and rewritten. Numerous illustrations and 19 plates. Nearly 1,000 pages.....$8.00

THURSTON, PROF. R. H.—Stationary Steam Engines, Especially Adapted to Electric Lighting Purposes. Treating of the development of Steam Engines, the Principles of Construction and Economy, with description of Moderate and High Speed Engines. With many folding plates.....$2.50

TREVERT.—How to Make Electric Batteries at Home. Illustrated.....$0.25

URQUHART.—Electro-Plating. A Practical Hand Book on the Deposition of Copper, Silver, Nickel, Gold, Aluminum, Brass, Platinum, etc. Second edition; carefully revised, with additions.....$2.00

WALKER, F.—Practical Dynamo Building, for Amateurs. How to wind for any output. With numerous illustrations. 16mo, boards. (Van Nostrand's Science Series, No. 98).....$0.60

WEBB, H. L.—A Practical Guide to the Testing of Insulated Wires and Cables. Illustrated.....$1.00

WEBB, HERBERT LAWS.—Telephone Hand Book. Illustrated. 12mo, cloth. Chicago, 1895.....$1.00
The only complete work on the Telephone. All possible information for any one interested in Telephones and how to make and operate them.

WEBER.—The Handy Vest Pocket Electrical Dictionary. Cloth.....$0.25
Leather.....$0.60

ELECTRICIAN PUBLISHING CO.,

.....510 Marquette Building, Chicago.....

BITUMINIZED FIBER CONDUIT

FOR UNDERGROUND CONSTRUCTION

Combines the **good features** of other conduits.
Eliminates the **bad features** existing in many kinds.
Has valuable features not found in any other ducts.

Made in 7-foot lengths with male and female joints, making construction very rapid and simple, with consequent low cost.

Alignment is perfect and permanent without tedious care and skill required in laying of butt-joint conduits.

Users are astonished by the ease and rapidity with which cables can be drawn in, and this without the slightest scratching or injury to the lead covering thereof.

Made in sizes from 1-inch to 10-inch diameter.

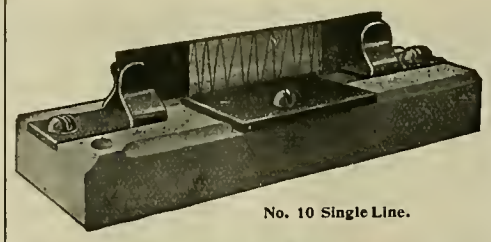
Bends of any radius and any angle.

Write us for further information and prices, stating sizes and quantities required.

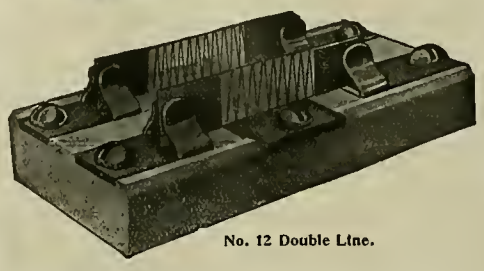
American Conduit Co.

Main Offices: 1005-6 Manhattan Building, Chicago

Other Offices:
170 Broadway, New York. 336 Macy St., Los Angeles



No. 10 Single Line.



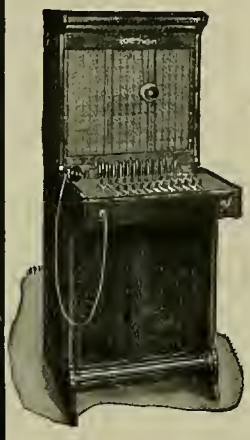
No. 12 Double Line.

PROTECTORS THAT PROTECT.

Our patent wrapped fuse used in our protectors are an insurance policy against lightning.

Sample free by mail to any Exchange or Toll Line

CENTRAL TELEPHONE AND ELECTRIC CO.,
909 Market St.,
ST. LOUIS, U. S. A.



INTERNATIONAL

Mechanical Self-Restoring Drop Switchboard.

A PERFECT APPARATUS.

Made in any desired capacity.
Sample parts and quotations on request.

INTERNATIONAL TELEPHONE MANUFACTURING CO.
CHICAGO, U. S. A.

THE BEST KIND OF INSURANCE FOR TOLL LINES

To be erected on the most exposed parts of the line. They require no attention after erecting.

Minnesota Electric Co.,
MINNEAPOLIS, MINN.

We introduced successful 4-party lines

LEICH SELECTIVE SYSTEM

Write for our booklet—"Selective W."

Impedance Coil for Selectives. No Springs.

CENTRAL ENERGY OR MAGNETO

AMERICAN ELECTRIC TELEPHONE CO.
CHICAGO, ILLINOIS

AS SIMPLE AS ITS NAME.

A B C
—OF—
THE TELEPHONE

By J. E. HOMANS, A. M.
352 pages.
Cloth, Price $1.00.

An up-to-date, practical treatise on the construction, theory, installation, care and management of telephones and their appliances.
Sent prepaid on receipt of price.

Electrician Publishing Co.,
510 Marquette Building, Chicago, Ill.

CENTRAL STATION HEATING

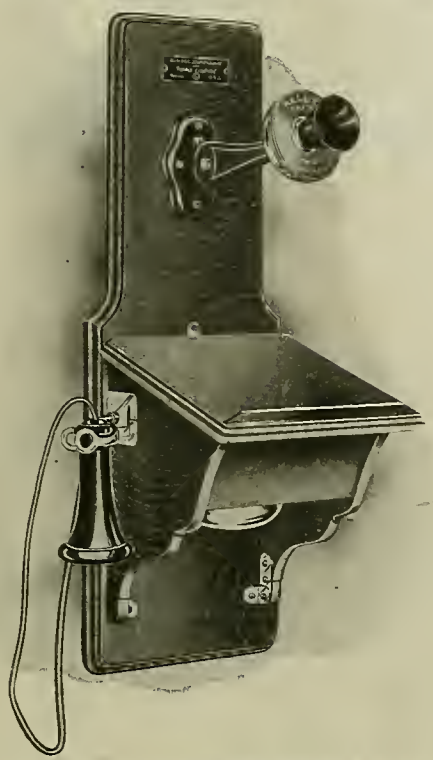
We are the originators and builders of the underground system of live and exhaust steam heating. Our system is used for the utilization and distribution of exhaust steam from electric and power plants for heating purposes. 250 Plants in successful operation. We have the only Meter System. Also manufacturers of Wooden Water Pipe, Steam Pipe Casing, Steam Traps, Condensation Meters, Valves, Economizing Coils, Separators and full line of Steam Fitters' Supplies.

WRITE FOR PAMPHLET AND PRICE LIST

AMERICAN DISTRICT STEAM COMPANY
MENTION WESTERN ELECTRICIAN. LOCKPORT, N.Y. CHICAGO, ILL.

KELLOGG SWITCHBOARD & SUPPLY CO.

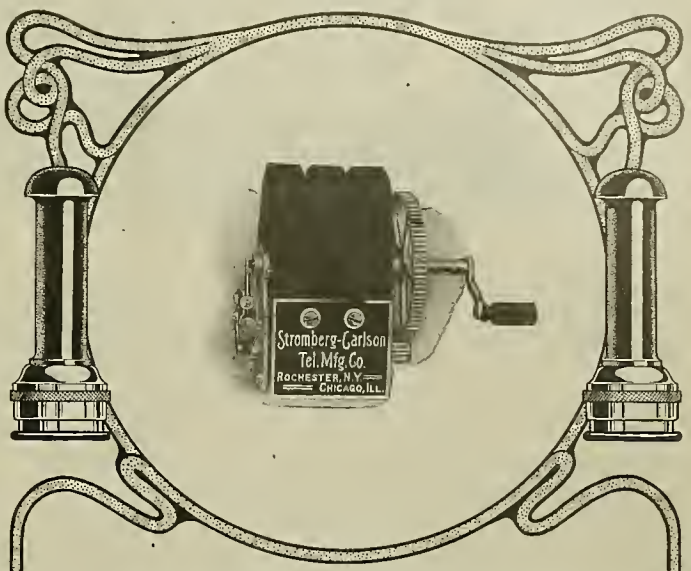
Manufacturers of the Largest and Busiest Telephone Exchanges in the United States



The Kellogg Transmitter stands first in volume, clearness of articulation and in carrying power. Our prices are low when cost of maintenance and quality of apparatus are considered. Do not fail to visit our exhibit in the Electricity Building at the St. Louis Exposition.

Kellogg Switchboard & Supply Co., Green and Congress Streets - CHICAGO

Seymour Bldg., Los Angeles Electric Bldg., Cleveland Keystone Telephone Bldg., Philadelphia



Standard three-bar generator, same as used in our series telephones. We have manufactured generators since we first started in business. What this experience means to you enables us to sell the best generator made at a price slightly above the ordinary. The difference is caused by the better grade of material used and the superior workmanship.

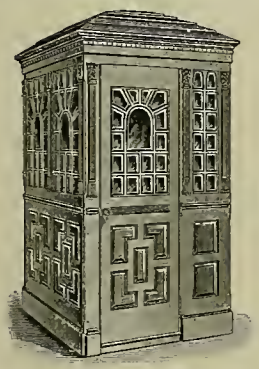
You pay nothing for our experience. Our Bulletin No. 11-E explains fully this apparatus. Mailed free.

Stromberg-Carlson Telephone Mfg. Co.

GENERAL AND EASTERN OFFICE **ROCHESTER, N. Y.**

SALES DEPT. **CHICAGO, ILL.**

INCREASED RECEIPTS PAY THE COST OF TELEPHONE BOOTHS,



Oftentimes the first thirty days will do it.

TRY ONE.

Write for catalog

W. S. SEAMAN & CO.

218 E. WATER STREET, MILWAUKEE, WIS.

TELEPHONE BOOTHS

When in want of the Right Kind write us.

Catalogue Free

Yesbera Mfg. Co.

TOLEDO, OHIO.

Automatic Telephones.

Privacy

Promptness

Precision

Profits.

Automatic Electric Co., Chicago, U. S. A.

PRODUCERS AND WHOLESALERS OF WHITE CEDAR PRODUCTS

CEDAR POLES

SPECIAL PRICES ON SMALL POLES.
Write for a copy of our TELEGRAPH CODE FOR CEDAR PRODUCTS

C. H. WORCESTER CO.
SUITE 1206 TRIBUNE BLDG. CHICAGO.

YARDS
KOSS MICH.
L'ANSE "
MUNISING "
ONTONAGON
WAGNER, WIS
PESHTIGO "

Cedar TORREY CEDAR CO., CLINTONVILLE, WIS. Poles
Large Stock Constantly on Hand

POLES, TIES, POSTS. THE PORTER CEDAR CO., SAGINAW, MICH.
PRODUCERS. We want your inquiries always.

BRACKETS—X ARMS—PINS
little things it is true, but they cut a big figure in line construction.
OUR MOTTO IS:
Prompt Shipment Quality Satisfaction Right Price
COLUMBIA MFG. CO. ANTIGO, WIS.

POLES W. C. STERLING & SON, MONROE, MICH. TIES.
Eleven Pole Yards in Michigan.
Wholesale Producers for 20 years

Poles and Ties

The Fowler Companies
TRADE MARK
Fisher Bldg. Chicago

Points in Wisconsin and the Northwest
are covered by Wisconsin Central Railway's convenient, solid, wide vestibuled trains, equipped with Pullman sleepers, free reclining chair cars and modern coaches which leave Central Station, 12th Street and Park Row (Lake Front), Chicago for St. Paul, Minneapolis, Ashland and Duluth, connecting with all western lines. Meals in dining and cafe cars served a la carte.
For tickets and further information apply to nearest ticket agent, or write
JAS. C. POND, Gen'l Pass. Agt., Milwaukee, Wis.

Send your Book Orders to
ELECTRICIAN PUBLISHING CO.,
510 Marquette Bldg., Chicago.

WHITE CEDAR POLES
HALL L. BROOKS
52 WISCONSIN AVENUE
TOMAHAWK, WIS.

BUY Your Electrical Books of the Electrician Publishing Co., Suite 510 Marquette Bldg., Chicago. You will save TIME and MONEY by doing so. . . . . .

"By two or three witnesses shall a matter be established."

FIVE POINTS OF EXCELLENCE.

Leaving the center of the city from which you start; reaching the center of the city of your destination, over smooth and level tracks; giving rest and comfort; riding beside running waters most of the way, through the centers of population to the gateways of commerce; when you travel by the

NEW YORK CENTRAL LINES.

A copy of the Illustrated Catalogue of the "Four Track Series" will be sent free upon receipt of a two-cent stamp by George H. Daniels, General Passenger Agent, Grand Central Station, New York.

A Trip Through Yellowstone Park

is what everyone hopes to have—**some day**. It is the most wonderful trip in the world. There are more than 3,000 square miles of weird, marvelous, unimaginable things that can be seen nowhere else, therefore if one ever sees them one **must** go to the Park, in the heart of the magnificent Rockies with snow tipped peaks all around. If Old Faithful geyser, a Paint Pot, Mud Volcano, or Emerald Pool were to be found in Lincoln Park, Chicago; Central Park, New York; or Fairmount Park, Philadelphia; the people would flock to see it or them by tens of thousands. For a very small sum, comparatively, all these and hundreds more of nature's unduplicated marvels can be seen between June 1 and September 30, of each year, and one will enjoy, to boot, the best coaching trip in the country.

The **Northern Pacific** folder on Yellowstone Park, just issued, is a new, right up to date, finely illustrated dessertation on this Yellowstone Park trip. It is not descriptive, but deals with the detailed, technical matters everyone needs to know about such a trip. It tells all about the hotels, the stage coaches, the roads, the cost of the tour; where the geysers, the waterfalls, the bears, the canyons are, and where the trout fishing is found. We have printed thousands of this beautiful leaflet and want everybody interested to have a copy, and it can be obtained by sending A. M. Cleland, General Passenger Agent, St. Paul, Minn., **two cents** with proper address.

"Wonderland 1904" which is a very fine pamphlet of 116 pages, descriptive of the Northwest, including the Park, will be sent for **six cents.**

Locations for Industries
Erie Railroad
Chicago to New York

The Erie Railroad Company's Industrial Department has all the territory traversed by the railroad districted in relation to resources, adaptability, markets and advantages for manufacturing, and can advise with manufacturers in relation to the most suitable locations. For full information address

LUIS JACKSON
Industrial Commissioner, Erie Railroad Company
21 Cortlandt Street, New York

ARE YOU LOOKING FOR TROUBLE?
IF SO, GET A COPY OF
TELEPHONE TROUBLES
AND HOW TO FIND THEM
—IN—
BOTH MAGNETO AND COMMON BATTERY SYSTEMS.
9th Edition Just Out. Price, 25c.
Electrician Publishing Co.,
510 Marquette Building,
CHICAGO.

Standard Vitrified Conduit Co.

B. B. BARNARD, Manager
39-41 CORTLANDT ST.
NEW YORK

LARGEST FACTORIES IN THE WORLD : STOCK ON HAND
SEND FOR CATALOGUE

Preserve Your Copies
OF THE WESTERN ELECTRICIAN.
BINDERS $1.00 EACH.
ELECTRICIAN PUBLISHING CO.,
Suite 510 Marquette Building. . . . .

Idaho Cedar Poles
PACIFIC COAST POLE CO. SPOKANE, WASH.

Possibly our promptness in shipping Poles has brought you to expect it of everybody.

Do you understand that we are just as prompt in shipping Ties? Send us that rush order and we can prove it.

MALTBY CEDAR COMPANY, 509 Phoenix Block, Bay City, Michigan.
Tipper & Patton, Pittsburg Agents, 509 Bessemer Bldg.

WHITE CEDAR POLES
Don't forget our Minnesota Transfer Yard—midway between St. Paul and Minneapolis, where we load in forty-eight hours from the time we have your order.
PAGE & HILL CO. 1003 Lumber Exchange, MINNEAPOLIS, MINN.

Cedar Poles.
Pittsburg and Lake Superior Iron Co. Producers and Wholesalers. Escanaba, Mich.

TELEPHONE POLES
Yards at Red Cliff, Wis., Aitkin, Feeley, Cohasset, Deer River, Tenstrike and Black Duck, Minnesota.
Large stocks. Prompt shipments. Carefully inspected stock at low prices.
J. W. MORRISON LUMBER CO., 918-19 Lumber Exchange MINNEAPOLIS, MINN.

POLES. WHITE CEDAR. IDAHO CEDAR up to 80 ft.
BERTHOLD & JENNINGS, ST. LOUIS. Chemical Building.
CROSS ARMS. LONG LEAF PINE AND FIR.

MICHIGAN AND WESTERN **CEDAR POLES**
ALL LENGTHS AND SIZES
LINDSLEY BROS CO.
TRIBUNE BLDG., CHICAGO

CEDAR POLES
ESTABLISHED 1862
WM. MUELLER COMPANY
1211-12-13 MARQUETTE BLDG. CHICAGO.
EIGHT DISTRIBUTING YARDS

Southern Cedar POLES Are the Best.
NO ROTTEN BUTTS.
D. W. PHELAN, 277 Broadway, New York

POLE DEALERS ADVERTISING IN THE WESTERN ELECTRICIAN OBTAIN MOST EXCELLENT RESULTS BECAUSE IT PLACES THEM IN TOUCH WITH ACTUAL BUYERS OF POLES. TRY A CARD.

THE CROUSE-HINDS
HARPOON GUY ANCHOR

Is made of forged steel and weighs 22 pounds. The rod is one inch square and five feet long. The wings have a spread of thirteen inches.

The anchor is installed with no other tools than a common sledge hammer. It can be driven into the ground with 30 or 40 blows of the sledge.

WRITE US FOR CIRCULAR AND PRICES.

CROUSE-HINDS COMPANY,
133 S. CLINTON STREET, - - - - CHICAGO, ILL.

MICHIGAN WHITE **CEDAR POLES** LARGE STOCK.
PROMPT SHIPMENTS. KELLOGG SWITCHBOARD & SUPPLY CO., Chicago.

BOILER WATERS CORRECTED

to remove and prevent scale and to stop corrosion. DEARBORN TREATMENT does the work. Send gallon sample for analysis. Booklet "R" now ready.

DEARBORN DRUG & CHEMICAL WORKS,

27-34 RIALTO BUILDING, CHICAGO, ILL. WM. H EDGAR, President Telephone: Harrison 3930 and 3931.

Dixon's Solid Belt Dressing

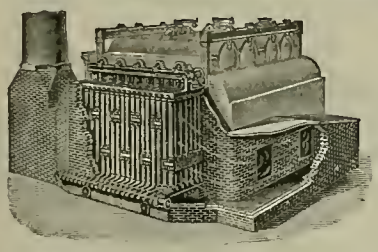
In Handy 1-lb. Bars

ends all slipping, without hardening or otherwise injuring the leather. Circular 125 and free samples upon request.

JOSEPH DIXON CRUCIBLE CO., JERSEY CITY, N. J.

If the Installation of a

GREEN'S ECONOMIZER



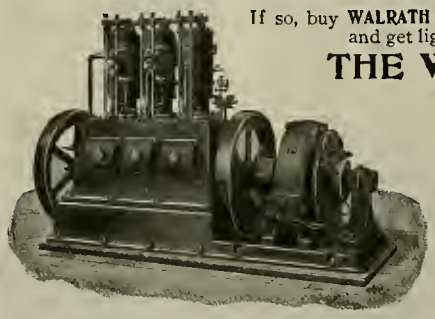
Were long an expense, then you would be justified in deliberating, but under ordinary conditions, depending largely upon coal cost, it soon pays for itself by utilizing waste gases. **Electric light and power plants** find it a paying investment outside of the 10 to 20% saving on coal bill. Ask for explanation through our experts, also for booklet, both free.

The **Green Fuel Economizer Co.**

Matteawan, N. Y. *Sole Manufacturers in the U. S.*

ARE YOU LOOKING FOR MONEY?

If so, buy **WALRATH GAS OR GASOLINE ENGINES** and get light on the subject.



THE WALRATH

Received the Highest Award at the Pan-American Exposition.

It will produce as good a commercial light as that of an automatic steam engine, either belted or direct-connected generator. Simple, Economical and Reliable

Send for Catalogue W.

MARINETTE GAS ENGINE CO.,

CHICAGO HEIGHTS, ILL.

AGENCIES:
Keystone Engineering Co., Farmer's Bank Bldg., Pittsburg, Pa.
Strong, Carlisle & Hammond Co., 61-67 Frankfort St., Cleveland, Ohio
Mackay Engineering Co., 149 Broadway, N. Y.
C. H. Seidenglanz., 52 When Bldg., Indianapolis, Ind.

JEFFREY CHAIN BUCKET DREDGES FOR CATALOGUE, ADDRESS THE JEFFREY MFG. CO. COLUMBUS, OHIO.

H. N. FENNER, President J. F. BLAUVELT, Agent RUSSELL W. KNIGHT, Treasurer

NEW ENGLAND BUTT COMPANY

MANUFACTURERS OF

Machinery for Insulating Electrical Wires

Braiding, Taping, Winding, Twinning, Cabling, Stranding, Polishing and Measuring Machines. Cable Covering Braiders

FINE CASTINGS A SPECIALTY

304 PEARL STREET, - - - PROVIDENCE, R. I., U. S. A.

REG. TRADE MARKS

"Phosphor Bronze" DELTA

THE PHOSPHOR BRONZE SMELTING CO. LIMITED, 2200 WASHINGTON AVE., PHILADELPHIA.
"ELEPHANT BRAND PHOSPHOR-BRONZE"
INGOTS, CASTINGS, WIRE, RODS, SHEETS, ETC.
— DELTA METAL —
CASTINGS, STAMPINGS AND FORGINGS
ORIGINAL AND SOLE MAKERS IN THE U.S.

BEST ON EARTH.

BURGER AUTOMATIC.

For Electric Work

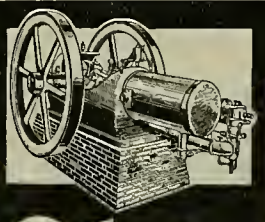
REGULATION AND ECONOMY OF FUEL UNSURPASSED.

WRITE FOR CATALOGUE H

Then compare it with some Gas Engine hand books that cost $1.00.

Woolley Foundry & Mach. Works

Box 400, Anderson, Ind. U. S. A.



Olds Gas and Gasoline Engines

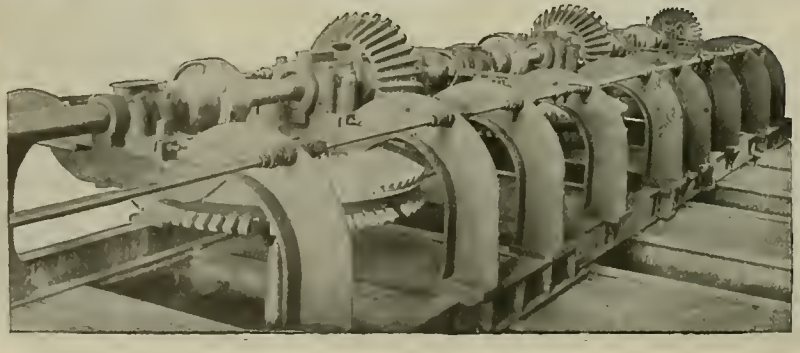
Are built on lines of strict originality, and are protected by the Olds patents. The essential parts of our engines combine the highest efficiency with the greatest simplicity of construction and operation. No engine made approaches the Olds for economy and durability.

Stationary Engines - - 2 to 100 H. P.
Portable Engines - - 8 to 18 H. P.

Write to-day for full information and new illustrated catalog.

Olds Gasoline Engine Works
252 River Street, - Lansing, Mich

3 982



SAMSON TURBINE

In connection with our turbines we build the highest grade of POWER TRANSMISSION MACHINERY in the way of GEARS, SHAFTS, BRIDGETREES, BEARINGS, etc.

Write Dept. D for Catalogue

JAMES LEFFEL & CO.

SPRINGFIELD, OHIO U. S. A.

Fort Wayne Revolving Field Alternators

Fort Wayne Three-Phase Engine Driven Alternator
Type T R E 48-200-150-2,300 volts.

Engine Driven

Multiphase alternators furnish most economical and flexible equipment for lighting and power plants

Write for Literature and Prices

Fort Wayne Electric Works, Fort Wayne, Indiana.

248

The Inspector AND Trouble Man.

By A. E. DOBBS.

Full of information and diagrams for the operator, exchange owner, exchange manager, inspector, trouble man, lineman.

A complete description of telephones and their troubles. How to find and remedy them, together with working plans for exchange construction, complete with diagrams of all up-to-date telephones and switchboards.

This is a practical book, written in **plain language**, and for **anyone** interested in telephony.

Mailed anywhere on receipt of price . . . **ONE DOLLAR.**

No technicalities. Substantially bound in cloth.

ELECTRICIAN PUBLISHING CO.,

510 MARQUETTE BUILDING, CHICAGO.

Good Advice

No. 6

If you have not yet tried a Duncan Wattmeter for your Direct Current service, send for one of our latest high torque type. They have 12 per cent greater turning moment than any meter on the market. This means extreme accuracy on low loads for an indefinite period and a positive earning on your small load service. A meter sent on 30 days trial to prove our assertion, tells the story.

Good Advice No. 7 Next Week

Write for Bulletin and Prices

DUNCAN ELECTRIC MFG. CO.

LAFAYETTE, IND.

Allis-Chalmers Co
CHICAGO

5000 horsepower Allis-Chalmers Engine

Machinery Hall, World's Fair, St. Louis.

WHAT IT HAS DONE

Began unloading from train Jan. 15th 27 carloads – Generator 10 carloads.
Steam first turned on April 20th, Engine and Generator operated perfectly ever since.
St. Louis Exposition officially opened April 30th, 1904.

Decorative lighting of Exposition Buildings and Grounds first turned on evening April 29th, this Engine and Generator carrying the load.

Ran non-condensing one month while Exposition was getting its condenser plant erected and connections made. During that time carried 4300 horsepower night after night.

Sometimes required to operate the Cascades,—2000 horsepower.

Exposition having finished its condenser plant, the Engine was required to take full load June 10th. That night the unit carried 4800 horse power. Began with 26-inch vacuum—no load—which, under load, ran down to about 14 inch, or 7 to 8 pounds. Engine has never been out of commission, except for two nights when a sewer burst and flooded the wheel-pit.

Since then Engine ran condensing until July 25th,—carrying 4800 horsepower with from 13 to 16 inches vacuum. On July 25th a break occurred in the Exposition discharge pipe which takes the condenser water to the Lagoon. The Engine then ran non-condensing for two nights. It carried 4400 horsepower during that time. On July 28th ran condensing,—since then it has regularly carried 5600 horsepower with 15 inches vacuum.

The "Big Reliable"

Bullock
Electric Mfg Co
Cincinnati

Canadian representatives, Allis-Chalmers-Bullock, Ltd., Montreal

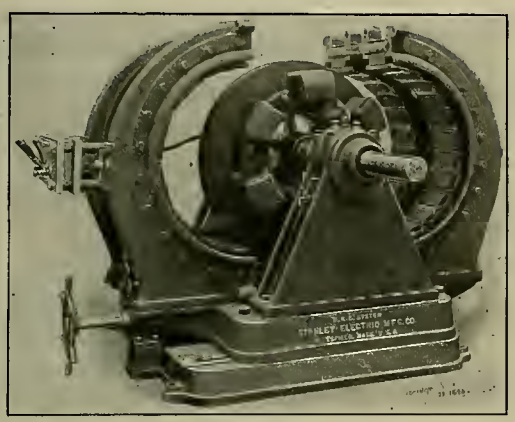
THE ELECTRIC STORAGE BATTERY CO.

PHILADELPHIA

Extends an invitation to its exhibit at Section Twenty, in the Palace of Electricity, Louisiana Purchase Exposition.

September 12, 1904

SALES OFFICES
PHILADELPHIA—Allegheny Av. and 19th St. NEW YORK—100 Broadway.



The S. K. C. Inductor Alternator

Ability to Start Up
Oil Up
Shut Up
and occasionally Clean Up

is all that is required to operate the Inductor Alternator as built by the Stanley Electric Manufacturing Company.

Does simplicity appeal to you? You have it in the Inductor with no moving wires, brushes, commutator or collector rings.

Do you desire inexpensive operation? The Inductor has nothing to renew, and only the bearings require attention.

Are your facilities for handling machinery limited? The Inductor is not difficult to install.

Bulletins Nos. 123 and 128 tell all about it. Send for them.

The Stanley Electric Manufacturing Company
Pittsfield, Massachusetts, U. S. A.

W. D. PAINT.

A PERMANENT INSULATING PROTECTION FOR WOOD OR METAL. A quick drying, moisture-proofing, black paint. An elastic anti-rust coating. A jet black finishing paint, efficient and not expensive.

Write for "Data on Insulating Materials."

DIELECTRIC MANUFACTURING CO., SAINT LOUIS.

CARBONS

CONSUMERS CARBON CO.

LANCASTER, OHIO, U. S. A.

Carbons of all kinds and for all purposes.

PLATINUM

PLATINUM RIVETS FOR CONTACT POINTS IN TELEPHONES—SPARK COILS AND OTHER ELECTRICAL APPARATUS. PLATINUM SHEET AND WIRE IN ANY FORM AND DEGREE OF HARDNESS. PLATINUM SCRAP PURCHASED.

BAKER & COMPANY, Inc.

ARTISANS IN PLATINUM

408-410-412-414 N. J. R. R. AVE. - NEWARK, N. J.

New York Office: 120 Liberty St.

ALPHABETICAL INDEX TO ADVERTISEMENTS.

Adams-Bagnall Electric Co...—
Akron Electrical Mfg Co.... 10
Allen Company, L. B.....—
Allis-Chalmers Company..... 2
American Battery Co.....—
Amer. Circular Loom Co..... 1
American Conduit Co.....14
Amer. District Steam Co.....17
Amer. Elec. Fuse Co..... 9
Amer. El. Telephone Co.....15
American Electrical Works..11
Arnold Elec. Power Station Co..... 13
Automatic Electric Co..... 14

Babcock & Wilcox Co.....16
Bain, Forée.....11
Baker & Company..... 3
Baker & Co., W. E.....13
Barnett Company, G. & H....20
Beardslee Chandelier Mfg. Co.10
Berthold & Jennings.....16
Big Four Route.....16
Bissell Co., The F.....10
Bossert Electric Construction Co.....12
Brooks, Hall L.....16
Bryan-Marsh Co.....—
Bryan, Wm. H.....13
Buckeye Electric Co.....—
Bullock Elec. Mfg. Co..... 2
Butterfield, J. F.....--
Byllesby & Co., H. M.....13

Cantwell Press, The..... 9
Central Electric Co.....—
Cent. Stat. Improvement Co..12
Central Tel. & El. Co.....—
Century Electric Co.....11
Chicago Die & Electric Co....—
Chicago Edison Co.....4, 12
Chic. Fuse Wire & Mfg. Co...—
Chicago Insulated Wire Co.. 1
Chicago Mica Co.....10
Columbia Incand. Lamp Co..—
Columbia Mfg. Co.....17
Columbus Storage Bat'ry Co.—
Consumers Carbon Co..... 3
Continuous Rail Joint Company of America.....10
Cope, T. J..... 8
Crawfordsville Electric Co..12
Crescent Ins. Wire & Cbl. Co. 1
Crocker-Wheeler Company... 5
Crouse-Hinds Co.....—
Cutler-Hammer Mfg. Co.....19
Cutter Elec. & Mfg. Company—

D. & W. Fuse Company.....—
Dearborn Drug & Chem. Wks. 8
Diamond Meter Company....—
Dielectric Manufacturing Co. 3
Directory of Engineers..... 13
Dixon Crucible Co., Joseph.. 8
Driver-Harris Wire Co..... 1
Duncan Elec. Mfg. Co.....19

Economical Elec Lamp Co.. 7
Edison Decorative & Miniature Lamp Departm't.....10
Edison Mfg. Company..... 7
Edwards & Co.....—
Egan, J. J..... 7
Electric Appliance Co..... 10
Electric Storage Battery Co.. 3
Electrical Appliance Co..... 6
Electrical Engineer Institute. 5
Electrician Pub. Company...13
Erie Ry.....12

Faries Mfg. Co.....20
"For Sale" Advertisements..12
Ft. Wayne Elec. Works, Inc..19
Fostoria Incand. Lamp Co...—
Fowler, John H.....16
Fowler-Jacobs Company.....16

General Electric Co..... 9
General Engineering Co., The 13
General Incandescent Arc Light Company.....—
General Incand. Lamp Co....—
Gould Storage Battery Co....—
Gt. West. Smelt. & Refining Co.—
Green Fuel Economizer Co..—
Gregory Electric Company...12

Hallberg, J. H 13
Haller Machine Co.....11
Hart Mfg. Co..... 1
Hartford Steam Boiler Inspection & Insurance Co.... 8
Hazard Manufacturing Co...20
Highland Park College. ... 11
Hipwell Mfg. Co..... .... —
Hobart Elec. Mfg. Company. 1
Hoffman, G. W.....17
Holmes Fibre-Graph. Co..... 4
Holophane Glass Co.....20
Holtzer-Cabot Electric Co...11
Hornaday & Co., J. P.....13
Humphrey, Henry H.....—
Hunt & Co., Robt. W.....13

Illinois Central Ry.....12
Incandescent Electric Light Manipulator Company..... 1
Indiana Rub. & Ins. W. Co.... 1
India Rubber & Gutta Percha Insulating Company..... 5
International Elec. Meter Co 12
International Tel. Mfg. Co...15

Jackson, D. C. & W. B.....13
Jeffrey Manufacturing Co.... 8
Jewell Electrical Inst. Co....—
Johns-Manville Co., H. W.....—

Kartavert Manufacturing Co.20
Kellogg Switchboard & Supply Company.....15, 16
Kemp, R. W..... 13
Kester Elec. Mfg. Co.....12
Klein & Sons, Mathias..... 5
Kohler Brothers.....13
Kuhlman Electric Co.....11

Leather Preserv. M. Corp....—
Leffel & Co., James..... 8
Lindsley Brothers Company..17
Loud's Sons Co., H. M.....17

Machado & Roller..... 7
Maltby Cedar Company.....17
Manhattan El. Supply Co.... 4
Manross, F. N..... 4
Marinette Gas Engine Co..... 8
Matthews & Bros., W. N.....11
McLaughlin, James.... 13
McLaughlin & Co., Jas..... 8
McLennan & Company, K....10
Mechanical Appliance Co....—
Mica Insulator Company.....—
Michigan College of Mines..—
Minnesota Electric Co.....14
Miscellaneous Advs.....12
Moxon Railroad..... . ---
Moon Mfg. Co., The.....14
Morrison Lbr. Co., J. W.....—
Mueller Company, William..17
Munsell & Co., Eugene.....10

National Electric Co..... 4
National India Rubber Co....—
New England Butt Co..... 1
Newgard & Co., Henry.....10
New York Cent. Ry.....14
New York Ins. Wire Co.....11
Northern Elect'l Mfg. Co.... 8
Northern Pacific Ry.....16
Northwestern Storage Battery Co.. 11
Norton Elect'l Instrument Co. 1

Okonite Co., The..... 1
Olds Gasoline Engine Works. 8
Pacific Coast Pole Co.....17
Page & Hill Co.....16
Paragon Fan & Motor Co.....—
Pardridge Shade & Refl. Co..—
Pass & Seymour, Inc.....—
Phelan, D. W.....16
Phillips, Eugene F.....11
Phillips Insulated Wire Co...11
Phœnix Glass Co..... 1
Phosphor-Bronze S. Co..... 8
Pignolet, L. M.....10
Pittsburg & L. S. Iron Co....17
Plume & Atwood Mfg. Co....—
Porter Cedar Company....,.17

Reisinger, Hugo.....—
Reynolds El. Flasher Mfg. Co.12
Roebling's Sons Co., J. A.....20
Ruebel-Schwedtmann-Wells..13
Ruuzel-Lenz Elec. Mfg. Co...14

Safety Ins. Wire & Cable Co.. 1
Sargent & Lundy.....—
Sauquoit Silk Mfg. Co..... 5
Schott, W. H.....13
Seaman & Co., W. S.....14
Sears, Roebuck & Co.....—
Simplex Electrical Co., The.. 1
Simplex Elec. Heating Co....11
Speer Carbon Co..... . 3
Sprague Electric Company... 5
Squire Electric Co.....—
Standard Elec. Mfg. Co.....11
Standard Underg. Cable Co.... 1
Standard Vitrified Conduit Co17
Stanley Elec. Mfg. Co., The 3
Stanley Instrument Co..... 7
Stanton, LeRoy W..... 13
State Univ. of Iowa.....13
Sterling & Son, W. C.....16
Sterling Electrical Mfg. Co... —
Sterling Varnish Co., The.... 7
Stow Mfg. Company.....10
Stromberg-Carlson Tel. Mfg. Company.....15
Sturtevant Company, B. F...20

Torrey Cedar Company.....17
Trumbull Elec. Mnfg. Co.....--
Turner Brass Works.....—

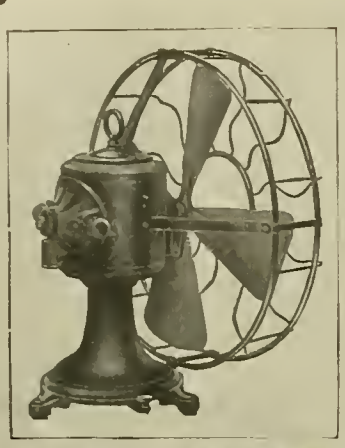
Union Electric Mfg. Co.....—

Valentine-Clark Co., The....17
Vulcanized Fibre Company..20

Wagner Electric Mfg. Co.....15
Walsh's Sons & Company..... 1
Warren Elec. Mfg. Co.....10
Wesco Supply Co.....—
Western Electric Company...12
Western El. Supply Co..... 9
Westinghouse Electric & Manufacturing Co.....18
Weston Electrical Inst. Co... 1
Wilmerding, C. H.....13
Wisconsin Central Ry.....16
Woolley Fdy. & Mach. Wks..—
Worcester Company, C. H....16

Yesbera Mfg. Co..... .. —
Yost Electric Mfg. Co 5, 11

For Classified Index of Advertisements See Page 6.



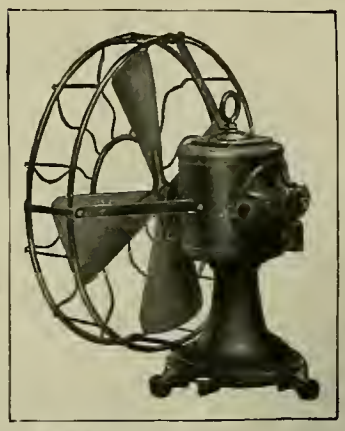
REMEMBER THE NAME AND BUY THE BEST.

PARAGON FAN MOTORS

NEW STYLES NEW PRICES
EASY RUNNING RIGID CONSTRUCTION NOISELESS

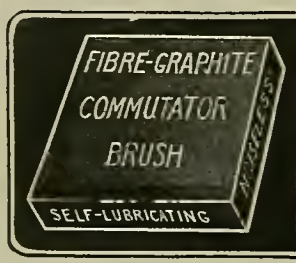
CALL AND SEE THEM OR WRITE FOR PRICES

CHICAGO EDISON COMPANY,
139 ADAMS ST., CHICAGO.



"MANROSS"
HAIR SPRINGS
For Electric Indicating and Recording Gauges, Steam Gauges, Etc

LARGEST MANUFACTURER OF
HAIR SPRINGS in the United States.
F. N. MANROSS,
FORESTVILLE, CONN.



There's No Friction
with the Fibre-Graphite Commutator Brush. Being 90 per cent. pure graphite, it insures low resistance, no sparking under a varying load, and longer wear. There is no greasing required. The Fibre-Graphite is therefore the most economic brush on the market. Send for price list.
HOLMES FIBRE-GRAPHITE MFG. CO.
5155 Wakefield St., Germantown, PHILADELPHIA.

DON'T BUY ELECTRICAL SUPPLIES

Until you have seen our new Catalogue and new Price List.
Free to the trade.

Manhattan Electrical Supply Co.
NEW YORK: 32 Cortlandt St.
CHICAGO: 188 Fifth Ave.

National Electrical Machinery

1000 K. W. Rotary Converter for Street Railway Service

BUILT IN ALL CAPACITIES

NATIONAL APPARATUS is *high grade* in every respect. Modern in design and superior in performance. We solicit specifications covering Generating Equipment for Lighting, Power or Railway Service.

Write for Catalogue No. 27

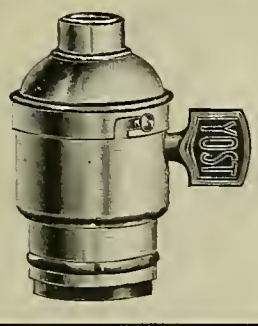
National Electric Company

New York: 135 Broadway
Philadelphia: 1509 Land Title Bldg.
Charleston, W. Va.: Agnew Electric Co.

Main Office and Works
Milwaukee

Pittsburg: Gellatly & Co.
Chicago: Old Colony Bldg.
Seattle and San Francisco: Kilbourne & Clark Co.

SPEER HIGH GRADE CARBON BRUSHES
MOTOR AND GENERATOR CARBON BRUSHES
SPEER CARBON CO., - St. Marys, Pa.



They Stand on Their Own Merit.

THE GENERAL ELECTRIC COMPANY
DEFEATED BY
The Yost Electric Manufacturing Company

Painter patent for insulating lining made of a single piece of fiber tubing held to be void for want of Patentable Novelty in view of Prior Art.

This decision was handed down by Judge Hazel of the United States Circuit Court in the Southern District of New York, filed July 30, 1904, in a suit brought by The General Electric Company against The Yost Electric Manufacturing Company of Toledo, Ohio.

Yost Sockets and Electrical Specialties save you time, labor and annoyance. Full information for the asking. Catalogue free.

The Yost Electric Manufacturing Company
TOLEDO, OHIO

M. KLEIN & SON.
Send 2c stamp for new catalogue No. 6 of
KLEIN'S TOOLS
For Electrical Workers and Line Builders.
MATHIAS KLEIN & SONS.
81 W. Van Buren St., Chicago, Ill.

SAUQUOIT SILK MFG. COMPANY.
INSULATING and BRAIDING SILKS
MILLS:
BETHLEHEM, PA.
PHILADELPHIA, PA.
SCRANTON, PA.
NEW YORK REPRESENTATIVES:
WILLIAM RYLE & COMPANY
54 HOWARD STREET
PHILADELPHIA OFFICE:
4015 Clarissa St.
CHICAGO OFFICE:
210 Monroe St.
BOSTON OFFICE:
78 Chauncy St.

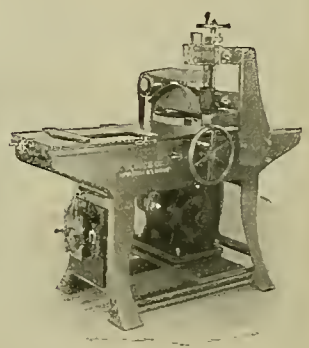
Engineering TAUGHT BY CORRESPONDENCE
Our system of training by mail has helped thousands held down in poor positions to rise to better salaries and situations. Your chance to rise is just as good as others. Write for our free illustrated book, "Can I Become An Electrical Engineer?" We teach by mail, Electrical Engineering, Mechanical Engineering, Steam Engineering, Mechanical Drawing, Electric Lighting, Electric Railways. ELECTRICAL ENGINEER INSTITUTE, Dept. K, 240 West 23rd St., New York.

Crocker-Wheeler. Brown, Boveri.

By arrangement with the celebrated electrical engineers, Brown, Boveri & Cie. of Baden, Switzerland, the Crocker - Wheeler Company has secured their alternating current designs, patents and rights to manufacture in America, and has retained them as consulting engineers.

Crocker-Wheeler Company is now putting on the market alternating current generators, transformers and accessories of the most perfect design and construction, adapted to American practice. Opportunities to bid on this apparatus are invited.

DIRECT CURRENT
MOTORS



THE ADAPTATION of our motors to mechanical drive is practically universal, and their service is unequaled.

Write for Bulletin No. 21814.

SPRAGUE
ELECTRIC COMPANY

General Offices:
527 West 34th Street, New York.

Chicago Office: Fisher Building.

There is No Higher-Class India-Rubber Insulation For Wires and Cables than

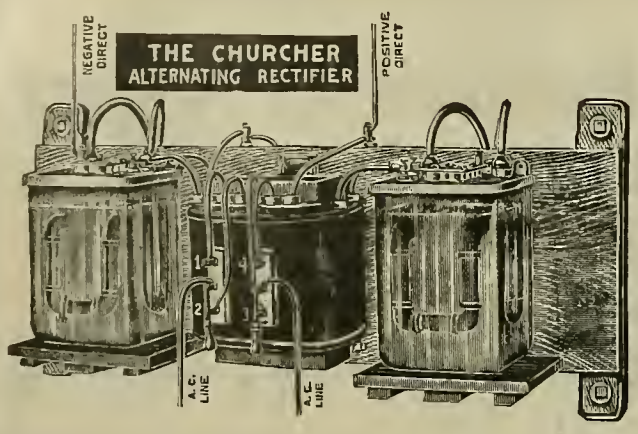
HABIRSHAW.

Authorized Manufacturers of the
ATTIX FLEXIBLE TUBE WIRE.

The India-Rubber and Gutta-Percha Insulating Co.,
MAIN OFFICE, Glenwood Works,
YONKERS, N. Y.

Sales Office,
15 Cortlandt St., New York.

(10928)



CHURCHER ALTERNATING-CURRENT RECTIFIER

will not only transform any cycle of alternating current into direct current, but will, at the same time, if desired, convert the potential of the direct current produced to a higher or lower voltage.

SOLD ON 30 DAYS' APPROVAL

Cheaper to install and operate than a motor generator. Very slight renewal costs. **Guaranteed net efficiency of 50 per cent.** Full particulars in Bulletin No. 18.

THE ELECTRICAL APPLIANCE CO.

CINCINNATI, OHIO

CLASSIFIED INDEX OF ADVERTISEMENTS.

Adjusters, Cord.
Incandes. El. Lt. Manip. Co.

Adjusters, Inc. Lamps.
Inc. El. Lt. Manipulator Co.

Anchors (Tel. & Tel.)
Matthews & Bro., W. N.
Crouse-Hinds Co.

Annunciators.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Moon Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Batteries and Jars.
Bissell Co., The F.
Central Electric Co.
Columbus Storage Battery Co.
Edison Mfg. Co.
Edwards & Company.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Bells, Buzzers, Etc.
Central Electric Co.
Edwards & Co.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Belt Dressing.
Dixon Crucible Co., Jos.
Leather Preserver Mfg. Corp.

Belting.
Leather Preserver Mfg. Corp

Blow Pipes.
Turner Brass Works

Blowers.
Sturtevant Co., B. F.

Boiler Compounds.
Dearborn Drug & Chem. Wks.

Boilers.
Allis-Chalmers Company.
Babcock & Wilcox Co.

Books, Electrical.
Cantwell Press, The.
Electrician Publishing Co.

Booths, Telephone.
Seaman & Co., W. S.
Yesbera Mfg. Co.

Brackets.
Faries Mfg. Co.

Brushes.
Central Electric Co.
Hobart Elec. Mfg. Co.
Holmes Fibre-Graphite Co.
Speer Carbon Co.
Western Electric Company.

Cable Hangers.
Bissell Co., B. F.
Western Electric Co.

Cables (See Wires and Cables)

Canopies.
Faries Mfg. Co.

Carbons, Points and Plates.
Central Electric Co.
Chicago Edison Co.
Consumers Carbon Co.
Electric Appliance Co.
Reisinger, Hugo.
Speer Carbon Co.
Wesco Supply Co.
Western Elec. Supply Co.

Castings.
Faries Mfg. Co.
New England Butt Co.
National Electric Co.

Chains.
Jeffrey Mfg. Co.

Chandeliers.
Faries Mfg. Co.

Circuit Breakers.
Cutler-Hammer Mfg. Co.
Cutter Elec. & Mfg. Co.
Ft. Wayne Elec. Wks. Inc.
Union Electric Mfg. Co.
Western Electric Company.
Westinghouse El. & Mfg. Co.

Clusters.
Faries Mfg. Co.

Clutches, Electrical and Mechanical.
Akron Electrical Mfg. Co.

Coal and Ashes Handling Machinery.
Jeffrey Mfg. Co.

Coils and Magnets.
Western Electric Co.

Commutator Compound
Allen Co., L. B.
Egan, J. J.
McLaughlin & Co., Jas.
McLennan & Co., K.

Commutator Truing Device.
Akron Electrical Mfg. Co.

Condensers, Electric.
Stanley Elec. Mfg. Co.

Conduit and Conduits.
American Circular Loom Co.
American Conduit Company
Central Electric Co.
Electric Appliance Co.
Sprague Electric Co.
Standard Vitrified Cond. Co.
Wesco Supply Co.
Western Electrical Supply Co.

Contractors and Electric Light Plants.
Allis-Chalmers Company.
Bullock El. Mfg. Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
General Inc. Arc Light Co.
National Electric Co.
Northern Electrical Mfg. Co.
Sprague Electric Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Controllers, Crane.
Amer. Elec. Fuse Co.

Cord.
Runzel-Lenz Elec. Mfg Co.

Cross-Arms, Pins and Brackets.
Berthold & Jennings.
Central Electric Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Company.
Western Elec. Supply Co.

Cut-Outs and Switches.
Bissell Co., The F.
Bossert Elec. Const. Co.
Central Electric Co.
Chicago Edison Co.
Crouse-Hinds Co.
Cutter Elec. & Mfg. Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
General Inc. Arc Light Co.
Bart Manufacturing Co.
Manhattan Elec. Supply Co.
Trumbull Elec. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Dynamos and Motors.
Akron Electrical Mfg. Co.
Allis-Chalmers Company.
Bissell Co., The F.
Bullock Elec. Mfg. Co.
Central Electric Co.
Century Electric Co.
Crawfordsville Electric Co.
Crocker-Wheeler Co.
Dustin Co., Chas. E.
Ft. Wayne Elec. Wks. Inc.
General Elec. Co.
General Inc. Arc Light Co.
Gregory Electric Co.
Hobart Elec. Mfg. Co.
Holtzer-Cabot Electric Co
Mechanical Appliance Co.
National Electric Co.
Northern Electrical Mfg. Co.
Sprague Electric Co.
Stanley Elec. Mfg. Co.
Stow Manufacturing Co.
Sturtevant Co., B. F.
Wagner Electric Mfg. Co.
Warren Elec. Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Economizers, Fuel.
Green Fuel Economizer Co.

Electric Heating Appl.
Simplex Elec. Heating Co.
Western Electric Co.

Electric Railways.
Crocker-Wheeler Co.
General Electric Co.
Sprague Electric Co.
Westinghouse El. & Mfg. Co.

Electrical and Mechanical Engineers.
Arnold Elec. Power Stat'n Co.
Baker & Co., W. E.
Bryan, Wm. H.
Butterfield, J. F.
Bylesby & Co., H. M.
General Engineering Co., The.
Hallberg, J. H.
Hornaday, J. P. & Co.
Humphrey, Henry B.
Hunt & Co., Robt. W.
Jackson, D. C. & W. B.
Kemp, R. W.
Kohler Brothers.
McLaughlin, James
Newgard & Co., Henry.
Northern Electrical Mfg. Co.
Ruebel, Schwedtman, Wells.
Sargent & Lundy.
Schott, W. H.
Squire Electric Co.
Stanley Elec. Mfg. Co.
Stanton, LeRoy W.
Wilmerding, C. H.

Electrical Instruments. (Recording and Testing.)
Bissell Co., The F.
Central Electric Co.
Diamond Meter Co.
Duncan Elec. Mfg. Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
General Inc. Arc Light Co.
Jewell Electrical Inst. Co.
Machado & Roller.
Norton Elec'l Instrument Co.
Pignolet, L. M.
Stanley Elec. Mfg. Co.
Stanley Instrument Co.
Wagner Electric Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.
Weston Electrical Inst. Co.

Electro-Plating Mach'y
Crocker-Wheeler Company.
General Electric Co.

Elevators-Conveyors.
Jeffrey Mfg. Co.

Engines, Gas and Gasoline.
Allis-Chalmers Company.
Marinette Gas Engine Co.
Olds Gasoline Engine Works.
Woolley Fdy. & Mach. Wks.

Engines, Steam.
Allis-Chalmers Company.
Dustin Co., Chas. E.
Sturtevant Co., B. F.

Fans and Fan Motors.
Central Electric Co.
Crocker-Wheeler Company.
Edison Mfg. Co.
General Electric Co.
General Inc. Arc Light Co.
Sprague Electric Co.
Sturtevant Co., B. F.
Wesco Supply Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Fibre.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Files.
Barnett Co., G. & H.

Fittings.
Faries Mfg. Co.

Fixtures, Gas and Elec.
Beardslee Chandelier Mfg. Co.

Flashers.
Bissell Co., The F.
Haller Machine Co.
Reynolds El. Flasher Mfg. Co

Flexible Shafts.
Stow Mfg. Co.

Forges.
Sturtevant Co., B. F.

Fuses and Fuse Wire.
Amer. Elec. Fuse Co.
Bissell Co., The F.
Central Electric Co.
Central Tel. & El. Co.
Chicago Die & Electric Co.
Chicago Fuse Wire & Mfg. Co.
D. & W. Fuse Company.
Electric Appliance Co.
Johns-Manville Co., H. W.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Company.
Western Elect. Supply Co.

Globes, Reflectors and Shades.
Fostoria Incan. Lamp Co.
Haller Machine Co.
Holophane Glass Co.
Pardridge Shade & Refl. Co.
Phœnix Glass Co.
Wesco Supply Co.
Western Electric Co.
Western Elect. Supply Co.

Graphite Specialties.
Dixon Crucible Co., Jos.
Holmes Fibre-Graphite Co.

Heating (Exhaust Steam).
Amer. District Steam Co.

Heating and Ventilating Apparatus.
Sturtevant Co., B. F.

Holders, Inc. Lamps.
Incandesent Electric Light Manipulator Co.

Inspection & Insurance
Hartford Steam Boiler Inspection & Insurance Co.

Insulating Machinery.
New England Butt Co.

Insulators and Insulating Materials.
Akron Electrical Mfg. Co.
American Electrical Works.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Inc. Arc Light Co.
Indiana Rub. & Ins. Wire Co.
Johns-Manville Co., H. W.
Kartavert Mfg. Co.
Manhattan Elec. Supply Co.
Mica Insulator Co.
Munsell & Co., Eugene.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Standard Vitrified Cond. Co.
Sterling Varnish Co.
Vulcanized Fibre Co.
Wesco Supply Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Junction Boxes.
Bossert Elect. Const. Co.
General Inc. Arc Light Co.

Lamps, Arc.
Bissell Co., The F.
Central Electric Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
General Inc. Arc Lt. Co.
Gregory Electric Co.
Hipwell Manufacturing Co
Manhattan Elec. Supply Co.
Stanley Elec. Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Lamps, Incandescent.
Bissell Co., The F.
Bryan-Marsh Company.
Buckeye Electric Company.
Central Electric Co.
Chicago Edison Co.
Columbia Incan. Lamp Co.
Economical Elec. Lamp Co.
Edison Decorative & Miniature Lamp Dept.
Electric Appliance Co.
Fostoria Incand. Lamp Co.
General Electric Co.
General Inc. Arc Light Co.
Standard Elec'l Mfg Co.
Sterling Electrical Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Lamps, Incandescent—Replacers & Cleaners.
Inc. El. Lt. Manipulator Co.

Letters, Metal.
Haller Machine Co.

Lightning Arresters.
Central Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
Manhattan Elec. Supply Co.
Minnesota Electric Co.
Stanley Elec. Mfg. Co.
Western Electric Co.

Linemen's Climbers.
Klein & Sons, Mathias.

Magnet Wires.
(See Wires and Cables.)

Mechanical Draft.
Sturtevant Co., B. F.

Mica.
Chicago Mica Co.
Mica Insulator Co.
Munsell & Co., Eugene.

Mining Apparatus, Elec.
Allis-Chalmers Company.
Crocker-Wheeler Company.
General Electric Co.
Jeffrey Mfg. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Motors. (See Dynamos and Motors.)

Nippers and Pliers.
Klein & Sons, Mathias.

Nozzles.
Faries Mfg. Co.

Paints.
Dielectric Mfg. Co.

Patent Attorneys.
Baln, Force.

Phosphor Bronze.
Phosphor Bronze Sm. Co. Ltd.

Platinum, Wire and Sheet.
Baker & Company Inc.

Poles and Ties.
Berthold & Jennings.
Brooks, Hall L.
Columbia Mfg. Co.
Fowler, John H.
Fowler-Jacobs Company.
Kellogg Switch. & Sup. Co.
Lindsley Bros. Co.
Loud's Sons Co., H. M.
Maltby Cedar Co.
Morrison Lbr. Co., J. W.
Mueller Company, William.
Pacific Coast Pole Co.
Page & Hill Company.
Phelan, D. W.
Pittsburg & L. S. Iron Co.
Porter Cedar Company.
Sterling & Son, W. C.
Torrey Cedar Co.
Valentine-Clark Co., The.
Worcester Co., C. H.

Polish (Metal).
Allen Co., Inc., L. H.
Hoffman, Geo. W.

Portables.
Faries Mfg. Co.

Power Transmission Machinery.
Jeffrey Mfg. Co.

Rail Joints.
Continuous Rail Joint Company of America.

Rectifiers.
Electrical Appliance Co.

Refiners.
Gt. West Smelt. & Refining Co

Re-Winding—Repairs.
Chicago Edison Co.
Gregory Electric Co.

Rheostats.
Cutler-Hammer Mfg. Co.
General Electric Co.
Gen'l Inc. Arc Lt. Co.
Union Electric Mfg. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Rods, Conduit.
Cope, T. J.

Safes.
Sears, Roebuck & Co.

Schools and Colleges.
Electrical Engineer Inst.
Highland Park College
Michigan College of Mines.
State Univ. of Iowa.

Second-Hand Mach'y.
Bissell Co., The F.
Cent. Stat. Improvement Co.
Gregory Electric Co.
Matthews & Bro., W. N.
Walsh's Sons & Co.

Shades, Lamp.
Faries Mfg. Co.

Sheet Brass & Copper.
Plume & Atwood Mfg. Co.

Signs, Electric.
Haller Machine Co.

Silks, Insulating & Braiding.
Saulquoit Silk Mfg. Co.

Sockets & Receptacles.
Pass & Seymour.
Yost Elec. Mfg. Co.

Soldering Sticks, Salts and Paste.
Allen Co., L. B.
Crescent Co.
Kester Elec. Mfg. Co.
Western Electric Co.

Speaking Tubes.
Central Electric Co.
Edwards & Co.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Specialties, Electrical Mfrs. and Designers.
Haller Machine Co.

Speed Indicators.
Weston Electrical Inst. Co.

Storage Batteries.
American Battery Co.
Electric Storage Battery Co.
Gould Storage Battery Co.

Supplies, General Elec
Bissell Co., The F.
Central Electric Co.
Century Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Electric Co.
Manhattan Elect'l Supply Co
Wesco Supply Co.
Western Electric Co.
Western Elect. Supply Co.

Switchboards.
Bissell Co., The F.
Crouse-Hinds Co.
Gen. Incan. Arc Light Co.

Telephones, Telephone Material and Switchboards.
American El. Telephone Co
Automatic Electric Co.
Bissell Co., The F.
Central Electric Co.
Central Tel. & El. Co.
Holtzer-Cabot Elec. Co.
International Tel. Mfg. Co.
Kellogg Switchb. & Sup. Co.
Manhattan Elec. Supply Co.
Moon Mfg. Co., The.
Stromberg-Carlson Tel. M. Co
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Time Switches.
Bissell Co., The F.

Tools.
Klein & Sons, Mathias.
Western Electric Co.

Transformers.
Central Electric Co.
Crawfordsville Electric Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Works, Inc.
General Electric Co.
Gregory Electric Co.
Kuhlman Electric Co.
Manhattan Elec. Supply Co.
National Electric Co.
Stanley Elec. Mfg. Co.
Wagner Electric Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Trucks, Electric Car.
General Electric Co.
Westinghouse El. & Mfg. Co.

Turbines, Steam.
Allis-Chalmers Co.
General Electric Co.
Westinghouse El. & Mfg. Co

Turbine Water Wheels
Leffel & Co., Jas.

Varnishes.
Dielectric Mfg. Co.
Sterling Varnish Co.

Vulcanized Fibre.
Vulcanized Fibre Co.

Wires & Cables—Magnet Wires.
American Electrical Works.
Bissell Co., The F.
Central Electric Co.
Chicago Insulated Wire Co.
Crescent Ins. Wire & Cble. Co.
Driver-Harris Wire Co.
Electric Appliance Co.
General Electric Co.
Hazard Manufacturing Co.
Indiana Rub. & Ins. Wire Co
India Rubber & Gutta Percha Insulating Co.
Kellogg Switch. & Sup. Co.
Manhattan Elec. Supply Co.
National India Rubber Co
New York Insulated Wire Co.
Okonite Co., The.
Phillips, Eugene F.
Phillips Insulated Wire Co
Roebling's Sons Co., J. A.
Runzel-Lenz Elec. Mfg Co.
Safety Ins. Wire & Cable Co.
Simplex Electrical Co.
Standard Underground C. Co
Wesco Supply Co.
Western Electric Company.
Western Elec. Supply Co.

For Alphabetical Index of Advertisements See Page 3.

THE
"I. P." (ISOLATED PLANT) TYPE
DIRECT-CURRENT
INSTRUMENTS

Are winners. Scales are equally divided, indications are dead beat, high range ammeters have separate shunts and the cases are of heavy polished brass.

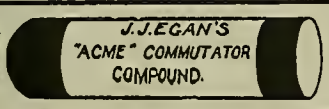
Prices are right, the list figure for the meter illustrated, for instance, being $16.50.

WRITE FOR DISCOUNTS TO

Diam. of body, 6 in., of base flange 7½ in.

MACHADO & ROLLER,
203 BROADWAY, NEW YORK CITY, N. Y., Or Your Nearest Supply House.

All Supply Houses



J. J. EGAN'S "ACME" COMMUTATOR COMPOUND absolutely prevents sparking or cutting. One stick of "Acme" is equal to one gallon of oil for lubricating commutators. Free Sample. AGENTS WANTED. 50c per Stick. $5.00 per doz.
J. J. Egan Sole Mfg., 317 Austin Ave., Tel. Polk, 1779 Chicago

EDISON PRIMARY BATTERIES FORMERLY EDISON LA LANDE

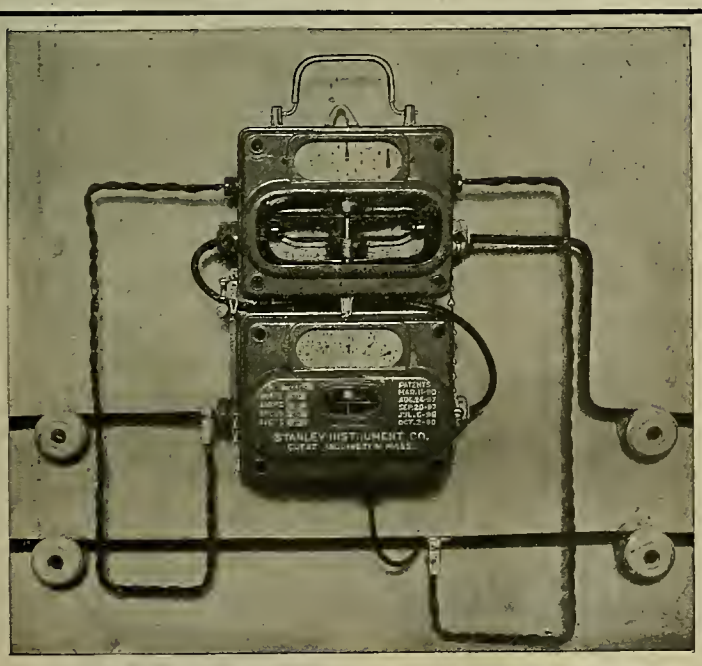
There is no deterioration in the permanent parts of these batteries. It follows, therefore, that each time a cell is recharged it will last as long a time and deliver as heavy a current as the original charge when the cell was first put into service. Our catalogue No. 7 will tell you more about this. Let us send it.

EDISON MANUFACTURING CO.,
TRADE Thomas A. Edison MARK
Factory, ORANGE, N. J.
NEW YORK, 83 Chambers St.
CHICAGO, 304 Wabash Ave.

Sterling Black Plastic Insulator.

One hundred days' continuous baking at 180° F. will not make it brittle. Water repellent. Oil proof.

THE STERLING VARNISH CO., - - Pittsburg, Pa.



TESTING WATTMETER

ACCURATE TESTS
in a few minutes, anywhere, by one man alone without regulation of VOLTAGE, LOAD OR FREQUENCY

STANLEY INSTRUMENT CO.
GREAT BARRINGTON, MASS.

Economical Turn Down LAMP "PATENTS"

Our PATENT COUNSEL after careful EXAMINATION and SEARCH, advises us there is

NO INFRINGEMENT

of the Phelps Patents by the

ECONOMICAL ELECTRIC LAMP COMPANY

and that the **Economical Turn Down Lamps** are made under and protected by patents

No. 740,369,	Patented Sept. 29, 1903,	Application	Dec. 10, 1902
No. 676,814	" June 11, 1901	"	April 2, 1901
No. 676,068	" June 11, 1901	"	Oct. 11, 1900
No. 676,069	" June 11, 1901	"	April 1, 1901
No. 732,644	" June 30, 1903	"	Dec. 30, 1902

which are **Good** and **Valid Patents.**

BABY FILAMENTS are known to the *art* and have been in use in this and other countries since 1882, and thus the *broader* claims of the Phelps Patents having been anticipated by other patents are INVALID.

The usual cry of INFRINGEMENT and IMITATION was employed by the Phelps Company as soon as our "ECONOMICAL LAMP" was put on the market in October, 1902, the *trade* at once saw the SUPERIORITY of ours over all other *Turn Down Lamps* and have found INCREASED and READY *sales* because of such SUPERIORITY and its SIMPLICITY.

On February 11th, 1903, we made a demand directly on the Phelps Company to begin suit *against us* to permit the courts to adjudicate the validity of their patents, this they *refused* to do, but instead, after having waited so long a time, sued several of our customers, which is done only to annoy them, and attempt to INTIMIDATE the trade, and is in our opinion a *bluff* to try and force the customers sued to handle the Phelps Company INFERIOR product.

We PROMPTLY assumed the DEFENSE of the suits against our customers and will do likewise for all whom the Phelps Company may bring action against for selling or using the

ECONOMICAL TURN DOWN LAMPS

We know that our *Customers* and the *Trade* will not permit the Phelps Company's action to work to our mutual injury, and will continue the sale of our *Lamp,* which is

NO INFRINGEMENT OR IMITATION

NEW YORK, August 22, 1904.

ECONOMICAL ELECTRIC LAMP COMPANY
123 Liberty Street

BOILER WATERS CORRECTED

to remove and prevent scale and to stop corrosion. DEARBORN TREATMENT does the work. Send gallon sample for analysis. Booklet "R" now ready.

DEARBORN DRUG & CHEMICAL WORKS,

27-34 RIALTO BUILDING, CHICAGO, ILL. WM. H EDGAR, President Telephone: Harrison 3930 and 3931.

Dixon's Pure Flake Graphite

As a Cylinder Lubricant

Makes cylinders, valves and rods wonderfully smooth and bright. Reduces friction, saving oil and packing. Booklet 125C and sample upon request.

JOSEPH DIXON CRUCIBLE CO., JERSEY CITY, N. J.

JEFFREY ELEVATING, CONVEYING, POWER TRANSMISSION **MACHINERY** FOR CATALOGUE, ADDRESS THE JEFFREY MFG. CO. COLUMBUS, O.

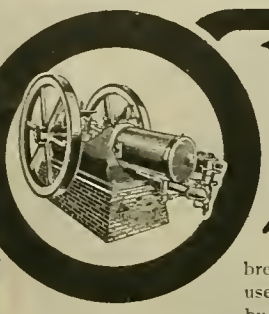
Our Compound Stops Sparking and Saves Commutators.

14 Years' Use on Street Ry., Light and Power Commutators Has Proven its Worth. WE GUARANTEE RESULTS.

Send Your Address for FREE SAMPLE THAT CONVINCES.

JAS. McLAUGHLIN & CO., ELECTRICAL ENGINEERS

586 Fulton Street, - - Chicago, Ill.



Olds Gas and Gasoline Engines

are backed by a broad guarantee that absolutely protects the purchaser against faults or breakage due to construction or material used. Its liberal terms are made possible by the experience of years which have established the success of the Olds' patents.

STATIONARY ENGINES - - 2 to 100 H. P.
PORTABLE ENGINES - - - 8 to 18 H. P.

Our new illustrated catalog will be sent on request

OLDS GASOLINE ENGINE WORKS

252 River Street - - - Lansing, Mich.

No. 979

155

NORTHERN SMALL MOTORS

Compact....Efficient....Superior

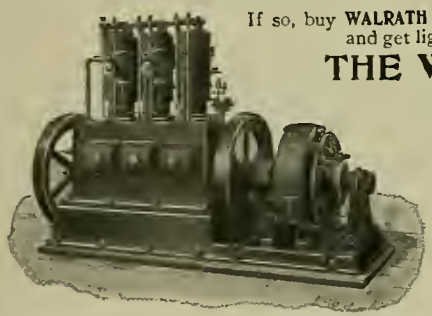
High type of construction....susceptible of good speed variation....multipolar....form-wound armatures....simple....hardy....trustworthy.

Booklet No. 3325

NORTHERN ELECTRICAL MFG. CO.

Engineers...Manufacturers Madison, Wis., U. S. A.

ARE YOU LOOKING FOR MONEY?



If so, buy WALRATH GAS OR GASOLINE ENGINES and get light on the subject.

THE WALRATH

Received the Highest Award at the Pan-American Exposition.

It will produce as good a commercial light as that of an automatic steam engine, either belted or direct-connected generator. Simple, Economical and Reliable

Send for Catalogue W.

MARINETTE GAS ENGINE CO.,

CHICAGO HEIGHTS, ILL.

AGENCIES:

Keystone Engineering Co., Farmer's Bank Bldg., Pittsburg, Pa.
Strong, Carlisle & Hammond Co., 61-67 Frankfort St., Cleveland, Ohio
Mackay Engineering Co., 149 Broadway, N. Y.
C. H. Seidenglanz., 52 When Bldg., Indianapolis, Ind.

THE TELEPHONE HAND-BOOK

BY HERBERT LAWS WEBB.

Price $1.00.

A complete and practical work in handy pocket size.

PUBLISHED BY

THE ELECTRICIAN PUBLISHING CO.,

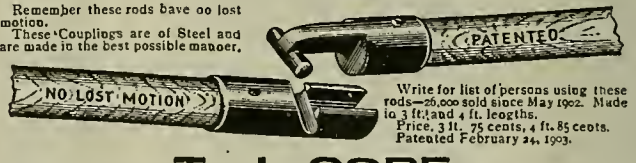
Suite 510 Marquette Building, Chicago.

REG. TRADE MARKS

THE PHOSPHOR BRONZE SMELTING CO. LIMITED,
2200 WASHINGTON AVE., PHILADELPHIA.
"ELEPHANT BRAND PHOSPHOR-BRONZE"
INGOTS, CASTINGS, WIRE, RODS, SHEETS, ETC.
— DELTA METAL —
CASTINGS, STAMPINGS AND FORGINGS
ORIGINAL AND SOLE MAKERS IN THE U.S.

Cope's Patent Quick Coupling Conduit Rod

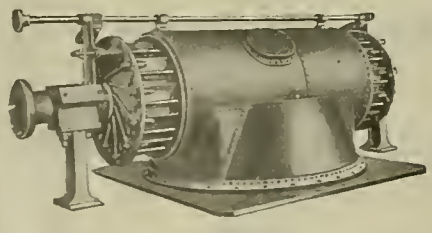
Remember these rods have no lost motion.
These Couplings are of Steel and are made in the best possible manner.



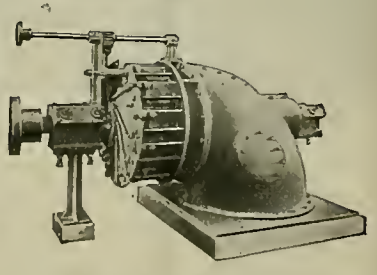
Write for list of persons using these rods—25,000 sold since May 1902. Made in 3 ft. and 4 ft. lengths. Price, 3 ft. 75 cents, 4 ft. 85 cents. Patented February 24, 1903.

T. J. COPE

3244 North Fifteenth Street PHILADELPHIA, PA.



SAMSON TURBINE



In constructing the SAMSON we use only the BEST MATERIAL that can be purchased, furthermore, we employ only skilled labor in their erection. It is necessary to use HIGH GRADE MATERIAL so that all wearing parts will have a LONG LIFE. The SAMSON operates continuously.

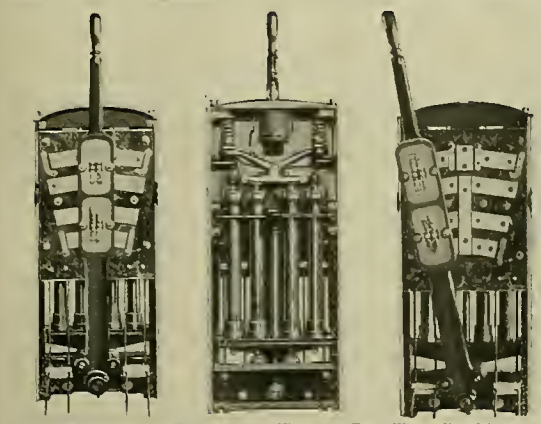
Write Department D for Catalogue.

JAMES LEFFEL & CO.

SPRINGFIELD, OHIO, U. S. A.

Allen-Bradley Electric Crane Controllers

Patented



Front View—before starting Rear View Front View—all resistance cut

Manufactured by AMERICAN ELECTRIC FUSE CO., Chicago

A New Controller. Positively No Sparking. No Repairs. Guaranteed for One Year. Three Months' Free Trial. Perfect Control.

OUR GUARANTEE: Ask any Other Manufacturer to Duplicate It.

THE AMERICAN ELECTRIC FUSE COMPANY hereby guarantees to..... that it will at any time within three months from this date upon demand repay to said..... the sum of..... .....Dollars, being the full purchase price paid (or agreed to be paid) by said..... to the American Electric Fuse Company for one..... horsepower Allen-Bradley Crane Controller, number.....upon delivery within three months after this date of said controller, freight prepaid and in good condition, ordinary wear and tear from use excepted, at the office of the American Electric Fuse Company, Chicago, Illinois, together with a written statement that said controller has proved unsatisfactory to said .....

FURTHERMORE, the said American Electric Fuse Company agrees that it will at any time within one year from this date replace, without charge, any part of said controller which may prove defective or wear out during the ordinary use of said controller, provided that it is a condition of this guarantee that said..... hereby agrees to use ordinary care in the operation of said controller, and that said controller will be operated by some person, or persons, familiar with the use of crane controllers, and further that said controller will not be wilfully or maliciously injured while in the possession of said.....

TELEPHONE PRINCIPLES AND PRACTICE

A NEW BOOK IN TELEPHONY

By

GEORGE WALKER WILDER, PH. D.

Professor in Telephony in the Armour Institute of Technology

Complete and up-to-date, written by a practical man. All about modern telephone apparatus, their principles and use:

I. Fundamental Ideas
II. Telephone Apparatus
III. Systems of Communication
IV. Construction and Equipment

IN 32 CHAPTERS, 450 PAGES, 375 ILLUSTRATIONS. PRICE $2.00 POSTPAID.

Send Postal Money Order to

THE CANTWELL PRESS - Madison, Wis.

WESTERN ELECTRICAL SUPPLY CO.,

ENGINEERS AND BUILDERS

OF

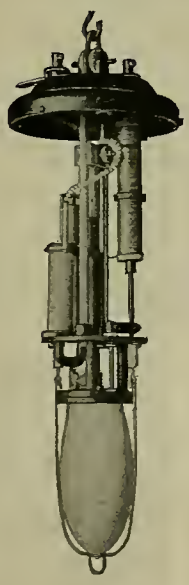
Electric Railways, Lighting and Power Plants.

Western Electrical Supply Co.,

Chemical Building, - - ST. LOUIS, U. S. A.

Estimates Furnished.

General Electric Company



Edgewise Wound Enclosed Arc Lamps

FOR 110-VOLT DIRECT CURRENT SERVICE

Embody the latest features of Arc Lamp manufacture.

INDESTRUCTIBLE.
PERFECT REGULATION.
PERMANENT ADJUSTMENT.
COMPOSED OF FEW PARTS.
SIMPLICITY AND RIGIDITY OF CONNECTIONS.

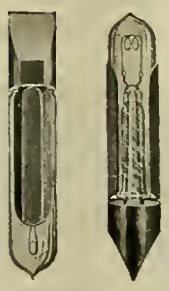
Write for further information.

GENERAL OFFICES: SCHENECTADY, N. Y.

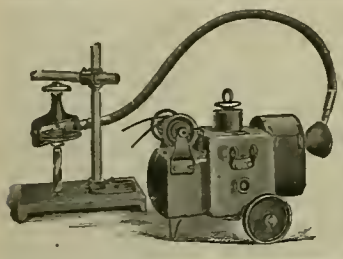
Chicago Office: Monadnock Block. Sales Offices In All Large Cities.

HAVE YOU SEEN
OUR NEW
PRICE LIST
ON
PORCELAIN
KNOBS TUBES CLEATS
Don't Overlook It
ELECTRIC APPLIANCE COMPANY
CHICAGO AND SAN FRANCISCO

EDISON TELEPHONE LAMPS



ARE
The Standard for Visual Signals.
They save the "Exchange" time and money; because every lamp is perfect. Sure to fit. Sure to burn. The life is extremely long—running into years.
Be sure to get the EDISON.
EDISON DECORATIVE & MINIATURE LAMP DEPT.,
General Electric Company, Harrison, N. J.
CHICAGO OFFICE, MONADNOCK BLOCK.



ESTABLISHED 1875.
COMBINATION OF
Stow Flexible Shaft
—AND—
MULTI-SPEED MOTOR
Practically dust and water proof. For Portable Drilling, Tapping, Reaming, Emery Grinding, etc. Write for Catalogue and Prices.
STOW MFG. CO., Binghamton, N. Y.
Gen'l European Agents, Selig, Sonnenthal & Co., 85 Queen Victoria Street, London, England

MICABOND Biggest Stock in the West.
CHICAGO MICA CO., - Valparaiso, Ind.

YOU NEED IT!

Gale's Commutator Compound.
The Only Article That Will Prevent Sparking.
Will keep the Commutator in good condition and prevent cutting. Absolutely will not gum the brushes.
50c. per stick. $5.00 per dozen Send 50c. for trial stick.
FOR SALE BY ALL SUPPLY HOUSES OR
K. McLENNAN & CO., Sole Manufacturers, Room 411 Inter Ocean Bldg., 130 Dearborn Street CHICAGO

MICA Of all Qualities, in any Form at Lowest Prices
EUGENE MUNSELL AND CO.
NEW YORK and CHICAGO
INSULATION That Is.
Micanite, Linotape, M. I. C. Compound, Empire Cloth and Paper. For Years the Standard.
MICA INSULATOR CO., Originators
NEW YORK and CHICAGO

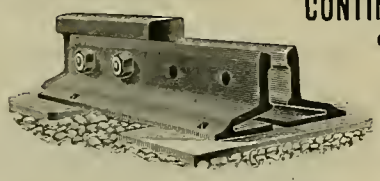
Warren Alternator

Do not be content with a tolerably good alternator.
GET THE BEST
When you have tried the "Warren" you will be able to judge.
WE GUARANTEE WHAT WE SELL
AND
SELL WHAT WE GUARANTEE.
WARREN ELECTRIC MFG. CO.
Sandusky, O.

BEARDSLEE CHANDELIER MFG CO. 256 AND 257 S. CANAL ST. CHICAGO
GAS & ELECTRIC FIXTURES FOR THE TRADE.
CATALOG SENT PREPAID TO DEALERS MENTION THIS PAPER

VOLT - AMMETERS,
POCKET SIZE.
For Testing Batteries and Battery Circuits, Locating Faults, Grounds, etc.
RELIABLE. ACCURATE.
Send for Circular.
L. M. PIGNOLET,
78-80 Cortlandt St., NEW YORK, N. Y.

AKRON
Generators, Motors, Clutches, Commutator Truing Devices.
AKRON ELECTRICAL MFG. CO.,
AKRON, O.
N. Y. Office: McKay Engineering Co., 149 Broadway



CONTINUOUS RAIL JOINT CO. OF AM.
GENL. OFFICES: CENTURY BLDG., NEWARK, N.J.
OVER 20,000 MILES IN USE
See our exhibit, World's Fair, St. Louis, Mo., Transportation Bldg., Aisle "C," Posts 7 and 8.

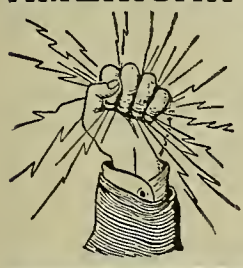
HENRY NEWGARD & CO.
ELECTRICAL CONSTRUCTION
Power and Light Plants. Switchboards and Panel Boards.
We install Municipal and Isolated Electric Lighting Plants.
We manufacture Switchboards, Table boards, Iron Cutout Boxes and Electrical Specialties.
We sell Dynamos, Motors and Electrical Supplies.
We wire old as well as new Residences, Factory Buildings, School and College Buildings.
87 Fifth Avenue, Chicago, Illinois.

"QUOTATIONS ON THE SPOT"
That is what we call our new and complete hand-book of switchboards.
Ask for 117 W
WE BUILD SWITCHBOARDS
THE F. BISSELL COMPANY
MANUFACTURERS AND JOBBERS OF
ELECTRICAL GOODS
226-228-230 HURON STREET
TOLEDO, O.

FRANK N. PHILLIPS, President. G. H. WAGENSEIL, Treasurer. EUGENE F. PHILLIPS, General Manager. E. ROWLAND PHILLIPS, Vice-Pres. C. R. REMINGTON, Jr., Sec

AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.

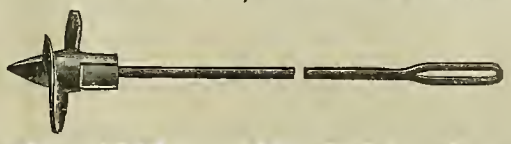


BARE AND INSULATED ELECTRIC WIRE,
ELECTRIC LIGHT LINE WIRE,
INCANDESCENT AND FLEXIBLE CORDS,
Railway Feeder and Trolley Wire,
AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR WIRES.
CABLES FOR AERIAL AND UNDERGROUND USE.

NEW YORK STORE, W. J. Watson, 26 Cortlandt St.
CHICAGO STORE, F. E. Donohoe, 82 Lake St.
MONTREAL BRANCH, Eugene F. Phillips' Electrical Works.
MAIN OFFICES AND FACTORIES, PHILLIPSDALE, R.I.

STOMBAUGH GUY ANCHORS

SAVE
Digging, Filling, Tamping,
Labor, Time and Money.



SIMPLY SCREW THEM IN—THAT'S ALL.

W. N. MATTHEWS & BRO.
Distributers
603 CARLETON BUILDING ST. LOUIS

EXPERT IN ELECTRICITY MECHANICS PATENT CAUSES
SOLICITOR OF U. S. & FOREIGN PATENTS
FOREE BAIN, 1652-3 Monadnock Blk., CHICAGO

Electric Heating Apparatus
SEND FOR 62-PAGE CATALOGUE.
"UNIT" ENAMELED RHEOSTATS
SIMPLEX ELECTRIC HEATING CO.,
Cambridgeport, Mass.

"STAR" INCANDESCENT LAMPS

LONG LIFE
GUARANTEED CANDLEPOWER,
HIGHEST EFFICIENCY.

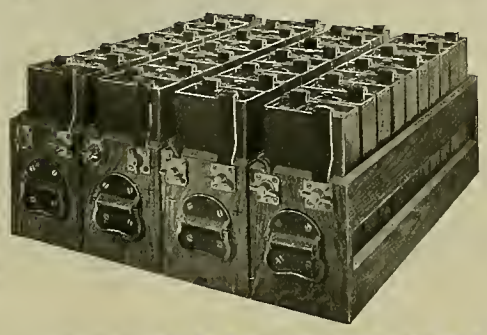
MADE BY THE MOST SKILLED WORKMEN.

STANDARD ELECTRICAL MFG. COMPANY, : Niles, Ohio.

SINGLE AND POLYPHASE
TRANSFORMERS
KUHLMAN ELECTRIC CO., - - Elkhart, Ind.

Engineering MECHANICAL, ELECTRICAL, STEAM, CIVIL.
Complete and short courses. Thoroughly equipped engineering shops. Shop work from the beginning. Short courses in Steam and Electrical Engineering. Expenses low. Accommodations the best. School all year. Students may enter any time. Correspondence steam and electrical courses. Send for catalogue. Mention course in which interested.
HIGHLAND PARK COLLEGE, DES MOINES, IOWA.

GIVES BEST RESULTS



Northwestern Storage Battery
Cannot be equaled for
Great Capacity, Lightness and Efficiency
LOW TENSION WORK
Write for Catalogue.

Northwestern Storage Battery Co.,
285 Madison Street, - - - - Chicago, Ill.

YOST SPECIALTIES.

Sockets, Wall Sockets, Weatherproof Sockets, Rosettes, Receptacles, Cord Adjusters.
Catalogue for the asking.

THE YOST ELECTRIC MFG. CO.
TOLEDO, OHIO.

Pillsbury Alternating Current Ceiling Fans
MANUFACTURED BY
CENTURY ELECTRIC CO., St. Louis, Mo.

Grimshaw
Raven White Core
Raven Black Core

ALL OUR WIRES pass inspection and carry the above TRADE-MARKS on our tags. We also manufacture Grimshaw and Competition Tapes and Splicing Compounds.

NEW YORK INSULATED WIRE COMPANY,

MAIN OFFICE: 114, 116 & 118 Liberty St., New York.
BRANCHES: CHICAGO: 192 Desplaines St. BOSTON: 7 Otis St. SAN FRANCISCO: 33 Second St.

NATIONAL CODE STANDARD

WEATHER-PROOF TRADE MARK "O.K." LINE AND HOUSE WIRES

"O. K." Weatherproof Wire.
Slow-Burning Weatherproof and Ideal Wire.
Prices and Samples on Application.

Phillips Insulated Wire Co.

Office and Factory: PAWTUCKET, R. I.

127 FULTON STREET CHICAGO

For Signs, Letters, Flashers, Dimmers, Timeswitches, Lamps, Rubberrings and anything pertaining to Signs,
—WRITE TO—
HALLER MACHINE COMPANY
Designers and Manufacturers, of Sheetmetal, Electric and Machinery Specialties

WANTED, FOR SALE *and similar* **WANT COLUMN** *advertisements (50 words or less), $1.50 an insertion; additional words 3c each.* **POSITION WANTED** *advertisements (50 words or less), $1.00 an insertion; additional words 2c each.*

POSITION WANTED.

As manager, superintendent or electrical engineer of light or power plant. Eleven years' practical experience. Very best references. Can leave on short notice. Thirty-four years' old. Married. Salary not less than $125 per month at start. Address BOX 389, care Western Electrician, 510 Marquette Bldg., Chicago.

POSITION WANTED.

By young man as superintendent of electric-light plant or municipal light and water plant. Ten years' practical experience and technical education. Can handle engineering and business ends. Would consider electric railway or salesman's positions. Address BOX 390, care of Western Electrician, 510 Marquette Building, Chicago.

FOR SALE.

About 100 New England Butt Company's double insulating machines for insulating wire, in good order; some almost new. Also a Payne Spooler. NEWTON I. STEERS, 128 Maiden Lane, New York City.

FOR SALE

Two complete No. 3 Westinghouse Motors in good condition, with two controllers. Will sell one or both motors, also two extra armatures. Will sell cheap if taken at once. Address

THE CITY ELECTRIC SPRINKLER CO.,
Rock Island, Ill.

REPAIRING RECALIBRATING

ELECTRIC METERS.

INTERNATIONAL ELECTRIC METER CO.
167 S. CANAL STREET, CHICAGO.

FOR SALE.

ALTERNATORS.

1-360 K. W. General Electric 3-phase.
1-120 " " " "
1-75 " Westinghouse 2-phase.

250-VOLT GENERATORS.

1-250 K. W. Western Electric M. P.
1-200 " Eddy M. P.

125-VOLT GENERATORS.

1-125 K. W. Western Electric M. P.

Immediate shipment.

GREGORY ELECTRIC CO.
54-62 S. CLINTON ST. CHICAGO

Monitor Bushings

Greatest efficiency at least cost. Absolute protection to wires drawn over conduit ends. Made of one piece of sheet steel and cannot be broken. Enameled insulation. No special tools required to attach. Approved by fire underwriters. Write for bulletin 1002.

BOSSERT
Electric Construction Company
UTICA, N. Y.

BUY YOUR BOOKS

FROM THE

Electrician Pub. Co., 510 Marquette Bldg., Chicago.

KESTER SELF FLUXING SOLDER

A Tube of Solder Filled with Flux. Requires no Acid.

SAVES—LABOR—TIME—MONEY.

PATENTED.

Send for Free Samples.

L. F. Mahler Co., R. 1008 Chemical Bldg., St. Louis, Mo., Gen. Western Agent.

KESTER ELECTRIC M'F'G CO.,
46 N. UNION STREET, CHICAGO, ILL.

Locations for Industries

Erie Railroad

Chicago to New York

The Erie Railroad Company's Industrial Department has all the territory traversed by the railroad districted in relation to resources, adaptability, markets and advantages for manufacturing, and can advise with manufacturers in relation to the most suitable locations. For full information address

LUIS JACKSON
Industrial Commissioner, Erie Railroad Company
21 Cortlandt Street, New York

INDUSTRIES ARE OFFERED LOCATIONS

WITH

Satisfactory Inducements,
Favorable Freight Rates,
Good Labor Conditions,
Healthful Communities,

ON THE LINES OF

THE ILLINOIS CENTRAL R. R.
AND THE
YAZOO & MISSISSIPPI VALLEY R. R.

For full information and descriptive pamphlet address

J. C. CLAIR,
Industrial Commissioner,
1 Park Row, Chicago, Ill.

ARE YOU LOOKING FOR TROUBLE?
IF SO, GET A COPY OF

TELEPHONE TROUBLES

AND HOW TO FIND THEM
—IN—
BOTH MAGNETO AND COMMON BATTERY SYSTEMS.

9th Edition Just Out. Price, 25c.

Electrician Publishing Co.,
510 Marquette Building,
CHICAGO.

ELECTRIC SIGN

FLASHERS

BEST IN THE WORLD
Write for full particulars
Reynolds Elec. Flasher Mfg. Co.
221 Fifth Ave., Chicago.

BOILERS.

One 42-in. x 15 ft. 9-in., 250 H. P. Worthington Water Tube.
One 60-in. x 16 ft., John Mohr Return Tubular Boiler.
One 54-in. x 16 ft., John Mohr Return Tubular Boiler.
One 54-in. x 16 ft., Devine Tubular Boiler.

ENGINES.

One 600 H. P., 21 x 36 x 30, Williams Tandem Horizontal Compound, 140 R. P. M.
Two 600 H. P., 20 x 30 x 24, Porter-Allen Tandem Compound, 200 R. P. M.
One 250 H. P., 12 x 24 x 18 Williams Tandem Compound, 250 R. P. M.
Two 100 H. P., 13 x 12, Dick & Church, High Speed Automatic.

PARTIAL LIST ONLY.

Send for latest Catalogue for bargains in Engines, Boilers, Dynamos and Motors.

CENTRAL STATION IMPROVEMENT CO., 938 Monadnock Block, Chicago

HORNBERGER-IRWIN Transformers

(LARGE AND SMALL)

½ K. W. to 500 K. W.

This transformer represents the latest improvements in transformer construction; made in three types; multi-coil construction; ventilated cores; built for all commercial voltages and frequencies; **higher efficiencies together with lower temperatures than have heretofore been attained are guaranteed.**

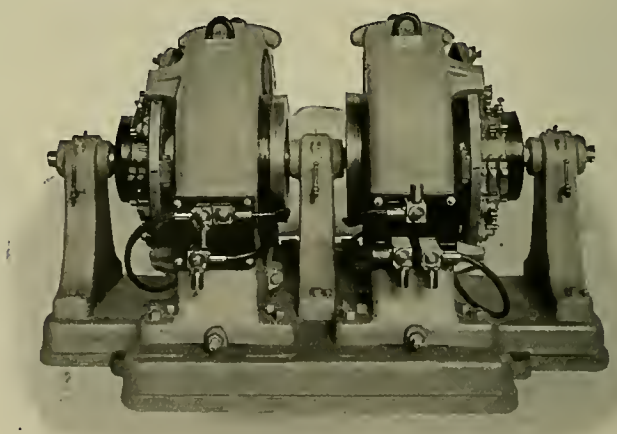
Catalogue just issued explains details.

Manufactured by

Crawfordsville Electric Co.
CRAWFORDSVILLE,
INDIANA, U. S. A.

DIRECT CURRENT

Generators and Motors



WESTERN ELECTRIC COMPENSATOR

Western Electric Company

CHICAGO NEW YORK
And Other Large Cities

Space 17, Electricity Building, Louisiana Purchase Exposition

CHICAGO EDISON COMPANY REPAIR SHOPS

76 MARKET STREET, CHICAGO. TELEPHONE MAIN 1280.

Machine and Carpenter Work of All Kinds
Correspondence Solicited.

OPEN DAY AND NIGHT.

FIRST-CLASS EQUIPMENT THROUGHOUT.

Dynamos, Armatures, Motors, Arc Lamps, Fans, Instruments.

ARNOLD ELECTRIC POWER STATION Co.
Engineers, Constructors for Complete Electric Plants. Results Guaranteed.
SUITE 1539, MARQUETTE BLDG., CHICAGO.
NEW YORK OFFICE: 711 TRANSIT BLDG.

E. W. Hammer, Pres. and Treas. H. J. Minhinnick, Sec. and Gen'l Sup't.
GENERAL ENGINEERING Co., THE
Consulting and Contracting Engineers.
Telephones, Electric Light, Power Transmission
Suite 1112, 135 ADAMS ST., CHICAGO.
Long Distance Telephone Central 473.

ROBERT W. HUNT & Co.,
ENGINEERS
1121 The Rookery, Chicago. 66 Broadway, New York.
Monongahela Bank Bldg., Pittsburg.
Norfolk House, Cannon St., London.

RUEBEL · SCHWEDTMANN-WELLS,
CONSULTING, MECHANICAL AND ELECTRICAL ENGINEERS,
Suite 801 Chemical Building, ST. LOUIS, U. S. A.

W. E. BAKER. H. B. BISHOP.
BAKER, W. E. & CO.
ENGINEERS.
ELECTRIC RAILWAYS.
27 William St., NEW YORK.

ENGINEERS
Represented in this "Directory" are enabled to come in touch with many prospective customers who cannot be reached through any other source.

KEMP, R. W.
Consulting and Contracting Telephone Engineer.
Plans and specification for complete plants. Old plants overhauled and placed on paying basis Territory, Kansas, Oklahoma and Indian Territory.
WELLINGTON, - - - KANSAS.

Long Distance Phone Central 2448.
SCHOTT, W. H.,
ENGINEER AND CONTRACTOR,
SPECIALTIES—Central Station Heating Plants, Water Works Steam Plants, Electric Light, Gas and Street Railway Plants.
1220-21 MARQUETTE BUILDING, CHICAGO.

BRYAN, WILLIAM H.
M. Am. Soc. M. E.,
Consulting Mechanical and Electrical Engineer.
Lincoln Trust Building, ST. LOUIS.

J. H. HALLBERG
Consulting Arc Lighting Expert and Practical Electrical Engineer
45 Broadway - NEW YORK
Room 169A

KOHLER BROS.,
Contracting Electrical Engineers, Lighting Power Railways,
1804-1806-1808-1810-1812 Fisher Building, CHICAGO.

STANTON, LE ROY W.
Consulting Telephone Engineer.
Plans, Specifications and Supervision of Installation of complete telephone plants.
Special Reports on Telephone Properties and Apparatus.
411 Electrical Bldg., Cleveland, Ohio.

BYLLESBY, H. M. & Co.
(Incorporated)
ENGINEERS
Design, Construct and Operate Railway, Light, Power and Hydraulic Plants.
Examinations and Reports.
New York Life Building, - CHICAGO, ILL.

HORNADAY, J. P. & Co.
SUITE 1108 TRACTION BUILDING
CINCINNATI, O.
WATERWORKS, ELECTRIC RAILWAY, LIGHT, TRACTION, INDUSTRIAL AND MINERAL PROPERTIES BOUGHT AND SOLD

McLAUGHLIN, JAMES
CONSULTING
ARC LIGHTING EXPERT,
PRACTICAL ELECTRICAL AND MECHANICAL ENGINEER,
53 RIVER ST., - CHICAGO, ILL.

Telephone Main 3123.
WILMERDING, C. H.
CONSULTING ENGINEER
1100 Old Colony Bldg., CHICAGO.

DUGALD C. JACKSON, C. E.
WILLIAM B. JACKSON, M. E.
MEMBERS
AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS
AMERICAN SOCIETY OF MECHANICAL ENGINEERS
AMERICAN SOCIETY OF CIVIL ENGINEERS
ENGINEERS. EXPERTS.
MADISON, WIS.

ALL Live men read the WESTERN ELECTRICIAN Each Week. Do You?

THE STATE UNIVERSITY OF IOWA
SCHOOL OF APPLIED SCIENCE, Iowa City, Iowa
Four year courses of the highest grade in
Civil
Municipal
Sanitary
Electrical
Mechanical
Mining
ENGINEERING
Numerous short practical courses. Special courses in technical chemistry, bacteriology, etc. Adequate equipment in shops and laboratories. Waterpower.
University environment. Expenses low.
Address C. E. MacLEAN, President

ELECTRICITY FOR ENGINEERS. 424 PAGES. ILLUSTRATED. PRICE $2.50.
ELECTRICIAN PUBLISHING CO.,
510 Marquette Building, • • CHICAGO.

THE MONTH OF SEPTEMBER 1904

will be a memorable one in electrical circles.

The International Electrical Congress,

The American Institute of Electrical Engineers,

The National Electrical Contractors' Association,

The Northwestern Electrical Association,

The International Association of Municipal Electricians,

The American Electrochemical Society,

The American Electrotherapeutic Association

will all meet in St. Louis during the week beginning September 12th. The Independent Telephone Association of the U. S. will hold its annual meeting in St. Louis beginning September 21. A number of State conventions will also be held during the month.

The September issues of the WESTERN ELECTRICIAN, therefore, will prove unusually interesting to everyone in any way connected with the trade.

Advertisers will find these numbers well worthy of extra space, and it will pay those not regularly represented to begin a standing card now.

WESTERN ELECTRICIAN, 510 MARQUETTE BLDG., CHICAGO.

THE BEST KIND OF INSURANCE FOR TOLL LINES

To be erected on the most exposed parts of the line. They require no attention after erecting.

Minnesota Electric Co.,
MINNEAPOLIS, MINN.

CORDS AND CABLES

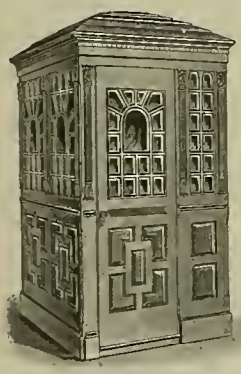
We manufacture Cords of all descriptions used in conjunction with Telephone and Switchboard work, also Cables for Switchboard and Interior Purposes.

Write us for Prices

RUNZEL-LENZ ELECTRIC MFG. CO.
97-101 S. CLINTON STREET CHICAGO

TELEPHONE BOOTHS

PAY FOR THEMSELVES



By Increase of Receipts, Oftentimes in one Month

WRITE FOR CATALOGUE

W. S. SEAMAN & CO.
216 E. Water St.
MILWAUKEE, - - WIS.

BITUMINIZED FIBER CONDUIT

FOR UNDERGROUND CONSTRUCTION

Combines the **good features** of other conduits.
Eliminates the **bad features** existing in many kinds.
Has valuable features not found in any other ducts.

Made in 7-foot lengths with male and female joints, making construction very rapid and simple, with consequent low cost

Alignment is perfect and permanent without tedious care and skill required in laying of butt-joint conduits.

Users are astonished by the ease and rapidity with which cables can be drawn in, and this without the slightest scratching or injury to the lead covering thereof.

Made in sizes from 1-inch to 10-inch diameter.

Bends of any radius and any angle.

Write us for further information and prices, stating sizes and quantities required.

American Conduit Co.
Main Offices: 1005-6 Manhattan Building, Chicago
Other Offices:
170 Broadway, New York. 336 Macy St., Los Angeles

"The Nation's pleasure ground and sanitarium."—*David Bennett Hill.*

THE ADIRONDACK MOUNTAINS.

The lakes and streams in the Adirondack Mountains are full of fish, the woods are inviting, the air is filled with health, and the nights are cool and restful. If you visit this region once, you will go there again. An answer to almost any question in regard to the Adirondacks will be found in No. 20 of the "Four-Track Series," "The Adirondack Mountains and How to Reach Them;" issued by the

NEW YORK CENTRAL

A copy will be mailed free on receipt of a two-cent stamp, by George H. Daniels, General Passenger Agent, Grand Central Station, New York.

AS SIMPLE AS ITS NAME.

A B C
—OF—
THE TELEPHONE

By J. E. HOMANS, A. M.
352 pages.
Cloth, Price $1.00.

An up-to-date, practical treatise on the construction, theory, installation, care and management of telephones and their appliances.
Sent prepaid on receipt of price.

Electrician Publishing Co.,
510 Marquette Building, Chicago, Ill.

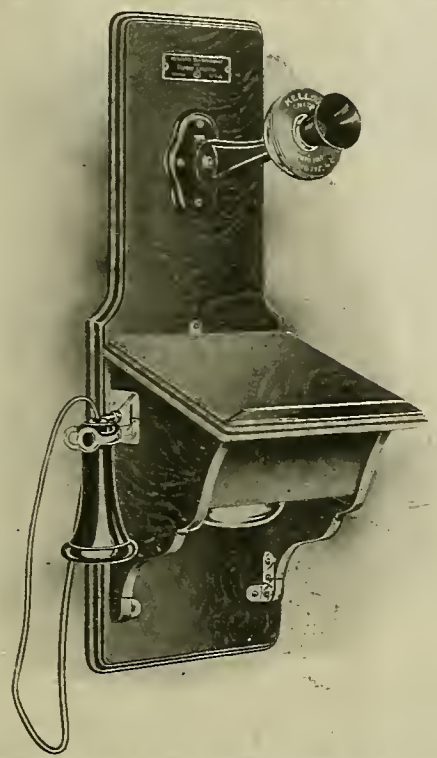
Automatic Telephones.

Privacy
Promptness
Precision
Profits.

Automatic Electric Co., Chicago, U. S. A.

KELLOGG SWITCHBOARD & SUPPLY CO.

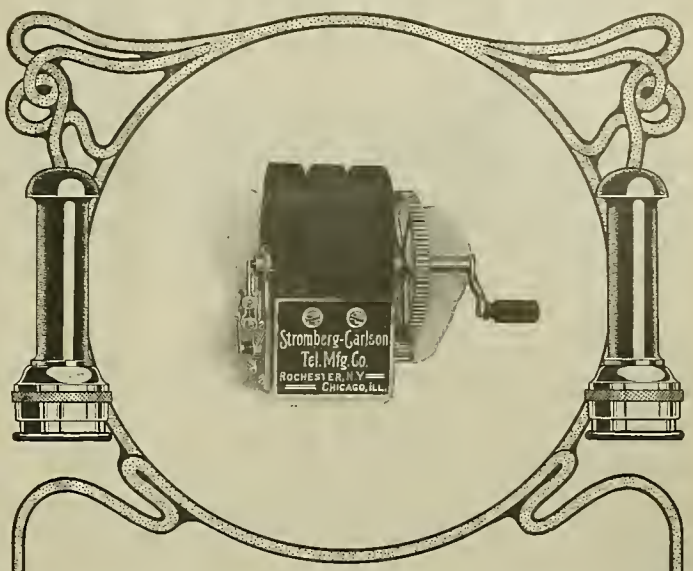
Manufacturers of the Largest and Busiest Telephone Exchanges in the United States



The Kellogg Transmitter stands first in volume, clearness of articulation and in carrying power. Our prices are low when cost of maintenance and quality of apparatus are considered. Do not fail to visit our exhibit in the Electricity Building at the St. Louis Exposition.

Kellogg Switchboard & Supply Co., Green and Congress Streets - CHICAGO

Seymour Bldg., Los Angeles Electric Bldg., Cleveland Keystone Telephone Bldg., Philadelphia



Standard three-bar generator, same as used in our series telephones. We have manufactured generators since we first started in business. What this experience means to you enables us to sell the best generator made at a price slightly above the ordinary. The difference is caused by the better grade of material used and the superior workmanship.

You pay nothing for our experience. Our Bulletin No. 11-E explains fully this apparatus. Mailed free.

Stromberg-Carlson Telephone Mfg. Co.

GENERAL AND EASTERN OFFICE **ROCHESTER, N. Y.**

SALES DEPT. **CHICAGO, ILL.**

INTERNATIONAL

Mechanical Self-Restoring Drop Switchboard.

A PERFECT APPARATUS.

Made in any desired capacity.
Sample parts and quotations on request.

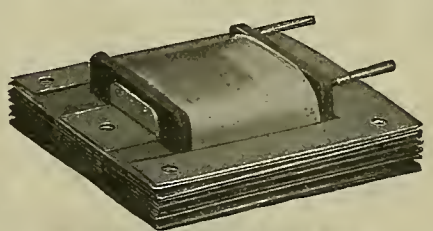
INTERNATIONAL TELEPHONE MANUFACTURING CO.

CHICAGO, U. S. A.

We introduced successful 4-party lines

LEICH SELECTIVE SYSTEM

Write for our booklet—"Selective W."

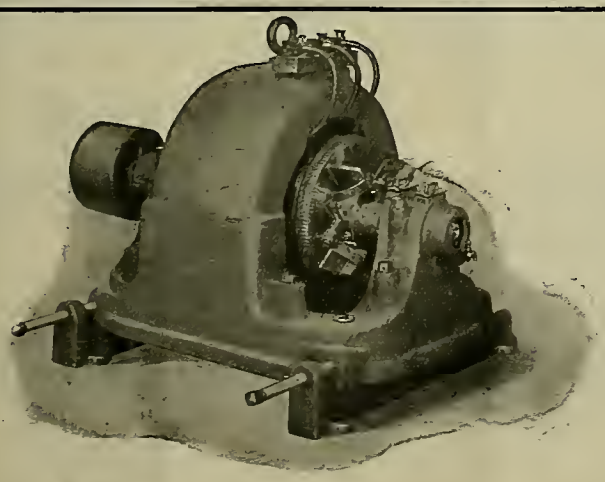


Impedance Coil for Selectives. No Springs.

CENTRAL ENERGY OR MAGNETO

AMERICAN ELECTRIC TELEPHONE CO.

CHICAGO, ILLINOIS



CENTRAL STATION MANAGERS

Don't Be Afraid

of the Gas Plant

WORK UP A MOTOR LOAD

We can furnish you

SINGLE PHASE MOTORS

that will start under full load in sizes ranging from 1/8 to 35 H. P.

Wagner Electric Mfg. Co.

ST. LOUIS, MO., U. S. A.

PRODUCERS AND WHOLESALERS OF WHITE CEDAR PRODUCTS

CEDAR POLES

YARDS
KOSS MICH.
L'ANSE "
MUNISING "
ONTONAGON
WAGNER, WIS
PESHTIGO "

SPECIAL PRICES ON SMALL POLES.
Write for a copy of our TELEGRAPH CODE FOR CEDAR PRODUCTS

C. H. WORCESTER CO.
SUITE 1206 TRIBUNE BLDG. CHICAGO.

WHITE CEDAR POLES
Don't forget our Minnesota Transfer Yard—midway between St. Paul and Minneapolis, where we load in forty-eight hours from the time we have your order.
PAGE & HILL CO. 1003 Lumber Exchange, MINNEAPOLIS, MINN.

POLES. WHITE CEDAR. IDAHO CEDAR up to 80 ft.
BERTHOLD & JENNINGS, ST. LOUIS. Chemical Building.
CROSS ARMS. LONG LEAF PINE AND FIR.

Southern Cedar POLES Are the Best.
NO ROTTEN BUTTS.
D. W. PHELAN, 277 Broadway, New York

POLES W. C. STERLING & SON, MONROE, MICH. Eleven Pole Yards in Michigan. TIES.
Wholesale Producers for 20 years.

MICHIGAN WHITE CEDAR POLES LARGE STOCK.
PROMPT SHIPMENTS. KELLOGG SWITCHBOARD & SUPPLY CO., Chicago.

The Electrician Publishing Co., Suite 510 Marquette Building, Chicago. Headquarters for all latest Electrical Books. Write for Catalogue.

A Trip Through Yellowstone Park

is what everyone hopes to have—**some day**. It is the most wonderful trip in the world. There are more than 3,000 square miles of weird, marvelous, unimaginable things that can be seen nowhere else, therefore if one ever sees them one **must** go to the Park, in the heart of the magnificent Rockies with snow tipped peaks all around. If Old Faithful geyser, a Paint Pot, Mud Volcano, or Emerald Pool were to be found in Lincoln Park, Chicago; Central Park, New York; or Fairmount Park, Philadelphia; the people would flock to see it or them by tens of thousands. For a very small sum, comparatively, all these and hundreds more of nature's unduplicated marvels can be seen between June 1 and September 30, of each year, and one will enjoy, to boot, the best coaching trip in the country.

The **Northern Pacific** folder on Yellowstone Park, just issued, is a new, right up to date, finely illustrated dessertation on this Yellowstone Park trip. It is not descriptive, but deals with the detailed, technical matters everyone needs to know about such a trip. It tells all about the hotels, the stage coaches, the roads, the cost of the tour; where the geysers, the waterfalls, the bears, the canyons are, and where the trout fishing is found. We have printed thousands of this beautiful leaflet and want everybody interested to have a copy, and it can be obtained by sending A. M. Cleland, General Passenger Agent, St. Paul, Minn., **two cents** with proper address.

"Wonderland 1904" which is a very fine pamphlet of 116 pages, descriptive of the Northwest, including the Park, will be sent for **six cents.**

WHITE CEDAR POLES
HALL L. BROOKS
52 WISCONSIN AVENUE
TOMAHAWK, WIS.

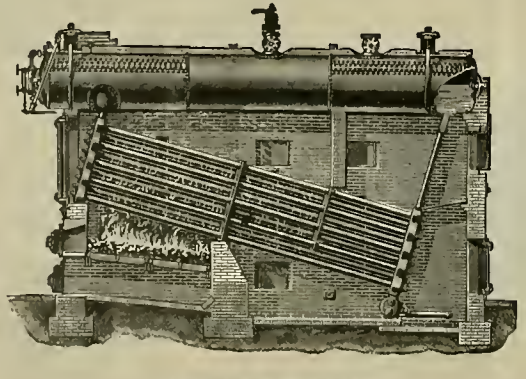
Poles and Ties
The Fowler Companies
TRADE MARK
Fisher Bldg. Chicago

Points in Wisconsin and the Northwest
are covered by Wisconsin Central Railway's convenient, solid, wide vestibuled trains, equipped with Pullman sleepers, free reclining chair cars and modern coaches which leave Central Station, 12th Street and Park Row (Lake Front), Chicago for St. Paul, Minneapolis, Ashland and Duluth, connecting with all western lines. Meals in dining and cafe cars served a la carte.
For tickets and further information apply to nearest ticket agent, or write
JAS. C. POND, Gen'l Pass. Agt., Milwaukee, Wis.

STUDENTS
Will find that the WESTERN ELECTRICIAN can help them wonderfully in the study of electricity. Subscribe now.
$3.00 per year, in advance.
Electrician Publishing Co.,
Suite 510 Marquette Bldg., - CHICAGO

THE BABCOCK & WILCOX CO., 85 LIBERTY ST., N. Y.

BRANCH OFFICES:
BOSTON, 36 FEDERAL STREET.
PHILADELPHIA, 1110-1112 NORTH AM. BLDG.
SAN FRANCISCO, 63 FIRST STREET.
PITTSBURG, 1218 FRICK BUILDING.
NEW ORLEANS, 339 CARONDELET STREET.
CHICAGO, 1216 MARQUETTE BLDG.
ATLANTA, EMPIRE BLDG.
CLEVELAND, 706 NEW ENGLAND BLDG.
MEXICO CITY, 7 AVENIDA JUAREZ.
HAVANA, CUBA, 116 1-2 CALLE DE LA HABANA



200 Pounds Working Pressure

WATER TUBE STEAM BOILERS

STEAM SUPERHEATERS

Our Book, STEAM, mailed free on application.

Cedar Poles.

Pittsburg and Lake Superior Grow Co. Producers and Wholesalers. Escanaba, Mich.

That Cheaper Tie that we have been talking about is just the same quality as the "Steam" size. The only difference is the size.

Further particulars and delivered price for immediate shipment, on request.

MALTBY CEDAR COMPANY, 509 Phoenix Block, Bay City, Michigan
PITTSBURG AGENTS: Tipper & Patton, 509 Bessemer Bldg.

Idaho Cedar Poles

PACIFIC COAST POLE CO. SPOKANE, WASH.

POLES, TIES, POSTS.

THE PORTER CEDAR CO., SAGINAW, MICH.

PRODUCERS. We want your inquiries always.

MICHIGAN AND WESTERN **CEDAR POLES**
ALL LENGTHS AND SIZES
LINDSLEY BROS CO.
TRIBUNE BLDG., CHICAGO

BRACKETS—X ARMS—PINS

little things it is true, but they cut a big figure in line construction.

OUR MOTTO IS:
Prompt Shipment Quality Satisfaction Right Price

COLUMBIA MFG. CO. ANTIGO, WIS.

WORKS QUICK AND EASY. KEEPS ITS LUSTER. HOLDS OLD TRADE AND MAKES NEW. DOES NOT DETERIORATE. ESTABLISHED 16 YEARS. SOLD BY AGENTS AND DEALERS ALL OVER THE WORL
U.S. METAL POLISH 3 OUNCE BOX 10 CENTS. SAMPLES SENT FREE
GEO. W. HOFFMAN
POLISHES ALL METALS. BRANCHES NEW YORK, CHICAGO, SAN FRANCISCO. 295 E. WASHINGTON ST. INDIANAPOLIS, IN.

CEDAR POLES, POSTS, TIES,

H. M. LOUD'S SONS CO., Au Sable, Mich.

CEDAR POLES

ESTABLISHED 1862
WM. MUELLER COMPANY
1211-12-13 MARQUETTE BLDG. CHICAGO.
EIGHT DISTRIBUTING YARDS

Cedar Poles

TORREY CEDAR CO., CLINTONVILLE, WIS.

Large Stock Constantly on Hand

CEDAR POLES

THE
Valentine-Clark Co.
234 La Salle Street, CHICAGO

YARDS:
Pinconning, Mich. : Green Bay, Wis. : New London, Wis.

Standard Vitrified Conduit Co.

B. B. BARNARD, Manager

39-41 CORTLANDT ST.
NEW YORK

LARGEST FACTORIES IN THE WORLD : STOCK ON HAND
SEND FOR CATALOGUE

CENTRAL STATION HEATING

We are the originators and builders of the underground system of live and exhaust steam heating. Our system is used for the utilization and distribution of exhaust steam from electric and power plants for heating purposes. 250 Plants in successful operation. We have the only Meter System. Also manufacturers of Wooden Water Pipe, Steam Pipe Casing, Steam Traps, Condensation Meters, Valves, Economizing Coils, Separators and full line of Steam Fitters' Supplies.

WRITE FOR PAMPHLET AND PRICE LIST

AMERICAN DISTRICT STEAM COMPANY

MENTION WESTERN ELECTRICIAN. LOCKPORT, N.Y. CHICAGO, ILL.

Every

Westinghouse Precision Wattmeter

Has at least 2,000 Readable Deflections

The Scale is a five-inch circle on a silvered dial, and has 200 or 250 accurately spaced divisions. The vernier affords readings of tenths of divisions without calculation.

For Calibrating

Integrating Wattmeters, a style is furnished with three current ranges of maximum capacity of 5, 20 and 100 amperes. With resistance suitable for 100 volts, this instrument will accurately measure from 10 to 10,000 watts, and proportional values at other voltages.

In Operation

When current passes through the instrument, the sight wire is drawn to the right; by turning the knurled head in the center of the dial the vernier pointer is moved to the left until the sight wire is brought back to zero. Fine adjustment is obtained by the knurled knob shown at the right.

Equally Accurate on Direct and Alternating Currents

Compare the accuracy of the machine-divided scale with the uneven divisions of the hand-drawn scales of ordinary standard instruments. The fine hairline of the sight wire with the pointer ordinarily employed. The long range of this instrument with the short range of readable deflections of others.

The Westinghouse Department of Standards will calibrate free of cost to owner, excepting expense of carriage, any Westinghouse Instrument of Precision received within five years from date of purchase; compare this with calibration service elsewhere obtainable.

These Instruments
made only by

Free Calibration
furnished only by

Westinghouse Electric & Mfg. Co.

Pittsburg, Pa.

For full particulars address nearest District Office

New York, Atlanta, Dallas, Baltimore, Boston, Buffalo, Chicago, Cincinnati, Cleveland, Detroit, Los Angeles, Minneapolis, New Orleans, Philadelphia, Pittsburg, St. Louis Salt Lake City, San Francisco, Syracuse, Seattle, Denver, Mountain Electric Co.
Canada: Canadian Westinghouse Co., Limited, Hamilton, Ontario. Mexico: G. & O. & Braniff Co., City of Mexico.

Fort Wayne Revolving Field Alternators

Fort Wayne Three-Phase Engine Driven Alternator
Type T R E 48-200-150-2,300 volts.

Engine Driven

Multiphase alternators furnish most economical and flexible equipment for lighting and power plants

Write for Literature and Prices

Fort Wayne Electric Works, Fort Wayne, Indiana.

248

Good Advice

No. 7.

A low torque Direct Current Wattmeter is like a sickly child, in that it has to be continually doctored and attended to. When purchasing a meter for Direct Currents, be careful in your choice. Don't buy a "weak" one simply because it is cheap, or an alleged "strong" one on the strength of its ancestral history. The meter that holds the highest record for accuracy, permanency and torque is the one you want; it's the Duncan.

Good Advice No. 8 Next Week.

Send for Bulletin and Prices.

DUNCAN ELECTRIC MFG. CO.

LAFAYETTE, IND.

"C & H on a controller means highest quality"

The C&H Rotary Press Controller

Gives any speed desired.

It starts the press gradually and gives a steady motion at all speeds.

Perfect and immediate control from any part of press by means of a series of push buttons.

The Cutler-Hammer Mfg. Co.

MILWAUKEE, WIS.

New York Boston Chicago Pittsburg

REFLECTIONS ON FARIES REFLECTORS

Fit any socket
Quickly attached or detached.
Made of aluminum or steel.
Very light and will not rack socket to pieces.
Finish not affected by heat.
Made in many styles and finishes.

Catalogue mailed upon application.

FARIES MFG. CO.
DECATUR, ILL.

WIRES AND CABLES
HIGH-GRADE, RUBBER-COVERED, WEATHER-PROOF
MAGNET, OFFICE, ANNUNCIATOR WIRE.
HAZARD MANUFACTURING CO.,
GENERAL OFFICE AND WORKS, Wilkesbarre, Pa. NEW YORK OFFICE, 50 Dey St. CHICAGO OFFICE, 71 and 73 West Adams St.

VULCANIZED FIBRE
Highest grades for electrical insulation and mechanical purposes, in sheets, tubes, rods and special shapes. Catalogues and samples on application.
VULCANIZED FIBRE CO., - Wilmington, Del.

KARTAVERT.
HARD AND FLEXIBLE FIBER IN SHEETS, RODS AND TUBING.
For Electrical and Mechanical Purposes, Railway Dust Guards, Washers and Packings. Patent Insulating Cleats.
MANUFACTURED BY
THE KARTAVERT MANUFACTURING CO. Wilmington, Del.

HAVE YOU SEEN
The Holophane Booth in Section 25, Electricity Building, St. Louis, which represents an expenditure of nearly $30,000?

DO YOU KNOW
Why all the offices of the Department of Electricity at the World's Fair are equipped with Holophane Globes and Pagoda Reflectors? Ask Prof. Goldsborough, chief of the Department of Electricity at the Louisiana Purchase Exposition, why he selected Holophanes.

HOLOPHANE GLASS CO.
15 East 32d St. New York
THE V. R. LANSINGH CO., Western Distributors
207-209-211 Jackson Boulevard, CHICAGO.

SUCCESSFUL HEATING
IS ASSURED

WITH THE

Sturtevant Blower System

B. F. STURTEVANT CO.
BOSTON

New York Philadelphia Chicago London

Black Diamond File Works
Est. 1863. Inc. 1895.

Twelve Medals Awarded at International Expositions

Special Prize Gold Medal at Atlanta, 1895.

OUR GOODS ARE ON SALE IN EVERY LEADING HARDWARE STORE IN THE UNITED STATES AND CANADA.

G. & H. BARNETT COMPANY,
PHILADELPHIA, PA.

JOHN A. ROEBLING'S SONS CO.

Insulated Wire of All Kinds

Bare Copper Wire

MAIN OFFICE AND WORKS **TRENTON, N. J.**

AGENCIES AND BRANCHES
New York Chicago Cleveland San Francisco Philadelphia Atlanta

Western Electrician

Vol. XXXV. $3.00 Per Annum. Copyright, 1904, by Electrician Publishing Company, Chicago. CHICAGO, SEPTEMBER 10, 1904. Entered at Chicago Postoffice as mail matter of the second class. 10 Cents a Copy. No. 11.

SIMPLEX INSULATED WIRES AND CABLES.

RUBBER COVERED, WEATHERPROOF, UNDERGROUND AND SUBMARINE.

WESTERN SELLING AGENT H. R. NIXSON 1 [illegible] Street, CHICAGO

The Simplex Electrical Co., 110 State Street, BOSTON, MASS.

National India Rubber Co.'s RUBBER COVERED WIRES AND CABLES.

OFFICE AND FACTORY: BRISTOL, R. I.

OKONITE

TRADE MARK

1889—Paris Exposition, Medal for Rubber Insulation.

1893—World's Fair, Medal for Rubber Insulation.

THE STANDARD FOR RUBBER INSULATION.

Sole Manufacturers of

Okonite Wires, Okonite Tape, Manson Tape, Candee Weather-proof Wires.

THE OKONITE CO., LTD.

Willard L. Candee, Ourant Cheever, } Managers. 253 Broadway, New York. Geo. T. Manson, Gen'l Supt. W. H. Hodgins, Secy.

TRADE MARK

CRESCENT INSULATED WIRE & CABLE CO. TRENTON, N. J.

CRESCENT RUBBER INSULATED WIRES AND CABLES

National Code Standard.

CRESCENT INSULATED WIRE AND CABLE CO.,

New York Office, 83 BARCLAY STREET. Main Office and Factory, TRENTON, N. J.

DRIVER-HARRIS WIRE CO.

HARRISON (NEWARK), N. J.

Manufacturers of Fine Sizes Wire of Every Description.

Resistance Wires a Specialty.

INDIANA RUBBER AND INSULATED WIRE CO.,

MANUFACTURERS OF

Paranite Rubber Covered Wires and Cables,

UNDERGROUND, AERIAL, SUBMARINE AND INSIDE USE:

TELEPHONE, TELEGRAPH AND FIRE ALARM CABLES.

All Wires are tested at Factory. JONESBORO, IND.

AKRON

Generators, Motors, Clutches, Commutator Truing Devices.

AKRON ELECTRICAL MFG. CO., AKRON, O.

N. Y. Office: McKay Engineering Co., 149 Broadway

"CIRCULAR LOOM" THE FLEXIBLE CONDUIT

AMERICAN CIRCULAR LOOM CO. TRADE MARK REGISTERED

CONDUITS FOR INTERIOR WIRING.

American Circular Loom Co.

Chelsea, Mass., New York, Chicago, San Francisco.

THERMOPILES 1½ VOLTS 1½ AMPERES

For Electrolytic analysis, charging storage batteries, and other constant current requirements. $3 Each.

WALSH'S SONS & CO., 264 Washington Street. Newark, N. J.

All Supply Houses

J. J. EGAN'S "ACME" COMMUTATOR COMPOUND.

J. J. EGAN'S "ACME" COMMUTATOR COMPOUND absolutely prevents sparking or cutting. One stick of "Acme" is equal to one gallon of oil for lubricating commutators. Free Sample. AGENTS WANTED. 50c per Stick. $5.00 per doz.

J. J. Egan Sole Mfg., 317 Austin Ave., Tel. Polk, 1779 Chicago

I-T-E

CIRCUIT BREAKERS

CUTTER ELECTRICAL CO., PHILADELPHIA

Sterling Black Plastic Insulator.

One hundred days' continuous baking at 180° F. will not make it brittle. Water repellent. Oil proof.

THE STERLING VARNISH CO., - - Pittsburg, Pa.

THOUSANDS IN USE.

Motors, ¼ h. p. to 100 h. p. Dynamos, 1 k. w. to 75 k. w. Highest Quality. Reasonable Prices.

THE HOBART ELECTRIC MFG. CO. TROY, OHIO.

"STAR" INCANDESCENT LAMPS

LONG LIFE GUARANTEED CANDLEPOWER, HIGHEST EFFICIENCY.

MADE BY THE MOST SKILLED WORKMEN.

STANDARD ELECTRICAL MFG. COMPANY, : Niles, Ohio.

Our Compound Stops Sparking and Saves Commutators.

14 Years' Use on Street Ry., Light and Power Commutators Has Proven its Worth. WE GUARANTEE RESULTS

Send Your Address for FREE SAMPLE THAT CONVINCES.

JAS. McLAUGHLIN & CO., ELECTRICAL ENGINEERS

586 Fulton Street, - - Chicago, Ill.

YOST SPECIALTIES.

Sockets, Wall Sockets, Weatherproof Sockets, Rosettes, Receptacles, Cord Adjusters.

Catalogue for the asking.

THE YOST ELECTRIC MFG. CO. TOLEDO, OHIO.

Cope's Patent Quick Coupling Conduit Rod

Remember these rods have no lost motion. These Couplings are of Steel and are made in the best possible manner.

Write for list of persons using these rods—25,000 sold since May 1902. Made in 3 ft. and 4 ft. lengths. Price, 3 ft. 75 cents, 4 ft. 85 cents. Patented February 24, 1903.

T. J. COPE

3244 North Fifteenth Street PHILADELPHIA, PA.

WESTON Electrical Instrument Co.,

Waverly Park, NEWARK, N. J.

Weston Portable Galvanometer for Bridge Work.

Weston Standard Portable Direct Reading

Voltmeters, Millivoltmeters, Voltammeters, Ammeters, Milammeters,

Ground Detectors and Circuit Testers,

Ohmmeters, Portable Galvanometers.

Our Portable Instruments are recognized as **The Standard** the world over. The **Semi-Portable Laboratory Standards** are still better

Our **Station Voltmeters and Ammeters** are unsurpassed in point of extreme accuracy and lowest consumption of energy.

BERLIN—European Weston Electrical Instrument Co., Ritterstrasse No. 88.

LONDON—Elliott Bros., Century Works, Lewisham.

PARIS, FRANCE—E. H. Cadiot 12 Rue St Georges.

New York Office—74 Cortlandt St.

HENRY NEWGARD & CO.

ELECTRICAL CONSTRUCTION

Power and Light Plants. Switchboards and Panel Boards.

We install Municipal and Isolated Electric Lighting Plants.

We manufacture Switchboards, Table boards, Iron Cutout Boxes and Electrical Specialties.

We sell Dynamos, Motors and Electrical Supplies.

We wire old as well as new Residences. Factory Buildings, School and College Buildings.

87 Fifth Avenue, Chicago, Illinois.

Allis-Chalmers Co
CHICAGO

5000 horsepower Allis-Chalmers Engine

Machinery Hall, World's Fair, St. Louis.

WHAT IT HAS DONE

Began unloading from train Jan. 15th—27 carloads—Generator 10 carloads.

Steam first turned on April 20th, Engine and Generator operated perfectly ever since.

St. Louis Exposition officially opened April 30th, 1904.

Decorative lighting of Exposition Buildings and Grounds first turned on evening April 29th, this Engine and Generator carrying the load.

Ran non-condensing one month while Exposition was getting its condenser plant erected and connections made. During that time carried 1300 horsepower night after night.

Sometimes required to operate the Cascades,—2000 horsepower.

Exposition having finished its condenser plant, the Engine was required to take full load June 10th. That night the unit carried 4800 horsepower. Began with 26-inch vacuum—no load—which, under load, ran down to about 14 inch, or 7 to 8 pounds. Engine has never been out of commission, except for two nights when a sewer burst and flooded the wheel-pit.

Since then Engine ran condensing until July 25th,—carrying 4800 horsepower with from 13 to 16 inches vacuum. On July 25th a break occurred in the Exposition discharge pipe which takes the condenser water to the Lagoon. The Engine then ran non-condensing for two nights. It carried 4400 horsepower during that time. On July 28th ran condensing,—since then it has regularly carried 5600 horsepower with 15 inches vacuum.

The "Big Reliable"

Bullock
Electric Mfg Co
Cincinnati

Canadian representatives, Allis-Chalmers-Bullock, Ltd., Montreal

THE ELECTRIC STORAGE BATTERY CO.

PHILADELPHIA

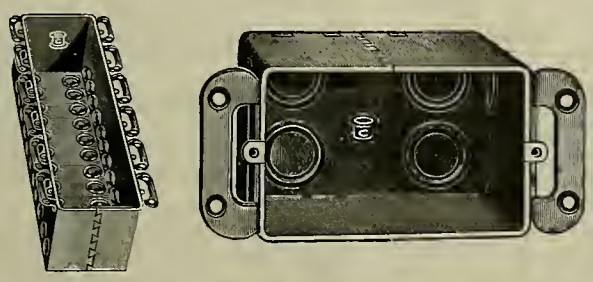
Extends an invitation to its exhibit at Section Twenty, in the Palace of Electricity, Louisiana Purchase Exposition.

September 12, 1904

SALES OFFICES
PHILADELPHIA—Allegheny Av. and 19th St. NEW YORK—100 Broadway.

"UNION" SWITCH OUTLET BOX

APPROVED by The Underwriters' National Electric Association ***For finished house work***



Construction, 14-gauge steel, dove-tailed joints, finished in black enamel.
Made to conform to the latest Underwriters' rules.
Gangs of 2, 3, 4, 5 and 6 carried in stock.
Spacing in gang boxes 1 13-16" between centers.
Provided with clamps for holding Sprague Cable.
Tandem boxes made to order.
Takes plate 4¼" and longer. Outlet holes ⅝".
Dimensions at bottom of single box, 3 1-16" by 2".

Takes all makes of switches and receptacles.

Chicago Fuse Wire & Mfg. Co.,

358 Dearborn St., CHICAGO *853 Broadway, NEW YORK* *Mutual Life Building, BUFFALO*

Engineering MECHANICAL, ELECTRICAL, STEAM, CIVIL.

Complete and short courses. Thoroughly equipped engineering shops. Shop work from the beginning. Short courses in Steam and Electrical Engineering. Expenses low. Accommodations the best. School all year. Students may enter any time. Correspondence steam and electrical courses. Send for catalogue. Mention course in which interested.
HIGHLAND PARK COLLEGE, DES MOINES, IOWA.

CARBONS
CONSUMERS CARBON CO.
LANCASTER, OHIO, U. S. A.
Carbons of all kinds and for all purposes.

Electric Heating Apparatus
SEND FOR 32-PAGE CATALOGUE.
UNIT" ENAMELED RHEOSTATS
SIMPLEX ELECTRIC HEATING CO.,
Cambridgeport, Mass.

PLATINUM

PLATINUM RIVETS FOR CONTACT POINTS IN TELEPHONES—SPARK COILS AND OTHER ELECTRICAL APPARATUS. PLATINUM SHEET AND WIRE IN ANY FORM AND DEGREE OF HARDNESS. PLATINUM SCRAP PURCHASED.

BAKER & COMPANY, Inc.
ARTISANS IN PLATINUM
408-410-412-414 N. J. R. R. AVE. - NEWARK, N. J.
New York Office: 120 Liberty St.

ALPHABETICAL INDEX TO ADVERTISEMENTS.

Adams-Bagnall Electric Co.. 5
Akron Electrical Mfg Co.... 1
Allen Company, L. H.....—
Allis-Chalmers Company..... 2
American Battery Co.....15
Amer. Circular Loom Co.... ...1
American Conduit Co.....21
Amer. District Steam Co.....24
Amer. Elec. Fuse Co..... 4
Amer. Electrical Heater Co..17
Amer. El. Telephone Co.....23
American Electrical Works..15
Arnold Elec. Power Station Co.....17
Automatic Electric Co..... 21

Babcock & Wilcox Co.....—
Badt, F. H.....17
Bain, Forée.....15
Baker & Company..... 3
Baker & Co., W. E.....17
Barnett Company, G. & H....28
Beardslee Chandelier Mfg.Co.—
Berthold & Jennings.....25
Big Four Route.....—
Bissell Co., The F.....17
Bossert Electric Construction Co.....14, 16
Brooks, Hall L.....25
Bryan-Marsh Co.....—
Bryan, Wm. H.....17
Buckeye Electric Co.....—
Bullock Elec. Mfg. Co..... 2
Butterfield, J. F.....17
Byllesby & Co., H. M.....17

Cantwell Press, The.....23
Central Electric Co.....—
Cent. Stat. Improvement Co..16
Central Tel. & El. Co.....21
Century Electric Co.....—
Chicago Dis & Electric Co....—
Chicago Edison Co.....4, 16
Chic. Fuse Wire & Mfg. Co... 3
Chicago Insulated Wire Co..—
Chicago Mica Co.....14
Columbia Incand. Lamp Co..11
Columbia Mfg. Co.....24
Columbus Storage Bat'ry Co.14
Consumers Carbon Co..... 3
Continuous Rail Joint Company of America.....13
Cope, T. J..... 1
Crawfordsville Electric Co..—
Crescent Ins. Wire & Cbl. Co. 1
Crocker-Wheeler Company...16
Crouse-Hinds Co.....25
Cutler-Hammer Mfg. Co..... 9
Cutter Elec. & Mfg. Company 1

D. & W. Fuse Company.....—
Dearborn Drug & Chem. Wks.19
Diamond Meter Company....25
Dielectric Manufacturing Co.15
Directory of Engineers..... 17
Dixon Crucible Co., Joseph..19
Driver-Harris Wire Co..... 1
Duncan Elec. Mfg. Co.....25

Economical Elec Lamp Co..--
Edison Decorative & Miniature Lamp Departm't.....14
Edison Mfg. Company.....10
Edwards & Co.....15
Egan, J. J..... 1
Electric Appliance Co..... 14
Electric Storage Battery Co.. 3
Electrical Appliance Co.....—
Electrical Engineer Institute.—
Electrician Pub. Company...10
Erie Ry.....24

Faries Mfg. Co.....14
"For Sale" Advertisements..16
Ft. Wayne Elec. Works, Inc..27
Fostoria Incand. Lamp Co...—
Fowler, John H.....24
Fowler-Jacobs Company.....24

General Electric Co..... 9
General Engineering Co., The 17
General Incandescent Arc Light Company.....13
General Incand. Lamp Co....—
Glogau & Co. H. M.....20
Gould Storage Battery Co.... 6
Gt. West. Smelt. & Refining Co.—
Green Fuel Economizer Co..19
Gregory Electric Company...16

Hallberg, J. H 17
Haller Machine Co.....—
Hart Mfg. Co.....12
Hartford Steam Boiler Inspection & Insurance Co....—
Hazard Manufacturing Co....—
Hemingray Glass Co..... 8
Highland Park College. ... 3
Hipwell Mfg. Co..... 16
Hobart Elec. Mfg. Company. 1
Hoffman, G. W.....25
Holmes Fibre-Graph. Co.....—
Holophane Glass Co..... 7
Holtzer-Cabot Electric Co...12
Hornaday & Co., J. P.....17
Humphrey, Henry H.....—
Hunt & Co., Robt. W.....17

Illinois Central Ry.....16
Incandescent Electric Light Manipulator Company.....—
Indiana Rub. & Ins. W. Co.... 1
India Rubber & Gutta Percha Insulating Company.....—
International Elec. Meter Co 16
International Tel. Mfg. Co...20

Jackson, D. C. & W. H.....17
Jeffrey Manufacturing Co....19
Jewell Electrical Inst. Co.....—
Johns-Manville Co., H. W.....13

Kartavert Manufacturing Co.—
Kellogg Switchboard & Supply Company.....23, 25
Kemp, R. W..... 17
Kester Elec. Mfg. Co.....14
Klein & Sons, Mathias.....15
Kohler Brothers.....17
Kuhlman Electric Co.....14

Leather Preserv. M. Corp....17
Leffel & Co., James.....19
Lindsley Brothers Company..25
Loud's Sons Co., H. M.....—

Machado & Roller..... 9
Maltby Cedar Company.....25
Manhattan El. Supply Co....15
Manross, F. N. ....—
Marinette Gas Engine Co.....19
Matthews & Bros., W. N.....15
McLaughlin, James.... 17
McLaughlin & Co., Jas..... 1
McLennan & Company, K....14
Mechanical Appliance Co....19
Mica Insulator Company.....—
Michigan College of Mines ..—
Minnesota Electric Co.....14
Miscellaneous Advs.....17
Monon Railroad..... ..16
Moon Mfg. Co., The.....—
Morrison Lbr. Co., J. W.....25
Mueller Company, William..24
Munsell & Co., Eugene.....14

National Electric Co.....12
National India Rubber Co.... 1
New England Butt Co..... 4
Newgard & Co., Henry..... 1
New York Cent. Ry.....24
New York Ins. Wire Co.....15
Northern Elect'l Mfg. Co....14
Northern Pacific Ry.....20
Northwestern Storage Battery Co.. 9
Norton Elect'l Instrument Co.—

Okonite Co., The..... 1
Olds Gasoline Engine Works.19
Pacific Coast Pole Co.....23
Page & Hill Co.....25
Paragon Fan & Motor Co.....—
Pardridge Shade & Refl. Co.. 4
Pass & Seymour, Inc..... 4
Phelan, D. W.....24
Phillips, Eugene F.....15
Phillips Insulated Wire Co...15
Phœnix Glass Co.....—
Phosphor-Bronze S. Co.....19
Pigeolet, L. M.....14
Pittsburg & L. S. Iron Co....24
Plume & Atwood Mfg. Co....28
Porter Cedar Company.....25

Reisinger, Hugo.....10
Reynolds El. Flasher Mfg.Co.15
Roebling's Sons Co., J. A....28
Ruebel-Schwedtmann-Wells..17
Runzel-Lenz Elec. Mfg. Co....—

Safety Ins. Wire & Cable Co..28
Sargent & Luudy.....—
Sauquoit Silk Mfg. Co.....16
Schott, W. H.....17
Seaman & Co., W. S.....21
Sears, Roebuck & Co.....17
Simplex Electrical Co., The.. 1
Simplex Elec. Heating Co.... 3
Speer Carbon Co..... .—
Sprague Electric Company...23
Squire Electric Co.....17
Standard Elec. Mfg. Co..... 1
Standard Underg. Cable Co....--
Standard Vitrified Conduit Co24
Stanley Elec. Mfg. Co., The 13
Stanley Instrument Co.....12
Stanton, LeRoy W..... 17
State Univ. of Iowa.....15
Sterling & Son, W. C.....25
Sterling Electrical Mfg.Co... —
Sterling Varnish Co., The.... 1
Stow Mfg. Company.....—
Stromberg-Carlson Tel. Mfg. Company.....23
Sturtevant Company, B. F...28

Torrey Cedar Company.....24
Trumbull Elec. Mfg. Co.....--
Turner Brass Works.....15

Union Electric Mfg. Co.....21

Valentine-Clark Co., The....--
Vulcanized Fibre Company..28

Wagner Electric Mfg. Co.....18
Walsh's Sons & Company..... 1
Warren Elec. Mfg. Co.....28
Wesco Supply Co.....14
Western Electric Company...17
Western El. Supply Co.....—
Westinghouse Electric & Manufacturing Co.....—
Weston Electrical Inst. Co... 1
Whitney Electrical Inst. Co.. 9
Wilmerding, C. H.....—
Wisconsin Central Ry.....17
Woolley Fdy. & Mach. Wks..19
Worcester Company, C. H....24

Yesbera Mfg. Co..... .. 21
Yost Electric Mfg. Co 1

For Classified Index of Advertisements See Page 6.

REMEMBER THE NAME AND BUY THE BEST.

PARAGON FAN MOTORS

NEW STYLES NEW PRICES
EASY RUNNING RIGID CONSTRUCTION NOISELESS

CALL AND SEE THEM OR WRITE FOR PRICES

CHICAGO EDISON COMPANY,
139 ADAMS ST., CHICAGO.

ASK ABOUT THEM. 3 NEW INVENTIONS. ASK ABOUT THEM.

PARDRIDGE REFLECTORS

Pardridge Easy Cord Adjusters
and Pardridge Easy Lamp Changers.

PARDRIDGE SHADE & REFLECTOR CO., 416-185 Dearborn St., Chicago.

P. & S. FUSELESS
ATTACHMENT PLUGS ARE APPROVED

For 3 Amperes 300 Volts
Send for a Sample and get our Prices

NEW YORK
CHICAGO
SAN FRANCISCO

Pass & Seymour, Inc.
SOLVAY, N. Y.

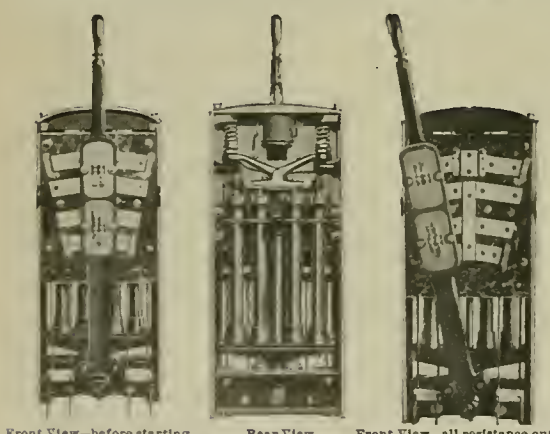
ELECTRICITY FOR ENGINEERS.

424 PAGES. ILLUSTRATED. PRICE $2.50.
ELECTRICIAN PUBLISHING CO.,
510 Marquette Building, CHICAGO

Allen-Bradley Electric Crane Controllers

Patented

Manufactured by AMERICAN ELECTRIC FUSE CO., Chicago



Front View—before starting Rear View Front View—all resistance out

A New Controller. Positively No Sparking. No Repairs. Guaranteed for One Year. Three Months' Free Trial. Perfect Control.

OUR GUARANTEE: Ask any Other Manufacturer to Duplicate It.

THE AMERICAN ELECTRIC FUSE COMPANY hereby guarantees to..... that it will at any time within three months from this date upon demand repay to said..... ..... the sum of..... .....Dollars, being the full purchase price paid (or agreed to be paid) by said..... to the American Electric Fuse Company for one..... horsepower Allen-Bradley Crane Controller, number.....upon delivery within three months after this date of said controller, freight prepaid and in good condition, ordinary wear and tear from use excepted, at the office of the American Electric Fuse Company, Chicago, Illinois, together with a written statement that said controller has proved unsatisfactory to said .....

FURTHERMORE, the said American Electric Fuse Company agrees that it will at any time within one year from this date replace, without charge, any part of said controller which may prove defective or wear out during the ordinary use of said controller, provided that it is a condition of this guarantee that said..... ..... hereby agrees to use ordinary care in the operation of said controller, and that said controller will be operated by some person, or persons, familiar with the use of crane controllers, and further that said controller will not be wilfully or maliciously injured while in the possession of said..... .....

H. N. FENNER, President J. F. BLAUVELT, Agent RUSSELL W. KNIGHT, Treasurer

NEW ENGLAND BUTT COMPANY

MANUFACTURERS OF

Machinery for Insulating Electrical Wires

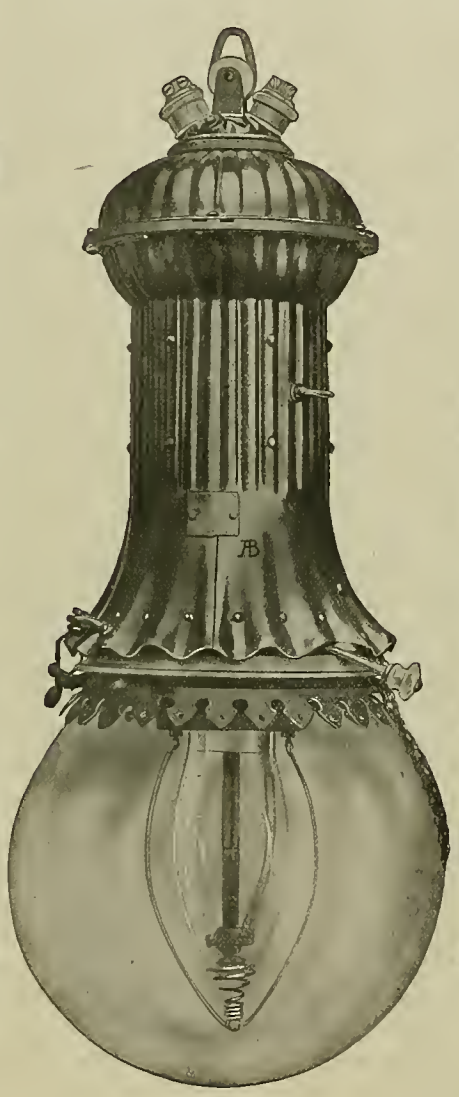
Braiding, Taping, Winding, Twinning, Cabling, Stranding, Polishing and Measuring Machines. Cable Covering Braiders

FINE CASTINGS A SPECIALTY

304 PEARL STREET, - - - PROVIDENCE, R. I., U. S. A.

A-B ARC LAMPS

FOR ALL CIRCUITS



SPECIAL FEATURES

Accessibility of Mechanism,

Ease of Removing Inner and Outer Globe,

Ease of Trimming,

Weatherproof Construction,

Stamped Copper Cases and Simplicity of Mechanism.

THERE IS

A greater number of Adams-Bagnall Constant Direct Current Series Enclosed Arc Lamps used for street lighting throughout the United States, Canada and Mexico than all other makes of this type of lamp combined.

SEND FOR CATALOGUE

AGENCIES

Doubleday-Hill Electric Co., Pittsburg, Pa.
Electric Appliance Co., Chicago, Ill.
The Wesco Supply Co., St. Louis, Mo.
H. C. Roberts Electric Supply Co., Philadelphia, Pa.
Pettingell-Andrews Co., Boston, Mass.
Cia. Benbow-Dutton, S. A., City of Mexico, Mex.
Geo. F. Rohn, Milwaukee, Wis.

AGENCIES

B-R Electric Co., Kansas City, Mo.
A. J. Michell, Atlanta, Ga.
Interstate Electric Co., New Orleans, La.
Post-Glover Electric Co., Cincinnati, O.
Miller-Seldon Electric Co., Detroit, Mich.
W. G. Nagel Electric Co., Toledo, Ohio.
R. E. T. Pringle Co., Ltd., Montreal Que.

THE ADAMS - BAGNALL ELECTRIC CO.

CLEVELAND, OHIO

New York Office: 136 Liberty St.

Chicago Office: 303 Dearborn St.

Gould Storage Battery Co.

Complete Storage Battery Plants

Railway Line and Regulating Isolated and Train Lighting Central Lighting and Power Electric Vehicle and Telephone

GOULD COUNTER E. M. F. BOOSTER SYSTEMS

Sales Offices { NEW YORK, 1 W. 34th Street. BOSTON, 89 State Street. CHICAGO, The "Rookery." SAN FRANCISCO, Century Electric Co.

WORKS: DEPEW, N. Y.

Bulletins.

CLASSIFIED INDEX OF ADVERTISEMENTS.

Adjusters, Cord.
Incandes. El. Lt. Manip. Co.

Adjusters, Inc. Lamps.
Inc. El. Lt. Manipulator Co.

Anchors (Tel. & Tel.)
Matthews & Bro., W. N.
Crouse-Hinds Co.

Annunciators.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Moon Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Batteries and Jars.
Bissell Co., The F.
Central Electric Co.
Columbus Storage Battery Co.
Edison Mfg. Co.
Edwards & Company.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Bells, Buzzers, Etc.
Central Electric Co.
Edwards & Co.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Belt Dressing.
Dixon Crucible Co., Jos.
Leather Preserver Mfg. Corp.

Belting.
Leather Preserver Mfg. Corp

Blow Pipes.
Turner Brass Works

Blowers.
Sturtevant Co., B. F.

Boiler Compounds.
Dearborn Drug & Chem. Wks.

Boilers.
Allis-Chalmers Company.
Babcock & Wilcox Co.

Books, Electrical.
Cantwell Press, The.
Electrician Publishing Co.

Booths, Telephone.
Seaman & Co., W. S.
Yesbera Mfg. Co.

Brackets.
Faries Mfg. Co.

Brushes.
Central Electric Co.
Hobart Elec. Mfg. Co.
Holmes Fibre-Graphite Co.
Speer Carbon Co.
Western Electric Company.

Cable Hangers.
Bissell Co., B. F.
Western Electric Co.

Cables (See Wires and Cables)

Canopies.
Faries Mfg. Co.

Carbons, Points and Plates.
Central Electric Co.
Chicago Edison Co.
Consumers Carbon Co.
Electric Appliance Co.
Reisinger, Hugo.
Speer Carbon Co.
Wesco Supply Co.
Western Elec. Supply Co.

Castings.
Faries Mfg. Co.
New England Butt Co.
National Electric Co.

China.
Jeffrey Mfg. Co.

Chandeliers.
Faries Mfg. Co.

Circuit Breakers.
Cutler-Hammer Mfg. Co.
Cutter Elec. & Mfg. Co.
Ft. Wayne Elec. Wks. Inc.
Union Electric Mfg. Co.
Western Electric Company.
Westinghouse El. & Mfg. Co.

Clusters.
Faries Mfg. Co.

Clutches, Electrical and Mechanical.
Akron Electrical Mfg. Co.

Coal and Ashes Handling Machinery.
Jeffrey Mfg. Co.

Coils and Magnets.
Western Electric Co.

Commutator Compound
Allen Co., L. B.
Egan, J. J.
McLaughlin & Co., Jas.
McLennan & Co., K.

Commutator Truing Device.
Akron Electrical Mfg. Co.

Condensers, Electric.
Stanley Elec. Mfg. Co.

Condnit and Conduits.
American Circular Loom Co.
American Conduit Company
Central Electric Co.
Electric Appliance Co.
Sprague Electric Co.
Standard Vitrified Cond. Co.
Wesco Supply Co.
Western Electrical SupplyCo.

Contractors and Electric Light Plants.
Allis-Chalmers Company.
Bullock El. Mfg. Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
National Electric Co.
Northern Electrical Mfg. Co.
Sprague Electric Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Controllers, Crane.
Amer. Elec. Fuse Co.

Cord.
Runzel-Lenz Elec. Mfg. Co.

Cross-Arms, Pins and Brackets.
Berthold & Jennings.
Central Electric Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Company.
Western Elec. Supply Co.

Cut-Outs and Switches.
Bissell Co., The F.
Bossert Elec. Const. Co.
Central Electric Co.
Chicago Edison Co.
Crouse-Hinds Co.
Cutter Elec. & Mfg. Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
General Inc. Arc Light Co.
Hart Manufacturing Co.
Manhattan Elec. Supply Co.
Trumbull Elec. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Dynamos and Motors.
Akron Electrical Mfg. Co.
Allis-Chalmers Company.
Bissell Co., The F.
Bullock Elec. Mfg. Co.
Central Electric Co.
Century Electric Co.
Crawfordsville Electric Co.
Crocker-Wheeler Co.
Dustin Co., Chas. E.
Ft. Wayne Elec. Wks. Inc.
General Elec. Co.
General Inc. Arc Light Co.
Gregory Electric Co.
Hobart Elec. Mfg. Co.
Holtzer-Cabot Electric Co
Mechanical Appliance Co.
National Electric Co.
Northern Electrical Mfg. Co.
Sprague Electric Co.
Stanley Elec. Mfg. Co.
Stow Manufacturing Co.
Sturtevant Co., B. F.
Wagner Electric Mfg. Co.
Warren Elec. Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Economizers, Fuel.
Green Fuel Economizer Co.

Electric Heating Appl.
Simplex Elec. Heating Co.
Western Electric Co.

Electric Railways.
Crocker-Wheeler Co.
General Electric Co.
Sprague Electric Co.
Westinghouse El. & Mfg. Co.

Electrical and Mechanical Engineers.
Arnold Elec. Power Stat'n Co.
Badt, F. B.
Baker & Co., W. E.
Bryan, Wm. H.
Butterfield, J. F.
Byllesby & Co., H. M.
General Engineering Co., The.
Hallberg, J. H.
Hornaday, J. P. & Co.
Humphrey, Henry H.
Hunt & Co., Robt. W.
Jackson, D. C. & W. B.
Kemp, R. W.
Kohler Brothers.
McLaughlin, James
Newgard & Co., Henry.
Northern Electrical Mfg. Co.
Ruebel, Schwedtman, Wells.
Sargent & Lundy.
Schott, W. H.
Squire Electric Co.
Stanley Elec. Mfg. Co.
Stanton, LeRoy W.
Wilmerding, C. H.

Electrical Instruments. (Recording and Testing.)
Bissell Co., The F.
Central Electric Co.
Diamond Meter Co.
Duncan Elec. Mfg. Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
General Inc. Arc Light Co.
Jewell Electrical Inst. Co.
Machado & Roller.
Norton Elec'l Instrument Co.
Pignolet, L. M.
Stanley Elec. Mfg. Co.
Stanley Instrument Co.
Wagner Electric Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co
Weston Electrical Inst. Co.
Whitney Electl. Inst. Co.

Electro-Plating Mach'y
Crocker-Wheeler Company.
General Electric Co.

Elevators-Conveyors.
Jeffrey Mfg. Co.

Engines, Gas and Gasoline.
Allis-Chalmers Company.
Marinette Gas Engine Co.
Olds Gasoline Engine Works.
Woolley Fdy. & Mach. Wks.

Engines, Steam.
Allis-Chalmers Company.
Dustin Co., Chas. E.
Sturtevant Co., B. F.

Fans and Fan Motors.
Central Electric Co.
Crocker-Wheeler Company.
Edison Mfg. Co.
General Electric Co.
General Inc. Arc Light Co.
Sprague Electric Co.
Sturtevant Co., B. F.
Wesco Supply Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Fibre.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Files.
Barnett Co., G. & H.

Fittings.
Faries Mfg. Co.

Fixtures, Gas and Elec.
Beardslee Chandelier Mfg. Co.

Finishers.
Bissell Co., The F.
Haller Machine Co.
Reynolds El. Flasher Mfg. Co

Flexible Shafts.
Stow Mfg. Co.

Forges.
Sturtevant Co., B. F.

Fuses and Fuse Wire.
Amer. Elec. Fuse Co.
Bissell Co., The F.
Central Electric Co.
Central Tel. & El. Co.
Chicago Die & Electric Co.
Chicago Fuse Wire & Mfg. Co.
D. & W. Fuse Company.
Electric Appliance Co.
Johns-Manville Co., H. W.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Company.
Western Elect. Supply Co.

Globes, Reflectors and Shades.
Fostoria Incan. Lamp Co.
Haller Machine Co.
Holophane Glass Co.
Pardridge Shade & Refl. Co.
Phœnix Glass Co.
Wesco Supply Co.
Western Electric Co.
Western Elect. Supply Co.

Graphite Specialties.
Dixon Crucible Co., Jos.
Holmes Fibre-Graphite Co.

Heating (Exhaust Steam).
Amer. District Steam Co.

Heating and Ventilating Apparatus.
American Electl. Heater Co.
Sturtevant Co., B. F.

Holders, Inc. Lamps.
Incandesent Electric Light Manipulator Co.

Inspection & Insurance
Hartford Steam Boiler Inspection & Insurance Co.

Insulating Machinery.
New England Butt Co.

Insulators and Insulating Materials.
Akron Electrical Mfg. Co.
American Electrical Works.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Inc. Arc Light Co.
Hemingray Glass Co.
Indiana Rub. & Ins. Wire Co.
Johns-Manville Co., H. W.
Kartavert Mfg. Co.
Manhattan Elec. Supply Co.
Mica Insulator Co.
Munsell & Co., Eugene.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Standard Vitrified Cond. Co.
Sterling Varnish Co.
Vulcanized Fibre Co.
Wesco Supply Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Junction Boxes.
Bossert Elect. Const. Co.
General Inc. Arc Light Co.

Lamps, Arc.
Bissell Co., The F.
Central Electric Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
General Inc. Arc Lt. Co.
Gregory Electric Co.
Hipwell Manufacturing Co
Manhattan Elec. Supply Co.
Stanley Elec. Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Lamps, Incandescent.
Bissell Co., The F.
Bryan-Marsh Company.
Buckeye Electric Company.
Central Electric Co.
Chicago Edison Co.
Columbia Incan. Lamp Co.
Economical Elec. Lamp Co.
Edison Decorative & Miniature Lamp Dept.
Electric Appliance Co.
Fostoria Incand. Lamp Co.
General Electric Co.
General Inc. Arc Light Co.
Standard Elec'l Mfg. Co.
Sterling Electrical Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Lamps, Incandescent—Replacers & Cleaners.
Inc. El. Lt. Manipulator Co.

Letters, Metal.
Haller Machine Co.

Lightning Arresters.
Central Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
Manhattan Elec. Supply Co.
Minnesota Electric Co.
Stanley Elec. Mfg. Co.
Western Electric Co.

Lights, Show.
Glogan & Co., H. M.

Linemen's Climbers.
Klein & Sons, Mathias.

Magnet Wires.
(See Wires and Cables.)

Mechanical Draft.
Sturtevant Co., B. F.

Mica.
Chicago Mica Co.
Mica Insulator Co.
Munsell & Co., Eugene.

Mining Apparatus, Elec.
Allis-Chalmers Company.
Crocker-Wheeler Company.
General Electric Co.
Jeffrey Mfg. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Motors. (See Dynamos and Motors.)

Nippers and Pliers.
Klein & Sons, Mathias.

Nozzles.
Faries Mfg. Co.

Paints.
Dielectric Mfg. Co.

Patent Attorneys.
Bain, Foree.

Phosphor Bronze.
Phosphor Bronze Sm. Co. Ltd.

Platinum, Wire and Sheet.
Baker & Company Inc.

Poles and Ties.
Berthold & Jenninga.
Brooks, Hall L.
Columbia Mfg. Co.
Fowler, John H.
Fowler-Jacobs Company.
Kellogg Switch. & Sup. Co.
Lindsley Bros. Co.
Loud's Sons Co., H. M.
Maltby Cedar Co.
Morrison Lbr. Co., J. W.
Mueller Company, William.
Pacific Coast Pole Co.
Page & Hill Company.
Phelan, D. W.
Pittsburg & L. S. Iron Co.
Porter Cedar Company.
Sterling & Son, W. C.
Torrey Cedar Co.
Valentine-Clark Co., The.
Worcester Co., C. H.

Polish (Metal).
Allen Co., Inc., L. B.
Heffman, Geo. W.

Portables.
Faries Mfg. Co.

Power Transmission Machinery.
Jeffrey Mfg. Co.

Rail Joints.
Continuous Rail Joint Company of America.

Rectifiers.
Electrical Appliance Co.

Refiners.
Gt. West Smelt. & Refining Co

Re-Winding—Repairs.
Chicago Edison Co.
Gregory Electric Co.

Rheostats.
Cutler-Hammer Mfg. Co.
General Electric Co.
Gen'l Inc. Arc Lt. Co.
Union Electric Mfg. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Rods, Conduit.
Cope, T. J.

Safes.
Scars, Roebuck & Co.

Schools and Colleges.
Electrical Engineer Inst.
Highland Park College
Michigan College of Mines.
State Univ. of Iowa.

Second-Hand Mach'y.
Bissell Co., The F.
Cent. Stat. Improvement Co.
Gregory Electric Co.
Matthews & Bro., W. N.
Walsh's Sons & Co.

Shades, Lamp.
Faries Mfg. Co.

Sheet Brass & Copper.
Plume & Atwood Mfg. Co.

Signs, Electric.
Haller Machine Co.

Silks, Insulating & Braiding.
Sauquoit Silk Mfg. Co.

Sockets & Receptacles.
Pass & Seymour.
Yost Elec. Mfg. Co.

Soldering Sticks, Salts and Paste.
Allen Co., L. B.
Crescent Co.
Kester Elec. Mfg. Co.
Western Electric Co.

Speaking Tubes.
Central Electric Co.
Edwards & Co.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Specialties, Electrical Mfrs. and Designers.
Haller Machine Co.

Speed Indicators.
Weston Electrical Inst. Co.

Storage Batteries.
American Battery Co.
Electric Storage Battery Co.
Gould Storage Battery Co.

Supplies, General Elec.
Bissell Co., The F.
Central Electric Co.
Century Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Electric Co.
Manhattan Elect'l Supply Co
Wesco Supply Co.
Western Electric Co.
Western Elect. Supply Co.

Switchboards.
Bissell Co., The F.
Crouse-Hinds Co.
Gen. Incan. Arc Light Co.

Telephones, Telephone Material and Switchboards.
American El. Telephone Co
Automatic Electric Co.
Bissell Co., The F.
Central Electric Co.
Central Tel. & El. Co.
Holtzer-Cabot Elec. Co.
International Tel. Mfg. Co.
Kellogg Switchb. & Sup. Co.
Manhattan Elec. Supply Co.
Moon Mfg. Co., The.
Stromberg-Carlson Tel. M.Co
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Time Switches.
Bissell Co., The F.

Tools.
Klein & Sons, Mathias.
Western Electric Co.

Transformers.
Central Electric Co.
Crawfordsville Electric Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Works, Inc.
General Electric Co.
Gregory Electric Co.
Kuhlman Electric Co.
Manhattan Elec. Supply Co.
National Electric Co.
Stanley Elec. Mfg. Co.
Wagner Electric Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Trucks, Electric Car.
General Electric Co.
Westinghouse El. & Mfg. Co.

Turbines, Steam.
Allis-Chalmers Co.
General Electric Co.
Westinghouse El. & Mfg. Co

Turbine Water Wheels
Leffel & Co., Jas.

Varnishes.
Dielectric Mfg. Co.
Sterling Varnish Co.

Vulcanized Fibre.
Vulcanized Fibre Co.

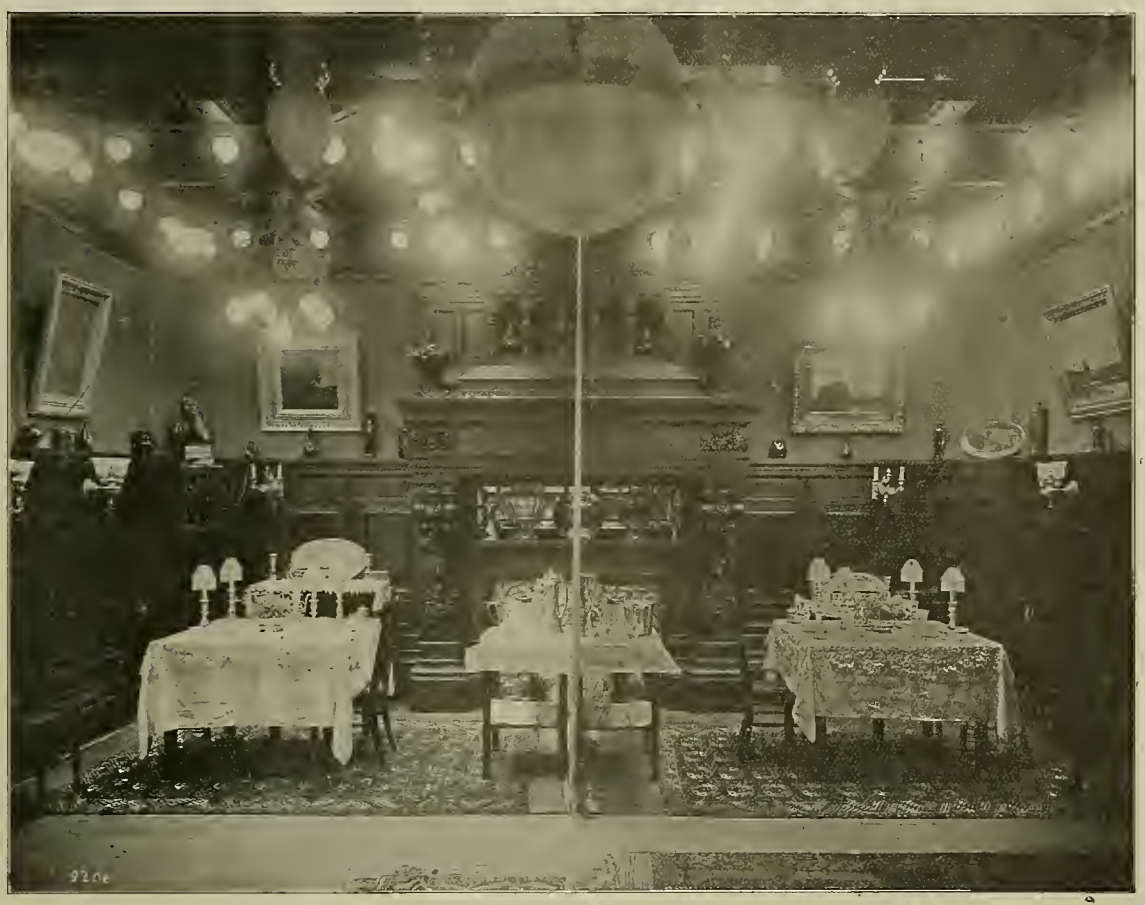
Wires & Cables—Magnet Wires.
American Electrical Works.
Bissell Co., The F.
Central Electric Co.
Chicago Insulated Wire Co.
Crescent Ins. Wire & Cble. Co.
Driver-Harris Wire Co.
Electric Appliance Co.
General Electric Co.
Hazard Manufacturing Co.
Indiana Rub. & Ins. Wire Co
India Rubber & Gutta Percha Insulating Co.
Kellogg Switch. & Sup. Co.
Manhattan Elec. Supply Co.
National India Rubber Co
New York Insulated Wire Co.
Okonite Co., The.
Phillips, Eugene F.
Phillips Insulated Wire Co
Roebling's Sons Co., J. A.
Runzel-Lenz Elec. Mfg. Co.
Safety Ins. Wire & Cable Co.
Simplex Electrical Co.
Standard Underground C. Co
Wesco Supply Co.
Western Electric Company.
Western Elec. Supply Co.

For Alphabetical Index of Advertisements See Page 3.

HOLOPHANE GLASS CO'S EXHIBIT

ELECTRICITY BUILDING, WORLD'S FAIR

ST. LOUIS, MO.



No one interested in electricity, electric lighting, or illumination in general who visits the St. Louis fair should fail to visit the Holophane Glass Co's exhibit of scientific glassware, and especially to see the demonstrations made in their dark rooms of the merits of Holophane globes and reflectors for giving a much higher illuminating return from artificial lights than can be obtained from any of the ordinary glass globes and reflectors now so generally used.

The Holophane Glass Co. claim that their scientific glassware gives a much higher light return than can be obtained from any other glass globes and reflectors, and also that an intelligent use of the different globes and reflectors designed by them for different light distribution enables any architect or engineer to not only get the greatest illuminating results from a given quantity of artificial light, but to practically get exactly the light distribution that is needed to suit each case.

After careful tests made in their own laboratories, the following electric lamp manufacturers not only thoroughly endorse the scientific and practical merits of Holophane scientific glassware, but intend to make large use of it in connection with their lamps:

General Electric Co.
Bryan-Marsh Co.
The Columbia Inc. Lamp Co.
Western Electric Co.
The Buckeye Electric Co.
The Fostoria Inc. Lamp Co.
The Shelby Electric Co.
The Sunbeam Inc. Lamp Co. of Canada, Ltd.
Independent Incandescent Lamp Co.
The Warren Electric & Specialty Co.
The Colonial Electric Co.
New York & Ohio Co.
Brilliant Electric Co., Etc., Etc.

HOLOPHANE GLOBES AND REFLECTORS ARE FOR SALE BY ALL FIRST-CLASS ELECTRICAL DEALERS IN THE UNITED STATES.

HOLOPHANE GLASS CO.

15 EAST 32d ST., NEW YORK

THE V. R. LANSINGH CO., Western Distributors, 207-209-211 Jackson Boulevard, CHICAGO.

WE MAKE

STANDARD
SCREW GLASS INSULATORS

For all purposes

TELEPHONE

TELEGRAPH

RAILWAY

POWER

If you want the best let US know

HEMINGRAY GLASS CO.
COVINGTON, KY.

Factories: Muncie, Ind. Established 1848

NEW CATALOGUE

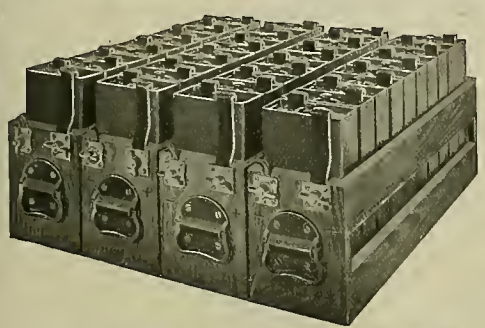
The 1904 edition of catalogue of

WHITNEY INSTRUMENTS

Showing a full line of Portable and Switchboard meters for direct and alternating current is ready for distribution.
It sbows some new and interesting lines, notably some hot wire apparatus. SEND FOR A COPY

WHITNEY ELECTRICAL INSTRUMENT COMPANY
MACHADO & ROLLER, 205 Broadway, New York City, N. Y.
GENERAL SALES OFFICE

GIVES BEST RESULTS



Northwestern Storage Battery

Cannot be equaled for

Great Capacity, Lightness and Efficiency

LOW TENSION WORK

Write for Catalogue.

Northwestern Storage Battery Co.,
285 Madison Street, - - - - Chicago, Ill.

C&H Field Regulator

THE BEST, THE SIMPLEST AND THE MOST DURABLE FIELD REGULATOR ON THE MARKET

WHY

It has no enamel to crack; will not ground; white hot wire tests have proven worth of resistance material; will carry overloads safely; no small parts to get out of order; no loose contacts to bother with; made of the best material; easily controlled; will not stick; jar of machinery will not deviate lever.

THE CUTLER-HAMMER MFG. CO.,
MILWAUKEE, WIS.

NEW YORK: 136 Liberty St. | BOSTON: 176 Federal St. | CHICAGO: Monadnock Bldg. | PITTSBURG: Frick Bldg.

General Electric Company

Manufactures all Forms of **Insulated Wires and Cables**

Rubber, Varnished Cambric,

Paper, Asbestos, Weatherproof

Write for information concerning Wires and Cables insulated with our special form of Varnished Cambric. This insulation is equal and in many respects superior, to high grade rubber insulation and considerably cheaper.

General Office: SCHENECTADY, N. Y.

Chicago Office: Monadnock Block

Sales Offices in all large Cities

"ELECTRA" HIGHEST GRADE NUERNBERG

CARBONS

BEST LIGHT

STEADIEST LIGHT

LONGEST LIFE

LEAST DUST

REMAIN THE STANDARD OF THE WORLD FOR ALL ARC LIGHTING SYSTEMS, BECAUSE they cannot be equaled in QUALITY or EFFICIENCY, producing the highest standard of candlepower in proportion to the current consumed.

HUGO REISINGER, Sole Importer, - - 11 Broadway, NEW YORK.

THE remaining September issues of the WESTERN ELECTRICIAN will contain the proceedings of the International Electrical Congress and the many other important conventions which will be held within the next three weeks.

Advertisers will find these issues of the greatest value for placing the merits of their product before the buyers of the world. Send copy for an attractive announcement TODAY.

WESTERN ELECTRICIAN

510 Marquette Building, Chicago

EDISON PRIMARY BATTERY

FORMERLY EDISON—LALANDE

Each type of Edison Primary cells is constructed to fill special requirements of the electrical profession. For instance we recommend:—

Type BB for Slot Machines, Gas Engines and Annunciators.
Type Q for Gas Engines, Small Fan Motors, Spark Coils, Large Annunciators, Burglar Alarms and Slot Machines.
Type RR for Gas Engines, Railroad Crossing Signals, Fan Motors, Phonographs, District Telegraph, Fire Alarm Telegraph, Local and Main Line Batteries, Turntable Motors, Electro-plating and Slot Machines.
Type S for Fan Motors, Phonographs, Electro-plating, Chemical Analysis, Miniature Lamps, Sewing Machines and X-Ray Coils.

Details about them in catalogue No. 7. Send for it.

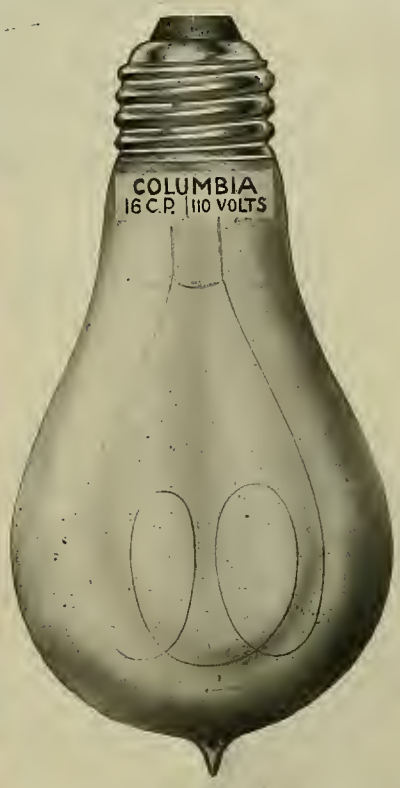
TRADE Thomas A. Edison MARK

EDISON MFG. CO.,

FACTORY, ORANGE, N. J.
83 CHAMBERS STREET, N. Y.
304 WABASH AVENUE, CHICAGO.

COLUMBIA LAMPS

GIVE MOST LIGHT



Have you used Columbia Lamps?

If not, you have not used The Best

Place an order at once

You will not regret it

Send for our Booklet, A Wallet Full of Wisdom.

Send for our Catalogue of Crystal Lamps (Meridian Type)

Columbia Lamps are manufactured under a License to use the Chemical Exhaust Process of exhausting lamps. This process is vitally necessary in the production of the highest quality of lamp. Every package of Columbia lamps carries a label reading

Licensed Under

Patent No. 537,693, April 16, '95
Patent No. 726,293, April 28, '03
Patent No. 444,530, Jan. 13, '91
Patent No. 532,760, Jan. 22, '95

The Columbia Incandescent Lamp Co.

2115-17-19 Locust St., ST. LOUIS, MO.

NEW YORK: 1311 Havemeyer Building
CHICAGO: Central Electric Co.
SAN FRANCISCO: Paul Seiler Elec. Works
PHILADELPHIA: 1227 Real Estate Trust Bldg.
MINNEAPOLIS: 638 Boston Block
MEMPHIS: 35 Equitable Bldg.
MEXICO: Monterey, Van Veorhis Hnos.

The S. K. C. Inductor Alternator

Ability to Start Up
Oil Up
Shut Up
and occasionally Clean Up

is all that is required to operate the Inductor Alternator as built by the Stanley Electric Manufacturing Company.

Does simplicity appeal to you? You have it in the Inductor with no moving wires, brushes, commutator or collector rings.

Do you desire inexpensive operation? The Inductor has nothing to renew, and only the bearings require attention.

Are your facilities for handling machinery limited? The Inductor is not difficult to install.

Bulletins Nos. 123 and 128 tell all about it. Send for them.

The Stanley Electric Manufacturing Company
Pittsfield, Massachusetts, U. S. A.

"Diamond H" Switches

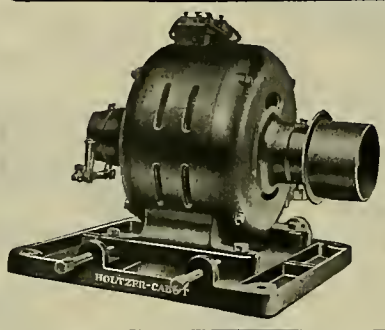
Trade H Mark

This Trade-Mark guarantees quality.

The Hart Mfg. Co., Hartford, Conn.

New York Boston Chicago Toronto, Ont.

Do You Know It?



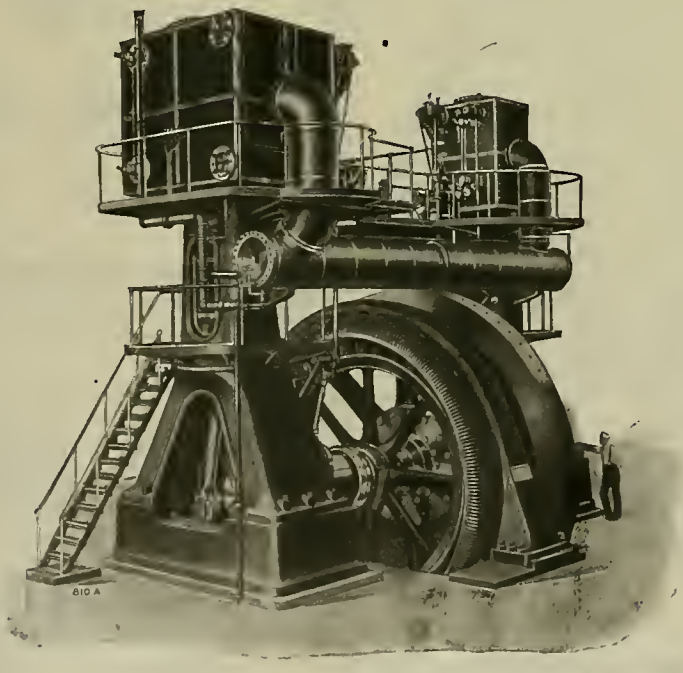
WHAT!

¶ That we make single phase alternating current motors from 1-8 to 2 H. P.

¶ **Are they good and what is the price?**

¶ Well, just send for Bulletin 0304. It tells all about it.

THE HOLTZER-CABOT ELECTRIC COMPANY
BROOKLINE, MASS. NEW YORK CHICAGO



MODERN DESIGN SUPERIOR PERFORMANCE

Revolving Field

Alternators

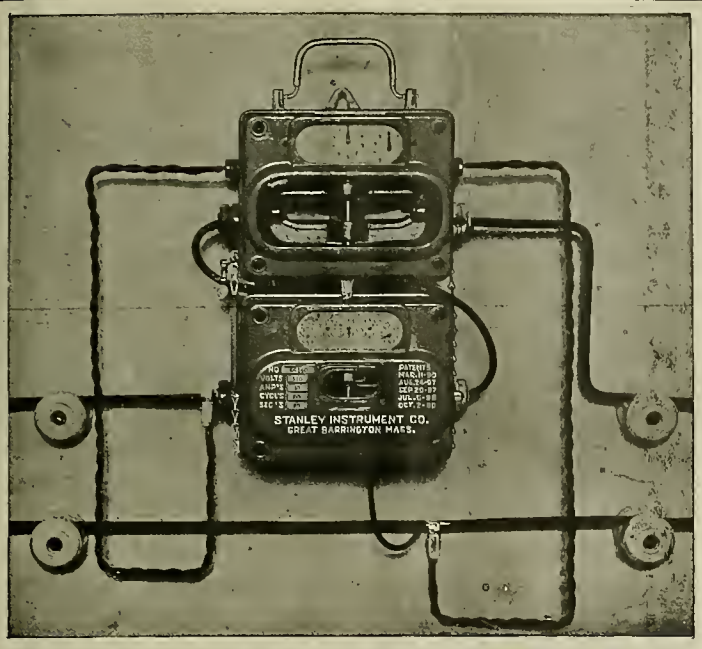
The accompanying illustration is of the National 1500 K. W. Alternator installed in Machinery Building

Louisiana Purchase Exposition

Power from this unit operates the large pumps, streams from which flow over the cascades

National Electric Company,

Milwaukee, U. S. A.

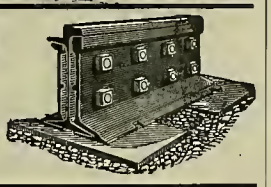


TESTING WATTMETER

ACCURATE TESTS
in a few minutes, anywhere, by one man alone without regulation of
VOLTAGE, LOAD OR FREQUENCY

STANLEY INSTRUMENT CO.
GREAT BARRINGTON, MASS.

CONTINUOUS RAIL JOINT CO. OF AM.



GENERAL OFFICES: CENTURY BUILDING
NEWARK, N. J.
OVER 20,000 MILES IN USE
Highest Award at Paris Exposition, 1900, Buffalo, 1901

AFFORD ABSOLUTE SAFETY AS PROTECTIVE DEVICES AND FREEDOM FROM ALL FIRE HAZARD : : : : : : :

SACHS TRADE NOARK MARK FUSE

ASK YOUR SUPPLY DEALER FOR "NOARK"

We Carry a Large and Complete Stock of Standard and Special **Mica Plate, Flexible Mica, Cut Mica** and **oiled insulating cloths and papers.**

New York
Milwaukee
Chicago
St. Louis
Boston
Philadelphia

H. W. JOHNS-MANVILLE CO.
100 William St., New York

Pittsburg
Cleveland
New Orleans
London
Paris
Brussels

You will admit there is

a doubt about the decision -- from these votes until the Bulletin is in--

no doubt about the decision -- on G. I. goods as soon as the first Bulletin is in--

States	Democratic	Electoral Votes	Republican
Ala.	11		
Ark.	9		
Cal.	10		
Colo	5		
Conn.	7		
Del.	3		
Fla.	5		
Ga.	13		
Idaho	3		
Ill.	27		
Ind.	15		
Iowa	13		
Kan.	10		
Ky	13		
La.	9		
Me.	6		
Md.	8		
Mass.	16		
Mich	14		
Minn	11		
Miss.	10		
Mo.	18		
Mont.	3		
Neb	8		
Nev.	3		
N. H.	4		
N. J.	12		
N. Y.	39		
N. C.	12		
N. D.	4		
Ohio	23		
Ore.	4		
Pa.	34		
R. I.	4		
S. C.	9		
S. D.	4		
Tenn	12		
Tex.	18		
Utah	3		
Vt.	4		
Va.	12		
Wash.	5		
W. Va.	7		
Wis.	13		
Wyo	3		

G. I.

Write for

Arc Lamps and Arc Lamp Accessories	G. I. Bulletin No.
D. C. Series to 600 V. Arc L.	174
D. C. Series Constant Cur. Arc L.	175
A. C. Multiple, to 133 C. Arc L.	382
A. C. Diff. Arc L. "L 8" Series	383
D. C. Mul. to 125 V. L. "L 11"–"L 21"	372
D. D.-Mul. to 250 V. Arc L. "L 12"	273
Lightning Arresters, Choke Coils and Line Discharges	358
Switches and Circuit Breakers	
Automatic Switches	157
Flush Push Button Switches.	254
Knife Switches Slow and Quick Bk.	150
Oil Switches and High Tension Ap.	153
Volt and Ammeter Switches.	265
Circuit Breakers	
Motors and Generators	
D. C. Motors and Generators	364
A. C. Small Motors.	166
D.C.—A.C. Sewing Machine Trans.	165
D. C. Fans	261
Panels and Sw. Boards	
Automobile Charging Panels	115
Small Plant Switch Panels	309
Plug Panel Boards	107
Switch Bds. High and Low Tension.	150
"G. I." Panel Boards and Fuse Carriers	51
Boxes, Plugs, Receptacles, Instruments and Meters	
Primary Fuse Box, Insulator Type	369
Floor Outlet Boxes (water tight)	194
Protective Fuse Devices	324
Round Pattern Voltmeters and Ammeters	363
"G. I." Incandescent Lamps.	390

General Incandescent Arc Light Co.

GENERAL OFFICES: 529 W. 34th STREET
NEW YORK

BRANCH OFFICES:

Boston
Denver
San Francisco

Chicago
Cleveland
Cincinnati
St. Louis

Butte
Los Angeles
Seattle

PRISMO ZENITH LAMPS

Two watts per candlepower.
Two sizes—25 and 55 candlepower.

Prismo Zenith Lamps carried in stock: Chicago, San Francisco, Warren.

ELECTRIC APPLIANCE COMPANY
ELECTRICAL SUPPLIES
CHICAGO AND SAN FRANCISCO

You've Heard of the
PEERLESS
INCANDESCENT LAMPS

If you don't know them you are missing a great light giving bulb of incandescence that is electrically and mechanically perfect and rightly named "Peerless."

They are not labeled one way and rated another. Restassured when you are buying "Peerless" lamps you are getting full rated candlepower.

The Wesco guarantee stands behind every "Peerless" lamp for efficiency, sustained candlepower, current-consumption and life.

On yearly contracts we are prepared to make the lowest price that has ever been made on a strictly high grade lamp.

ELECTRICAL MACHINERY AND SUPPLIES
WESCO SUPPLY CO., ST. LOUIS, MO., U. S. A.

MICA INSULATION That Is.

Of all Qualities, in any Form at Lowest Prices
EUGENE MUNSELL AND CO.
NEW YORK and CHICAGO

Micanite, Linotape, M. I. C. Compound, Empire Cloth and Paper. For Years the Standard.

MICA INSULATOR CO., Originators
NEW YORK and CHICAGO

Continuous satisfactory service under severe conditions of operation proves the superiority of Northern apparatus for industrial work.

Get Bulletin No. 2533.

CHICAGO SALES OFFICE, SUITE 425 MONADNOCK BLOCK
NORTHERN ELECTRICAL MFG. CO., Madison, Wis., U. S. A.
Engineers, Manufacturers. 248E

MICABOND
CHICAGO MICA CO.,
"PERFECTORS" VALPARAISO, IND.
THE PEER OF INSULATORS.

KESTER SELF FLUXING SOLDER

A Tube of Solder Filled with Flux.
Requires no Acid.

SAVES—LABOR—TIME—MONEY.

PATENTED.

Send for Free Samples.

L. F. Mahler Co., R. 1008 Chemical Bldg., St. Louis, Mo., Gen. Western Agent.

KESTER ELECTRIC M'F'G CO.,
48 N. UNION STREET, CHICAGO, ILL.

SINGLE AND POLYPHASE TRANSFORMERS

KUHLMAN ELECTRIC CO., - - Elkhart, Ind.

VOLT - AMMETERS,
POCKET SIZE.

For Testing Batteries and Battery Circuits, Locating Faults, Grounds, etc.
RELIABLE. ACCURATE.
Send for Circular.

L. M. PIGNOLET,
78-80 Cortlandt St., NEW YORK, N. Y.

WANTED

You Who are Troubled with Sparking and Cutting of Commutators to Use

The only article that will PREVENT SPARKING. Will keep the commutator in good condition and PREVENT CUTTING.

Absolutely will Not Gum The Brushes . . .

It will put that high gloss on the commutator you have so long sought after.

50 Cts. per Stick. $5.00 per Dozen.
For Sale by all Supply Houses, or
FREE, Sample Stick.

K. McLENNAN & CO.,
Sole Manufacturers,
Room 411 Inter Ocean Bldg., 130 Dearborn St., CHICAGO, ILL.

MAILED FREE.

A valuable treatise on
STORAGE BATTERIES
for
Private Lighting Plants
together with our catalogue.

COLUMBUS STORAGE BATTERY CO.,
COLUMBUS, OHIO.

Machado & Roller, New York.
Goltz Engineering Co., Chicago.

THE BEST KIND OF INSURANCE FOR TOLL LINES

To be erected on the most exposed parts of the line. They require no attention after erecting.

Minnesota Electric Co.,
MINNEAPOLIS, MINN.

EDISON MINIATURE LAMPS

Dry Battery Lamps

For use in portable lighting devices—electric candle sticks, pocket lanterns, carriage and bicycle lamps, clock lights for bed rooms, ruby lanterns for photography and for optical; dental and surgical instruments.

All types supplied—
Accurately rated—
Carefully selected.

EDISON DECORATIVE & MINIATURE LAMP DEPT.,
General Electric Company, Harrison, N. J.
Chicago Office: Monadnock Block. Sales Office all large cities.

Monitor Bushings

Greatest efficiency at least cost. Absolute protection to wires drawn over conduit ends. Made of one piece of sheet steel and cannot be broken. Enameled insulation. No special tools required to attach. Approved by fire underwriters. Write for bulletin 1002.

BOSSERT
Electric Construction Company
UTICA, N. Y.

FARIES
ADJUSTABLE LAMP HOLDERS, SHADES, PORTABLES, ELECTRIC and COMBINATION FIXTURES

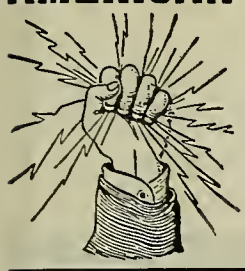
CATALOGUE WILL BE SENT ON REQUEST

FARIES MFG. CO., - DECATUR, ILL.

FRANK N. PHILLIPS, PRESIDENT. C. H. WAGENSEIL, TREASURER. EUGENE F. PHILLIPS, GENERAL MANAGER. E. ROWLAND PHILLIPS, VICE-PRES. C. R. REMINGTON, JR., SEC.

AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.



BARE AND INSULATED ELECTRIC WIRE,

ELECTRIC LIGHT LINE WIRE, INCANDESCENT AND FLEXIBLE CORDS,

Railway Feeder and Trolley Wire,

AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR WIRES.

CABLES FOR AERIAL AND UNDERGROUND USE.

NEW YORK STORE, W. J. Watson, 26 Cortlandt St.
CHICAGO STORE, F. E. Donohoe, 82 Lake St.
MONTREAL BRANCH, Eugene F. Phillips' Electrical Works.

MAIN OFFICES AND FACTORIES, PHILLIPSDALE, R. I.

DO YOU BURY MONEY?

WHY NOT EARN THE INTEREST?

Burying Dead Men is like Burying Money WHEN

STOMBAUGH GUY ANCHORS

ARE SO MUCH MORE INEXPENSIVE AND DO THE WORK BETTER.

SIMPLY SCREW THEM IN—THAT'S ALL.

W. N. MATTHEWS & BRO.

Distributers

603 CARLETON BUILDING ***ST. LOUIS***

EXPERT IN ELECTRICITY MECHANICS PATENT CAUSES **PATENTS**

SOLICITOR OF U. S. & FOREIGN

FORÉE BAIN, 1652-3 Monadnock Blk., CHICAGO

M. KLEIN & SON.

Send 2c stamp for new catalogue No. 6 of

KLEIN'S TOOLS

For Electrical Workers and Line Builders.

MATHIAS KLEIN & SONS.

81 W. Van Buren St., Chicago, Ill.

W. D. PAINT.

A PERMANENT INSULATING PROTECTION FOR WOOD OR METAL. A quick drying, moisture-proofing, black paint. An elastic anti-rust coating. A jet black finishing paint, efficient and not expensive.

Write for "Data on Insulating Materials."

DIELECTRIC MANUFACTURING CO., **SAINT LOUIS.**

THE STATE UNIVERSITY OF IOWA

SCHOOL OF APPLIED SCIENCE, Iowa City, Iowa

Four year courses of the highest grade in

Civil
Municipal
Sanitary
Electrical
Mechanical
Mining

ENGINEERING

Numerous short practical courses. Special courses in technical chemistry, bacteriology, etc. Adequate equipment in shops and laboratories. Waterpower.

University environment. Expenses low.

Address G. E. MacLEAN, President

DON'T BUY ELECTRICAL SUPPLIES

Until you have seen our new Catalogue and new Price List.

Free to the trade.

Manhattan Electrical Supply Co.

NEW YORK: 32 Cortlandt St. CHICAGO: 188 Fifth Ave.

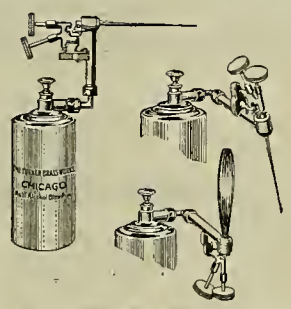
"AMERICAN" STORAGE CELLS

ARE THE BEST. Send for descriptive Circular.

AMERICAN BATTERY CO.,

CATO 1889. 171 S. Clinton St., Chicago

SEE THAT FLAME



IT'S JUST WHAT YOU NEED

for fine soldering for internal wiring and switchboard work, storage battery, lead burning, etc.

The Turner Double Jet Alcohol Blow Pipe No. 10.

Burns wood alcohol and produces a clean non-oxidizing needle pointed or a brush flame of over 3,000 degrees of heat. The burner can be turned in any position. Reservoir 2½ x 5 inches. Capacity ¾ pint. Shipping weight 2 lbs.

No. 10 Alcohol Blow Pipe. $4.50 each.
Express prepaid upon receipt of cash.
DISCOUNT TO DEALERS.

THE **Turner Brass Works**

23 N. FRANKLIN ST., CHICAGO

EDWARDS and Co

Lock Gravity Drop Annunciator.

Extra heavy, well finished case of ornamental design.
The drops being fastened to the back-board, the case may be removed without disconnecting wires.

WESTERN ELECTRIC CO.,
Selling Agents.

NEW YORK N.Y.

Crimshaw

Raven White Core

Raven Black Core

ALL OUR WIRES pass inspection and carry the above **TRADE-MARKS** on our tags. We also manufacture **Crimshaw** and **Competition Tapes** and **Splicing Compounds.**

NEW YORK INSULATED WIRE COMPANY,

MAIN OFFICE: 114, 116 & 118 Liberty St., New York.

BRANCHES: CHICAGO: 192 Desplaines St. BOSTON: 7 Otis St. SAN FRANCISCO: 33 Second St.

NATIONAL CODE STANDARD

WEATHER-PROOF TRADE MARK "O.K." LINE AND HOUSE WIRES

"O. K." Weatherproof Wire.

Slow-Burning Weatherproof and Ideal Wire.

Prices and Samples on Application.

Phillips Insulated Wire Co.

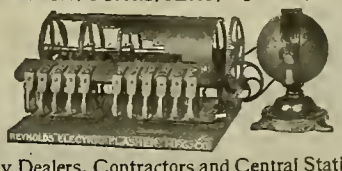
Office and Factory: PAWTUCKET, R. I.

FLASHERS

IMPROVED REYNOLDS FLASHER

For ELECTRIC SIGNS, FLAGS, DISPLAYS, ETC.

The simplest and most practical Flasher on earth.



A Proven Success, Not an Experiment.

Electrical Supply Dealers, Contractors and Central Stations find it very profitable to advocate our Flashers among their patrons.

WRITE US for Flasher information and pointers on electric signs.

REYNOLDS ELECTRIC FLASHER MFG. CO.

221 FIFTH AVE., CHICAGO, ILL.

WANTED, FOR SALE *and similar* **WANT COLUMN** *advertisements (50 words or less), $1.50 an insertion; additional words 3c each.* **POSITION WANTED** *advertisements (50 words or less), $1.00 an insertion; additional words 2c each.*

POSITION WANTED.

By a practical man of 12 years' experience, as superintendent of an electric-light plant in town of 3,000 or more (Michigan preferred). Can put a plant on paying basis. Either municipal or private parties desiring to change men, or who are about to install an electric-light plant, will please address BOX 391, care of Western Electrician, 510 Marquette Bldg., Chicago.

WANTED.

Second engineer; must understand and be competent to operate Corliss engines, condensers, pumps, A. C. generators, motors, etc., One that is reliable, industrious and competent to take first engineer's place if necessary. Send full information as to age, experience, salary expected and references to BOX 392, care of Western Electrician, 510 Marquette Bldg., Chicago.

FOR SALE

Two complete No. 3 Westinghouse Motors in good condition, with two controllers. Will sell one or both motors, also two extra armatures. Will sell cheap if taken at once. Address

THE CITY ELECTRIC SPRINKLER CO.,
Rock Island, Ill.

RECEIVER'S SALE OF LIGHT AND ICE PLANT.

The undersigned, by order of the United States Circuit Court, for the Southern District of Illinois, in the matter of Union Trust Co. of St. Louis, Mo., vs. Chester Light, Water & Ice Co., will on Saturday, October 1st, 1904, at the premises in the City of Chester, Randolph County, Illinois, beginning at the hour of one o'clock p. m. of said day, sell at public sale, the plant of the Chester Light, Water & Ice Co. together with all real estate, machinery, appurtenances and franchises belonging to said Company. Sale to be absolute, free of liens and without right of redemption. Purchaser to receive deed on approval of report of sale by Court.

Terms of Sale, one half cash on day of sale, balance in six months, deferred payment to be secured by note with approved personal security, and mortgage on property sold.

Dated this—— ——day of September, 1904.

DON E. DETRICH, Receiver.

H. CLAY HORNER, Attorney.

WARNING.

The trade is warned against selling or using bushings which infringe upon our Letters Patent No. 687,812, dated December 3, 1901. We have brought suit against the Chase-Shawmut Company under said Letters Patent, and shall enforce our rights, against those who use, and those who sell infringing bushings.

The Bossert Elec'tric Construction Co.,
UTICA N. Y.

REPAIRING RECALIBRATING

ELECTRIC METERS.

INTERNATIONAL ELECTRIC METER CO.
167 S. CANAL STREET, CHICAGO.

FOR SALE.

ALTERNATORS.

1-360 K. W. General Electric 3-phase.
1-120 " " " "
1-75 " Westinghouse 2-phase.

250-VOLT GENERATORS.

1-250 K. W. Western Electric M. P.
1-200 " Eddy M. P.

125-VOLT GENERATORS.

1-125 K. W. Western Electric M. P.

Immediate shipment.

GREGORY ELECTRIC CO.
54-62 S. CLINTON ST. CHICAGO

SAUQUOIT SILK MFG. COMPANY

INSULATING and BRAIDING SILKS

MILLS:
BETHLEHEM, PA.
PHILADELPHIA, PA.
SCRANTON, PA.

NEW YORK REPRESENTATIVES:
WILLIAM RYLE & COMPANY
54 HOWARD STREET

PHILADELPHIA OFFICE:
4015 Clarissa St.
CHICAGO OFFICE:
210 Monroe St.
BOSTON OFFICE:
78 Chauncy St.

"NEW TRAIN SERVICE TO

French Lick and West Baden Springs."

A parlor and dining car now leave Chicago at 12:00 o'clock noon, arrive at the Springs at 8:45 p. m. Leave Springs 9:00 a. m., arrive Chicago 5:55 p. m. Reservations at Monon Route City Office, 232 Clark Street. Telephone Har. 1245.

INDUSTRIES ARE OFFERED LOCATIONS

WITH

Satisfactory Inducements,
Favorable Freight Rates,
Good Labor Conditions,
Healthful Communities,

ON THE LINES OF

THE ILLINOIS CENTRAL R. R.
AND THE
YAZOO & MISSISSIPPI VALLEY R. R.

For full information and descriptive pamphlet address

J. C. CLAIR,
Industrial Commissioner,
1 Park Row, Chicago, Ill.

BOILERS.

One 42-in. x 15 ft. 9-in., 250 H. P. Worthington Water Tube.
One 60-in. x 16 ft., John Mohr Return Tubular Boiler.
One 54-in. x 16 ft., John Mohr Return Tubular Boiler.
One 54-in. x 16 ft., Devine Tubular Boiler.

ENGINES.

One 600 H. P., 21 x 36 x 80, Williams Tandem Horizontal Compound, 140 R. P. M.
Two 600 H. P., 20 x 30 x 24, Porter-Allen Tandem Compound, 200 R. P. M.
One 250 H. P., 12 x 24 x 18 Williams Tandem Compound, 250 R. P. M.
Two 100 H. P., 13 x 12, Dick & Church, High Speed Automatic.

PARTIAL LIST ONLY.

Send for latest Catalogue for bargains in Engines, Boilers, Dynamos and Motors.

CENTRAL STATION IMPROVEMENT CO., 938 Monadnock Block, Chicago

"HIPWELL" ENCLOSED ARC LAMP

"MARVEL OF MECHANICAL SIMPLICITY"

MADE FOR ALL CIRCUITS—DIRECT AND ALTERNATING

SAMPLES SENT ON 30 DAYS' TRIAL—COSTS NOTHING TO TRY THEM.

HIPWELL MNFG. CO.
ALLEGHENY, PA.

Crocker-Wheeler. Brown, Boveri.

By arrangement with the celebrated electrical engineers, Brown, Boveri & Cie. of Baden, Switzerland, the Crocker-Wheeler Company has secured their alternating current designs, patents and rights to manufacture in America, and has retained them as consulting engineers.

Crocker-Wheeler Company is now putting on the market alternating current generators, transformers and accessories of the most perfect design and construction, adapted to American practice. Opportunities to bid on this apparatus are invited.

CHICAGO EDISON COMPANY REPAIR SHOPS

76 MARKET STREET, CHICAGO. TELEPHONE MAIN 1280.

Machine and Carpenter Work of All Kinds Correspondence Solicited.

OPEN DAY AND NIGHT.

FIRST-CLASS EQUIPMENT THROUGHOUT.

Dynamos Armatures, Motors, Arc Lamps, Fans, Instruments.

ARNOLD ELECTRIC POWER STATION Co.
Engineers, Constructors for Complete Electric Plants. Results Guaranteed.
SUITE 1539, MARQUETTE BLDG., CHICAGO. NEW YORK OFFICE: 711 TRANSIT BLDG.

BUTTERFIELD, J. F.
ELECTRICAL ENGINEER AND CONTRACTOR.
Complete Telephone Exchanges Built and Material Furnished.
Cable Construction and Underground Conduit Construction a Specialty.
Room 595, 113 Adams Street, CHICAGO, ILL.

ROBERT W. HUNT & Co.,
ENGINEERS
1121 The Rookery, Chicago. 65 Broadway, New York.
Monongahela Bank Bldg., Pittsburg.
Norfolk House, Cannon St., London.

RUEBEL - SCHWEDTMANN-WELLS,
CONSULTING, MECHANICAL AND ELECTRICAL ENGINEERS,
Suite 801 Chemical Building, ST. LOUIS, U. S. A.

F. B. BADT,
Monadnock, Chicago.

BYLLESBY, H. M. & Co.
(Incorporated)
ENGINEERS
Design, Construct and Operate Railway, Light, Power and Hydraulic Plants.
Examinations and Reports.
New York Life Building, - CHICAGO, ILL.

A WEEKLY REPRESENTATION
in this "Directory" enables engineers to keep before all possible customers.

Long Distance Phone Central 2148.
SCHOTT, W. H.,
ENGINEER AND CONTRACTOR,
SPECIALTIES—Central Station Heating Plants, Water Works Steam Plants, Electric Light, Gas and Street Railway Plants.
1220-21 MARQUETTE BUILDING, CHICAGO.

W. E. BAKER. H. B. BISHOP.
BAKER, W. E. & CO.
ENGINEERS,
ELECTRIC RAILWAYS.
27 William St., NEW YORK.

E. W. Hammer, Pres. and Treas. H. J. Minhinnick, Sec. and Gen'l Sup't.
GENERAL ENGINEERING CO., THE Consulting and Contracting Engineers.
Telephones, Electric Light, Power Transmission
Suite 1112, 135 ADAMS ST., CHICAGO.
Long Distance Telephone Central 478.

KEMP, R. W.
Consulting and Contracting Telephone Engineer.
Plans and Specification for complete plants. Old plants overhauled and placed on paying basis Territory, Kansas, Oklahoma and Indian Territory.
WELLINGTON, - - - KANSAS.

TRY IT.
Keep your name and address in this directory where it will be seen by possible clients.

ENGINEERS
Represented in this "Directory" are enabled to come in touch with many prospective customers who cannot be reached through any other source.

J. H. HALLBERG
Consulting Arc Lighting Expert and Practical Electrical Engineer
45 Broadway - NEW YORK
Room 169A

KOHLER BROS.,
Contracting Electrical Engineers, Lighting Power Railways,
1804-1806-1808-1810-1812 Fisher Building, CHICAGO.

SQUIRE ELECTRIC CO.
Engineers and Contractors
113 E. Eighth St., KANSAS CITY, MO.
Consulting, Designing and Supervising Engineers.
Plans and Specifications Furnished.

BRYAN, WILLIAM H.
M. Am. Soc. M. E.,
Consulting Mechanical and Electrical Engineer.
Lincoln Trust Building, ST. LOUIS.

HORNADAY, J. P. & Co.
SUITE 1108 TRACTION BUILDING
CINCINNATI, O.
WATERWORKS, ELECTRIC RAILWAY, LIGHT, TRACTION, INDUSTRIAL AND MINERAL PROPERTIES BOUGHT AND SOLD

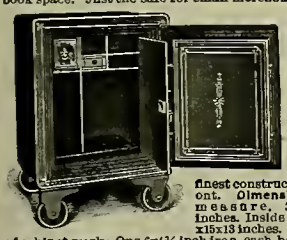
McLAUGHLIN, JAMES
CONSULTING
ARC LIGHTING EXPERT,
PRACTICAL ELECTRICAL AND MECHANICAL ENGINEER,
53 RIVER ST., - CHICAGO, ILL.

STANTON, LE ROY W.
Consulting Telephone Engineer.
Plans, Specifications and Supervision of Installation of complete telephone plants.
Special Reports on Telephone Properties and Apparatus.
411 Electrical Bldg., Cleveland, Ohio.

DUGALD C. JACKSON, C. E.
WILLIAM B. JACKSON, M. E.
MEMBERS
AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS
AMERICAN SOCIETY OF MECHANICAL ENGINEERS
AMERICAN SOCIETY OF CIVIL ENGINEERS
ENGINEERS. EXPERTS.
MADISON, WIS.

$11.95 FIREPROOF SAFE.

$11.95 buys this 300-pound guaranteed Fireproof Safe, highest grade, heavy wrought steel continuous plate construction, fitted with genuine Yale triplex 3-tumbler combination lock; best workmanship throughout, positively the equal of safes that sell at $20.00 to $25.00. Dimensions: outside, 24x14¾x16¾ inches; inside, 12x5¾x9 inches. Has one 5x4-inch cash box with fine lock; one 3x4-inch drawer; one 3¾x4-inch pigeonhole; one 12x3¾-inch book space. Just the safe for small merchants and offices.



$23.95 BUYS THIS 675-POUND HIGHEST GRADE FIREPROOF SAFE (guaranteed). Equipped with genuine Yale unpickable, triplex, combination lock; finest construction throughout. Dimensions: Outside measure, 37¾ x 24 x 22¾ inches. Inside measure, 29¾ x15x15 inches. Arrangement of cabinet work: One 6x4¾-inch iron cash box with high grade lock, with two flat keys; one 3x4¾-inch drawer with knob, two 2¾x4¾-inch pigeonholes; one 3x4¾-inch pigeonhole; one large book space, 14¾x9¾ inches; one small book space, 14¾x4¾ inches. **A BIG BARGAIN FOR ANY STORE, OFFICE, FACTORY, SHOP OR HOTEL.**

We will letter your name or firm name in gold over door free of charge if requested. You can send us your order for either one of these safes with the understanding that we will return your money and pay freight charges both ways if you are not pleased or do not consider you have received a wonderful bargain and saved about one-half in price.

For large illustrations and descriptions of our complete line of safes, including our massive heavy wall single and double door safes at $15.60 up to $102.00, for detailed explanation of our method of fireproofing, heavy construction, how we make our safes heavier, stronger and better than others, how we can sell the highest grade safes it is possible to build for about one-half the prices all other dealers ask, for our great 30-day free trial offer, explanation of our binding guarantee, our money refund offer, for freight rates, for our liberal terms of shipment, write for our Free Safe Catalogue. Cut this ad. out and mail to us and the complete SAFE CATALOGUE and our WONDERFUL MONEY SAVING SAFE PROPOSITION WILL BE SENT BY RETURN MAIL. Address,

SEARS, ROEBUCK & CO., Chicago, Ill.

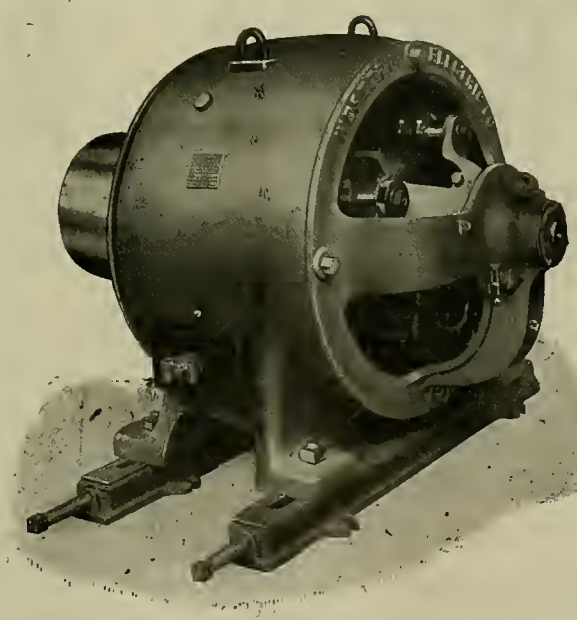
Points in Wisconsin and the Northwest

are covered by Wisconsin Central Railway's convenient, solid, wide vestibuled trains, equipped with Pullman sleepers, free reclining chair cars and modern coaches which leave Central Station, 12th Street and Park Row (Lake Front), Chicago for St. Paul, Minneapolis, Ashland and Duluth, connecting with all western lines. Meals in dining and cafe cars served a la carte.

For tickets and further information apply to nearest ticket agent, or write

JAS. C. POND, Gen'l Pass. Agt., Milwaukee, Wis.

ESTABLISHED
1894
AMERICAN ELECTRICAL HEATER CO.
DETROIT, MICH.



DIRECT CURRENT
Generators and Motors
Western Electric Company
CHICAGO NEW YORK
And Other Large Cities
Space 17, Electricity Building, Louisiana Purchase Exposition

WE BUY OLD BELTS
OR SCRAPS, ANY SIZE OR CONDITION.
WE CLEAN, REPAIR AND RENEW OLD BELTS.
LEATHER PRESERVER MFG. CORP.
27 W. MONROE ST., CHICAGO.

"QUOTATIONS ON THE SPOT"

That is what we call our new and complete hand-book of switchboards.

Ask for 117 W

WE BUILD SWITCHBOARDS

THE F. BISSELL COMPANY
MANUFACTURERS AND JOBBERS OF
ELECTRICAL GOODS
226-228-230 HURON STREET
TOLEDO, O.

WAGNER ELECTRIC MFG. CO. will be glad to see all its friends at its

World's Fair Headquarters

Block No. 9. Electricity Building

and cordially invites them to make its General Offices their headquarters at such times as they find themselves in the city. At the Fair we would be glad to have you inspect our exhibit of machine tools, organ blowers, dough mixers, and ventilating fans as driven by our single-phase motors, together with the various other forms of apparatus we manufacture.

At our General Offices we will provide stenographic and other facilities for the prompt disposition of your personal business matters and will be glad to do all in our power toward furthering the general enjoyment of your stay in St. Louis.

Wagner Electric Mfg. Co.

2017 Locust Street, St. Louis, Mo.

ELECTRICAL BOOKS

Make your book purchases from the only large stock of electrical books carried in the West. Prompt shipments guaranteed. If you do not find what you want in the following list, write for complete and up-to-date book catalogue.

	Price.
Webb's Telephone Hand Book, cloth binding	$1.00
Badt's New Dynamo Tender's Hand Book, cloth binding	1.00
Badt's Incandescent Wiring Hand Book, cloth binding	1.00
Badt's Bell Hanger's Hand Book, cloth binding	1.00
Badt's Electric Transmission Hand Book, cloth binding	1.00
Dobb's The Inspector and Trouble Man, cloth binding	1.00
Steven's Mechanical Catechism, cloth binding	1.00
Hawkins' Catechism of Electricity, leather binding	2.00
Practical Electricity, leather binding	2.00
Thompson's Polyphase Electric Currents, cloth binding	3.50
Varley's Electro-Magnet, cloth binding	1.00
Buckley's Electric Lighting Plants, cloth binding	2.00
Haskins' Electricity Made Simple, cloth binding	1.00
Haskins' Transformer, cloth binding	1.25
Houston's 2-volume Electrical Dictionary, half leather, very cheap, half price	6.00
Watson's Electrician's Handy Book, cloth binding	2.50
Trevert's Armature and Magnet Winding, cloth binding	1.50
Trevert's How to Build Dynamo Electric Machinery, cloth binding	2.50
Trevert's Experimental Electricity, cloth binding	1.00
Trevert's Electricity for Students, cloth binding	1.00
Trevert's Electric Railway Engineering, cloth binding	2.00
Allsop's Bell Construction, cloth binding	1.25

	Price.
Trevert's Electrical Measurements for Amateurs, cloth binding	$1.00
Allsop's Telephones, Their Construction and Fitting, cloth binding	1.25
Allsop's Bell Fitting, cloth binding	1.25
Allsop's Induction Coils, cloth binding	1.25
Bell's Electric Power Transmission, cloth binding	3.00
Bell's Distribution for Electric Railroads, cloth binding	2.50
Cushing's Standard Wiring for Electric Light and Power, leather binding	1.00
Hanchett's Modern Electric Railway Motors, cloth binding	2.00
Houston & Kennelly's Electric Transmission of Intelligence, cloth binding	1.00
Houston & Kennelly's Electrical Measurements, cloth binding	1.00
Houston & Kennelly's Electric Heating, cloth binding	1.00
Houston & Kennelly's Electric Arc Lighting, cloth binding	1.00
Houston & Kennelly's Electric Motor, cloth binding	1.00
Houston & Kennelly's Electric Street Railways, cloth binding	1.00
Houston & Kennelly's Electric Telegraphy, cloth binding	1.00
Houston & Kennelly's Electro Therapeutics, cloth binding	1.00
Houston & Kennelly's Electricity Made Easy, cloth binding	1.50
Merill's Electric Light Specifications, cloth binding	1.50
Wiener's Dynamo Electric Machines, cloth binding	3.00

ANY OF THE ABOVE BOOKS SENT PREPAID ON RECEIPT OF PRICE.

ELECTRICIAN PUBLISHING CO.

SUITE 510 MARQUETTE BUILDING, CHICAGO.

BOILER WATERS CORRECTED

to remove and prevent scale and to stop corrosion. DEARBORN TREATMENT does the work. Send gallon sample for analysis. Booklet "R" now ready.

DEARBORN DRUG & CHEMICAL WORKS,

27-34 RIALTO BUILDING, CHICAGO, ILL. WM. H EDGAR, President Telephone: Harrison 3930 and 3931.

Dixon's Traction Belt Dressing *Has a 27 Years' Record* in restoring and preserving the clinging power of leather belts. Descriptive booklet 175 and sample upon request.

JOSEPH DIXON CRUCIBLE CO., JERSEY CITY, N. J.

REG. TRADE MARKS

"Phosphor Bronze" DELTA

THE PHOSPHOR BRONZE SMELTING CO. LIMITED, 2200 WASHINGTON AVE., PHILADELPHIA.

"ELEPHANT BRAND PHOSPHOR-BRONZE" INGOTS, CASTINGS, WIRE, RODS, SHEETS, ETC.

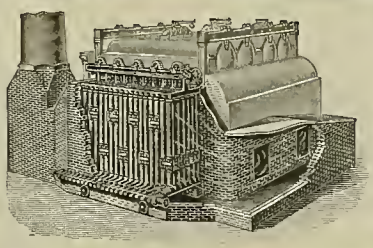
— DELTA METAL —

CASTINGS, STAMPINGS AND FORGINGS

ORIGINAL AND SOLE MAKERS IN THE U.S.

Steam Gained——Fuel Reduced

GREEN'S ECONOMIZER

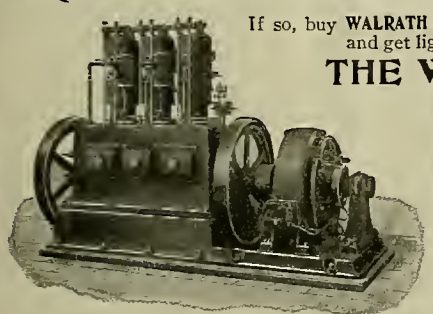


Installed in any Electric Light and Power Plant produces this result. Its not a long story—simply utilizing waste gases—keeping feed-water heated above the evaporative point—saving 10 to 20% on coal bill. Additional advantages in our free booklet, which your engineer could explain to your satisfaction. Simply address

The Green Fuel Economizer Co.

MATTEAWAN, N. Y. Sole Manufacturers in the U. S.

ARE YOU LOOKING FOR MONEY?



If so, buy WALRATH GAS OR GASOLINE ENGINES and get light on the subject.

THE WALRATH

Received the Highest Award at the Pan-American Exposition.

It will produce as good a commercial light as that of an automatic steam engine, either belted or direct-connected generator. Simple, Economical and Reliable

Send for Catalogue W.

MARINETTE GAS ENGINE CO.,

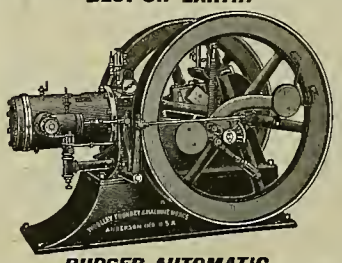
CHICAGO HEIGHTS, ILL.

AGENCIES:

Keystone Engineering Co., Farmer's Bank Bldg., Pittsburg, Pa.
Strong, Carlisle & Hammond Co., 61-67 Frankfort St., Cleveland, Ohio
Mackay Engineering Co., 149 Broadway, N. Y.
C. H. Seidenglanz, 52 When Bldg., Indianapolis, Ind.

JEFFREY DETACHABLE STEEL ROLLER SPECIAL **CHAINS** FOR CATALOGUE, ADDRESS THE JEFFREY MFG. CO COLUMBUS, OHIO.

BEST ON EARTH.



BURGER AUTOMATIC.

For Electric Work

REGULATION AND ECONOMY OF FUEL UNSURPASSED.

WRITE FOR CATALOGUE H

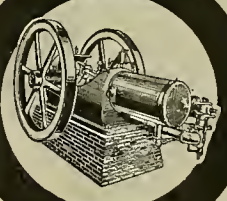
Then compare it with some Gas Engine hand books that cost $1.00.

Woolley Foundry & Mach. Works

Box 400, Anderson, Ind. U. S. A.

Watson Motors

If you want a small motor for a special purpose—Write us—Mechanical Appliance Co—Milwaukee—Wis.



Olds Gas and Gasoline Engines

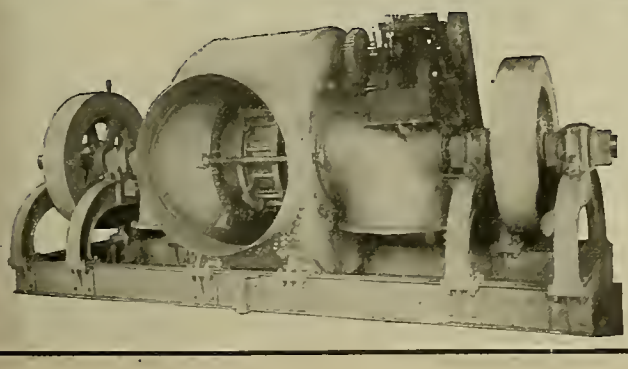
are strong and simple in construction. Parts are few and easily understood. Olds engines can be readily operated by any man of ordinary intelligence without previous experience. Repairs, though seldom necessary, can be quickly and economically made.

Stationary Engines - - 2 to 100 H. P.
Portable Engines - - 8 to 18 H. P.

For complete information and new illustrated catalog write

OLDS GASOLINE ENGINE WORKS

252 River Street - - - Lansing, Mich.



SAMSON TURBINE

A gain of 3% in EFFICIENCY means 3 H. P. additional in each 100 H. P. You can soon figure out what this would amount to at the end of the year. Very HIGH EFFICIENCY at all gateages is one of the strong points in a SAMSON TURBINE.

JAMES LEFFEL & CO.

Write Department D for Catalogue. SPRINGFIELD, OHIO, U. S. A.

Encourage Shop Keepers

To Install Electric Lights.

BY DISPLAYING OUR SELF-PROPELLING, COLOR-REFLECTING SHOW LIGHT

you not only advertise your own business but promote their use among shop keepers, thus getting new users of current.

LASTS A LIFETIME. ONE INCANDESCENT GLOBE OPERATES IT WITHOUT FURTHER ATTENTION.

DESCRIPTION

Before an artfully constructed large concave mirror-reflector a beautiful globe covered with magnificent stones in different colors is supported on chains by a fan-wheel, which runs with its steel point in a jewel knob. The light has its place in the center of the globe, wonderfully glittering and shining through the colored stones and the skillfully placed openings in the metal parts of the globe. The heat from the electric bulb light brings the fan-wheel into rotation and the globe revolves around the light. The whole mirror-screen is covered with the reflecting of the bright stones, always changing colors.

The whole effect is one of such unspeakable beauty that no picture is able to give a description of it; the colors move like in a kaleidoscope, but have such a splendor that every comparison is displaced.

Price $25 Each Special Price for Large Quantities

H. M. GLOGAU & CO.
40 DEARBORN STREET CHICAGO

INTERNATIONAL

Mechanical Self-Restoring Drop Switchboard.

A PERFECT APPARATUS.

Made in any desired capacity.
Sample parts and quotations on request.

INTERNATIONAL TELEPHONE MANUFACTURING CO.
CHICAGO, U. S. A.

IMPORTANT TELEPHONE BOOKS.

THE TELEPHONE HANDBOOK. By Herbert Laws Webb. 16mo, 150 pp. Price $1.00.
This handbook is a reliable treatise on telephony, and a practical book on telephone working and management, based entirely on standard American practice. It is extremely useful to telephone inspectors and operators.

AMERICAN TELEPHONE PRACTICE. By Kempster B. Miller, M. E. 510 pp. 380 illustrations. Price $3.00.
This is the first complete treatise on telephony in the English language. The text is profusely illustrated by cuts of commercial apparatus and carefully prepared diagrams of circuits. No diagram is given without a full explanation. The apparatus, circuits and methods of the American Bell Telephone Company and of the various independent companies are fully described. The apparatus and methods used in making all of the tests required in commercial telephone work are fully treated.

THE INSPECTOR AND TROUBLE MAN. By A. E. Dobbs. 106 pp. Price $1.00.
A practical book, written in plain language. Full of information and diagrams for the operator, exchange manager, inspector, trouble man and lineman. A complete description of telephones, how to find and remedy their troubles, together with working plans for exchange construction, complete with diagrams of all up-to-date telephones and switchboards.

A, B, C, OF THE TELEPHONE. By J. E. Homans, A. M. 352 pp. 269 illustrations. Price $1.00.
Owing to the demand for a comprehensive book giving a clear, terse idea of the principles governing the construction, installation, care and management of telephones and their appliances, this book has been compiled. It has been the aim of the author to make this the most complete elementary book on the subject for the practical electrician, wireman, lineman and engineer, and it is written in a clear and careful style.

THE PRACTICAL TELEPHONE HANDBOOK. By Joseph Poole, A. I. E. E. Second edition, revised and enlarged. 360 pp. 288 illustrations. Price $1.50.
In this work the writer has endeavored to produce a manual of moderate size and cost, but thoroughly practical, and detailing, as far as space will allow, the most recent methods of telephone working. While the requirements of telephone employes have been kept constantly in view it is fully intended also that the book shall be of service as a source of information on telephonic matters to users of the telephone and to the public generally.

PRACTICAL FEATURES OF TELEPHONE WORK. By A. E. Dobbs. 134 pp. Price 75 cents.
A simple, plain-speaking handbook for the practical telephone man.

TELEPHONE TROUBLES AND HOW TO FIND THEM. A complete handbook for telephone inspectors. By W. Hyde and J. H. McManman, edited by Prof. C. H. Haskins. Eighth edition. 16mo, 48 pp. Price 25 cents.
This little volume is an extremely practical work for telephone employes, written in a popular style and devoid of technicalities.

TELEPHONE LINES AND THEIR PROPERTIES. By Wm. J. Hopkins. Sixth edition. 272 pp. Illustrated. Price $1.50.

A MANUAL OF TELEPHONY. A new and large edition. By W. H. Preece, F. R. S., and A. J. Stubbs. 508 pp. 333 illustrations. Price $4.50.

TELEPHONES, THEIR CONSTRUCTION AND FITTING. A Practical Manual on the Fitting Up and Maintenance of Telephone and Auxiliary Apparatus. By F. C. Allsop. 191 pp. 168 illustrations. Price $1.25.

PATENTED TELEPHONY. A Review of the Patents Pertaining to Telephones and Telephonic Apparatus. Published by the American Electrical Engineering Association. Cloth bound; fully illustrated. Price, $1.50.

THE ELECTRIC TELEPHONE. By E. J. Houston, Ph. D., and A. E. Kennelly, Sc. D.; 12mo, cloth, 422 pp., 142 illustrations. Price $1.00.

HOW TO MAKE AND USE THE TELEPHONE. By Geo. H. Cary. 136 pp.; illustrated. Price $1.00.

The Above, or Any Other Electrical Work Published, Sent on Receipt of Price.

ELECTRICIAN PUBLISHING CO., 510 MARQUETTE BLDG., CHICAGO.

THE PLACE TO GET A HOME

IS

MONTANA IDAHO OR WASHINGTON OREGON

THE WAY

via

NORTHERN PACIFIC

THE TIME

SEPTEMBER 15 to OCTOBER 15

VERY LOW RATES

ONE-WAY COLONIST TICKETS

FREE GOVERNMENT and LOW PRICED RAILWAY LANDS

Good for Fruit, Grain, Dairying and Poultry. Fine Summer and Winter Climate

Splendid Schools and Churches

Regarding Rates and Train Service write to
A. M. CLELAND,
General Passenger Agent, N. P. R.
ST. PAUL, MINN.

For Information and Maps write to
C. W. MOTT,
General Emigration Agent, N. P. R.
ST. PAUL, MINN.

"Practical and to the Point"

IS ALL THAT NEED BE SAID OF

THE TELEPHONE HAND-BOOK

By Herbert Laws Webb.

160 Pages, 133 Illustrations, Cloth, Price $1.00.

The book for those interested in telephony.

ELECTRICIAN PUBLISHING CO.,
510 Marquette Bldg.,
CHICAGO.

DERIVATION OF

Practical Electrical Units.

BY

LIEUT. F. B. BAOT and PROF. H. S. CARHART.

PRICE, POSTAGE PREPAID, 75c.

This is a very handsome book of 60 pages, printed on fine heavy paper, with neat cloth binding. It contains Portraits and Biographies of Ohm, Watt, Faraday, Joule, Gauss, Weber, Sir William Siemens, Dr. Werner von Siemens, Volta, Ampere, Daniell, von Jacobi, together with a carefully prepared table of the Practical Electrical Units, with their relative values.

In no other Single Volume can this Rare Collection of Portraits be Found.

Electrician Publishing Company,
510 Marquette Building, - CHICAGO.

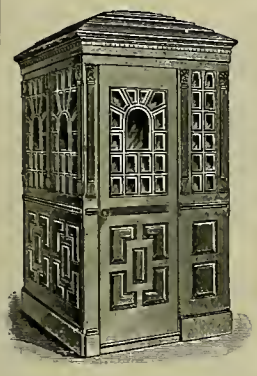
TELEPHONE BOOTHS

When in want of the Right Kind write us.

Catalogue Free

Yesbera Mfg. Co.
TOLEDO, OHIO.

DO YOU KNOW that



Telephone Booths

have increased the receipts (where exposed telephones had previously been in use) *sufficiently* to pay the cost of the booths within the first thirty days? SPECIAL PRICES to demonstrate what booths will do for you.

WRITE FOR CATALOG

W. S. SEAMAN & CO.
216 E. WATER ST., MILWAUKEE, WIS.

BITUMINIZED FIBER CONDUIT

FOR UNDERGROUND CONSTRUCTION

Combines the **good features** of other conduits.
Eliminates the **bad features** existing in many kinds.
Has valuable features not found in any other ducts.

Made in 7-foot lengths with male and female joints, making construction very rapid and simple, with consequent low cost

Alignment is perfect and permanent without tedious care and skill required in laying of butt-joint conduits.

Users are astonished by the ease and rapidity with which cables can be drawn in, and this without the slightest scratching or injury to the lead covering thereof.

Made in sizes from 1-inch to 10-inch diameter.

Bends of any radius and any angle.

Write us for further information and prices, stating sizes and quantities required.

American Conduit Co.
Main Offices: 1005-6 Manhattan Building, Chicago
Other Offices:
170 Broadway, New York. 336 Macy St., Los Angeles

MECHANICAL

Engineers interested in electricity should send for our complete Catalogue (mailed free to any address). Any electrical book published sent prepaid on receipt of price.

ELECTRICIAN PUBLISHING CO., - 510 Marquette Bldg., Chicago.

Motor Starter with Automatic Release. Manufactured under our own patents.

MOTOR STARTERS, SPEED REGULATORS, FIELD REGULATORS

And Special Controlling Devices of all kinds. Send for catalogue and discounts.

UNION ELECTRIC MFG. CO.,
Milwaukee, Wis.

ALL TOGETHER—EVERYBODY

Meet Me In St. Louis Meet Me At The Fair
Close The Exchange
Bring The Linemen and The Operators

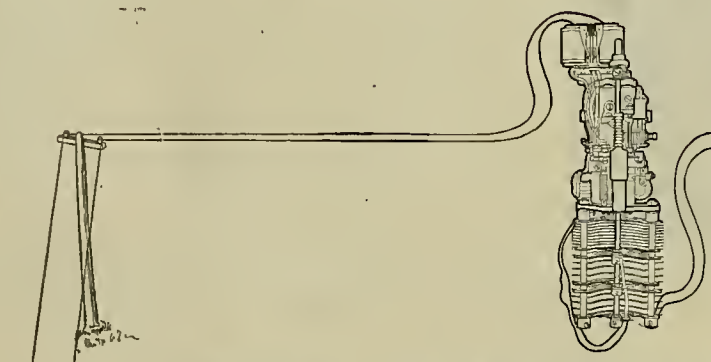
NATIONAL INDEPENDENT TELEPHONE ASSOCIATION CONVENTION, SEPTEMBER 21st and 22nd

WELCOME TO DELEGATES

Use our booth, section 23, Electricity Building, as your headquarters. Have your mail addressed care of booth and use our stenographer for dictating replies. Quench your thirst and see the best line of telephone apparatus and supplies in the U. S. at section 23, Electricity Bldg.

DON'T FAIL TO VISIT OUR NEW FACTORY

CENTRAL TELEPHONE AND ELECTRIC CO.
N. E. CORNER 22ND AND LUCAS AVE., ST. LOUIS



THE POSSIBILITIES OF AUTOMATIC TELEPHONY

are strikingly demonstrated by the equipments we have installed in the cities named below and in our working exhibit at the St. Louis World's Fair, Section 24, Palace of Electricity.

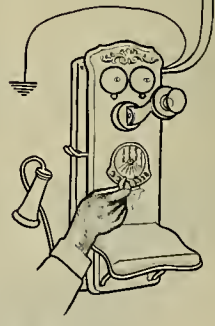
We have installed there two complete Automatic Telephone Exchanges of the 10,000 type, each having 100 stations.

Ours is the only perfect working, absolutely Automatic Telephone System, adaptable to any size exchange, that has been adopted and is in general use in this or any other country. It has long since passed the "trying-on" stage and when you buy our system you invest your money in experience, not in experiments. Our system is rapidly being adopted by progressive Independent Telephone Companies to replace manual boards and is proving profitable to the operating companies, and satisfactory to the patrons.

Among the principal places where it has been adopted are

Chicago, Ill.	Sioux City, Iowa.
Grand Rapids, Mich.	Cleburne, Texas.
Columbus, Ohio.	Columbus, Ga.
Dayton, Ohio.	Augusta, Ga.
Lincoln, Neb.	Medford, Wis.
Portland, Maine.	St. Mary's, Ohio.
Auburn, New York.	Woodstock, N. B.
Lewiston, Maine.	Westerly, R. I.
Auburn, Maine.	Manchester, Iowa.
Fall River, Mass.	Princeton, N. J.
New Bedford, Mass.	Albuquerque, N. M.
Los Angeles, Cal.	Battle Creek, Mich.
San Diego, Cal.	Van Wert, Ohio, and
Hopkinsville, Ky.	Berlin, Germany.

You are cordially invited to inspect our exhibition exchange at the World's Fair. It will be well worth your while. If you cannot do so, write to us for information.



AUTOMATIC ELECTRIC COMPANY,

CHICAGO, U. S. A.

TELEPHONE PRINCIPLES AND PRACTICE

A NEW BOOK IN TELEPHONY

By

GEORGE WALKER WILDER, PH. D.

Professor in Telephony in the Armour Institute of Technology

Complete and up-to-date, written by a practical man. All about modern telephone apparatus, their principles and use:

I. Fundamental Ideas
II. Telephone Apparatus
III. Systems of Communication
IV. Construction and Equipment

IN 32 CHAPTERS, 450 PAGES, 375 ILLUSTRATIONS. PRICE $2.00 POSTPAID.

Send Postal Money Order to

THE CANTWELL PRESS - Madison, Wis.

We introduced successful 4-party lines

LEICH SELECTIVE SYSTEM

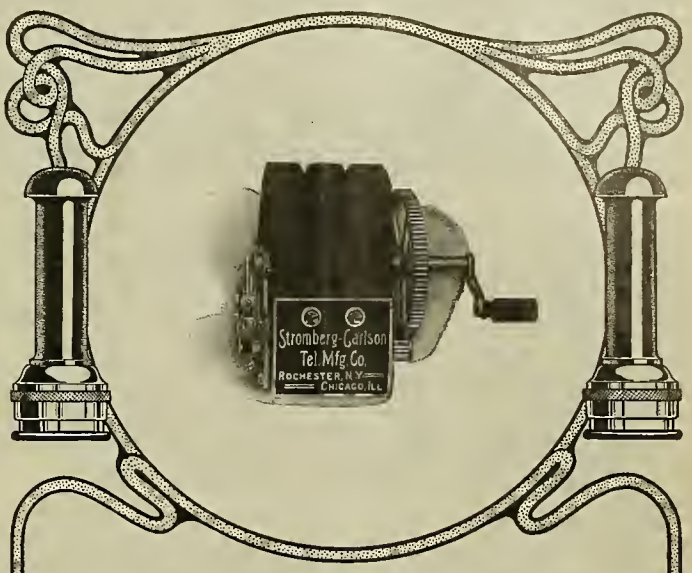
Write for our booklet—"Selective W."

CENTRAL ENERGY OR MAGNETO

Impedance Coil for Selectives. No Springs.

AMERICAN ELECTRIC TELEPHONE CO.

CHICAGO, ILLINOIS



Standard three-bar generator, same as used in our series telephones. We have manufactured generators since we first started in business. What this experience means to you enables us to sell the best generator made at a price slightly above the ordinary. The difference is caused by the better grade of material used and the superior workmanship.

You pay nothing for our experience. Our Bulletin No. 11-E explains fully this apparatus. Mailed free.

Stromberg-Carlson Telephone Mfg. Co.

GENERAL AND EASTERN OFFICE
ROCHESTER, N. Y.

SALES DEPT.
CHICAGO, ILL.

"JUST AS GOOD AS KELLOGG APPARATUS"

cannot be bought outside our factories for the same price we ask—for a higher price or for a lower price.

Our customers never think Kellogg prices high.

We are quoting attractive magneto prices. Write us for quotations on everything in the magneto line.

Send for our new bulletins Nos. 8 to 13.

Do not miss visiting the Kellogg exhibit at the St. Louis Exposition, Electricity Building.

KELLOGG SWITCHBOARD & SUPPLY COMPANY

GREEN AND CONGRESS STREETS, CHICAGO

ELECTRIC BUILDING, CLEVELAND

KEYSTONE TELEPHONE BUILDING, PHILADELPHIA

PRODUCERS AND WHOLESALERS OF WHITE CEDAR PRODUCTS

CEDAR POLES

SPECIAL PRICES ON SMALL POLES.
Write for a copy of our TELEGRAPH CODE FOR CEDAR PRODUCTS

YARDS
KOSS MICH.
L'ANSE "
MUNISING "
ONTONAGON
WAGNER, WIS
PESHTIGO "

C. H. WORCESTER CO.
SUITE 1206 TRIBUNE BLDG. CHICAGO.

Cedar TORREY CEDAR CO., CLINTONVILLE, WIS. Poles
Large Stock Constantly on Hand

BRACKETS—X ARMS—PINS
little things it is true, but they cut a big figure in line construction.
OUR MOTTO IS:
Prompt Shipment Quality Satisfaction Right Price
COLUMBIA MFG. CO. ANTIGO, WIS.

Cedar Poles.
Pittsburg and Lake Superior Iron Co. Producers and Wholesalers. Escanaba, Mich.

"The Nation's pleasure ground and sanitarium,"—*David Bennett Hill.*

THE ADIRONDACK MOUNTAINS.

The lakes and streams in the Adirondack Mountains are full of fish, the woods are inviting, the air is filled with health, and the nights are cool and restful. If you visit this region once, you will go there again. An answer to almost any question in regard to the Adirondacks will be found in No. 20 of the "Four-Track Series," "The Adirondack Mountains and How to Reach Them;" issued by the

NEW YORK CENTRAL

A copy will be mailed free on receipt of a two-cent stamp, by George H. Daniels, General Passenger Agent, Grand Central Station, New York.

CEDAR POLES
ESTABLISHED 1862
WM. MUELLER COMPANY
1211-12-13 MARQUETTE BLDG. CHICAGO.
EIGHT DISTRIBUTING YARDS

Poles and Ties

TRADE MARK
The Fowler Companies
Fisher Bldg. Chicago

Standard Vitrified Conduit Co.

B. B. BARNARD, Manager
39-41 CORTLANDT ST.
NEW YORK

LARGEST FACTORIES IN THE WORLD : STOCK ON HAND
SEND FOR CATALOGUE

The Electrician Publishing Co., Suite 510 Marquette Building, Chicago. Headquarters for all latest Electrical Books. Write for Catalogue.

STUDENTS
Will find that the WESTERN ELECTRICIAN can help them wonderfully in the study of electricity. Subscribe now.
$3.00 per year, in advance.
Electrician Publishing Co.,
Suite 510 Marquette Bldg., - CHICAGO

Southern Cedar POLES Are the Best.
NO ROTTEN BUTTS.
D. W. PHELAN,
277 Broadway, New York

Locations for Industries
Erie Railroad
Chicago to New York

The Erie Railroad Company's Industrial Department has all the territory traversed by the railroad districted in relation to resources, adaptability, markets and advantages for manufacturing, and can advise with manufacturers in relation to the most suitable locations. For full information address

LUIS JACKSON
Industrial Commissioner, Erie Railroad Company
21 Cortlandt Street, New York

CENTRAL STATION HEATING

We are the originators and builders of the underground system of live and exhaust steam heating. Our system is used for the utilization and distribution of exhaust steam from electric and power plants for heating purposes. 250 Plants in successful operation. We have the only Meter System. Also manufacturers of Wooden Water Pipe, Steam Pipe Casing, Steam Traps, Condensation Meters, Valves, Economizing Coils, Separators and full line of Steam Fitters' Supplies.

WRITE FOR PAMPHLET AND PRICE LIST

AMERICAN DISTRICT STEAM COMPANY
MENTION WESTERN ELECTRICIAN. LOCKPORT, N.Y. CHICAGO, ILL.

MICHIGAN WHITE
LARGE STOCK.
CEDAR POLES
PROMPT SHIPMENTS.
KELLOGG SWITCHBOARD & SUPPLY CO., Chicago.

We can't help referring to our exceptional facilities for handling rush orders of either Poles or Ties.

There are very few firms situated as we are, and still fewer that handle both Poles and Ties in the same large quantities.

Get our prices and see what we can do for you.

MALTBY CEDAR COMPANY, 509 Phoenix Block, Bay City, Mich.
Pittsburg Agents, Tipper & Patton, 509 Beasemer Bldg.

POLES W. C. STERLING & SON, MONROE, MICH. **TIES.**
Eleven Pole Yards in Michigan.
Wholesale Producers for 20 years.

WHITE CEDAR POLES
HALL L. BROOKS
52 WISCONSIN AVENUE
TOMAHAWK, WIS.

Idaho Cedar Poles
PACIFIC COAST POLE CO. SPOKANE, WASH.

POLES, TIES, POSTS.
THE PORTER CEDAR CO., SAGINAW, MICH.
PRODUCERS. We want your inquiries always.

MICHIGAN AND WESTERN **CEDAR POLES**
ALL LENGTHS AND SIZES
LINDSLEY BROS CO.
TRIBUNE BLDG., CHICAGO

You don't have to

use any augers, wrenches, or other special tools to install a Crouse-Hinds Harpoon Guy Anchor.

You simply drive it in with a 12 pound sledge, 30 or 40 blows will do it.

WRITE US FOR CIRCULAR AND PRICES.

CROUSE-HINDS COMPANY,
133 S. CLINTON STREET, - - - - CHICAGO, ILL.

POLES. WHITE CEDAR. IDAHO CEDAR up to 80 ft.
BERTHOLD & JENNINGS, ST. LOUIS. Chemical Building.
CROSS ARMS. LONG LEAF PINE AND FIR.

WHITE CEDAR POLES
Don't forget our Minnesota Transfer Yard—midway between St. Paul and Minneapolis, where we load in forty-eight hours from the time we have your order.
PAGE & HILL CO. 1003 Lumber Exchange, MINNEAPOLIS, MINN.

WORKS QUICK AND EASY. KEEPS ITS LUSTER. HOLDS OLD TRADE AND MAKES NEW. DOES NOT DETERIORATE. ESTABLISHED 15 YEARS. SOLD BY AGENTS AND DEALERS ALL OVER THE WORLD
U.S. METAL POLISH 3 OUNCE BOX 10 CENTS. SAMPLES SENT FREE
POLISHES ALL METALS. BRANCHES NEW YORK, CHICAGO, SAN FRANCISCO. GEO. W. HOFFMAN 295 E. WASHINGTON ST. INDIANAPOLIS, IND.

TELEPHONE POLES
Yards at Red Cliff, Wis., Aitkin, Feeley, Cohasset, Deer River, Tenstrike and Black Duck, Minnesota.
Large stocks. Prompt shipments. Carefully inspected stock at low prices.
J. W. MORRISON LUMBER CO., 918-19 Lumber Exchange MINNEAPOLIS, MINN.

TYPE E.

ALTERNATING CURRENT.

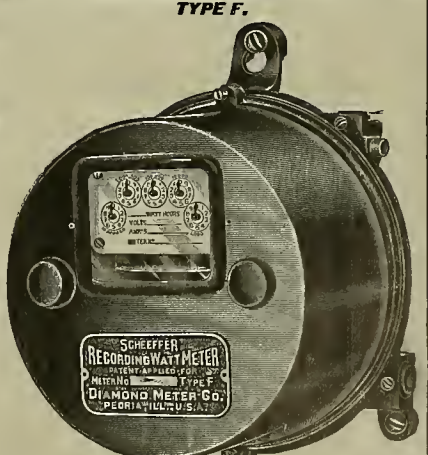
SCHEEFFER INTEGRATING WATTMETER
Type E for Alternating Current — Type F for Direct Current Circuits

DUST AND BUG PROOF
IMPROVED CONSTRUCTION

MOVING PARTS ARE EXTREMELY LIGHT, INSURING A HIGHLY SENSITIVE AND ACCURATE METER.

WRITE FOR PRICES AND DESCRIPTIVE LITERATURE.

DIAMOND METER COMPANY,
PEORIA, ILL., - - - - U. S. A.

TYPE F.


DIRECT CURRENT.

MICHAEL FARADY
AND
JOSEPH HENRY

are credited with the discovery of electro-magnetic induction and the Duncan Electric Manufacturing Company is assigned the honor of discovering the "Visual" bearing for integrating wattmeters which permits of the spindle point and jewel being examined while the meter is in operation.

The Duncan Direct Current Wattmeter is the only one of its type that embodies the very latest ideas in the meter art and is recognized as the *Standard* by which all others are judged. Its extreme accuracy is universally admitted; its up-to-date features unapproached and its record for permanency and reliability has never been questioned.

Send for Descriptive Bulletin.

Duncan Electric Manufacturing Co.,
LA FAYETTE, INDIANA.

"WOOD SYSTEMS" FORT WAYNE ELECTRIC WORKS

Space 9, Electricity Building, St. Louis Exposition

A practical demonstration of

generating | electrical
transforming | power and
distributing | lighting
operating | systems

all in actual operating service

A new alternating current series arc system, a new line of multiphase integrating wattmeters, a new arc lamp and the old reliable "Wood" arc and alternating generators, motors, and transformers all working. A complete ten-panel switchboard furnishing direct current to motor-generators and distributing alternating and direct current to arc lamps and fan motors through transformers, wattmeters, ammeters, etc Details of construction are shown by parts of generators, arc lamps, wattmeters, transformers, etc., mounted for inspection.

253

FORT WAYNE ELECTRIC WORKS Fort Wayne Ind.

FORT WAYNE ELECTRIC WORKS Fort Wayne Ind.

BRASS & BRASS GOODS

ASK FOR CATALOG

THE PLUME & ATWOOD MFG. CO.

New York Boston San Francisco Chicago

VULCANIZED FIBRE

Highest grades for electrical insulation and mechanical purposes, in sheets, tubes, rods and special shapes. Catalogues and samples on application.

VULCANIZED FIBRE CO., - Wilmington, Del.

USE

"SAFETY" RUBBER COVERED WIRE AND CABLE

FOR EVERY ELECTRICAL SERVICE.

M. B. AUSTIN & CO.,

CHICAGO REPRESENTATIVE.

THE SAFETY INSULATED WIRE & CABLE CO.,

WORKS: Bayonne, N. J. 114-116 LIBERTY STREET, N. Y.

DIRECT CURRENT

MOTORS

THE ADAPTATION of our motors to mechanical drive is practically universal, and their service is unequaled.

Write for Bulletin No. 21814

SPRAGUE ELECTRIC COMPANY

General Offices: 527 West 34th Street, New York.

Chicago Office: Fisher Building.

STURTEVANT

Fans, Blowers, Engines, Motors, Generating Sets, Economizers, Exhaust Heads, Mechanical Draft Apparatus, Forges, Heating, Ventilating and Drying Apparatus, Industrial Equipments

B. F. STURTEVANT CO.

Boston Massachusetts

General Office and Works, Hyde Park, Mass.

New York Philadelphia Chicago London

Warren Alternator

SIMPLE AS A GRINDSTONE

SPARKLESS AS A WATER WHEEL

WE GUARANTEE WHAT WE SELL AND SELL WHAT WE GUARANTEE.

WARREN ELECTRIC MFG. CO.

Sandusky, O.

Black Diamond File Works

Est. 1863. Inc. 1895.

Twelve Medals Awarded at International Expositions

Special Prize Gold Medal at Atlanta, 1895.

OUR GOODS ARE ON SALE IN EVERY LEADING HARDWARE STORE IN THE UNITED STATES AND CANADA.

G. & H. BARNETT COMPANY,

PHILADELPHIA, PA.

JOHN A. ROEBLING'S SONS CO.

Insulated Wire of All Kinds

Bare Copper Wire

MAIN OFFICE AND WORKS TRENTON, N. J.

AGENCIES AND BRANCHES

New York Chicago Cleveland San Francisco Philadelphia Atlanta

Western Electrician

Vol. XXXV. $3.00 Per Annum. Copyright, 1904, by Electrician Publishing Company, Chicago. CHICAGO, SEPTEMBER 17, 1904. Entered at Chicago Postoffice as mail matter of the second class. 10 Cents a Copy. No. 12.

SIMPLEX INSULATED WIRES AND CABLES.

RUBBER COVERED, WEATHERPROOF, UNDERGROUND AND SUBMARINE.

WESTERN SELLING AGENT: H. A. HIBSON, 1108 Monadnock Block, CHICAGO. The Simplex Electrical Co., 110 State Street, BOSTON, MASS.

CHICAGO INSULATED WIRE CO.

152-154 LAKE ST., CHICAGO
1108-1110 PINE ST., ST. LOUIS, MO.

Bare and Insulated Wires and Cables
Galvanized Steel Strands

OKONITE TRADE MARK

1889—Paris Exposition, Medal for Rubber Insulation.
1893—World's Fair, Medal for Rubber Insulation.

THE STANDARD FOR RUBBER INSULATION.

Sole Manufacturers of

Okonite Wires, Okonite Tape, Manson Tape, Candee Weather-proof Wires.

THE OKONITE CO., LTD.

Willard L. Candee, Durant Cheever, Managers. 253 Broadway, New York. Geo. T. Manson, Gen'l Supt. W. H. Hodgins, Secy.

TRADE MARK. CRESCENT INSULATED WIRE & CABLE CO. TRENTON, N. J.

CRESCENT RUBBER INSULATED WIRES AND CABLES

National Code Standard.

CRESCENT INSULATED WIRE AND CABLE CO.,

New York Office, 63 BARCLAY STREET. Main Office and Factory, TRENTON, N. J.

STANDARD

STANDARD UNDERGROUND CABLE CO.

322 The Rookery, Chicago. Westinghouse Bldg., Pittsburg. 56 Liberty St., New York City. 1225 Betz Bldg., Philadelphia, Pa. Crossley Bldg., San Francisco. 10 Post Office Square, Boston.

BARE AND WEATHERPROOF WIRES AND CABLES.

Rubber Covered Wires and Cables. Underground Cables for all Purposes

INDIANA RUBBER AND INSULATED WIRE CO.,

MANUFACTURERS OF

Paranite Rubber Covered Wires and Cables,

UNDERGROUND, AERIAL, SUBMARINE AND INSIDE USE:

TELEPHONE, TELEGRAPH AND FIRE ALARM CABLES.

All Wires are tested at Factory. JONESBORO, IND.

"CIRCULAR LOOM" THE FLEXIBLE CONDUIT

AMERICAN CIRCULAR LOOM CO. TRADE MARK REGISTERED

CONDUITS FOR INTERIOR WIRING.

American Circular Loom Co.

Chelsea, Mass., New York, Chicago, San Francisco.

THE PHOENIX GLASS CO. Pittsburg New York Chicago

Manufacturers of

Electric Globes and Shades, both Arc and Incandescent

Inner and Outer Globes for all enclosed arc systems

CATALOGUES SENT ON REQUEST

DRIVER-HARRIS WIRE CO.

HARRISON (NEWARK), N. J.

Manufacturers of Fine Sizes Wire of Every Description.

Resistance Wires a Specialty.

EDISON PRIMARY BATTERIES FORMERLY EDISON LA LANDE

There is no deterioration in the permanent parts of these batteries. It follows, therefore, that each time a cell is recharged it will last as long a time and deliver as heavy a current as the original charge when the cell was first put into service. Our catalogue No. 7 will tell you more about this. Let us send it.

EDISON MANUFACTURING CO.,

TRADE Thomas A. Edison MARK

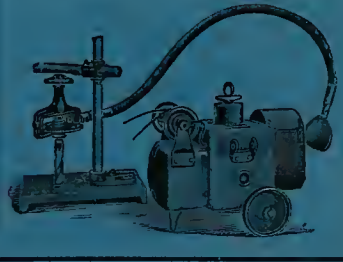
Factory, ORANGE, N. J.
NEW YORK, 83 Chambers St.
CHICAGO, 304 Wabash Ave.

THERMOPILES 1½ VOLTS 1½ AMPERES

For Electrolytic analysis, charging storage batteries, and other constant current requirements. $3 Each.

WALSH'S SONS & CO.,
264 Washington Street. Newark, N. J.

THOUSANDS IN USE.
Motors, ¼ h. p. to 100 h. p.
Dynamos, 1 k. w. to 75 k. w.
Highest Quality. Reasonable Prices.
THE HOBART ELECTRIC MFG. CO.
TROY, OHIO.



ESTABLISHED 1875.

COMBINATION OF

Stow Flexible Shaft

AND

MULTI-SPEED MOTOR

Practically dust and water proof. For Portable Drilling, Tapping, Reaming, Emery Grinding, etc. Write for Catalogue and Prices.

STOW MFG. CO., Binghamton, N. Y.

Gen'l European Agents, Selig, Sonnenthal & Co., 85 Queen Victoria Street, London, England

H. N. FENNER, President J. F. BLAUVELT, Agent RUSSELL W. KNIGHT, Treasurer

NEW ENGLAND BUTT COMPANY

MANUFACTURERS OF

Machinery for Insulating Electrical Wires

Braiding, Taping, Winding, Twinning, Cabling, Stranding, Polishing and Measuring Machines. Cable Covering Braiders

FINE CASTINGS A SPECIALTY

304 PEARL STREET, - - - PROVIDENCE, R. I., U. S. A.

WESTON Electrical Instrument Co.,

Waverly Park, NEWARK, N. J.

Illuminated Dial Station Instruments.

These instruments are made upon the same general principle as our regular Standard Portable Direct Current Voltmeters and Ammeters, but are much larger and the working parts are inclosed in a neatly designed, dust-proof cast-iron case which effectively shields the instruments from disturbing influences of external magnetic fields.

BERLIN—European Weston Electrical Instrument Co., Ritterstrasse

Weston Standard Illuminated Dial Potential Indicator, Style B. "Flush Type."

Weston Standard

Portable Direct Reading Voltmeters and Millivoltmeters. Ammeters and Milliammeters, Wattmeters and Voltmeters, for Alternating and Direct Current Circuits.

Our portable instruments are recognized as standards throughout the civilized world.

Our Semi-Portable Laboratory Standard Voltmeters and Ammeters are still better.

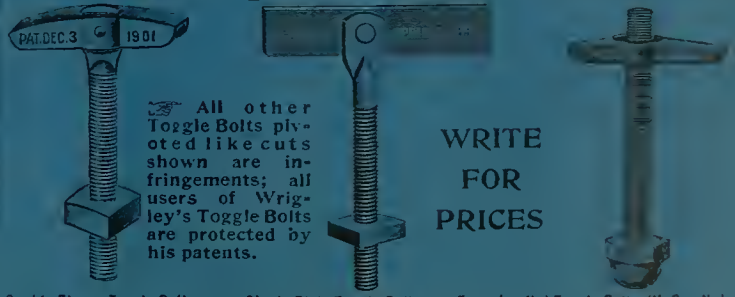
They are the most reliable, absolute standards for Laboratory use.

LONDON—Elliott Bros., Century Works, Lewisham.

PARIS, France—H. Cad et 12 Rue St. Georges New York Office—74—Cortlandt St.

Why Not Use the Best and the Only Genuine

Wrigley Toggle Bolt



All other Toggle Bolts pivoted like cuts shown are infringements; all users of Wrigley's Toggle Bolts are protected by his patents.

WRITE FOR PRICES

Double Flange Toggle Bolt. Single Plate Toggle Bolt. Trunnion Nut Toggle Bolt with Cap Nut.

Other Patents Pending

THOS. WRIGLEY & CO.

Sole Manufacturers, 300-306 Dearborn Street, CHICAGO, ILL.

Allis-Chalmers Co
CHICAGO

5000 horsepower Allis-Chalmers Engine
and Bullock, 3,500 K. W. Generator
Machinery Hall, World's Fair, St. Louis.

WHAT IT HAS DONE

Began unloading from train Jan. 15th—27 carloads—Generator 10 carloads.
Steam first turned on April 20th, Engine and Generator operated perfectly ever since.
St. Louis Exposition officially opened April 30th, 1904.

Decorative lighting of Exposition Buildings and Grounds first turned on evening April 29th, this Engine and Generator carrying the load.

Ran non-condensing one month while Exposition was getting its condenser plant erected and connections made. During that time carried 4300 horsepower night after night.

Sometimes required to operate the Cascades,—2000 horsepower.

Exposition having finished its condenser plant, the Engine was required to take full load June 10th. That night the unit carried 4800 horsepower. Began with 26-inch vacuum—no load—which, under load, ran down to about 14 inches, or 7 to 8 pounds. Engine has never been out of commission, except for two nights when a sewer burst and flooded the wheel-pit.

Since then Engine ran condensing until July 25th,—carrying 4800 horsepower with from 13 to 16 inches vacuum. On July 25th a break occurred in the Exposition discharge pipe which takes the condenser water to the Lagoon. The Engine then ran non-condensing for two nights. It carried 4400 horsepower during that time. On July 28th ran condensing,—since then it has regularly carried 5600 horsepower with an average of 12 inches vacuum.

The "Big Reliable"

Bullock
Electric Mfg Co
Cincinnati

Canadian representatives, Allis-Chalmers-Bullock, Ltd., Montreal

THE ELECTRIC STORAGE BATTERY CO.

PHILADELPHIA

Extends an invitation to its exhibit at Section Twenty, in the Palace of Electricity, Louisiana Purchase Exposition.

September 12, 1904

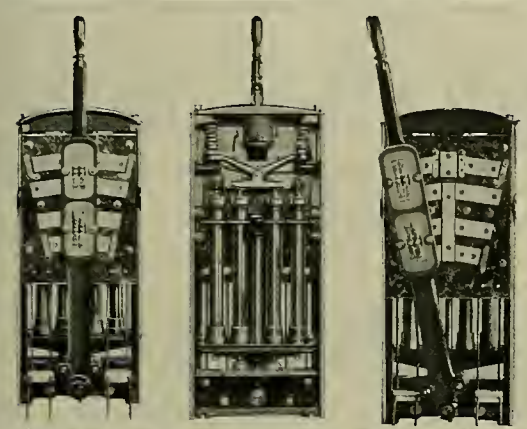
SALES OFFICES

PHILADELPHIA, Allegheny Ave. and 19th St. | NEW YORK, 100 Broadway. | BOSTON, 60 State St. | CHICAGO, Marquette Bldg. | ST. LOUIS Walnwright Bldg.

SAN FRANCISCO, Rialto Bldg. | CLEVELAND, Citizens Bldg. | CANADA, Canadian General Electric Co., Ltd., Toronto | HAVANA, CUBA. C. F. Greenwood, Manager 34 Empadrado St.

Allen-Bradley Electric Crane Controllers

Patented



Front View—before starting | Rear View | Front View—all resistance out

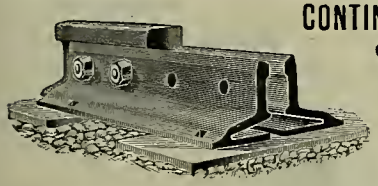
Manufactured by AMERICAN ELECTRIC FUSE CO., Chicago

A New Controller. Positively No Sparking. No Repairs. Guaranteed for One Year. Three Months' Free Trial. Perfect Control.

OUR GUARANTEE: Ask any Other Manufacturer to Duplicate It.

THE AMERICAN ELECTRIC FUSE COMPANY hereby guarantees to ..... that it will at any time within three months from this date upon demand repay to said ..... the sum of ..... Dollars, being the full purchase price paid (or agreed to be paid) by said ..... to the American Electric Fuse Company for one ..... horsepower Allen-Bradley Crane Controller, number ..... upon delivery within three months after this date of said controller, freight prepaid and in good condition, ordinary wear and tear from use excepted, at the office of the American Electric Fuse Company, Chicago, Illinois, together with a written statement that said controller has proved unsatisfactory to said .....

FURTHERMORE, the said American Electric Fuse Company agrees that it will at any time within one year from this date replace, without charge, any part of said controller which may prove defective or wear out during the ordinary use of said controller, provided that it is a condition of this guarantee that said ..... hereby agrees to use ordinary care in the operation of said controller, and that said controller will be operated by some person, or persons, familiar with the use of crane controllers, and further that said controller will not be wilfully or maliciously injured while in the possession of said .....



CONTINUOUS RAIL JOINT CO. OF AM.

GENL. OFFICES: CENTURY BLDG., NEWARK, N. J.

OVER 20,000 MILES IN USE

See our exhibit, World's Fair, St. Louis, Mo., Transportation Bldg., Aisle "C," Posts 7 and 8.

CARBONS

CONSUMERS CARBON CO.

LANCASTER, OHIO, U. S. A.

Carbons of all kinds and for all purposes.

PLATINUM

PLATINUM RIVETS FOR CONTACT POINTS IN TELEPHONES—SPARK COILS AND OTHER ELECTRICAL APPARATUS. PLATINUM SHEET AND WIRE IN ANY FORM AND DEGREE OF HARDNESS. PLATINUM SCRAP PURCHASED.

BAKER & COMPANY, Inc.

ARTISANS IN PLATINUM

408-410-412-414 N. J. R. R. AVE. - NEWARK, N. J.

New York Office: 120 Liberty St.

ALPHABETICAL INDEX TO ADVERTISEMENTS.

Adams-Bagnall Electric Co...—
Allis-Chalmers Company..... 2
American Battery Co.....—
Amer. Circular Loom Co... ... 1
American Conduit Co.....16
Amer. District Steam Co.....13
Amer. Elec. Fuse Co..... 3
Amer. El. Telephone Co.....17
American Electrical Works..11
Arnold Elec. Power Station Co..... 13
Automatic Electric Co..... 17

Babcock & Wilcox Co.....—
Badt, F. B.....13
Bain, Forée.....11
Baker & Company..... 3
Baker & Co., W. E.....13
Barnett Company, G. & H....22
Beardslee Chandelier Mfg.Co.10
Berthold & Jennings.....18
Big Four Route.....—
Bissell Co., The F.....12
Bossert Electric Construction Co.....8, 12
Brooks, Hall L.....19
Bryan-Marsh Co.....—
Bryan, Wm. H.....13
Buckeye Electric Co.....—
Bullock Elec. Mfg. Co..... 2
Butterfield, J. F.....—
Byllesby & Co., H. M.....13

Cantwell Press, The.....15
Central Electric Co..... 5
Cent. Stat. Improvement Co..12
Central Tel. & El. Co.....—
Century Electric Co.....11
Chicago Dia & Electric Co....—
Chicago Edison Co.....4, 12
Chic. Fuse Wire & Mfg. Co...—
Chicago Insulated Wire Co.. 1
Chicago Mica Co.....10
Columbia Incand. Lamp Co..—
Columbia Mfg. Co.....19
Columbus Storage Battry Co.—
Consumers Carbon Co..... 3
Continuous Rail Joint Company of America..... 3
Cope, T. J.....14
Crawfordsville Electric Co..22
Crescent Ins. Wire & Cbl. Co. 1
Crocker-Wheeler Company... 8
Crouse-Hinds Co.....—
Cutler-Hammer Mfg. Co..... 5
Cutter Elec. & Mfg. Company—

D. & W. Fuse Company.....—
Dearborn Drug & Chem. Wks.14
Diamond Meter Company....—
Dielectric Manufacturing Co.19
Directory of Engineers..... 13
Dixon Crucible Co., Joseph..14
Driver-Harris Wire Co..... 1
Duncan Elec. Mfg. Co.....22

Edison Decorative & Miniature Lamp Departm't.....10
Edison Mfg. Company..... 1
Edwards & Co..... 4
Egan, J. J.....12
Electric Appliance Co.:..... 10
Electric Storage Battery Co.. 3
Electrical Appliance Co..... 6
Electrical Engineer Institute.13
Electrician Pub. Company... 9
Erie Ry.....18

Faries Mfg. Co..... 8
"For Sale" Advertisements..12
Ft. Wayne Elec. Works, Inc..21
Fostoria Incand. Lamp Co...—
Fowler, John H.....18
Fowler-Jacobs Company.....18

General Electric Co..... 9
General Engineering Co., The 13
General Incandescent Arc Light Company.....—
General Incand. Lamp Co....—
Glogau & Co. H. M.....—
Gould Storage Battery Co....—
Green Fuel Economizer Co...-
Gregory Electric Company...12

Hallberg, J. H 13
Haller Machine Co..... 4
Hart Mfg. Co.....12
Hartford Steam Boiler Inspection & Insurance Co....14
Hazard Manufacturing Co...22
Highland Park College. ... 11
Hipwell Mfg. Co..... .... —
Hobart Elec. Mfg. Co.....1, 11
Hoffman, G. W.....19
Holmes Fibre-Graph. Co.....14
Holophane Glass Co..... 7
Holtzer-Cabot Electric Co...—
Hornaday & Co., J. P.....13
Humphrey, Henry H.....—
Hunt & Co., Robt. W.....13

Illinois Central Ry.....18
Incandescent Electric Light Manipulator Company.....—
Indiana Rub. & Ins. W. Co.... 1
India Rubber & Gutta Percha Insulating Company.....15
International Elec. Meter Co 12
International Tel. Mfg. Co...15

Jackson, D. C. & W. B.....13
Jeffrey Manufacturing Co....14
Jewell Electrical Inst. Co....—
Johns-Manville Co., H. W.....—

Kartavert Manufacturing Co.22
Kellogg Switchboard & Supply Company.....16, 19
Kemp, R. W.....13
Kester Elec. Mfg. Co..... 8
Klein & Sons, Mathias.... ...16
Kohler Brothers.....13
Kuhlman Electric Co.....19

Leather Preserv. M. Corp....—
Leffel & Co., James.....14
Lindsley Brothers Company..18
Loud's Sons Co., H. M.....19

Machado & Roller.....—
Maltby Cedar Company.....19
Manhattan El. Supply Co....19
Manross, F. N. ... .19
Marinette Gas Engine Co.....14
Matthews & Bros., W. N.....11
McLaughlin, James. 13
McLaughlin & Co., Jas.....11
McLennan & Company, K...10
Mechanical Appliance Co....--
Mica Insulator Company.....—
Minnesota Electric Co.....16
Miscellaneous Advs.....12
Monon Railroad..... ..—
Moon Mfg. Co., The.....16
Morrison Lbr. Co., J. W.....—
Mueller Company, William..19
Munsell & Co., Eugene.....10

National Electric Co..... 5
National India Rubber Co....—
New England Butt Co..... 1
Newgard & Co., Henry.....18
New York Cent Ry.....18
New York Ins. Wire Co.....11
Northern Elect'l Mfg. Co.... 4
Northern Pacific Ry.....16
Northwestern Storage Battery Co.. ... .22

Okonite Co., The..... 1
Olds Gasoline Engine Works.14

Pacific Coast Pole Co.....19
Page & Hill Co.....18
Paragon Fan & Motor Co.....—
Pardridge Shade & Refl. Co..—
Pass & Seymour, Inc.....—
Phelan, D. W.....18
Phillips, Eugene F.....11
Phillips Insulated Wire Co...11
Phœnix Glass Co..... 1
Phosphor-Bronze S. Co.....14
Pignolet, L. M.....10
Pittsburg & L. S. Iron Co....19
Plume & Atwood Mfg. Co....—
Porter Cedar Company.....19

Reisinger, Hugo.....—
Reynolds El. Flasher Mfg.Co.10
Roebling's Sons Co., J. A....13
Ruebel-Schwedtmann-Wells..13
Runzel-Lenz Elec. Mfg. Co...17

Safety Ins. Wire & Cable Co..11
Sargent & Lundy.....13
Sauquoit Silk Mfg. Co.....11
Schott, W. H.....13
Seaman & Co., W. S.....—
Sears, Roebuck & Co.....—
Simplex Electrical Co., The.. 1
Simplex Elec. Heating Co....10
Speer Carbon Co..... .14
Sprague Electric Company...10
Squire Electric Co.....—
Standard Elec. Mfg. Co.....18
Standard Underg. Cable Co.... 1
Stanley Elec. Mfg. Co., The 8
Stanley Instrument Co.....10
Stanton, LeRoy W..... 13
State Univ. of Iowa.....18
Sterling & Son, W. C.....18
Sterling Electrical Mfg.Co... 13
Sterling Varnish Co., The....11
Stow Mfg. Company..... 1
Stromberg-Carlson Tel. Mfg. Company.....17
Sturtevant Company, B. F...22

Torrey Cedar Company.....18
Trumbull Elec. Mnfg. Co.....--
Turner Brass Works.....—

Union Electric Mfg. Co.....—

Valentine-Clark Co., The....18
Vulcanized Fibre Company..22

Wagner Electric Mfg. Co.....—
Walsh's Sons & Company..... 1
Warren Elec. Mfg. Co.....10
Wesco Supply Co.....—
Western Electric Company... 8
Western El. Supply Co.....—
Westinghouse Electric & Manufacturing Co.....20
Weston Electrical Inst. Co... 1
Whitney Electrical Inst. Co..—
Wilmerding, C. H.....13
Wisconsin Central Ry.....18
Woolley Fdy. & Mach. Wks..—
Worcester Company, C. H....18
Wrigley & Co., Thomas 1

Yesbera Mfg. Co..... .. —
Yost Electric Mfg. Co 11

For Classified Index of Advertisements See Page 6.

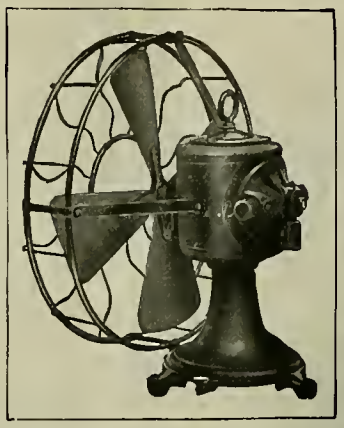
REMEMBER THE NAME AND BUY THE BEST.

PARAGON FAN MOTORS

NEW STYLES NEW PRICES
EASY RUNNING RIGID CONSTRUCTION NOISELESS

CALL AND SEE THEM OR WRITE FOR PRICES

CHICAGO EDISON COMPANY,
139 ADAMS ST., CHICAGO.



127 FULTON STREET CHICAGO

SIGNS

For Signs, Letters, Flashers, Dimmers, Timeswitches, Lamps, Rubberrings and anything pertaining to Signs,
—WRITE TO—

HALLER MACHINE COMPANY
Designers and Manufacturers, of Sheetmetal, Electric and Machinery Specialties

ECONOMICAL ELECTRIC LIGHTING

219

NORTHERN DYNAMOS

SIMPLE COMPACT

We build them for direct connection to any type of engine, or to be driven by belt. Northern Apparatus readily adapted to any service

Bulletin No. 2530

NORTHERN ELECTRICAL MFG. CO., - Madison, Wis., U. S. A.
Engineers Manufacturers

These, our little "SHOW WINDOWS," coming out even as they do every week, can't give you an adequate idea of ALL the goods we manufacture—

BUT OUR CATALOGUE CAN.

SEND FOR IT.

EDWARDS & CO., New York.

Selling Agents: WESTERN ELECTRIC COMPANY, New York, Chicago, Philadelphia, Denver, St. Louis, Pittsburg, Kansas City. AMERICAN ELECTRICAL COMPANY, St. Paul. CALIFORNIA ELECTRIC WORKS, San Francisco, Cal. STANDARD ELECTRIC COMPANY, Cincinnati.

OKONITE TRADE MARK.

EXPERIENCE HAS TAUGHT

OKONITE TRADE MARK.

almost every man that it is wise to thoroughly inspect an article before making a purchase and not to pass judgment without a trial. Judgment passed on OKONITE has made it what it is—THE UNDISPUTED STANDARD.

WE CLAIM FOR OKONITE THE BEST INSULATION

OKONITE WIRE——OKONITE TAPE——MANSON TAPE

Central Electric Company,

OKONITE TRADE MARK

GENERAL WESTERN AGENTS
264-266-268-270 FIFTH AVENUE, CHICAGO

OKONITE TRADE MARK

C & H Field Regulator

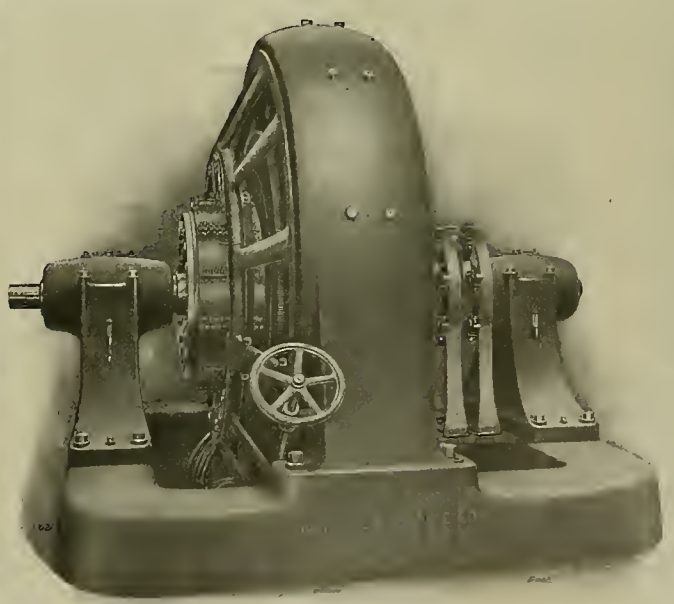
The best, the simplest and the most durable field regulator on the market.

WHY ?

Has no enamel to crack; will not ground; white hot wire tests have proven worth of resistance material; will carry overloads safely; no small parts to get out of order; no loose contacts to bother with; made of best material throughout; easily controlled; will not stick, nor will jar of machinery deviate lever.

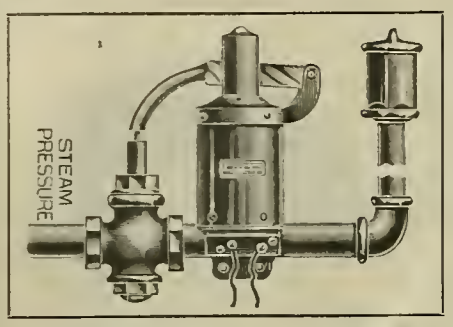
The Cutler-Hammer Mfg. Co.
MILWAUKEE, WIS.
New York Boston Chicago Pittsburg
2

National Electrical Machinery
built in all capacities
Direct and Alternating
apparatus of the highest grade



1,000-K. W. Rotary Converter

National Electric Company
GENERAL SALES OFFICES & WORKS:
Philadelphia: Land Title Bldg.
New York: 135 Broadway
Chicago: Old Colony Bldg.
Pittsburg: Gellotly & Co.
Charleston, W. Va.: Agnew Electric Co.
Milwaukee
Seattle & San Francisco
Kilbourne & Clark Co.



BLOW YOUR WHISTLE

BY PUSHING A BUTTON.

A device which electrically operates a whistle situated at any distance by the simple pressure of a button close at hand. Sold under a guarantee of its perfect operation. If it does not work to your entire satisfaction when put up you may return it at our expense. Send for Bulletin B 18.

THE ELECTRICAL APPLIANCE CO.,

CINCINNATI, OHIO.

CLASSIFIED INDEX OF ADVERTISEMENTS.

Adjusters, Cord.
Incandes. El. Lt. Manip. Co.

Adjusters, Inc. Lamps.
Inc. El. Lt. Manipulator Co.

Anchors (Tel. & Tel.)
Matthews & Bro., W. N.
Crouse-Hinds Co.

Annunciators.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Moon Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Batteries and Jars.
Bissell Co., The F.
Central Electric Co.
Columbus Storage Battery Co.
Edison Mfg. Co.
Edwards & Company.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Bells, Buzzers, Etc.
Central Electric Co.
Edwards & Co.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Belt Dressing.
Dixon Crucible Co., Jos.
Leather Preserver Mfg. Corp.

Belting.
Leather Preserver Mfg. Corp

Blow Pipes.
Turner Brass Works

Blowers.
Sturtevant Co., B. F.

Boiler Compounds.
Dearborn Drug & Chem. Wks.

Boilers.
Allis-Chalmers Company.
Babcock & Wilcox Co.

Books, Electrical.
Cantwell Press, The.
Electrician Publishing Co.

Booths, Telephone.
Seaman & Co., W. S.
Yesbera Mfg. Co.

Brackets.
Farles Mfg. Co.

Brushes.
Central Electric Co.
Hobart Elec. Mfg. Co.
Holmes Fibre-Graphite Co.
Speer Carbon Co.
Western Electric Company.

Cable Hangers.
Bissell Co., B. F.
Western Electric Co.

Cables (See Wires and Cables)

Canopies.
Farles Mfg. Co.

Carbons, Points and Plates.
Central Electric Co.
Chicago Edison Co.
Consumers Carbon Co.
Electric Appliance Co.
Reisinger, Hugo.
Speer Carbon Co.
Wesco Supply Co.
Western Elec. Supply Co.

Castings.
Farles Mfg. Co.
New England Butt Co.
National Electric Co.

Chains.
Jeffrey Mfg. Co.

Chandeliers.
Farles Mfg. Co.

Circuit Breakers.
Cutler-Hammer Mfg. Co.
Cutter Elec. & Mfg. Co.
Ft. Wayne Elec. Wks. Inc.
Union Electric Mfg. Co.
Western Electric Company.
Westinghouse El. & Mfg. Co.

Clusters.
Farles Mfg. Co.

Coal and Ashes Handling Machinery.
Jeffrey Mfg. Co.

Coils and Magnets.
Western Electric Co.

Commutator Compound
Egan, J. J.
McLaughlin & Co., Jas.
McLennan & Co., K.

Condensers, Electric.
Stanley Elec. Mfg. Co.

Conduit and Conduits.
American Circular Loom Co.
American Conduit Company
Central Electric Co.
Electric Appliance Co.
Sprague Electric Co.
Standard Vitrified Cond. Co.
Wesco Supply Co.
Western Electrical Supply Co.

Contractors and Electric Light Plants.
Allis-Chalmers Company.
Bullock El. Mfg. Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
National Electric Co.
Northern Electrical Mfg. Co.
Sprague Electric Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Controllers, Crane.
Amer. Elec. Fuse Co.

Cord.
Runzel-Lenz Elec. Mfg. Co.

Cross-Arms, Pins and Brackets.
Berthold & Jennings.
Central Electric Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Company.
Western Elec. Supply Co.

Cut-Outs and Switches.
Bissell Co., The F.
Bossert Elec. Const. Co.
Central Electric Co.
Chicago Edison Co.
Crouse-Hinds Co.
Cutter Elec. & Mfg. Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
General Inc. Arc Light Co.
Hart Manufacturing Co.
Manhattan Elec. Supply Co.
Trumbull Elec. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Dynamos and Motors.
Allis-Chalmers Company.
Bissell Co., The F.
Bullock Elec. Mfg. Co.
Central Electric Co.
Century Electric Co.
Crawfordsville Electric Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks. Inc.
General Elec. Co.
General Inc. Arc Light Co.
Gregory Electric Co.
Hobart Elec. Mfg. Co.
Holtzer-Cabot Electric Co
Mechanical Appliance Co.
National Electric Co.
Northern Electrical Mfg. Co.
Sprague Electric Co.
Stanley Elec. Mfg. Co.
Stow Manufacturing Co.
Sturtevant Co., B. F.
Wagner Electric Mfg. Co.
Warren Elec. Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Economizers, Fuel.
Green Fuel Economizer Co.

Electric Heating Appl.
Simplex Elec. Heating Co.
Western Electric Co.

Electric Railways.
Crocker-Wheeler Co.
General Electric Co.
Sprague Electric Co.
Westinghouse El. & Mfg. Co.

Electrical and Mechanical Engineers.
Arnold Elec. Power Stat'n Co.
Badt, F. B.
Baker & Co., W. E.
Bryan, Wm. H.
Butterfield, J. P.
Byllesby & Co., H. M.
General Engineering Co., The.
Hallberg, J. H.
Hornaday, J. P. & Co.
Humphrey, Henry H.
Hunt & Co., Robt. W.
Jackson, D. C. & W. B.
Kemp, R. W.
Kohler Brothers.
McLaughlin, James
Newgard & Co., Henry.
Northern Electrical Mfg. Co.
Ruebel, Schwedtman, Wells.
Sargent & Lundy.
Schott, W. H.
Squire Electric Co.
Stanley Elec. Mfg. Co.
Stanton, LeRoy W.
Wilmerding, C. H.

Electrical Instruments. (Recording and Testing.)
Bissell Co., The F.
Central Electric Co.
Diamond Meter Co.
Duncan Elec. Mfg. Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
General Inc. Arc Light Co.
Jewell Electrical Inst. Co.
Machado & Roller.
Pignolet, L. M.
Stanley Elec. Mfg. Co.
Stanley Instrument Co.
Wagner Electric Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co
Weston Electrical Inst. Co.
Whitney Electl. Inst. Co.

Electro-Plating Mach'y
Crocker-Wheeler Company.
General Electric Co.

Elevators-Conveyors.
Jeffrey Mfg. Co.

Engines, Gas and Gasoline.
Allis-Chalmers Company.
Marinette Gas Engine Co.
Olds Gasoline Engine Works.
Woolley Fdy. & Mach. Wks.

Engines, Steam.
Allis-Chalmers Company.
Sturtevant Co., B. F.

Fans and Fan Motors.
Central Electric Co.
Crocker-Wheeler Company.
Edison Mfg. Co.
General Electric Co.
General Inc. Arc Light Co.
Sprague Electric Co.
Sturtevant Co., B. F.
Wesco Supply Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Fibre.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Files.
Barnett Co., G. & H.

Fittings.
Farles Mfg. Co.

Fixtures, Gas and Elec.
Beardslee Chandelier Mfg. Co.

Flashers.
Bissell Co., The F.
Haller Machine Co.
Reynolds El. Flasher Mfg. Co

Flexible Shafts.
Stow Mfg. Co.

Forges.
Sturtevant Co., B. F.

Fuses and Fuse Wire.
Amer. Elec. Fuse Co.
Bissell Co., The F.
Central Electric Co.
Central Tel. & El. Co.
Chicago Die & Electric Co.
Chicago Fuse Wire & Mfg. Co.
D. & W. Fuse Company.
Electric Appliance Co.
Johns-Manville Co., H. W.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Company.
Western Elect. Supply Co.

Globes, Reflectors and Shades.
Fostoria Incan. Lamp Co.
Haller Machine Co.
Holophane Glass Co.
Pardridge Shade & Refl. Co.
Phœnix Glass Co.
Wesco Supply Co.
Western Electric Co.
Western Elect. Supply Co.

Graphite Specialties.
Dixon Crucible Co., Jos.
Holmes Fibre-Graphite Co.

Heating (Exhaust Steam).
Amer. District Steam Co.

Heating and Ventilating Apparatus.
Sturtevant Co., B. F.

Holders, Inc. Lamps.
Incandesent Electric Light Manipulator Co.

Inspection & Insurance
Hartford Steam Boiler Inspection & Insurance Co.

Inspirating Machinery.
New England Butt Co.

Insulators and Insulating Materials.
American Electrical Works.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Inc. Arc Light Co.
Indiana Rub. & Ins. Wire Co.
Johns-Manville Co., H. W.
Kartavert Mfg. Co.
Manhattan Elec. Supply Co.
Mica Insulator Co.
Munsell & Co., Eugene.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Standard Vitrified Cond. Co.
Sterling Varnish Co.
Vulcanized Fibre Co.
Wesco Supply Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Junction Boxes.
Hossert Elect. Const. Co.
General Inc. Arc Light Co.

Lamps, Arc.
Bissell Co., The F.
Central Electric Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
General Inc. Arc Lt. Co.
Gregory Electric Co.
Hipwell Manufacturing Co
Manhattan Elec. Supply Co.
Stanley Elec. Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Lamps, Incandescent.
Bissell Co., The F.
Bryan-Marsh Company.
Buckeye Electric Company.
Central Electric Co.
Chicago Edison Co.
Columbia Incan. Lamp Co.
Edison Decorative & Miniature Lamp Dept.
Electric Appliance Co.
Fostoria Incand. Lamp Co.
General Electric Co.
General Inc. Arc Light Co.
Standard Elec'l Mfg Co.
Sterling Electrical Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Lamps, Incandescent—Replacers & Cleaners.
Inc. El. Lt. Manipulator Co.

Letters, Metal.
Haller Machine Co.

Lightning Arresters.
Central Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
Manhattan Elec. Supply Co.
Minnesota Electric Co.
Stanley Elec. Mfg. Co.
Western Electric Co.

Lights, Show.
Clogan & Co., H. M.

Linemen's Climbers.
Klein & Sons, Mathias.

Magnet Wires.
(See Wires and Cables.)

Mechanical Draft.
Sturtevant Co., B. F.

Mica.
Chicago Mica Co.
Mica Insulator Co.
Munsell & Co., Eugene.

Mining Apparatus, Elec.
Allis-Chalmers Company.
Crocker-Wheeler Company.
General Electric Co.
Jeffrey Mfg. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Motors. (See Dynamos and Motors.)

Nippers and Pliers.
Klein & Sons, Mathias.

Nozzles.
Farles Mfg. Co.

Paints.
Dielectric Mfg. Co.

Patent Attorneys.
Bain, Foree.

Phosphor Bronze.
Phosphor Bronze Sm. Co. Ltd.

Platinum, Wire and Sheet.
Baker & Company Inc.

Poles and Ties.
Berthold & Jenninga.
Brooks, Hall L.
Columbia Mfg. Co.
Fowler, John H.
Fowler-Jacobs Company.
Kellogg Switch. & Sup. Co.
Lindsley Bros. Co.
Loud's Sons Co., H. M.
Maltby Cedar Co.
Morrison Lbr. Co., J. W.
Mueller Company, William.
Pacific Coast Pole Co.
Page & Hill Company.
Phelan, D. W.
Pittsburg & L. S. Iron Co.
Porter Cedar Company.
Sterling & Son, W. C.
Torrey Cedar Co.
Valentine-Clark Co., The.
Worcester Co., C. H.

Polish (Metal).
Alleo Co., Inc., L. B.
Hoffman, Geo. W.

Portables.
Farles Mfg. Co.

Power Transmission Machinery.
Jeffrey Mfg. Co.

Rail Joints.
Continuous Rail Joint Company of America.

Rectifiers.
Electrical Appliance Co.

Reflectors.
Gt. West Smelt. & Refining Co

Re-Winding—Repairs.
Chicago Edison Co.
Gregory Electric Co.

Rheostats.
Cutler-Hammer Mfg. Co.
General Electric Co.
Gen'l Inc. Arc Lt. Co.
Union Electric Mfg. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Rods, Conduit.
Cope, T. J.

Safes.
Sears, Roebuck & Co.

Schools and Colleges.
Electrical Engineer Inst.
Highland Park College
State Univ. of Iowa.

Second-Hand Mach'y.
Bissell Co., The F.
Cent. Stat. Improvement Co.
Gregory Electric Co.
Matthews & Bro., W. N.
Walsh's Sons & Co.

Shades, Lamp.
Farles Mfg. Co.

Sheet Brass & Copper.
Plume & Atwood Mfg. Co.

Signs, Electric.
Haller Machine Co.

Silks, Insulating & Braiding.
Sauquoit Silk Mfg. Co.

Sockets & Receptacles.
Pass & Seymour.
Yost Elec. Mfg. Co.

Soldering Sticks, Salts and Paste.
Allen Co., L. B.
Crescent Co.
Kester Elec. Mfg. Co.
Western Electric Co.

Speaking Tubes.
Central Electric Co.
Edwards & Co.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Specialties, Electrical Mfrs. and Designers.
Haller Machine Co.

Speed Indicators.
Weston Electrical Inst. Co.

Storage Batteries.
American Battery Co.
Electric Storage Battery Co.
Gould Storage Battery Co.

Supplies, General Elec.
Bissell Co., The F.
Central Electric Co.
Century Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Electric Co.
Manhattan Elect'l Supply Co
Wesco Supply Co.
Western Electric Co.
Western Elect. Supply Co.

Switchboards.
Bissell Co., The F.
Crouse-Hinds Co.
Gen. Incan. Arc Light Co.

Telephones, Telephone Material and Switchboards.
American El. Telephone Co
Automatic Electric Co.
Bissell Co., The F.
Central Electric Co.
Central Tel. & El. Co.
Holtzer-Cabot Elec. Co.
International Tel. Mfg. Co.
Kellogg Switchb. & Sup. Co.
Manhattan Elec. Supply Co.
Moon Mfg. Co., The.
Stromberg-Carlson Tel. M.Co
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Time Switches.
Bissell Co., The F.

Tools.
Klein & Sons, Mathias.
Western Electric Co.

Transformers.
Central Electric Co.
Crawfordsville Electric Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Works, Inc.
General Electric Co.
Gregory Electric Co.
Kuhlman Electric Co.
Manhattan Elec. Supply Co.
National Electric Co.
Stanley Elec. Mfg Co.
Wagner Electric Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Trucks, Electric Car.
General Electric Co.
Westinghouse El. & Mfg. Co.

Turbines, Steam.
Allis-Chalmers Co.
General Electric Co.
Westinghouse El. & Mfg. Co

Turbine Water Wheels
Leffel & Co., Jas.

Varnishes.
Dielectric Mfg. Co.
Sterling Varnish Co.

Vulcanized Fibre.
Vulcanized Fibre Co.

Whistles, Electric.
Electrical Appliance Co.

Wires & Cables—Magnet Wires.
American Electrical Works.
Bissell Co., The F.
Central Electric Co.
Chicago Insulated Wire Co.
Crescent Ins. Wire & Cble. Co.
Driver-Harris Wire Co.
Electric Appliance Co.
General Electric Co.
Hazard Manufacturing Co.
Indiana Rub. & Ins. Wire Co
India Rubber & Gutta Percha Insulating Co.
Kellogg Switch. & Sup. Co.
Manhattan Elec. Supply Co.
National India Rubber Co
New York Insulated Wire Co.
Okonite Co., The.
Phillips, Eugene F.
Phillips Insulated Wire Co
Roebling's Sons Co., J. A.
Runzel-Lenz Elec. Mfg. Co.
Safety Ins. Wire & Cable Co.
Simplex Electrical Co.
Standard Underground C. Co
Wesco Supply Co.
Western Electric Company.
Western Elec. Supply Co.

For Alphabetical Index of Advertisements See Page 3.

HOLOPHANE GLASS CO'S EXHIBIT

ELECTRICITY BUILDING, WORLD'S FAIR

ST. LOUIS, MO.

No one interested in electricity, electric lighting, or illumination in general who visits the St. Louis fair should fail to visit the Holophane Glass Co's exhibit of scientific glassware, and especially to see the demonstrations made in their dark rooms of the merits of Holophane globes and reflectors for giving a much higher illuminating return from artificial lights than can be obtained from any of the ordinary glass globes and reflectors now so generally used.

The Holophane Glass Co. claim that their scientific glassware gives a much higher light return than can be obtained from any other glass globes and reflectors, and also that an intelligent use of the different globes and reflectors designed by them for different light distribution enables any architect or engineer to not only get the greatest illuminating results from a given quantity of artificial light, but to practically get exactly the light distribution that is needed to suit each case.

After careful tests made in their own laboratories, the following electric lamp manufacturers not only thoroughly endorse the scientific and practical merits of Holophane scientific glassware, but intend to make large use of it in connection with their lamps:

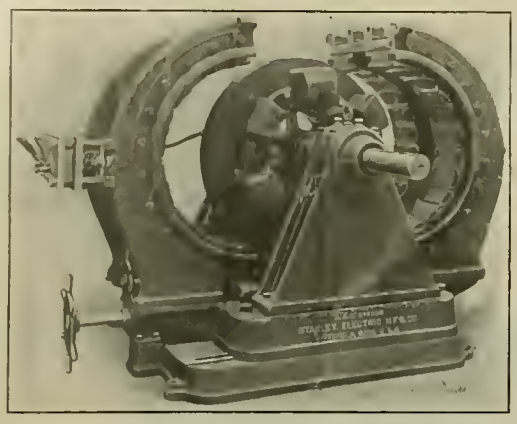
General Electric Co.
Bryan-Marsh Co.
The Columbia Inc. Lamp Co.
Western Electric Co.
The Buckeye Electric Co.
The Fostoria Inc. Lamp Co.
The Shelby Electric Co.
The Sunbeam Inc. Lamp Co. of Canada, Ltd.
Independent Incandescent Lamp Co.
The Warren Electric & Specialty Co.
The Colonial Electric Co.
New York & Ohio Co.
Brilliant Electric Co., Etc., Etc.

HOLOPHANE GLOBES AND REFLECTORS ARE FOR SALE BY ALL FIRST-CLASS ELECTRICAL DEALERS IN THE UNITED STATES.

HOLOPHANE GLASS CO.

15 EAST 32d ST., NEW YORK

THE V. R. LANSINGH CO., Western Distributors, 207-209-211 Jackson Boulevard, CHICAGO.



The S. K. C. Inductor Alternator

Ability to Start Up
Oil Up
Shut Up
and occasionally Clean Up

is all that is required to operate the Inductor Alternator as built by the Stanley Electric Manufacturing Company.

Does simplicity appeal to you? You have it in the Inductor with no moving wires, brushes, commutator or collector rings.

Do you desire inexpensive operation? The Inductor has nothing to renew, and only the bearings require attention.

Are your facilities for handling machinery limited? The Inductor is not difficult to install.

Bulletins Nos. 123 and 128 tell all about it. Send for them.

The Stanley Electric Manufacturing Company
Pittsfield, Massachusetts, U. S. A.

Monitor Bushings

Greatest efficiency at least cost. Absolute protection to wires drawn over conduit ends. Made of one piece of sheet steel and cannot be broken. Enameled insulation. No special tools required to attach. Approved by fire underwriters. Write for bulletin 1002.

BOSSERT
Electric Construction Company
UTICA, N. Y.

ADJUST YOUR LIGHT

by means of our

Wall, Desk, Floor or Ceiling Adjustable Fixtures

TO ANY DESIRED POSITION INSTANTLY.

Many shapes and styles—plain and ornamental—for shop, factory, store, office, residence—in fact, wherever the incandescent lamp is used.

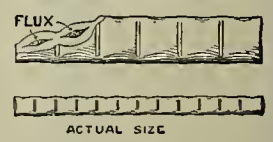
Catalog mailed upon request.

FARIES MFG. CO.,
DECATUR, ILL.

KESTER SELF FLUXING SOLDER

A Tube of Solder Filled with Flux. Requires no Acid.

SAVES—LABOR—TIME—MONEY.



PATENTED.

Send for Free Samples.

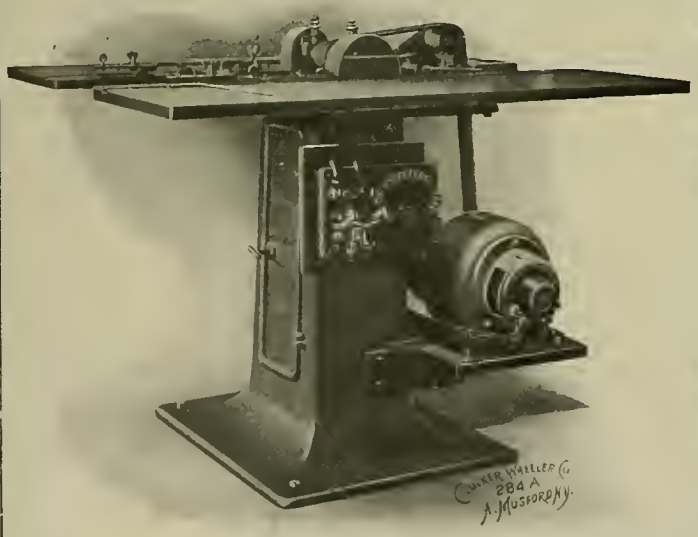
L. F. Mahler Co., R. 1008 Chemical Bldg., St. Louis, Mo., Gen. Western Agent.

KESTER ELECTRIC M'F'G CO.,
46 N. UNION STREET, CHICAGO, ILL.

"Uncle Sam, Printer"

uses over 500 C.-W. Motors in the Government Printing Office

Our bulletin 45 tells of this equipment. Write for it



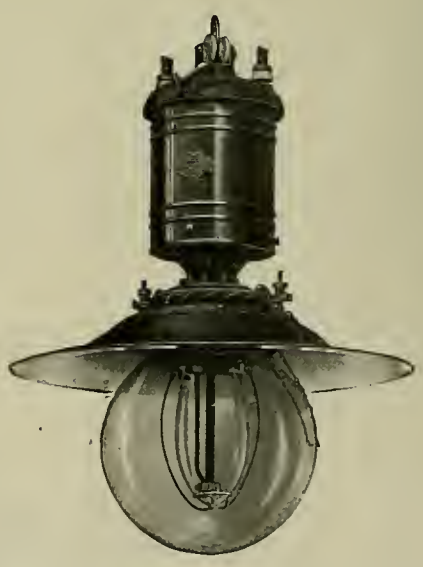
Electrotyping Saw in Government Printing Office.

Crocker-Wheeler Company
Manufacturers of
Generators and Motors
AMPERE, N. J.

Branch Offices in Sixteen Principal Cities

Complete Lighting Systems

DIRECT AND ALTERNATING CURRENTS



Western Electric Company

CHICAGO NEW YORK
And Other Principal Cities.

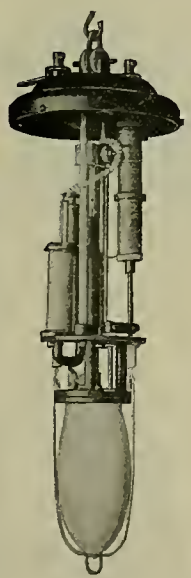
Space 17 Electricity Building, Louisiana Purchase Exposition

THE remaining September issues of the WESTERN ELECTRICIAN will contain the proceedings of the International Electrical Congress and the many other important conventions which will be held within the next three weeks.

Advertisers will find these issues of the greatest value for placing the merits of their product before the buyers of the world. Send copy for an attractive announcement TODAY.

WESTERN ELECTRICIAN
510 Marquette Building, Chicago

General Electric Company



Edgewise Wound Enclosed Arc Lamps

FOR 110-VOLT DIRECT CURRENT SERVICE

Embody the latest features
of Arc Lamp manufacture.

INDESTRUCTIBLE.
PERFECT REGULATION.
PERMANENT ADJUSTMENT.
COMPOSED OF FEW PARTS.
SIMPLICITY AND RIGIDITY OF CONNECTIONS.

Write for further information.

GENERAL OFFICES: SCHENECTADY, N. Y.

Chicago Office: Monadnock Block. Sales Offices In All Large Cities.

PRISMO ZENITH LAMPS

Two watts per candlepower.
Two sizes—25 and 55 candlepower.

Prismo Zenith Lamps carried in stock. { Chicago, San Francisco, Warren.

ELECTRIC APPLIANCE COMPANY

ELECTRICAL SUPPLIES

CHICAGO AND SAN FRANCISCO

EDISON MINIATURE LAMPS

Have been for twenty years
The Standard of the World

and are to-day more largely used than all other makes combined.

Serviceable, Economical, Reliable.

Miniature and Candelabra Sockets and Receptacles.

EDISON DECORATIVE & MINIATURE LAMP DEPT.,
General Electric Company, Harrison, N. J.

ELECTRIC SIGN FLASHERS

BEST IN THE WORLD
Write for full particulars
Reynolds Elec. Flasher Mfg. Co.
221 Fifth Ave., Chicago.

BEARDSLEE CHANDELIER M'F'G CO. 256 AND 257 SO CANAL ST. CHICAGO
GAS & ELECTRIC FIXTURES FOR THE TRADE.
CATALOG SENT PREPAID TO DEALERS MENTION THIS PAPER

VOLT - AMMETERS,

POCKET SIZE,

For Testing Batteries and Battery Circuits, Locating Faults, Grounds, etc.
RELIABLE. ACCURATE.
Send for Circular.

L. M. PIGNOLET,
78-80 Cortlandt St., NEW YORK, N. Y.

Electric Heating Apparatus

SEND FOR 82-PAGE CATALOGUE.

UNIT" ENAMELED RHEOSTATS

SIMPLEX ELECTRIC HEATING CO.,
Cambridgeport, Mass.

MICA

Of all Qualities, in any Form at Lowest Prices

EUGENE MUNSELL AND CO.
NEW YORK and CHICAGO

INSULATION That Is.

Micanite, Linotape, M. I. C. Compound, Empire Cloth and Paper. For Years the Standard.

MICA INSULATOR CO., Originators
NEW YORK and CHICAGO

SPARKING

Reduces the working capacity of a motor or dynamo, wears out the commutator, wastes power and may cause a fire. All this may be avoided if you use . . . . . .

The only article that will PREVENT SPARKING. Will keep the commutator in good condition and PREVENT CUTTING.

Absolutely Will Not Gum The Brushes.

It will put that high gloss on the Commutator you have so long sought after.

50 Cents per Stick. $5.00 per Dozen.
SEND FOR FREE SAMPLE STICK.
For sale by all supply houses, or

K. McLENNAN & CO., Sole Mfrs., Room 411 Inter Ocean Bldg., 130 Dearborn St., CHICAGO

Warren Alternator

It's not the OLD-FASHIONED kind that revolves a bundle of copper wire and a mysterious set of copper rings one or two thousand revolutions a minute—takes brushes and intricate apparatus to collect the current and get it out on the circuit wires.

WE GUARANTEE WHAT WE SELL

AND

SELL WHAT WE GUARANTEE

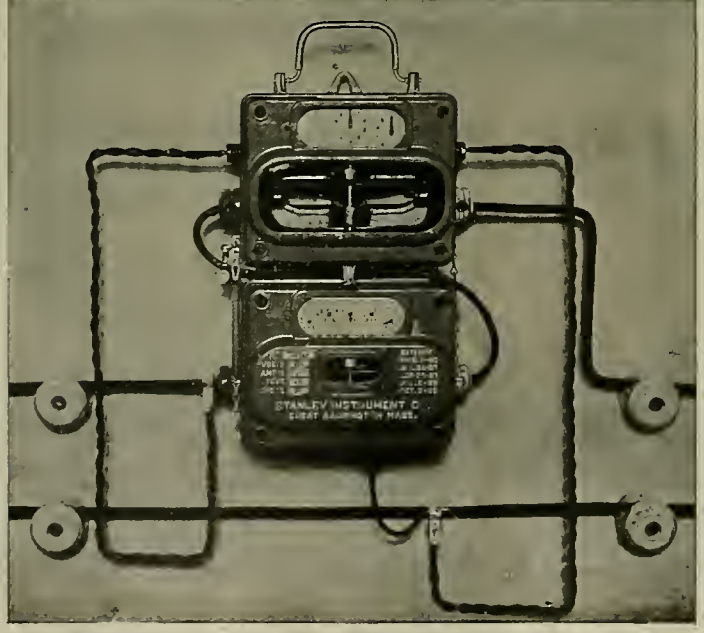
WARREN ELECTRIC MFG. CO.

Sandusky, O.

MICA-BOND

Notice how our competitors try gradually to raise Cut Mica prices—same thing would occur in manufactured mica if we were not the leaders.

CHICAGO MICA CO
"PERFECTORS" VALPARAISO, IND.



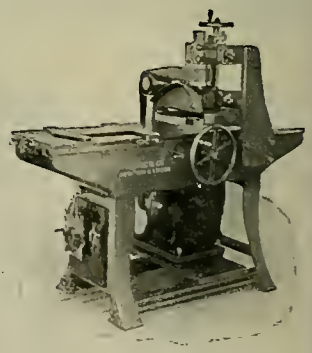
TESTING WATTMETER

ACCURATE TESTS
in a few minutes, anywhere, by one man alone without regulation of VOLTAGE, LOAD OR FREQUENCY

STANLEY INSTRUMENT CO.
GREAT BARRINGTON, MASS.

DIRECT CURRENT

MOTORS



THE ADAPTATION of our motors to mechanical drive is practically universal, and their service is unequaled.

Write for Bulletin No. 21814.

SPRAGUE ELECTRIC COMPANY

General Offices:
527 West 34th Street, New York.

Chicago Office: Fisher Building.

FRANK N. PHILLIPS, PRESIDENT. C. H. WAGENSEIL, TREASURER. EUGENE F. PHILLIPS, GENERAL MANAGER. E. ROWLAND PHILLIPS, VICE-PRES. C. R. REMINGTON, JR., SEC

AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.

BARE AND INSULATED ELECTRIC WIRE,

ELECTRIC LIGHT LINE WIRE, INCANDESCENT AND FLEXIBLE CORDS,

Railway Feeder and Trolley Wire,

AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR WIRES.

CABLES FOR AERIAL AND UNDERGROUND USE.

NEW YORK STORE, W. J. Watson, 26 Cortlandt St.
CHICAGO STORE, F. E. Donohoe, 82 Lake St.
MONTREAL BRANCH, Eugene F. Phillips' Electrical Works.

MAIN OFFICES AND FACTORIES, PHILLIPSDALE, R.I.

DO YOU BURY MONEY?

WHY NOT EARN THE INTEREST?

Burying Dead Men is like Burying Money WHEN

STOMBAUGH GUY ANCHORS

ARE SO MUCH MORE INEXPENSIVE AND DO THE WORK BETTER.

SIMPLY SCREW THEM IN—THAT'S ALL.

W. N. MATTHEWS & BRO.

Distributers

603 CARLETON BUILDING *ST. LOUIS*

EXPERT IN ELECTRICITY MECHANICS PATENT CAUSES

SOLICITOR OF U. S. & FOREIGN **PATENTS**

FOREE BAIN, 1652-3 Monadnock Blk., CHICAGO

Pillsbury Alternating Current Ceiling Fans

MANUFACTURED BY CENTURY ELECTRIC CO., St. Louis, Mo

Sterling Black Plastic Insulator.

One hundred days' continuous baking at 180° F. will not make it brittle. Water repellent. Oil proof.

THE STERLING VARNISH CO., - - Pittsburg, Pa.

Engineering MECHANICAL, ELECTRICAL, STEAM, CIVIL.

Complete and short courses. Thoroughly equipped engineering shops. Shop work from the beginning. Short courses in Steam and Electrical Engineering. Expenses low. Accommodations the best. School all year. Students may enter any time. Correspondence steam and electrical courses. Send for catalogue. Mention course in which interested.

HIGHLAND PARK COLLEGE, DES MOINES, IOWA.

USE

"SAFETY" RUBBER COVERED WIRE AND CABLE

FOR EVERY ELECTRICAL SERVICE.

M. B. AUSTIN & CO.,

CHICAGO REPRESENTATIVE.

THE SAFETY INSULATED WIRE & CABLE CO.,

WORKS: Bayonne, N. J. 114-116 LIBERTY STREET, N. Y.

SAUQUOIT SILK MFG. COMPANY,

INSULATING and BRAIDING SILKS

MILLS:
BETHLEHEM, PA.
PHILADELPHIA, PA.
SCRANTON, PA.

NEW YORK REPRESENTATIVES:
WILLIAM RYLE & COMPANY
84 HOWARD STREET

PHILADELPHIA OFFICE: 4015 Clarissa St.
CHICAGO OFFICE: 210 Monroe St.
BOSTON OFFICE: 78 Chauncy St.

YOST SPECIALTIES.

Sockets, Wall Sockets, Weatherproof Sockets, Rosettes, Receptacles, Cord Adjusters.

Catalogue for the asking.

THE YOST ELECTRIC MFG. CO.
TOLEDO, OHIO.

Our Compound Stops Sparking and Saves Commutators.

14 Years' Use on Street Ry., Light and Power Commutators Has Proven its Worth. WE GUARANTEE RESULTS.

Send Your Address for FREE SAMPLE THAT CONVINCES.

JAS. McLAUGHLIN & CO., ELECTRICAL ENGINEERS

586 Fulton Street, - - Chicago, Ill.

Crimshaw

Raven White Core

Raven Black Core

ALL OUR WIRES pass inspection and carry the above TRADE-MARKS on our tags. We also manufacture Crimshaw and Competition Tapes and Splicing Compounds.

NEW YORK INSULATED WIRE COMPANY,

MAIN OFFICE: 114, 116 & 118 Liberty St., New York.

BRANCHES: CHICAGO: 192 Desplaines St. BOSTON: 7 Otis St. SAN FRANCISCO: 33 Second St.

NATIONAL CODE STANDARD

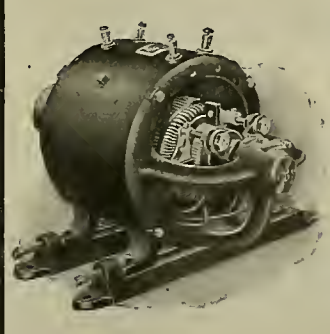
"O. K." Weatherproof Wire.

Slow-Burning Weatherproof and Ideal Wire.

Prices and Samples on Application.

Phillips Insulated Wire Co.

Office and Factory: PAWTUCKET, R. I.



Hobart Motors

have the best bearing and simplest brush holder found on any motor. The rest of the machine is built to correspond.

The Hobart Electric Mfg. Co.
TROY, OHIO

WANTED, FOR SALE *and similar* **WANT COLUMN** *advertisements (50 words or less), $1.50 an insertion; additional words 3c each.* **POSITION WANTED** *advertisements (50 words or less), $1.00 an insertion; additional words 2c each.*

POSITION WANTED.

By young man as superintendent of electric light plant or municipal light and water plant. Ten years' practical experience and technical education. Can handle engineering and business ends. Would consider electric railway or salesman's positions. Address BOX 390, care of Western Electrician, 510 Marquette Building, Chicago.

POSITION WANTED.

As manager, superintendent or electrical engineer of light or power plant; or would considar other positions in the electrical line where a man of trust and ability is needed. Eleven years' experience. Very best references. Thirty-four years old. Address BOX 393, care Western Electrician, 510 Marquette Bldg., Chicago.

POSITION WANTED.

As superintendent, electrician or engineer, in electric light or water-works plant; have had 16 years' experience with dynamos, motors, arc lamps, meters, inside wiring and construction work; have had 20 years with boilers, engines and water-works machinery. Will guarantee results. Address BOX 394, care Western Electrician, 510 Marquette Bldg., Chicago.

POSITION WANTED.

Chief engineer now in charge of a large power, light, ice and refrigerating plant, desires change of position. 18 years' experience, technical education, fully familiar with compound condensing engines, D. C. and A. C. 3-phase generators and refrigerating machinery. Address BOX 395, care Western Electrician, 510 Marquette Bldg., Chicago.

MACHINERY FOR SALE BY THE CITY OF ELY, MINNESOTA.

1—Steal Smokestack, height 80 ft., diameter 4 ft.

2—16 ft. x 60 in. Ducey Boilers, 46-4 in. tubes.

1 Buckeye automatic cut-off high speed Engine, size 15x16 in., 68 in. fly-wheel, 21 in. face.

1—Erie Ball automatic cut-off high speed Engine, size 12x13 in., 54 in. fly-wheel, 13 in. face.

1—Erie Ball automatic cut-off high speed Engine, size 9x12 in., 54 in. fly-wheel, 13 in. face.

1—General Electric Co. 120 K. W. Alt. Current Generator, 1,040 to 1,150 volts, 16,000 alt., ring oilers, sliding base.

2—Westinghouse, 60 K.W. Alt. Current Generators, 1,040 to 1,150 volts, 16,000 alt., ring oilers, sliding base.

These three machines are equipped with Exciters mounted on sliding bases; marble switchboard, size 9x6 ft., mounted with 3 three-way knife switches; 3 Exciter Switches; 6 Rheostats; 3 Volt-meters; 3 Ampere Meters; 3 Pilot Transformers; 1 eight-point Ground Detector and 3 sets of Wurts Lightning Arresters.

1—35 Light Brush Series Arc Machine with Regulator, Ampere Meter and 25 9.9 Series Open Arc Lamps.

1—Endless Leather Belt—30 feet long—double, two-ply, 16 inches wide.

1—Endless Leather Dynamo Belt 28 feet long, double, 12 inches wide, two-ply, good as new.

1—Endless Leather Dynamo Belt 20 feet long, double, 12 inches wide, two-ply, good as new.

1—Boiler Breeching for three boilers, breeching is 60 feet long with elbow in center, size of breeching 3 feet by 6 feet.

This machinery is all in running order and can be seen at the old light and water plant at Ely, Minn.

The city has also for sale one Hutson Chemical Engine, manufactured by the Marinette Iron Works, at Chicago, Ill. Same may be seen at the City Fire Hall.

Any information desired will be furnished by the undersigned.

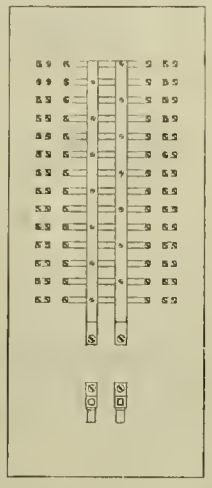
L. J. WHITE, City Clerk.

WARNING.

The trade is warned against selling or using bushings which infringe upon our Letters Patent No. 687,812, dated December 3, 1901. We have brought suit against the Chase-Shawmut Company under said Letters Patent, and shall enforce our rights, against those who use, and those who sell infringing bushings.

The Bossert Electric Construction Co.,
UTICA, N. Y.

PANEL BOARDS



WE BUILD THEM

Send for illustrated Bulletin 20 W, on high-grade Panels, Boxes and Covers.

THE F. BISSELL COMPANY
MANUFACTURERS AND JOBBERS OF
ELECTRICAL GOODS
226-228-230 HURON STREET
TOLEDO, O.

REPAIRING RECALIBRATING

ELECTRIC METERS.
INTERNATIONAL ELECTRIC METER CO.
167 S. CANAL STREET, CHICAGO.

FOR SALE.

ALTERNATORS.

1-360 K. W. General Electric 3-phase.
1-120 " " " "
1-75 " Westinghouse 2-phase.

250-VOLT GENERATORS.

1-250 K. W. Western Electric M. P.
1-200 " Eddy M. P.

125-VOLT GENERATORS.

1-125 K. W. Western Electric M. P.

Immediate shipment.

GREGORY ELECTRIC CO.
54-62 S. CLINTON ST. CHICAGO

"Practical and to the Point"

IS ALL THAT NEED BE SAID OF

THE TELEPHONE HAND-BOOK

By HERBERT LAWS WEBB.

160 Pages, 133 Illustrations, Cloth, Price $1.00.

The book for those interested in telephony.

ELECTRICIAN PUBLISHING CO.,
510 Marquette Bldg.,
CHICAGO.

All Supply Houses

J.J.EGAN'S "ACME" COMMUTATOR COMPOUND.

J. J. EGAN'S "ACME" COMMUTATOR COMPOUND absolutely prevents sparking or cutting. One stick of "Acme" is equal to one gallon of oil for lubricating commutators. Free Sample. AGENTS WANTED. 50c per Stick. $5.00 per doz.

J. J. Egan Sole Mfg., 317 Austin Ave., Tel. Polk, 1779 Chicago

BOILERS.

One 42-in. x 16 ft. 9-in., 250 H. P. Worthington Water Tube.
One 60-in. x 16 ft., John Mohr Return Tubular Boiler.
One 54-in. x 16 ft., John Mohr Return Tubular Boiler.
One 54-in. x 16 ft., Devine Tubular Boiler.

ENGINES.

One 600 H. P., 21 x 36 x 30, Williams Tandem Horizontal Compound, 140 R. P. M.
Two 600 H. P., 20 x 30 x 24, Porter-Allen Tandem Compound, 200 R. P. M.
One 250 H. P., 12 x 24 x 18 Williams Tandem Compound, 250 R. P. M.
Two 100 H. P., 13 x 12, Dick & Church, High Speed Automatic.

PARTIAL LIST ONLY.

Send for latest Catalogue for bargains in Engines, Boilers, Dynamos and Motors.

CENTRAL STATION IMPROVEMENT CO., 938 Monadnock Block, Chicago

"Diamond H" Switches

Trade H Mark

This Trade-Mark guarantees quality.

The Hart Mfg. Co., Hartford, Conn.

New York . Boston Chicago Toronto, Ont.

—OFFICE OF—
Town Clerk
A. R. KAUFMAN, CLERK

BOARD OF TRUSTEES
GEO. A. PAINTER
A. V. FANKHONER
J. J. HERRE
P. VAN NUYS, ATTY.

Summitville Ind. Nov 23 1903

Western Electrician
Chicago Ill.

Gentlemen: You may discontinue our Want Advertisement with the one issue. As I have already received about 40 answers to same. Send me your bill and I will remit same to you. Thanking you very kindly for your promptness I am Yours Resp.

A. R. Kaufman
Clerk.

CHICAGO EDISON COMPANY REPAIR SHOPS
76 MARKET STREET, CHICAGO. TELEPHONE MAIN 1280.

Machine and Carpenter Work of All Kinds
Correspondence Solicited.

OPEN DAY AND NIGHT.
FIRST-CLASS EQUIPMENT THROUGHOUT.

Dynamos Armatures, Motors, Arc Lamps, Fans, Instruments.

ARNOLD ELECTRIC POWER STATION Co.
Engineers, Constructors for Complete Electric Plants. Results Guaranteed.
SUITE 1539, MARQUETTE BLDG., CHICAGO. NEW YORK OFFICE: 711 TRANSIT BLDG.

BYLLESBY, H. M. & Co.
(Incorporated)
ENGINEERS
Design, Construct and Operate Railway, Light, Power and Hydraulic Plants. Examinations and Reports.
New York Life Building, - CHICAGO, ILL.

ROBERT W. HUNT & Co., ENGINEERS
1121 The Rookery, Chicago. 66 Broadway, New York.
Monongahela Bank Bldg., Pittsburg. Norfolk House, Cannon St., London.

SARGENT & LUNDY, ENGINEERS,
RAILWAY EXCHANGE,
Cor. Jackson and Michigan Boulevards, CHICAGO.
FREDERICK SARGENT. A. D. LUNDY.

F. B. BADT,
Monadnock. Chicago.

E. W Hammer, Pres. and Treas. H. J. Minhinnick, Sec. and Gen'l Sup't.
GENERAL ENGINEERING Co., THE Consulting and Contracting Engineers.
Telephones, Electric Light, Power Transmission
Suite 1112, 135 ADAMS ST., CHICAGO.
Long Distance Telephone Central 478.

KEMP, R. W.
Consulting and Contracting Telephone Engineer.
Plans and specification for complete plants. Old plants overhauled and placed on paying basis. Territory, Kansas, Oklahoma and Indian Territory.
WELLINGTON, - - - KANSAS.

Long Distance Phone Central 2448.
SCHOTT, W. H.,
ENGINEER AND CONTRACTOR,
SPECIALTIES—Central Station Heating Plants, Water Works Steam Plants, Electric Light, Gas and Street Railway Plants.
1220-21 MARQUETTE BUILDING, CHICAGO.

W. E BAKER. H. B. BISHOP.
BAKER, W. E. & CO.
ENGINEERS,
ELECTRIC RAILWAYS.
27 William St., NEW YORK.

A WEEKLY REPRESENTATION
in this "Directory" enables engineers to keep before all possible customers.

KOHLER BROS.,
Contracting Electrical Engineers, Lighting Power Railways,
1804-1806-1808-1810-1812 Fisher Building, CHICAGO.

TRY IT.
Keep your name and address in this directory where it will be seen by possible clients.

ENGINEERS
Represented in this "Directory" are enabled to come in touch with many prospective customers who cannot be reached through any other source.

J. H. HALLBERG
Consulting Arc Lighting Expert and Practical Electrical Engineer
45 Broadway - NEW YORK
Room 169A

McLAUGHLIN, JAMES
CONSULTING
ARC LIGHTING EXPERT,
PRACTICAL ELECTRICAL AND MECHANICAL ENGINEER,
53 RIVER ST., - CHICAGO, ILL.

STANTON, LE ROY W.
Consulting Telephone Engineer
Plans, Specifications and Supervision of Installation of Complete Telephone Plants
Special Reports on Telephone Properties and Apparatus
411 Electrical Bldg., Cleveland, Ohio

BRYAN, WILLIAM H.
M. Am. Soc. M. E.,
Consulting Mechanical and Electrical Engineer.
Lincoln Trust Building, ST. LOUIS.

HORNADAY, J. P. & Co.
SUITE 1108 TRACTION BUILDING
CINCINNATI, O.
WATERWORKS, ELECTRIC RAILWAY, LIGHT, TRACTION, INDUSTRIAL AND MINERAL PROPERTIES BOUGHT AND SOLD

RUEBEL - SCHWEDTMANN-WELLS,
CONSULTING, MECHANICAL AND ELECTRICAL ENGINEERS,
Suite 801 Chemical Building, ST. LOUIS, U. S. A.

Telephone Main 3123.
WILMERDING, C. H.
CONSULTING ENGINEER
1100 Old Colony Bldg., CHICAGO.

DUGALD C. JACKSON, C. E.
WILLIAM B. JACKSON, M. E.
MEMBERS
AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS
AMERICAN SOCIETY OF MECHANICAL ENGINEERS
AMERICAN SOCIETY OF CIVIL ENGINEERS
ENGINEERS. EXPERTS.
MADISON, WIS.

DO YOU?
BUY LAMPS—OR—BUY CANDLE POWER
16 THIS LAMP AVERAGES 12
THE STEHLING ELECTRIC MANUFACTURING CO.
NEW YORK, N. Y. WARREN, O. CHICAGO, ILL.

Engineering TAUGHT BY CORRESPONDENCE
Our system of training by mail has helped thousands held down in poor positions to rise to better salaries and situations. Your chance to rise is just as good as others. Write for our free illustrated book, "Can I Become An Electrical Engineer?" We teach by mail, Electrical Engineering, Mechanical Engineering, Steam Engineering, Mechanical Drawing, Electric Lighting, Electric Railways. ELECTRICAL ENGINEER INSTITUTE, Dept. K 240 West 23rd St., New York.

A PRACTICAL BOOK
FOR PRACTICAL MEN
"MODERN WIRING DIAGRAMS AND DESCRIPTIONS FOR ELECTRICAL WORKERS."
By Henry C. Horstmann and Victor H. Tousley. 160 pages, over 200 illustrations. Full leather binding, red edges. Pocket size 4 x 6. Price, net, $1.50.
A work that not only tells you how to do it, but shows you.
THIS BOOK tells how to wire for call and alarm bells. For burglar and fire alarm. How to run bells from dynamo current. How to install and manage batteries. How to test batteries. How to test circuits. How to wire for annunciators; for telegraph and gas lighting. It tells how to locate "trouble" and "ring out" circuits. It tells about meters and transformers. It contains 30 diagrams of electric lighting circuits alone. It explains dynamos and motors; alternating and direct current. It gives 10 diagrams of ground detectors alone. It gives "Compensator" and Storage Battery installation. It gives simple and explicit explanations of the "Wheatstone Bridge" and its uses as well as volt-meter and other testing. It gives a new and simple wiring table, covering all voltages and all losses or distances, etc., etc.
SENT PREPAID ON RECEIPT OF PRICE
ELECTRICIAN PUBLISHING CO.
510 Marquette Building, Chicago

JOHN A. ROEBLING'S SONS CO.
Insulated Wire of All Kinds

Bare Copper Wire
MAIN OFFICE AND WORKS TRENTON, N. J.
AGENCIES AND BRANCHES
New York Chicago Cleveland San Francisco Philadelphia Atlanta

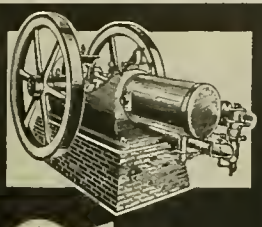
CENTRAL STATION HEATING
We are the originators and builders of the underground system of live and exhaust steam heating. Our system is used for the utilization and distribution of exhaust steam from electric and power plants for heating purposes. 250 Plants in successful operation. We have the only Meter System. Also manufacturers of Wooden Water Pipe, Steam Pipe Casing, Steam Traps, Condensation Meters, Valves, Economizing Coils, Separators and full line of Steam Fitters' Supplies.
WRITE FOR PAMPHLET AND PRICE LIST
AMERICAN DISTRICT STEAM COMPANY
LOCKPORT, N.Y. CHICAGO, ILL.
MENTION WESTERN ELECTRICIAN.

BOILER WATERS CORRECTED

to remove and prevent scale and to stop corrosion. DEARBORN TREATMENT does the work. Send gallon sample for analysis. Booklet "R" now ready.

DEARBORN DRUG & CHEMICAL WORKS,

27-34 RIALTO BUILDING, CHICAGO, ILL. WM. H EDGAR, President Telephone: Harrison 3930 and 3931.



Olds Gas and Gasoline Engines

Each engine is fully tested before it leaves our factory to its full indicated horsepower. Its simplicity of construction and perfection of mechanical principles have been amply demonstrated during the past 23 years. Olds engines are standard the world over.

Stationary Engines - 2 to 100 H. P.
Portable Engines - 8 to 18 H P.

We will send full information and new illustrated catalog upon request

Olds Gasoline Engine Works
252 River Street, - Lansing, Mich.
6

Dixon's Graphite Pipe Joint Compound

Makes the tightest joints that remain free from rust and come apart easily at any time.
Write for Booklet 125D and a sample.
JOSEPH DIXON CRUCIBLE CO., JERSEY CITY, N. J.

JEFFREY Elevating, Conveying, Power Transmission, Screening, Crushing Dredging, Rock and Coal Drilling, Coal Cutting, Hauling and Washing Machinery.
OUR CATALOGUES ARE YOURS FOR THE ASKING.
The JEFFREY MANUFACTURING CO., Columbus, O., U. S. A.

Cope's Patent Quick Coupling Conduit Rod

Remember these rods have no lost motion.
These Couplings are of Steel and are made in the best possible manner.

Write for list of persons using these rods—26,000 sold since May 1902. Made in 3 ft. and 4 ft. lengths.
Price, 3 ft. 75 cents, 4 ft. 85 cents.
Patented February 24, 1903.

T. J. COPE
3244 North Fifteenth Street PHILADELPHIA, PA.

REG. TRADE MARKS
"Phosphor Bronze" DELTA

THE PHOSPHOR BRONZE SMELTING CO. LIMITED,
2200 WASHINGTON AVE., PHILADELPHIA.
"ELEPHANT BRAND PHOSPHOR-BRONZE"
INGOTS, CASTINGS, WIRE, RODS, SHEETS, ETC.
— DELTA METAL —
CASTINGS, STAMPINGS AND FORGINGS
ORIGINAL AND SOLE MAKERS IN THE U.S.

THE TELEPHONE HAND-BOOK
BY
HERBERT LAWS WEBB.
Price $1 00.
A complete and practical work in handy pocket size.
PUBLISHED BY
THE ELECTRICIAN PUBLISHING CO.,
Suite 510 Marquette Building, Chicago.

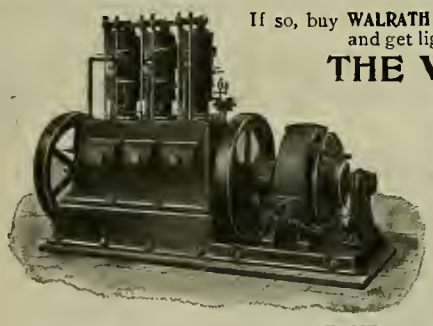
HARTFORD STEAM BOILER INSPECTION AND INSURANCE CO.
HARTFORD, CONN

ARE YOU LOOKING FOR MONEY?

If so, buy WALRATH GAS OR GASOLINE ENGINES and get light on the subject.

THE WALRATH

Received the Highest Award at the Pan-American Exposition.



It will produce as good a commercial light as that of an automatic steam engine, either belted or direct-connected generator. Simple, Economical and Reliable
Send for Catalogue W.

MARINETTE GAS ENGINE CO.,
CHICAGO HEIGHTS, ILL.

AGENCIES:
Keystone Engineering Co., Farmer's Bank Bldg., Pittsburg, Pa.
Strong, Carlisle & Hammond Co., 61-67 Frankfort St., Cleveland, Ohio
Mackay Engineering Co., 149 Broadway, N. Y.
C. H. Seidenglanz., 52 When Bldg., Indianapolis, Ind.

There's No Friction

with the Fibre-Graphite Commutator Brush.
Being 90 per cent. pure graphite, it insures low resistance, no sparking under a varying load, and longer wear. There is no greasing required. The Fibre-Graphite is therefore the most economic brush on the market. Send for price list.

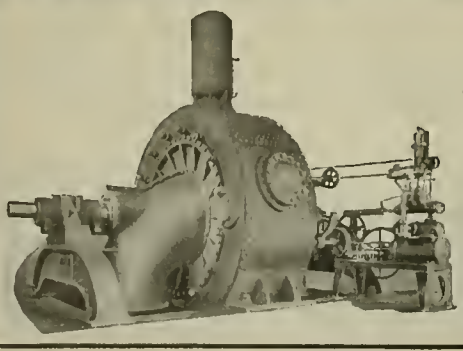
HOLMES FIBRE-GRAPHITE MFG. CO.
5155 Wakefield St., Germantown, PHILADELPHIA.

BUY Your Electrical Books of the **Electrician Publishing Co., Suite 510 Marquette Bldg., Chicago.** You will save **TIME** and **MONEY** by doing so. . . . . .

SPEER HIGH GRADE CARBON BRUSHES

MOTOR AND GENERATOR CARBON BRUSHES

SPEER CARBON CO., - St. Marys, Pa.



SAMSON TURBINE

The illustration shows the large NIAGARA design, HORIZONTAL SHAFT TURBINES recently installed by us for the TELLURIDE POWER TRANSMISSION CO., power station, Logan, Utah. Tests conducted by competent engineers developed as follows:

Head	Gateage	Speed	H-P	Generator Efficiency	Turbine Efficiency
211.5 ft.	1-2	400 r. p. m.	1038	.952 per cent	.738 per cent
209.7 "	3-4	400 " "	1560	.965 " "	.8359 " "
208.9 "	Full	406 " "	1677	.967 " "	.8057 " "

These results have never been equaled by any turbine of the Horizontal Shaft Design, operating under equally HIGH HEADS. The test was made **AFTER TURBINES WERE INSTALLED,** direct coupled to Generators. Francis' weirs and formulæ for discharge were used The original test reports on file at our offices. These turbines are all fitted with our SAMSON BALANCED GATES. Note especially the UNIFORM SPEED at ALL GATEAGES.

THE JAMES LEFFEL & CO., Springfield, Ohio, U. S. A.

There is No Higher-Class India-Rubber Insulation
For Wires and Cables than

HABIRSHAW.

Authorized Manufacturers of the
ATTIX FLEXIBLE TUBE WIRE.

The India-Rubber and Gutta-Percha Insulating Co.,
MAIN OFFICE, Glenwood Works,
Sales Office,
15 Cortlandt St., New York.
YONKERS, N. Y.
(10928)

INTERNATIONAL
Mechanical Self-Restoring
Drop Switchboard.

A PERFECT APPARATUS.
Made in any desired capacity.
Sample parts and quotations on request.

INTERNATIONAL
TELEPHONE MANUFACTURING CO.
CHICAGO, U. S. A.

TELEPHONE
PRINCIPLES AND PRACTICE
A NEW BOOK IN TELEPHONY
By
GEORGE WALKER WILDER, PH. D.
Professor in Telephony in the Armour Institute of Technology

Complete and up-to-date, written by a practical man. All about modern telephone apparatus, their principles and use:

I. Fundamental Ideas
II. Telephone Apparatus
III. Systems of Communication
IV. Construction and Equipment

IN 32 CHAPTERS, 450 PAGES, 375 ILLUSTRATIONS. PRICE $2.00 POSTPAID.
Send Postal Money Order to
THE CANTWELL PRESS - Madison, Wis.

ELECTRICAL BOOKS

Make your book purchases from the only large stock of electrical books carried in the West. Prompt shipments guaranteed. If you do not find what you want in the following list, write for complete and up-to-date book catalogue.

	Price.
Webb's Telephone Hand Book, cloth binding	$1.00
Badt's New Dynamo Tender's Hand Book, cloth binding	1.00
Badt's Incandescent Wiring Hand Book, cloth binding	1.00
Badt's Bell Hanger's Hand Book, cloth binding	1.00
Badt's Electric Transmission Hand Book, cloth binding	1.00
Dobb's The Inspector and Trouble Man, cloth binding	1.00
Steven's Mechanical Catechism, cloth binding	1.00
Hawkins' Catechism of Electricity, leather binding	2.00
Practical Electricity, leather binding	2.00
Thompson's Polyphase Electric Currents, cloth binding	3.50
Varley's Electro-Magnet, cloth binding	1.00
Buckley's Electric Lighting Plants, cloth binding	2.00
Haskins' Electricity Made Simple, cloth binding	1.00
Haskins' Transformer, cloth binding	1.25
Houston's 2-volume Electrical Dictionary, half leather, very cheap, half price	6.00
Watson's Electrician's Handy Book, cloth binding	2.50
Trevert's Armature and Magnet Winding, cloth binding	1.50
Trevert's How to Build Dynamo Electric Machinery, cloth binding	2.50
Trevert's Experimental Electricity, cloth binding	1.00
Trevert's Electricity for Students, cloth binding	1.00
Trevert's Electric Railway Engineering, cloth binding	2.00
Allsop's Bell Construction, cloth binding	1.25

	Price.
Trevert's Electrical Measurements for Amateurs, cloth binding	$1.00
Allsop's Telephones, Their Construction and Fitting, cloth binding	1.25
Allsop's Bell Fitting, cloth binding	1.25
Allsop's Induction Coils, cloth binding	1.25
Bell's Electric Power Transmission, cloth binding	3.00
Bell's Distribution for Electric Railroads, cloth binding	2.50
Cushing's Standard Wiring for Electric Light and Power, leather binding	1.00
Hanchett's Modern Electric Railway Motors, cloth binding	2.00
Houston & Kennelly's Electric Transmission of Intelligence, cloth binding	1.00
Houston & Kennelly's Electrical Measurements, cloth binding	1.00
Houston & Kennelly's Electric Heating, cloth binding	1.00
Houston & Kennelly's Electric Arc Lighting, cloth binding	1.00
Houston & Kennelly's Electric Motor, cloth binding	1.00
Houston & Kennelly's Electric Street Railways, cloth binding	1.00
Houston & Kennelly's Electric Telegraphy, cloth binding	1.00
Houston & Kennelly's Electro Therapeutics, cloth binding	1.00
Houston & Kennelly's Electricity Made Easy, cloth binding	1.50
Merill's Electric Light Specifications, cloth binding	1.50
Wiener's Dynamo Electric Machines, cloth binding	3.00

ANY OF THE ABOVE BOOKS SENT PREPAID ON RECEIPT OF PRICE.

ELECTRICIAN PUBLISHING CO.

SUITE 510 MARQUETTE BUILDING, CHICAGO.

"JUST AS GOOD AS KELLOGG APPARATUS"

cannot be bought outside our factories for the same price we ask—for a higher price or for a lower price.

Our customers never think Kellogg prices high.

We are quoting attractive magneto prices. Write us for quotations on everything in the magneto line.

Send for our new bulletins Nos. 8 to 13.

Do not miss visiting the Kellogg exhibit at the St. Louis Exposition, Electricity Building.

Kellogg Switchboard & Supply Co.,

GREEN AND CONGRESS STREETS, CHICAGO

Electric Building, Cleveland — Keystone Telephone Building, Philadelphia

BITUMINIZED FIBER CONDUIT

FOR UNDERGROUND CONSTRUCTION

Combines the **good features** of other conduits.
Eliminates the **bad features** existing in many kinds.
Has valuable features not found in any other ducts.

Made in 7-foot lengths with male and female joints, making construction very rapid and simple, with consequent low cost

Alignment is perfect and permanent without tedious care and skill required in laying of butt-joint conduits.

Users are astonished by the ease and rapidity with which cables can be drawn in, and this without the slightest scratching or injury to the lead covering thereof.

Made in sizes from 1-inch to 10-inch diameter.

Bends of any radius and any angle.

Write us for further information and prices, stating sizes and quantities required.

American Conduit Co.

Main Offices: 1005-6 Manhattan Building, Chicago

Other Offices:
170 Broadway, New York. 336 Macy St., Los Angeles

ELECTRICITY FOR ENGINEERS.

424 PAGES. ILLUSTRATED. PRICE $2.50.

ELECTRICIAN PUBLISHING CO.,
510 Marquette Building, • • CHICAGO.

M. KLEIN & SON.
Send 2c stamp for new catalogue No. 6 of
KLEIN'S TOOLS
For Electrical Workers and Line Builders.
MATHIAS KLEIN & SONS.
31 W. Van Buren St., Chicago, Ill.

MOON MFG. CO.,
43-47 So. Canal St., : CHICAGO

THE BEST KIND OF INSURANCE FOR TOLL LINES

To be erected on the most exposed parts of the line. They require no attention after erecting.

Minnesota Electric Co.,
MINNEAPOLIS, MINN.

THE PLACE TO GET A HOME
IS
MONTANA IDAHO OR WASHINGTON OREGON
THE WAY
via
NORTHERN PACIFIC
THE TIME
SEPTEMBER 15 to OCTOBER 15

VERY LOW RATES
ONE-WAY COLONIST TICKETS

FREE GOVERNMENT and LOW PRICED RAILWAY LANDS
Good for Fruit, Grain, Dairying and Poultry. Fine Summer and Winter Climate
Splendid Schools and Churches

Regarding Rates and Train Service write to
A. M. CLELAND,
General Passenger Agent, N. P. R.
ST. PAUL, MINN.

For Information and Maps write to
C. W. MOTT,
General Emigration Agent, N. P. R.
ST. PAUL, MINN.

STROMBERG-CARLSON MANUFACTURE THE SUCCESSFUL TELEPHONE SYSTEMS

Main Exchange, Kansas City Home Telephone Co., Kansas City, Mo.

Statistics show that the greatest number of SUCCESSFUL large Independent Telephone Exchanges are those using Stromberg-Carlson Apparatus. **The Reason is Apparent.**

WE ARE ALWAYS GLAD TO MAIL BULLETINS AND SUBMIT ESTIMATES

STROMBERG-CARLSON TELEPHONE MFG. CO.

Gen'l and Eastern Sales Office: Rochester, N. Y. Sales Dept: Chicago, Ill.

We introduced successful 4-party lines

LEICH SELECTIVE SYSTEM

Write for our booklet—"Selective W."

CENTRAL ENERGY OR MAGNETO

Impedance Coil for Selectives. No Springs.

AMERICAN ELECTRIC TELEPHONE CO.

CHICAGO, ILLINOIS

CORDS AND CABLES

We manufacture Cords of all descriptions used in conjunction with Telephone and Switchboard work, also Cables for Switchboard and Interior Purposes.

Write us for Prices

RUNZEL-LENZ ELECTRIC MFG. CO.

97-101 S. CLINTON STREET CHICAGO

Automatic Telephones.

Privacy

Promptness

Precision

Profits.

Automatic Electric Co., Chicago, U. S. A.

PRODUCERS AND WHOLESALERS OF WHITE CEDAR PRODUCTS

CEDAR POLES

YARDS
KOSS MICH.
L'ANSE "
MUNISING "
ONTONAGON
WAGNER, WIS
PESHTIGO "

SPECIAL PRICES ON SMALL POLES.
Write for a copy of our TELEGRAPH CODE FOR CEDAR PRODUCTS

C. H. WORCESTER CO.
SUITE 1206 TRIBUNE BLDG. CHICAGO.

POLES. WHITE CEDAR. IDAHO CEDAR up to 80 ft.

BERTHOLD & JENNINGS, ST. LOUIS. Chemical Building.

CROSS ARMS. LONG LEAF PINE AND FIR.

Cedar TORREY CEDAR CO., CLINTONVILLE, WIS. Poles
Large Stock Constantly on Hand

"STAR" INCANDESCENT LAMPS

LONG LIFE
GUARANTEED CANDLEPOWER,
HIGHEST EFFICIENCY.

MADE BY THE MOST SKILLED WORKMEN.

STANDARD ELECTRICAL MFG. COMPANY, : Niles, Ohio.

HENRY NEWGARD & CO.

ELECTRICAL CONSTRUCTION

Power and Light Plants. Switchboards and Panel Boards.

We install Municipal and Isolated Electric Lighting Plants.
We manufacture Switchboards, Table boards, Iron Cutout Boxes and Electrical Specialties.
We sell Dynamos, Motors and Electrical Supplies.
We wire old as well as new Residences, Factory Buildings, School and College Buildings.

87 Fifth Avenue, Chicago, Illinois.

THE STATE UNIVERSITY OF IOWA
SCHOOL OF APPLIED SCIENCE. Iowa City, Iowa
Four year courses of the highest grade in
Civil
Municipal
Sanitary
Electrical
Mechanical
Mining
ENGINEERING
Numerous short practical courses. Special courses in technical chemistry, bacteriology, etc. Adequate equipment in shops and laboratories. Waterpower.
University environment. Expenses low.
Address C. E. MacLEAN, President

Poles and Ties — The Fowler Companies
TRADE MARK
Fisher Bldg. Chicago

"The Nation's pleasure ground and sanitarium."—*David Bennett Hill.*

THE ADIRONDACK MOUNTAINS.

The lakes and streams in the Adirondack Mountains are full of fish, the woods are inviting, the air is filled with health, and the nights are cool and restful. If you visit this region once, you will go there again. An answer to almost any question in regard to the Adirondacks will be found in No. 20 of the "Four-Track Series," "The Adirondack Mountains and How to Reach Them;" issued by the

NEW YORK CENTRAL

A copy will be mailed free on receipt of a two-cent stamp, by George H. Daniels, General Passenger Agent, Grand Central Station, New York.

Southern Cedar POLES Are the Best.
NO ROTTEN BUTTS.
D. W. PHELAN, 277 Broadway, New York

MICHIGAN AND WESTERN CEDAR POLES
ALL LENGTHS AND SIZES
LINDSLEY BROS CO.
TRIBUNE BLDG., CHICAGO

POLES W. C. STERLING & SON, MONROE, MICH. TIES.
Eleven Pole Yards in Michigan.
Wholesale Producers for 20 years

WHITE CEDAR POLES
Don't forget our Minnesota Transfer Yard—midway between St. Paul and Minneapolis, where we load in forty-eight hours from the time we have your order.
PAGE & HILL CO. 1003 Lumber Exchange, MINNEAPOLIS, MINN.

INDUSTRIES ARE OFFERED LOCATIONS WITH

Satisfactory Inducements,
Favorable Freight Rates,
Good Labor Conditions,
Healthful Communities,

ON THE LINES OF

THE ILLINOIS CENTRAL R. R.
AND THE
YAZOO & MISSISSIPPI VALLEY R. R.

For full information and descriptive pamphlet address

J. C. CLAIR,
Industrial Commissioner,
1 Park Row, Chicago, Ill.

Locations for Industries
Erie Railroad
Chicago to New York

The Erie Railroad Company's Industrial Department has all the territory traversed by the railroad districted in relation to resources, adaptability, markets and advantages for manufacturing, and can advise with manufacturers in relation to the most suitable locations. For full information address

LUIS JACKSON
Industrial Commissioner, Erie Railroad Company
21 Cortlandt Street, New York

CEDAR POLES
THE
Valentine-Clark Co.
234 La Salle Street, CHICAGO
YARDS:
Pinconning, Mich. : Green Bay, Wis. : New London, Wis.

Points in Wisconsin and the Northwest

are covered by Wisconsin Central Railway's convenient, solid, wide vestibuled trains, equipped with Pullman sleepers, free reclining chair cars and modern coaches which leave Central Station, 12th Street and Park Row (Lake Front), Chicago for St. Paul, Minneapolis, Ashland and Duluth, connecting with all western lines. Meals in dining and cafe cars served a la carte.
For tickets and further information apply to nearest ticket agent, or write
JAS. C. POND, Gen'l Pass. Agt., Milwaukee, Wis.

READ THE BLUE ELECTRICAL PAPER.

Cedar Poles.

Pittsburg and Lake Superior Iron Co. Producers and Wholesalers. Escanaba, Mich.

POLES, TIES, POSTS. THE PORTER CEDAR CO., SAGINAW, MICH.

PRODUCERS. We want your inquiries always.

Did you ever hear about our "Trolley" Tie? The only cheap thing about it is the price.

A card will bring you full information and price, in any quantity and for immediate shipment.

Let us hear from you.

MALTBY CEDAR COMPANY, 509 Phoenix Block, Bay City, Michigan
Pittsburg Agents: Tipper & Patton, 509 Bessemer Bldg.

WORKS QUICK AND EASY. KEEPS ITS LUSTER. HOLDS OLD TRADE AND MAKES NEW. DOES NOT DETERIORATE. ESTABLISHED 15 YEARS. SOLD BY AGENTS AND DEALERS ALL OVER THE WORLD
U.S. METAL POLISH 3 OUNCE BOX, 10 CENTS. SAMPLES SENT FREE. GEO. W. HOFFMAN
POLISHES ALL METALS. BRANCHES NEW YORK, CHICAGO, SAN FRANCISCO. 295 E. WASHINGTON ST. INDIANAPOLIS, IND.

BRACKETS—X ARMS—PINS
little things it is true, but they cut a big figure in line construction.
OUR MOTTO IS:
Prompt Shipment Quality Satisfaction Right Price
COLUMBIA MFG. CO. **ANTIGO, WIS.**

"MANROSS"
HAIR SPRINGS
For Electric Indicating and Recording Gauges, Steam Gauges, Etc
LARGEST MANUFACTURER OF **HAIR SPRINGS** in the United States.
F. N. MANROSS,
FORESTVILLE, CONN.

CEDAR POLES
ESTABLISHED 1862
WM. MUELLER COMPANY
1211-12-13 MARQUETTE BLDG. CHICAGO.
EIGHT DISTRIBUTING YARDS

DON'T BUY ELECTRICAL SUPPLIES
Until you have seen our new Catalogue and new Price List.
Free to the trade.
Manhattan Electrical Supply Co.
NEW YORK: 32 Cortlandt St. CHICAGO: 188 Fifth Ave.

W. D. PAINT.
A PERMANENT INSULATING PROTECTION FOR WOOD OR METAL. A quick drying, moisture-proofing, black paint. An elastic anti-rust coating. A jet black finishing paint, efficient and not expensive.
Write for "Data on Insulating Materials."
DIELECTRIC MANUFACTURING CO., SAINT LOUIS.

SINGLE AND POLYPHASE
TRANSFORMERS
KUHLMAN ELECTRIC CO., - - Elkhart, Ind.

Idaho Cedar Poles
PACIFIC COAST POLE CO. SPOKANE, WASH.

CEDAR POLES, POSTS, TIES,
H. M. LOUD'S SONS CO., Au Sable, Mich.

WHITE CEDAR POLES
HALL L. BROOKS
52 WISCONSIN AVENUE
TOMAHAWK, WIS.

POLE DEALERS ADVERTISING IN THE WESTERN ELECTRICIAN OBTAIN MOST EXCELLENT RESULTS BECAUSE IT PLACES THEM IN TOUCH WITH ACTUAL BUYERS OF POLES. TRY A CARD.

ALL Live men read the WESTERN ELECTRICIAN Each Week. Do You?

MICHIGAN WHITE **CEDAR POLES** LARGE STOCK.
PROMPT SHIPMENTS. KELLOGG SWITCHBOARD & SUPPLY CO., Chicago.

Westinghouse
Arc Lighting System

Train Shed of the St. Louis Union Station, Lighted by Westinghouse Arc Lamps.

The efficient illumination of the enormous train shed and adjoining yards of the St. Louis Union Station, in preparation for the World's Fair traffic, was an important question.—After the keenest competition the following equipment was decided upon.

For the Train Shed and Express Buildings

550 Westinghouse A. C. Multiple Arc Lamps

For the Yards

600 Westinghouse A. C. Series Arc Lamps

Westinghouse Electric & Mfg. Co.

Pittsburg, Pa.

For full particulars address our nearest District Office

New York, Atlanta, Dallas, Baltimore, Boston, Buffalo, Chicago, Cincinnati, Cleveland, Detroit, Los Angeles, Minneapolis, New Orleans, Philadelphia, Pittsburg, St. Louis, Salt Lake City, San Francisco, Syracuse, Seattle, Denver, Mountain Electric Co.

Canada: Canadian Westinghouse Co., Limited, Hamilton, Ontario. Mexico: G. & O. & Braniff Co., City of Mexico.

FORT WAYNE ELECTRIC WORKS

Form C enclosed arc lamps are first made durable—then efficient

The solid sheet copper case, cast-iron gas cap and suspension hood joined by the central brass carbon tube form a combination that endures the stress of long and severe service. There are no penny-wise-pound-foolish economies shown in these lamps.

The edgewise contact feeding the carbon, the pivot supported mechanism, balanced flotation of armature, globe protecting gas cap and holders are but a few of the elements in the various lamps that raise their efficiency above the average.

We build Form C arc lamps for any commercial circuit and in several special types for special lighting systems of our own. All worth investigating.

268

FORT WAYNE ELECTRIC WORKS · Fort Wayne Ind. ·

FORT WAYNE ELECTRIC WORKS · Fort Wayne Ind. ·

GIVES BEST RESULTS

Northwestern Storage Battery

Can be applied for

Great Capacity, Lightness and Efficiency

LOW TENSION WORK

Write for Catalogue.

Northwestern Storage Battery Co.,

285 Madison Street, - - - - Chicago, Ill.

WIRES AND CABLES

HIGH-GRADE, RUBBER-COVERED, WEATHER-PROOF

MAGNET, OFFICE, ANNUNCIATOR WIRE.

HAZARD MANUFACTURING CO.,

GENERAL OFFICE AND WORKS, Wilkesbarre, Pa. NEW YORK OFFICE, 50 Day St. CHICAGO OFFICE, 71 and 73 West Adams St.

VULCANIZED FIBRE

Highest grades for electrical insulation and mechanical purposes, in sheets, tubes, rods and special shapes. Catalogues and samples on application.

VULCANIZED FIBRE CO., - Wilmington, Del.

KARTAVERT.

HARD AND FLEXIBLE FIBER IN SHEETS, RODS AND TUBING.

For Electrical and Mechanical Purposes, Railway Dust Guards, Washers and Packings. Patent Insulating Cleats.

MANUFACTURED BY

THE KARTAVERT MANUFACTURING CO. Wilmington, Del.

Good Advice

No. 8

A meter salesman recently accosted the manager of a large and well equipped central station and after handing him the proverbial "Havana," he announced that he was selling the best Direct Current Wattmeter on the market, to which the manager replied: It's the Duncan and I'm using it.

Good Advice No. 9 Next Week

Send for Bulletin and Prices

DUNCAN ELECTRIC MFG. CO.

LAFAYETTE, IND.

STURTEVANT GENERATING SETS

For Lighting and Power

All Types and Sizes
Between 1½ and 250 K. W.

We Build Both Engine and Generator

B. F. STURTEVANT CO.

BOSTON, MASS.

General Office and Works, Hyde Park, Mass.

NEW YORK PHILADELPHIA CHICAGO LONDON

Black Diamond File Works

Est. 1863. Inc. 1895.

Twelve Medals Awarded at International Expositions

Special Prize Gold Medal at Atlanta, 1895.

OUR GOODS ARE ON SALE IN EVERY LEADING HARDWARE STORE IN THE UNITED STATES AND CANADA.

G. & H. BARNETT COMPANY,

PHILADELPHIA, PA.

HORNBERGER-IRWIN Transformers

(LARGE AND SMALL)

½ K. W. to 500 K. W.

This transformer represents the latest improvements in transformer construction, made in three types: multi-coil construction; ventilated cores; built for all commercial voltages and frequencies **higher efficiencies together with lower temperatures than have heretofore been attained are guaranteed.**

Catalogue just issued explaining our designs

Manufactured by

Crawfordsville Electric Co.

CRAWFORDSVILLE, INDIANA, U. S. A.

Western Electrician

Vol. XXXV. $3.00 Per Annum. Copyright, 1903, by Electrician Publishing Company, Chicago. CHICAGO, SEPTEMBER 24, 1904. Entered at Chicago Postoffice as mail matter of the second class. 10 Cents a Copy. No. 13.

SIMPLEX INSULATED WIRES AND CABLES.
RUBBER COVERED, WEATHERPROOF, UNDERGROUND AND SUBMARINE.
WESTERN SELLING AGENT, H. R. HIXSON, 1144 Monadnock Block, CHICAGO.
The Simplex Electrical Co., 110 State Street, BOSTON, MASS.

National India Rubber Co.'s
RUBBER COVERED
WIRES AND CABLES.
OFFICE AND FACTORY: BRISTOL, R. I.

TRADE MARK.
1889—Paris Exposition, Medal for Rubber Insulation.
1893—World's Fair, Medal for Rubber Insulation.
THE STANDARD FOR RUBBER INSULATION.
Sole Manufacturers of
Okonite Wires, Okonite Tape, Manson Tape, Candee Weather-proof Wires.
THE OKONITE CO., LTD.
Willard L. Candee, Ourent Cheever, } Managers. 253 Broadway, New York. Geo. T. Manson, Gen'l Supt. W. H. Hodgins, Secy.

TRADE MARK
CRESCENT INSULATED WIRE & CABLE CO. TRENTON, N.J.
CRESCENT RUBBER INSULATED WIRES AND CABLES
National Code Standard.
CRESCENT INSULATED WIRE AND CABLE CO.,
New York Office, 63 BARCLAY STREET. Main Office and Factory, TRENTON, N. J.

DRIVER-HARRIS WIRE CO.
HARRISON (NEWARK), N. J.
Manufacturers of Fine Sizes Wire of Every Description.
Resistance Wires a Specialty.

INDIANA RUBBER AND INSULATED WIRE CO.,
MANUFACTURERS OF
Paranite Rubber Covered Wires and Cables,
UNDERGROUND, AERIAL, SUBMARINE AND INSIDE USE.
TELEPHONE, TELEGRAPH AND FIRE ALARM CABLES.
All Wires are tested at Factory. JONESBORO, IND.

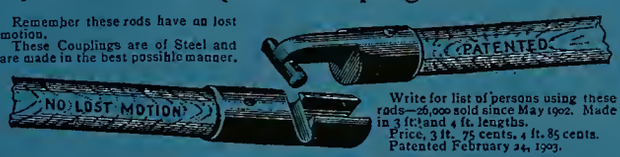
STERLING SPECIAL
DO YOU?
BUY LAMPS-OR-BUY CANDLE POWER
16 THIS LAMP AVERAGES 12
THE STERLING ELECTRICAL MANUFACTURING CO.
NEW YORK, N. Y. WARREN, O. CHICAGO, ILL.

REGULAR TYPE

"CIRCULAR LOOM" THE FLEXIBLE CONDUIT
AMERICAN CIRCULAR LOOM CO. TRADE MARK
REGISTERED
CONDUITS FOR INTERIOR WIRING.
American Circular Loom Co.
Chelsea, Mass., New York, Chicago, San Francisco.

THERMOPILES 1½ VOLTS 1½ AMPERES
For Electrolytic analysis, charging storage batteries, and other constant current requirements. $3 Each.
WALSH'S SONS & CO.,
264 Washington Street. Newark, N. J.

THOUSANDS IN USE.
Motors, ¼ h. p. to 100 h. p.
Dynamos, 1 k. w. to 75 k. w.
Highest Quality. Reasonable Price.
THE HOBART ELECTRIC MFG. CO.
TROY, OHIO.

Cope's Patent Quick Coupling Conduit Rod
Remember these rods have no lost motion.
These Couplings are of Steel and are made in the best possible manner.


Write for list of persons using these rods—26,000 sold since May 1902. Made in 3 ft. and 4 ft. lengths.
Price, 3 ft. 75 cents, 4 ft. 85 cents.
Patented February 24, 1903.
T. J. COPE
3244 North Fifteenth Street PHILADELPHIA, PA.

SAUQUOIT SILK MFG. COMPANY
INSULATING and BRAIDING SILKS
MILLS:
BETHLEHEM, PA.
PHILADELPHIA, PA.
SCRANTON, PA.
NEW YORK REPRESENTATIVES:
WILLIAM RYLE & COMPANY
54 HOWARD STREET
PHILADELPHIA OFFICE: 4015 Clarissa St.
CHICAGO OFFICE: 210 Monroe St.
BOSTON OFFICE: 78 Chauncy St.

I-T-E
CIRCUIT BREAKERS
CUTTER ELECTRICAL CO., PHILADELPHIA

DON'T BUY ELECTRICAL SUPPLIES
Until you have seen our new Catalogue and new Price List.
Free to the trade.
Manhattan Electrical Supply Co.
NEW YORK: 32 Cortlandt St. CHICAGO: 188 Fifth Ave.

USE
"SAFETY" RUBBER COVERED WIRE AND CABLE
FOR EVERY ELECTRICAL SERVICE.
M. B. AUSTIN & CO.,
CHICAGO REPRESENTATIVE.
THE SAFETY INSULATED WIRE & CABLE CO.,
WORKS: Bayonne, N. J. 114-116 LIBERTY STREET, N. Y.

Electric Heating Apparatus
SEND FOR 32-PAGE CATALOGUE.
UNIT" ENAMELED RHEOSTATS
SIMPLEX ELECTRIC HEATING CO.,
Cambridgeport, Mass.

WESTON Electrical Instrument Co.,
Waverly Park, NEWARK, N. J.

Weston Portable Galvanometer for Bridge Work.
Weston Standard Portable Direct Reading
Voltmeters, Millivoltmeters, Voltammeters,
Ammeters, Milammeters,
Ground Detectors and Circuit Testers,
Ohmmeters, Portable Galvanometers.
Our Portable Instruments are recognized as The Standard the world over. The Semi-Portable Laboratory Standards are still better
Our Station Voltmeters and Ammeters are unsurpassed in point of extreme accuracy and lowest consumption of energy.
BERLIN—European Weston Electrical Instrument Co., Ritterstrasse No. 88.
LONDON—Elliott Bros., Century Works, Lewisham.
PARIS, FRANCE—E. H. Cadiot, 12 Rue St. Georges.
New York Office—74 Cortlandt St.

CORDS AND CABLES
We manufacture Cords of all descriptions used in conjunction with Telephone and Switchboard work, also Cables for Switchboard and Interior Purposes.
Write us for Prices
RUNZEL-LENZ ELECTRIC MFG. CO.
97-101 S. CLINTON STREET CHICAGO

Allis-Chalmers Co
CHICAGO

5000 horsepower Allis-Chalmers Engine
and 3,500 K. W., Bullock Generator
Machinery Hall, World's Fair, St. Louis.

WHAT IT HAS DONE

Began unloading from train Jan. 15th—27 carloads—Generator 10 carloads.
Set first turned on April 2nd, Engine and Generator operated perfectly ever since.
St. Louis Exposition officially opened April 30th, 1904.

Preparatory testing of Exposition Buildings and Grounds first turned on evening April 20th, this Engine and Generator carrying the load.

Ran non-condensing one month while Exposition was getting its condenser plant erected and connections made. During that time carried 4800 horsepower night after night.

Steam test required to operate the Cascade.—2000 horsepower.

Exposition having finished its condenser plant, the Engine was required to take full load June 10th. That night the load reached 5175 horsepower. Began with 26 inch vacuum, no load, which, under load, ran low to about 14 inches, for 7 to 8 hours. Engine has never been out of commission, except for two nights when a valve broke and pulled the wheel off.

Since then Engine ran condensing until July 25th.—carrying 5175 horsepower with from 13 to 16 inches vacuum. On July 25th a break occurred in the Exposition's discharge pipe which takes the condenser water to the Lagoon. The Engine then ran non-condensing for two nights. It carried 4800 horsepower during that time. On July 28 ran condensing, since then it has regularly carried 4500 horsepower with an average of 12 inches vacuum.

The "Big Reliable"

Bullock
Electric Mfg Co
Cincinnati

Canadian representatives, Allis-Chalmers Bullock, Ltd., Montreal

THE ELECTRIC STORAGE BATTERY CO.

PHILADELPHIA

Extends an invitation to its exhibit at Section Twenty, in the Palace of Electricity, Louisiana Purchase Exposition.

September 12, 1904

SALES OFFICES

Philadelphia, Allegheny Ave. and 19th St. | New York, 100 Broadway. | Boston, 60 State St. | Chicago, Marquette Bldg. | St. Louis Wainwright Bldg.

San Francisco, Rialto Bldg. | Cleveland, Citizens Bldg. | Canada, Canadian General Electric Co., Ltd., Toronto | Havana, Cuba. C. F. Greenwood, Manager 34 Empedrado St.

WEATHERPROOF WIRE

"ONE OF OUR 61 VARIETIES"

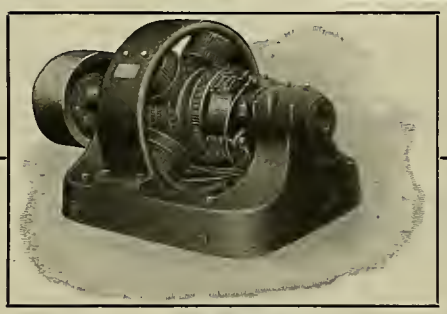
LARGE STOCK CARRIED REGULARLY AT TOLEDO

Are Prepared to Handle Big Orders Promptly

AS WELL AS SMALLER ONES

THE F. BISSELL COMPANY TOLEDO, O.

WIRE and ALL ELECTRICAL SUPPLIES



HOBART GENERATORS.

1 TO 100 K. W. THE REAL TEST IS USE.

THE HOBART ELECTRIC MFG. CO.,

TROY, OHIO.

W. D. PAINT.

A PERMANENT INSULATING PROTECTION FOR WOOD OR METAL. A quick drying, moisture-proofing, black paint. An elastic anti-rust coating. A jet black finishing paint, efficient and not expensive.

Write for "Data on Insulating Materials."

DIELECTRIC MANUFACTURING CO., SAINT LOUIS.

CARBONS

CONSUMERS CARBON CO.

LANCASTER, OHIO, U. S. A.

Carbons of all kinds and for all purposes.

PLATINUM

PLATINUM RIVETS FOR CONTACT POINTS IN TELEPHONES—SPARK COILS AND OTHER ELECTRICAL APPARATUS. PLATINUM SHEET AND WIRE IN ANY FORM AND DEGREE OF HARDNESS. PLATINUM SCRAP PURCHASED.

BAKER & COMPANY, Inc.

ARTISANS IN PLATINUM

408-410-412-414 N. J. R. R. AVE. - NEWARK, N. J.

New York Office: 120 Liberty St.

ALPHABETICAL INDEX TO ADVERTISEMENTS.

Adams-Bagnall Electric Co..—
Allis-Chalmers Company..... 2
American Battery Co.....12
Amer. Circular Loom Co.... ...1
American Conduit Co.....18
Amer. District Steam Co.....17
Amer. Elec. Fuse Co..... 8
Amer. El. Telephone Co.....18
American Electrical Works..13
Arnold Elec. Power Station Co..... 15
Automatic Electric Co..... 18

Babcock & Wilcox Co.....—
Badt, F. B.....15
Bain, Forée.....13
Baker & Company..... 3
Baker & Co., W. E.....15
Barnett Company, G. & H....24
Beardslee Chandelier Mfg.Co.--
Berthold & Jennings.....20
Big Four Route.....—
Bissell Co., The F..... 3
Bossert Electric Construction Co..... 13
Brooks, Hall L.....21
Bryan-Marsh Co.....—
Bryan, Wm. H.....15
Buckeye Electric Co.....—
Bullock Elec. Mfg. Co..... 2
Butterfield, J. F.....15
Bylesby & Co., H. M.....15

Cantwell Press, The.....17
Central Electric Co..... 5
Cent. Stat. Improvement Co..14
Central Tel. & El. Co.....19
Century Electric Co.....—
Chicago Die & Electric Co....13
Chicago Edison Co.....4, 14
Chic. Fuse Wire & Mfg. Co...17
Chicago Insulated Wire Co..—
Chicago Mica Co.....12
Clinton Stamping & Elec. Co.19
Columbia Incand. Lamp Co..—
Columbia Mfg. Co.....20
Consumers Carbon Co..... 3
Continuous Rail Joint Company of America..... 5, 8
Cope, T. J..... 1
Crawfordsville Electric Co..—
Crescent Ins. Wire & Cbl. Co. 1
Crocker-Wheeler Company... 9
Crouse-Hinds Co.....20
Cutler-Hammer Mfg. Co..... 4
Cutter Elec. & Mfg. Company 1

D. & W. Fuse Company.....—
Dearborn Drug & Chem.Wks.16
Diamond Meter Company....17
Dielectric Manufacturing Co. 3
Directory of Engineers..... 15
Dixon Crucible Co., Josepb..16
Driver-Harris Wire Co..... 1
Duncan Elec. Mfg. Co.....23
Dyar, H. W..... 14

Edison Decorative & Miniature Lamp Departm't.....12
Edison Mfg. Company.....24
Edwards & Co.....11
Egan, J. J.....14
Electric Appliance Co..... 12
Electric Storage Battery Co.. 3
Electrical Appliance Co.....—
Electrical Engineer Institute.—
Electrician Pub. Company...10
Erie Ry.....20

Faries Mfg. Co..... 8
"For Sale" Advertisements..14
Ft. Wayne Elec. Works, Inc..23
Fostoria Incand. Lamp Co...—
Fowler, John H.....20
Fowler-Jacobs Company.....20

General Electric Co..... 9
General Engineering Co., The 15
General Incandescent Arc Light Company.....—
General Incand. Lamp Co....—
Glogau & Co. H. M.....10
Gould Storage Battery Co.... 6
Green Fuel Economizer Co..16
Gregory Electric Company...14

Hallberg, J. H 15
Haller Machine Co.....--
Hart Mfg. Co..... 5
Hartford Steam Boiler Inspection & Insurance Co....—
Hazard Manufacturing Co...—
Highland Park College. ... 15
Hipwell Mfg. Co..... 17
Hobart Elec. Mfg. Co.....1, 3
Hoffman, G. W.....14
Holmes Fibre-Graph. Co.....—
Holophane Glass Co.....22
Holtzer-Cabot Electric Co... 5
Hornaday & Co., J. P.....15
Humphrey, Henry H.....15
Hunt & Co., Robt. W.....15

Illinois Central Ry.....20
Incandescent Electric Light Manipulator Company.....—
Indiana Rub. & Ins. W. Co.... 1
India Rubber & Gutta Percha Insulating Company.....—
International Elec. Meter Co 14
International Tel. Mfg. Co...18
Jackson, D. C. & W. B.....15
Jeffrey Manufacturing Co....16
Jewell Electrical Inst. Co....—
Johns-Manville Co., H. W..... 8

Kartavert Manufacturing Co.—
Kellogg Switchboard & Supply Company.....19, 21
Kemp, R. W.....15
Kester Elec. Mfg. Co.....13
Klein & Sons, Mathias.....12
Kohler Brothers.....15
Kuhlman Electric Co.....13

Leather Preserv. M. Corp....15
Leffel & Co., James.....16
Lindsley Brothers Company..21
Loud's Sons Co., H. M.....—

Machado & Roller.....—
Maltby Cedar Company.....21
Manhattan El. Supply Co.... 1
Manross, F. N. ....—
Marinette Gas Engine Co.....16
Matthews & Bros., W. N.....13
McLaughlin, James.....15
McLaughlin & Co., Jas.....14
McLennan & Company, K....12
Mechanical Appliance Co....21
Mica Insulator Company.....—
Minnesota Electric Co.....18
Miscellaneous Advs.....14
Monon Railroad.....14
Moon Mfg. Co., The.....—
Morrison Lhr. Co., J. W.....20
Mueller Company, William..21
Munsell & Co., Eugene.....12

National Electric Co..... 4
National India Rubber Co.... 1
New England Butt Co.....16
Newgard & Co., Henry.....17
New York Cent. Ry.....20
New York Ins. Wire Co.....13
Northern Elect'l Mfg. Co....12
Northern Pacific Ry.....15
Northwestern Storage Battery Co.. 9

Okonite Co., The..... 1
Olds Gasoline Engine Works.16

Pacific Coast Pole Co.....20
Page & Hill Co.....21
Paragon Fan & Motor Co.....—
Pardridge Shade & Refl. Co..—
Pass & Seymour, Inc..... 4
Phelan, D. W.....21
Phillips, Eugene F.....13
Phillips Insulated Wire Co...13
Phœnix Glass Co..... 7
Phosphor-Bronze S. Co.....16
Pignolet, L. M.....12
Pittsburg & L. S. Iron Co....20
Plume & Atwood Mfg. Co....10
Porter Cedar Company.....21

Reisinger, Hugo.....11
Reynolds El. Flasher Mfg.Co.24
Roebling's Sons Co., J. A.....24
Ruebel-Schwedtmann-Wells..15
Runzel-Lenz Elec. Mfg. Co... 1

Safety Ins. Wire & Cable Co.. 1
Sargent & Lundy.....—
Sauquoit Silk Mfg. Co..... 1
Schutt, W. H.....15
Sears, Roebuck & Co.....15
Simplex Electrical Co., The.. 1
Simplex Elec. Heating Co.... 1
Speer Carbon Co..... .—
Sprague Electric Company...24
Squire Electric Co.....—
Standard Elec. Mfg. Co.....12
Standard Underg. Cable Co....—
Stanley Elec. Mfg. Co., The 12
Stanley Instrument Co..... 8
Stanton, LeRoy W..... 15
State Univ. of Iowa.....13
Sterling & Son, W. C.....21
Sterling Electrical Mfg.Co.... 1
Sterling Varnish Co., The....14
Stow Mfg. Company.....—
Stromberg-Carlson Tel. Mfg. Company.....19
Sturtevant Company, B. F....24

Torrey Cedar Company.....21
Trumbull Elec. Mnfg. Co.....--
Turner Brass Works..... 8

Union Electric Mfg. Co.....—

Valentine-Clark Co., The....—
Vulcanized Fibre Company..24

Wagner Electric Mfg. Co.....11
Walsh's Sons & Company..... 1
Warren Elec. Mfg. Co.....24
Wesco Supply Co.....12
Western Electric Company...10
Western El. Supply Co.....—
Western Lumber & Pole Co..21
Westinghouse Electric & Manufacturing Co.....—
Weston Electrical Inst. Co.... 1
Whitehead Machinery Co... 14
Whitney Electrical Inst. Co..—
Wilmerding, C. H.....—
Wisconsin Central Ry.....20
Woolley Fdy. & Mach. Wks..16
Worcester Company, C. H....20
Wrigley & Co., Thomas..... 9

Yesbera Mfg. Co..... .. 18
Yost Electric Mfg. Co 14

Zero Marx Sign Works..... 13

For Classified Index of Advertisements See Page 6.

REMEMBER THE NAME AND BUY THE BEST.

PARAGON FAN MOTORS

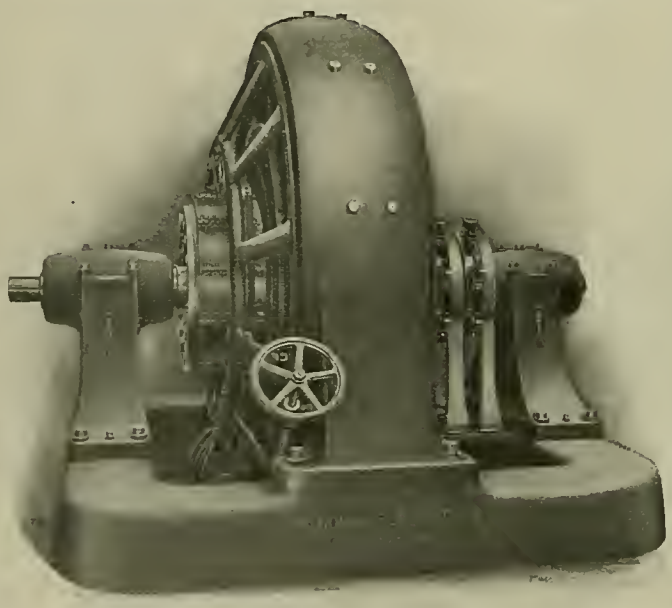
NEW STYLES NEW PRICES
EASY RUNNING RIGID CONSTRUCTION NOISELESS

CALL AND SEE THEM OR WRITE FOR PRICES

CHICAGO EDISON COMPANY,
139 ADAMS ST., CHICAGO.

National

Electrical Machinery
built in all capacities
Direct and Alternating
apparatus of the highest grade



1,000 K. W. Rotary Converter

National Electric Company

GENERAL SALES OFFICES & WORKS:

Philodelphia: Land Title Bldg.
New York: 135 Broadway
Chicago: Old Colony Bldg.
Pittsburg: Gellatly & Co

Milwaukee

Charleston, W. Va: Agnew Electric Co.
Seattle & San Francisco
Kilbourne & Clark Co.

C & H Field Regulator

The best, the simplest and the most durable field regulator on the market.

WHY ?

Has no enamel to crack; will not ground; white hot wire tests have proven worth of resistance material; will carry overloads safely; no small parts to get out of order; no loose contacts to bother with; made of best material throughout; easily controlled; will not stick, nor will jar of machinery deviate lever.

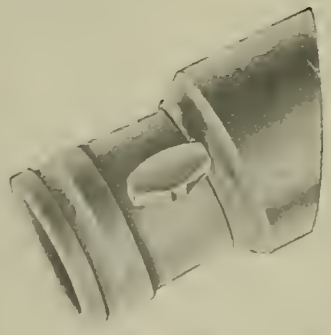
The Cutler-Hammer Mfg. Co.

MILWAUKEE, WIS.

New York Boston Chicago Pittsburg

2

Key Keyless



Patented Sept. 8, 1896; Oct. 6, 1896

Edison

T. H. W. H.

P. & S.

Porcelain Angle Sockets

Designed especially for show window work, and may be used in open or concealed wiring.

PASS & SEYMOUR, Inc.

SOLVAY, N. Y.

NEW YORK CHICAGO SAN FRANCISCO

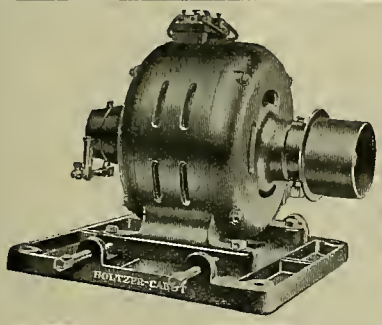
Pittsburg Transformers

Are not a source of expense as they do not burn out under normal conditions and will, when operated in oil, carry over-loads of 25 per cent. for periods of three or four hours without a temperature rise entirely within safe limits.

WE CARRY A STOCK IN CHICAGO.

Central Electric Company, *GENERAL SALES AGENTS,* 264-266-268-270 FIFTH AVENUE, CHICAGO.

Do You Know It?



WHAT!

¶ That we make single phase alternating current motors from 1-8 to 2 H. P.

¶ **Are they good and what is the price?**

¶ Well, just send for Bulletin 0304. It tells all about it.

THE HOLTZER-CABOT ELECTRIC COMPANY
BROOKLINE, MASS. NEW YORK CHICAGO

"Diamond H" Switches

Trade H Mark

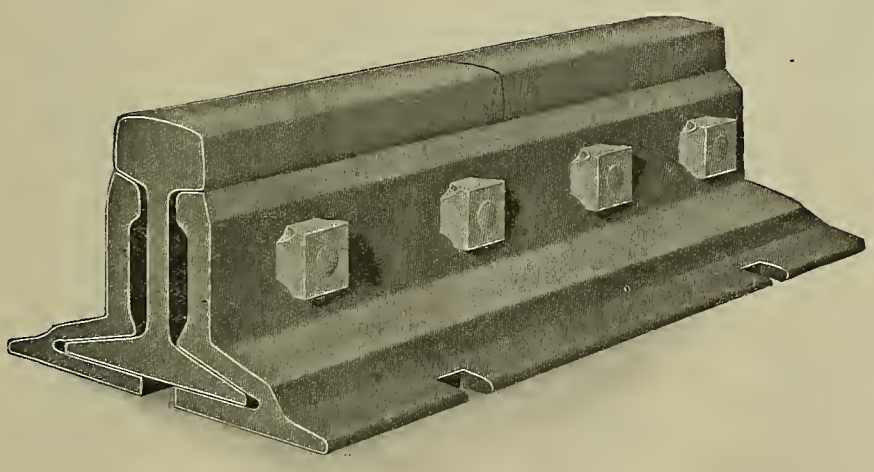
This Trade-Mark guarantees quality.

The Hart Mfg. Co., Hartford, Conn.

New York Boston Chicago Toronto, Ont.

Over 20,000 Miles in Use

SEE OUR EXHIBIT AT THE WORLD'S FAIR
ST. LOUIS, MO.
Transportation Bldg., Aisle "C," Posts 7 and 8



P ERFECTLY willing to give you an estimate on rail joints or any track material.

D O justice to yourself and Company by asking our quotations before placing your orders.

Q UESTIONS answered and prices quoted for special rolling, angles, rounds, flats, tramangles, etc.

ROLLED FROM BEST QUALITY STEEL

For RAIL JOINTS address

CONTINUOUS RAIL JOINT CO. OF AMERICA, Century Building NEWARK, N. J.

For Special and other Track Material address

ALBANY IRON AND STEEL WORKS, 142 Market St., NEWARK, N. J.

Gould Storage Battery Co.

Complete Storage Battery Plants

Railway Line and Regulating
Isolated and Train Lighting
Central Lighting and Power
Electric Vehicle and Telephone

GOULD COUNTER E. M. F. BOOSTER SYSTEMS

Sales Offices { NEW YORK, 1 W. 34th Street. BOSTON, 89 State Street. CHICAGO, The "Rookery." SAN FRANCISCO, Century Electric Co.

WORKS: DEPEW, N. Y.

Bulletins.

CLASSIFIED INDEX OF ADVERTISEMENTS.

Adjusters, Cord.
Incandes. El. Lt. Manip. Co.

Adjusters, Inc. Lamps.
Inc. El. Lt. Manipulator Co.

Anchors (Tel. & Tel.)
Matthews & Bro., W. N.
Crouse-Hinds Co.

Annunciators.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Moon Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Batteries and Jars.
Bissell Co., The F.
Central Electric Co.
Edison Mfg. Co.
Edwards & Company.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Bells, Buzzers, Etc.
Central Electric Co.
Edwards & Co.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Belt Dressing.
Dixon Crucible Co., Jos.
Leather Preserver Mfg. Corp.

Belting.
Leather Preserver Mfg. Corp

Blow Pipes.
Turner Brass Works

Blowers.
Sturtevant Co., B. F.

Boiler Compounds.
Dearborn Drug & Chem. Wks.

Boilers.
Allis-Chalmers Company.
Babcock & Wilcox Co.

Books, Electrical.
Cantwell Press, The.
Electrician Publishing Co.

Booths, Telephone.
Yesbera Mfg. Co.

Brackets.
Faries Mfg. Co.

Brushes.
Central Electric Co.
Hobart Elec. Mfg. Co.
Holmes Fibre-Graphite Co.
Speer Carbon Co.
Western Electric Company.

Cable Hangers.
Bissell Co., B. F.
Western Electric Co.

Cables (See Wires and Cables)

Canopies.
Faries Mfg. Co.

Carbons, Plates and Plates.
Central Electric Co.
Chicago Edison Co.
Consumers Carbon Co.
Electric Appliance Co.
Reisinger, Hugo.
Speer Carbon Co.
Wesco Supply Co.
Western Elec. Supply Co.

Castings.
Faries Mfg. Co.
New England Butt Co.
National Electric Co.

Chains.
Jeffrey Mfg. Co.

Chandeliers.
Faries Mfg. Co.

Circuit Brenkers.
Cutler-Hammer Mfg. Co.
Cutter Elec. & Mfg. Co.
Ft. Wayne Elec. Wks. Inc.
Union Electric Mfg. Co.
Western Electric Company.
Westinghouse El. & Mfg. Co.

Clusters.
Faries Mfg. Co.

Coal and Ashes Handling Machinery.
Jeffrey Mfg. Co.

Coils and Magnets.
Western Electric Co.

Commutator Compound
Egao, J. J.
McLaughlin & Co., Jas.
McLennan & Co., K.

Condensers, Electric.
Stanley Elec. Mfg. Co.

Conduit and Conduits.
American Circular Loom Co.
American Conduit Company
Central Electric Co.
Electric Appliance Co.
Sprague Electric Co.
Standard Vitrified Cond. Co.
Wesco Supply Co.
Western Electrical Supply Co.

Contractors and Electric Light Plants.
Allis-Chalmers Company.
Bullock El. Mfg. Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
National Electric Co.
Northern Electrical Mfg. Co.
Sprague Electric Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Controllers, Crane.
Amer. Elec. Fuse Co.

Cord.
Runzel-Lenz Elec. Mfg. Co.

Cross-Arms, Pins and Brackets.
Berthold & Jennings.
Central Electric Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Company.
Western Elec. Supply Co.

Cut-Outs and Switches.
Bissell Co., The F.
Bossert Elec. Const. Co.
Central Electric Co.
Chicago Edison Co.
Clinton Stamping & Elec. Co.
Crouse-Hinds Co.
Cutter Elec. & Mfg. Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
General Inc. Arc Light Co.
Hart Manufacturing Co.
Manhattan Elec. Supply Co.
Trumbull Elec. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Dynamos and Motors.
Allis-Chalmers Company.
Bissell Co., The F.
Bullock Elec. Mfg. Co.
Central Electric Co.
Century Electric Co.
Crawfordsville Electric Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks. Inc.
General Elec. Co.
General Inc. Arc Light Co.
Gregory Electric Co.
Hobart Elec. Mfg. Co.
Holtzer-Cabot Electric Co
Mechanical Appliance Co.
National Electric Co.
Northern Electrical Mfg. Co.
Sprague Electric Co.
Stanley Elec. Mfg. Co.
Stow Manufacturing Co.
Sturtevant Co., B. F.
Wagner Electric Mfg. Co.
Warren Elec. Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Economizers, Fuel.
Green Fuel Economizer Co.

Electric Heating Appl.
Simplex Elec. Heating Co.
Western Electric Co.

Electric Railways.
Crocker-Wheeler Co.
General Electric Co.
Sprague Electric Co.
Westinghouse El. & Mfg. Co.

Electrical and Mechanical Engineers.
Arnold Elec. Power Stat'n Co.
Badt, F. B.
Baker & Co., W. E.
Bryan, Wm. H.
Butterfield, J. F.
Byllesby & Co., H. M.
General Engineering Co., The.
Hallberg, J. H.
Hornaday, J. P. & Co.
Humphrey, Henry H.
Hunt & Co., Robt. W.
Jackson, D. C. & W. B.
Kemp, R. W.
Kohler Brothers.
McLaughlin, James
Newgard & Co., Henry.
Northern Electrical Mfg. Co.
Ruebel, Schwedtman, Wells.
Sargent & Lundy.
Schott, W. H.
Squire Electric Co.
Stanley Elec. Mfg. Co.
Stanton, LeRoy W.
Wilmerding, C. H.

Electrical Instruments.
(Recording and Testing.)
Bissell Co., The F.
Central Electric Co.
Diamond Meter Co.
Duncan Elec. Mfg. Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
General Inc. Arc Light Co.
Jewell Electrical Inst. Co.
Machada & Roller.
Pignolet, L. M.
Stanley Elec. Mfg. Co.
Stanley Instrument Co.
Wagner Electric Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co
Weston Electrical Inst. Co.
Whitney Electl. Inst. Co.

Electro-Plating Mach'y
Crocker-Wheeler Company.
General Electric Co.

Elevators-Conveyors.
Jeffrey Mfg. Co.

Engines, Gas and Gasoline.
Allis-Chalmers Company.
Marinette Gas Engine Co.
Olds Gasoline Engine Works.
Woolley Fdy. & Mach. Wks.

Engines, Steam.
Allis-Chalmers Company.
Sturtevant Co., B. F.

Fans and Fan Motors.
Central Electric Co.
Crocker-Wheeler Company.
Edison Mfg. Co.
General Electric Co.
General Inc. Arc Light Co.
Sprague Electric Co.
Sturtevant Co., B. F.
Wesco Supply Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Fibre.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Files.
Barnett Co., G. & H.

Fittings.
Faries Mfg. Co.

Fixtures, Gas and Elec.
Beardslee Chandelier Mfg. Co.

Finishers.
Bissell Co., The F.
Haller Machine Co.
Reynolds El. Flasher Mfg. Co

Flexible Shafts.
Stow Mfg. Co.

Forges.
Sturtevant Co., B. F.

Fuses and Fuse Wire.
Amer. Elec. Fuse Co.
Bissell Co., The F.
Central Electric Co.
Central Tel. & El. Co.
Chicago Die & Electric Co.
Chicago Fuse Wire & Mfg. Co.
Clinton Stamping & Elec. Co.
D. & W. Fuse Company.
Electric Appliance Co.
Johns-Manville Co., H. W.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Company.
Western Elect. Supply Co.

Globes, Reflectors and Shades.
Fostoria Incan. Lamp Co.
Haller Machine Co.
Holophane Glass Co.
Pardridge Shade & Refl. Co.
Phoenix Glass Co.
Wesco Supply Co.
Western Electric Co.
Western Elect. Supply Co.

Graphite Specialties.
Dixon Crucible Co., Jos.
Holmes Fibre-Graphite Co.

Heating (Exhaust Steam).
Amer. District Steam Co.

Heating and Ventilating Apparatus.
Sturtevant Co., B. F.

Holders, Inc. Lamps.
Incandescent Electric Light Manipulator Co.

Inspection & Insurance
Hartford Steam Boiler Inspection & Insurance Co.

Insulating Machinery.
New England Butt Co.

Insulators and Insulating Materials.
American Electrical Works.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Inc. Arc Light Co.
Indiana Rub. & Ins. Wire Co.
Johns-Manville Co., H. W.
Kartavert Mfg. Co.
Manhattan Elec. Supply Co.
Mica Insulator Co.
Munsell & Co., Eugene.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Standard Vitrified Cond. Co.
Sterling Varnish Co.
Vulcanized Fibre Co.
Wesco Supply Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Junction Boxes.
Bossert Elect. Const. Co.
General Inc. Arc Light Co.

Lamps, Arc.
Bissell Co., The F.
Central Electric Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
General Inc. Arc Lt. Co.
Gregory Electric Co.
Hipwell Manufacturing Co
Manhattan Elec. Supply Co.
Stanley Elec. Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Lamps, Incandescent.
Bissell Co., The F.
Bryan-Marsh Company.
Buckeye Electric Company.
Central Electric Co.
Chicago Edison Co.
Columbia Incan. Lamp Co.
Edison Decorative & Miniature Lamp Dept.
Electric Appliance Co.
Fostoria Incand. Lamp Co.
General Electric Co.
General Inc. Arc Light Co.
Standard Elec'l Mfg. Co.
Sterling Electrical Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Lamps, Incandescent—Replacers & Cleaners.
Inc. El. Lt. Manipulator Co.

Letters, Metal.
Haller Machine Co.

Lightning Arresters.
Central Electric Co.
Clinton Stamping & Elec. Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
Manhattan Elec. Supply Co.
Minnesota Electric Co.
Stanley Elec. Mfg. Co.
Western Electric Co.

Lights, Show.
Glogau & Co., H. M.

Linemen's Climbers.
Klein & Sons, Mathias.

Magnet Wires.
(See Wires and Cables.)

Mechanical Draft.
Sturtevant Co., B. F.

Mica.
Chicago Mica Co.
Mica Insulator Co.
Munsell & Co., Eugene.

Mining Apparatus, Elec.
Allis-Chalmers Company.
Crocker-Wheeler Company.
General Electric Co.
Jeffrey Mfg. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Motors. (See Dynamos and Motors.)

Nippers and Pliers.
Klein & Sons, Mathias.

Nozzles.
Faries Mfg. Co.

Paints.
Dielectric Mfg. Co.

Patent Attorneys.
Bain, Foree.

Phosphor Bronze.
Phosphor Bronze Sm. Co. Ltd.

Platinum, Wire and Sheet.
Baker & Company Inc.

Poles and Ties.
Berthold & Jenninga.
Brooks, Hall L.
Columbia Mfg. Co.
Fowler, John B.
Fowler-Jacobs Company.
Kellogg Switch. & Sup. Co.
Lindsley Bros. Co.
Loud's Sons Co., H. M.
Maltby Cedar Co.
Morrison Lbr. Co., J. W.
Mueller Company, William.
Pacific Coast Pole Co.
Page & Hill Company.
Phelan, D. W.
Pittsburg & L. S. Iron Co.
Porter Cedar Company.
Sterling & Son, W. C.
Torrey Cedar Co.
Valentine-Clark Co., The.
Western Lbr. & Pole Co.
Worcester Co., C. H.

Polish (Metal).
Allen Co., Inc., L. B.
Hoffman, Geo. W.

Portables.
Faries Mfg. Co.

Power Transmission Machinery.
Jeffrey Mfg. Co.

Rail Joints.
Continuous Rail Joint Company of America.

Rectifiers.
Electrical Appliance Co.

Refiners.
Gt. West Smelt. & Refining Co

Re-Winding—Repairs.
Chicago Edison Co.
Gregory Electric Co.

Rheostats.
Cutler-Hammer Mfg. Co.
General Electric Co.
Gen'l Inc. Arc Lt. Co.
Union Electric Mfg. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Rods, Conduit.
Cope, T. J.

Safes.
Sears, Roebuck & Co.

Schools and Colleges.
Electrical Engineer Inst.
Highland Park College
State Univ. of Iowa.

Second-Hand Mach'y.
Bissell Co., The F.
Cent. Stat. Improvement Co.
Dyar, B. W.
Gregory Electric Co.
Matthews & Bro., W. N.
Walsh's Sons & Co.

Shades, Lamp.
Faries Mfg. Co.

Sheet Brass & Copper.
Plume & Atwood Mfg. Co.

Signs, Electric.
Haller Machine Co.
Zero Marx Sign Works.

Silks, Insulating & Braiding.
Sauquoit Silk Mfg. Co.

Sockets & Receptacles.
Pass & Seymour.
Yost Elec. Mfg. Co.

Soldering Sticks, Salts and Paste.
Allen Co., L. B.
Crescent Co.
Kester Elec. Mfg. Co.
Western Electric Co.

Spanking Tubes.
Central Electric Co.
Edwards & Co.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Specialties, Electrical Mfrs. and Designers.
Haller Machine Co.

Speed Indicators.
Weston Electrical Inst. Co.

Storage Batteries.
American Battery Co.
Electric Storage Battery Co.
Gould Storage Battery Co.

Supplies, General Elec.
Bissell Co., The F.
Central Electric Co.
Century Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Electric Co.
Manhattan Elect'l Supply Co
Wesco Supply Co.
Western Electric Co.
Western Elect. Supply Co.

Switchboards.
Bissell Co., The F.
Crouse-Hinds Co.
Gen. Incan. Arc Light Co.

Telephones, Telephone Material and Switchboards.
American El. Telephone Co
Automatic Electric Co.
Bissell Co., The F.
Central Electric Co.
Central Tel. & El. Co.
Holtzer-Cabot Elec. Co.
International Tel. Mfg. Co.
Kellogg Switchb. & Sup. Co.
Manhattan Elec. Supply Co.
Moon Mfg. Co., The.
Stromberg-Carlson Tel. M.Co
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Time Switches.
Bissell Co, The F.

Tools.
Klein & Sons, Mathias.
Western Electric Co.

Transformers.
Central Electric Co.
Crawfordsville Electric Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Works, Inc.
General Electric Co.
Gregory Electric Co.
Kuhlman Electric Co.
Manhattan Elec. Supply Co.
National Electric Co.
Stanley Elec. Mfg. Co.
Wagner Electric Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Tracks, Electric Car.
General Electric Co.
Westinghouse El. & Mfg. Co.

Turbines, Steam.
Allis-Chalmers Co.
General Electric Co.
Westinghouse El. & Mfg. Co

Turbine Water Wheels
Leffel & Co., Jas.

Varnishes.
Dielectric Mfg. Co.
Sterling Varnish Co.

Vulcanized Fibre.
Vulcanized Fibre Co.

Whistles, Electric.
Electrical Appliance Co.

Wires & Cables—Magnet Wires.
American Electrical Works.
Bissell Co., The F.
Central Electric Co.
Chicago Insulated Wire Co.
Crescent Ins. Wire & Cble. Co.
Driver-Harris Wire Co.
Electric Appliance Co.
General Electric Co.
Hazard Manufacturing Co.
Indiana Rub. & Ins. Wire Co
India Rubber & Gutta Percha Insulating Co.
Kellogg Switch. & Sup. Co.
Manhattan Elec. Supply Co.
National India Rubber Co
New York Insulated Wire Co.
Okonite Co., The.
Phillips, Eugene F.
Phillips Insulated Wire Co
Roebling's Sons Co., J. A.
Runzel-Lenz Elec. Mfg. Co.
Safety Ins. Wire & Cable Co.
Simplex Electrical Co.
Standard Underground C. Co
Wesco Supply Co.
Western Electric Company.
Western Elec. Supply Co.

For Alphabetical Index of Advertisements See Page 3.

"PHŒNIX QUALITY"

INNER GLOBES

are deservedly popular and in favor because they possess all the points of excellence and merit so necessary in their use.

Years of experience, careful and intelligent attention to every detail

in their manufacture has resulted in our producing Inner Globes for all Enclosed Arc Systems that are recognized as of

Standard Excellence and Superiority

Catalogue and prices upon application.

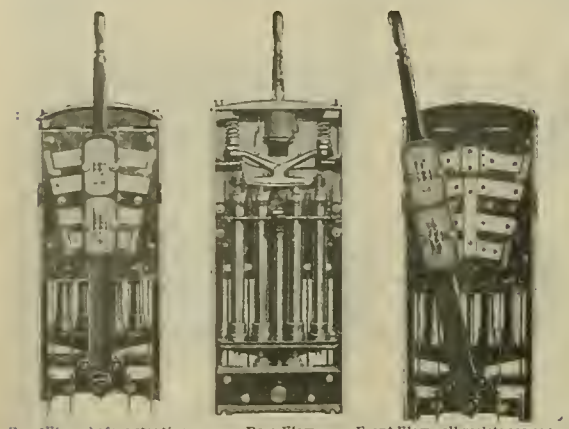
(Licensed under Patent 745,677)

THE PHŒNIX GLASS COMPANY

NEW YORK PITTSBURG CHICAGO

Allen-Bradley Electric Crane Controllers

Patented



Front View—before starting Rear View Front View—all resistance out

Manufactured by AMERICAN ELECTRIC FUSE CO., Chicago.

A New Controller. Positively No Sparking. No Repairs. Guaranteed for One Year. Three Months' Free Trial. Perfect Control.

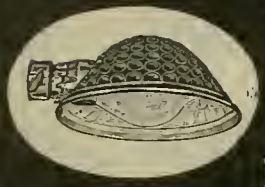
OUR GUARANTEE: Ask any Other Manufacturer to Duplicate It.

THE AMERICAN ELECTRIC FUSE COMPANY hereby guarantees to..... that it will at any time within three months from this date upon demand repay to said..... the sum of..... .....Dollars, being the full purchase price paid (or agreed to be paid) by said..... to the American Electric Fuse Company for one..... horsepower Allen-Bradley Crane Controller, number.....upon delivery within three months after this date of said controller, freight prepaid and in good condition, ordinary wear and tear from use excepted, at the office of the American Electric Fuse Company, Chicago, Illinois, together with a written statement that said controller has proved unsatisfactory to said .....

FURTHERMORE, the said American Electric Fuse Company agrees that it will at any time within one year from this date replace, without charge, any part of said controller which may prove defective or wear out during the ordinary use of said controller, provided that it is a condition of this guarantee that said..... ..... hereby agrees to use ordinary care in the operation of said controller, and that said controller will be operated by some person, or persons, familiar with the use of crane controllers, and further that said controller will not be wilfully or maliciously injured while in the possession of said..... .....

FARIES FIXTURES

Shades
Brackets
Clusters
Portables
Canopies
Chandeliers
Nozzles
Fittings
Castings

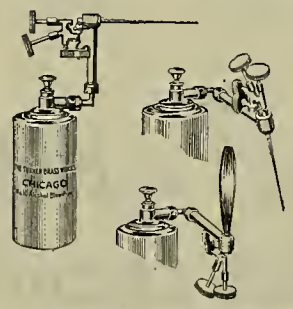


are UNIVERSALLY USED

Catalog Mailed on Application

FARIES MFG. CO.
DECATUR, ILL.

SEE THAT FLAME



No. 10 Alcohol Blow Pipe. $4.50 each.
Express prepaid upon receipt of cash.
DISCOUNT TO DEALERS.

IT'S JUST WHAT YOU NEED

for fine soldering for internal wiring and switchboard work, storage battery, lead burning, etc.

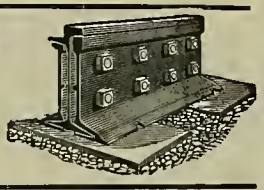
The Turner Double Jet Alcohol Blow Pipe No. 10.

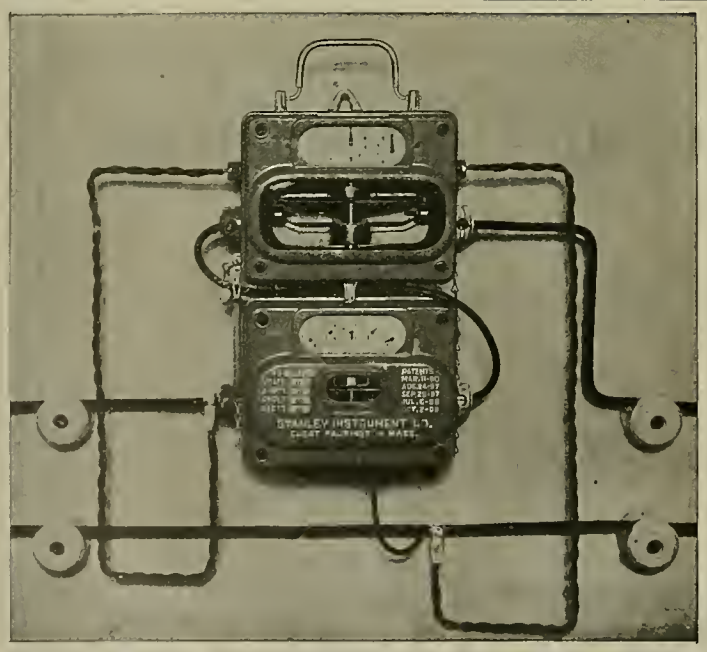
Burns wood alcohol and produces a clean non-oxidizing needle pointed or a brush flame of over 3,000 degrees of heat. The burner can be turned in any position. Reservoir 2½ x 5 inches. Capacity ¾ pint. Shipping weight 2 lbs.

THE
Turner Brass Works
23 N. FRANKLIN ST., CHICAGO

CONTINUOUS RAIL JOINT CO. OF AM.

General Offices: Century Building
NEWARK, N. J.
OVER 20,000 MILES IN USE
Highest Award at Paris Exposition, 1900, Buffalo, 1901





TESTING WATTMETER

ACCURATE TESTS
in a few minutes, anywhere, by one man alone without regulation of
VOLTAGE, LOAD OR FREQUENCY

STANLEY INSTRUMENT CO.
GREAT BARRINGTON, MASS.

AFFORD ABSOLUTE SAFETY AS PROTECTIVE DEVICES AND FREEDOM FROM ALL FIRE HAZARD : : : : : : :

SACHS TRADE NOARK MARK FUSE

ASK YOUR SUPPLY DEALER FOR "NOARK"

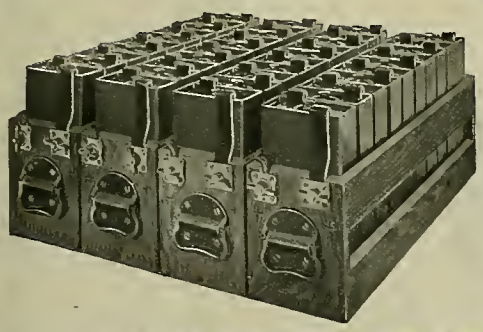
We Carry a Large and Complete Stock of **oiled insulating cloths and papers.**

New York
Milwaukee
Chicago
St. Louis
Boston
Philadelphia

H. W. JOHNS-MANVILLE CO.
100 William St., New York

Pittsburg
Cleveland
New Orleans
London
Paris
Brussels

GIVES BEST RESULTS



Northwestern Storage Battery

Cannot be equaled for

Great Capacity, Lightness and Efficiency

LOW TENSION WORK

Write for Catalogue.

Northwestern Storage Battery Co.,

285 Madison Street, - - - - Chicago, Ill.

Why Not Use the Best and the Only Genuine Wrigley Toggle Bolt

☞ All other Toggle Bolts pivoted like cuts shown are infringements; all users of Wrigley's Toggle Bolts are protected by his patents.

WRITE FOR PRICES

Double Flange Toggle Bolt. Single Plate Toggle Bolt. Trunnion Nut Toggle Bolt with Cap Nut.

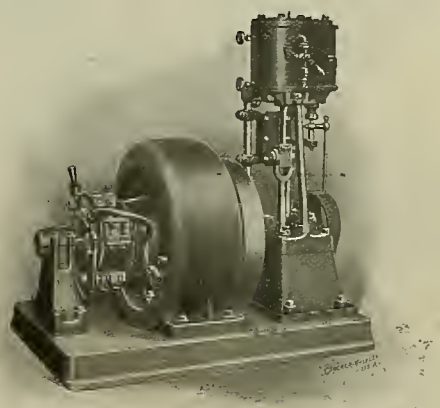
Other Patents Pending

THOS. WRIGLEY & CO.

Sole Manufacturers, 300-306 Dearborn Street, CHICAGO, ILL.

Small Units in Electric Generating Sets.

Write for our estimates and prices.



Crocker-Wheeler Company

Manufacturers of

Generators and Motors

Electrical Engineers

AMPERE, N. J.

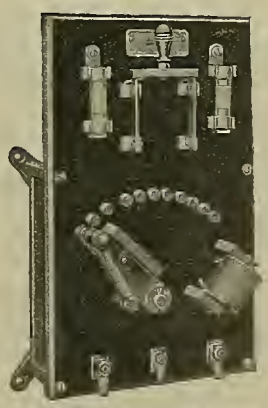
Branch Offices in Sixteen Principal Cities

General Electric Company

RHEOSTATS

Field Rheostat Front Connected.

The General Electric Company can furnish Rheostats to meet every condition of service.

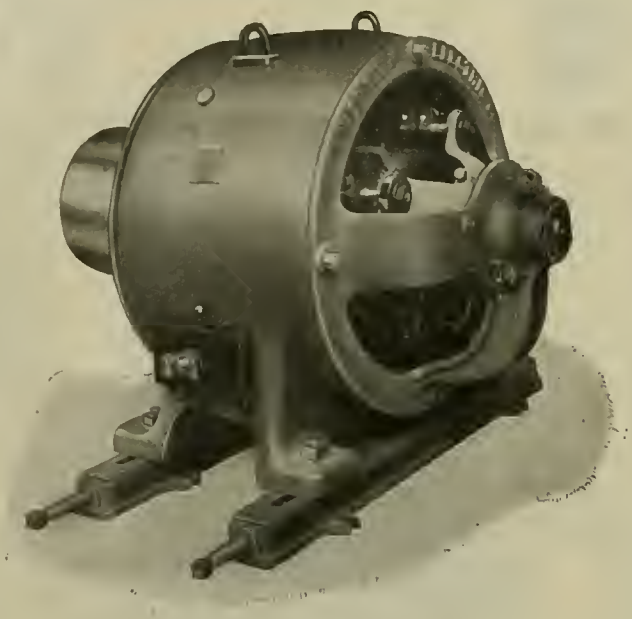


Universal Motor Starting Rheostat.

Write for further information.

General Office: SCHENECTADY, N. Y.

Chicago Office: Monadnock Block. Sales offices in all large cities.



DIRECT CURRENT

Generators and Motors

Western Electric Company

CHICAGO NEW YORK

And Other Principal Cities

Space 17, Electricity Building, Louisiana Purchase Exposition

Encourage Shop Keepers

To Install Electric Lights.

BY DISPLAYING OUR SELF-PROPELLING, COLOR-REFLECTING SHOW LIGHT

you not only advertise your own business but promote their use among shop keepers, thus getting new users of current

LASTS A LIFETIME. ONE INCANDESCENT GLOBE OPERATES IT WITHOUT FURTHER ATTENTION.

DESCRIPTION

Before an artfully constructed large concave mirror-reflector a beautiful globe covered with magnificent stones in different colors is supported on chains by a fan-wheel, which runs with its steel point in a jewel knob. The light has its place in the center of the globe, wonderfully glittering and shining through the colored stones and the skillfully placed openings in the metal parts of the globe. The heat from the electric bulb light brings the fan-wheel into rotation and the globe revolves around the light. The whole mirror-screen is covered with the reflecting of the bright stones, always changing colors.

The whole effect is one of such unspeakable beauty that no picture is able to give a description of it; the colors move like in a kaleidoscope, but have such a splendor that every comparison is displaced.

Price $25 Each Special Price for Large Quantities

H. M. GLOGAU & CO.

40 DEARBORN STREET CHICAGO

Sheet Brass, *All Tempers*

Brass and Bronze Drill Rods

Brass and Copper Wire

German Silver Sheet and Rod

Brazed and Seamless Tubing

Eagle Brand *Copper Rivets and Burrs, Brass Escutcheon Pins*

Brass Butts, *Desk Narrow, Broad Middle, Ball Tipped and Water Closet*

Brass and Iron Jack Chain, Brass Safety Chain, Etc.

Catalogues on Application

THE PLUME & ATWOOD MFG. CO.

New York Boston San Francisco Chicago

ANNUAL FALL TRADE NUMBER

In view of present trade conditions *The Western Electrician's Annual Fall Trade Number,* which will be dated October 1st, will prove of more than ordinary interest. It will be a most excellent issue for advertisers. A large, special announcement, attractively arranged, will prove beneficial to your business.

This number will go to press Wednesday, September 28th.

WESTERN ELECTRICIAN 510 MARQUETTE BUILDING CHICAGO

It Will Interest You to Know What the **Western Electric Company** Have to Say Regarding

ELECTRA
TRADE MARK

HIGHEST GRADE NUERNBERG

CARBONS

in their circular, dated November 23, 1903, which in part reads as follows:

"The Western Electric Company have made an exhaustive test of carbons of all kinds and have found that the 'ELECTRA' Carbons cannot be equaled in quality or efficiency, produce practically no dust and give an excellent and steady light. They produce the highest standard of candlepower in proportion to the current consumed, and are the most economical carbons manufactured."

How is this for an argument?

HUGO REISINGER, Sole Importer, 11 Broadway, NEW YORK CITY.

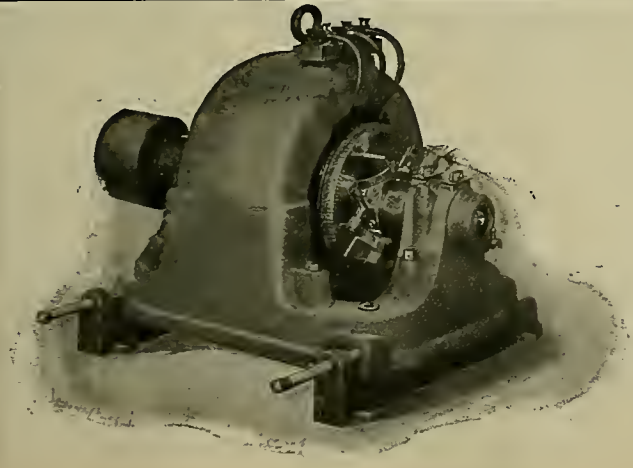
These, our little "SHOW WINDOWS," coming out even as they do every week, can't give you an adequate idea of ALL the goods we manufacture—

BUT OUR CATALOGUE CAN.

SEND FOR IT.

EDWARDS & CO., New York.

Selling Agents: WESTERN ELECTRIC COMPANY, New York, Chicago, Philadelphia, Denver, St. Louis, Pittsburg, Kansas City. AMERICAN ELECTRICAL COMPANY, St. Paul. CALIFORNIA ELECTRIC WORKS, San Francisco, Cal. STANDARD ELECTRIC COMPANY, Cincinnati.



CENTRAL STATION MANAGERS

Don't Be Afraid

of the Gas Plant

WORK UP A MOTOR LOAD

We can furnish you

SINGLE PHASE MOTORS

that will start under full load in sizes ranging from 1/8 to 35 H.P.

Wagner Electric Mfg. Co.

ST. LOUIS, MO., U. S. A.

PRISMO ZENITH LAMPS

Two watts per candlepower.
Two sizes--25 and 55 candlepower.

Prismo Zenith Lamps carried in stock. Chicago, San Francisco, Warren.

ELECTRIC APPLIANCE COMPANY
ELECTRICAL SUPPLIES
CHICAGO AND SAN FRANCISCO

YOU NEED IT!

Gale's Commutator Compound.
The Only Article That Will Prevent Sparking.

Will keep the Commutator in good condition and prevent cutting. Absolutely will not gum the brushes.
50c. per stick. $5.00 per dozen Send 50c. for trial stick.
FOR SALE BY ALL SUPPLY HOUSES OR
K. McLENNAN & CO., Sole Manufacturers. Room 411 Inter Ocean Bldg., 130 Dearborn Street CHICAGO

Set a high ideal for the electric machinery needed in your work—Northern direct current apparatus will meet this ideal and exceed your greatest expectations.

Get Bulletin No. 2533.
CHICAGO SALES OFFICE, SUITE 425 MONADNOCK BLOCK
NORTHERN ELECTRICAL MFG. CO., Madison, Wis., U. S. A.
Engineers, Manufacturers. 248F

You've Heard of the
PEERLESS
WESCO

INCANDESCENT LAMPS

If you don't know them you are missing a great light giving bulb of incandescence that is electrically and mechanically perfect and rightly named "Peerless."

They are not labeled one way and rated another. Rest assured when you are buying "Peerless" lamps you are getting full rated candlepower.

The Wesco guarantee stands behind every "Peerless" lamp for efficiency, sustained candlepower, current-consumption and life.

On yearly contracts we are prepared to make the lowest price that has ever been made on a strictly high grade lamp.

ELECTRICAL MACHINERY AND SUPPLIES
WESCO SUPPLY CO., ST. LOUIS, MO., U. S. A.

MICA INSULATION

Of all Qualities, in any Form at Lowest Prices
EUGENE MUNSELL AND CO.
NEW YORK and CHICAGO

That Is.

Micanite, Linotape, M. I. C. Compound, Empire Cloth and Paper. For Years the Standard.

MICA INSULATOR CO., Originators
NEW YORK and CHICAGO

MICABOND

CHICAGO MICA CO.,
"PERFECTORS" VALPARAISO, IND.
THE PEER OF INSULATORS.

"STAR" INCANDESCENT LAMPS

LONG LIFE
GUARANTEED CANDLEPOWER,
HIGHEST EFFICIENCY.

MADE BY THE MOST SKILLED WORKMEN.

STANDARD ELECTRICAL MFG. COMPANY, : Niles, Ohio.

EDISON MINIATURE LAMPS

Over 400,000 Annually Shipped to Users.

All types—every variety.
Prompt shipment—in any quantity.

Miniature and Candelabra Sockets and Receptacles.

EDISON DECORATIVE & MINIATURE LAMP DEPT.,
General Electric Company, Harrison, N. J.

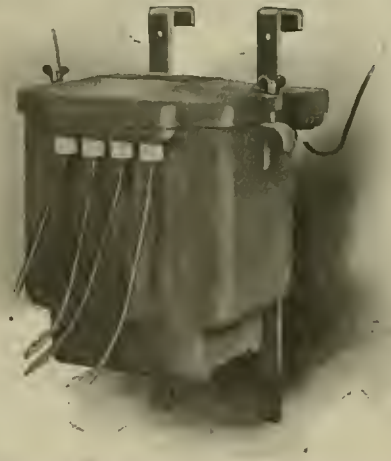
VOLT - AMMETERS,
POCKET SIZE.

For Testing Batteries and Battery Circuits, Locating Faults, Grounds, etc.
RELIABLE. ACCURATE.
Send for Circular.
L. M. PIGNOLET,
78-80 Cortlandt St., NEW YORK, N. Y.

"AMERICAN" STORAGE CELLS

ARE THE BEST. Send for descriptive Circular.
AMERICAN BATTERY CO.,
EST'D 1887. 171 S. Clinton St., Chicago.

M. KLEIN & SON.
Send 2c stamp for new catalogue No. 6 of
KLEIN'S TOOLS
For Electrical Workers and Line Builders.
MATHIAS KLEIN & SONS,
81 W. Van Buren St., Chicago, Ill.



THE B. O. TRANSFORMER

Do you expect to need new transformers this fall? If you do, the B. O. will interest you.

Low Losses
High Efficiencies
High Insulation
Low Price.

Are you familiar with oil duct transformers?
Send us your address and we will tell you about our insulation and the advantages of slab windings in connection with oil ducts.

THE STANLEY ELECTRIC MANUFACTURING COMPANY
PITTSFIELD, MASSACHUSETTS

Atlanta, Ga., Empire Building Boston, Mass., Oliver Building
CHICAGO, ILL., MONADNOCK BLOCK
Denver, Col., Hendrie & Bolthoff Mfg. & Supply Co. Los Angeles, Cal., Douglas Block
New York, N. Y., 29 Broadway Philadelphia, Pa., North American Building
St. Louis, Mo., Century Bldg. San Francisco, Cal., 69-75 New Montgomery St.
Seattle, Wash., Pioneer Bldg.

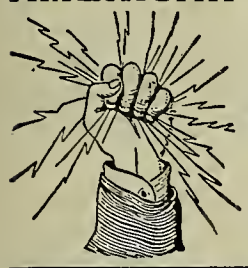
Representatives for the Dominion of Canada, THE CANADIAN GENERAL ELECTRIC CO. of Toronto

"THE S. K. C. SYSTEM"

FRANK N. PHILLIPS, PRESIDENT. C. H. WAGENSEIL, TREASURER. EUGENE F. PHILLIPS, GENERAL MANAGER. E. ROWLAND PHILLIPS, VICE-PRES. G. R. REMINGTON, JR., SEC

AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.



BARE AND INSULATED ELECTRIC WIRE,
ELECTRIC LIGHT LINE WIRE,
INCANDESCENT AND FLEXIBLE CORDS,
Railway Feeder and Trolley Wire,
AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR WIRES.
CABLES FOR AERIAL AND UNDERGROUND USE.
NEW YORK STORE, W. J. Watson, 26 Cortlandt St.
CHICAGO STORE, F. E. Donohoe, 82 Lake St.
MONTREAL BRANCH, Eugene F. Phillips' Electrical Works.
MAIN OFFICES AND FACTORIES, PHILLIPSDALE, R.I.

SINGLE AND POLYPHASE
TRANSFORMERS
KUHLMAN ELECTRIC CO., - - Elkhart, Ind.

DO YOU BURY MONEY?
WHY NOT EARN THE INTEREST?
Burying Dead Men is like Burying Money
WHEN
STOMBAUGH GUY ANCHORS
ARE SO MUCH MORE INEXPENSIVE AND DO THE WORK BETTER.

SIMPLY SCREW THEM IN—THAT'S ALL.
W. N. MATTHEWS & BRO.
Distributers
603 CARLETON BUILDING *ST. LOUIS*

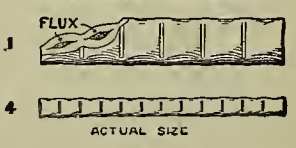
EXPERT IN ELECTRICITY MECHANICS PATENT CAUSES
SOLICITOR OF **PATENTS**
U. S. & FOREIGN
FORÉE BAIN, 1652-3 Monadnock Blk., CHICAGO

Monitor Bushings
Greatest efficiency at least cost. Absolute protection to wires drawn over conduit ends. Made of one piece of sheet steel and cannot be broken. Enameled insulation. No special tools required to attach. Approved by fire underwriters. Write for bulletin 1002.
BOSSERT
Electric Construction Company
UTICA, N. Y.

YOU BUY
Maxstadt Patent Mica Fuses,
Maxstadt Patent Copper and Steel Wire Joints,
Maxstadt Patent Fuse Blocks and Lightning Arresters—Fuse Wire, Fuse Links, Etc.
We manufacture and
WE SELL THEM
TO THE WISE BUYER THE ABOVE IS SUFFICIENT.
CHICAGO DIE AND ELECTRIC CO.,
87-89-91 W. LAKE STREET,
CHICAGO, - - - - - ILLINOIS.

THE STATE UNIVERSITY OF IOWA
SCHOOL OF APPLIED SCIENCE, Iowa City, Iowa
Four year courses of the highest grade in
Civil
Municipal
Sanitary
Electrical
Mechanical
Mining
ENGINEERING
Numerous short practical courses. Special courses in technical chemistry, bacteriology, etc. Adequate equipment in shops and laboratories. Waterpower.
University environment. Expenses low.
Address C. E. MacLEAN, President

KESTER
SELF FLUXING SOLDER
A Tube of Solder Filled with Flux.
Requires no Acid.
SAVES—LABOR—TIME—MONEY.



ACTUAL SIZE
PATENTED.
Send for Free Samples.
L. F. Mahler Co., R. 1008 Chemical Bldg., St. Louis, Mo., Gen. Western Agent.
KESTER ELECTRIC M'F'G CO.,
46 N. UNION STREET, CHICAGO, ILL.

Crimshaw

Raven White Core

Raven Black Core

ALL OUR WIRES pass inspection and carry the above TRADE-MARKS on our tags. We also manufacture Crimshaw and Competition Tapes and Splicing Compounds.

NEW YORK INSULATED WIRE COMPANY,

MAIN OFFICE: 114, 116 & 118 Liberty St., New York.
BRANCHES: CHICAGO: 192 Desplaines St. BOSTON: 7 Otis St. SAN FRANCISCO: 33 Second St.

NATIONAL CODE STANDARD

"O. K." Weatherproof Wire.
Slow-Burning Weatherproof and Ideal Wire.
Prices and Samples on Application.
Phillips Insulated Wire Co.
Office and Factory: PAWTUCKET, R. I.

ELECTRIC SIGNS
INCREASE YOUR CURRENT CONSUMPTION.
Assist us to sell ELECTRIC SIGNS to the best merchants in your city.
No repair bills with our signs, we furnish the best—all metal raised letters equipped with removable copper shell sockets. WRITE US, we will conscientiously study your sign wants and gladly submit drawings with very low quotations for the best work.
ZEROMARX SIGN WORKS
CHICAGO, ILL.

WANTED, FOR SALE *and similar* **WANT COLUMN** *advertisements (50 words or less), $1.50 an insertion; additional words 3c each.* **POSITION WANTED** *advertisements (50 words or less), $1.00 an insertion; additional words 2c each.*

POSITION WANTED.

By young man as superintendent of electric-light plant or municipal light and water plant. Ten years' practical experience and technical education. Can handle engineering and business ends. Would consider electric railway or saleman's positions. Address BOX 390, care of Western Electrician, 510 Marquette Building, Chicago.

POSITION WANTED.

By good, all around electric-light and telephone man. 34 and married. Sober; good references. Address BOX 397, care Western Electrician, 510 Marquette Building, Chicago.

POSITION WANTED.

By young married man of 23 years as assistant electrician and inside wireman; have some experience. High school graduate; have paid-up course in electrical engineering with the International Correspondence Schools, of Scranton, Pa. Ohio or bounding states most desired. Parties answering please state salary. Can furnish references. Address BOX 398, care of Western Electrician, 510 Marquette Building, Chicago.

FOR SALE.

4 L. D. 12, T.-H. arc machines with one extra armature. Also 200 6.6 ampere open T. H. double and single arc lamps. 1-50 light Manhattan series A. C. arc system, complete with step-up transformer, 1 regulator and 35 lamps. All at present in operation and in excellent condition. Address BOX 396, care of Western Electrician, 510 Marquette Bldg., Chicago.

MACHINERY FOR SALE BY THE CITY OF ELY, MINNESOTA.

1—Steel Smokestack, height 80 ft., diameter 4 ft.

2—16 ft. x 60 in. Ducey Boilers, 46-4 in. tubes.

1—Buckeye automatic cut-off high speed Engine, size 15x16 in., 68 in. fly-wheel, 21 in. face.

1—Erie Ball automatic cut-off high speed Engine, size 12x13 in., 54 in. fly-wheel, 13 in. face.

1—Erie Ball automatic cut-off high speed Engine, size 9x12 in., 54 in. fly-wheel, 13 in. face.

1—General Electric Co. 120 K. W. Alt. Current Geoerator, 1,040 to 1,150 volts, 16,000 alt., ring oilers, sliding base.

2—Westinghouse, 60 K.W. Alt. Current Generators, 1,040 to 1,150 volts, 16,000 alt., ring oilers, sliding base.

These three machines are equipped with Exciters mounted on sliding bases; marble switchboard, size 9x6 ft., mounted with 3 three-way knife switches; 3 Exciter Switches; 6 Rheostats; 3 Volt-meters; 3 Ampere Meters; 3 Pilot Transformers; 1 eight-point Ground Detector and 3 sets of Wurts Lightning Arresters.

1—35 Light Brush Series Arc Machine with Regulator, Ampere Meter and 25 9.9 Series Open Arc Lamps.

1—Endless Leather Belt—30 feet long—double, two-ply, 16 inches wide.

1—Endless Leather Dynamo Belt 28 feet long, double, 12 inches wide, two-ply, good as new.

1—Endless Leather Dynamo Belt 20 feet long, double, 12 inches wide, two-ply, good as new.

1—Boiler Breeching for three boilers, breeching is 60 feet long with elbow in center, size of breeching 3 feet by 6 feet.

This machinery is all in running order and can be seen at the old light and water plant at Ely, Minn.

The city has also for sale one Hutson Chemical Engine, manufactured by the Marinette Iron Works, at Chicago, Ill. Same may be seen at the City Fire Hall.

Any information desired will be furnished by the undersigned.

L. J. WHITE, City Clerk.

FOR SALE.

ALTERNATORS.

1-360 K. W. General Electric 3-phase.
1-120 " " " "
1-75 " Westinghouse 2-phase.

250-VOLT GENERATORS.

1-250 K. W. Western Electric M. P.
1-200 " Eddy M. P.

125-VOLT GENERATORS.

1-125 K. W. Western Electric M. P.

Immediate shipment.

GREGORY ELECTRIC CO.
54-62 S. CLINTON ST. CHICAGO

Corliss Engines.

900 h. p., 34x60, International.
900 h. p., 22x42x48, Hamilton Tand. Comp.
750 h. p., 32x54, Hamilton, 1890 Frame.
650 h. p., 30x54, St. Louis, 1890 Frame.
600 h. p., 28x60, Philadelphia.
500 h. p., 16x32x42, Corliss Cross Comp., latest type.
450 h. p., 16x30x42, Allis Cross Comp.
400 h. p., 23½x60, Geo. H. Corliss.
450 h. p., 24x48, Harris, latest type.
450 h. p., 24x48, Brown.
350 h. p., 22x42, Allis, 1890 Frame.
350 h. h., 22x42, Slater, 1890 Frame.
300 h. p., 20x48, Harris.
300 h. p., 20x42, Hamilton.
225 h. p., 12x22x42, Atlas Tandem Comp.
225 h. p., 18x42, Hamilton.
175 h. p., 16x42, Allis.
165 h. p., 16x36, Sioux, 1902.
150 h. p., 15x38, Brown.
140 h. p., 14x42, Allis.
125 h. p., 14x36, Putnam.
90 h. p., 12x36, Harris.
600 h. p., 28½x52, Buckeye Automatic.
500 h.p., 17½x30½x27, Buckeye Cross Comp.
450 h.p., 16½x28½x27, Buckeye Cross Comp.
450 h. p., 24x48, Buckeye Automatic.
350 h. p., 16x26x18, Ideal Tandem Comp.
275 h. p., 14x22x16, Ideal Tandem Comp.
250 h. p., 16x27x16, Westinghouse Comp.
200 h. p., 18x24, Meyer Automatic.
150 h. p., 15x24, Cummer.
150h.p., 10½x18x18, Williams' Taudem Comp.
100 h. p., 12½x15, Taylor Beck.

Whitehead Machinery Company,
DAVENPORT, IOWA.

Dynamos, Engines, Boilers.

250-K. W., 500-volt Westinghouse Generator. Price.....$ 900
120-K. W., 125-cycle General Electric Alternator. Price..... 600

Can furnish a large variety of alternating and D. C. Generators and Motors, running from 5 K. W. to 650 K. W. each.

DIRECT CONNECTED UNITS from 27 K. W. to 400 K. W. each, both D. C. and alternating.

24x48 Harris Corliss Engine $1,750
18x42 Heavy duty Corliss Engine . 1,100
16x42 Greenwald-Brown automatic Engine 850

I have smaller and larger engines both Automatic and Corliss at very low figures.

COMPOUND ENGINES, Corliss and Automatic, from 75 H. P. to 600 H. P. each.

Tubular Boilers in first-class condition, from 50 H. P. to 150 H. P. each.

Watertube and Firebox Boilers, running from 40 H. P. to 350 H. P. each.

Can supply many of these boilers at much less than half original cost.

HUGH W. DYAR,
206 Dearborn Street, Chicago.

REPAIRING RECALIBRATING ELECTRIC METERS.

INTERNATIONAL ELECTRIC METER CO.
167 S. CANAL STREET, CHICAGO.

BUY YOUR BOOKS

FROM THE

Electrician Pub. Co., 510 Marquette Bldg., Chicago.

Louisville and Chicago

And the places north
And the places south
And the places between are reached by the quick day and night trains of THE

MONON ROUTE
CHICAGO INDIANAPOLIS & LOUISVILLE RAILWAY

Also the celebrated health resorts, French Lick and West Baden Springs, are reached only by this road.

Booklets about the Springs, their wonderful waters and the fine hotels, sent free.

CHAS. H. ROCKWELL, Traffic Manager
FRANK J. REED, Gen. Pass. Agt.
202 Custom House Place, Chicago

BOILERS FOR SALE

Six Heine Safety Water Tube Boilers. Rated by builders 340-horse-power each; 160 pounds working pressure. Built 1900. First in service 1901. In two batteries of three units each. Steam line and stacks available. Immediate Delivery.

Also Babcock & Wilcox in units of 400, 350, 280, 175 horse-power each.

Tubular boilers all sizes.

WHITEHEAD MACHINERY Co., DAVENPORT, IOWA

WORKS QUICK AND EASY. KEEPS ITS LUSTER. HOLDS OLD TRADE AND MAKES NEW. DOES NOT DETERIORATE. ESTABLISHED 16 YEARS. SOLD BY AGENTS AND DEALERS ALL OVER THE WORLD
3 OUNCE BOX 10 CENTS

U.S. METAL POLISH SAMPLES SENT FREE
GEO. W. HOFFMAN

POLISHES ALL METALS. BRANCHES NEW YORK, CHICAGO, SAN FRANCISCO. 295 E. WASHINGTON ST. INDIANAPOLIS, IND.

BOILERS.

One 42-in. x 15 ft. 9-in., 250 H. P. Worthington Water Tube.
One 60-in. x 16 ft., John Mohr Return Tubular Boiler.
One 64-in. x 16 ft., John Mohr Return Tubular Boiler.
One 54-in. x 16 ft., Devine Tubular Boiler.

ENGINES.

One 600 H. P., 21 x 36 x 30, Williams Tandem Horizontal Compound, 140 R. P. M.
Two 600 H. P., 20 x 30 x 24, Porter-Allen Tandem Compound, 200 R. P. M.
One 250 H. P., 12 x 24 x 18 Williams Tandem Compound, 250 R. P. M.
Two 100 H. P., 13 x 12, Dick & Church, High Speed Automatic.

PARTIAL LIST ONLY.

Send for latest Catalogue for bargains in Engines, Boilers, Dynamos and Motors.

CENTRAL STATION IMPROVEMENT CO., 938 Monadnock Block, Chicago

All Supply Houses

J. J. EGAN'S "ACME" COMMUTATOR COMPOUND
absolutely prevents sparking or cutting. One stick of "Acme" is equal to one gallon of oil for lubricating commutators. Free Sample. AGENTS WANTED.
50c per Stick. $5.00 per doz.
J. J. Egan Sole Mfg., 317 Austin Ave., Tel. Polk, 1779 Chicago

Sterling Black Plastic Insulator.

One hundred days' continuous baking at 180° F. will not make it brittle. Water repellent. Oil proof.

THE STERLING VARNISH CO., - - Pittsburg, Pa.

Our Compound Stops Sparking and Saves Commutators.

14 Years' Use on Street Ry., Light and Power Commutators Has Proven its Worth. WE GUARANTEE RESULTS.

Send Your Address for FREE SAMPLE THAT CONVINCES.

JAS. McLAUGHLIN & CO., ELECTRICAL ENGINEERS
586 Fulton Street, - - Chicago, Ill.

Only 10 Cents Each

Practical Books ON Electricity.

How to make a dynamo.
How to make a telephone.
How to make an electric motor.
How to make a storage battery.
How to make a Wimhurst electric machine.
How to make a magneto machine.
How to make a medical induction coil.
How to make a pocket accumulator.
How to make a plunge battery.
How to make a voltmeter.
How to make a galvanometer.
How to make a hand dynamo.
How to make a talking machine.
How to make a ⅛ H. P. dynamo or motor.
How to make a toy motor.
How to make an electric bell.
How to make a telegraph instrument.

These books are illustrated and will be sent prepaid on receipt of price.

Electrician Publ'g Co.,
510 Marquette Building,
CHICAGO.

YOST SPECIALTIES.

Sockets, Wall Sockets, Weatherproof Sockets, Rosettes, Receptacles, Cord Adjusters.

Catalogue for the asking.

THE YOST ELECTRIC MFG. CO.
TOLEDO, OHIO.

HELP

Secured quickly through Western Electrician "Help Wanted" ads.

CHICAGO EDISON COMPANY REPAIR SHOPS

76 MARKET STREET, CHICAGO. TELEPHONE MAIN 1280.

Machine and Carpenter Work of All Kinds
Correspondence Solicited.

OPEN DAY AND NIGHT.
FIRST-CLASS EQUIPMENT THROUGHOUT.

Dynamos, Armatures, Motors, Arc Lamps, Fans, Instruments.

ARNOLD ELECTRIC POWER STATION Co.
Engineers, Constructors for Complete Electric Plants. Results Guaranteed.
SUITE 1539, MARQUETTE BLDG., CHICAGO.
NEW YORK OFFICE: 711 TRANSIT BLDG.

BUTTERFIELD, J. F.
ELECTRICAL ENGINEER AND CONTRACTOR.
Complete Telephone Exchanges Built and Material Furnished.
Cable Construction and Underground Conduit Construction a Specialty.
Room 595, 113 Adams Street. CHICAGO, ILL.

HUMPHREY, HENRY H., CONSULTING ENGINEER.
Central Lighting Stations, Electric Power Transmission.
SUITE 1305, CHEMICAL BLDG., ST. LOUIS.

McLAUGHLIN, JAMES
CONSULTING ARC LIGHTING EXPERT, PRACTICAL ELECTRICAL AND MECHANICAL ENGINEER,
53 RIVER ST., - CHICAGO, ILL.

F. B. BADT,
Monadnock. Chicago.

BYLLESBY, H. M. & Co.
(Incorporated)
ENGINEERS
Design, Construct and Operate Railway, Light, Power and Hydraulic Plants.
Examinations and Reports.
New York Life Building, - CHICAGO, ILL.

ROBERT W. HUNT & Co., ENGINEERS
1121 The Rookery, Chicago. 66 Broadway, New York.
Monongahela Bank Bldg., Pittsburg.
Norfolk House, Cannon St., London.

RUEBEL - SCHWEDTMANN-WELLS,
CONSULTING, MECHANICAL AND ELECTRICAL ENGINEERS,
Suite 801 Chemical Building, ST. LOUIS, U. S. A.

W. E. BAKER. H. B. BISHOP.
BAKER, W. E. & CO.
ENGINEERS,
ELECTRIC RAILWAYS.
27 William St., NEW YORK.

E. W Hammer, Pres. and Treas. H. J. Minhinnick, Sec. and Gen'l Sup't.
GENERAL ENGINEERING Co., THE
Consulting and Contracting Engineers.
Telephones, Electric Light, Power Transmission
Suite 1112, 135 ADAMS ST., CHICAGO.
Long Distance Telephone Central 478.

A WEEKLY REPRESENTATION
in this "Directory" enables engineers to keep before all possible customers.

Long Distance Phone Central 2448.
SCHOTT, W. H.,
ENGINEER AND CONTRACTOR,
SPECIALTIES—Central Station Heating Plants, Water Works Steam Plants, Electric Light, Gas and Street Railway Plants.
1220-21 MARQUETTE BUILDING, CHICAGO.

ENGINEERS
Represented in this "Directory" are enabled to come in touch with many prospective customers who cannot be reached through any other source.

J. H. HALLBERG
Consulting Engineer
Electric Light, Power and Railway Plants
Suggestions to secure Economy, Specifications, Examinations and Reports
45 Broadway, NEW YORK
Long Distance Telephone 4578 Broad

KEMP, R. W.
Consulting and Contracting Telephone Engineer.
Plans and Specification for complete plants.
Old plants overhauled and placed on paying basis Territory, Kansas, Oklahoma and Indian Territory.
WELLINGTON, - - - KANSAS.

TRY IT.
Keep your name and address in this directory where it will be seen by possible clients.

BRYAN, WILLIAM H.
M. Am. Soc. M. E.,
Consulting Mechanical and Electrical Engineer.
Lincoln Trust Building, ST. LOUIS.

HORNADAY, J. P. & Co.
SUITE 1108 TRACTION BUILDING
CINCINNATI, O.
WATERWORKS, ELECTRIC RAILWAY, LIGHT, TRACTION, INDUSTRIAL AND MINERAL PROPERTIES BOUGHT AND SOLD

KOHLER BROS.,
Contracting Electrical Engineers, Lighting Power Railways,
1804-1806-1808-1810-1812 Fisher Building
CHICAGO.

STANTON, LE ROY W.
Consulting Telephone Engineer
Plans, Specifications and Supervision of Installation of Complete Telephone Plants
Special Reports on Telephone Properties and Apparatus
411 Electrical Bldg., Cleveland, Ohio

DUGALD C. JACKSON, C. E.
WILLIAM B. JACKSON, M. E.
MEMBERS
AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS
AMERICAN SOCIETY OF MECHANICAL ENGINEERS
AMERICAN SOCIETY OF CIVIL ENGINEERS
ENGINEERS. EXPERTS.
MADISON, WIS.

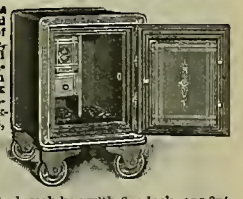
ALL Live men read the WESTERN ELECTRICIAN Each Week. Do You?

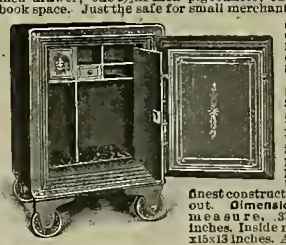
Engineering MECHANICAL, ELECTRICAL, STEAM, CIVIL.
Complete and short courses. Thoroughly equipped engineering shops. Shop work from the beginning. Short courses in Steam and Electrical Engineering. Expenses low. Accommodations the best. School all year. Students may enter any time. Correspondence steam and electrical courses. Send for catalogue. Mention course in which interested.
HIGHLAND PARK COLLEGE, DES MOINES, IOWA.

THE PLACE TO GET A HOME
IS
MONTANA IDAHO OR WASHINGTON OREGON
THE WAY
via
NORTHERN PACIFIC
THE TIME
SEPTEMBER 15 to OCTOBER 15
VERY LOW RATES
ONE-WAY COLONIST TICKETS
FREE GOVERNMENT and LOW PRICED RAILWAY LANDS
Good for Fruit, Grain, Dairying and Poultry. Fine Summer and Winter Climate
Splendid Schools and Churches
Regarding Rates and Train Service write to
A. M. CLELAND,
General Passenger Agent, N. P. R.
ST. PAUL, MINN.
For Information and Maps write to
C. W. MOTT,
General Emigration Agent, N. P. R.
ST. PAUL, MINN.

WE BUY OLD BELTS
OR SCRAPS. ANY SIZE OR CONDITION.
WE CLEAN, REPAIR AND RENEW OLD BELTS.
LEATHER PRESERVER MFG. CORP.
27 W. MONROE ST., CHICAGO

$11.95 FIREPROOF SAFE.
$11.95 buys this 300-pound guaranteed Fireproof Safe, highest grade, heavy wrought steel continuous plate construction, fitted with genuine Yale triplex 3-tumbler combination lock; best workmanship throughout, positively the equal of safes that sell at $20.00 to $25.00. Dimensions: outside, 24x14¾x16¾ inches; inside, 12x8¾x9 inches. Has one 5x4-inch cash box with fine lock; one 3x4-inch drawer; one 3¾x4-inch pigeonhole; one 12x3¾-inch book space. Just the safe for small merchants and offices.





$23.95 BUYS THIS 675-POUND HIGHEST GRADE FIREPROOF SAFE (guaranteed). Equipped with genuine Yale unpickable, triplex, combination lock; finest construction throughout. Dimensions: Outside measure, 37¾ x 24 x 22¾ inches. Inside measure, 20¾ x15x13 inches. Arrangement of cabinet work: One 5x4¾-inch iron cash box with high grade lock, with two flat keys; one 3x4¾-inch drawer with knob, two 2¾x4¾-inch pigeonholes; one 3x4¾-inch pigeonhole; one large book space, 14¾x9¾ inches; one small book space, 14¾x4¾ inches. A BIG BARGAIN FOR ANY STORE, OFFICE, FACTORY, SHOP OR HOTEL.
We will letter your name or firm name in gold over door free of charge if requested. You can send us your order for either one of these safes with the understanding that we will return your money and pay freight charges both ways if you are not pleased and do not consider you have received a wonderful bargain and saved about one-half in price.
For large illustrations and descriptions of our complete line of safes, including our massive heavy wall single and double door safes at $15.00 up to $102.00, for detailed explanation of our method of fireproofing, heavy construction, how we make our safes heavier, stronger and better than others, how we can sell the highest grade safes it is possible to build for about one-half the prices all other dealers ask, for our great 30-day free trial offer, explanation of our binding guarantee, our money refund offer, for freight rates, for our liberal terms of shipment, write for our Free Safe Catalogue. Cut this ad. out and mail to us and the complete SAFE CATALOGUE and our WONDERFUL MONEY SAVING SAFE PROPOSITION WILL BE SENT BY RETURN MAIL. Address,
SEARS, ROEBUCK & CO., Chicago, Ill.

BOILER WATERS CORRECTED

to remove and prevent scale and to stop corrosion. DEARBORN TREATMENT does the work. Send gallon sample for analysis. Booklet "R" now ready.

DEARBORN DRUG & CHEMICAL WORKS,

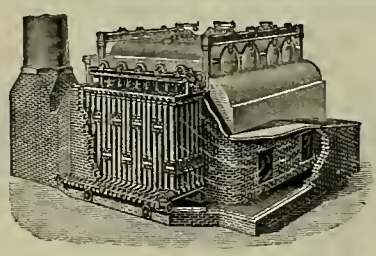
27-34 RIALTO BUILDING, CHICAGO, ILL. WM. H EDGAR, President Telephone: Harrison 3930 and 3931.

Dixon's Solid Belt Dressing *In Handy 1-lb. Bars* ends all slipping, without hardening or otherwise injuring the leather. Circular 125O and free samples upon request.

JOSEPH DIXON CRUCIBLE CO., JERSEY CITY, N. J.

If the Installation of a

GREEN'S ECONOMIZER



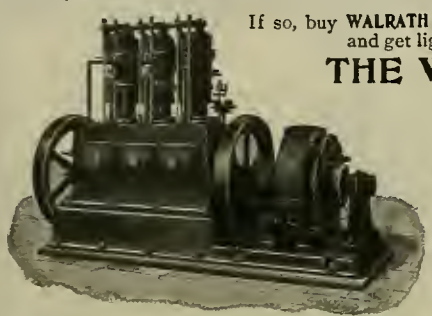
Were long an expense, then you would be justified in deliberating, but under ordinary conditions, depending largely upon coal cost, it soon pays for itself by utilizing waste gases. **Electric light and power plants** find it a paying investment outside of the 10 to 20% saving on coal bill. Ask for explanation through our experts, also for booklet, both free.

The **Green Fuel Economizer Co.**

Matteawan, N. Y. *Sole Manufacturers in the U. S.*

ARE YOU LOOKING FOR MONEY?

If so, buy **WALRATH GAS OR GASOLINE ENGINES** and get light on the subject.



THE WALRATH

Received the Highest Award at the Pan-American Exposition.

It will produce as good a commercial light as that of an automatic steam engine, either belted or direct-connected generator. Simple, Economical and Reliable

Send for Catalogue W.

MARINETTE GAS ENGINE CO.,

CHICAGO HEIGHTS, ILL.

AGENCIES:

Keystone Engineering Co., Farmer's Bank Bldg., Pittsburg, Pa.
Strong, Carlisle & Hammond Co., 61-67 Frankfort St., Cleveland, Ohio
Mackay Engineering Co., 149 Broadway, N. Y.
C. H. Seldenglanz., 52 When Bldg., Indianapolis, Ind.

REG. TRADE MARKS "Phosphor Bronze" DELTA

THE PHOSPHOR BRONZE SMELTING CO. LIMITED, 2200 WASHINGTON AVE., PHILADELPHIA.

"ELEPHANT BRAND PHOSPHOR-BRONZE" INGOTS, CASTINGS, WIRE, RODS, SHEETS, ETC.

— DELTA METAL —

CASTINGS, STAMPINGS AND FORGINGS

ORIGINAL AND SOLE MAKERS IN THE U. S.

H. N. FENNER, President J. F. BLAUVELT, Agent RUSSELL W. KNIGHT, Treasurer

NEW ENGLAND BUTT COMPANY

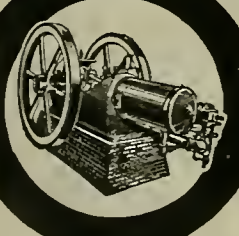
MANUFACTURERS OF

Machinery for Insulating Electrical Wires

Braiding, Taping, Winding, Twinning, Cabling, Stranding, Polishing and Measuring Machines. Cable Covering Braiders

FINE CASTINGS A SPECIALTY

304 PEARL STREET, - - - PROVIDENCE, R. I., U. S. A.



Olds Gas and Gasoline Engines

Competitive tests have established the superiority of the Olds in point of economy over any other engine. The maximum of power is obtained from a minimum of fuel, the cost averaging ¼ of a cent an hour for each horsepower.

Stationary Engines - - - 2 to 100 H. P.
Portable Engines - - - 8 to 10 H. P.

Our new illustrated catalog should be in the hands of every power user. Write to-day for a copy.

OLDS GASOLINE ENGINE WORKS.

252 River Street - - - Lansing, Mich.

No. 984

JEFFREY CHAIN BUCKET DREDGES FOR CATALOGUE, ADDRESS THE JEFFREY MFG. CO. COLUMBUS, OHIO.

BEST ON EARTH.

BURGER AUTOMATIC.

For Electric Work

REGULATION AND ECONOMY OF FUEL UNSURPASSED.

WRITE FOR CATALOGUE H

Then compare it with some Gas Engine hand books that cost $1.00.

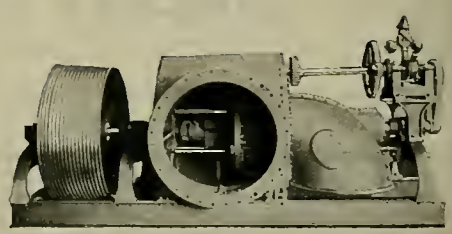
Woolley

Foundry & Mach. Works

Box 400, Anderson, Ind. U. S. A.

SAMSON TURBINE

We build these turbines in all SIZES AND STYLES, on UPRIGHT or HORIZONTAL shafts, BELTED or DIRECT CONNECTED, SINGLE or in PAIRS. They are suitable for direct connecting to GENERATORS, AIR-COMPRESSORS, PUMPS or other machinery driven on horizontal shafting.



THE JAMES LEFFEL & CO., Springfield, Ohio, U. S. A.

HENRY NEWGARD & CO.

ELECTRICAL CONSTRUCTION

Power and Light Plants. Switchboards and Panel Boards.

We install Municipal and Isolated Electric Lighting Plants.
We manufacture Switchboards, Table boards, Iron Cutout Boxes and Electrical Specialties.
We sell Dynamos, Motors and Electrical Supplies.
We wire old as well as new Residences, Factory Buildings, School and College Buildings.

87 Fifth Avenue, Chicago, Illinois.

"HIPWELL"

ENCLOSED

ARC LAMP

"MARVEL OF MECHANICAL SIMPLICITY"

MADE FOR ALL CIRCUITS—DIRECT AND ALTERNATING

SAMPLES SENT ON 30 DAYS' TRIAL—COSTS NOTHING TO TRY THEM.

HIPWELL MNFG. CO.
ALLEGHENY, PA.

TYPE E.

ALTERNATING CURRENT.

SCHEEFFER INTEGRATING WATTMETER

Type E for Alternating Current Type F for Direct Current Circuits

DUST AND BUG PROOF
IMPROVED CONSTRUCTION

MOVING PARTS ARE EXTREMELY LIGHT, INSURING A HIGHLY SENSITIVE AND ACCURATE METER.

WRITE FOR PRICES AND DESCRIPTIVE LITERATURE.

DIAMOND METER COMPANY,
PEORIA, ILL., - - - - U. S. A.

TYPE F.

DIRECT CURRENT.

TESTED FUSE WIRE AND STRIP
OPEN FUSE LINKS
ENCLOSED FUSE LINKS
TELEPHONE FUSES
TUBULAR LINE FUSES

SWITCH OUTLET BOXES.

WIRE JOINTS TEST CONNECTORS

CHICAGO FUSE WIRE & MFG. CO.,
CHICAGO. BUFFALO. NEW YORK.

TELEPHONE PRINCIPLES AND PRACTICE

A NEW BOOK IN TELEPHONY

By
GEORGE WALKER WILDER, PH. D.
Professor in Telephony in the Armour Institute of Technology

Complete and up-to-date, written by a practical man. All about modern telephone apparatus, their principles and use:

I. Fundamental Ideas
II. Telephone Apparatus
III. Systems of Communication
IV. Construction and Equipment

IN 32 CHAPTERS, 450 PAGES, 378 ILLUSTRATIONS. PRICE $2.00 POSTPAID.

Send Postal Money Order to

THE CANTWELL PRESS - Madison, Wis.

CENTRAL STATION HEATING

We are the originators and builders of the underground system of live and exhaust steam heating. Our system is used for the utilization and distribution of exhaust steam from electric and power plants for heating purposes. 250 Plants in successful operation. We have the only Meter System. Also manufacturers of Wooden Water Pipe, Steam Pipe Casing, Steam Traps, Condensation Meters, Valves, Economizing Coils, Separators and full line of Steam Fitters' Supplies.

WRITE FOR PAMPHLET AND PRICE LIST

AMERICAN DISTRICT STEAM COMPANY

MENTION WESTERN ELECTRICIAN. LOCKPORT, N.Y. CHICAGO, ILL.

BITUMINIZED FIBER CONDUIT

FOR UNDERGROUND CONSTRUCTION

Combines the **good features** of other conduits.
Eliminates the **bad features** existing in many kinds.
Has valuable features not found in any other ducts.

Made in 7-foot lengths with male and female joints, making construction very rapid and simple, with consequent low cost

Alignment is perfect and permanent without tedious care and skill required in laying of butt-joint conduits.

Users are astonished by the ease and rapidity with which cables can be drawn in, and this without the slightest scratching or injury to the lead covering thereof.

Made in sizes from 1-inch to 10-inch diameter.

Bends of any radius and any angle.

Write us for further information and prices, stating sizes and quantities required.

American Conduit Co.

Main Offices: 1005-6 Manhattan Building, Chicago

Other Offices:
170 Broadway, New York. 336 Macy St., Los Angeles

TELEPHONE BOOTHS

When in want of the Right Kind write us.

Catalogue Free

Yesbera Mfg. Co.
TOLEDO, OHIO.

We introduced successful 4-party lines

LEICH SELECTIVE SYSTEM

Write for our booklet—"Selective W."

CENTRAL ENERGY OR MAGNETO

Impedance Coil for Selectives. No Springs.

AMERICAN ELECTRIC TELEPHONE CO.
CHICAGO, ILLINOIS

THE BEST KIND OF INSURANCE FOR TOLL LINES

To be erected on the most exposed parts of the line. They require no attention after erecting.

Minnesota Electric Co.,
MINNEAPOLIS, MINN.

INTERNATIONAL

Mechanical Self-Restoring Drop Switchboard.

A PERFECT APPARATUS.

Made in any desired capacity.
Sample parts and quotations on request.

INTERNATIONAL TELEPHONE MANUFACTURING CO.
CHICAGO, U. S. A.

AS SIMPLE AS ITS NAME.

A B C
—OF—
THE TELEPHONE

By J. E. HOMANS, A. M.
352 pages.
Cloth, Price $1.00.

An up-to-date, practical treatise on the construction, theory, installation, care and management of telephones and their appliances.
Sent prepaid on receipt of price.

Electrician Publishing Co.,
510 Marquette Building, Chicago, Ill.

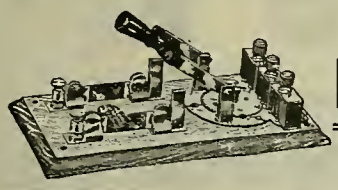
Automatic Telephones.

Privacy
Promptness
Precision
Profits.

Automatic Electric Co., Chicago, U. S. A.

SOMETHING DOING IN A STORM

WITHOUT A



King of Protectors

Better Buy a

"TORNQUIST"

COMBINATION LIGHTNING ARRESTER GROUND SWITCH FUSE AND LEVER CUT-OUT.

THE ONLY SAFE PROTECTOR MADE. ORDER SAMPLE NOW.

BABY KNIFE SWITCHES — STAMPING AND PLATING. — SOLD BY ALL JOBBERS.

Clinton Stamping & Electric Co.,

CLINTON, IA.

HART & CO., Chicago, General Agents.

"JUST AS GOOD AS KELLOGG APPARATUS"

cannot be bought outside our factories for the same price we ask—for a higher price or for a lower price.

Our customers never think Kellogg prices high.

We are quoting attractive magneto prices. Write us for quotations on everything in the magneto line.

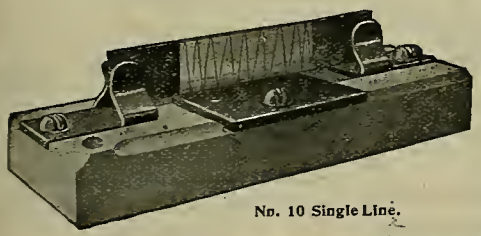
Send for our new bulletins Nos. 8 to 13.

Do not miss visiting the Kellogg exhibit at the St. Louis Exposition, Electricity Building.

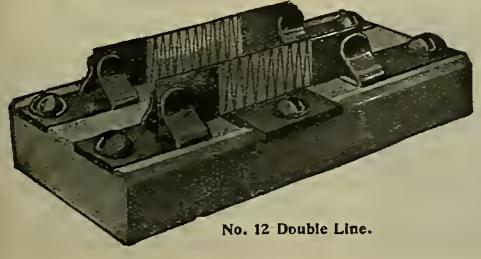
Kellogg Switchboard & Supply Co.,

GREEN AND CONGRESS STREETS, CHICAGO

Electric Building, Cleveland Keystone Telephone Building, Philadelphia



No. 10 Single Line.



No. 12 Double Line.

PROTECTORS THAT PROTECT.

Our patent wrapped fuse used in our protectors are an insurance policy against lightning.

Sample free by mail to any Exchange or Toll Line

CENTRAL TELEPHONE AND ELECTRIC CO.,

909 Market St.,

ST. LOUIS, U. S. A.

STROMBERG-CARLSON

Central Energy Multiple Switchboard Apparatus

IN USE BY THE

KANSAS CITY HOME TELEPHONE CO.

KANSAS CITY, MO.

Branch A, Kansas City, Mo.

"Manufacturers of the Complete Product."

Branch C, Kansas City, Kan.

"CENTRAL ENERGY"

OUR REGISTERED TRADE MARK IMPLIES

"PERFECT TELEPHONE SERVICE"

Branch B, Kansas City, Mo.

Quotations and Estimates Furnished on Request.

OUR BULLETINS MAILED FREE.

STROMBERG-CARLSON TEL. MFG. CO.,

GENERAL OFFICES, ROCHESTER, N. Y.

WESTERN SALES OFFICE. CHICAGO, ILL.

PRODUCERS AND WHOLESALERS OF WHITE CEDAR PRODUCTS

CEDAR POLES

SPECIAL PRICES ON SMALL POLES.
Write for a copy of our TELEGRAPH CODE FOR CEDAR PRODUCTS

YARDS
KOSS MICH.
L'ANSE "
MUNISING "
ONTONAGON
WAGNER, WIS
PESHTIGO "

C. H. WORCESTER CO.
SUITE 1206 TRIBUNE BLDG. CHICAGO.

TELEPHONE POLES

Yards at Red Cliff, Wis., Aitkin, Feeley, Cohasset, Deer River, Tenstrike and Black Duck, Minnesota.
Large stocks. Prompt shipments. Carefully inspected stock at low prices.

J. W. MORRISON LUMBER CO., 918-19 Lumber Exchange MINNEAPOLIS, MINN.

BRACKETS—X ARMS—PINS

little things it is true, but they cut a big figure in line construction.
OUR MOTTO IS:
Prompt Shipment Quality Satisfaction Right Price
COLUMBIA MFG. CO. ANTIGO, WIS.

Cedar Poles.

Pittsburg and Lake Superior Iron Co., Producers and Wholesalers. Escanaba, Mich.

INDUSTRIES ARE OFFERED LOCATIONS

WITH

Satisfactory Inducements,
Favorable Freight Rates,
Good Labor Conditions,
Healthful Communities,

ON THE LINES OF

THE ILLINOIS CENTRAL R. R.
AND THE
YAZOO & MISSISSIPPI VALLEY R. R.

For full information and descriptive pamphlet address

J. C. CLAIR,
Industrial Commissioner,
1 Park Row, Chicago, Ill.

ELECTRICAL BOOKS.
All Kinds.
ELECTRICIAN PUBLISHING COMPANY,
Suite 510 Marquette Bldg., CHICAGO

"The Nation's pleasure ground and sanitarium."—*David Bennett Hill.*

THE ADIRONDACK MOUNTAINS.

The lakes and streams in the Adirondack Mountains are full of fish, the woods are inviting, the air is filled with health, and the nights are cool and restful. If you visit this region once, you will go there again. An answer to almost any question in regard to the Adirondacks will be found in No. 20 of the "Four-Track Series," "The Adirondack Mountains and How to Reach Them;" issued by the

NEW YORK CENTRAL

A copy will be mailed free on receipt of a two-cent stamp, by George H. Daniels, General Passenger Agent, Grand Central Station, New York.

POLES.
WHITE CEDAR.
IDAHO CEDAR up to 80 ft.

BERTHOLD & JENNINGS,
ST. LOUIS.
Chemical Building.

CROSS ARMS.
LONG LEAF PINE AND FIR.

You don't have to

use any augers, wrenches, or other special tools to install a Crouse-Hinds Harpoon Guy Anchor.

You simply drive it in with a 12 pound sledge, 30 or 40 blows will do it.

WRITE US FOR CIRCULAR AND PRICES.

CROUSE-HINDS COMPANY,
133 S. CLINTON STREET, - - - CHICAGO, ILL.

Idaho Cedar Poles

PACIFIC COAST POLE CO. SPOKANE, WASH.

Poles and Ties

The Fowler Companies
TRADE MARK
Fisher Bldg. Chicago

Points in Wisconsin and the Northwest

are covered by Wisconsin Central Railway's convenient, solid, wide vestibuled trains, equipped with Pullman sleepers, free reclining chair cars and modern coaches which leave Central Station, 12th Street and Park Row (Lake Front), Chicago for St. Paul, Minneapolis, Ashland and Duluth, connecting with all western lines. Meals in dining and cafe cars served a la carte.
For tickets and further information apply to nearest ticket agent, or write
JAS. C. POND, Gen'l Pass. Agt., Milwaukee, Wis.

"TELEPHONE TROUBLES ...AND... HOW TO FIND THEM,"

By W. H. HYDE and J. A. McMANMAN,
FORMERLY
HASKINS' TELEPHONE TROUBLES.

This little book is strictly up-to-date on all matters pertaining to telephone troubles and their remedies.

Sent Postpaid for 25c.

New (ninth) edition just out, 52 pages. Many diagrams showing connections. A complete hand-book for telephone inspectors.
Telephone exchange managers and employes will find this book a great help in locating telephone troubles and remedies therefor.

ELECTRICIAN PUBLISHING CO.,
510 Marquette Bldg., Chicago.

Locations for Industries

Erie Railroad

Chicago to New York

The Erie Railroad Company's Industrial Department has all the territory traversed by the railroad districted in relation to resources, adaptability, markets and advantages for manufacturing, and can advise with manufacturers in relation to the most suitable locations. For full information address

LUIS JACKSON
Industrial Commissioner, Erie Railroad Company
21 Cortlandt Street, New York

BE WISE

Write us for prices on

CEDAR POLES

BIG STOCK *LOW PRICES*

THE WESTERN LUMBER & POLE CO.

Main Office, DENVER, COLORADO

Some of our customers in Poles and Ties telegraph us their orders.

Do we need say more?

MALTBY CEDAR COMPANY, 509 Phoenix Block, Bay City, Michigan

PITTSBURG AGENTS: Tipper & Patton, 509 Bessemer Bldg.

WHITE CEDAR POLES

Don't forget our Minnesota Transfer Yard—midway between St. Paul and Minneapolis, where we load in forty-eight hours from the time we have your order.

PACE & HILL CO. 1003 Lumber Exchange, MINNEAPOLIS, MINN.

Southern Cedar POLES Are the Best.

NO ROTTEN BUTTS. D. W. PHELAN, 277 Broadway, New York

CEDAR POLES

ESTABLISHED 1862

WM. MUELLER COMPANY

1211-12-13 MARQUETTE BLDG. CHICAGO.

EIGHT DISTRIBUTING YARDS

POLES W. C. STERLING & SON, MONROE, MICH. Eleven Pole Yards in Michigan. **TIES.**

Wholesale Producers for 20 years.

MICHIGAN AND WESTERN **CEDAR POLES**

ALL LENGTHS AND SIZES

LINDSLEY BROS CO.

TRIBUNE BLDG., CHICAGO

POLES, TIES, POSTS. THE PORTER CEDAR CO., SAGINAW, MICH.

PRODUCERS. We want your Inquiries always.

WHITE CEDAR POLES

HALL L. BROOKS

52 WISCONSIN AVENUE

TOMAHAWK, WIS.

Cedar TORREY CEDAR CO., CLINTONVILLE, WIS. **Poles**

Large Stock Constantly on Hand

Watson Motors

If you want a small motor for a special purpose, write us.

Mechanical Appliance Co.

Milwaukee, Wis.

POLE DEALERS ADVERTISING IN THE WESTERN ELECTRICIAN OBTAIN MOST EXCELLENT RESULTS BECAUSE IT PLACES THEM IN TOUCH WITH ACTUAL BUYERS OF POLES. TRY A CARD.

MICHIGAN WHITE LARGE STOCK.

CEDAR POLES

PROMPT SHIPMENTS. KELLOGG SWITCHBOARD & SUPPLY CO., Chicago.

HOLOPHANE PAGODAS

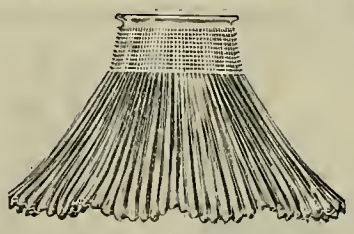
CHICAGO HOLOPHANE GLASS COMPANY NEW YORK

PATENTED JUNE 28, 1904

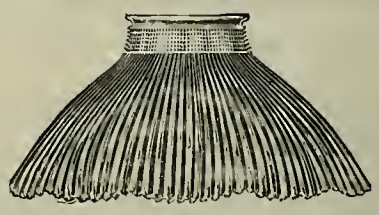
To fit Standard 2 1-4 in. Holder

(All cuts one-third actual size)

2622

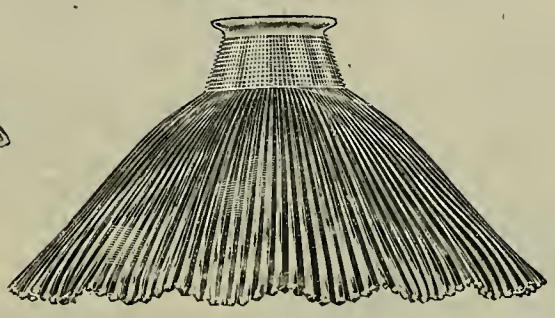


2633
(Plain edge is 2632)



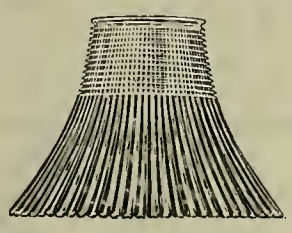
2623

2662

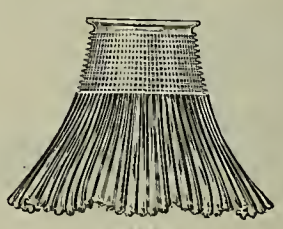


2651
(Plain edge is 2650)

2663



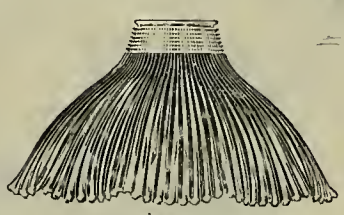
2682



2683

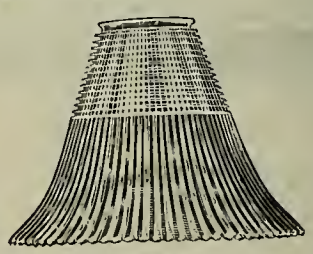
To fit Special 1 5-8 in. Holder Furnished Free with each Reflector

2631
(Plain edge is 2630)



2621
(Plain edge 2620)

2657



2656

NOTICE—In order to distinguish the Holophane CONCENTRATING reflector from the Holophane DIFFUSING globe the Trade-name "PAGODA" has been adopted for Holophane reflectors

HOLOPHANE SCIENTIFIC GLASSWARE IS PROTECTED BY THE FOLLOWING PATENTS

Nos. 563,836, July 14, 1896; 593,348, Nov. 9, 1897; 30,266, Feb. 28, 1899; 634,295, Oct. 3, 1899; 31,353, Aug. 8, 1899; 31,354, Aug. 8, 1899; 31,355, Aug. 8, 1899; 31,356, Aug. 8, 1899; 31,357, Aug. 8, 1899; 31,358, Aug. 8, 1899; 31,359, Aug. 8, 1899; 32,286, Feb. 27, 1900; 32,685, May 22, 1900; 32,686, May 22, 1900; 655,728, Aug. 14, 1900; 33 996, June 29, 1901; 679,770, Aug. 6, 1901; 679,771, Aug. 6, 1901; 687,848, Dec. 3, 1901; 35,616, Jan. 28, 1902; 35,684, Feb. 4, 1902; 35,755, Feb. 18, 1902; 35,756, Feb. 18, 1902; 35,757, Feb. 18, 1902; 35,682, Feb. 4, 1902; 35,683, Feb. 4, 1902; 36,215, Feb. 3, 1903; 36,214, Feb. 4, 1903; 732,211, June 30, 1903; 762,926, June 21, 1904; 762,927, June 21, 1904; 763,688, June 28, 1904; 763,689, June 28, 1904. Other patents pending.

The General Electric Company have adopted Holophane "Pagodas" exclusively for use with their celebrated "Meridian," and other electric lamps.

The following well-known lamp companies endorse and use Holophane "Pagodas" as being the most efficient and decorative reflectors on the market, namely: Bryan-Marsh Co., The Columbia Incandescent Lamp Co., Sunbeam Incandescent Lamp Co., The Buckeye Electric Co., Fostoria Incandescent Lamp Co., The Shelby Electric Co., The Independent Incandescent Lamp Co., The Warren Electric and Specialty Co., The Colonial Electric Co., The New York and Ohio Co., and all the leading electric lamp manufacturers of the United States.

ILLUSTRATED CATALOGUES AND TRADE DISCOUNTS SENT ON APPLICATION

Type K Induction Wattmeters

Glass case, separately sealed terminals

All moving parts can be removed and replaced without affecting to the slightest degree any adjustment or impairing the permanent accuracy of the meter.

We make Type K meters in all sizes for all commercial circuits with glass, metal or switchboard case with inner sealed or separately sealed terminals.

Fort Wayne Electric Works

"WOOD" SYSTEM.

263

Fort Wayne, Indiana.

The Inspector AND Trouble Man.

By A. E. DOBBS.

Full of information and diagrams for the operator, exchange owner, exchange manager, inspector, trouble man, lineman.

A complete description of telephones and their troubles. How to find and remedy them, together with working plans for exchange construction, complete with diagrams of all up-to-date telephones and switchboards.

This is a practical book, written in **plain language**, and for **anyone** interested in telephony.

Mailed anywhere on receipt of price . . . ONE DOLLAR.

No technicalities. Substantially bound in cloth.

ELECTRICIAN PUBLISHING CO.,

510 MARQUETTE BUILDING, CHICAGO.

Good Advice

No. 9.

A certain successful station superintendent, upon being asked what he considered to be the indispensable elements of a profit-making plant, stated that his long experience had taught him they were: good engines, good dynamos, close attention to business and DUNCAN METERS.

Good Advice No. 10 Next Week.

Send for Bulletin and Prices.

DUNCAN ELECTRIC MFG. CO.

LAFAYETTE, IND.

FLASHERS

IMPROVED REYNOLDS FLASHER
For ELECTRIC SIGNS, FLAGS, DISPLAYS, ETC

The simplest and most practical Flasher on earth.

A Proven Success, Not an Experiment.

Electrical Supply Dealers, Contractors and Central Stations find it very profitable to advocate our Flashers among their patrons.
WRITE US for Flasher information and pointers on electric signs.

REYNOLDS ELECTRIC FLASHER MFG. CO.
221 FIFTH AVE., CHICAGO, ILL.

VULCANIZED FIBRE

Highest grades for electrical insulation and mechanical purposes, in sheets, tubes, rods and special shapes. Catalogues and samples on application.

VULCANIZED FIBRE CO., - Wilmington, Del.

EDISON PRIMARY BATTERIES

FORMERLY EDISON LA LANDE

There is no deterioration in the permanent parts of these batteries. It follows, therefore, that each time a cell is recharged it will last as long a time and deliver as heavy a current as the original charge when the cell was first put into service. Our catalogue No. 7 will tell you more about this. Let us send it.

EDISON MANUFACTURING CO.,

TRADE Thomas A. Edison MARK

Factory, ORANGE, N. J.
NEW YORK, 83 Chambers St
CHICAGO, 304 Wabash Ave

DIRECT CURRENT
MOTORS

THE ADAPTATION of our motors to mechanical drive is practically universal, and their service is unequaled.

Write for Bulletin No. 21814

SPRAGUE
ELECTRIC COMPANY

General Offices:
527 West 34th Street, New York.

Chicago Office: Fisher Building.

STURTEVANT MOTORS

All Types, Sizes and Capacities to Meet Any Requirements

B. F. STURTEVANT CO.
Boston, Massachusetts
General Office and Works: Hyde Park, Mass.
New York Philadelphia Chicago London
364

Warren Alternator

It's the
INDUCTOR TYPE
Simple as a child's A. B. C.

"Anybody not a fool—ought to be able to operate it." This inductor carries the inducing magnetism.

WE GUARANTEE WHAT WE SELL
AND
SELL WHAT WE GUARANTEE

WARREN ELECTRIC MFG. CO.

Sandusky, O.

Black Diamond File Works

Est. 1863. Inc. 1895.

Twelve Medals Awarded at International Expositions

Special Prize Gold Medal at Atlanta, 1895.

OUR GOODS ARE ON SALE IN EVERY LEADING HARDWARE STORE IN THE UNITED STATES AND CANADA.

G. & H. BARNETT COMPANY,
PHILADELPHIA, PA.

JOHN A. ROEBLING'S SONS CO.

Insulated Wire of All Kinds

Bare Copper Wire

MAIN OFFICE AND WORKS **TRENTON, N. J.**

AGENCIES AND BRANCHES
New York Chicago Cleveland San Francisco Philadelphia Atlanta

Western Electrician

Vol. XXXV. $3.00 Per Annum. Copyright, 1904, by Electrician Publishing Company, Chicago. CHICAGO, OCTOBER 1, 1904. Entered at Chicago Postoffice as mail matter of the second class. 10 Cents a Copy. No. 14.

SIMPLEX INSULATED WIRES AND CABLES.
RUBBER COVERED, WEATHERPROOF, UNDERGROUND AND SUBMARINE.
WESTERN SELLING AGENT, H. R. HIXSON, 1104 Monadnock Block, CHICAGO.
The Simplex Electrical Co., 110 State Street, BOSTON, MASS.

CHICAGO INSULATED WIRE CO.
152-154 LAKE ST., CHICAGO
1108-1110 PINE ST., ST. LOUIS, MO.
Bare and Insulated Wires and Cables
Galvanized Steel Strands

OKONITE TRADE MARK
1889—Paris Exposition, Medal for Rubber Insulation.
1893—World's Fair, Medal for Rubber Insulation.
THE STANDARD FOR RUBBER INSULATION.
Sole Manufacturers of
Okonite Wires, Okonite Tape, Manson Tape, Candee Weather-proof Wires.
THE OKONITE CO., LTD.
Willard L. Candee, N. Ourant Chaever, Managers. 253 Broadway, New York. Geo. T. Manson, Gen'l Supt. W. H. Hodgins, Secy.

TRADE MARK CRESCENT INSULATED WIRE & CABLE CO. TRENTON, N. J.
CRESCENT RUBBER INSULATED WIRES AND CABLES
National Code Standard.
CRESCENT INSULATED WIRE AND CABLE CO.,
New York Office, 83 BARCLAY STREET. Main Office and Factory, TRENTON, N. J.

STANDARD UNDERGROUND CABLE CO.
322 The Rookery, Chicago. Westinghouse Bldg., Pittsburg. 55 Liberty St., New York City. 1225 Betz Bldg., Philadelphia, Pa.
Crossley Bldg., San Francisco. 10 Post Office Square, Boston.
BARE AND WEATHERPROOF WIRES AND CABLES.
Rubber Covered Wires and Cables. Underground Cables for all Purposes.

INDIANA RUBBER AND INSULATED WIRE CO.,
MANUFACTURERS OF
Paranite Rubber Covered Wires and Cables,
UNDERGROUND, AERIAL, SUBMARINE AND INSIDE USE;
TELEPHONE, TELEGRAPH AND FIRE ALARM CABLES.
All Wires are tested at Factory. JONESBORO, IND.

THE PHOENIX GLASS CO. Pittsburg, New York, Chicago
Manufacturers of
Electric Globes and Shades, both Arc and Incandescent
Inner and Outer Globes for all enclosed arc systems
CATALOGUES SENT ON REQUEST

THOUSANDS IN USE.
Motors, ½ h. p. to 100 h. p.
Dynamos, 1 k. w. to 75 k. w.
Highest Quality. Reasonable Price.
THE HOBART ELECTRIC MFG. CO.
TROY, OHIO.

Pillsbury Alternating Current Ceiling Fans
MANUFACTURED BY
CENTURY ELECTRIC CO., St. Louis, Mo.

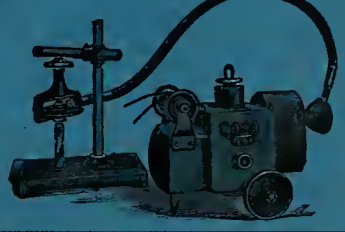
Electric Heating Apparatus
SEND FOR 82-PAGE CATALOGUE.
UNIT" ENAMELED RHEOSTATS
SIMPLEX ELECTRIC HEATING CO.,
Cambridgeport, Mass.

KESTER SELF FLUXING SOLDER
A Tube of Solder Filled with Flux.
Requires no Acid.
SAVES—LABOR—TIME—MONEY.

PATENTED.
Send for Free Samples.
L. F. Mehler Co., R. 1008 Chemical Bldg., St. Louis, Mo., Gen. Western Agent.
KESTER ELECTRIC M'F'G CO.,
48 N. UNION STREET, CHICAGO, ILL.

"CIRCULAR LOOM" THE FLEXIBLE CONDUIT
AMERICAN CIRCULAR LOOM CO. TRADE MARK REGISTERED
CONDUITS FOR INTERIOR WIRING.
American Circular Loom Co.
Chelsea, Mass., New York, Chicago, San Francisco.

All Supply Houses
J. J. EGAN'S "ACME" COMMUTATOR COMPOUND.
J. J. EGAN'S "ACME" COMMUTATOR COMPOUND absolutely prevents sparking or cutting. One stick of "Acme" is equal to one gallon of oil for lubricating commutators. Free Sample. AGENTS WANTED.
50c per Stick. $5.00 per doz.
J. J. Egan Sale Mfg., 317 Austin Ave., Tel. Polk, 1779 Chicago


ESTABLISHED 1875.
COMBINATION OF
Stow Flexible Shaft
—AND—
MULTI-SPEED MOTOR
Practically dust and water proof. For Portable Drilling, Tapping, Reaming, Emery Grinding, etc. Write for Catalogue and Prices.
STOW MFG. CO., Binghamton, N. Y.
Gen'l European Agents, Selig, Sonnenthal & Co., 85 Queen Victoria Street, London, England

THERMOPILES 1½ VOLTS 1½ AMPERES
For Electrolytic analysis, charging storage batteries, and other constant current requirements. $3 Each.
WALSH'S SONS & CO.,
264 Washington Street. Newark, N. J.

H. N. FENNER, President J. F. BLAUVELT, Agent RUSSELL W. KNIGHT, Treasurer
NEW ENGLAND BUTT COMPANY
MANUFACTURERS OF
Machinery for Insulating Electrical Wires
Braiding, Taping, Winding, Twinning, Cabling, Stranding, Polishing and Measuring Machines. Cable Covering Braiders
FINE CASTINGS A SPECIALTY
304 PEARL STREET, - - - PROVIDENCE, R. I., U. S. A.

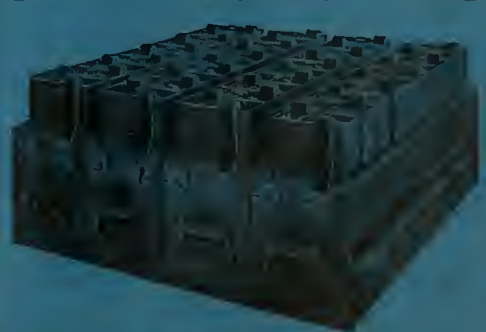
WESTON Electrical Instrument Co.,
Waverly Park, NEWARK, N. J.

Illuminated Dial Station Instruments.
These instruments are constructed upon the same general principle as our regular Standard Portable Direct Current Voltmeters and Ammeters, but are much larger, and the working parts are inclosed in a neatly designed, dust-proof cast-iron case which effectively shields the instruments from disturbing influences of external magnetic fields.
BERLIN—European Weston Electrical Instrument Co., Ritterstrasse No. 85.

Weston Standard Illuminated Dial Station Ammeter, Style B. "Flush Type."

Weston Standard
Portable Direct Reading Voltmeters and Millivoltmeters. Ammeters and Milammeters, Wattmeters and Voltmeters, for Alternating and Direct Current Circuits.
Our portable instruments are recognized as standards throughout the civilized world.
Our Semi-Portable Laboratory Standard Voltmeters and Ammeters are still better.
They are the most reliable, absolute standards for Laboratory use.
LONDON—Elliott Bros., Century Works, Lewisham.

PARIS, FRANCE—E. B. Cadiot, 12 Rue St. Georges. New York Office—74 Cortlandt St.

SATISFACTION ASSURED

Every battery has its own guarantee.
Lighting Batteries.
Automobile Sparkers.
Prompt delivery made on rush orders.
We work night and day.
Northwestern Storage Battery Co.,
285 Madison St., - - - Chicago, Ill.

Yes
We Will Sell
"The Big Reliable"

5000 horsepower Allis-Chalmers Engine and Bullock Generator

which have attracted more attention and caused more favorable comment
than any other power unit in the world

Supplying current for the Decorative Lighting of the

WORLD'S FAIR, ST. LOUIS

The Best Workmanship The Best Performance

Designed 1903 Shipped from our Works January 1904—37 Carloads
Steam first turned on April 20th, 1904 Operated perfectly ever since without costing a cent for repairs

The world-renowned Decorative Lighting of the St. Louis Exposition Buildings and Grounds started
April 29th, 1904, this Engine and Generator carrying the load then and ever since
Night after night carrying 1500 horsepower overload, running cool and steady

The Engineering Triumph of the World's Fair

Allis-Chalmers Co
CHICAGO

THE ELECTRIC STORAGE BATTERY CO.

PHILADELPHIA

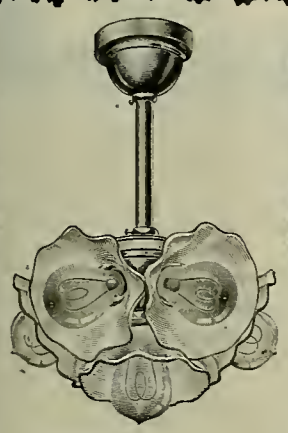
Extends an invitation to its exhibit at Section Twenty, in the Palace of Electricity, Louisiana Purchase Exposition.

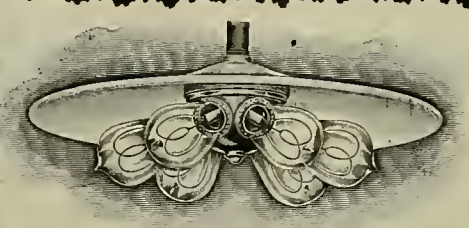
September 12, 1904

SALES OFFICES

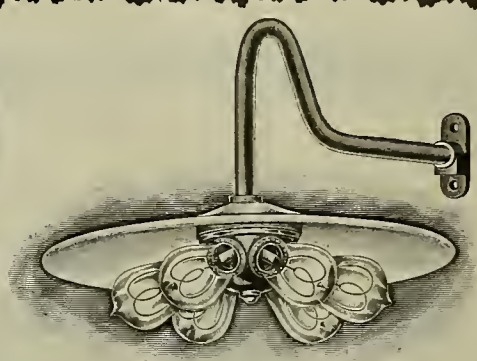
Philadelphia, Allegheny Ave. and 19th St. | New York, 100 Broadway. | Boston, 60 State St. | Chicago, Marquette Bldg. | St. Louis Wainwright Bldg.

San Francisco, Rialto Bldg. | Cleveland, Citizens Bldg. | Canada, Canadian General Electric Co., Ltd., Toronto | Havana, Cuba. C. F. Greenwood, Manager 34 Empedrado St.





BENJAMIN WIRELESS CLUSTERS
ARE THE
ONLY WIRELESS CLUSTERS.
APPROVED
BY THE
UNDERWRITERS' NATIONAL ELECTRIC ASSOCIATION



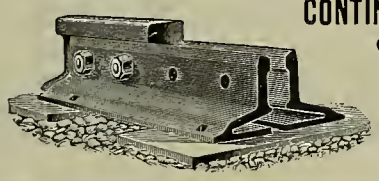
WRITE FOR CATALOGUE B-15. JUST ISSUING.

CHICAGO. BENJAMIN ELECTRIC MFG. COMPANY. NEW YORK.

Engineering MECHANICAL, ELECTRICAL, STEAM, CIVIL.

Complete and short courses. Thoroughly equipped engineering shops. Shop work from the beginning. Short courses in Steam and Electrical Engineering. Expenses low. Accommodations the best. School all year. Students may enter any time. Correspondence steam and electrical courses. Send for catalogue. Mention course in which interested.

HIGHLAND PARK COLLEGE, DES MOINES, IOWA.



CONTINUOUS RAIL JOINT CO. OF AM.

GENL. OFFICES: CENTURY BLDG., NEWARK, N.J.

OVER 20,000 MILES IN USE

See our exhibit, World's Fair, St. Louis, Mo., Transportation Bldg., Aisle "C," Posts 7 and 8.

The Incandescent Lamp Replacer and Cleaner replaces and cleans any o. p. lamp at any height or angle.

Incandescent Electric Light Manipulator Co., 116 Bedford St., Boston, Mass.

PLATINUM

PLATINUM RIVETS FOR CONTACT POINTS IN TELEPHONES—SPARK COILS AND OTHER ELECTRICAL APPARATUS. PLATINUM SHEET AND WIRE IN ANY FORM AND DEGREE OF HARDNESS. PLATINUM SCRAP PURCHASED.

BAKER & COMPANY, Inc.

ARTISANS IN PLATINUM

408-410-412-414 N. J. R. R. AVE. - NEWARK, N. J.

New York Office: 120 Liberty St.

ALPHABETICAL INDEX TO ADVERTISEMENTS.

Adams-Bagnall Electric Co..19
Allis-Chalmers Company..... 2
American Battery Co.....—
Amer. Circular Loom Co..... 1
American Conduit Co.....21
Amer. District Steam Co.....24
Amer. Elec. Fuse Co..... 4
Amer. El. Telephone Co.....23
American Electrical Works..15
Arnold Elec. Power Station Co.....17
Automatic Electric Co..... 23

Babcock & Wilcox Co.....25
Badt, F. B.....17
Bain, Forée.....15
Baker & Company..... 3
Baker & Co., W. E.....17
Barnett Company, G. & H....28
Beardslee Chandelier Mfg.Co.14
Benjamin Elec. Mfg Co..... 3
Berthold & Jennings.....25
Big Four Route.....24
Bissell Co., The F.....21
Bossert Electric Construction Co..... 11
Brooks, Hall L.....24
Bryan-Marsh Co.....—
Bryan, Wm. H.....17
Buchanan, R. G.....25
Buckeye Electric Co.....—
Bullock Elec. Mfg. Co..... 2
Butterfield, J. F.....—

Bylesby & Co., H. M.....17

Cantwell Press, The.....23
Central Electric Co..... 5
Cent. Stat. Improvement Co..16
Central Tel. & El. Co.....—
Century Electric Co..... 1
Chicago Die & Electric Co....—
Chicago Edison Co.....4, 16
Chic. Fuse Wire & Mfg. Co...—
Chicago Insulated Wire Co.. 1
Chicago Mica Co.....14
Clinton Stamping & Elec. Co.21
Columbia Incand. Lamp Co..—
Columbia Mfg. Co.....25
Consumers Carbon Co.....—
Continuous Rail Joint Company of America..... 3, 12
Cope, T. J..... 9
Crawfordsville Electric Co.. 5
Crescent Ins. Wire & Cbl. Co. 1
Crocker-Wheeler Company... 5
Crouse-Hinds Co.....—
Cutler-Hammer Mfg. Co.....10
Cutter Elec. & Mfg. Company—

D. & W. Fuse Company.....—
Dearborn Drug & Chem. Wks.18
Diamond Meter Company....—
Dielectric Manufacturing Co.15
Directory of Engineers..... 17
Dixon Crucible Co., Joseph..18
Duncan Elec. Mfg. Co.....27
Dyar, H. W.....—

Edison Decorative & Miniature Lamp Departm't.....14
Edison Mfg. Company..... 9
Edwards & Co..... 8
Egan, J. J..... 1
Electric Appliance Co..... 14
Electric Storage Battery Co.. 3
Electrical Appliance Co..... 6
Electrical Engineer Institute.14
Electrician Pub. Company...12
Erie Ry.....24
Evans, Almirall & Co..... ..17

Faries Mfg. Co..... 7
"For Sale" Advertisements..16
Ft. Wayne Elec. Works, Inc..27
Fostoria Incand. Lamp Co....—
Fowler, John H.....25
Fowler-Jacobs Company.....25
Franklin Elec. Mfg. Co .....—

General Electric Co..... 9
General Engineering Co., The 17
General Incandescent Arc Light Company..... 4
General Incand. Lamp Co....—
Glogau & Co. H. M.....—
Gould Storage Battery Co....-
Green Fuel Economizer Co..—
Gregory Electric Company...16

Hallberg, J. H 17
Haller Machine Co.....14
Hart Mfg. Co..... 7
Hartford Steam Boiler Inspection & Insurance Co....18
Hartford Time Switch Co....20
Hazard Manufacturing Co...28
Highland Park College. ... 3
Hipwell Mfg. Co.... .... —
Hobart Elec. Mfg. Co..... 1
Hoffman, G. W.....16
Holmes Fibre-Graph. Co.....18
Holophane Glass Co.....13
Holtzer-Cabot Electric Co...—
Hornaday & Co., J. P.....17
Humphrey, Henry H.....—
Hunt & Co., Robt. W.....17

Illinois Central Ry.....25
Incandescent Electric Light Manipulator Company..... 3
Indiana Rub. & Ins. W. Co.... 1
India Rubber & Gutta Percha Insulating Company.....17
International Elec. Meter Co 16
International Tel. Mfg. Co...23
Jackson, D. C. & W. B.....17
Jeffrey Manufacturing Co....18
Jewell Electrical Inst. Co....—
Johns-Manville Co., H. W.....—

Kartavert Manufacturing Co.28
Kellogg Switchboard & Supply Company.....19, 25
Kemp, R. W..... 17
Kester Elec. Mfg. Co..... 1
Klein & Sons, Mathias.... ...15
Kohler Brothers.....17
Kuhlman Electric Co.....15

Leather Preserv. M. Corp....—
Leffel & Co., James.....18
Lindsley Brothers Company..25
Loud's Sons Co., H. M.....24

Machado & Roller..... 7
Maltby Cedar Company.....25
Manhattan El. Supply Co....14
Manross, F. N..... 14
Marinette Gas Engine Co.....18
Matthews & Bros., W. N.....15
McLaughlin, James.... 17
McLaughlin & Co., Jas..... 9
McLennan & Company, K....14
Mechanical Appliance Co....—
Mica Insulator Company.....—
Minnesota Electric Co.....23
Miscellaneous Advs.....16
Monon Railroad..... ...—
Moon Mfg. Co., The.....23
Morrison Lbr. Co., J. W.....—
Mueller Company, William..25
Munsell & Co., Eugene.....14

National Electric Co.....21
National India Rubber Co....—
New England Butt Co..... 1
Newgard & Co., Henry.....23
New York Cent. Ry.....21
New York Ins. Wire Co.....15
Northern Elect'l Mfg. Co.... 5
Northwestern Storage Battery Co.. ... .

Okonite Co., The..... 1
Olds Gasoline Engine Works.18

Pacific Coast Pole Co.....25
Page & Hill Co.....24
Paragon Fan & Motor Co.....—
Pardridge Shade & Refl. Co..—
Pass & Seymour, Inc.....—
Phelan, D. W.....24
Phillips, Eugene F.....15
Phillips Insulated Wire Co...15
Phœnix Glass Co..... 1
Phosphor-Bronze S. Co.....18
Pignolet, L. M.....14
Pittsburg & L. S. Iron Co....25
Plume & Atwood Mfg. Co....—
Porter Cedar Company.....24

Reisinger, Hugo..... 7
Reynolds El. Flasher Mfg.Co.14
Roche, Wm.....16
Roebling's Sons Co., J. A.....28
Ruebel-Schwedtmann-Wells..17
Runzel-Lenz Elec. Mfg. Co...19

Safety Ins. Wire & Cable Co..14
Sargent & Lundy.....—
Sauquoit Silk Mfg. Co.....15
Schott, W. H.....17
Sears, Roebuck & Co.....—
Simplex Electrical Co., The.. 1
Simplex Elec. Heating Co.... 1
Speer Carbon Co..... .20
Sprague Electric Company...28
Squire Electric Co.....—
Standard Elec. Mfg. Co.....16
Standard Underg. Cable Co.... 1
Stanley Elec. Mfg. Co., The 10
Stanley Instrument Co.....10
Stanton, LeRoy W..... 17
Sterling & Son, W. C.....24
Sterling Electrical Mfg.Co....14
Sterling Varnish Co., The....14
Stow Mfg. Company..... 1
Stromberg-Carlson Tel. Mfg. Company.....23
Sturtevant Company, B. F...28

Torrey Cedar Company.....24
Trumbull Elec. Mnfg. Co.....—
Turner Brass Works.....—

Union Electric Mfg. Co.....—

Valentine-Clark Co., The....24
Vulcanized Fibre Company..28

Wagner Electric Mfg. Co.....—
Walsh's Sons & Company..... 1
Warren Elec. Mfg. Co.....28
Wesco Supply Co.....—
Western Electric Company... 9
Western El. Supply Co.....—
Westinghouse Electric & Manufacturing Co.....26
Weston Electrical Inst. Co... 1
Whitehead Machinery Co... 16
Whitney Electrical Inst. Co..—
Wilmerding, C. H.....17
Wisconsin Central Ry.....24
Woolley Fdy. & Mach. Wks..—
Worcester Company, C. H....24

Yesbera Mfg. Co..... .. —
Yost Electric Mfg. Co 15

Zero Marx Sign Works 15

For Classified Index of Advertisements See Page 6.

Motors,
Switches,
Arc Lamps,
Circuit Breakers, Etc., Etc.

ALWAYS IN STOCK.

MANUFACTURED BY

G. I. Co.

CHICAGO EDISON COMPANY, 139 Adams Street, CHICAGO.

Allen-Bradley Electric Crane Controllers

Patented

Front View—before starting

Rear View

Front View—all resistance out

Manufactured by AMERICAN ELECTRIC FUSE CO., Chicago

A New Controller. Positively No Sparking. No Repairs. Guaranteed for One Year. Three Months' Free Trial. Perfect Control.

OUR GUARANTEE: Ask any Other Manufacturer to Duplicate It.

THE AMERICAN ELECTRIC FUSE COMPANY hereby guarantees to..... that it will at any time within three months from this date upon demand repay to said..... the sum of..... .....Dollars, being the full purchase price paid (or agreed to be paid) by said..... to the American Electric Fuse Company for one..... horsepower Allen-Bradley Crane Controller, number.....upon delivery within three months after this date of said controller, freight prepaid and in good condition, ordinary wear and tear from use excepted, at the office of the American Electric Fuse Company, Chicago, Illinois, together with a written statement that said controller has proved unsatisfactory to said .....

FURTHERMORE, the said American Electric Fuse Company agrees that it will at any time within one year from this date replace, without charge, any part of said controller which may prove defective or wear out during the ordinary use of said controller, provided that it is a condition of this guarantee that said..... ..... hereby agrees to use ordinary care in the operation of said controller, and that said controller will be operated by some person, or persons, familiar with the use of crane controllers, and further that said controller will not be wilfully or maliciously injured while in the possession of said.....

G. I. G. I.

Dust and Watertight Floor Outlet Box.

FIREPROOF MAGAZINE, April, 1904, writes as follows, viz:

"Several schemes have been brought forward at various times to provide an absolutely waterproof Outlet Box. The G. I. Dust and Waterproof Outlet Box seems to have solved this problem in a practical manner."

WRITE FOR DESCRIPTION AND PRICES TO

GENERAL INCANDESCENT ARC LIGHT CO.

529 W. 34th St., New York.

BRANCHES: BOSTON, BUTTE, PHILADELPHIA, CHICAGO. SAN FRANCISCO, CINCINNATI, ST. LOUIS, DENVER, LOS ANGELES, SEATTLE.

COLUMBIA CRYSTAL LAMPS

With Prismo Glass Shades or Metal Reflectors

COLUMBIA CRYSTAL LAMPS with Prismo Glass Shades present a very handsome appearance and have met with great favor. When the lamp is lighted the shade presents a beautiful spectacle of radiant light, and is of great value for decorative lighting. Descriptive catalogue sent on request

Central Electric Company,

GENERAL SALES AGENTS

264-266-268-270 FIFTH AVENUE, CHICAGO

Northern Apparatus For Industrial Work

Built for service in industrial plants, to operate in isolated industries, etc. Its simplicity favors Northern Apparatus for this work, and users and those familiar with it favor Northern Apparatus also.

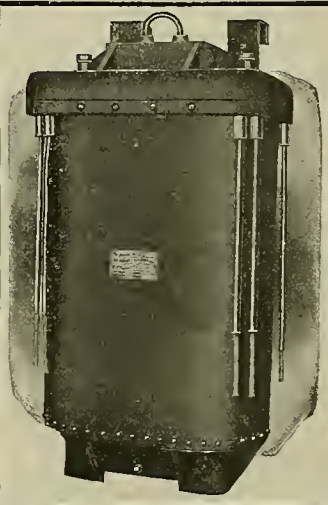
DIRECT CURRENT DYNAMOS AND MOTORS

Get acquainted through Bulletin No. 2535. See Northern Apparatus at Section 14, Palace of Electricity, St. Louis.

211

Northern Electrical Mfg. Co.

Engineers Manufacturers Madison, Wis., U. S. A.



HORNBERGER-IRWIN Transformers

(LARGE AND SMALL)

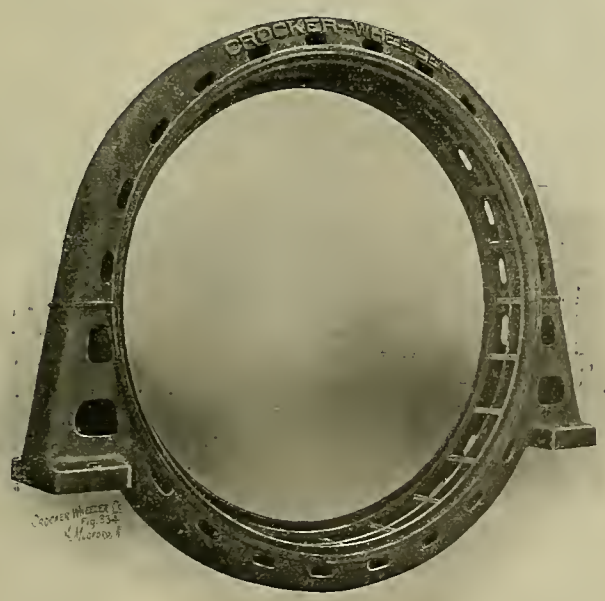
½ K. W. to 500 K. W.

This transformer represents the latest improvements in transformer coostruction; made in three types; multi-coil construction; ventilated cores; built for all commercial voltages and frequencies; **higher efficiencies together with lower temperatures than have heretofore been attained are guaranteed.** Catalogue just issued explains details.

Manufactured by

Crawfordsville Electric Co.

CRAWFORDSVILLE, INDIANA, U. S. A.



200 K. W. Stator Frame.

Alternators

Revolving Field Type
Any Standard Frequency
Single or Multiphase Winding

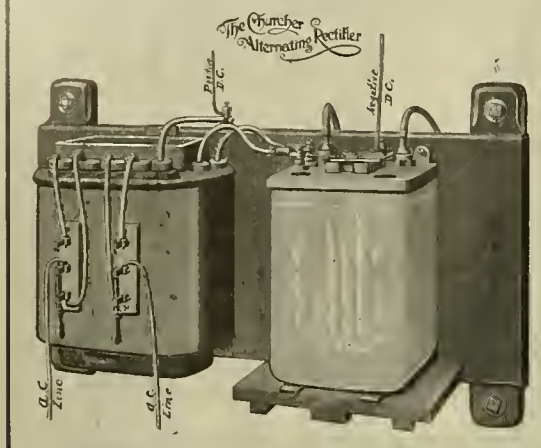
The same excellence for which our D. C. apparatus is known characterizes our work in the alternating field.

We have secured the American rights to the designs and patents of the celebrated Swiss firm of Brown, Boveri & Cie., who will act as consulting engineers for us.

Crocker-Wheeler Company

AMPERE, N. J.

Branch Offices in Sixteen Principal Cities.



CHURCHER ALTERNATING CURRENT RECTIFIERS

Transform any cycle of alternating current into direct current and will at the same time, if desired, convert the potential of the direct current produced to a higher or lower voltage.

SOLD ON 30 DAYS' APPROVAL.

Guaranteed to be cheaper to install, have lower maintenance cost and higher efficiency than a motor-generator.

Send for Bulletin No. 11.

THE ELECTRICAL APPLIANCE CO., - - Cincinnati, Ohio

CLASSIFIED INDEX OF ADVERTISEMENTS.

Adjusters, Cord.
Incandes. El. Lt. Manip. Co.

Adjusters, Inc. Lamps.
Inc. El. Lt. Manipulator Co.

Anchors (Tel. & Tel.)
Matthews & Bro., W. N.
Crouse-Hinds Co.

Annunciators.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Moon Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Batteries and Jars.
Bissell Co., The F.
Central Electric Co.
Edison Mfg. Co.
Edwards & Company.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Roche, Wm.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Bells, Buzzers, Etc.
Central Electric Co.
Edwards & Co.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Belt Dressing.
Dixon Crucible Co., Jos.
Leather Preserver Mfg. Corp.

Belting.
Leather Preserver Mfg. Corp

Blow Pipes.
Turner Brass Works

Blowers.
Sturtevant Co., B. F.

Boiler Compounds.
Dearborn Drug & Chem. Wks.

Boilers.
Allis-Chalmers Company.
Babcock & Wilcox Co.

Books, Electrical.
Cantwell Press, The.
Electrician Publishing Co.

Booths, Telephone.
Yesbera Mfg. Co.

Brackets.
Farles Mfg. Co.

Brushes.
Central Electric Co.
Hobart Elec. Mfg. Co.
Holmes Fibre-Graphite Co.
Speer Carbon Co.
Western Electric Company.

Cable Hangers.
Bissell Co., B. F.
Western Electric Co.

Cables (See Wires and Cables)

Canopies.
Farles Mfg. Co.

Carbons, Points and Plates.
Central Electric Co.
Chicago Edison Co.
Consumers Carbon Co.
Electric Appliance Co.
Reisinger, Hugo.
Spear Carbon Co.
Wesco Supply Co.
Western Elec. Supply Co.

Castings.
Farles Mfg. Co.
New England Butt Co.
National Electric Co.

Chains.
Jeffrey Mfg. Co.

Chandeliers.
Farles Mfg. Co.

Circuit Breakers.
Cutler-Hammer Mfg. Co.
Cutter Elec. & Mfg. Co.
Ft. Wayne Elec. Wks. Inc.
Union Electric Mfg. Co.
Western Electric Company.
Westinghouse El. & Mfg. Co.

Clusters.
Benjamin Elec. Mfg. Co.
Farles Mfg. Co.

Coal and Ashes Handling Machinery.
Jeffrey Mfg. Co.

Coils and Magnets.
Western Electric Co.

Commutator Compound
Egan, J. J.
McLaughlin & Co., Jas.
McLennan & Co., K.

Condensers, Electric.
Stanley Elec. Mfg. Co.

Conduit and Conduits.
American Circular Loom Co.
American Conduit Company
Central Electric Co.
Electric Appliance Co.
Sprague Electric Co.
Standard Vitrified Cond. Co.
Wesco Supply Co.
Western Electrical Supply Co.

Contractors and Electric Light Plants.
Allis-Chalmers Company.
Bullock El. Mfg. Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
National Electric Co.
Northern Electrical Mfg. Co.
Sprague Electric Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Controllers, Crane.
Amer. Elec. Fuse Co.

Cord.
Runzel-Lenz Elec. Mfg. Co

Cross-Arms, Pins and Brackets.
Berthold & Jennings.
Central Electric Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Company.
Western Elec. Supply Co.

Cut-Outs and Switches.
Bissell Co., The F.
Bossert Elec. Const. Co.
Central Electric Co.
Chicago Edison Co.
Clinton Stamping & Elec. Co.
Crouse-Hinds Co.
Cutter Elec. & Mfg. Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
General Inc. Arc Light Co.
Hart Manufacturing Co.
Manhattan Elec. Supply Co.
Trumbull Elec. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Dynamos and Motors.
Allis-Chalmers Company.
Bissell Co., The F.
Bullock Elec. Mfg. Co.
Central Electric Co.
Century Electric Co.
Crawfordsville Electric Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks. Inc.
General Elec. Co.
General Inc. Arc Light Co.
Gregory Electric Co.
Hobart Elec. Mfg. Co.
Holtzer-Cabot Electric Co
Mechanical Appliance Co.
National Electric Co.
Northern Electrical Mfg. Co.
Sprague Electric Co.
Stanley Elec. Mfg. Co.
Stow Manufacturing Co.
Sturtevant Co., B. F.
Wagner Electric Mfg. Co.
Warren Elec. Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Economizers, Fuel.
Green Fuel Economizer Co.

Electric Heating Appl.
Simplex Elec. Heating Co.
Western Electric Co.

Electric Railways.
Crocker-Wheeler Co.
General Electric Co.
Sprague Electric Co.
Westinghouse El. & Mfg. Co.

Electrical and Mechanical Engineers.
Arnold Elec. Power Stat'n Co.
Badt, F. B.
Baker & Co., W. E.
Bryan, Wm. H.
Butterfield, J. F.
Byllesby & Co., H. M.
Evans, Almirall & Co.
General Engineering Co., The.
Hallberg, J. H.
Hornaday, J. P. & Co.
Humphrey, Henry H.
Hunt & Co., Robt. W.
Jackson, D. C. & W. B.
Kemp, R. W.
Kohler Brothers.
McLaughlin, James
Newgard & Co., Henry.
Northern Electrical Mfg. Co.
Ruebel, Schwedtman, Wells.
Sargent & Lundy.
Schott, W. H.
Squire Electric Co.
Stanley Elec. Mfg. Co.
Stanton, LeRoy W.
Wilmerding, C. H.

Electrical Instruments. (Recording and Testing.)
Bissell Co., The F.
Central Electric Co.
Diamond Meter Co.
Duncan Elec. Mfg. Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
General Inc. Arc Light Co.
Jewell Electrical Inst. Co.
Machado & Roller.
Pignolet, L. M.
Stanley Elec. Mfg. Co.
Stanley Instrument Co.
Wagner Electric Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co
Weston Electrical Inst. Co.
Whitney Electl. Inst. Co.

Electro-Plating Mach'y
Crocker-Wheeler Company.
General Electric Co.

Elevators-Conveyors.
Jeffrey Mfg. Co.

Engines, Gas and Gasoline.
Allis-Chalmers Company.
Marinette Gas Engine Co.
Olds Gasoline Engine Works.
Woolley Fdy. & Mach. Wks.

Engines, Steam.
Allis-Chalmers Company.
Sturtevant Co., B. F.

Fans and Fan Motors.
Central Electric Co.
Crocker-Wheeler Company.
Edison Mfg. Co.
General Electric Co.
General Inc. Arc Light Co.
Sprague Electric Co.
Sturtevant Co., B. F.
Wesco Supply Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Fibre.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Files.
Barnett Co., G. & H.

Fittings.
Farles Mfg. Co.

Fixtures, Gas and Elec.
Beardslee Chandelier Mfg. Co.

Flashers.
Bissell Co., The F.
Haller Machine Co.
Reynolds El. Flasher Mfg. Co

Flexible Shafts.
Stow Mfg. Co.

Forges.
Sturtevant Co., B. F.

Fuses and Fuse Wire.
Amer. Elec. Fuse Co.
Bissell Co., The F.
Central Electric Co.
Central Tel. & El. Co.
Chicago Die & Electric Co.
Chicago Fuse Wire & Mfg. Co.
Clinton Stamping & Elec. Co.
D. & W. Fuse Company.
Electric Appliance Co.
Johns-Manville Co., H. W.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Company.
Western Elect. Supply Co.

Globes, Reflectors and Shades.
Fostoria Incan. Lamp Co.
Haller Machine Co.
Holophane Glass Co.
Pardridge Shade & Refl. Co.
Phoenix Glass Co.
Wesco Supply Co.
Western Electric Co.
Western Elect. Supply Co.

Graphite Specialties.
Dixon Crucible Co., Jos.
Holmes Fibre-Graphite Co.

Heating (Exhaust Steam).
Amer. District Steam Co.

Heating and Ventilating Apparatus.
Sturtevant Co., B. F.

Heating, Hot Water.
Evans, Almirall & Co.

Holders, Inc. Lamps.
Incandescent Electric Light Manipulator Co.

Inspection & Insurance
Hartford Steam Boiler Inspection & Insurance Co.

Insulating Machinery.
New England Butt Co.

Insulators and Insulating Materials.
American Electrical Works.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Inc. Arc Light Co.
Indiana Rub. & Ins. Wire Co.
Johns-Manville Co., H. W.
Kartavert Mfg. Co.
Manhattan Elec. Supply Co.
Mica Insulator Co.
Munsell & Co., Eugene.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Standard Vitrified Cond. Co.
Sterling Varnish Co.
Vulcanized Fibre Co.
Wesco Supply Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Lamps, Arc.
Bissell Co., The F.
Central Electric Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
General Inc. Arc Lt. Co.
Gregory Electric Co.
Hipwell Manufacturing Co
Manhattan Elec. Supply Co.
Stanley Elec. Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Lamps, Incandescent.
Bissell Co., The F.
Bryan-Marsh Company.
Buckeye Electric Company.
Central Electric Co.
Chicago Edison Co.
Columbia Incan. Lamp Co.
Edison Decorative & Miniature Lamp Dept.
Electric Appliance Co.
Fostoria Incand. Lamp Co.
Franklin Electric Mfg. Co.
General Electric Co.
General Inc. Arc Light Co.
Standard Elec'l Mfg Co.
Sterling Electrical Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Lamps, Incandescent—Replacers & Cleaners.
Inc. El. Lt. Manipulator Co.

Letters, Metal.
Haller Machine Co.

Lightning Arresters.
Central Electric Co.
Clinton Stamping & Elec. Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
Manhattan Elec. Supply Co.
Minnesota Electric Co.
Stanley Elec. Mfg. Co.
Western Electric Co.

Lights, Show.
Glogan & Co., H. M.

Linemen's Climbers.
Klein & Sons, Mathias.

Magnet Wires.
(See Wires and Cables.)

Mechanical Draft.
Sturtevant Co., B. F.

Mica.
Chicago Mica Co.
Mica Insulator Co.
Munsell & Co., Eugene.

Mining Apparatus, Elec.
Allis-Chalmers Company.
Crocker-Wheeler Company.
General Electric Co.
Jeffrey Mfg. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Motors. (See Dynamos and Motors.)

Nippers and Pliers.
Klein & Sons, Mathias.

Nozzles.
Farles Mfg. Co.

Paints.
Dielectric Mfg. Co.

Patent Attorneys.
Bain, Foree.

Phosphor Bronze.
Phosphor Bronze Sm. Co. Ltd.

Platinum, Wire and Sheet.
Baker & Company Inc.

Poles and Ties.
Berthold & Jenninga.
Brooks, Hall L.
Buchanan, R. G.
Columbia Mfg. Co.
Fowler, John H.
Fowler-Jacobs Company.
Kellogg Switch. & Sup. Co.
Lindsley Bros. Co.
Loud's Sons Co., H. M.
Maltby Cedar Co.
Morrison Lbr. Co., J. W.
Mueller Company, William.
Pacific Coast Pole Co.
Page & Hill Company.
Phelan, D. W.
Pittsburg & L. S. Iron Co.
Porter Cedar Company.
Sterling & Son, W. C.
Torrey Cedar Co.
Valentine-Clark Co., The.
Worcester Co., C. H.

Polish (Metal).
Allen Co., Inc., L. B.
Hoffman, Geo. W.

Portables.
Farles Mfg. Co.

Power Transmission Machinery.
Jeffrey Mfg. Co.

Rail Joints.
Continuous Rail Joint Company of America.

Rectifiers.
Electrical Appliance Co.

Refiners.
Gt. West Smelt. & Refining Co

Re-Winding—Repairs.
Chicago Edison Co.
Gregory Electric Co.

Rheostats.
Cutler-Hammer Mfg. Co.
General Electric Co.
Gen'l Inc. Arc Lt. Co.
Union Electric Mfg. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Rods, Conduit.
Cope, T. J.

Safes.
Sears, Roebuck & Co.

Schools and Colleges.
Electrical Engineer Inst.
Highland Park College

Second-Hand Mach'y.
Bissell Co., The F.
Cent. Stat. Improvement Co.
Dyar, H. W.
Gregory Electric Co.
Matthews & Bro., W. N.
Walsh's Sons & Co.

Shades, Lamp.
Farles Mfg. Co.

Sheet Brass & Copper.
Plume & Atwood Mfg. Co.

Signs, Electric.
Haller Machine Co.
Zero Marx Sign Works.

Silks, Insulating & Braiding.
Sauquoit Silk Mfg. Co.

Sockets & Receptacles.
Pass & Seymour.
Yost Elec. Mfg. Co.

Soldering Sticks, Salts and Paste.
Allen Co., L. B.
Crescent Co.
Kester Elec. Mfg. Co.
Western Electric Co.

Speaking Tubes.
Central Electric Co.
Edwards & Co.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Specialties, Electrical Mfrs. and Designers.
Haller Machine Co.

Speed Indicators.
Weston Electrical Inst. Co.

Storage Batteries.
American Battery Co.
Electric Storage Battery Co.
Gould Storage Battery Co.

Supplies, General Elec.
Bissell Co., The F.
Central Electric Co.
Century Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Electric Co.
Manhattan Elec'l Supply Co
Wesco Supply Co.
Western Electric Co.
Western Elect. Supply Co.

Switchboards.
Bissell Co., The F.
Crouse-Hinds Co.
Gen. Incan. Arc Light Co.

Telephones, Telephone Material and Switchboards.
American El. Telephone Co
Automatic Electric Co.
Bissell Co., The F.
Central Electric Co.
Central Tel. & El. Co.
Holtzer-Cabot Elec. Co.
International Tel. Mfg. Co.
Kellogg Switchb. & Sup. Co.
Manhattan Elec. Supply Co.
Moon Mfg. Co., The.
Stromberg-Carlson Tel. M. Co
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Time Switches.
Bissell Co., The F.
Hartford Time Switch Co.

Tools.
Klein & Sons, Mathias.
Western Electric Co.

Transformers.
Central Electric Co.
Crawfordsville Electric Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Works, Inc.
General Electric Co.
Gregory Electric Co.
Kuhlman Electric Co.
Manhattan Elec. Supply Co.
National Electric Co.
Stanley Elec. Mfg. Co.
Wagner Electric Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Trucks, Electric Car.
General Electric Co.
Westinghouse El. & Mfg. Co.

Turbines, Steam.
Allis-Chalmers Co.
General Electric Co.
Westinghouse El. & Mfg. Co

Turbine Water Wheels
Leffel & Co., Jas.

Varnishes.
Dielectric Mfg. Co.
Sterling Varnish Co.

Vulcanized Fibre.
Vulcanized Fibre Co.

Whistles, Electric.
Electrical Appliance Co.

Wires & Cables—Magnet Wires.
American Electrical Works.
Bissell Co., The F.
Central Electric Co.
Chicago Insulated Wire Co.
Crescent Ins. Wire & Chle. Co.
Electric Appliance Co.
General Electric Co.
Hazard Manufacturing Co.
Indiana Rub. & Ins. Wire Co
India Rubber & Gutta Percha Insulating Co.
Kellogg Switch. & Sup. Co.
Manhattan Elec. Supply Co.
National India Rubber Co
New York Insulated Wire Co.
Okonite Co., The.
Phillips, Eugene F.
Phillips Insulated Wire Co
Roebling's Sons Co., J. A.
Runzel-Lenz Elec. Mfg. Co.
Safety Ins. Wire & Cable Co.
Simplex Electrical Co.
Standard Underground C. Co
Wesco Supply Co.
Western Electric Company.
Western Elec. Supply Co.

For Alphabetical Index of Advertisements See Page 3.

It Will Interest You to Know What the **Western Electric Company** Have to Say Regarding

HIGHEST GRADE NUERNBERG

CARBONS

in their circular, dated November 23, 1903, which in part reads as follows:

"The Western Electric Company have made an exhaustive test of carbons of all kinds and have found that the 'ELECTRA' Carbons cannot be equaled in quality or efficiency, produce practically no dust and give an excellent and steady light. They produce the highest standard of candlepower in proportion to the current consumed, and are the most economical carbons manufactured."

HUGO REISINGER, Sole Importer, 11 Broadway, NEW YORK CITY.

Diam. of body, 6 in., of base flange 7½ in.

THE
"I. P." (ISOLATED PLANT) TYPE
DIRECT-CURRENT
INSTRUMENTS

Are winners. Scales are eqnally divided, indications are dead beat, high range ammeters have separate shunts and the cases are of heavy polished brass.

Prices are right, the list figure for the meter illustrated, for instance, being $16.50.

WRITE FOR DISCOUNTS TO

MACHADO & ROLLER,
203 BROADWAY, NEW YORK CITY, N. Y., Or Your Nearest Supply House.

REFLECTIONS ON FARIES REFLECTORS

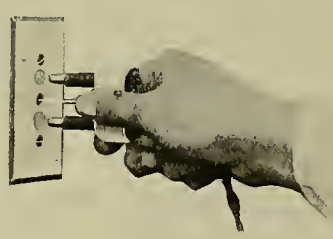
Fit any socket.
Quickly attached or detached.
Made of aluminum or steel.
Very light and will not rack socket to pieces.
Finish not affected by heat.
Made in many styles and finishes.

Catalogue mailed upon application.

FARIES MFG. CO.
DECATUR, ILL.

"DIAMOND H"

This Trademark on a Switch means "Perfection."



Automatic Flush Receptacles and Plugs

Are always used with "DIAMOND H" Switches to complete the best Electrical Installations.
We also make a complete line of Steel Wall Appliances.
Catalogue "B" on request.
Are easy to operate and make an absolutely perfect contact.
No screwdriver is necessary to open the lid, as it is opened automatically by inserting the plug.
Be sure to order "DIAMOND H" and get the best.

THE HART MANUFACTURING CO., = HARTFORD, CONN.

Manufacturer of "Diamond H" Switches

NEW YORK	BOSTON	CHICAGO	TORONTO, ONT.	LONDON, ENG.
203 Broadway	170 Summer Street	170 S. Canal Street	52 Adelaide Street, W.	25 Victoria Street
WILLIAM TAYLOR	F. B. SMITH	W. P. CROCKETT	C. W. BONGARD	WILLIAM CRICHTON

EDWARDS & CO.'S Specialties

Our Watchman's Time Detector Reduces Insurance.

No. 98.

Battery or Magneto System

Approved by the National Board of Fire Underwriters

Records exact time of watchman's visits, causing regular inspections. Circuit is automatically broken as soon as record is made. Handsomely finished. Furnished with or without time piece.

BETTER SATISFY

BOTH YOUR CUSTOMER AND YOURSELF THAN EITHER ONE.

Better look up the EDWARDS specialties when figuring on a contract, because they are bound to give a great deal more satisfaction than a great many devices of other makes.

The EDWARDS goods are thoroughly well made by competent workmen under careful supervision. The ideas embodied in the EDWARDS specialties are original with us, are money-makers because of their good points; save labor in installing and worry after they are put in.

The Lüngen Door Switch.

Specially made for telephone booths, bank vaults and other places where light is needed intermittently; made in two styles so that light is turned on or off as the door is closed according to the wish of the user. Each movement of the door reverses the operation of the switch automatically.

Wires can be connected after the switch is in place; absolutely reliable electrically and perfect mechanically.

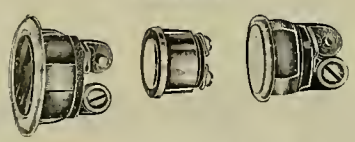
The only switch approved by the National Board of Fire Underwriters.

The Eco Door Switch, operates the light "Every other time."

ELECTRO MECHANICAL GONG.

Rings 375 times for each winding. Very powerful mechanism, strongly made, encased in iron, absolutely waterproof. Made for continuous ringing or single stroke, as desired.

PUSHES.



The Midget push fits a ⅞-inch hole; the Midget, Jr., a ⅝ inch hole and the New Mite a ½-inch hole. This last is the smallest push made. It is only different from the others in its size.

The binding posts of any of these pushes take any size of wire. The centers may be of light or dark pearl, or of a black, white, red or blue composition.

R. E.-A. L. MONITOR BELL.

All the mechanism is inside the gong and cannot be tampered with.

It Will Not Get Out of Order through operation, because there are no screws or nuts used in its adjustment. The hammer rod is thrown straight in and out by the armature, doing away with the weak points of the ordinary bell—the pivot. The sound is a full, clear, rich tone. hammer concealed preventing interference.

FOR ILLUSTRATED CIRCULARS OF THESE SPECIALTIES AND GENERAL CATALOG WRITE DIRECT TO THE COMPANY AT

144th Street and Fourth Avenue, New York City

SELLING AGENTS: Western Electric Co., New York, Philadelphia, Chicago, St. Louis, Kansas City, Denver, California Electric Works, San Francisco, American Electric Co., St. Paul.

Cope's Patent Quick Coupling Conduit Rod

Remember these rods have no lost motion.
These Couplings are of Steel and are made in the best possible manner.

Write for list of persons using these rods—26,000 sold since May 1902. Made in 3 ft. and 4 ft. lengths.
Price, 3 ft. 75 cents, 4 ft. 85 cents.
Patented February 24, 1903.

T. J. COPE

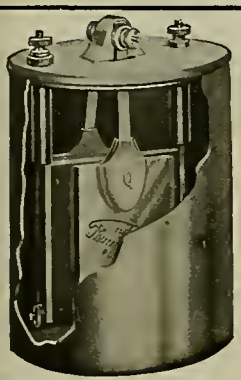
3244 North Fifteenth Street PHILADELPHIA, PA.

Our Compound Stops Sparking and Saves Commutators.

14 Years' Use on Street Ry., Light and Power Commutators Has Proven its Worth. WE GUARANTEE RESULTS

Send Your Address for FREE SAMPLE THAT CONVINCES.

JAS. McLAUGHLIN & CO., ELECTRICAL ENGINEERS
586 Fulton Street, - - Chicago, Ill.



EDISON PRIMARY BATTERIES FORMERLY EDISON LA LANDE

There is no deterioration in the permanent parts of these batteries. It follows, therefore, that each time a cell is recharged it will last as long a time and deliver as heavy a current as the original charge when the cell was first put into service. Our catalogue No. 7 will tell you more about this. Let us send it.

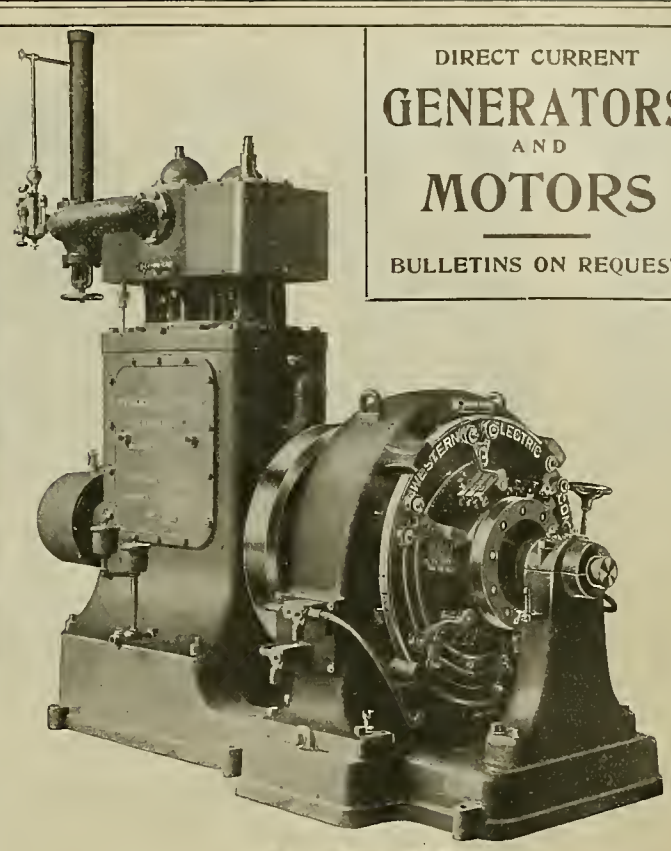
EDISON MANUFACTURING CO.,

TRADE Thomas A. Edison PARIS

Factory, ORANGE, N. J.
NEW YORK, 83 Chambers St.
CHICAGO, 304 Wabash Ave.

BOOKS.

BUY YOUR BOOKS FROM THE ELECTRICIAN PUBLISHING COMPANY,
510 Marquette Bldg., CHICAGO.



DIRECT CURRENT
GENERATORS AND MOTORS

BULLETINS ON REQUEST

TYPE "T" GENERATING SET

Western Electric Company

CHICAGO NEW YORK
And Other Leading Cities

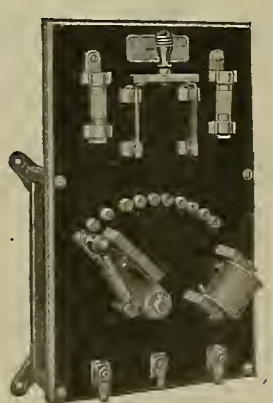
Space 17, Electricity Building, Louisiana Purchase Exposition

General Electric Company

RHEOSTATS

Field Rheostat Front Connected

The General Electric Company can furnish Rheostats to meet every condition of service.



Universal Motor Starting Rheostat

Write for further information

General Office: SCHENECTADY, N. Y.

Chicago Office: Monadnock Block. Sales offices in all large cities.

S. K. C.
Induction Motors

The Stanley Electric Manufacturing Company's Induction Motors are well proportioned, electrically and mechanically.

The efficiencies and power factors are high.

The mechanical strength is great.

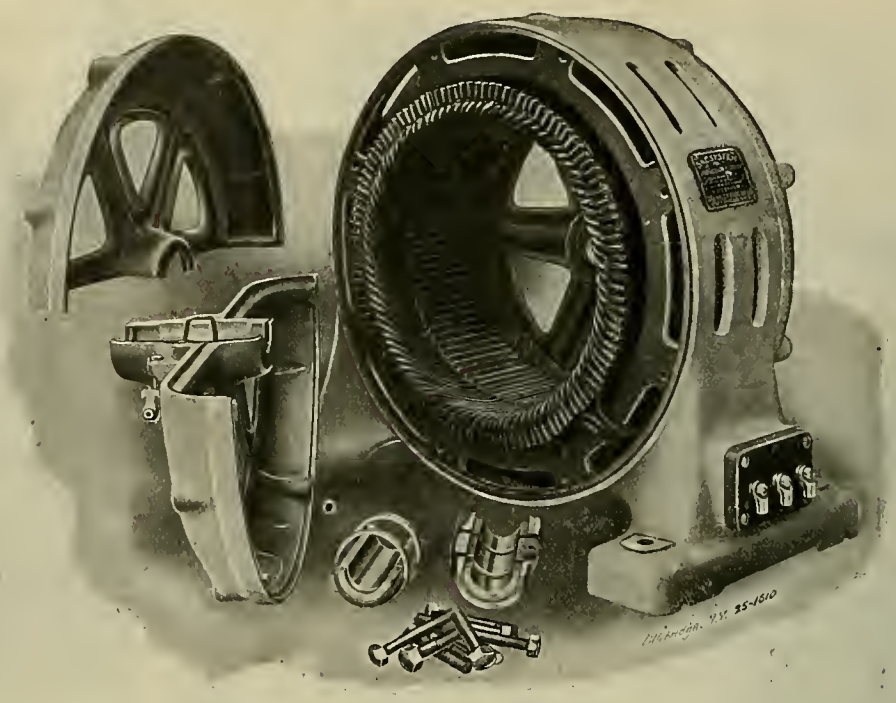
The construction is careful and accurate.

As in the Inductor Alternator, special attention has been given to the bearings.

The bearing construction permits of floor, wall or ceiling suspension, without special devices.

The frame is provided with ventilation holes and air is circulated throughout the motor, especially in and around the heated parts, thus keeping down the average temperature as well as the maximum.

Send for Bulletin No. 136
showing details.



The Stanley Electric Manufacturing Company,
PITTSFIELD, MASSACHUSETTS.

Atlanta, Ga., Empire Building.
Boston, Mass., Oliver Building.
Chicago, Ill., Monadnock Block.
Denver, Colo., Hendrie & Bolthoff Mfg. & Supply Co.
Los Angeles, Cal., Douglas Block.
New York, N. Y., 29 Broadway.
Philadelphia, Pa., North American Building.
St. Louis, Mo., Century Building.
San Francisco, Cal., 69-75 New Montgomery Street.
Seattle, Wash., Pioneer Building.

Representative for the Dominion of Canada, The Canadian General Electric Co. of Toronto.

"THE S. K. C. SYSTEM"

C & H Field Regulator

The best, the simplest and the most durable field regulator on the market.

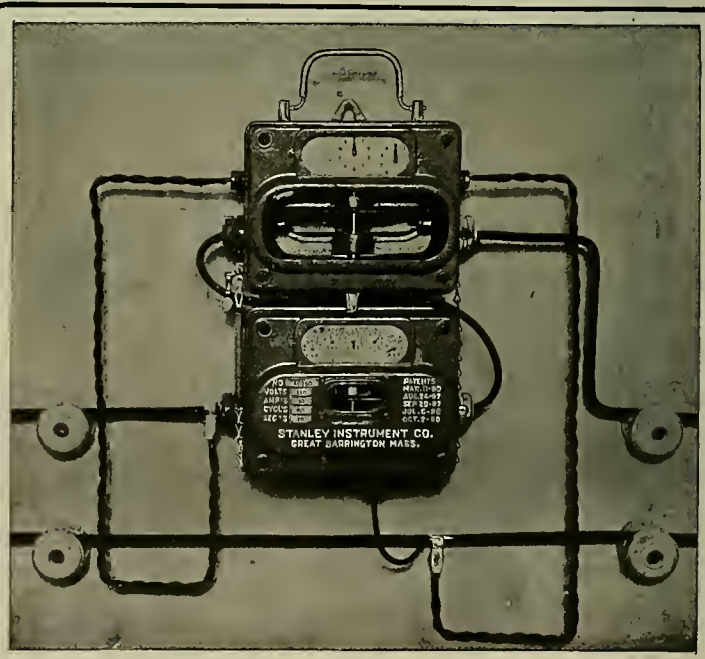
WHY ?

Has no enamel to crack; will not ground; white hot wire tests have proven worth of resistance material; will carry overloads safely; no small parts to get out of order; no loose contacts to bother with; made of best material throughout; easily controlled; will not stick, nor will jar of machinery deviate lever.

The Cutler-Hammer Mfg. Co.
MILWAUKEE, WIS.

New York Boston Chicago Pittsbur

The Electrician Publishing Co., 510 Marquette Bldg., Chicago. Headquarters for all latest Electrical Books. Write for Catalogue.



TESTING WATTMETER

ACCURATE TESTS
in a few minutes, anywhere, by one man alone without regulation of
VOLTAGE, LOAD OR FREQUENCY

STANLEY INSTRUMENT CO.
GREAT BARRINGTON, MASS.

BOSSERT

Steel Drawn WALL Boxes

are indestructible and economical. They have holes closed with hermetically sealed plugs that can be knocked out with a hammer, producing a clean hole every time without the use of a file. Figure up the cost of breakage and the time used in making clean holes in cast iron boxes. Then decide to save this unnecessary expense by using drawn steel boxes. We own the patents and are the sole manufacturers of drawn steel boxes and

Drawn Steel Bushings

The fact that they are made of steel makes them very smooth, but in addition they are finished with enameled insulation, making them smoother than it is possible to make cast iron bushings. They assure absolute protection to wires drawn over conduit ends, and cannot be broken.

Bossert Knife Switches

are made with multiple blades to each pole. Thus the radiating surface is increased and the tendency to heat lessened. Blades are provided with adjustable bolts for taking up wear. Current carrying parts are of pure drawn copper—no cast metal being used.

WE ALSO MAKE

Panel Boards

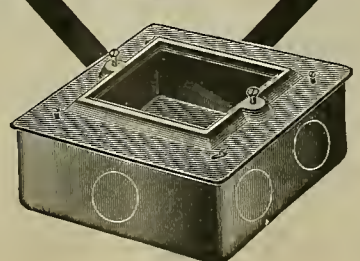
Carrying a large variety in stock

Write for Complete Catalog.

BOSSERT Electric

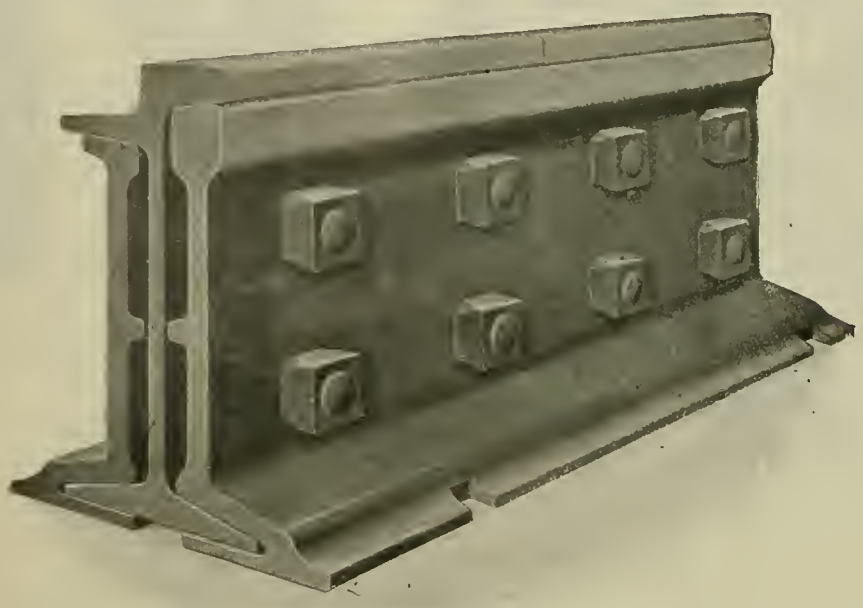
Construction CO.,

Utica, N. Y.



Over 20,000 Miles in Use

SEE OUR EXHIBIT AT THE WORLD'S FAIR
ST. LOUIS, MO.
Transportation Bldg., Aisle "C," Posts 7 and 8



PERFECTLY willing to give you an estimate on rail joints or any track material.

DO justice to yourself and Company by asking our quotations before placing your orders.

QUESTIONS answered and prices quoted for special rolling, angles, rounds, flats, tramangles, etc.

ROLLED FROM BEST QUALITY STEEL

For RAIL JOINTS address
CONTINUOUS RAIL JOINT CO. OF AMERICA, Century Building NEWARK, N. J.

For Special and other Track Material address
ALBANY IRON AND STEEL WORKS, 142 Market St., NEWARK, N. J.

STREET RAILWAY CONVENTION

The annual meeting of the American Street Railway Association will be held in St. Louis, October 11th, 12th and 13th.

The WESTERN ELECTRICIAN of October 8th will be especially prepared for the occasion and will be distributed at the convention.

The issues of October 15th and 22nd will contain a full report of the proceedings.

If you desire to increase your business with the street railway companies of the world it will pay you to run a special advertising announcement in the above numbers.

WESTERN ELECTRICIAN
510 MARQUETTE BUILDING, CHICAGO

HOLOPHANE PAGODAS

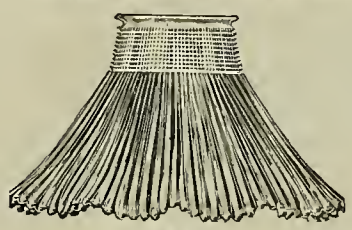
CHICAGO HOLOPHANE GLASS COMPANY NEW YORK

PATENTED JUNE 28, 1904

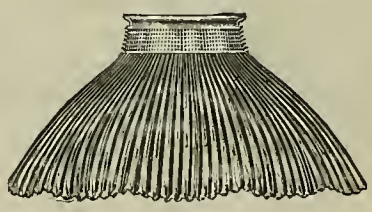
To fit Standard 2 1-4 in. Holder

(All cuts one-third actual size)

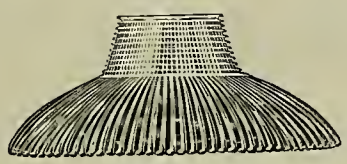
2622



2633
(Plain edge is 2632)

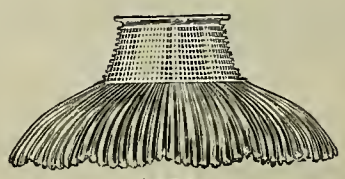


2623

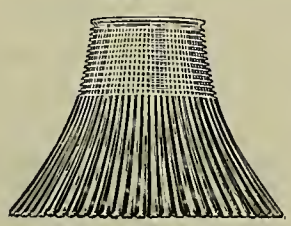


2662

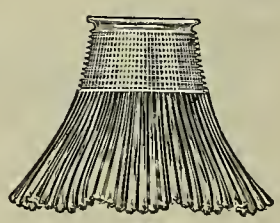
2651
(Plain edge is 2650)



2663



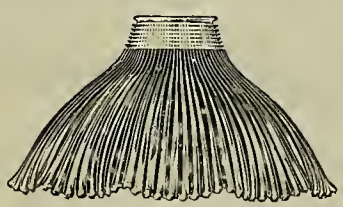
2682



2683

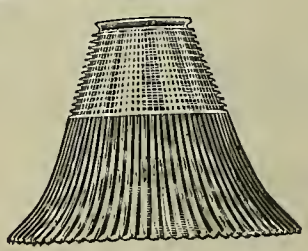
To fit Special 1 5-8 in. Holder Furnished Free with each Reflector

2631
(Plain edge is 2630)



2621
(Plain edge 2620)

2657



2656

NOTICE—In order to distinguish the Holophane CONCENTRATING reflector from the Holophane DIFFUSING globe the Trade-name "PAGODA" has been adopted for Holophane reflectors

HOLOPHANE SCIENTIFIC GLASSWARE IS PROTECTED BY THE FOLLOWING PATENTS

Nos. 563,836, July 14, 1896; 593,348, Nov. 9, 1897; 30,266, Feb. 28, 1899; 634,295, Oct. 3, 1899; 31,353, Aug. 8, 1899; 31,354, Aug. 8, 1899; 31,355, Aug. 8, 1899; 31,356, Aug. 8, 1899; 31,357, Aug. 8, 1899; 31,358, Aug. 8, 1899; 31,359, Aug. 8, 1899; 32,286, Feb. 27, 1900; 32,685, May 22, 1900; 32,686, May 22, 1900; 655,728, Aug. 14, 1900; 33 996, June 29, 1901; 679,770, Aug. 6, 1901; 679,771, Aug. 6, 1901; 687,848, Dec. 3, 1901; 35,616, Jan. 28, 1902; 35,684, Feb. 4, 1902; 35,755, Feb. 18, 1902; 35,756, Feb. 18, 1902; 35,757, Feb. 18, 1902; 35,682, Feb. 4, 1902; 35,683, Feb. 4, 1902; 36,215, Feb. 3, 1903; 36,214, Feb. 4, 1903; 732,211, June 30, 1903; 762,926, June 21, 1904; 762,927, June 21, 1904; 763,688, June 28, 1904; 763,689, June 28, 1904. Other patents pending.

The General Electric Company have adopted Holophane "Pagodas" exclusively for use with their celebrated "Meridian," and other electric lamps.

The following well-known lamp companies endorse and use Holophane "Pagodas" as being the most efficient and decorative reflectors on the market, namely: Bryan-Marsh Co., The Columbia Incandescent Lamp Co., Sunbeam Incandescent Lamp Co., The Buckeye Electric Co., Fostoria Incandescent Lamp Co., The Shelby Electric Co., The Independent Incandescent Lamp Co., The Warren Electric and Specialty Co., The Colonial Electric Co., The New York and Ohio Co., and all the leading electric lamp manufacturers of the United States.

ILLUSTRATED CATALOGUES AND TRADE DISCOUNTS SENT ON APPLICATION

A SUPPLY HOUSE
IS KNOWN BY THE SPECIALTIES IT HANDLES

Have you looked our line over?
Have you copies of our Catalogues and Price Lists?

ELECTRIC APPLIANCE COMPANY
EVERYTHING IN ELECTRICAL SUPPLIES
CHICAGO and SAN FRANCISCO

EDISON MINIATURE LAMPS

are made in more than 10,000 varieties,

for all classes of work in Candelabra and Decorative Lighting, Multiple and Series Burning and in all types of Battery Lamps.

Miniature Sockets and Receptacles,

EDISON DECORATIVE & MINIATURE LAMP DEPT.,
General Electric Company, Harrison, N. J.

BEARDSLEE CHANDELIER M'F'G CO. 256 AND 257 5TH CANAL ST. CHICAGO
GAS & ELECTRIC FIXTURES FOR THE TRADE.
CATALOG SENT PREPAID TO DEALERS MENTION THIS PAPER

Sterling Black Plastic Insulator.
One hundred days' continuous baking at 180° F. will not make it brittle. Water repellent. Oil proof.
THE STERLING VARNISH CO., - - Pittsburg, Pa.

WANTED
You Who are Troubled with Sparking and Cutting of Commutators to Use

GALES COMMUTATOR COMPOUND

The only article that will PREVENT SPARKING. Will keep the commutator in good condition and PREVENT CUTTING.

Absolutely will Not Gum The Brushes . . .

It will put that high gloss on the commutator you have so long sought after.

50 Cts. per Stick. $5.00 per Dozen.
For Sale by all Supply Houses, or
FREE, Sample Stick.

K. McLENNAN & CO.,
Sole Manufacturers,
Room 411 Inter Ocean Bldg., 130 Dearborn St., CHICAGO, ILL.

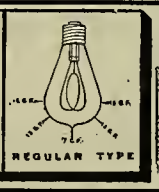
MICA
Of all Qualities, in any Form at Lowest Prices
EUGENE MUNSELL AND CO.
NEW YORK and CHICAGO

INSULATION That Is.
Micanite, Linotape, M. I. C. Compound, Empire Cloth and Paper. For Years the Standard.
MICA INSULATOR CO., Originators
NEW YORK and CHICAGO

MICA—BOND
Notice how our competitors try gradually to raise Cut Mica prices—same thing would occur in manufactured mica if we were not the leaders.
CHICAGO MICA CO
"PERFECTORS" VALPARAISO, IND.

VOLT - AMMETERS,
POCKET SIZE.
For Testing Batteries and Battery Circuits, Locating Faults, Grounds, etc.
RELIABLE. ACCURATE.
Send for Circular.
L. M. PIGNOLET,
78-80 Cortlandt St., NEW YORK, N. Y.

DO YOU?
BUY LAMPS—OR—BUY CANDLE POWER
16 {THIS LAMP AVERAGES} 12
THE STERLING ELECTRICAL MANUFACTURING CO.
NEW YORK, N. Y. WARREN, O. CHICAGO, ILL.
STERLING SPECIAL



REGULAR TYPE

Engineering TAUGHT BY CORRESPONDENCE

Our system of training by mail has helped thousands hold down to poor positions to rise to better salaries and situations. Your chance to rise is just as good as others. Write for our free illustrated book, "Can I Become An Electrical Engineer?" We teach by mail, Electrical Engineering, Mechanical Engineering, Steam Engineering, Mechanical Drawing, Electric Lighting, Electric Railways. ELECTRICAL ENGINEER INSTITUTE, Dept. R, 240 West 23rd St., New York.

"MANROSS" HAIR SPRINGS
For Electric Indicating and Recording Gauges, Steam Gauges, Etc

LARGEST MANUFACTURER OF HAIR SPRINGS in the United States.
F. N. MANROSS,
FORESTVILLE, CONN.

USE
"SAFETY" RUBBER COVERED WIRE AND CABLE
FOR EVERY ELECTRICAL SERVICE.
M. B. AUSTIN & CO.,
CHICAGO REPRESENTATIVE.
THE SAFETY INSULATED WIRE & CABLE CO.,
WORKS: Bayonne, N. J. 114-116 LIBERTY STREET, N. Y.

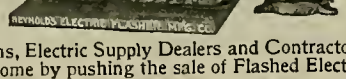
DON'T BUY ELECTRICAL SUPPLIES
Until you have seen our new Catalogue and new Price List.
Free to the trade.
Manhattan Electrical Supply Co.
NEW YORK: 32 Cortlandt St. CHICAGO: 188 Fifth Ave.

127 FULTON STREET **CHICAGO**

For Signs, Letters, Flashers, Dimmers, Timeswitches, Lamps, Rubberrings and anything pertaining to Signs,
—WRITE TO—
HALLER MACHINE COMPANY
Designers and Manufacturers, of Sheetmetal, Electric and Machinery Specialties

FLASHERS
IMPROVED REYNOLDS FLASHER A Proven Success—Not an Experiment
For Flashing ELECTRIC SIGNS, FLAGS and WINDOW DISPLAYS

MONEY MAKERS
Because they increase trade



MONEY SAVERS
Because they cut down current bills

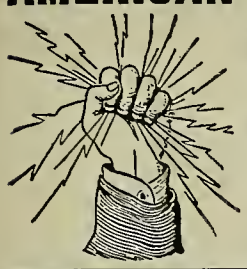
Central Stations, Electric Supply Dealers and Contractors can increase heir income by pushing the sale of Flashed Electric Signs
WRITE NOW for Flasher Information and pointers on electric signs.

REYNOLDS ELECTRIC FLASHER MFG. CO.
221 FIFTH AVE., CHICAGO, ILL.

FRANK N. PHILLIPS, PRESIDENT. EUGENE F. PHILLIPS, GENERAL MANAGER. E. ROWLAND PHILLIPS, VICE-PRES. C. N. WAGENSEIL, TREASURER. C. N. REMINGTON, JR., SEC.

AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.



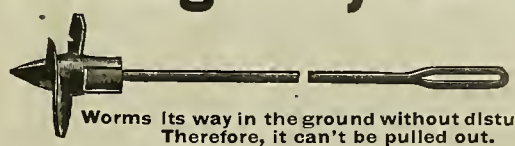
BARE AND INSULATED ELECTRIC WIRE,

ELECTRIC LIGHT LINE WIRE,
INCANDESCENT AND FLEXIBLE CORDS,
Railway Feeder and Trolley Wire,
AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR WIRES.
CABLES FOR AERIAL AND UNDERGROUND USE.

NEW YORK STORE, W. J. Watson, 26 Cortlaodt St.
CHICAGO STORE, F. E. Donohoe, 82 Lake St,
MONTREAL BRANCH, Eugene F. Phillips' Electrical Works.
MAIN OFFICES AND FACTORIES, PHILLIPSDALE, R.I.

SINGLE AND POLYPHASE
TRANSFORMERS
KUHLMAN ELECTRIC CO., - - Elkhart, Ind.

Simply Screw Them In.
THAT'S ALL
THERE IS TO THE INSTALLATION OF THE
Stombaugh Guy Anchor



Worms its way in the ground without disturbing it. Therefore, it can't be pulled out.
WRITE FOR FURTHER INFORMATION TO
W. N. MATTHEWS & BRO., Distributors
603 Carleton Building, St. Louis

EXPERT IN ELECTRICITY MECHANICS PATENT CAUSES
SOLICITOR OF **PATENTS**
U. S. & FOREIGN
FOREE BAIN, 1652-3 Monadnock Blk., CHICAGO

W. D. PAINT.
A PERMANENT INSULATING PROTECTION FOR WOOD OR METAL. A quick drying, moisture-proofing, black paint. An elastic anti-rust coating. A jet black finishing paint, efficient and not expensive.
Write for "Data on Insulating Materials."
DIELECTRIC MANUFACTURING CO., SAINT LOUIS.

YOST SPECIALTIES.

Sockets, Wall Sockets, Weatherproof Sockets, Rosettes, Receptacles, Cord Adjusters.
Catalogue for the asking.
THE YOST ELECTRIC MFG. CO.
TOLEDO, OHIO.

EXPERIENCED HANDS POINT TO

ASK YOUR LINE-MAN.

KLEIN'S TOOLS
The best when first introduced in 1857 and have been the best ever since.
St. Louis World's Fair visitors are especially invited to visit this office when in Chicago.
ESTABLISHED 1857

48-page Catalogue for 2-cent stamp to cover postage.

Climbers' Spurs, Splicing Clamps, Klein's Pliers, Lag Screw Wrenches, Pulley Blocks, Wire Grips, Wire Stretchers, Linemen's Leather, Wire Reels, Ladles and Melting Pots. Melting Furnaces, Tool Bags, Tree Trimmers, Post Hole Augers, Digging Bars, Tamping Bars, Shovels and Spoons, Anchor Rods, Turn Buckles, Butt Protectors, Pole Seats.
STANDARD TOOLS.
MATHIAS KLEIN & SONS,
82 W. VAN BUREN ST., CHICAGO, ILL.

SAUQUOIT SILK MFG. COMPANY
INSULATING and BRAIDING SILKS
MILLS:
BETHLEHEM, PA.
PHILADELPHIA, PA.
SCRANTON, PA.
NEW YORK REPRESENTATIVES:
WILLIAM RYLE & COMPANY
54 Howard St.
PHILADELPHIA OFFICE:
4015 Clarissa St.
CHICAGO OFFICE:
210 Monroe St.
BOSTON OFFICE:
78 Chauncy St

Grimshaw

Raven White Core

Raven Black Core

ALL OUR WIRES pass inspection and carry the above TRADE-MARKS on our tags. We also manufacture Grimshaw and Competition Tapes and Splicing Compounds.
NEW YORK INSULATED WIRE COMPANY,
MAIN OFFICE: 114, 116 & 118 Liberty St., New York.
BRANCHES: CHICAGO: 192 Desplaines St. BOSTON: 7 Otis St. SAN FRANCISCO: 33 Secood St.

NATIONAL CODE STANDARD

"O. K." Weatherproof Wire.
Slow - Burning Weatherproof and Ideal Wire.
Prices and Samples on Application.
Phillips Insulated Wire Co.
Office and Factory: PAWTUCKET, R. I.

ELECTRIC SIGNS
INCREASE YOUR CURRENT CONSUMPTION.
Assist us to sell ELECTRIC SIGNS to the best merchants in your city.
No repair bills with our signs, we furnish the best—all metal raised letters equipped with removable copper shell sockets. WRITE US, we will conscientiously study your sign wants and gladly submit drawings with very low quotations for the best work.
ZEROMARX SIGN WORKS
CHICAGO, ILL.

WANTED, FOR SALE *and similar* **WANT COLUMN** *advertisements (50 words or less), $1.50 an insertion; additional words 3c each.* **POSITION WANTED** *advertisements (50 words or less), $1.00 an insertion; additional words 2c each.*

POSITION WANTED.

By young man as superintendent of electric-light plant or municipal light and water plant. Ten years' practical experience and technical education. Can handle engineering and business ends. Would consider electric railway or saleman's positions. Address BOX 390, care of Western Electrician, 510 Marquette Building, Chicago.

POSITION WANTED.

As superintendent, electrician or engineer, in electric-light or water-works plant; have had 16 years' experience with dynamos, motors, arc lamps, meters, inside wiring and construction work; have had 20 years with boilers, engines and water-works machinery. Will guarantee results. Address BOX 394, care Western Electrician, 510 Marquette Bldg., Chicago.

POSITION WANTED.

As superintendent or electrician in medium sized plant; understand every detail of electric lighting or power plant including business, and am at present general manager of plant operating 24 hours but desire change of climate; prefer lake regions. also familiar with telephone work. Address BOX 399, care of Western Electrician, 510 Marquette Bldg., Chicago.

POSITION WANTED.

Engineer with thorough technical and general education, good practical experience with large machines and high voltages; good business ability, best of references, and ready to undertake development and promotion of a power transmission business. address BOX 400, care of Western Electrician, 510 Marquette Bldg., Chicago.

FOR SALE.

4 L. D. 12, T.-H. arc machines with one extra armature. Also 200 6.6 ampere open T. H. double and single arc lamps. 1-50 light Manhattan series A. C. arc system, complete with step-up transformer, 1 regulator and 35 lamps. All at present in operation and in excellent condition. Address BOX 396, care of Western Electrician, 510 Marquette Bldg., Chicago.

FOR SALE.

Electrical supply and contract business in the best city in Nebraska. Oldest house of its kind in the state. Good rushing business. I have other interests and must sell. Price, $3,000. Business can be enlarged with more capital. Address BOX 401, care Western Electrician, 510 Marquette Building, Chicago.

FOR SALE

1 Stanley generator, two-phase, 16,000 alternations, 1,000-2,000 volts, 40 K. W., 1333 R. P. M. and exciter.

1 Stanley generator, two-phase, 16,000 alternations, 1,000-2,000 volts, 60 K. W., 1,000 R. P. M. with exciter.

Complete marble switchboard with new instruments for above.

1 Westinghouse generator, 75 K. W., single-phase, 1,100 volts, 7,200 alternations, exciter, switchboard, new instruments complete, 750 R. P. M.

2 New belts.

1 Russell 13x20 4-valve engine, 200 R. P. M.

1 Ball 9½x10 engine, 350 R. P. M.

2 Boilers, 16x54 inch, 42 4-inch tubes, allowed 110 lbs. pressure, complete with 50-foot stack.

1 Hoppes heater. All steam pipe, valves, etc.

All in good condition. Can be seen running until December 15th. We are abandoning this plant on account of removal, and will sell all or in part. For further information, address

TIBBE ELECTRIC CO., Washington, Mo., or RUEBEL-SCHWEDTMANN-WELLS, St. Louis.

REPAIRING REGALIBRATING

ELECTRIC METERS.

INTERNATIONAL ELECTRIC METER CO.

167 S. CANAL STREET, CHICAGO.

HELP

Secured quickly through Western Electrician "Help Wanted" ads.

Corliss Engines.

900 h. p., 34x60, International.
900 h. p., 22x42x48, Hamilton Tand. Comp.
750 h. p., 32x54, Hamilton, 1890 Frame.
650 h. p., 30x54, St. Louis, 1890 Frame.
600 h. p., 28x60, Philadelphia.
500 h. p., 16x32x42, Corliss Cross Comp., latest type.
450 h. p., 16x30x42, Allis Cross Comp.
400 h. p., 23½x60, Geo. H. Corliss.
450 h. p., 24x48, Harris, latest type.
450 h. p., 24x48, Brown.
350 h. p., 22x42, Allis, 1890 Frame.
350 h. h., 22x42, Slater, 1890 Frame.
300 h. p., 20x48, Harris.
300 h. p., 20x42, Hamilton.
225 h. p., 12x22x42, Atlas Tandem Comp.
225 h. p., 18x42, Hamilton.
175 h. p., 16x42, Allis.
165 h. p., 16x36, Sioux, 1902.
150 h. p., 15x38, Brown.
140 h. p., 14x42, Allis.
125 h. p., 14x36, Putnam.
90 h. p., 12x36, Harris.
600 h. p., 28½x52, Buckeye Automatic.
500 h.p.,17½x30½x27, Buckeye Cross Comp.
450 h.p.,16½x28½x27, Buckeye Cross Comp.
450 h. p., 24x48, Buckeye Automatic.
350 h. p., 16x26x18, Ideal Tandem Comp.
275 h. p., 14x22x16, Ideal Tandem Comp.
250 h. p., 16x27x16, Westinghouse Comp.
200 h. p., 18x24, Meyer Automatic.
150 h. p., 15x24, Cummer.
150h.p.,10½x18x18,Williams' Tandem Comp.
100 h. p., 12½x15, Taylor Beck.

Whitehead Machinery Company,

DAVENPORT, IOWA.

"STAR" INCANDESCENT LAMPS

LONG LIFE
GUARANTEED CANDLEPOWER,
HIGHEST EFFICIENCY.

MADE BY THE MOST SKILLED WORKMEN.

STANDARD ELECTRICAL MFG. COMPANY, : Niles, Ohio.

FOR SALE.

ALTERNATORS.

1-360 K. W. General Electric 3-phase.
1-120 " " " "
1-75 " Westinghouse 2-phase.

250-VOLT GENERATORS.

1-250 K. W. Western Electric M. P.
1-200 " Eddy M. P.

125-VOLT GENERATORS.

1-125 K. W. Western Electric M. P.

Immediate shipment.

GREGORY ELECTRIC CO.
54-62 S. CLINTON ST. CHICAGO

ROBT. FERRIS' BOOK ON METERS

IS SO SIMPLE THAT ONE WONDERS AT THE COURAGE OF THE AUTHOR

IT TELLS JUST WHAT SOME PEOPLE THINK THEY KNOW.

Written expressly for the men who handle the pliers.
Sent prepaid on receipt of $1.00. Address

ELECTRICIAN PUB. CO.,
510 Marquette Bldg., CHICAGO.

WORKS QUICK AND EASY. KEEPS ITS LUSTER. HOLDS OLD TRADE AND MAKES NEW. DOES NOT DETERIORATE. ESTABLISHED 16 YEARS. SOLD BY AGENTS AND DEALERS ALL OVER THE WORLD

U.S. METAL POLISH

30 OUNCE BOX 10 CENTS
SAMPLES SENT FREE
GEO. W. HOFFMAN
POLISHES ALL METALS. BRANCHES NEW YORK, CHICAGO, SAN FRANCISCO. 295 E. WASHINGTON ST. INDIANAPOLIS, IND.

BOILERS.

One 42-in. x 15 ft. 9-in., 250 H. P. Worthington Water Tube.
One 60-in. x 16 ft., John Mohr Return Tubular Boiler.
One 64-in. x 16 ft., John Mohr Return Tubular Boiler.
One 54-in. x 16 ft., Devine Tubular Boiler.

ENGINES.

One 600 H. P., 21 x 36 x 30, Williams Tandem Horizontal Compound, 140 R. P. M.
Two 600 H. P., 20 x 30 x 24, Porter-Allen Tandem Compound, 200 R. P. M.
One 250 H. P., 12 x 24 x 18 Williams Tandem Compound, 250 R. P. M.
Two 100 H. P., 13 x 12, Dick & Church, High Speed Automatic.

PARTIAL LIST ONLY.

Send for latest Catalogue for bargains in Engines, Boilers, Dynamos and Motors.

CENTRAL STATION IMPROVEMENT CO., 938 Monadnock Block, Chicago

BOILERS FOR SALE

Six Heine Safety Water Tube Boilers. Rated by builders 340-horse-power each; 160 pounds working pressure. Built 1900. First in service 1901. In two batteries of three units each. Steam line and stacks available. Immediate Delivery.

Also Babcock & Wilcox in units of 400, 350, 280, 175 horse power each.

Tubular boilers all sizes.

WHITEHEAD MACHINERY Co., DAVENPORT, IOWA

"SPEAKING OF GOOD BATTERIES"

Our No. 5 NAVY STANDARD is the best on earth for telephone and general open-circuit work. Long experience in manufacture and the use of the best procurable materials enable us to give you a peerless cell.

NOW, AS TO YOUR AUTOMOBILE; the use of our "Auto Gas" Battery in conjunction with the "Economic" Make and Break or "Fire Ball" Jump Coils will increase the power of your motor 10 to 15 per cent.

Send for our Catalogue No. 7 full of "good tips" on *BATTERIES, SPARK COILS* and *PLUGS, FLASH LIGHTS, CIGAR LIGHTERS,* etc.

VEST POCKET FLASHLIGHTS (to readers of Western Electrician) 80c postpaid.

WILLIAM ROCHE
INVENTOR AND SOLE MANUFACTURER
52 PARK PLACE, NEW YORK CITY

OFFICE OF
Town Clerk
A. R. KAUFMAN, CLERK

BOARD OF TRUSTEES
GEO. A. PAINTER
A. V. FANKBONER
J. J. HEREN
F. VAN NUYS, ATTY.

Summitville Ind. Nov. 23 1903

Western Electrician
Chicago Ill.

Gentlemen: You may discontinue our Want Advertisement with the One issue. as I have already received about 40 answers to same. Send me your bill and I will remit same to you Thanking you Very Kindly for Your Promptness

I am Yours Resp.

A. R. Kaufman
Clerk.

CHICAGO EDISON COMPANY REPAIR SHOPS

76 MARKET STREET, CHICAGO. TELEPHONE MAIN 1280.

Machine and Carpenter Work of All Kinds
Correspondence Solicited.

OPEN DAY AND NIGHT.

FIRST-CLASS EQUIPMENT THROUGHOUT.

Dynamos Armatures, Motors, Arc Lamps, Fans, Instruments.

ARNOLD ELECTRIC POWER STATION Co.
Engineers, Constructors for Complete Electric Plants. Results Guaranteed.
SUITE 1539, MARQUETTE BLDG., CHICAGO, NEW YORK OFFICE: 711 TRANSIT BLDG.

BYLLESBY, H. M. & Co.
(Incorporated)
ENGINEERS
Design, Construct and Operate Railway, Light, Power and Hydraulic Plants.
Examinations and Reports.
New York Life Building, - CHICAGO, ILL.

HORNADAY, J. P. & Co.
SUITE 1108 TRACTION BUILDING
CINCINNATI, O.
WATERWORKS, ELECTRIC RAILWAY, LIGHT, TRACTION, INDUSTRIAL AND MINERAL PROPERTIES BOUGHT AND SOLD

RUEBEL - SCHWEDTMANN-WELLS,
CONSULTING, MECHANICAL AND ELECTRICAL ENGINEERS,
Suite 801 Chemical Building, ST. LOUIS, U. S. A.

F. B. BADT,
Monadnock, Chicago.

EVANS, ALMIRALL & CO.,
Central Station Heating, High Pressure Piping.
1057 Monadnock Blk., Chicago.

ROBERT W. HUNT & Co.,
ENGINEERS
1121 The Rookery, Chicago. 66 Broadway, New York.
Monongahela Bank Bldg., Pittsburg. Norfolk House, Cannon St., London.

Long Distance Phone Central 2443.
SCHOTT, W. H.,
ENGINEER AND CONTRACTOR,
SPECIALTIES—Central Station Heating Plants, Water Works Steam Plants, Electric Light, Gas and Street Railway Plants.
1220-21 MARQUETTE BUILDING, CHICAGO.

W. E BAKER. H. B. BISHOP.
BAKER, W. E. & CO.
ENGINEERS,
ELECTRIC RAILWAYS.
27 William St., NEW YORK.

E. W Hammer, Pres. and Treas. H. J. Minhinnick, Sec. and Gen'l Sup't.
GENERAL ENGINEERING Co., THE Consulting and Contracting Engineers.
Telephones, Electric Light, Power Transmission
Suite 1112, 135 ADAMS ST., CHICAGO.
Long Distance Telephone Central 473.

KEMP, R. W.
Consulting and Contracting Telephone Engineer.
Plans and specification for complete plants. Old plants overhauled and placed on paying basis. Territory, Kansas, Oklahoma and Indian Territory.
WELLINGTON, - - - KANSAS.

TRY IT.
Keep your name and address in this directory where it will be seen by possible clients.

ENGINEERS
Represented in this "Directory" are enabled to come in touch with many prospective customers who cannot be reached through any other source.

A WEEKLY REPRESENTATION
in this "Directory" enables engineers to keep before all possible customers.

KOHLER BROS.,
Contracting Electrical Engineers, Lighting Power Railways,
1804-1806-1808-1810-1812 Fisher Building, CHICAGO.

STANTON, LE ROY W.
Consulting Telephone Engineer
Plans, Specifications and Supervision of Installation of Complete Telephone Plants
Special Reports on Telephone Properties and Apparatus
411 Electrical Bldg., Cleveland, Ohio

BRYAN, WILLIAM H.
M. Am. Soc. M. E.,
Consulting Mechanical and Electrical Engineer.
Lincoln Trust Building, ST. LOUIS.

J. H. HALLBERG
Consulting Engineer
Electric Light, Power and Railway Plants
Suggestions to secure Economy, Specifications, Examinations and Reports
45 Broadway, NEW YORK
Long Distance Telephone 4578 Broad

McLAUGHLIN, JAMES
CONSULTING ARC LIGHTING EXPERT, PRACTICAL ELECTRICAL AND MECHANICAL ENGINEER,
53 RIVER ST., - CHICAGO, ILL.

Telephone Main 3123.
WILMERDING, C. H.
CONSULTING ENGINEER
1100 Old Colony Bldg., CHICAGO.

DUGALD C. JACKSON, C. E.
WILLIAM B. JACKSON, M. E.
MEMBERS
AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS
AMERICAN SOCIETY OF MECHANICAL ENGINEERS
AMERICAN SOCIETY OF CIVIL ENGINEERS
ENGINEERS. EXPERTS.
MADISON, WIS.

ALL Live men read the WESTERN ELECTRICIAN Each Week. Do You?

PLACE YOUR
"Want" and "For Sale" advertisements in the
WESTERN ELECTRICIAN,
Immediate Returns.

IMPORTANT TELEPHONE BOOKS.

THE TELEPHONE HANDBOOK. By Herbert Laws Webb. 16mo, 150 pp. Price $1.00.
This handbook is a reliable treatise on telephony, and a practical book on telephone working and management, based entirely on standard American practice. It is extremely useful to telephone inspectors and operators.

AMERICAN TELEPHONE PRACTICE. By Kempster B. Miller, M. E. 510 pp. 380 illustrations. Price $3.00.
This is the first complete treatise on telephony in the English language. The text is profusely illustrated by cuts of commercial apparatus and carefully prepared diagrams of circuits. No diagram is given without a full explanation. The apparatus, circuits and methods of the American Bell Telephone Company and of the various independent companies are fully described. The apparatus and methods used in making all of the tests required in commercial telephone work are fully treated.

THE INSPECTOR AND TROUBLE MAN. By A. E. Debbs. 106 pp. Price $1.00.
A practical book, written in plain language. Full of information and diagrams for the operator, exchange manager, inspector, trouble man and lineman. A complete description of telephones, how to find and remedy their troubles, together with working plans for exchange construction, complete with diagrams of all up-to-date telephones and switchboards.

A, B, C, OF THE TELEPHONE. By J. E. Homans, A. M. 352 pp. 269 illustrations. Price $1.00.
Owing to the demand for a comprehensive book giving a clear, terse idea of the principles governing the construction, installation, care and management of telephones and their appliances, this book has been compiled. It has been the aim of the author to make this the most complete elementary book on the subject for the practical electrician, wireman, lineman and engineer, and it is written in a clear and careful style.

THE PRACTICAL TELEPHONE HANDBOOK. By Joseph Poole, A. I. E. E. Second edition, revised and enlarged. 360 pp. 288 illustrations. Price $1.50.
In this work the writer has endeavored to produce a manual of moderate size and cost, but thoroughly practical, and detailing, as far as space will allow, the most recent methods of telephone working. While the requirements of telephone employes have been kept constantly in view it is fully intended also that the book shall be of service as a source of information on telephonic matters to users of the telephone and to the public generally.

PRACTICAL FEATURES OF TELEPHONE WORK. By A. E. Debbs. 134 pp. Price 75 cents.
A simple, plain-speaking handbook for the practical telephone man.

TELEPHONE TROUBLES AND HOW TO FIND THEM. A complete handbook for telephone inspectors. By W. Hyde and J. H. McManman, edited by Prof. C. H. Haskins. Eighth edition. 16mo, 48 pp. Price 25 cents.
This little volume is an extremely practical work for telephone employes, written in a popular style and devoid of technicalities.

TELEPHONE LINES AND THEIR PROPERTIES. By Wm. J. Hopkins. Sixth edition. 272 pp. Illustrated. Price $1.50.

A MANUAL OF TELEPHONY. A new and large edition. By W. H. Preece, F. R. S., and A. J. Stubbs. 508 pp. 333 illustrations. Price $4.50.

TELEPHONES, THEIR CONSTRUCTION AND FITTING. A Practical Manual on the Fitting Up and Maintenance of Telephone and Auxiliary Apparatus. By F. C. Allsop. 191 pp. 168 illustrations. Price $1.25.

PATENTED TELEPHONY. A Review of the Patents Pertaining to Telephones and Telephonic Apparatus. Published by the American Electrical Engineering Association Cloth bound; fully illustrated. Price, $1.50.

THE ELECTRIC TELEPHONE. By E. J. Houston, Ph. D., and A. E. Kennelly, Sc. D.; 12mo, cloth, 422 pp., 142 illustrations. Price $1.00.

HOW TO MAKE AND USE THE TELEPHONE. By Geo. H. Cary. 136 pp.; illustrated. Price $1.00.

The Above, or Any Other Electrical Work Published, Sent on Receipt of Price.

ELECTRICIAN PUBLISHING CO., 510 MARQUETTE BLDG., CHICAGO.

There is No Higher-Class India-Rubber Insulation For Wires and Cables than

HABIRSHAW.

Authorized Manufacturers of the
ATTIX FLEXIBLE TUBE WIRE.

The India-Rubber and Gutta-Percha Insulating Co.,
MAIN OFFICE, Glenwood Works,
YONKERS, N. Y.
Sales Office, 15 Cortlandt St., New York.
(10923)

BOILER WATERS CORRECTED

to remove and prevent scale and to stop corrosion. DEARBORN TREATMENT does the work. Send gallon sample for analysis. Booklet "R" now ready.

DEARBORN DRUG & CHEMICAL WORKS,

27-34 RIALTO BUILDING, CHICAGO, ILL. WM. H. EDGAR, President Telephone: Harrison 3930 and 3931.

Dixon's Pure Flake Graphite

"The Perfect Solid Lubricant," saves shut-downs and repairs due to imperfect lubrication. Booklet 125C and sample upon request.

JOSEPH DIXON CRUCIBLE CO., JERSEY CITY, N. J.

JEFFREY ELEVATING, CONVEYING, POWER TRANSMISSION **MACHINERY** FOR CATALOGUE, ADDRESS THE JEFFREY MFG. CO. COLUMBUS, O.

REG. TRADE MARKS

"Phosphor Bronze" DELTA

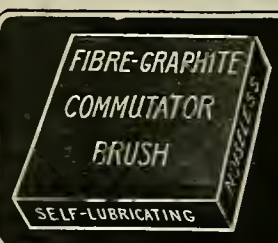
THE PHOSPHOR BRONZE SMELTING CO. LIMITED, 2200 WASHINGTON AVE., PHILADELPHIA.

"ELEPHANT BRAND PHOSPHOR-BRONZE" INGOTS, CASTINGS, WIRE, RODS, SHEETS, ETC.

— DELTA METAL —

CASTINGS, STAMPINGS AND FORGINGS

ORIGINAL AND SOLE MAKERS IN THE U.S.

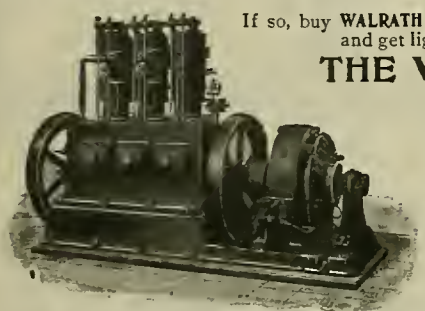


There's No Friction

with the Fibre-Graphite Commutator Brush. Being 90 per cent. pure graphite, it insures low resistance, no sparking under a varying load, and longer wear. There is no greasing required. The Fibre-Graphite is therefore the most economic brush on the market. Send for price list.

HOLMES FIBRE-GRAPHITE MFG. CO.
5155 Wakefield St., Germantown, PHILADELPHIA.

ARE YOU LOOKING FOR MONEY?



If so, buy WALRATH GAS OR GASOLINE ENGINES and get light on the subject.

THE WALRATH

Received the Highest Award at the Pan-American Exposition.

It will produce as good a commercial light as that of an automatic steam engine, either belted or direct-connected generator. Simple, Economical and Reliable

Send for Catalogue W

MARINETTE GAS ENGINE CO.,
CHICAGO HEIGHTS, ILL.

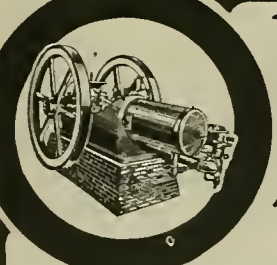
AGENCIES:
Keystone Engineering Co., Farmer's Bank Bldg., Pittsburg, Pa.
Strong, Carlisle & Hammond Co., 61-67 Frankfort St., Cleveland, Ohio
Mackay Engineering Co., 149 Broadway, N. Y.
C. H. Seidenglanz., 52 When Bldg., Indianapolis, Ind.

CORDS AND CABLES

We manufacture Cords of all descriptions used in conjunction with Telephone and Switchboard work, also Cables for Switchboard and Interior Purposes.

Write us for Prices

RUNZEL-LENZ ELECTRIC MFG. CO.
97-101 S. CLINTON STREET CHICAGO



Olds Gas and Gasoline Engines

When gasoline is used for fuel it can be pumped up only as fast as it is used. Perfect mechanical appliances make for absolute safety and economy.

STATIONARY ENGINES - - 2 to 100 H. P.
PORTABLE ENGINES - - - 8 to 18 H. P.

We have a new catalog, fully describing and illustrating our line, which will be sent on request.

OLDS GASOLINE ENGINE WORKS,
252 River Street, - - Lansing, Mich.
No. 983

THE TELEPHONE HAND-BOOK

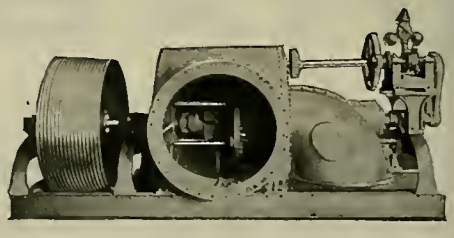
BY HERBERT LAWS WEBB.
Price $1.00.
A complete and practical work in handy pocket size.
PUBLISHED BY
THE ELECTRICIAN PUBLISHING CO.,
Suite 510 Marquette Building, Chicago.

Preserve Your Copies OF THE WESTERN ELECTRICIAN.

BINDERS $1.00 EACH.
ELECTRICIAN PUBLISHING CO.,
Suite 510 Marquette Building.

SAMSON TURBINE

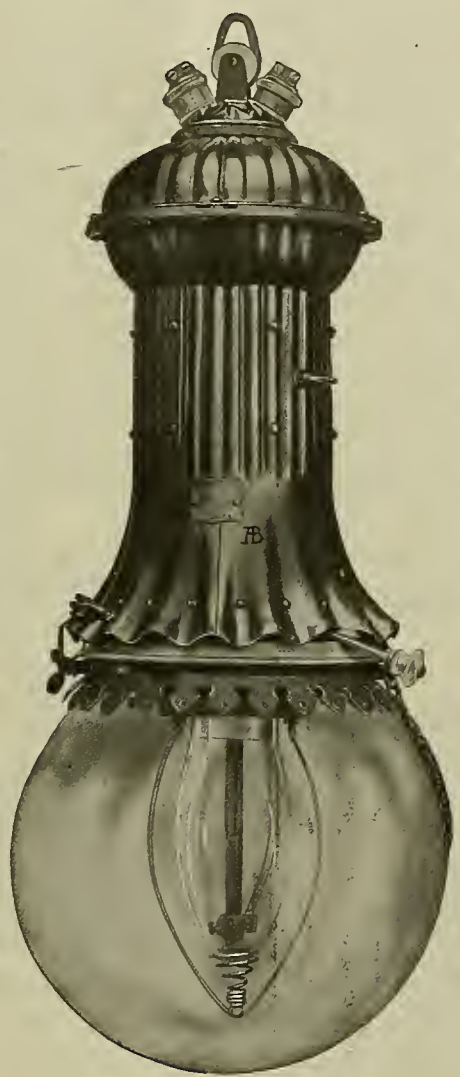
We build these turbines in all SIZES AND STYLES, on UPRIGHT or HORIZONTAL shafts, BELTED or DIRECT CONNECTED, SINGLE or in PAIRS. They are suitable for direct connecting to GENERATORS, AIR-COMPRESSORS, PUMPS or other machinery driven on horizontal shafting.



THE JAMES LEFFEL & CO., Springfield, Ohio, U. S. A.

A-B ARC LAMPS

FOR ALL CIRCUITS



SPECIAL FEATURES

Accessibllity of Mechanism,

Ease of Removing Inner and Outer Globe,

Ease of Trimming,

Weatherproof Construction,

Stamped Copper Cases and Simplicity of Mechanism.

THERE IS

A greater number of Adams-Bagnall Constant Direct Current Series Enclosed Arc Lamps used for street lighting throughout the United States, Canada and Mexico than all other makes of this type of lamp combined.

SEND FOR CATALOGUE

AGENCIES

Doubleday-Hill Electric Co., Pittsburg, Pa.
Electric Appliance Co., Chicago, Ill.
The Wesco Supply Co., St. Louis, Mo.
H. C. Roberts Electric Supply Co., Philadelphia, Pa.
Pettingell-Andrews Co., Boston, Mass.
Cia. Benbow-Dutton, S. A., City of Mexico, Mex.
Geo. F. Rohn, Milwaukee, Wis.

AGENCIES

B-R Electric Co., Kansas City, Mo.
A. J. Micheli, Atlanta, Ga.
Interstate Electric Co., New Orleans, La.
Post-Glover Electric Co., Cincinnati, O.
Miller-Seldon Electric Co., Detroit, Mich.
W. G. Nagel Electric Co., Toledo, Ohio.
R. E. T. Pringle Co., Ltd., Montreal Que.

THE ADAMS - BAGNALL ELECTRIC CO.

New York Office: 136 Liberty St. CLEVELAND, OHIO Chicago Office: 303 Dearborn St.

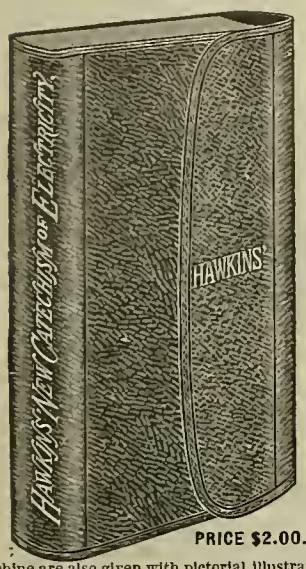
SPEER HIGH GRADE CARBON BRUSHES

MOTOR AND GENERATOR CARBON BRUSHES

SPEER CARBON CO., - St. Marys, Pa.

HAWKINS' NEW CATECHISM OF ELECTRICITY.

Plan of the Work, Contents, Etc.



PRICE $2.00.

The New Catechism of Electricity will be found to be surprisingly plain, and free from useless and ambiguous terms. The plan upon which it is arranged is unique.

The book is, first of all, intended to be plain and instructive; some 300 illustrations have been introduced, so that the mere pictures will afford almost a knowledge of the subjects.

It is a school book from the manner in which it proceeds from the simple facts to the abstract principles which the facts indicate; it is also a book of reference through the index of seventeen double columns of fine type pages; by means of this index a thousand items of practical importance are at once available.

It is an up-to-date work, which has cost a large outlay of capital and time, and, in short, it is doubtful if any more attractive book has ever been issued—or one more useful.

The subjects treated upon are as follows: Dedication to Thomas A. Edison, with engraving of Mr. Edison; Preface and Introduction; Nature and Source of Electricity and Magnetism.

The Dynamo; Conductors and Non-Conductors; Symbols, abbreviations and definitions relating to electricity; Parts of the Dynamo; The Motor; The Care and Management of the Dynamo and Motor.

Electric Lighting; Wiring; The rules and requirements of the National Board of Underwriters in full; Electrical Measurements.

The Electric Railway; Line Work; Instruction and Cautions for Linemen and the Dynamo Room; Storage Batteries; Care and Management of the Street Car Motor; Electro Plating.

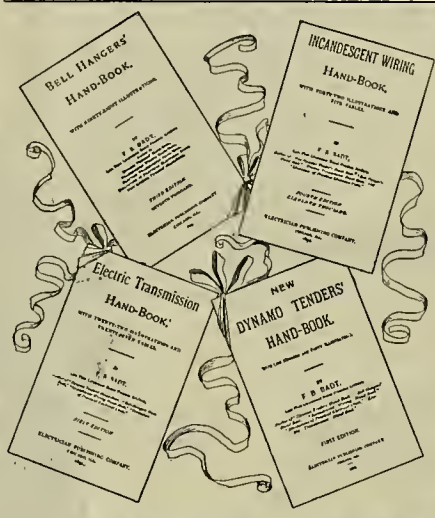
The Telephone and Telegraph; The Electric Elevator; Accidents and Emergencies, etc., etc.

The full one-third part of the whole work has been devoted to the explanation and illustrations of the dynamo, and particular directions relating to its care and management;—all the directions are given in the simplest and most kindly way to assist rather than confuse the learner. The names of the various parts of the machine are also given with pictorial illustrations of the same.

In the Catechism no less than 25 full page illustrations have been given of the various dynamo machines made in different parts of the country, and an equal number of part page illustrations.

ELECTRICIAN PUBLISHING CO., 510 Marquette Bldg., CHICAGO.

BADT'S HAND BOOKS.



PRICE ONE DOLLAR EACH.

DYNAMO TENDER'S HAND BOOK.

BELL HANGER'S HAND BOOK.

ELECTRIC TRANSMISSION HAND BOOK.

INCANDESCENT WIRING HAND BOOK.

These books are of convenient pocket size and are widely known as authorities in their respective branches.

Any of the above will be sent, postage paid, on receipt of price.

ELECTRICIAN PUBLISHING CO.,

610 MARQUETTE BLDG., - - - - - CHICAGO.

NEW TYPES

Hartford Automatic Time Switches

In addition to our Standard Switch we have brought out the following types:

Type "C" automatically cuts out the switch operation Sunday, or any other day desired.

Type "D" is arranged to throw on the switch for two periods each day. This type is particularly desirable for attracting the attention of theater crowds before and after performances, saving current between times.

All switches are equipped with Seth Thomas 8-Day Movements, and require only weekly winding.

We are glad to consider the construction of Automatic Time Switches for special purposes.

Send for Catalogue.

The Hartford Time Switch Company

438 ASYLUM STREET, HARTFORD, CONN.

A. HALL BERRY, Manager Sales Department, 97 Warren Street, NEW YORK CITY
VERITYS, LTD., 31 King Street, Covent Garden, LONDON, W. C., ENGLAND

The Inspector AND Trouble Man.

By A. E. DOBBS.

Full of information and diagrams for the operator, exchange owner, exchange manager, inspector, trouble man, lineman.

A complete description of telephones and their troubles. How to find and remedy them, together with working plans for exchange construction, complete with diagrams of all up-to-date telephones and switchboards.

This is a practical book, written in **plain language**, and for **anyone** interested in telephony.

Mailed anywhere on receipt of price . . . ONE DOLLAR.

No technicalities. Substantially bound in cloth.

ELECTRICIAN PUBLISHING CO.,

510 MARQUETTE BUILDING, CHICAGO.

"By two or three witnesses shall a matter be established."

FIVE
POINTS
OF EXCELLENCE

Leaving the center of the city from which you start; reaching the center of the city of your destination, over smooth and level tracks; giving rest and comfort; riding beside running waters most of the way; through the centers of population to the gateways of commerce; when you travel by the

NEW YORK CENTRAL LINES

A copy of the Illustrated Catalogue of the "Four Track Series" will be sent free upon receipt of a two-cent stamp by George H. Daniels, General Passenger Agt., Grand Central Station, New York.

Bound Volumes

OF THE

WESTERN ELECTRICIAN

FOR SALE.

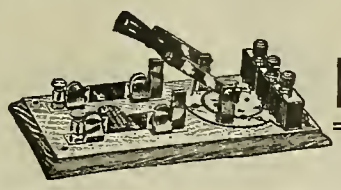
From Vol. 1 to Date.

ADDRESS

ELECTRICIAN PUBLISHING CO.,

510 Marquette Building, CHICAGO

SOMETHING DOING IN A STORM



WITHOUT A

King of Protectors

Better Buy a

"TORNQUIST"

COMBINATION LIGHTNING ARRESTER GROUND SWITCH FUSE AND LEVER CUT-OUT.

THE ONLY SAFE PROTECTOR MADE. ORDER SAMPLE NOW.

BABY KNIFE SWITCHES
STAMPING AND PLATING.
SOLD BY ALL JOBBERS.

Clinton Stamping & Electric Co.,

CLINTON, IA.

HART & CO., Chicago, General Agents.

The Electro-Magnet

—BY—

TOWNSEND WOLCOTT, A. E. KENNELLY, RICHARD VARLEY.

PRICE, ONE DOLLAR,

CONTENTS.

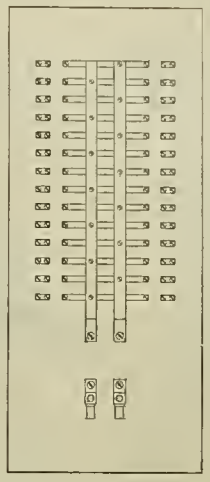
General Properties. Magnetic Field of Force. Magnetic Units. Induced Magnet, Reluctance, Permeability. Discovery of Electro-Magnetism. Iron Ring in the Magnetic Field. Calculation of Magnet Windings. Magnetic Circuit. Given Ampere-Turns to Find Proper Current. Relation of Ampere-Turns to Wire Space. Room Occupied by Insulation, Heating and Other Limiting Conditions. Winding a Magnet for a Given Voltage. Hysteresis, Self-Induction. Alternating Currents. Traction.

On the Relative Values of the Windings of Electro-Magnetic Coils. Properties of Fixed Winding Spaces and a Fixed Size of Wire. Properties of Fixed Winding Space and Variable Size of Wire. Fixed Winding Space and Fixed Length of Wire or Number of Turns. Constant Internal Dimensions, but External Diameter of Coil Variable. Fixed Internal Radius and Interflange-Fixed Number of Turns of Same Size of Wire.

The Importance of Details. Actual Calculations. Working Formulæ. Diameter of Wire to Carry Given Current. Diameter of Wire to Have Given Resistance. Thickness of Insulation in a Given Coil. Weight of Copper in a Given Coil. Table of Constants for Insulated Wire. Standard Table of Resistances of Insulated Wires. Table Showing Percentage of Copper and Insulation in Cotton or Silk Covered Wire. Standard Copper Wire Table. 17 Problems (Solved) Illustrated. Cuts of 37 Magnets of Standard Dimensions, Lengths Variable. Logarithms and Anti-Logarithms. Decimal Parts of an Inch. Logarithmic Scale.

—FOR SALE BY—

ELECTRICIAN PUBLISHING CO., 510 MARQUETTE BLDG., CHICAGO.



PANEL BOARDS

In the manufacture of Panel Boards we have the best possible facilities.

Our new illustrated Bulletin No. 20w will be mailed on request.

THE F. BISSELL COMPANY
TOLEDO, O.

ELECTRIC LIGHTING GOODS, DYNAMOS, MOTORS, SWITCHBOARDS, ARC AND INCANDESCENT LAMPS, SUPPLIES.

BITUMINIZED FIBER CONDUIT

FOR UNDERGROUND CONSTRUCTION

Combines the **good features** of other conduits.
Eliminates the **bad features** existing in many kinds.
Has valuable features not found in any other ducts.

Made in 7-foot lengths with male and female joints, making construction very rapid and simple, with consequent low cost.

Alignment is perfect and permanent without tedious care and skill required in laying of butt-joint conduits.

Users are astonished by the ease and rapidity with which cables can be drawn in, and this without the slightest scratching or injury to the lead covering thereof.

Made in sizes from 1-inch to 10-inch diameter.

Bends of any radius and any angle.

Write us for further information and prices, stating sizes and quantities required.

American Conduit Co.

Main Offices: 1005-6 Manhattan Building, Chicago

Other Offices:

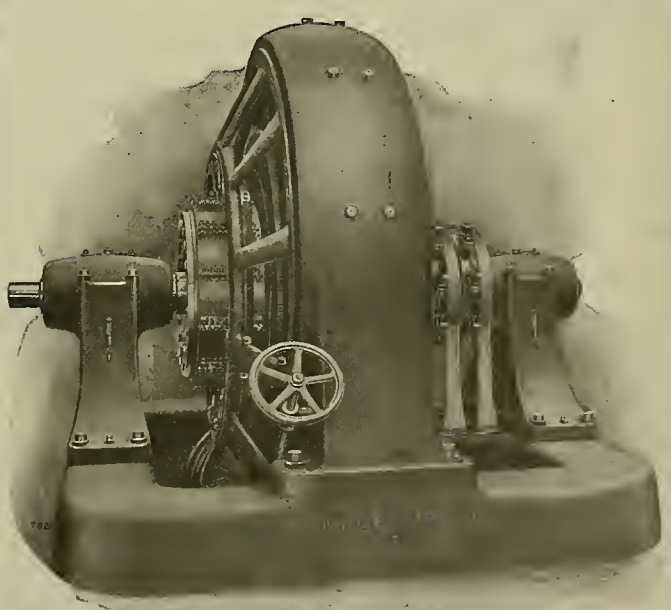
170 Broadway, New York. 336 Macy St., Los Angeles

National Electrical Machinery

built in all capacities

Direct and Alternating

apparatus of the highest grade



1,000-K. W. Rotary Converter

National Electric Company

GENERAL SALES OFFICES & WORKS:

Philadelphia: Land Title Bldg.
New York: 135 Broadway
Chicago: Old Colony Bldg.
Pittsburg: Gellatly & Co.
Charleston, W. Va: Agnew Electric Co.
Milwaukee
Seattle & San Francisco
Kilbourne & Clark Co.

It is a Well Known Fact

AND NO ONE DENIES IT—THAT

The Kellogg Switchboard and Supply Company Has Manufactured and Completely Equipped

More large city exchanges than all the other Independent telephone manufacturing companies combined.

Besides that the company has equipped wholly or in part, more than TWO THOUSAND (2,000) TELEPHONE EXCHANGES in the United States.

Why this success? Simply the quality and efficiency of the apparatus, and the unquestioned high reputation of the house.

Write for our bulletins and catalogues.

KELLOGG

SWITCHBOARD & SUPPLY CO. CHICAGO.

LOS ANGELES CLEVELAND PHILADELPHIA

We introduced successful 4-party lines

LEICH SELECTIVE SYSTEM

Write for our booklet—"Selective W."

CENTRAL ENERGY OR MAGNETO

Impedance Coil for Selectives. No Springs.

AMERICAN ELECTRIC TELEPHONE CO.

CHICAGO, ILLINOIS

INTERNATIONAL

Mechanical Self-Restoring Drop Switchboard.

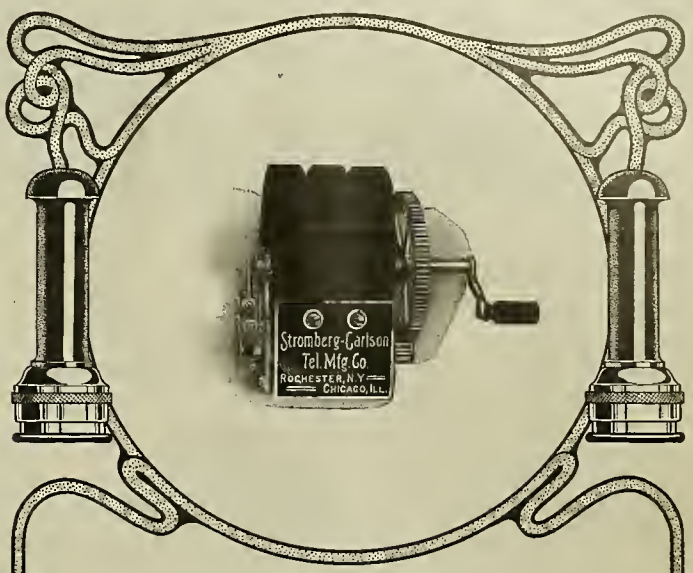
A PERFECT APPARATUS.

Made in any desired capacity.

Sample parts and quotations on request.

INTERNATIONAL TELEPHONE MANUFACTURING CO.

CHICAGO, U. S. A.



Standard three-bar generator, same as used in our series telephones. We have manufactured generators since we first started in business. What this experience means to you enables us to sell the best generator made at a price slightly above the ordinary. The difference is caused by the better grade of material used and the superior workmanship.

You pay nothing for our experience. Our Bulletin No. 11-E explains fully this apparatus. Mailed free.

Stromberg-Carlson Telephone Mfg. Co.

GENERAL AND EASTERN OFFICE
ROCHESTER, N. Y.

SALES DEPT.
CHICAGO, ILL.

The Electrician Publishing Co., Suite 510 Marquette Building, Chicago. Headquarters for all latest Electrical Books. Write for Catalogue.

TELEPHONE PRINCIPLES AND PRACTICE

A NEW BOOK IN TELEPHONY

By
GEORGE WALKER WILDER, PH. D.
Professor in Telephony in the Armour Institute of Technology

Complete and up-to-date, written by a practical man. All about modero telephone apparatus, their principles and use:

I. Fundamental Ideas
II. Telephone Apparatus
III. Systems of Communication
IV. Construction and Equipment

IN 32 CHAPTERS, 450 PAGES, 375 ILLUSTRATIONS. PRICE $2.00 POSTPAID.

Send Postal Money Order to

THE CANTWELL PRESS - Madison, Wis.

THE BEST KIND OF INSURANCE FOR TOLL LINES

To be erected on the most exposed parts of the line. They require no attention after erecting.

Minnesota Electric Co.,
MINNEAPOLIS, MINN.

Automatic Telephones.

Privacy

Promptness

Precision

Profits.

Automatic Electric Co., Chicago, U. S. A.

PRODUCERS AND WHOLESALERS OF WHITE CEDAR PRODUCTS

CEDAR POLES

SPECIAL PRICES ON SMALL POLES.
Write for a copy of our TELEGRAPH CODE FOR CEDAR PRODUCTS

YARDS
KOSS MICH.
L'ANSE "
MUNISING "
ONTONAGON
WAGNER, WIS
PESHTIGO "

C. H. WORCESTER CO.
SUITE 1206 TRIBUNE BLDG. CHICAGO.

Southern Cedar POLES Are the Best.
NO ROTTEN BUTTS. D. W. PHELAN, 277 Broadway, New York

POLES W. C. STERLING & SON, MONROE, MICH. TIES.
Eleven Pole Yards in Michigan. Wholesale Producers for 20 years

Points in Wisconsin and the Northwest

are covered by Wisconsin Central Railway's convenient, solid, wide vestibuled trains, equipped with Pullman sleepers, free reclining chair cars and modern coaches which leave Central Station, 12th Street and Park Row (Lake Front), Chicago for St. Paul, Minneapolis, Ashland and Duluth, connecting with all western lines. Meals in dining and cafe cars served a la carte.
For tickets and further information apply to nearest ticket agent, or write
JAS. C. POND, Gen'l Pass. Agt., Milwaukee, Wis.

Locations for Industries

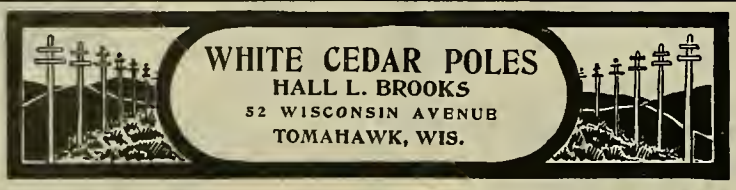
Erie Railroad

Chicago to New York

The Erie Railroad Company's Industrial Department has all the territory traversed by the railroad districted in relation to resources, adaptability, markets and advantages for manufacturing, and can advise with manufacturers in relation to the most suitable locations. For full information address

LUIS JACKSON
Industrial Commissioner, Erie Railroad Company
21 Cortlandt Street, New York

Send your Book Orders to
ELECTRICIAN PUBLISHING CO.,
510 Marquette Bldg., Chicago.



CEDAR POLES

THE
Valentine-Clark Co.
234 La Salle Street, CHICAGO

YARDS:
Pinoonning, Mich. : Green Bay, Wis. : New London, Wis.

Cedar TORREY CEDAR CO., CLINTONVILLE, WIS. Poles
Large Stock Constantly on Hand

The "WAY of the WORLD" to the WORLD'S FAIR.
BIG FOUR ROUTE
to
ST. LOUIS.
1904
Write for Folders & Booklets
M. E. INGALLS, PRESIDENT, CINCINNATI. WARREN J. LYNCH, G. P. & T. A.

WHITE CEDAR POLES

Don't forget our Minnesota Transfer Yard—midway between St. Paul and Minneapolis, where we load in forty-eight hours from the time we have your order.
PAGE & HILL CO. 1003 Lumber Exchange, MINNEAPOLIS, MINN.

POLES, TIES, POSTS.

THE PORTER CEDAR CO., SAGINAW, MICH.
PRODUCERS. We want your Inquiries always.

CEDAR POLES, POSTS, TIES,

H. M. LOUD'S SONS CO., Au Sable, Mich.

POLE DEALERS ADVERTISING IN THE WESTERN ELECTRICIAN OBTAIN MOST EXCELLENT RESULTS BECAUSE IT PLACES THEM IN TOUCH WITH ACTUAL BUYERS OF POLES. TRY A CARD.

CENTRAL STATION HEATING

We are the originators and builders of the underground system of live and exhaust steam heating. Our system is used for the utilization and distribution of exhaust steam from electric and power plants for heating purposes. 250 Plants in successful operation. We have the only Meter System. Also manufacturers of Wooden Water Pipe, Steam Pipe Casing, Steam Traps, Condensation Meters, Valves, Economizing Coils, Separators and full line of Steam Fitters' Supplies.

WRITE FOR PAMPHLET AND PRICE LIST

AMERICAN DISTRICT STEAM COMPANY
MENTION WESTERN ELECTRICIAN. LOCKPORT, N.Y. CHICAGO, ILL.

MICHIGAN WHITE
CEDAR POLES
LARGE STOCK.
PROMPT SHIPMENTS.
KELLOCC SWITCHBOARD & SUPPLY CO., Chicago.

JUST RECEIVED a new batch of 20 and 25 ft. Poles and have reduced prices accordingly. Also, we have plenty of those "Trolley" Ties yet. May we quote you now?
MALTBY CEDAR COMPANY, 509 Phoenix Block, Bay City, Michigan
Pittsburg Agents: Tipper & Patton, 509 Bessemer Bldg.

POLES. WHITE CEDAR. IDAHO CEDAR up to 80 ft.
BERTHOLD & JENNINGS, ST. LOUIS. Chemical Building.
CROSS ARMS. LONG LEAF PINE AND FIR.

Cedar Poles.
Pittsburg and Lake Superior Iron Co. Producers and Wholesalers. Escanaba, Mich.

INDUSTRIES ARE **OFFERED LOCATIONS** WITH
Satisfactory Inducements,
Favorable Freight Rates,
Good Labor Conditions,
Healthful Communities,
ON THE LINES OF
THE ILLINOIS CENTRAL R. R. AND THE YAZOO & MISSISSIPPI VALLEY R. R.
For full information and descriptive pamphlet address
J. C. CLAIR,
Industrial Commissioner,
1 Park Row, Chicago, Ill.

Idaho Cedar Poles
PACIFIC COAST POLE CO. SPOKANE, WASH.

BRACKETS—X ARMS—PINS
little things it is true, but they cut a big figure in line construction.
OUR MOTTO IS:
Prompt Shipment Quality Satisfaction Right Price
COLUMBIA MFG. CO. ANTIGO, WIS.

MICHIGAN AND WESTERN **CEDAR POLES**
ALL LENGTHS AND SIZES
LINDSLEY BROS CO.
TRIBUNE BLDG., CHICAGO

TENNESSEE RED CEDAR POLES, POSTS AND PILING
R. C. BUCHANAN
MILL AND YARDS: LAVERGNE, TENN.
LARGE STOCK ON HAND

Poles and Ties

The Fowler Companies
TRADE MARK
Fisher Bldg. Chicago

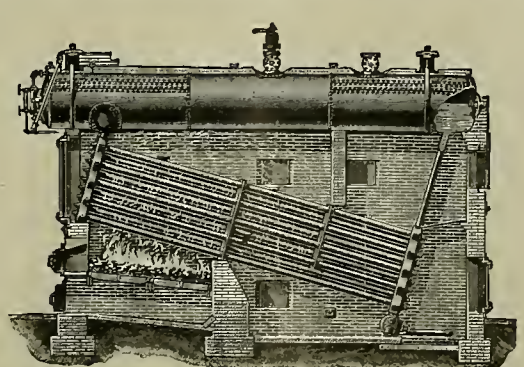
Practical Running of Dynamos.
A little booklet on the care and the locating and remedying of troubles in dynamos and motors.
Price, 10 Cents.
Catalogue of mechanical and electrical books free.
ELECTRICIAN PUBLISHING COMPANY,
510 Marquette Bldg., Chicago.

Telephone Troubles and How to Find Them.
A complete hand-book for telephone inspectors, by Wm. H Hyde and J. A. McManman.
NINTH EDITION. 52 PAGES. PRICE, 25 CENTS.
The large number of telephone exchange managers and employes will find this book a great help in locating telephone troubles and remedies therefor. Considerable new matter has been added in this edition.
Sent prepaid on receipt of price by the
Electrician Publishing Co., 510 Marquette Building, CHICAGO.

CEDAR POLES
ESTABLISHED 1862
WM. MUELLER COMPANY
1211-12-13 MARQUETTE BLDG. CHICAGO.
EIGHT DISTRIBUTING YARDS

THE BABCOCK & WILCOX CO., 85 LIBERTY ST., N. Y.

BRANCH OFFICES:
BOSTON, 35 FEDERAL STREET.
PHILADELPHIA, 1110-1112 NORTH AM. BLDG.
SAN FRANCISCO, 63 FIRST STREET.
PITTSBURG, 1218 FRICK BUILDING.
NEW ORLEANS, 339 CARONDELET STREET.
CHICAGO, 1215 MARQUETTE BLDG.
ATLANTA, EMPIRE BLDG.
CLEVELAND, 706 NEW ENGLAND BLDG.
MEXICO CITY, 7 AVENIDA JUAREZ.
HAVANA, CUBA, 116 1-2 CALLE DE LA HABANA


200 Pounds Working Pressure

WATER TUBE STEAM BOILERS

STEAM SUPERHEATERS

Our Book, STEAM, mailed free on application.

Westinghouse

Type N and OD Transformers

Described in Circulars 1057 and 1060

Westinghouse Electric & Mfg. Co.

Pittsburg, Pa.

Sales Offices in all Large Cities

For Canada: Canadian Westinghouse Co., Ltd., Hamilton, Ontario

FORT WAYNE ELECTRIC WORKS
WOOD LIGHTING & POWER SYSTEMS
Fort Wayne, Ind.

Type A transformers combine perfection in insulation with economy of operation to the highest degree and have shown by published data that they are as good as the best. The shell type construction is, in the Type A, developed to its highest efficiency. In close regulation on unbalanced three-wire systems or on inductive loads, as well as on average loads, Type A transformers satisfy the most exacting demands of their users. Lighting circuits of various ratios and all commercial voltages with lighting or power loads from 0.6 to 60 kw. can be supplied by a Standard A

261

Worth Having!

STEVENS' MECHANICAL CATECHISM

PRACTICAL KNOWLEDGE

FOR

Stationary and Marine Engineers, Firemen, Electricians, Motormen, Ice Machine Men and Mechanics in General.

New and Original. All Modern Machinery fully described and explained. Technical Points made Clear by Word and Drawing. Questions and Answers for Civil Service Examinations, etc.

SUBJECTS TREATED:

WATER, STEAM, COMBUSTION, SMOKE PREVENTION, BOILERS, BOILER CONSTRUCTION, TESTING AND MANAGEMENT, SAFETY VALVES, INJECTORS, PUMPS AND GOVERNORS, STEAM GAUGES, LUBRICATORS, ENGINES, COMMON SLIDE VALVE, TANDEM COMPOUND, CROSS COMPODND, RECEIVER ENGINES, HOT AIR AND COMPRESSED AIR ENGINES, TRACTION ENGINES, ELECTRIC ENGINES, AUTOMATIC AND CORLISS ENGINES, CONDENSERS, JET AND SURFACE, ECCENTRIC, BALANCED SLIDE VALVE, LINK MOTION, HORSE POWERS IN DETAIL, INDICATOR, REFRIGERATION, ABSORPTION AND COMPRESSION METHODS, BRINE AND DIRECT EXPANSION SYSTEMS, PUMPS, VALVES, TESTS, TABLES, AMMONIA, AMMONIA FITTINGS, LIQUID AIR, MACHINE SHOP PRACTICE, STANDARD NUMBERS AND RULES, PULLEY SPEED CALCULATION, SQUARE ROOT, LEVERAGE, ELECTRICITY, DYNAMOS, ACCUMULATOR, RHEOSTAT, TRANSFORMER, VARIETIES OF DYNAMOS, PARALLEL AND SERIES WIRING, THREE-WIRE SYSTEM, MANAGEMENT AND CARE OF ELECTRIC PLANT, REPAIRS, ELECTRICAL MEASUREMENTS, MOTORS, STATIONARY, TROLLEY AND THIRD RAIL SYSTEMS, CONTROLLER, ELECTRIC LOCOMOTIVE, ELECTRIC HEATING AND COOKING, HOUSE WIRING, DIFFERENTIAL GEAR, FRICTION CLUTCH, COMPOUND CYLINDERS, REVERSING GEAR, THE STACKER. ALSO, THE ELEMENTS OF ALGEBRA MADE EASY.

336 Pages. 240 Illustrations.

PRICE, $1.00. Sent anywhere prepaid on receipt of price.

ELECTRICIAN PUBLISHING COMPANY,
510 Marquette Bldg., Chicago.

Good Advice

No. 10

Direct Current Wattmeters are like watches in that some are good, some bad; some run fast, some slow; some are cheap, some more expensive, and some have a reputation in name only. Don't be misled into buying a cheap chronometer or cheap wattmeter, as both are sure to stop when you need them most. The person who wants an accurate watch must pay the price, and whoever wants a meter that is accurate on all loads all the time must buy a Duncan.

Good Advice No. 11 Next Week

Send for Bulletin and Prices

DUNCAN ELECTRIC MFG. CO.
LAFAYETTE, IND.

HENRY NEWGARD & CO.

ELECTRICAL CONSTRUCTION

Power and Light Plants. Switchboards and Panel Boards.

We install Municipal and Isolated Electric Lighting Plants
We manufacture Switchboards, Table boards, Iron Cutout Boxes and Electrical Specialties.
We sell Dynamos, Motors and Electrical Supplies.
We wire old as well as new Residences, Factory Buildings, School and College Buildings.

87 Fifth Avenue, Chicago, Illinois.

WIRES AND CABLES

HIGH-GRADE, RUBBER-COVERED, WEATHER-PROOF
MAGNET, OFFICE, ANNUNCIATOR WIRE.

HAZARD MANUFACTURING CO.,
GENERAL OFFICE AND WORKS, Wilkesbarre, Pa. NEW YORK OFFICE, 50 Dey St. CHICAGO OFFICE, 71 and 73 West Adams St

VULCANIZED FIBRE

Highest grades for electrical insulation and mechanical purposes, in sheets, tubes, rods and special shapes. Catalogues and samples on application.

VULCANIZED FIBRE CO., - Wilmington, Del.

KARTAVERT.

HARD AND FLEXIBLE FIBER IN SHEETS, RODS AND TUBING.

For Electrical and Mechanical Purposes, Railway Dust Guards, Washers and Packings. Patent Insulating Cleats.

MANUFACTURED BY

THE KARTAVERT MANUFACTURING CO. Wilmington, Del.

DIRECT CURRENT

MOTORS

THE ADAPTATION of our motors to mechanical drive is practically universal, and their service is unequaled.

Write for Bulletin No. 21814.

SPRAGUE
ELECTRIC COMPANY

General Offices:
527 West 34th Street, New York.

Chicago Office: Fisher Building.

POSITIVE IN ACTION
ECONOMICAL IN OPERATION
The
Sturtevant System
of
HEATING AND VENTILATION

Forced circulation of air by means of a fan. A centralized plant. Operation independent of weather. Exhaust steam utilized.

B. F. STURTEVANT CO.

Boston, Massachusetts

General Office and Works, Hyde Park, Mass.

New York Philadelphia Chicago London

364

Warren
Alternator

In the WARREN ALTERNATOR everything possible has been done for reliability, durability, ease of management and efficiency, everything to avoid burnouts, repairs and excessive cost of operation. The machine is pleasing in appearance because of good proportions, is massive, strong, of the highest grade of workmanship and impresses a thoughtful person with its solidity and special adaptation to the most severe constant and exacting service, a machine constructed for the one sole purpose of EARNING MONEY WITH, AND NOT TO SPEND MONEY UPON

WE GUARANTEE WHAT WE SELL and SELL WHAT WE GUARANTEE

WARREN ELECTRIC MFG. CO.

Sandusky, O.

Black Diamond File Works

Est. 1863. Inc. 1895.

Twelve Medals Awarded at International Expositions

Special Prize Gold Medal at Atlanta, 1895.

OUR GOODS ARE ON SALE IN EVERY LEADING HARDWARE STORE IN THE UNITED STATES AND CANADA.

G. & H. BARNETT COMPANY,
PHILADELPHIA, PA.

JOHN A. ROEBLING'S SONS CO.

Insulated Wire of All Kinds

Bare Copper Wire

MAIN OFFICE AND WORKS **TRENTON, N. J.**

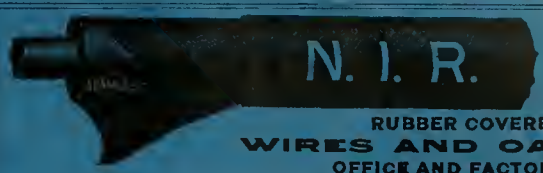
AGENCIES AND BRANCHES

New York Chicago Cleveland San Francisco Philadelphia

Western Electrician

Vol. XXXV. $3.00 Per Annum. Copyright, 1904, by Electrician Publishing Company, Chicago. CHICAGO, OCTOBER 8, 1904. Entered at Chicago Postoffice as mail matter of the second class. 10 Cents a Copy. No. 15.

SIMPLEX INSULATED WIRES AND CABLES.
RUBBER COVERED, WEATHERPROOF, UNDERGROUND AND SUBMARINE.
WESTERN SELLING AGENT: M. B. HIXSON, 112 Monadnock Block, CHICAGO.
The Simplex Electrical Co., 110 State Street, BOSTON, MASS.



National India Rubber Co.'s
RUBBER COVERED
WIRES AND CABLES.
OFFICE AND FACTORY: BRISTOL, R. I.

OKONITE
TRADE
1889—Paris Exposition, Medal for Rubber Insulation.
1893—World's Fair, Medal for Rubber Insulation.
THE STANDARD FOR RUBBER INSULATION.
Sole Manufacturers of
Okonite Wires, Okonite Tape, Manson Tape, Candee Weather-proof Wires.
THE OKONITE CO., LTD.
Willard L. Candee, W. Durant Cheever, } Managers. 253 Broadway, New York. Geo. T. Manson, Gen'l Supt. W. H. Hodgins, Secy.

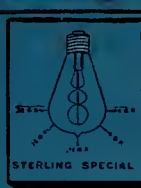
TRADE MARK
CRESCENT INSULATED WIRE & CABLE CO. TRENTON, N.J.
CRESCENT RUBBER INSULATED WIRES AND CABLES
National Code Standard.
CRESCENT INSULATED WIRE AND CABLE CO.,
New York Office, 83 BARCLAY STREET. Main Office and Factory, TRENTON, N. J.

SINGLE AND POLYPHASE
TRANSFORMERS
KUHLMAN ELECTRIC CO., - - Elkhart, Ind.

INDIANA RUBBER AND INSULATED WIRE CO.,
MANUFACTURERS OF
Paranite Rubber Covered Wires and Cables,
UNDERGROUND, AERIAL, SUBMARINE AND INSIDE USE.
TELEPHONE, TELEGRAPH AND FIRE ALARM CABLES.
All Wires are tested at Factory. JONESBORO, IND.

"CIRCULAR LOOM"
THE FLEXIBLE CONDUIT
AMERICAN CIRCULAR LOOM CO.
TRADE MARK
REGISTERED
CONDUITS FOR INTERIOR WIRING.
American Circular Loom Co.
Chelsea, Mass., New York, Chicago, San Francisco.

THOUSANDS IN USE.
Motors, ¼ h. p. to 100 h. p.
Dynamos, 1 k. w. to 75 k. w.
Highest Quality. Reasonable Prices.
THE HOBART ELECTRIC MFG. CO.
TROY, OHIO.


DO YOU?
BUY LAMPS—OR—BUY CANDLE POWER
16 { THIS LAMP / AVERAGES } 12
THE STERLING ELECTRICAL MANUFACTURING CO.
NEW YORK, N. Y. WARREN, O. CHICAGO, ILL.
STERLING SPECIAL

REGULAR TYPE

Controlling Devices
OF ALL KINDS
MOTOR STARTERS
SPEED REGULATORS
FIELD REGULATORS

Motor Starter with Automatic Release.
Manufactured under our own patents.
SEND FOR CATALOG
Union Electric Mfg. Co.
Milwaukee, Wis.

THERMOPILES 1½ VOLTS 1½ AMPERES
For Electrolytic analysis, charging storage batteries, and other constant current requirements. $3 Each.
WALSH'S SONS & CO.,
264 Washington Street. Newark, N. J.

W. D. PAINT.
A PERMANENT INSULATING PROTECTION FOR WOOD OR METAL.
A quick drying, moisture-proofing, black paint. An elastic anti-rust coating. A jet black finishing paint, efficient and not expensive.
Write for "Data on Insulating Materials."
DIELECTRIC MANUFACTURING CO., SAINT LOUIS.

"STAR" INCANDESCENT LAMPS

LONG LIFE
GUARANTEED CANDLEPOWER,
HIGHEST EFFICIENCY.
MADE BY THE MOST SKILLED WORKMEN.
STANDARD ELECTRICAL MFG. COMPANY, : Niles, Ohio.

EDISON PRIMARY BATTERIES FORMERLY EDISON LA LANDE
There is no deterioration in the permanent parts of these batteries. It follows, therefore, that each time a cell is recharged it will last as long a time and deliver as heavy a current as the original charge when the cell was first put into service. Our catalogue No. 7 will tell you more about this. Let us send it.
EDISON MANUFACTURING CO.,
TRADE Thomas A Edison MARK
Factory, ORANGE, N. J.
NEW YORK, 83 Chambers St.
CHICAGO, 304 Wabash Ave.

I-T-E
CIRCUIT BREAKERS
CUTTER ELECTRICAL CO., PHILADELPHIA

WESTON Electrical Instrument Co.,
Waverly Park, NEWARK, N. J.
Weston Standard Portable Direct Reading
Voltmeters, Millivoltmeters, Voltammeters, Ammeters, Milammeters,
Ground Detectors and Circuit Testers,
Ohmmeters, Portable Galvanometers,
Our Portable Instruments are recognized as The Standard the world over. The Semi-Portable Laboratory Standards are still better.
Our Station Voltmeters and Ammeters are unsurpassed in point of extreme accuracy and lowest consumption of energy.
BERLIN—European Weston Electrical Instrument Co., Ritterstrasse, No. 88.
LONDON—Elliott Bros., Century Works, Lewisham.
PARIS, FRANCE—E. H. Cadiot, 12 Rue St Georges
New York Office 74 Cortlandt St.

Weston Standard Portable Direct Reading Ammeter.

SOMETHING DOING IN A STORM
WITHOUT A

King of Protectors
Better Buy a
"TORNQUIST"
COMBINATION LIGHTNING ARRESTER GROUND SWITCH FUSE AND LEVER CUT-OUT.
THE ONLY SAFE PROTECTOR MADE. ORDER SAMPLE NOW.
Clinton Stamping & Electric Co.,
CLINTON, IA.
HART & CO., Chicago, General Agents.
BABY KNIFE SWITCHES
STAMPING AND PLATING.
SOLD BY ALL JOBBERS.

For Sale
"The Big Reliable"

5000 horsepower Allis-Chalmers Engine and Bullock Generator

Supplying Current for the

Famous Decorative Lighting

of the

WORLD'S FAIR, ST. LOUIS

attracting more attention and causing more favorable comment
than any other power unit in the world

Designed 1903 Shipped from our Works January 1904—37 Carloads

RECORD

First Operated April 20th, 1904

Ran non-condensing several weeks while Exposition Authorities were making their condenser connections. During that time carried 4900 horsepower night after night

When other plants were out of commission, operated the Cascades—2000 horsepower—and supplied St. Louis Transit Co. with 3000 horsepower

Ever since Exposition Authorities finished their condenser connections the "Big Reliable" has carried 6500 horsepower night after night, running cool and steady, with only 12 inches vacuum in exhaust pipe at engine

Always ready; frequently called upon for extra service in emergencies; has never failed; has not cost a cent for repairs

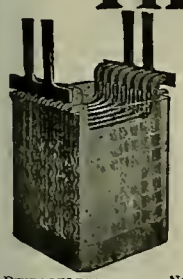
THE ENGINEERING TRIUMPH OF THE WORLD'S FAIR

For particulars address

Allis-Chalmers Co
CHICAGO

THE ELECTRIC STORAGE BATTERY CO.

PHILADELPHIA



MANUFACTURER OF THE

"Chloride Accumulator"

For Central Stations, Electric Railways, Isolated Lighting and Power Stations, Fire Alarm, Telegraph, Train Lighting, etc., etc.

PRICE LISTS AND DESCRIPTIVE BULLETINS FORWARDED UPON REQUEST.

SALES OFFICES:

PHILADELPHIA, Allegheny Ave. and 19th St. | NEW YORK, 100 Broadway, | BOSTON, 60 State St. | CHICAGO, Marquette Bldg. | ST. LOUIS, Wainwright Bldg. | SAN FRANCISCO, Rialto Bldg. | CLEVELAND, Citizens Bldg. | CANADA, Canadian General Electric Co., Ltd. Toronto | HAVANA, CUBA, G. F. Greenwood, Manager 34 Empedrado St.

Allen-Bradley Electric Crane Controllers

Patented

Front View—before starting

Rear View

Front View—all resistance out

Manufactured by AMERICAN ELECTRIC FUSE CO., Chicago

A New Controller. Positively No Sparking. No Repairs. Guaranteed for One Year. Three Months' Free Trial. Perfect Control.

OUR GUARANTEE: Ask any Other Manufacturer to Duplicate It.

THE AMERICAN ELECTRIC FUSE COMPANY hereby guarantees to..... that it will at any time within three months from this date upon demand repay to said..... the sum of..... .....Dollars, being the full purchase price paid (or agreed to be paid) by said..... to the American Electric Fuse Company for one..... horsepower Allen-Bradley Crane Controller, number.....upon delivery within three months after this date of said controller, freight prepaid and in good condition, ordinary wear and tear from use excepted, at the office of the American Electric Fuse Company, Chicago, Illinois, together with a written statement that said controller has proved unsatisfactory to said .....

FURTHERMORE, the said American Electric Fuse Company agrees that it will at any time within one year from this date replace, without charge, any part of said controller which may prove defective or wear out during the ordinary use of said controller, provided that it is a condition of this guarantee that said..... hereby agrees to use ordinary care in the operation of said controller, and that said controller will be operated by some person, or persons, familiar with the use of crane controllers, and further that said controller will not be wilfully or maliciously injured while in the possession of said.....

Engineering

MECHANICAL, ELECTRICAL, STEAM, CIVIL.

Complete and short courses. Thoroughly equipped engineering shops. **Shop work from the beginning.** Short courses in Steam and Electrical Engineering. Expenses low. Accommodations the best. School all year. Students may enter any time. Correspondence steam and electrical courses. Send for catalogue. Mention course in which interested.

HIGHLAND PARK COLLEGE, DES MOINES, IOWA.

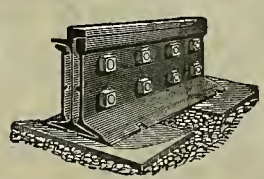
CONTINUOUS RAIL JOINT CO. OF AM.

GENERAL OFFICES: CENTURY BUILDING

NEWARK, N. J.

OVER 20,000 MILES IN USE

Highest Award at Paris Exposition, 1900, Buffalo, 1901



Electric Heating Apparatus

SEND FOR 32-PAGE CATALOGUE.

UNIT" ENAMELED RHEOSTATS

SIMPLEX ELECTRIC HEATING CO.,

Cambridgeport, Mass.

PLATINUM

PLATINUM RIVETS FOR CONTACT POINTS IN TELEPHONES—SPARK COILS AND OTHER ELECTRICAL APPARATUS. PLATINUM SHEET AND WIRE IN ANY FORM AND DEGREE OF HARDNESS. PLATINUM SCRAP PURCHASED.

BAKER & COMPANY, Inc.

ARTISANS IN PLATINUM

408-410-412-414 N. J. R. R. AVE. - NEWARK, N. J.

New York Office: 120 Liberty St.

ALPHABETICAL INDEX TO ADVERTISEMENTS.

Adams-Bagnall Electric Co.—
Allis-Chalmers Company..... 2
American Battery Co.....12
Amer. Circular Loom Co.... 1
American Conduit Co.....10
Amer. District Steam Co.....21
Amer. Elec. Fuse Co..... 3
Amer. El. Telephone Co.....19
American Electrical Works..13
Arnold Elec. Power Station Co.....15
Automatic Electric Co..... 18

Babcock & Wilcox Co.....—
Badt, F. B.....15
Bain, Forée.....13
Baker & Company..... 3
Baker & Co., W. E.....15
Barnett Company, G. & H....24
Beardslee Chandelier Mfg. Co.—
Benjamin Elec. Mfg Co.....—
Berthold & Jennings.....20
Big Four Route.....—
Bissell Co., The F.....12
Bossert Electric Construction Co..... 9
Brooks, Hall L.....20
Brown Corliss Engine Co....22
Bryan-Marsh Co.....—
Bryan, Wm. H.....15
Buchanan, R. G.....20
Buckeye Electric Co..... 7
Bullock Elec. Mfg. Co..... 2
Butterfield, J. F.....15
Byllesby & Co., H. M.....15

Cantwell Press, The.....—
Central Electric Co..... 5
Cent. Stat. Improvement Co..14
Central Tel. & El. Co.....18
Century Electric Co.....19
Chicago Dia & Electric Co.....—
Chicago Edison Co.....4, 14
Chic. Fuse Wire & Mfg. Co...13
Chicago Insulated Wire Co..—
Chicago Mica Co.....12
Clinton Stamping & Elec Co. 1
Columbia Incand. Lamp Co.. 8
Columbia Mfg. Co.....20
Continuous Rail Joint Company of America..... 3, 15
Cope, T. J.....12
Crawfordsville Electric Co..--
Crescent Ins. Wire & Cbl. Co. 1
Crocker-Wheeler Company...17
Cutler-Hammer Mfg. Co.....10
Cutter Elec. & Mfg. Company 1

D. & W. Fuse Company.....—
Dearborn Drug & Chem. Wks.16
Diamond Meter Company....20
Dielectric Manufacturing Co. 1
Directory of Engineers..... 15
Dixon Crucible Co., Joseph..16
Duncan Elec. Mfg. Co.....23
Dyar, H. W.....—

Edison Decorative & Miniature Lamp Departm't.....12
Edison Mfg. Company..... 1
Edwards & Co.....13
Egan, J. J.....13
Electric Appliance Co..... 12
Electric Storage Battery Co.. 3
Electrical Appliance Co.....—
Electrical Engineer Institute.—
Electrician Pub. Company...17
Erie Ry.....20
Evans, Almirall & Co..... 15

Faries Mfg. Co.....21
"For Sale" Advertisements..14
Ft. Wayne Elec. Works, Inc..23
Fostoria Incand. Lamp Co...—
Fowler, John H.....20
Fowler-Jacobs Company.....20
Franklin Elec. Mfg. Co .....--

General Electric Co..... 9
General Engineering Co., The 15
General Incandescent Arc Light Company.....—
General Incand. Lamp Co.....—
Glogau & Co. H. M.....—
Gould Storage Battery Co....11
Green Fuel Economizer Co..16
Gregory Electric Company...14

Hallberg, J. H 15
Hafler Machine Co.....—
Hart Mfg. Co.....18
Hartford Steam Boiler Inspection & Insurance Co....—
Hartford Time Switch Co.....—
Hazard Manufacturing Co...—
Hermann Mfg Co..... 6
Highland Park College. ... 3
Hipwell Mfg. Co..... 14
Hobart Elec. Mfg. Co..... 1
Hoffman, G. W.....14
Holmes Fibre-Graph. Co.....—
Holophane Glass Co.....24
Holzday & Co., J. P.....15
Humphrey, Henry H.....—
Hunt & Co., Robt. W.....15

Illinois Central Ry.....14
Incandescent Electric Light Manipulator Company.....—
Indiana Rub. & Ins. W. Co.... 1
India Rubber & Gutta Percha Insulating Company.....—
International Elec. Meter Co 14
International Tel. Mfg. Co...19

Jackson, D. C. & W. B.....15
Jeffrey Manufacturing Co....16
Jewell Electrical Inst. Co.....—
Johns-Manville Co., H. W.... 4

Kartavert Manufacturing Co.--
Kellogg Switchboard & Supply Company.....19, 20
Kemp, R. W.....15
Kester Elec. Mfg. Co.....18
Klein & Sons, Mathias..... .. 18
Kohler Brothers.....15
Kuhlman Electric Co..... 1

Leather Preserv. M. Corp....15
Leffel & Co., James.....16
Lindsley Brothers Company..21
Loud's Sons Co., H. M.....—

Machado & Roller .....—
Maltby Cedar Company.....21
Manhattan El. Supply Co....13
Manross, F. N. ... .—
Marinette Gas Engine Co.....16
Matthews & Bros., W. N.....13
McLaughlin, James.... 15
McLaughlin & Co., Jas.....13
McLennan & Company, K....12
Mechanical Appliance Co....21
Mica Insulator Company.....—
Minnesota Electric Co.....—
Miscellaneous Advs.....14
Monon Railroad..... 18
Moon Mfg. Co., The.....—
Morrison Lbr. Co., J. W.....20
Mueller Company, William..20
Munsell & Co., Eugene..... 12

National Electric Co.....23
National India Rubber Co.... 1
New England Butt Co.....16
Newgard & Co., Henry..... 9
New York Cent. Ry.....20
New York Ins. Wire Co.....13
Northern Elect'l Mfg. Co....12
Northwestern Storage Battery Co.. 10

Okonite Co., The..... 1
Olds Gasoline Engine Works.16

Pacific Coast Pole Co.....21
Page & Hill Co.....20
Paragon Fan & Motor Co.....—
Pardridge Shade & Refl. Co..—
Pass & Seymour, Inc..... 4
Phelan, D. W.....21
Phillips, Eugene F.....13
Phillips Insulated Wire Co...13
Phœnix Glass Co. .....—
Phosphor-Bronze S. Co.....16
Pignolet, L. M.....12
Pittsburg & L. S. Iron Co....21
Plume & Atwood Mfg. Co....24
Porter Cedar Company.....21

Reisinger, Hugo..... 9
Reynolds El. Flasher Mfg. Co.12
Roebling's Sons Co., J. A.....24
Ruebel-Schwedtman-Wells..15
Runzel-Lenz Elec. Mfg. Co...—

Safety Ins. Wire & Cable Co..24
Sargent & Lundy.....—
Sauquoit Silk Mfg. Co.....18
Schott, W. H.....15
Sears, Roebuck & Co.....18
Simplex Electrical Co., The.. 1
Simplex Elec. Heating Co.... 3
Speer Carbon Co..... .—
Sprague Electric Company...10
Squire Electric Co.....15
Standard Elec. Mfg. Co..... 1
Standard Underg. Cable Co... .—
Stanley Elec. Mfg. Co., The 10
Stanley Instrument Co..... 4
Stanton, LeRoy W..... 15
Sterling & Son, W. C.....21
Sterling Electrical Mfg. Co.... 1
Sterling Varnish Co., The.... 4
Stow Mfg. Company.....—
Stromberg-Carlson Tel. Mfg. Company.....19
Sturtevant Company, B. F...24

Torrey Cedar Company.....21
Trumbull Elec. Mnfg. Co..... 5
Turner Brass Works..... 6

Union Electric Mfg. Co..... 1

Valentine-Clark Co., The....—
Vulcanized Fibre Company..24

Wabash R. R.....14
Wagner Electric Mfg. Co.....22
Walsh's Sons & Company..... 1
Warren Elec. Mfg. Co.....12
Wesco Supply Co.....12
Western Electric Company... 5
Western El. Supply Co.....—
Westinghouse Electric & Manufacturing Co.....—
Westoo Electrical Inst. Co... 1
Whitehead Machinery Co.... 14
Whitney Electrical Inst. Co.—
Wilmerding, C. H.....—
Wisconsin Central Ry.....20
Woolley Fdy. & Mach. Wks..16
Worcester Company, C. H....20

Yesbera Mfg. Co..... .. 18
Yost Electric Mfg. Co 9

Zero Marx Sign Works 13

For Classified Index of Advertisements See Page 6.

Motors,
Switches,
Arc Lamps,
Circuit Breakers, Etc., Etc.

ALWAYS IN STOCK.

MANUFACTURED BY

G. E. Co.

CHICAGO EDISON COMPANY, 139 Adams Street. CHICAGO.

AFFORD ABSOLUTE SAFETY AS PROTECTIVE DEVICES
AND
FREEDOM FROM ALL
FIRE HAZARD

ASK YOUR SUPPLY DEALER FOR
"NOARK"

New York
Milwaukee
Chicago
St. Louis
Boston
Philadelphia

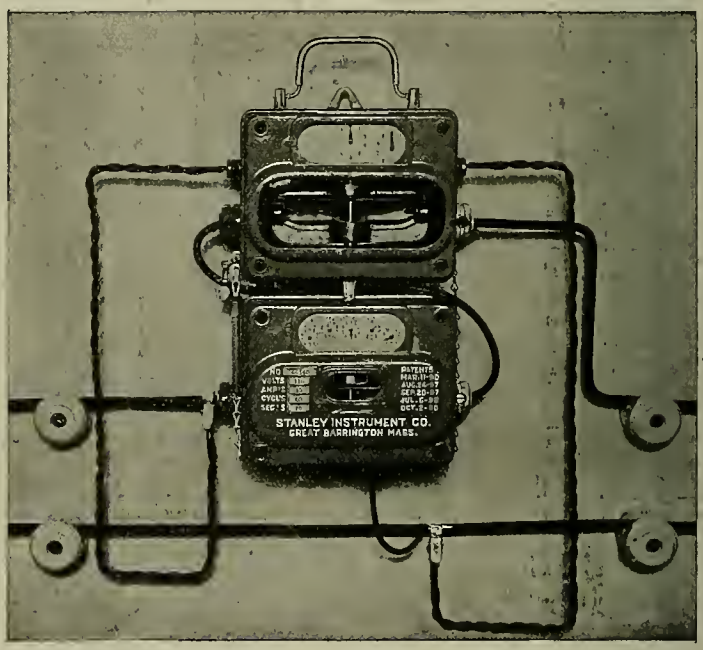
H. W. JOHNS-MANVILLE CO.
100 William St., New York

Pittsburg
Cleveland
New Orleans
London
Paris
Brussels

Sterling Black Plastic Insulator.

One hundred days' continuous baking at 180° F. will not make it brittle. Water repellent. Oil proof.

THE STERLING VARNISH CO., - - Pittsburg, Pa.

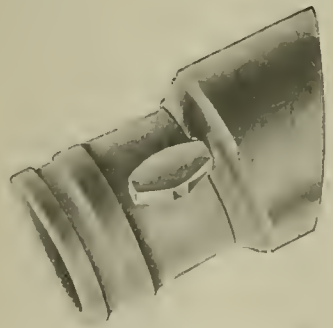


TESTING WATTMETER

ACCURATE TESTS
in a few minutes, anywhere, by one man alone without regulation of VOLTAGE, LOAD OR FREQUENCY

STANLEY INSTRUMENT CO.
GREAT BARRINGTON, MASS.

Key Keyless



Patented Sept. 8, 1896; Oct. 6, 1896.
Edison
T. H. W. H. NEW YORK

P. & S.
Porcelain Angle Sockets

Designed especially for show window work, and may be used in open or concealed wiring.

PASS & SEYMOUR, Inc.
SOLVAY, N. Y.
CHICAGO SAN FRANCISCO

DON'T BE CONTENTED

TYPE C INDICATING FUSE BEFORE BLOWING

TYPE C INDICATING FUSE AFTER BLOWING

With trusting your property to the care of an open fuse, send for our bulletins on

D. & W. SAFETY DEVICES

OKONITE — IT NEVER DISAPPOINTS

Central Electric Company,

SALES AGENTS
264-266-268-270 FIFTH AVENUE, CHICAGO

OKONITE — IT NEVER DISAPPOINTS

"ELECTROSE"

OVERHEAD LINE MATERIAL

A COMPLETE LINE OF "ELECTROSE" OVERHEAD LINE MATERIAL CAN BE FOUND AT OUR EXHIBIT—
SPACE 17, ELECTRICITY BUILDING,
LOUISIANA PURCHASE EXPOSITION

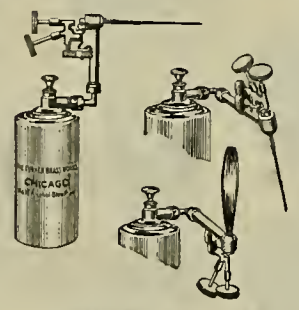
WESTERN ELECTRIC COMPANY

CHICAGO NEW YORK

OTHER LEADING CITIES

Hemmm-
MFG. CO.
ELECTRIC
SIGNS and LETTERS
OF EVERY DESCRIPTION
We furnish the best signs at the cheapest price. WRITE US.
339-343 Larrabee Street - - CHICAGO

SEE THAT FLAME



IT'S JUST WHAT YOU NEED
for fine soldering for internal wiring and switchboard work, storage battery, lead burning, etc.

The Turner Double Jet Alcohol Blow Pipe No. 10.
Burns wood alcohol and produces a clean non-oxidizing needle pointed or a brush flame of over 3,000 degrees of heat. The burner can be turned in any position. Reservoir 2½ x 5 inches. Capacity ¾ pint. Shipping weight 2 lbs.

No. 10 Alcohol Blow Pipe, $4.50 each.
Express prepaid upon receipt of cash.
DISCOUNT TO DEALERS.

THE Turner Brass Works
23 N. FRANKLIN ST., CHICAGO

CLASSIFIED INDEX OF ADVERTISEMENTS.

Adjusters, Cord.
Incandes. El. Lt. Manip. Co.

Adjusters, Inc. Lamps.
Inc. El. Lt. Manipulator Co.

Anchors (Tel. & Tel.)
Matthews & Bro., W. N.

Annunciators.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Mooo Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Batteries and Jars.
Bissell Co., The F.
Central Electric Co.
Edison Mfg. Co.
Edwards & Company.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Bells, Buzzers, Etc.
Central Electric Co.
Edwards & Co.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Belt Dressing.
Dixon Crucible Co., Jos.
Leather Preserver Mfg. Corp.

Belting.
Leather Preserver Mfg. Corp

Blow Pipes.
Turner Brass Works

Blowers.
Sturtevant Co., B. F.

Boiler Compounds.
Dearborn Drug & Chem Wks.

Boilers.
Allis-Chalmers Company.
Babcock & Wilcox Co.

Books, Electrical.
Cantwell Press, The.
Electrician Publishing Co.

Booths, Telephone.
Yesbera Mfg. Co.

Brackets.
Faries Mfg. Co.

Brushes.
Central Electric Co.
Hobart Elec. Mfg. Co.
Holmes Fibre-Graphite Co.
Speer Carbon Co.
Western Electric Company.

Cable Hangers.
Bissell Co., B. F.
Western Electric Co.

Cables (See Wires and Cables)

Canopies.
Faries Mfg. Co.

Carbons, Points and Plates.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
Reisinger, Hugo.
Speer Carbon Co.
Wesco Supply Co.
Western Elec. Supply Co.

Castings.
Faries Mfg. Co.
New England Butt Co.
National Electric Co.

Chains.
Jeffrey Mfg. Co.

Chandeliers.
Faries Mfg. Co.

Circuit Breakers.
Cutler-Hammer Mfg. Co.
Cutter Elec. & Mfg. Co.
Ft. Wayne Elec. Wks. Inc.
Union Electric Mfg. Co.
Western Electric Company.
Westinghouse El. & Mfg. Co.

Clusters.
Benjamin Elec. Mfg. Co.
Faries Mfg. Co.

Coal and Ashes Handling Machinery.
Jeffrey Mfg. Co.

Coils and Magnets.
Western Electric Co.

Commutator Compound
Egan, J. J.
McLaughlin & Co., Jas.
McLennan & Co., K.

Condensers, Electric.
Stanley Elec. Mfg. Co

Conduit and Conduits.
American Circular Loom Co.
American Conduit Company
Central Electric Co.
Electric Appliance Co.
Sprague Electric Co.
Standard Vitrified Cond. Co.
Wesco Supply Co.
Western Electrical Supply Co.

Contractors and Electric Light Plants.
Allis-Chalmers Company.
Bullock El. Mfg. Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
National Electric Co.
Northern Electrical Mfg. Co.
Sprague Electric Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Controllers, Crane.
Amer. Elec. Fuse Co.

Cord.
Rnozel-Lenz Elec. Mfg. Co

Cross-Arms, Pins and Brackets.
Berthold & Jennings.
Central Electric Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Company.
Western Elec. Supply Co.

Cut-Outs and Switches.
Bissell Co., The F.
Bossert Elec. Const. Co.
Central Electric Co.
Chicago Edison Co.
Clinton Stamping & Elec. Co.
Crouse-Hinds Co.
Cutter Elec. & Mfg. Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
General Inc. Arc Light Co.
Hart Manufacturing Co.
Manhattan Elec. Supply Co.
Trumbull Elec. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Dynamos and Motors.
Allis-Chalmers Company.
Bissell Co., The F.
Bullock Elec. Mfg. Co.
Central Electric Co.
Century Electric Co.
Crawfordsville Electric Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks. Inc.
General Elec. Co.
General Inc. Arc Light Co.
Gregory Electric Co.
Hobart Elec. Mfg. Co.
Mechanical Appliance Co.
National Electric Co.
Northern Electrical Mfg. Co.
Sprague Electric Co.
Stanley Elec. Mfg. Co.
Stow Manufacturing Co.
Sturtevant Co., B. F.
Wagner Electric Mfg. Co.
Warren Elec. Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Economizers, Fuel.
Green Fuel Economizer Co.

Electric Heating Appl.
Simplex Elec. Heating Co.
Western Electric Co.

Electric Railways.
Crocker-Wheeler Co.
General Electric Co.
Sprague Electric Co.
Westinghouse El. & Mfg. Co.

Electrical and Mechanical Engineers.
Arnold Elec. Power Stat'n Co.
Badt, F. B.
Baker & Co., W. F.
Bryan, Wm. B.
Butterfield, J. F.
Bylleshy & Co., H. M.
Evans, Almirall & Co.
General Engineering Co., The.
Hallberg, J. H.
Hornaday, J. P. & Co.
Humphrey, Henry B.
Hunt & Co., Robt. W.
Jackson, D. C. & W. B
Kemp, R. W.
Kohler Brothers.
McLaughlin, James
Newgard & Co., Henry.
Northern Electrical Mfg. Co.
Ruebel, Schwedtman, Wells.
Sargent & Lundy.
Schott, W. H.
Squire Electric Co.
Stanley Elec. Mfg. Co.
Stanton, LeRoy W.
Wilmerding, C. B.

Electrical Instruments.
(Recording and Testing.)
Bissell Co., The F.
Central Electric Co.
Diamond Meter Co.
Duncan Elec. Mfg. Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
General Inc. Arc Light Co.
Jewell Electrical Inst. Co.
Machado & Roller.
Pignolet, L. M.
Stanley Elec. Mfg. Co.
Stanley Instrument Co.
Wagner Electric Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co
Weston Electrical Inst. Co.
Whitney Electl. Inst. Co.

Electro-Plating Mach'y
Crocker-Wheeler Company.
General Electric Co.

Elevators-Conveyors.
Jeffrey Mfg. Co.

Engines, Gas and Gasoline.
Allis-Chalmers Company.
Marinette Gas Engine Co.
Olds Gasoline Engine Works.
Woolley Fdy. & Mach. Wks.

Engines, Steam.
Allis-Chalmers Company.
Brown Corliss Engine Co.
Sturtevant Co., B. F.

Fans and Fan Motors.
Central Electric Co.
Crocker-Wheeler Company.
Edison Mfg. Co.
General Electric Co.
General Inc. Arc Light Co.
Sprague Electric Co.
Sturtevant Co., B. F.
Wesco Supply Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Fibre.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Files.
Barnett Co., G. & H.

Fittings.
Furles Mfg. Co.

Fixtures, Gas and Elec.
Beardslee Chandelier Mfg. Co.

Finishers.
Bissell Co., The F.
Haller Machine Co.
Reynolds El. Flasher Mfg. Co

Flexible Shafts.
Stow Mfg. Co.

Forges.
Sturtevant Co., B. F.

Fuses and Fuse Wire.
Amer. Elec. Fuse Co.
Bissell Co., The F.
Central Electric Co.
Central Tel. & El. Co.
Chicago Die & Electric Co.
Chicago Fuse Wire & Mfg. Co.
Clinton Stamping & Elec. Co.
D. & W. Fuse Company.
Electric Appliance Co.
Johns-Manville Co., H. W.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Company.
Western Elect. Supply Co.

Globes, Reflectors and Shades.
Fostoria Incan. Lamp Co.
Haller Machine Co.
Bolophane Glass Co.
Pardridge Shade & Refl. Co.
Phœnix Glass Co.
Wesco Supply Co.
Western Electric Co.
Western Elect. Supply Co.

Graphite Specialties.
Dixon Crucible Co., Jos.
Holmes Fibre-Graphite Co

Heating (Exhaust Steam).
Amer. District Steam Co.

Heating and Ventilating Apparatus.
Sturtevant Co., B. F.

Heating, Hot Water.
Evans, Almirall & Co.

Holders, Inc. Lamps.
Incandescent Electric Light Manipulator Co.

Inspection & Insurance
Hartford Steam Boiler Inspection & Insurance Co.

Insulating Machinery.
New England Butt Co.

Insulators and Insulating Materials.
American Electrical Works.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Inc. Arc Light Co.
Indiana Rub. & Ins. Wire Co.
Johns-Manville Co., H. W.
Kartavert Mfg. Co.
Manhattan Elec. Supply Co.
Mica Insulator Co.
Munsell & Co., Eugene.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Standard Vitrified Cond. Co.
Sterling Varnish Co.
Vulcanized Fibre Co.
Wesco Supply Co.
Western Electric Co.
Western Elect. Supply Co.
Westinghouse El. & Mfg. Co.

Junction Boxes.
Bossert Elect. Const. Co.
General Inc. Arc Light Co.

Lamps, Arc.
Bissell Co., The F.
Central Electric Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
General Inc. Arc Lt. Co.
Gregory Electric Co.
Hilpwell Manufacturing Co
Manhattan Elec. Supply Co.
Stanley Elec. Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co.

Lamps, Incandescent.
Bissell Co., The F.
Bryan-Marsh Company.
Buckeye Electric Company.
Central Electric Co.
Chicago Edison Co.
Columbia Incan. Lamp Co.
Edison Decorative & Miniature Lamp Dept.
Electric Appliance Co.
Fostoria Incand. Lamp Co.
Franklin Electric Mfg. Co.
General Electric Co.
General Inc. Arc Light Co.
Standard Elec'l Mfg Co.
Sterling Electrical Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Lamps, Incandescent—Replacers & Cleaners.
Inc. El. Lt. Manipulator Co.

Letters, Metal.
Haller Machine Co.

Lightning Arresters.
Central Electric Co.
Clinton Stamping & Elec. Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
Manhattan Elec. Supply Co.
Minnesota Electric Co.
Stanley Elec. Mfg. Co.
Western Electric Co.

Lights, Show.
Glogau & Co., H. M.

Linemen's Climbers.
Klein & Sons, Mathias.

Magnet Wires.
(See Wires and Cables.)

Mechanical Draft.
Sturtevant Co., B. F.

Mica.
Chicago Mica Co.
Mica Insulator Co.
Munsell & Co., Eugene.

Mining Apparatus, Elec.
Allis-Chalmers Company.
Crocker-Wheeler Company.
General Electric Co.
Jeffrey Mfg. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Motors. (See Dynamos and Motors.)

Nippers and Pliers.
Klein & Sons, Mathias.

Nozzles.
Faries Mfg. Co.

Paints.
Dielectric Mfg. Co.

Patent Attorneys.
Bain, Foree.

Phosphor Bronze.
Phosphor Bronze Sm. Co. Ltd.

Platinum, Wire and Sheet.
Baker & Company Inc.

Poles and Ties.
Berthold & Jennings.
Brooks, Ball L.
Buchanan, R. G.
Columbia Mfg. Co.
Fowler, John H.
Fowler-Jacobs Company.
Kellogg Switch. & Sup. Co.
Lindsley Bros. Co.
Loud's Sons Co., B. M.
Maltby Cedar Co.
Morrison Lbr. Co., J. W.
Mueller Company, William.
Pacific Coast Pole Co.
Page & Hill Company.
Phelan, D. W.
Pittsburg & L. S. Iron Co.
Porter Cedar Company.
Sterling & Son, W. C.
Torrey Cedar Co.
Valentine-Clark Co., The.
Worcester Co., C. H.

Polish (Metal).
Allen Co., Inc., L. B.
Hoffman, Geo. W.

Portables.
Faries Mfg. Co.

Power Transmission Machinery.
Jeffrey Mfg. Co.

Rail Joints.
Continuous Rail Joint Company of America.

Rectifiers.
Electrical Appliance Co.

Refiners.
Gt. West Smelt. & Refining Co

Re-Winding—Repairs.
Chicago Edison Co.
Gregory Electric Co.

Rheostats.
Cutler-Hammer Mfg. Co.
General Electric Co.
Gen'l Inc. Arc Lt. Co.
Union Electric Mfg. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Rods, Conduit.
Cope, T. J.

Safes.
Sears, Roebuck & Co.

Schools and Colleges.
Electrical Engineer Inst.
Highland Park College

Second-Hand Mach'y.
Bissell Co., The F.
Cent. Stat. Improvement Co.
Dyar, H. W.
Gregory Electric Co.
Matthews & Bro., W. N.
Walsh's Sons & Co.

Shades, Lamp.
Faries Mfg. Co.

Sheet Brass & Copper.
Plume & Atwood Mfg. Co.

Signs, Electric.
Haller Machine Co.
Hermann Mfg. Co.
Zero Marx Sign Works.

Silks, Insulating & Braiding.
Sauquoit Silk Mfg. Co.

Sockets & Receptacles.
Pass & Seymour.
Yost Elec. Mfg. Co.

Soldering Sticks, Salts and Paste.
Allen Co., L. B.
Crescent Co.
Kester Elec. Mfg. Co.
Western Electric Co.

Speaking Tubes.
Central Electric Co.
Edwards & Co.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Specialties, Electrical Mfrs. and Designers.
Haller Machine Co.

Speed Indicators.
Weston Electrical Inst. Co.

Storage Batteries.
American Battery Co.
Electric Storage Battery Co.
Gould Storage Battery Co.

Supplies, General Elec.
Bissell Co., The F.
Central Electric Co.
Century Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Electric Co.
Manhattan Elect'l Supply Co
Wesco Supply Co.
Western Electric Co.
Western Elect. Supply Co.

Switchboards.
Bissell Co., The F.
Crouse-Hinds Co.
Gen. Incan. Arc Light Co.

Telephones, Telephone Material and Switchboards.
American El. Telephone Co
Automatic Electric Co.
Bissell Co., The F.
Central Electric Co.
Central Tel. & El. Co.
International Tel. Mfg. Co.
Kellogg Switchb. & Sup. Co.
Manhattan Elec. Supply Co.
Mooo Mfg. Co., The.
Stromberg-Carlson Tel. M. Co
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.

Time Switches.
Bissell Co., The F.
Hartford Time Switch Co.

Tools.
Klein & Sons, Mathias.
Western Electric Co.

Transformers.
Central Electric Co.
Crawfordsville Electric Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Works, Inc.
General Electric Co.
Gregory Electric Co.
Kuhlman Electric Co.
Manhattan Elec. Supply Co.
National Electric Co.
Stanley Elec. Mfg. Co.
Wagner Electric Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Western Elec. Supply Co.
Westinghouse El. & Mfg. Co

Trucks, Electric Car.
General Electric Co.
Westinghouse El. & Mfg. Co.

Turbines, Steam.
Allis-Chalmers Co
General Electric Co.
Westinghouse El. & Mfg. Co

Turbine Water Wheels
Leffel & Co., Jas.

Varnishes.
Dielectric Mfg. Co
Sterling Varnish Co.

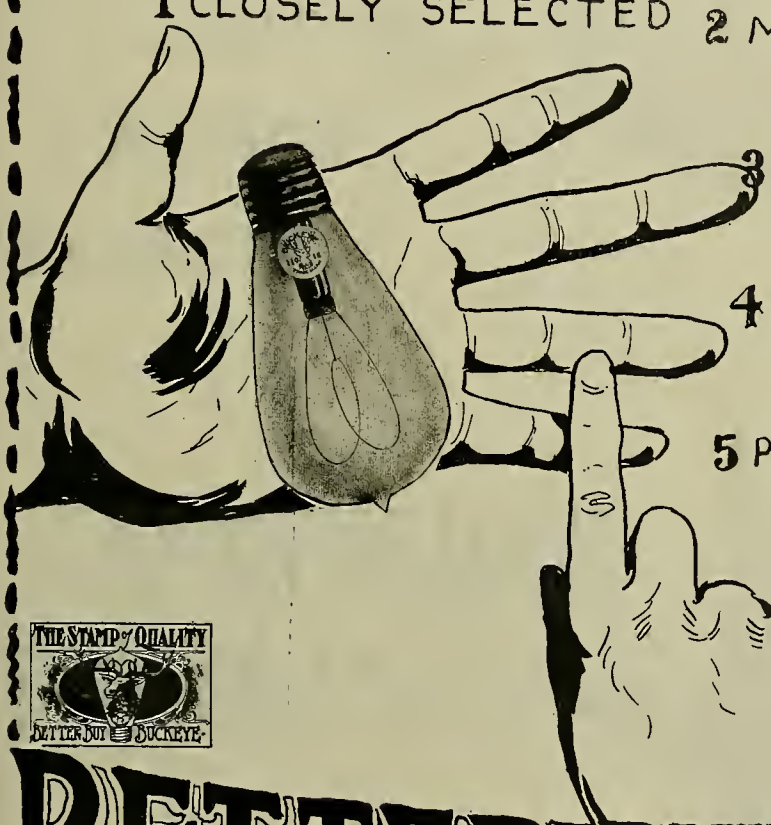
Vulcanized Fibre.
Vulcanized Fibre Co.

Whistles, Electric.
Electrical Appliance Co.

Wires & Cables—Magnet Wires.
American Electrical Works.
Bissell Co., The F.
Central Electric Co.
Chicago Insulated Wire Co.
Crescent Ins. Wire & Cble. Co.
Electric Appliance Co.
General Electric Co.
Hazard Manufacturing Co.
Indiana Rub. & Ins. Wire Co
India Rubber & Gutta Percha Insulating Co.
Kellogg Switch. & Sup. Co.
Manhattan Elec. Supply Co.
National India Rubber Co
New York Insulated Wire Co.
Okonite Co., The.
Phillips, Eugene F.
Phillips Insulated Wire Co
Roebling's Sons Co., J. A.
Runzel-Lenz Elec. Mfg. Co.
Safety Ins. Wire & Cable Co.
Simplex Electrical Co.
Standard Underground C. Co
Wesco Supply Co.
Western Electric Company.
Western Elec. Supply Co.

For Alphabetical Index of Advertisements See Page 3.

SOME REASONS WHY



1 CLOSELY SELECTED

2 MECHANICALLY PERFECT

3 LONGEST MAINTAINANCE OF USFFUL CANDLE POWER

4 ELECTRICALLY PERFECT

5 PROMPT DELIVERIES.

BETTER BUY BUCKEYE

31 RIGID INSPECTIONS

LICENSED UNDER
Patent 537,693, April 16, 1895.
Patent 726,293, April 28, 1903.
Patent 444,530, January 13, 1891.
Patent 532,760, January 22, 1895.

Buckeye Electric Company

SALES OFFICE AND FACTORY

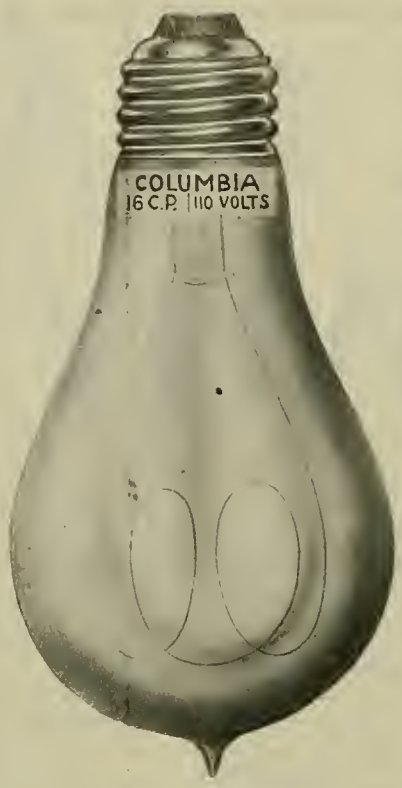
CLEVELAND, - - OHIO

CHICAGO OFFICE, 1537 Monadnock

PITTSBURG OFFICE, 1102 Empire Bldg.

ABOUT THAT TIP

(MEASUREMENT)



AND A FEW OTHER MINOR POINTS

ON "COLUMBIA" LAMPS

Send for our Booklet, a Wallet Full of Wisdom.

AS MUCH LIGHT HORIZONTALLY as any other lamp.

10% MORE LIGHT THAN any OTHER LAMP BELOW the HORIZONTAL.

40% MORE LIGHT AT TIP than any oval anchor lamp.

NO increase of current consumption per lamp to get this in the Columbia.

Send for our Catalogue of Crystal Lamps (Meridian Type).

Columbia Lamps are manufactured under a License to use the Chemical Exhaust Process of exhau ting lamps. This process is vitally necessary in the production of the highest quality of lamp. Every package of Columbia Lamps carries a label reading.

Licensed Under
Patent No. 537,693, April 16, '95
Patent No. 726,293. April 28, '03
Patent No. 444,530, Jan. 13, '91
Patent No. 532,760, Jan. 22, '95

The Columbia Incandescent Lamp Co.

2115-17-19 Locust St., ST. LOUIS, MO.

New York Office, 1311 Havemeyer Bldg. Chicago, Central Electric Co.
San Francisco, Paul Seiler Electric Works. Philadelphia, 1227 Real Estate Trust Bldg.
Memphis, Tenn., 35 Equitable Bldg. Minneapolis, 638 Boston Block.
Mexico, Monterey, Van Veorhis Hnos.

It Will Interest You to Know What the **Western Electric Company** Have to Say Regarding

HIGHEST GRADE NUERNBERG CARBONS

in their circular, dated November 23, 1903, which in part reads as follows:

"The Western Electric Company have made an exhaustive test of carbons of all kinds and have found that the 'ELECTRA' Carbons cannot be equaled in quality or efficiency, produce practically no dust and give an excellent and steady light. They produce the highest standard of candlepower in proportion to the current consumed, and are the most economical carbons manufactured."

HUGO REISINGER, Sole Importer, 11 Broadway, NEW YORK CITY.

YOST SPECIALTIES.

Sockets, Wall Sockets, Weatherproof Sockets, Rosettes, Receptacles, Cord Adjusters.

Catalogue for the asking.

THE YOST ELECTRIC MFG. CO.
TOLEDO, OHIO.

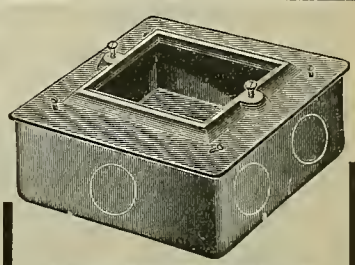
HENRY NEWGARD & CO.

ELECTRICAL CONSTRUCTION

Power and Light Plants. Switchboards and Panel Boards.

We install Municipal and Isolated Electric Lighting Plants.
We manufacture Switchboards, Table boards, Iron Cutout Boxes and Electrical Specialties.
We sell Dynamos, Motors and Electrical Supplies.
We wire old as well as new Residences, Factory Buildings, School and College Buildings.

87 Fifth Avenue, Chicago, Illinois.



INDESTRUCTIBLE DRAWN STEEL OUTLET BOXES

Drawn from one piece of sheet steel—fire and nail proof—outlets with hermetically sealed plugs that leave a clean hole exact size of conduit—thoroughly coated with insulating enamel. Box No. 1900 has side outlets for gas and electric bracket, two openings for gas pipes and thirteen plugged outlets for electric conduits. Write for bulletin No 1000

Bossert Electric Construction Co.
UTICA, N. Y.

General Electric Company

THOMSON HIGH TORQUE METER

For Alternating Current Circuits

High Torque

Light Moving Element

High Ratio of Torque to Weight

(Write for Bulletin)

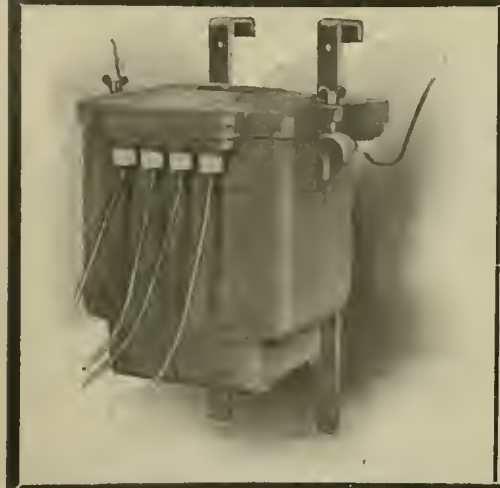
Small, Compact

Simple Adjustment

Reads Direct in Kilowatt Hours

Principal Offices: SCHENECTADY, N. Y.

Chicago Office: Monadnock Block. **Sales offices in all large cities.**



THE B. O. TRANSFORMER

Do you expect to need new transformers this fall? If you do, the B. O. will interest you.

Low Losses
High Efficiencies
High Insulation
Low Price.

Are you familiar with oil duct transformers?
Send us your address and we will tell you about our insulation and the advantages of slab windings in connection with oil ducts.

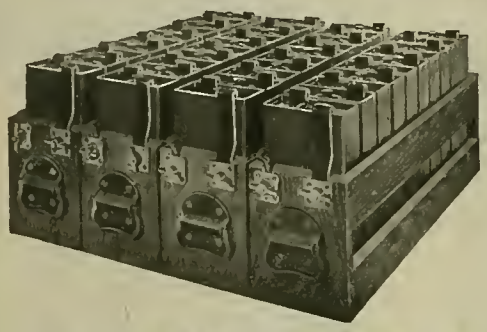
THE STANLEY ELECTRIC MANUFACTURING COMPANY
PITTSFIELD, MASSACHUSETTS

Atlanta, Ga., Empire Building
CHICAGO, ILL., MONADNOCK BLOCK
New York, N. Y., 29 Broadway
St. Louis, Mo., Century Bldg.
Boston, Mass., Oliver Building
Denver, Col., Hendrie & Bolthoff Mfg. & Supply Co.
Philadelphia, Pa., North American Building
San Francisco, Cal., 69-75 New Montgomery St.
Seattle, Wash., Pioneer Bldg.

Representatives for the Dominion of Canada, THE CANADIAN GENERAL ELECTRIC CO. of Toronto

"THE S. K. C. SYSTEM"

HIGH CLASS WORK



is assured when you use the

NORTHWESTERN STORAGE BATTERY

on all low-tension work.

Great Capacity, Light, Efficient and Compact.

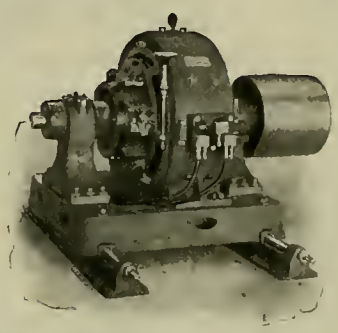
Send for catalogue. Let us figure with you.

Northwestern Storage Battery Co.,
285 Madison St., - - - Chicago, Ill.

DIRECT CURRENT

GENERATORS

FOR LIGHT AND POWER



Our generators have a high efficiency and great endurance under the most exacting conditions of service. Sizes up to 1,000 K. W.
Write for bulletin No. 10514.

SPRAGUE
ELECTRIC COMPANY

General Offices:
527 West 34th Street, New York
Chicago Office: Fisher Building

BITUMINIZED FIBER CONDUIT

FOR UNDERGROUND CONSTRUCTION

Combines the **good features** of other conduits.
Eliminates the **bad features** existing in many kinds.
Has valuable features not found in any other ducts.

Made in 7-foot lengths with male and female joints, making construction very rapid and simple, with consequent low cost.

Alignment is perfect and permanent without tedious care and skill required in laying of butt-joint conduits.

Users are astonished by the ease and rapidity with which cables can be drawn in, and this without the slightest scratching or injury to the lead covering thereof.

Made in sizes from 1-inch to 10-inch diameter.

Bends of any radius and any angle.

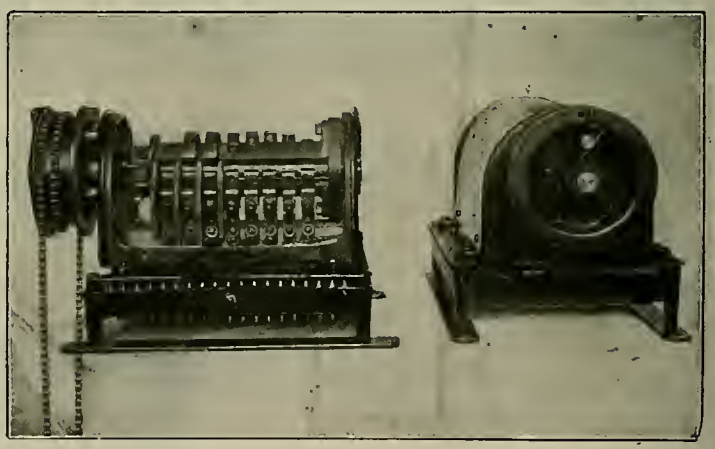
Write us for further information and prices, stating sizes and quantities required.

American Conduit Co.

Main Offices: 1005-6 Manhattan Building, Chicago

Other Offices:
170 Broadway, New York. 336 Macy St., Los Angeles

Rope-Operated, Reversible Drum Controller.



The ideal controller for small cranes and hoists where it is desired to operate from the floor.

Built to stand the most severe usage. Automatic return to "off" position when operator releases chain or rope.

Brushes and contacts are renewable and are made of hard drawn copper.

SPEED—Normal at full load to 50 per cent. at half load. Specially built for reduction of 90 per cent. regardless of load.

The Cutler-Hammer Mfg. Co.

MILWAUKEE, WIS.

New York Boston Chicago Pittsbur
g

We wish to extend a cordial invitation
to those attending the

American Street Railway Association

CONVENTION

to inspect our exhibit at

SECTION SIXTEEN

PALACE OF ELECTRICITY ST. LOUIS EXPOSITION

Gould Storage Battery Co.

NEW YORK BOSTON CHICAGO SAN FRANCISCO

A SUPPLY HOUSE
IS KNOWN BY THE SPECIALTIES IT HANDLES

Have you looked our line over?
Have you copies of our Catalogues and Price Lists?

ELECTRIC APPLIANCE COMPANY
EVERYTHING IN ELECTRICAL SUPPLIES
CHICAGO and SAN FRANCISCO

Northern dynamos and motors are the result of superiority in design, modern shop equipments and methods and skilled labor. In engineering propositions of any sort we supplement the superiority of our apparatus with the skill achieved in equipping practically every sort of American industry for economical operation by Northern machinery.

Get Bulletin No. 2533.

CHICAGO SALES OFFICE, SUITE 425 MONADNOCK BLOCK

NORTHERN ELECTRICAL MFG. CO., Madison, Wis., U. S. A.
Engineers, Manufacturers. 248F

SPARKING *Reduces the working capacity of a motor or dynamo, wears out the commutator, wastes power and may cause a fire. All this may be avoided if you use . . . . . .*

GALES COMMUTATOR COMPOUND

The only article that will PREVENT SPARKING. Will keep the Commutator in good condition and PREVENT CUTTING.

Absolutely Will Not Gum The Brushes.

50 Cents per Stick. $5.00 per Dozen.
SEND FOR FREE SAMPLE STICK.
For sale by all supply houses, or

It will put that high gloss on the Commutator you have so long sought after.

K. McLENNAN & CO. Sole Mfrs., Room 411 Inter Ocean Bldg., 130 Dearborn St., CHICAGO

You've Heard of the
PEERLESS
INCANDESCENT LAMPS

If you don't know them you are missing a great light giving bulb of incandescence that is electrically and mechanically perfect and rightly named "Peerless."

They are not labeled one way and rated another. Rest assured when you are buying "Peerless" lamps you are getting full rated candlepower.

The Wesco guarantee stands behind every "Peerless" lamp for efficiency, sustained candlepower, current-consumption and life.

On yearly contracts we are prepared to make the lowest price that has ever been made on a strictly high grade lamp.

ELECTRICAL MACHINERY AND SUPPLIES
WESCO SUPPLY CO, ST. LOUIS, MO., U. S. A.

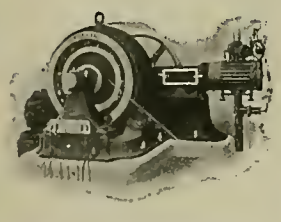
MICA
Of all Qualities, in any Form at Lowest Prices
EUGENE MUNSELL AND CO.
NEW YORK and CHICAGO

INSULATION That Is.
Micanite, Linotape, M. I. C. Compound, Empire Cloth and Paper. For Years the Standard.

MICA INSULATOR CO., Originators
NEW YORK and CHICAGO

MICABOND
CHICAGO MICA CO.,
"PERFECTORS" VALPARAISO, IND.
THE PEER OF INSULATORS.

Warren Alternator



The **WARREN ALTERNATOR**

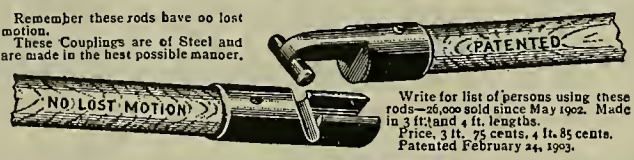
needs no garrulous knight to champion its virtues. Simple statements of merit and NOTHING BUT FACTS, devoid of technical verbiage, are all that are necessary in selling Warren Alternators.

WE GUARANTEE WHAT WE SELL and SELL WHAT WE GUARANTEE

WARREN ELECTRIC MFG. CO.
Sandusky, O.

Cope's Patent Quick Coupling Conduit Rod

Remember these rods have no lost motion. These Couplings are of Steel and are made in the best possible manner.



Write for list of persons using these rods—26,000 sold since May 1902. Made in 3 ft. and 4 ft. lengths. Price, 3 ft. 75 cents, 4 ft. 85 cents. Patented February 24, 1903.

T. J. COPE
3244 North Fifteenth Street PHILADELPHIA, PA.

VOLT - AMMETERS,
POCKET SIZE.
For Testing Batteries and Battery Circuits, Locating Faults, Grounds, etc.
RELIABLE. ACCURATE.
Send for Circular.
L. M. PIGNOLET,
78-80 Cortlandt St., NEW YORK, N. Y.

"AMERICAN" STORAGE CELLS
ARE THE BEST. Send for descriptive Circular.
AMERICAN BATTERY CO.,
ESTD 1888. 171 S. Clinton St., Chicago.

ELECTRIC SIGN
FLASHERS

BEST IN THE WORLD
Write for full particulars
Reynolds Elec. Flasher Mfg. Co.
221 Fifth Ave., Chicago.

EDISON MINIATURE LAMPS
Dry Battery Lamps

For use in portable lighting devices—electric candle sticks, pocket lanterns, carriage and bicycle lamps, clock lights for bed rooms, ruby lanterns for photography and for optical, dental and surgical instruments.

All types supplied—
Accurately rated—
Carefully selected.

EDISON DECORATIVE & MINIATURE LAMP DEPT.,
General Electric Company, Harrison, N. J.
Chicago Office: Monadnock Block. Sales Office all large cities.

Special Theater Switch
(Concealing flash)

We build
Switches, Switchboards And Panel Boards

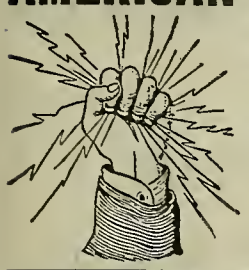
Correspondence invited.
Ask for catalogs on standard stock items.

THE F. BISSELL COMPANY
MANUFACTURERS AND JOBBERS OF
ELECTRICAL GOODS,
226-228-230 HURON STREET,
TOLEDO, O.

FRANK N. PHILLIPS, PRESIDENT. O. N. WAGENSEIL, TREASURER. EUGENE F. PHILLIPS, GENERAL MANAGER. E. ROWLAND PHILLIPS, VICE-PRES. C. R. REMINGTON, JR., SEC.

AMERICAN ELECTRICAL WORKS,

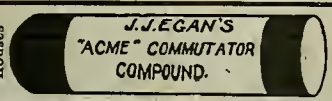
PROVIDENCE, R. I.



BARE AND INSULATED ELECTRIC WIRE,
ELECTRIC LIGHT LINE WIRE,
INCANDESCENT AND FLEXIBLE CORDS,
Railway Feeder and Trolley Wire,
AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR WIRES.
CABLES FOR AERIAL AND UNDERGROUND USE.

NEW YORK STORE, W. J. Watson, 26 Cortlandt St.
CHICAGO STORE, F. E. Donohoe, 82 Lake St.
MONTREAL BRANCH, Eugene F. Phillips' Electrical Works.
MAIN OFFICES AND FACTORIES, PHILLIPSDALE, R. I.

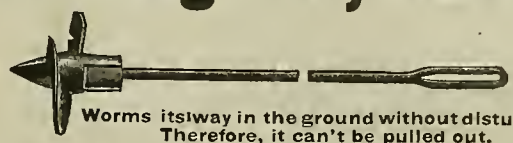
All Supply Houses



J. J. EGAN'S "ACME" COMMUTATOR COMPOUND absolutely prevents sparking or cutting. One stick of "Acme" is equal to one gallon of oil for lubricating commutators. Free Sample. AGENTS WANTED. 50c per Stick. $5.00 per doz.
J. J. Egan Sole Mfg., 317 Austin Ave., Tel. Polk, 1779 Chicago

Our Compound Stops Sparking and Saves Commutators.
14 Years' Use on Street Ry., Light and Power Commutators Has Proven its Worth. WE GUARANTEE RESULTS
Send Your Address for FREE SAMPLE THAT CONVINCES.
JAS. McLAUGHLIN & CO., ELECTRICAL ENGINEERS
586 Fulton Street, - - Chicago, Ill.

Simply Screw Them In.
THAT'S ALL
THERE IS TO THE INSTALLATION OF THE
Stombaugh Guy Anchor



Worms itsIway in the ground without disturbing it. Therefore, it can't be pulled out.
WRITE FOR FURTHER INFORMATION TO
W. N. MATTHEWS & BRO., Distributors
603 Carleton Building, St. Louis

M. KLEIN & SON.
Send 2c stamp for new catalogue No. 6 of
KLEIN'S TOOLS
For Electrical Workers and Line Builders.
MATHIAS KLEIN & SONS.
81 W. Van Buren St., Chicago, Ill.

EXPERT IN ELECTRICITY MECHANICS PATENT CAUSES
SOLICITOR OF **PATENTS**
U. S. & FOREIGN
FOREE BAIN, 1652-3 Monadnock Blk., CHICAGO

DON'T BUY ELECTRICAL SUPPLIES

Until you have seen our new Catalogue and new Price List.
Free to the trade.

Manhattan Electrical Supply Co.
NEW YORK: 32 Cortlandt St.
CHICAGO: 188 Fifth Ave.

"UNION" SWITCH OUTLET BOX

For Finished House Work

Approved by Underwriters' National Electric Association.

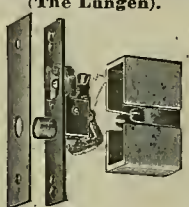
Construction 14-gauge steel, dovetailed joints, finished in black enamel.
Takes all makes of switches and receptacles.
Made to conform to the latest Underwriters' rules, and is approved.
Gangs of 2, 3, 4, 5 and 6 carried in stock.
Spacing in gang boxes 1 13-16" between centers.
Provided with clamps for holding Sprague Cable.
Tandem boxes made to order.
Dimensions at bottom of single box, 3 1-16"x2". Takes plate 4½" and longer. Outlet holes ⅝".

Takes all makes of Switches and Receptacles

CHICAGO FUSE WIRE & MFG. CO.
358 Dearborn Street, CHICAGO — Mutual Life Building, BUFFALO — 853 Broadway, NEW YORK

EDWARDS AND CO

DOOR SWITCH
(The Lungen).



Porcelain Insulation.
Wire Connections in Front.
Style A—Lights when door is open; out when door is closed.
Style B—Lights when door is closed; out when door is open.
THE ECO DOOR SWITCH OPERATES LIGHTS "EVERY OTHER TIME."
Approved by the National Board of Underwriters.
Western Electric Co., Selling Agents
NEW YORK N.Y.

Crimshaw

Raven White Core

Raven Black Core

ALL OUR WIRES pass inspection and carry the above TRADE-MARKS on our tags. We also manufacture Crimshaw and Competition Tapes and Splicing Compounds.

NEW YORK INSULATED WIRE COMPANY,

MAIN OFFICE: 114, 116 & 118 Liberty St., New York.
BRANCHES: CHICAGO: 192 Desplaines St. — BOSTON: 7 Otis St. — SAN FRANCISCO: 33 Second St.

NATIONAL CODE STANDARD

"O. K." Weatherproof Wire.
Slow-Burning Weatherproof and Ideal Wire.
Prices and Samples on Application.

Phillips Insulated Wire Co.
Office and Factory: PAWTUCKET, R. I.

ELECTRIC SIGNS

INCREASE YOUR CURRENT CONSUMPTION.

Assist us to sell ELECTRIC SIGNS to the best merchants in your city.

No repair bills with our signs we furnish the best—all metal raised letters equipped with removable copper shell sockets. WRITE US, we will conscientiously study your sign wants and gladly submit drawings with very low quotations for the best work.

ZEROMARX SIGN WORKS
CHICAGO, ILL.

WANTED, FOR SALE *and similar* **WANT COLUMN** *advertisements (50 words or less), $1.50 an insertion; additional words 3c each.*
POSITION WANTED *advertisements (50 words or less), $1.00 an insertion additional words 2c each.*

POSITION WANTED.

By young man as superintendent of electric-light plant or municipal light and water plant. Ten years' practical experience and technical education. Can handle engineering and business ends. Would consider electric railway or salesman's position. Address BOX 391, care of Western Electrician, 510 Marquette Building, Chicago.

POSITION WANTED

As superintendent or electrician in medium sized plant; understands every detail of electric lighting or power plant including business, and am at present general manager of plant operating 24 hours but desire change of climate; prefer lake regions. Also familiar with telephone work. Address BOX 399, care of Western Electrician, 510 Marquette Bldg. Chicago.

WANTED.

Granular carbon for common battery microphones and tinfoil in lengths suitable for standard 2 mf. condensers. Quotations for quantity F. O. B. New York, and samples to BOX 402, care Western Electrician, 510 Marquette Bldg., Chicago.

FOR SALE.

Electrical construction and supply business in city of (15,000) fifteen thousand, one of the best electrical towns in the United States. No competition to speak of, full particulars given. Address BOX 403, care Western Electrician, 510 Marquette Bldg., Chicago.

FOR SALE.

4 L. D. 12, T.-H. arc machines with one extra armature. Also 200 6.6 ampere open T. H. double and single arc lamps. 1-50 light Manhattan series A. C. arc system, complete with step-up transformer. 1 regulator and 35 lamps. All at present in operation and in excellent condition. Address BOX 396, care of Western Electrician, 510 Marquette Bldg., Chicago.

FOR SALE

1 Stanley generator, two-phase, 16,000 alternations, 1,000-2,000 volts, 40 K. W., 1333 R. P. M. and exciter.
1 Stanley generator, two phase, 16,000 alternations, 1,000-2,000 volts, 60 K. W., 1,000 R. P. M. with exciter.
Complete marble switchboard with new instruments for above.
1 Westinghouse generator, 75 K. W., single-phase, 1 100 volts, 7,200 alternations, exciter, switchboard, new instruments complete, 750 R. P. M.
2 New belts.
1 Russell 13x20 4-valve engine, 200 R. P. M.
1 Ball 9½x10 engine, 350 R. P. M.
2 Boilers 16x54 inch, 42 4-inch tubes, allowed 110 lbs. pressure, complete with 50-foot stack.
1 Hoppes heater. All steam pipe, valves, etc.

All in good condition. Can be seen running until December 15th. We are shutting down this plant on account of removal, and will sell all or in part. For further information, address

TIBBE ELECTRIC CO., Washington, Mo., or
RUEBEL-SCHWEDTMANN WELLS, St. Louis.

FOR SALE.

ALTERNATORS.

1-360 K. W. General Electric 3-phase.
1-120 " " " "
1-75 " Westinghouse 2-phase.

250-VOLT GENERATORS.

1-250 K. W. Western Electric M. P.
1-200 " Eddy M. P.

125-VOLT GENERATORS.

1-125 K. W. Western Electric M. P.

Immediate shipment.

GREGORY ELECTRIC CO.
54-62 S. CLINTON ST. CHICAGO

PLACE YOUR

"Want" and "For Sale" advertisements in the

WESTERN ELECTRICIAN,

Immediate Returns.

Corliss Engines.

900 h. p., 34x60, International.
800 h. p., 22x42x48, Hamilton Tand. Comp.
750 h. p., 32x54, Hamilton, 1890 Frame.
650 h. p., 30x54, St. Louis, 1890 Frame.
500 h. p., 28x60, Philadelphia.
500 h. p., 16x32x42, Corliss Cross Comp., latest type.
450 h. p., 16x30x42, Allis Cross Comp.
400 h. p., 23½x60, Geo. H. Corliss.
450 h. p., 24x48, Harris, latest type.
450 h. p., 24x48, Brown.
350 h. p., 22x42, Allis, 1890 Frame.
350 h. p., 22x42, Slater, 1890 Frame.
300 h. p., 20x48, Harris.
300 h. p., 20x42, Hamilton.
225 h. p., 12x22x42, Atlas Tandem Comp.
225 h. p., 18x42, Hamilton.
175 h. p., 16x42, Allis.
165 h. p., 16x36, Sioux, 1902.
150 h. p., 15x38, Brown.
140 h. p., 14x42, Allis, 1890 Frame.
125 h. p., 14x36, Putnam.
90 h. p., 12x36, Harris.
600 h. p., 28½x52, Buckeye Automatic.
500 h.p.,17½x30½x27, Buckeye Cross Comp.
450 h.p.,16½x28½x27, Buckeye Cross Comp.
450 h. p., 24x48, Buckeye Automatic.
350 h. p., 16x26x18, Ideal Tandem Comp.
275 h. p., 14x22x16, Ideal Tandem Comp.
250 h. p., 16x27x16, Westinghouse Comp.
200 h. p., 18x24, Meyer Automatic.
150 h. p., 15x24, Cummer.
150h.p.,10¼x18x18,Williams' Tandem Comp
100 h. p., 12¼x15, Taylor Beck.

Whitehead Machinery Company,
DAVENPORT, IOWA.

REPAIRING RECALIBRATING

ELECTRIC METERS.
INTERNATIONAL ELECTRIC METER CO.
167 S. CANAL STREET, CHICAGO.

INDUSTRIES ARE OFFERED LOCATIONS

WITH

Satisfactory Inducements,
Favorable Freight Rates,
Good Labor Conditions,
Healthful Communities,

ON THE LINES OF

THE ILLINOIS CENTRAL R. R.
AND THE
YAZOO & MISSISSIPPI VALLEY R. R.

For full information and descriptive pamphlet address

J. C. CLAIR,
Industrial Commissioner,
1 Park Row, Chicago, Ill.

Faster Time to St. Louis:

The Wabash Cuts the Schedule to 7 Hours.

Commencing Sunday, October 2nd, the Wabash banner Blue Limited, which leaves Chicago at 11:03 A. M. daily, will make the run from Chicago to St. Louis in seven hours—one hour faster time than has heretofore ever been made between Chicago and St. Louis. On the return trip this train leave St. Louis at 2:00 P. M. and reaches Chicago at 9:00 P. M.

The Banner Blue Limited is the finest day train in the world. The equipment, which is all new, consists of highback coaches, free reclining chair cars, dining car and parlor observation car.

WORKS QUICK AND EASY. KEEPS ITS LUSTER. HOLDS OLD TRADE AND MAKES NEW. DOES NOT DETERIORATE. ESTABLISHED 16 YEARS. SOLD BY AGENTS AND DEALERS ALL OVER THE WORLD.

U.S. METAL POLISH 30 OUNCE BOX 10 CENTS. SAMPLES SENT FREE.
GEO. W. HOFFMAN
POLISHES ALL METALS. BRANCHES: NEW YORK, CHICAGO, SAN FRANCISCO. 295 E. WASHINGTON ST. INDIANAPOLIS, IND.

BOILERS.

One 42-in. x 16 ft. 9-in., 250 H. P. Worthington Water Tube.
One 60-in. x 16 ft., John Mohr Return Tubular Boiler.
One 64-in. x 16 ft., John Mohr Return Tubular Boiler.
One 54-in. x 16 ft., Devine Tubular Boiler.

ENGINES.

One 600 H. P., 21 x 36 x 30, Williams Tandem Horizontal Compound, 140 R. P. M.
Two 600 H. P., 20 x 30 x 24, Porter-Allen Tandem Compound, 200 R. P. M.
One 250 H. P., 12 x 24 x 18 Williams Tandem Compound 250 R. P. M.
Two 100 H. P., 13 x 12, Dick & Church, High Speed Automatic.

PARTIAL LIST ONLY.

Send for latest Catalogue for bargains in Engines, Boilers, Dynamos and Motors.

CENTRAL STATION IMPROVEMENT CO., 938 Monadnock Block, Chicago

"HIPWELL" ENCLOSED ARC LAMP

"MARVEL OF MECHANICAL SIMPLICITY"

MADE FOR ALL CIRCUITS—DIRECT AND ALTERNATING

SAMPLES SENT ON 30 DAYS' TRIAL—COSTS NOTHING TO TRY THEM.

HIPWELL MNFG. CO.
ALLEGHENY, PA.

—OFFICE OF— Town Clerk
A. R. KAUFMAN, CLERK

BOARD OF TRUSTEES
GEO. A. PAINTER
AS. V. FANKBONER
J. J. HENRY
F. VAN BUYS, ATTY.

Summitville Ind. Nov 23 1903

Western Electrician
Chicago Ill.

Gentlemen: You may discontinue our Want Advertisement with the One issue. As I have already received about 40 answers to same. Send me your bill and I will remit same to you. Thanking you very kindly for your promptness
I am Yours Resp.

A. R. Kaufman
Clerk.

CHICAGO EDISON COMPANY REPAIR SHOPS
76 MARKET STREET, CHICAGO. TELEPHONE MAIN 1280.
Machine and Carpenter Work of All Kinds. Correspondence Solicited.
OPEN DAY AND NIGHT.
FIRST-CLASS EQUIPMENT THROUGHOUT.
Dynamos, Armatures, Motors, Arc Lamps, Fans, Instruments.

ARNOLD ELECTRIC POWER STATION Co.
Engineers, Constructors for Complete Electric Plants. Results Guaranteed.
SUITE 1539, MARQUETTE BLDG., CHICAGO, NEW YORK OFFICE: 711 TRANSIT BLDG.

BYLLESBY, H. M. & Co.
(Incorporated)
ENGINEERS
Design, Construct and Operate Railway, Light, Power and Hydraulic Plants.
Examinations and Reports.
New York Life Building. - CHICAGO, ILL.

ROBERT W. HUNT & Co.,
ENGINEERS
1121 The Rookery, Chicago. 66 Broadway, New York.
Monongahela Bank Bldg., Pittsburg.
Norfolk House, Cannon St., London.

RUEBEL · SCHWEDTMANN-WELLS,
CONSULTING, MECHANICAL AND ELECTRICAL ENGINEERS,
Suite 801 Chemical Building, ST. LOUIS, U. S. A.

F. B. BADT,
Monadnock, Chicago.

EVANS, ALMIRALL & CO.,
Central Station Heating, High Pressure Piping.
1057 Monadnock Blk., Chicago.

A WEEKLY REPRESENTATION
in this "Directory" enables engineers to keep before all possible customers.

Long Distance Phone Central 2448.
SCHOTT, W. H.,
ENGINEER AND CONTRACTOR,
SPECIALTIES—Central Station Heating Plants, Water Works Steam Plants, Electric Light, Gas and Street Railway Plants.
1220-21 MARQUETTE BUILDING, CHICAGO.

W. E. BAKER. H. B. BISHOP.
BAKER, W. E. & CO.
ENGINEERS,
ELECTRIC RAILWAYS.
27 William St., NEW YORK.

E. W. Hammer, Pres. and Treas. H. J. Minhinnick, Sec. and Gen'l Sup't.
GENERAL ENGINEERING Co., THE Consulting and Contracting Engineers.
Telephones, Electric Light, Power Transmission
Suite 1112, 185 ADAMS ST., CHICAGO.
Long Distance Telephone Central 478.

KEMP, R. W.
Consulting and Contracting Telephone Engineer.
Plans and specification for complete plants. Old plants overhauled and placed on paying basis. Territory, Kansas, Oklahoma and Indian Territory.
WELLINGTON, - - - KANSAS.

SQUIRE ELECTRIC CO.
Engineers and Contractors
113 E. Eighth St., KANSAS CITY, MO.
Consulting, Designing and Supervising Engineers.
Plans and Specifications Furnished.

BRYAN, WILLIAM H.
M. Am. Soc. M. E.,
Consulting Mechanical and Electrical Engineer.
Lincoln Trust Building, ST. LOUIS.

J. H. HALLBERG
Consulting Engineer
Electric Light, Power and Railway Plants
Suggestions to secure Economy, Specifications, Examinations and Reports
45 Broadway, NEW YORK
Long Distance Telephone 4578 Broad

KOHLER BROS.,
Contracting Electrical Engineers, Lighting Power Railways,
1804-1806-1808-1810-1812 Fisher Building, CHICAGO.

TRY IT.
Keep your name and address in this directory where it will be seen by possible clients.

BUTTERFIELD, J. F.
ELECTRICAL ENGINEER AND CONTRACTOR.
Complete Telephone Exchanges Built and Material Furnished.
Cable Construction and Underground Conduit Construction a Specialty.
Room 595, 113 Adams Street. CHICAGO, ILL.

HORNADAY, J. P. & Co.
SUITE 1108 TRACTION BUILDING
CINCINNATI, O.
WATERWORKS, ELECTRIC RAILWAY, LIGHT, TRACTION, INDUSTRIAL AND MINERAL PROPERTIES BOUGHT AND SOLD

McLAUGHLIN, JAMES
CONSULTING
ARC LIGHTING EXPERT,
PRACTICAL ELECTRICAL AND MECHANICAL ENGINEER,
53 RIVER ST., - CHICAGO, ILL.

STANTON, LE ROY W.
Consulting Telephone Engineer
Plans, Specifications and Supervision of Installation of Complete Telephone Plants
Special Reports on Telephone Properties and Apparatus
411 Electrical Bldg., Cleveland, Ohio

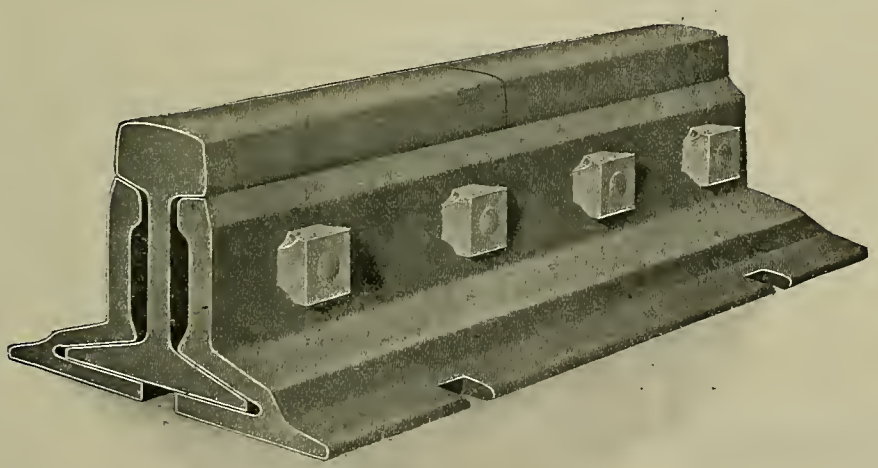
DUGALD C. JACKSON, C. E.
WILLIAM B. JACKSON, M. E.
MEMBERS
AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS
AMERICAN SOCIETY OF MECHANICAL ENGINEERS
AMERICAN SOCIETY OF CIVIL ENGINEERS
ENGINEERS. EXPERTS.
MADISON, WIS.

ALL Live men read the **WESTERN ELECTRICIAN** Each Week. Do You?

WE BUY OLD BELTS
OR SCRAPS, ANY SIZE OR CONDITION.
WE CLEAN, REPAIR AND RENEW OLD BELTS.
LEATHER PRESERVER MFG CORP.
27 W. MONROE ST., CHICAGO

Over 20,000 Miles in Use

SEE OUR EXHIBIT AT THE WORLD'S FAIR
ST. LOUIS, MO.
Transportation Bldg., Aisle "C," Posts 7 and 8



PERFECTLY willing to give you an estimate on rail joints or any track material.

DO justice to yourself and Company by asking our quotations before placing your orders.

QUESTIONS answered and prices quoted for special rolling, angles, rounds, flats, tramangles, etc.

ROLLED FROM BEST QUALITY STEEL

For RAIL JOINTS address
CONTINUOUS RAIL JOINT CO. OF AMERICA, Century Building NEWARK, N. J.

For Special and other Track Material address
ALBANY IRON AND STEEL WORKS, 142 Market St., NEWARK, N. J

BOILER WATERS CORRECTED

to remove and prevent scale and to stop corrosion. DEARBORN TREATMENT does the work. Send gallon sample for analysis. Booklet "R" now ready.

DEARBORN DRUG & CHEMICAL WORKS,

27-34 RIALTO BUILDING, CHICAGO, ILL. WM. H EDGAR, President Telephone: Harrison 3930 and 3931.

Dixon's Pure Flake Graphite

As a Cylinder Lubricant

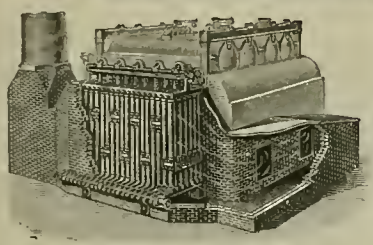
Makes cylinders, valves and rods wonderfully smooth and bright. Reduces friction, saving oil and packing. Booklet 125C and sample upon request.

JOSEPH DIXON CRUCIBLE CO., JERSEY CITY, N. J.

JEFFREY DETACHABLE STEEL ROLLER SPECIAL **CHAINS** FOR CATALOGUE, ADDRESS THE JEFFREY MFG. CO COLUMBUS, OHIO.

Steam Gained——Fuel Reduced

GREEN'S ECONOMIZER

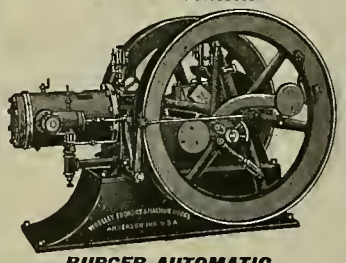


Installed in any Electric Light and Power Plant produces this result. Its not a long story—simply utilizing waste gases—keeping feed-water heated above the evaporative point—saving 10 to 20% on coal bill. Additional advantages in our free booklet, which your engineer could explain to your satisfaction. Simply address

The Green Fuel Economizer Co.

MATTEAWAN, N. Y. Sole Manufacturers in the U. S.

BEST ON EARTH.



BURGER AUTOMATIC.

For Electric Work

REGULATION AND ECONOMY OF FUEL UNSURPASSED.

WRITE FOR CATALOGUE H

Then compare it with some Gas Engine hand books that cost $1.00.

Woolley

Foundry & Mach. Works

Box 400, Anderson, Ind. U. S. A.

REG. TRADE MARKS

THE PHOSPHOR BRONZE SMELTING CO. LIMITED, 2200 WASHINGTON AVE., PHILADELPHIA.
"ELEPHANT BRAND PHOSPHOR-BRONZE"
INGOTS, CASTINGS, WIRE, RODS, SHEETS, ETC.
— DELTA METAL —
CASTINGS, STAMPINGS AND FORGINGS
ORIGINAL AND SOLE MAKERS IN THE U. S.

H. N. FENNER, President J. F. BLAUVELT, Agent RUSSELL W. KNIGHT, Treasurer

NEW ENGLAND BUTT COMPANY

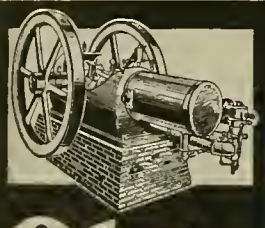
MANUFACTURERS OF

Machinery for Insulating Electrical Wires

Braiding, Taping, Winding, Twinning, Cabling, Stranding, Polishing and Measuring Machines. Cable Covering Braiders

FINE CASTINGS A SPECIALTY

304 PEARL STREET, - - - PROVIDENCE, R. I., U. S. A.



Olds Gas and Gasoline Engines

Are built on lines of strict originality, and are protected by the Olds patents. The essential parts of our engines combine the highest efficiency with the greatest simplicity of construction and operation. No engine made approaches the Olds for economy and durability.

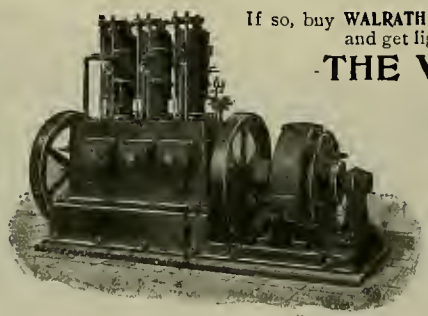
Stationary Engines - - 2 to 100 H. P.
Portable Engines - - 8 to 18 H. P.

Write to-day for full information and new illustrated catalog.

Olds Gasoline Engine Works
252 River Street, - Lansing, Mich.
3 982

ARE YOU LOOKING FOR MONEY?

If so, buy WALRATH GAS OR GASOLINE ENGINES and get light on the subject.



THE WALRATH

Received the Highest Award at the Pan-American Exposition.

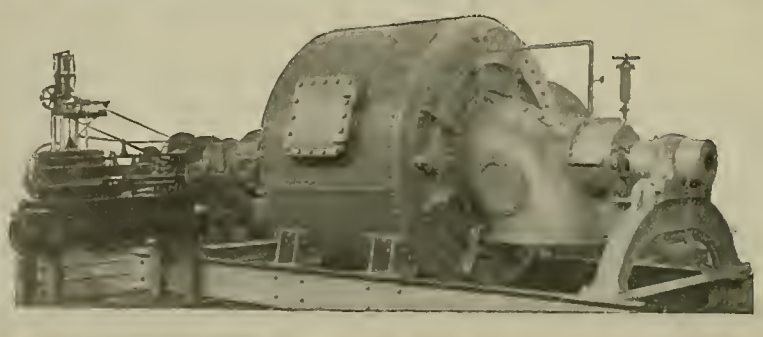
It will produce as good a commercial light as that of an automatic steam engine, either belted or direct-connected generator. Simple, Economical and Reliable

Send for Catalogue W

MARINETTE GAS ENGINE CO.,

CHICAGO HEIGHTS, ILL.

AGENCIES:
Keystone Engineering Co., Farmer's Bank Bldg., Pittsburg, Pa.
Strong, Carlisle & Hammond Co., 61-67 Frankfort St., Cleveland, Ohio
Mackay Engineering Co., 149 Broadway, N. Y.
C. H. Seidenglanz., 52 Wheo Bldg., Indianapolis, Ind.



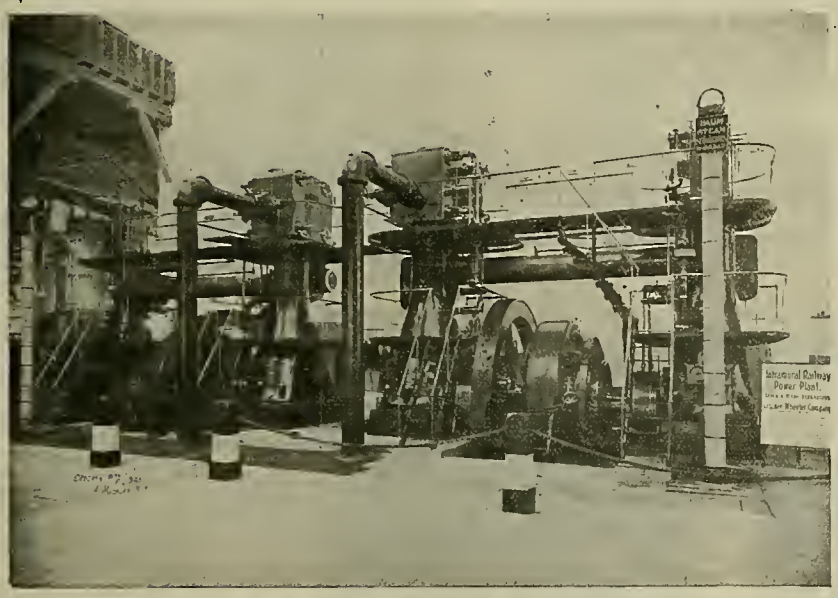
SAMSON TURBINE

To insure close speed regulation in a turbine it is necessary to have a gate which is easily operated. The gates on our SAMSON TURBINES are balanced and consequently moved with the greatest ease.

THE JAMES LEFFEL & CO.

SPRINGFIELD, OHIO, U. S. A.

Railway Generators For Sale



Two 500-K. W. generators, driven by Brown-Corliss engines

The Intramural Railway Power Plant

Block 42, Machinery Hall
Louisiana Purchase Exposition

consists of seven standard Crocker-Wheeler railway generators, driven by a variety of prime movers.

These power units are for sale—delivery January first.

If you are unable to inspect the Intramural plant at St. Louis, send for our Bulletin No. 49.

Crocker-Wheeler Company

Manufacturers of Alternating and Direct-Current Apparatus

AMPERE, N. J.

Branch Offices in Sixteen Principal Cities

ELECTRICITY FOR ENGINEERS.

Latest Edition, Now Published in One Complete Volume, 424 Pages, Profusely Illustrated.
Just the Work for Engineers, Electricians, Dynamo Tenders, etc.

PART I. CONTENTS.—CHAPTER I: Electricity; Positive and Negative; Conductors, Non-Conductors and Insulators; Electro-Motive Force; Volts; Resistance; Ohms; Current; Amperes.—CHAPTER II: Dynamos; Magnets; Field Coils; Electro Magnets; Permanent Magnets.—CHAPTER III: Armatures, Construction of, Different Kinds of; Commutators, How Made and Connected; Heating of Armatures; Eddy Currents.—CHAPTER IV: The Current; How Produced; Induction; Series Wound Dynamos; Shunt Wound Dynamos; Exciting the Fields; Constant Current and Constant Potential Dynamos; Series and Parallel; Parallel or Multiple Arc System.—CHAPTER V: Incandescent Lamps; Filaments; Connections; Flashing; Exhausting; Testing; Candle Power; Operated in Series; Automatic Cut-Out; In Multiple Arc or Parallel; Multiple Series; Multiple Series Cut-Out; Three Wire System.—CHAPTER VI: The Arc Light; How Formed; Causes of Unsteadiness; Remedy; Effect of Shades or Globes; Shape of Carbons Under Different Conditions of Burning; Arc Lamps; Regulating and Cut-Out Mechanism; Action of Current; Clutch Lamps; Clockwork Lamps; Double Lamps; Troubles in Lamps.—CHAPTER VII: Commutators and Brushes; The Brush Commutators; Brushes; Different Styles of Brushes; Double Brushes; Single Brushes; Troubles with Commutators and Brushes; Correct Position of Brushes; Sparking at Brushes; Care of Brushes and Commutators; Flashing.—CHAPTER VIII: Current Regulation; Hand Regulation; By Position of Brushes; Resistance Box; Resistance Coils.—CHAPTER IX: American System of Automatic Current Regulation; The Dynamo; Regulator; Action of Regulator.—CHAPTER X: Brush System of Automatic Current Regulation; Brush Armature; Diagram of Circuits through Dynamo, Regulator and Lamps; Dial or Regulator; Care and Adjustment of Dial; Dial Controller; Circuits and Connections of No. 8 Brush Dynamo; Circuits of Compound Wound Constant Potential Brush Dynamo.—CHAPTER XI: The Edison System; Automatic Regulator; Circuits of Regulator; Circuits of Dynamo; Action of Regulator; Howell Pressure Indicator; Diagram of Circuits; Description of Parts and Operation.—CHAPTER XII: Excelsior System of Automatic Current Regulation; Dynamo; Armature; Diagram of Circuits; The Regulator and Motor; Action of Regulator.—CHAPTER XIII: Schuyler System of Automatic Current Regulation; Dynamo; Armature, Commutator and Brushes; Diagram of Circuits in Armature and Field; Regulator; Circuits in Regulator.—CHAPTER XIV: Thomson-Houston System of Automatic Current Regulation; Dynamo; Armature; Commutator and Brushes; Controlling Magnet; Wall Controller; Diagram of Circuits; Air Blast.—CHAPTER XV: Waterhouse System of Three-Brush Automatic Current Regulation; Dynamo; Extra Brush; Resistance Coils and Regulator. CHAPTER XVI: Ampere Meters; Tangential Seals; Solenoid Meters.—CHAPTER XVII: Voltmeters; Pressure and Potential Indicators.—CHAPTER XVIII: Testing; Galvanometers; Astatic Needle; Differential Apparatus.—CHAPTER XIX: Wheatstone Bridge or Electrical Balance; Diagram of Circuits and Methods of use; Bridge and Rheostat; Round Form; Square Form.—CHAPTER XX: The Magneto as a Testing Instrument; Armature; Field; Bell; Diagram of Circuits.—CHAPTER XXI Coupling Dynamos Together; In Series; In Shunt; Series, Shunt and Compound Wound Machines.—CHAPTER XXII: Switches and Switchboards; Loop Switch; Plug and Socket; Change Over Plug and Socket; Conclusion. CHAPTER XXXIII: Electric Motors; General Principles the Same as in Dynamos; Types; Shunt and Series Motors Suitable for all General Purposes; Regulation of Shunt Motors; Of Series Motors; Counter E. M. F.; Direction of Rotation and Direction of Current; Starting Motors; Diagram of Connection.

PART II. CONTENTS.—CHAPTER I: Alternate Current Dynamos; Principles of the Field; Field Current Armature; Winding; Connections; Lamination; Different Types of Alternators; Regulation; Leading Systems; The Brush Generators; Magnets; Armature; Principles of Induction.—CHAPTER II: Dynamos, Continued; The Mordey Alternator; Stationary Armatures; Field Magnets; Ferranti Armature; Field Magnets; Winding; Collectors.—CHAPTER III: Dynamos Concluded; Siemens Dynamo; Best Magnetic Circuits; Stanley Constant Current Dynamo; The Armature; Self Induction; Regulation.—CHAPTER IV: Induction Coils; Converters; Transformers; Economy of Distribution; An Electrical H. P.; Losses in Conductor; Induction Coils; Effect of Induction; Transformers.—CHAPTER V: Transformers Continued; Induction Coils; Converters; Transforming Up and Down; Design of Transformers; The Static Charge; Protection Against; Grounding the Secondary; Other Devices; The Fuse Protector; Different Types of Transformers.—CHAPTER VI: Transformers, Concluded; Fuses; Regulation; Winding of Transformers; Connecting to Circuit; Regulation; Safety Fuses.—CHAPTER VII: Parallel System; Series Arc Light System; Diagram of Circuits; Parallel System; Primary Circuit; Secondary Circuit; Placing of Transformers; Fuses; Diagram of Series Arc Light Circuit.—CHAPTER VIII: Lines of Force; Hysteresis; Magnetic Penetration; The Circuit of Lines of Force; Experiments with Magnet; Rapidity of Reversals and Hysteresis.—CHAPTER IX: Arc Lamps; In Series; The Westinghouse Arc Lamp; Diagram of Circuits in Lamp; Action of the Mechanism; Flat Carbons.—CHAPTER X: Arc Lamps, in Multiple; Slattery Differential Lamp; Mechanism of Lamp; Its Operation.—CHAPTER XI: Measuring and Indicating Apparatus; Instruments for Use with Alternating Currents Differ from those used with Continuous Currents; Ammeters; Voltmeters; Description of Several Forms of Instruments.—CHAPTER XII: Measuring Instruments, Continued; Hot Wire Instruments; The Cardew Voltmeter; Details of the Instrument; Low Potential Voltmeter.—CHAPTER XIII: Voltmeters; Double Coil Voltmeter; Two Types.—CHAPTER XIV: Spring Meters; Curled Spring Meter.—CHAPTER XV: Twisted Strip Instruments; Diagram of Connections and Operation of Instrument.—CHAPTER XVI: Recording Meters; Stanley Meter; Construction and Principles of Operation; Diagrams of Parts; Slattery Induction Meter; Description of Parts and Principles of Operation; Watt Meter; Thomson Meter.—CHAPTER XVII: Generators in Parallel, Difficulties in Operating; Alternate Current Generators in Parallel; Arrangements of Circuits and Machines for Operating in Parallel; Diagram of Common Arrangement of Machines and Circuits.—CHAPTER XVIII: Ohm's Law; Strength of Current; Formulas and Examples; Power and Heating Effects of Currents.—CHAPTER XIX: Ground Alarms and Leak Detectors.

PRICE, $2.50.

Orders for above book, or any electrical work published promptly sent on receipt of price, postage prepaid.

ELECTRICIAN PUBLISHING CO., 510 Marquette Bldg., CHICAGO.

SAUQUOIT SILK MFG. COMPANY,

INSULATING and BRAIDING SILKS

MILLS:
BETHLEHEM, PA.
PHILADELPHIA, PA.
SCRANTON, PA.

NEW YORK REPRESENTATIVES:
WILLIAM RYLE & COMPANY
54 Howard St.
PHILADELPHIA OFFICE:
4015 Clarissa St.
CHICAGO OFFICE:
210 Monroe St.
BOSTON OFFICE:
78 Chauncy St

"Diamond H" Switches

Trade H Mark

This Trade-Mark guarantees quality.

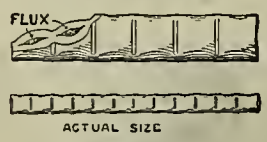
The Hart Mfg. Co., Hartford, Conn.

New York Boston Chicago Toronto, Ont.

KESTER
SELF FLUXING SOLDER

A Tube of Solder Filled with Flux.
Requires no Acid.

SAVES—LABOR—TIME—MONEY.



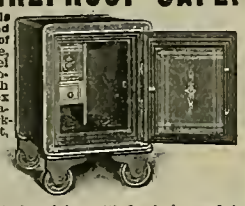
PATENTED.

Send for Free Samples.

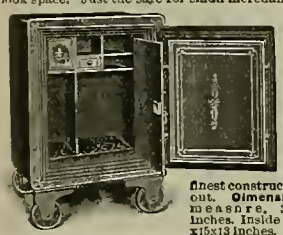
L. F. Mehler Co., R. 1008 Chemical Bldg., St. Louis, Mo., Gen. Western Agent.

KESTER ELECTRIC M'F'G CO.,
48 N. UNION STREET, CHICAGO, ILL.

$11.95 FIREPROOF SAFE.



$11.95 buys this 300-pound guaranteed Fireproof Safe, highest grade, heavy wrought steel continuous plate construction, fitted with genuine Yale triplex 4-tumbler combination lock; best workmanship throughout, positively the equal of safes that sell at $20.00 to $25.00. Dimensions: outside, 24x14¾x16¾ inches; inside, 12x8½x9 inches. Has one 6x4-inch cash box with fine lock; one 8x4-inch drawer; one 3½x4-inch pigeonhole; one 12x3½-inch book space. Just the safe for small merchants and offices.



$23.95 BUYS THIS 475-POUND HIGHEST GRADE FIREPROOF SAFE (guaranteed). Equipped with genuine Yale unpickable, triplex, combination lock; finest construction throughout. Dimensions: Outside measure, 37¾ x 24 x 23¾ inches. Inside measure, 20¾ x15x13 inches. Arrangement of cabinet work: One 6x4¾-inch iron cash box with high grade lock, with two flat keys; one 8x4¾-inch drawer with knob, two 2¾x4¾-inch pigeonholes; one 8x4¾-inch pigeonhole; one large book space, 14¾x9¾ inches; one small book space, 14¾x4¾ inches. A BIG BARGAIN FOR ANY STORE, OFFICE, FACTORY, SHOP OR HOTEL.

We will letter your name or firm neme in gold over door free of charge if requested. You can send us your order for either one of these safes with the understanding that we will return your money and pay freight charges both ways if you are not pleased or do not consider you have received a wonderful bargain and saved about one-half in price.

For large illustrations and descriptions of our complete line of safes, including our massive heavy wall single and double door safes at $15.60 up to $102.00, for detailed explanation of our method of fireproofing, heavy construction, how we make our safes heavier, stronger and better than others, how we can sell the highest grade safes it is possible to build for about one-half the prices all other dealers ask, for our great 30-day free trial offer, explanation of our binding guarantee, our money refund offer, for freight rates, for our liberal terms of shipment, write for our Free Safe Catalogue. Cut this ad. out and mail to us and the complete SAFE CATALOGUE and our WONDERFUL MONEY SAVING SAFE PROPOSITION WILL BE SENT BY RETURN MAIL. Address,

SEARS, ROEBUCK & CO., Chicago, Ill.

TELEPHONE BOOTHS

When in want of the Right Kind write us.

Catalogue Free

Yesbera Mfg. Co.
TOLEDO, OHIO.

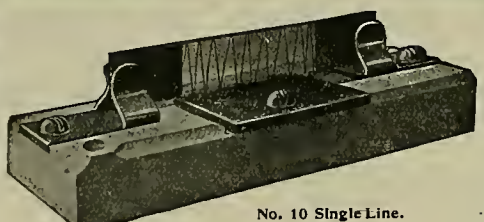
AS SIMPLE AS ITS NAME.

A B C
—OF—
THE TELEPHONE

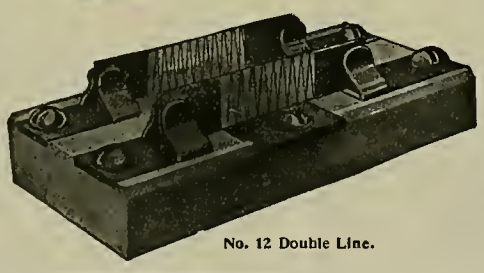
By J. E. HOMANS, A. M
352 pages.
Cloth, Price $1.00.

An up-to-date, practical treatise on the construction, theory, installation, care and management of telephones and their appliances.
Sent prepaid on receipt of price.

Electrician Publishing Co.,
510 Marquette Building, Chicago, Ill.



No. 10 Single Line.



No. 12 Double Line.

PROTECTORS THAT PROTECT.

Our patent wrapped fuse used in our protectors are an insurance policy against lightning.

Sample free by mail to any Exchange or Toll Line

CENTRAL TELEPHONE AND ELECTRIC CO.,
909 Market St.,
ST. LOUIS, U. S. A.

Louisville
and
Chicago

And the places north
And the places south
And the places between are reached by the quick day and night trains of THE

MONON ROUTE
CHICAGO, INDIANAPOLIS & LOUISVILLE RAILWAY

Also the celebrated health resorts, French Lick and West Baden Springs, are reached only by this road.

Booklets about the Springs, their wonderful waters and the fine hotels, sent free.

CHAS. H. ROCKWELL, Traffic Manager
FRANK J. REED, Gen. Pass Agt.
202 Custom House Place, Chicago

100 SUBSCRIBERS of the Citizens' Telephone Company of Grand Rapids, Michigan, were selected at random by a disinterested party and asked how they liked that company's Automatic Telephone Service in comparison with the manual service, which it replaced.

95 OF THEM said it was so perfect that there could be no comparison, they greatly preferred it;

4 OF THEM said they "didn't care which they had;"

1 OF THEM preferred the manual service.

The above percentages indicate the attitude of 6,000 subscribers to Automatic Telephone Service in Grand Rapids.

MR. TELEPHONE MANAGER, if you are trying to satisfy the public and give your patrons the sort of service they appreciate most you will take the hint that this conveys and give them Automatic Service.

AUTOMATIC ELECTRIC CO., Van Buren and Morgan Sts. CHICAGO, U. S. A.

Standard three-bar generator, same as used in our series telephones. We have manufactured generators since we first started in business. What this experience means to you enables us to sell the best generator made at a price slightly above the ordinary. The difference is caused by the better grade of material used and the superior workmanship.

You pay nothing for our experience. Our Bulletin No. 11-E explains fully this apparatus. Mailed free.

Stromberg-Carlson Telephone Mfg. Co.

GENERAL AND EASTERN OFFICE
ROCHESTER, N. Y.

SALES DEPT.
CHICAGO, ILL.

"JUST AS GOOD AS KELLOGG APPARATUS"

cannot be bought outside our factories for the same price we ask—for a higher price or for a lower price.

Our customers never think Kellogg prices high.

We are quoting attractive magneto prices. Write us for quotations on everything in the magneto line.

Send for our new bulletins Nos. 8 to 13.

Do not miss visiting the Kellogg exhibit at the St. Louis Exposition, Electricity Building.

Kellogg Switchboard & Supply Co.,

GREEN AND CONGRESS STREETS, CHICAGO

Electric Building, Cleveland — Keystone Telephone Building, Philadelphia

We introduced successful 4-party lines

LEICH SELECTIVE SYSTEM

Write for our booklet—"Selective W."

CENTRAL ENERGY OR MAGNETO

Impedance Coil for Selectives. No Springs.

AMERICAN ELECTRIC TELEPHONE CO.

CHICAGO, ILLINOIS

INTERNATIONAL

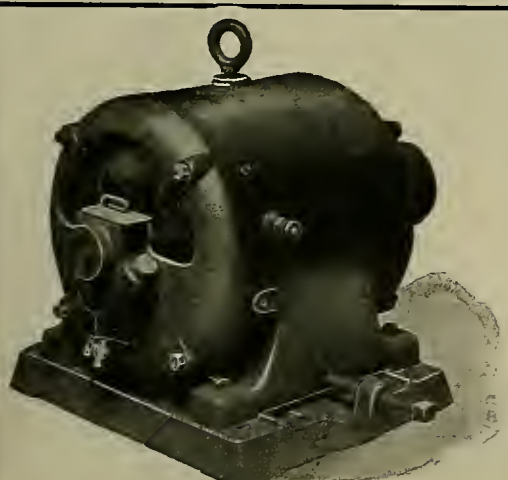
Mechanical Self-Restoring Drop Switchboard.

A PERFECT APPARATUS.

Made in any desired capacity.
Sample parts and quotations on request.

INTERNATIONAL TELEPHONE MANUFACTURING CO.

CHICAGO, U. S. A.



THE RAPID INCREASE IN ORDERS RECEIVED FOR OUR

Alternating Current Motors

is convincing evidence that they are doing all we claim for them. Why not investigate their many salient features and get our prices

CENTURY ELECTRIC CO.

1007-9-11 Locust Street, - - St. Louis, Mo.

PRODUCERS AND WHOLESALERS OF WHITE CEDAR PRODUCTS

CEDAR POLES

YARDS
KOSS MICH.
L'ANSE "
MUNISING "
ONTONAGON
WAGNER, WIS
PESHTIGO "

SPECIAL PRICES ON SMALL POLES.
Write for a copy of our TELEGRAPH CODE FOR CEDAR PRODUCTS

C. H. WORCESTER CO.
SUITE 1206 TRIBUNE BLDG. CHICAGO.

TELEPHONE POLES

Yards at Red Cliff, Wis., Aitkin, Feeley, Cohasset, Deer River, Tenstrike and Black Duck, Minnesota.
Large stocks. Prompt shipments. Carefully inspected stock at low prices.

J. W. MORRISON LUMBER CO., 918-19 Lumber Exchange MINNEAPOLIS, MINN.

WHITE CEDAR POLES

Don't forget our Minnesota Transfer Yard—midway between St. Paul and Minneapolis, where we load in forty-eight hours from the time we have your order.

PACE & HILL CO. 1003 Lumber Exchange, MINNEAPOLIS, MINN.

MICHIGAN WHITE LARGE STOCK.

CEDAR POLES

PROMPT SHIPMENTS. KELLOGG SWITCHBOARD & SUPPLY CO., Chicago.

Points in Wisconsin and the Northwest

are covered by Wisconsin Central Railway's convenient, solid, wide vestibuled trains, equipped with Pullman sleepers, free reclining chair cars and modern coaches which leave Central Station, 12th Street and Park Row (Lake Front), Chicago for St. Paul, Minneapolis, Asbland and Duluth, connecting with all western lines. Meals in dining and cafe cars served a la carte.
For tickets and further information apply to nearest ticket agent, or write
JAS. C. POND. Gen'l Pass. Agt., Milwaukee, Wis.

"By two or three witnesses shall a matter be established."

FIVE POINTS OF EXCELLENCE

Leaving the center of the city from which you start; reaching the center of the city of your destination, over smooth and level tracks; giving rest and comfort; riding beside running waters most of the way; through the centers of population to the gateways of commerce; when you travel by the

NEW YORK CENTRAL LINES

A copy of the Illustrated Catalogue of the "Four Track Series" will be sent free upon receipt of a two-cent stamp by George H. Daniels, General Passenger Agt., Grand Central Station, New York.

BRACKETS—X ARMS—PINS

little things it is true, but they cut a big figure in line construction.

OUR MOTTO IS:
Prompt Shipment Quality Satisfaction Right Price

COLUMBIA MFG. CO. ANTIGO, WIS.

CEDAR POLES

ESTABLISHED 1862
WM. MUELLER COMPANY
1211-12-13 MARQUETTE BLDG. CHICAGO.
EIGHT DISTRIBUTING YARDS

POLES.

WHITE CEDAR.
IDAHO CEDAR up to 80 ft.

BERTHOLD & JENNINGS, ST. LOUIS.
Chemical Building.

CROSS ARMS.

LONG LEAF PINE AND FIR.

WHITE CEDAR POLES
HALL L. BROOKS
52 WISCONSIN AVENUE
TOMAHAWK, WIS.

TENNESSEE RED CEDAR POLES, POSTS AND PILING

R. C. BUCHANAN
MILL AND YARDS: LAVERGNE, TENN.
LARGE STOCK ON HAND

Send your Book Orders to
ELECTRICIAN PUBLISHING CO.,
510 Marquette Bldg., Chicago.

Locations for Industries

Erie Railroad

Chicago to New York

The Erie Railroad Company's Industrial Department has all the territory traversed by the railroad districted in relation to resources, adaptability, markets and advantages for manufacturing, and can advise with manufacturers in relation to the most suitable locations. For full information address

LUIS JACKSON
Industrial Commissioner, Erie Railroad Company
21 Cortlandt Street, New York

TYPE B.

ALTERNATING CURRENT.

SCHEEFFER INTEGRATING WATTMETER

Type E for Alternating Current Type F for Direct Current Circuits

DUST AND BUG PROOF
IMPROVED CONSTRUCTION

MOVING PARTS ARE EXTREMELY LIGHT, INSURING A HIGHLY SENSITIVE AND ACCURATE METER.

WRITE FOR PRICES AND DESCRIPTIVE LITERATURE.

DIAMOND METER COMPANY,
PEORIA, ILL., - - - - U. S. A.

TYPE F.

DIRECT CURRENT.

FARIES ADJUSTABLE LAMP HOLDERS, SHADES, PORTABLES, ELECTRIC and COMBINATION FIXTURES

CATALOGUE WILL BE SENT ON REQUEST

FARIES MFG. CO., - DECATUR, ILL.

STREET RAILWAY MEN AT THE CONVENTION

or away from it, should not forget that MALTBY is one of the few men that can ship TIES or POLES promptly any month in the year.

Try us on the next inquiry.

(8-inch tops from 25 to 45 feet, are on the bargain counter just now. Don't you want a mixed carload?)

MALTBY CEDAR COMPANY, 509 Phoenix Block, Bay City, Michigan.

Pittsburg Agents, TIPPER & PATTON, 509 Bessemer Building.

POLES W. C. STERLING & SON, MONROE, MICH. Eleven Pole Yards in Michigan. Wholesale Producers for 20 years **TIES.**

Cedar Poles TORREY CEDAR CO., CLINTONVILLE, WIS. Large Stock Constantly on Hand

Idaho Cedar Poles

PACIFIC COAST POLE CO. SPOKANE, WASH.

Cedar Poles.

Pittsburg and Lake Superior Iron Co. Producers and Wholesalers. Escanaba, Mich.

MICHIGAN AND WESTERN **CEDAR POLES**

ALL LENGTHS AND SIZES

LINDSLEY BROS CO.

TRIBUNE BLDG., CHICAGO

Southern Cedar POLES Are the Best.

NO ROTTEN BUTTS. D. W. PHELAN, 277 Broadway, New York

Watson Motors

If you want a small motor for a special purpose write us.

Mechanical Appliance Co.

Milwaukee, Wis.

POLE DEALERS ADVERTISING IN THE WESTERN ELECTRICIAN OBTAIN MOST EXCELLENT RESULTS BECAUSE IT PLACES THEM IN TOUCH WITH ACTUAL BUYERS OF POLES. TRY A CARD.

POLES, TIES, POSTS. THE PORTER CEDAR CO., SAGINAW, MICH.

PRODUCERS. We want your inquiries always.

CENTRAL STATION HEATING

We are the originators and builders of the underground system of live and exhaust steam heating. Our system is used for the utilization and distribution of exhaust steam from electric and power plants for heating purposes. 250 Plants in successful operation. We have the only Meter System. Also manufacturers of Wooden Water Pipe, Steam Pipe Casing, Steam Traps, Condensation Meters, Valves, Economizing Coils, Separators and full line of Steam Fitters' Supplies.

WRITE FOR PAMPHLET AND PRICE LIST

AMERICAN DISTRICT STEAM COMPANY

MENTION WESTERN ELECTRICIAN. LOCKPORT, N.Y. CHICAGO, ILL.

One of six 2,500 H. P. Vert. cross-compound, direct connected engines. Built for the Public Service Corporation of N. J.

BROWN CORLISS ENGINE CO.

CORLISS, WIS.

MANUFACTURERS OF

HEAVY DUTY CORLISS ENGINES

FROM 100 TO 8,000 H. P. HIGH SPEED
ENGINES FROM 25 TO 500 H. P.

AGENTS

Pittsburg, Pa.
HENRY R. CORNELIUS, 832 Frick Building.
New York
WM. GIBBS BAIN, 85 Liberty Street.
Philadelphia, Pa.
1019 Real Estate Trust Building.
Boston, Mass.
C. W. WHITING, 813 Exchange Building.
Buffalo, N. Y.
F. duP. THOMPSON, 807 Fidelity Building.
Cleveland, Ohio
STAMP, STEVENSON & CO., New England Building.
St. Louis, Mo.
EDW. FIELD, Commonwealth Trust Building.

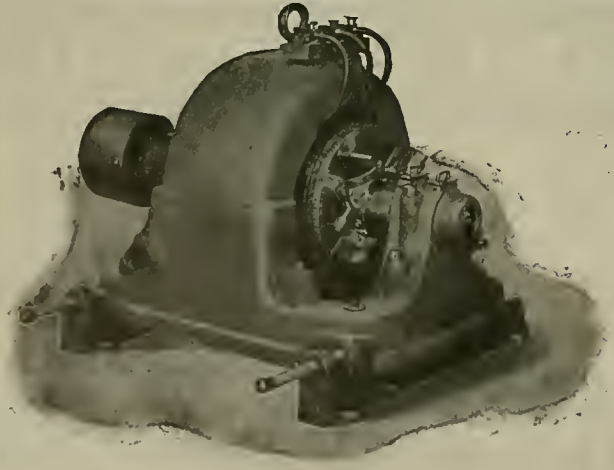
STREET RAILWAY CONVENTION

The annual meeting of the American Street Railway Association will be held in St. Louis, October 11th, 12th and 13th.

The WESTERN ELECTRICIAN of October 15th and 22nd will contain a full report of the proceedings.

If you desire to increase your business with the street railway companies of the world it will pay you to run a special advertising announcement in the above numbers.

WESTERN ELECTRICIAN
510 MARQUETTE BUILDING, CHICAGO



CENTRAL STATION MANAGERS

Don't Be Afraid

of the Gas Plant

WORK UP A MOTOR LOAD

We can furnish you

SINGLE PHASE MOTORS

that will start under full load in sizes ranging from 1/8 to 35 H. P.

Wagner Electric Mfg. Co.
ST. LOUIS, MO., U. S. A.

Form C Arc Lamps

Easy to

trim
adjust
inspect

thoroughly

reliable
efficient
durable

investigate

without
restrictions
of any kind

Complete

bulletins
instructions
catalogues

information

on lamps
for any
circuit

available

to any one
sending us
his address

Fort Wayne Electric Works

"Wood Systems"

Fort Wayne = = Indiana

260

National

Electrical Machinery
built in all capacities
Direct and Alternating
apparatus of the highest grade

1,000-K. W. Rotary Converter

National Electric Company

GENERAL SALES OFFICES & WORKS:

Philadelphia: Land Title Bldg.
New York: 135 Broadway
Chicago: Old Colony Bldg.
Pittsburg: Gellatly & Co
Milwaukee
Charleston, W. Va.: Agnew Electric Co.
Seattle & San Francisco { Kilbourne & Clark Co.

Good Advice

No. 11.

Don't be biased against a meter if you don't know anything about it. If the maker claims it to be the best on the market in every particular, give him the benefit of the doubt. If you haven't tried the Standard Direct Current Wattmeter of America, do so, it's the DUNCAN.

Good Advice No. 12 Next Week.

Send for Bulletin and Prices.

DUNCAN ELECTRIC MFG. CO.

LAFAYETTE, IND.

BRASS & BRASS GOODS

ASK FOR CATALOG

THE PLUME & ATWOOD MFG. CO.

New York Boston San Francisco Chicago

VULCANIZED FIBRE

Highest grades for electrical insulation and mechanical purposes, in sheets, tubes, rods and special shapes. Catalogues and samples on application.

VULCANIZED FIBRE CO., - Wilmington, Del.

USE

"SAFETY" RUBBER COVERED WIRE AND CABLE

FOR EVERY ELECTRICAL SERVICE.

M. B. AUSTIN & CO.,

CHICAGO REPRESENTATIVE.

THE SAFETY INSULATED WIRE & CABLE CO.,

WORKS: Bayonne, N. J. 114-116 LIBERTY STREET, N. Y.

This view is made from an unretouched photograph of two 16 candle power Holophane lamps. The effect of the soft light reflected in the Holophane scientific reflector globe No. 3350 (the ordinary opal globe). After the picture was placed between the two lights and the two reflecting surfaces, so that only one exposure was necessary.

HAVE YOU SEEN

The Holophane Booth in Section 25, Electricity Building, St Louis, which represents an expenditure of nearly $30,000?

DO YOU KNOW

Why all the offices of the Department of Electricity at the World's Fair are equipped with Holophane Globes and Pagoda Reflectors? Ask Prof. Goldsborough, chief of the Department of Electricity at the Louisiana Purchase Exposition, why he selected Holophanes.

HOLOPHANE GLASS CO.

15 East 32d St. New York

THE V. R. LANSINGH CO., Western Distributors

207-209-211 Jackson Boulevard, CHICAGO.

10,000

STURTEVANT ENGINES

Are in use throughout the world.

We build all types and sizes from 2 to 400 H. P.

B. F. STURTEVANT CO.

BOSTON, MASS.

General Works and Office, HYDE PARK, MASS.

New York Philadelphia Chicago London

Black Diamond File Works

Est. 1863. Inc. 1895.

Twelve Medals Awarded at International Expositions

TRADE MARK

Special Prize Gold Medal at Atlanta, 1895.

OUR GOODS ARE ON SALE IN EVERY LEADING HARDWARE STORE IN THE UNITED STATES AND CANADA.

G. & H. BARNETT COMPANY,

PHILADELPHIA, PA.

JOHN A. ROEBLING'S SONS CO.

Insulated Wire of All Kinds

Bare Copper Wire

MAIN OFFICE AND WORKS TRENTON, N. J.

AGENCIES AND BRANCHES

New York Chicago Cleveland San Francisco Philadelphia Atlanta

Western Electrician

Vol. XXXV. $3.00 Per Annum. Copyright, 1903, by Electrician Publishing Company, Chicago. CHICAGO, OCTOBER 15, 1904. Entered at Chicago Postoffice as mail matter of the second class. 10 Cents a Copy. No. 16.

SIMPLEX INSULATED WIRES AND CABLES.
RUBBER COVERED, WEATHERPROOF, UNDERGROUND AND SUBMARINE.
WESTERN SELLING AGENT: H. R. HIXSON, Monadnock Block, CHICAGO.
The Simplex Electrical Co., 110 Sears Street, BOSTON, MASS.

CHICAGO INSULATED WIRE CO.
152-154 LAKE ST., CHICAGO
1108-1110 PINE ST., ST. LOUIS, MO.
Bare and Insulated Wires and Cables
Galvanized Steel Strands

OKONITE
TRADE MARK
1889—Paris Exposition, Medal for Rubber Insulation.
1893—World's Fair, Medal for Rubber Insulation.
THE STANDARD FOR RUBBER INSULATION.
Sole Manufacturers of
Okonite Wires, Okonite Tape, Manson Tape, Candee Weather-proof Wires.
THE OKONITE CO., LTD.
Willard L. Candee, Durant Cheever, Managers. 253 Broadway, New York. Geo. T. Manson, Gen'l Supt. W. H. Hodgins, Secy.

TRADE MARK
CRESCENT INSULATED WIRE & CABLE CO. TRENTON, N.J.
CRESCENT RUBBER INSULATED WIRES AND CABLES
National Code Standard.
CRESCENT INSULATED WIRE AND CABLE CO.,
New York Office, 83 BARCLAY STREET. Main Office and Factory, TRENTON, N. J.

STANDARD
STANDARD UNDERGROUND CABLE CO.
322 The Rookery, Chicago. Westinghouse Bldg., Pittsburg. 56 Liberty St., New York City. 1225 Betz Bldg., Philadelphia, Pa.
Crossley Bldg., San Francisco. 10 Post Office Square, Boston.
BARE AND WEATHERPROOF WIRES AND CABLES.
Rubber Covered Wires and Cables. Underground Cables for all Purposes.

PARANITE
INDIANA RUBBER AND INSULATED WIRE CO.,
MANUFACTURERS OF
Paranite Rubber Covered Wires and Cables,
UNDERGROUND, AERIAL, SUBMARINE AND INSIDE USE;
TELEPHONE, TELEGRAPH AND FIRE ALARM CABLES.
All Wires are tested at Factory. JONESBORO, IND.

THE PHOENIX GLASS CO. Pittsburg New York Chicago
Manufacturers of
Electric Globes and Shades, both Arc and Incandescent
Inner and Outer Globes for all enclosed arc systems
CATALOGUES SENT ON REQUEST

"CIRCULAR LOOM" THE FLEXIBLE CONDUIT
AMERICAN CIRCULAR LOOM CO.
TRADE MARK
REGISTERED
CONDUITS FOR INTERIOR WIRING.
American Circular Loom Co.
Chelsea, Mass., New York, Chicago, San Francisco.

M. KLEIN & SON.
Send 2c stamp for new catalogue No. 6 of
KLEIN'S TOOLS
For Electrical Workers and Line Builders.
MATHIAS KLEIN & SONS.
81 W. Van Buren St., Chicago, Ill.

Electric Heating Apparatus
SEND FOR 32-PAGE CATALOGUE.
UNIT" ENAMELED RHEOSTATS
SIMPLEX ELECTRIC HEATING CO.,
Cambridgeport, Mass.

THERMOPILES 1½ VOLTS 1½ AMPERES
For Electrolytic analysis, charging storage batteries, and other constant current requirements. $3 Each.
WALSH'S SONS & CO.,
264 Washington Street. Newark, N. J.

ELECTRIC SIGN FLASHERS
BEST IN THE WORLD
Write for full particulars
Reynolds Elec. Flasher Mfg. Co.
221 Fifth Ave., Chicago.

THOUSANDS IN USE.
Motors, ¼ h. p. to 100 h. p.
Dynamos, 1 k. w. to 75 k. w.
Highest Quality. Reasonable Price.
THE HOBART ELECTRIC MFG. CO.
TROY, OHIO.

Cope's Patent Quick Coupling Conduit Rod
Remember these rods have no lost motion.
These Couplings are of Steel and are made in the best possible manner.
PATENTED
NO LOST MOTION
Write for list of persons using these rods—26,000 sold since May 1902. Made to 3 ft. and 4 ft. lengths.
Price, 3 ft. 75 cents, 4 ft. 85 cents.
Patented February 24, 1903.
T. J. COPE
3244 North Fifteenth Street PHILADELPHIA, PA.

1 Point for the Monitor Bushing
is the fact that it is made with a perfectly rounded orifice, making this the 1 bushing that will not cut insulation on wires. 1 other point is its covering of insulating enamel—producing the smoothest and safest surface possible. 1 minute spent in investigating this bushing will prove profitable to any 1. Only 1 house in the U. S. has the right to manufacture them and that 1, the 1 which owns the patent.
BOSSERT ELECTRIC CONSTRUCTION CO.,
Write for Catalog. UTICA, N. Y., U. S. A.

H. N. FENNER, President J. F. BLAUVELT, Agent RUSSELL W. KNIGHT, Treasurer
NEW ENGLAND BUTT COMPANY
MANUFACTURERS OF
Machinery for Insulating Electrical Wires
Braiding, Taping, Winding, Twinning, Cabling, Stranding, Polishing and Measuring Machines. Cable Covering Braiders
FINE CASTINGS A SPECIALTY
304 PEARL STREET, - - - PROVIDENCE, R. I., U. S. A.

WESTON Electrical Instrument Co.,
Waverly Park, NEWARK, N. J.

Weston "Round Pattern" Voltmeter, Type F.

"ROUND PATTERN," Type F.
Voltmeters and Ammeters.
These Instruments are particularly suitable for Isolated Plants and Feeder Circuits in Railway and Power Plants. Voltmeters in ranges from 3 to 750 volts. Ammeters in ranges from 1 to 2,500 amp. All Weston Instruments are unsurpassed in excellence of workmanship, in accuracy and economy of operation.
BERLIN—European Weston Electrical Instrument Co., Ritterstrasse No. 88.
LONDON—Elliott Bros., Century Works, Lewisham.
PARIS, FRANCE—E. H. Cadiot, 12 Rue St. Georges
New York Office—74 Cortlandt St.

DIRECT CURRENT
GENERATORS
FOR LIGHT AND POWER

Our generators have a high efficiency and great endurance under the most exacting conditions of service. Sizes up to 1,000 K. W.
Write for bulletin No. 10514.
SPRAGUE ELECTRIC COMPANY
General Offices:
527 West 34th Street, New York
Chicago Office: Fisher Building

For Sale
"The Big Reliable"

5000 horsepower Allis-Chalmers Engine and Bullock Generator

Supplying Current for the

Famous Decorative Lighting

of the

WORLD'S FAIR, ST. LOUIS

attracting more attention and causing more favorable comment
than any other power unit in the world

Designed 1903 Shipped from our Works January 1904—37 Carloads

RECORD

First Operated April 20th, 1904

Ran non-condensing several weeks while Exposition Authorities were making their condenser connections. During that time carried 4900 horsepower night after night

When other plants were out of commission, operated the Cascades—2000 horsepower—and supplied St. Louis Transit Co. with 3000 horsepower

Ever since Exposition Authorities finished their condenser connections the "Big Reliable" has carried 6500 horsepower night after night, running cool and steady, with only 12 inches vacuum in exhaust pipe at engine

Always ready; frequently called upon for extra service in emergencies; has never failed; has not cost a cent for repairs

THE ENGINEERING TRIUMPH OF THE WORLD'S FAIR

For particulars address

Allis-Chalmers Co
CHICAGO

EDISON PRIMARY BATTERIES

FORMERLY EDISON-LA-LANDE

The renewal parts of these batteries are so proportioned that they all become exhausted at the same time. Ordinary materials may be used for some of the renewals, but the highest efficiency can only be secured by using our renewals. The reasons for this are explained in our catalogue No. 7. Send for it.

TRADE Thomas A. Edison MARK

EDISON MFG. CO.

Factory, ORANGE, N. J.

NEW YORK: 83 Chambers Street
CHICAGO: 304 Wabash Avenue

OFFICERS.

L. A. WALTON, President. F. W. LITTLE, Vice-President.
C. D. ORGAN, Sec'y and Treasurer.

DIRECTORS.

A. G. BECKER, A. G. Becker & Co., Chicago.
F. W. LITTLE, Vice-Pres. Peoria Gas & Electric Co., Peoria.
G. A. RYTHER, Cashier National Live Stock Bank, Chicago.
J. R. WALSH, President Chicago National Bank, Chicago.
L. A. WALTON, Vice-Pres. The Equitable Trust Co., Chicago.

C. W. KNISELY, Manager.

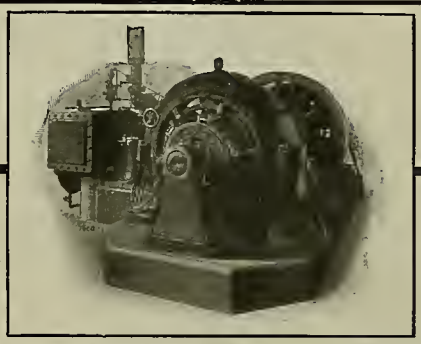
THE

AUDIT COMPANY OF ILLINOIS

635-642 Marquette Building, Chicago.

Public Accountants and Auditors

Regular and Special Audits for Corporations, Firms and Individuals.
Financial and Physical Examinations by Experienced Auditors and Engineers.
Takes Entire Charge of Accounts for Guardians, Trustees, Executors and Receivers.



147

As Good as The Best—"And Then Some."

Ball Compound Engine — Northern Dynamos

Northern Direct Current Apparatus possesses all the characteristics of economical, convenient operation common to excellent electric dynamos and motors and

Many exclusive meritorious features that make it worth your while to get acquainted by reading Bulletin No. 2,530.

NORTHERN ELECTRICAL MFG. CO.,

Engineers Manufacturers.

MADISON, WIS., - - - - U. S. A.

W. D. PAINT.

A PERMANENT INSULATING PROTECTION FOR WOOD OR METAL. A quick drying, moisture-proofing, black paint. An elastic anti-rust coating. A jet black finishing paint, efficient and not expensive.

Write for "Data on Insulating Materials."

DIELECTRIC MANUFACTURING CO., SAINT LOUIS.

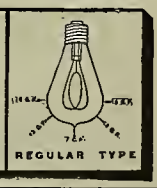
DO YOU?

BUY LAMPS-OR-BUY CANDLE POWER

16 {THIS LAMP AVERAGES} 12

THE STERLING ELECTRICAL MANUFACTURING CO.

NEW YORK, N. Y. WARREN, O. CHICAGO, ILL.



STERLING SPECIAL REGULAR TYPE

PLATINUM

PLATINUM RIVETS FOR CONTACT POINTS IN TELEPHONES—SPARK COILS AND OTHER ELECTRICAL APPARATUS. PLATINUM SHEET AND WIRE IN ANY FORM AND DEGREE OF HARDNESS. PLATINUM SCRAP PURCHASED.

BAKER & COMPANY, Inc.

ARTISANS IN PLATINUM

408-410-412-414 N. J. R. R. AVE. - NEWARK, N. J.

New York Office: 120 Liberty St.

ALPHABETICAL INDEX TO ADVERTISEMENTS.

Adams-Bagnall Electric Co..—
Allis-Chalmers Company..... 2
American Battery Co.....—
Amer. Circular Loom Co.... ...1
American Conduit Co.....16
Amer. District Steam Co.....18
Amer. Elec. Fuse Co.....15
Amer. El. Telephone Co.....16
American Electrical Works..11
Arnold Elec. Power Station Co.....13
Audit Co. of Ill., The..... 3
Automatic Electric Co..... 17

Babcock & Wilcox Co.....—
Badt, F. H.....13
Bain, Forée.....11
Baker & Company..... 3
Baker & Co., W. E.....13
Barnett Company, G. & H....22
Beardslee Chandelier Mfg. Co.....10
Berthold & Jennings.....19
Big Four Route.....—
Bissell Co., The F.....15
Bossert Electric Construction Co..... 1
Brooks, Hall L.....13
Bryan-Marsh Co.....—
Bryan, Wm. H.....13
Buckeye Electric Co.....—
Bullock Elec. Mfg. Co..... 2
Burlington R. R.....12
Butterfield, J. F.....—
Bylesby & Co., H. M.....13

Cantwell Press, The..... 17
Central Electric Co..... 5
Cent. Stat. Improvement Co.....12
Central Tel. & El. Co.....—
Century Electric Co.....—
Chicago Die & Electric Co....—
Chicago Edison Co.....4, 12
Chic. Fuse Wire & Mfg. Co...—
Chicago Insulated Wire Co.. 1
Chicago Mica Co.....10
Clinton Stamping & Elec. Co. 4
Columbia Incand. Lamp Co.—
Columbia Mfg. Co.....18
Continuous Rail Joint Company of America..... 5, 11
Cope, T. J..... 1
Crawfordsville Electric Co.. 4
Crescent Ins. Wire & Cbl. Co. 1
Crocker-Wheeler Company...15
Cutler-Hammer Mfg. Co..... 7
Cutter Elec. & Mfg. Company—

D. & W. Fuse Company.....15
Dearborn Drug & Chem. Wks.14
Diamond Meter Company....—
Dielectric Manufacturing Co. 3
Directory of Engineers..... 13
Dixon Crucible Co., Joseph..14
Duncan Elec. Mfg. Co.....21

Edison Decorative & Miniature Lamp Departm't.....10
Edison Mfg. Company..... 3
Edwards & Co.....12
Egan, J. J.....12
Electric Appliance Co..... 10
Electric Storage Battery Co.. 7
Electrical Appliance Co..... 6
Electrical Engineer Institute.10
Electrician Pub. Company...13
Erie Ry.....19
Evans, Almirall & Co..... ..13

Faries Mfg. Co..... 9
"For Sale" Advertisements..12
Ft. Wayne Elec. Works, Inc..21
Fostoria Incand. Lamp Co...—
Fowler, John H.....19
Fowler-Jacobs Company.....19
Franklin Elec. Mfg. Co 8

General Electric Co..... 9
General Engineering Co., The 13
General Incandescent Arc Light Company.....—
General Incand. Lamp Co....—
Gould Storage Battery Co....—
Green Fuel Economizer Co..—
Gregory Electric Company...12

Hallberg, J. H 13
Haller Machine Co.....16
Hart Mfg. Co.....22
Hartford Steam Boiler Inspection & Insurance Co....14
Hazard Manufacturing Co...22
Hermann Mfg. Co.....—
Highland Park College. ... 11
Hipwell Mfg. Co..... .... —
Hobart Elec. Mfg. Co..... 1
Hoffman, G. W.....12
Holmes Fibre-Graph. Co.....14
Holophane Glass Co.....—
Hornaday & Co., J. P.....13
Humphrey, Henry H.....—
Hunt & Co., Robt. W.....13

Illinois Central Ry.....12
Incandescent Electric Light Manipulator Company.....—
Indiana Rub. & Ins. W. Co.... 1
India Rubber & Gutta Percha Insulating Company..... 4
International Elec. Meter Co 12
International Tel. Mfg. Co...16

Jackson, D. C. & W. B.....13
Jeffrey Manufacturing Co....14
Jewell Electrical Inst. Co....—
Johns-Manville Co., H. W.....—

Kartavert Manufacturing Co.22
Kellogg Switchboard & Supply Company.....17, 19
Kemp, R. W.....13
Kester Elec. Mfg. Co.....12
Klein & Sons, Mathias.... ... 1
Kohler Brothers.....13
Kuhlman Electric Co.....11

Leather Preserv. M. Corp....—
Leffel & Co., James.....14
Lindsley Brothers Company..18
Lond's Sons Co., H. M.....19

Machado & Roller.....10
Maltby Cedar Company.....19
Manhattan El. Supply Co....10
Manross, F. N.....14
Marinette Gas Engine Co.....14
Matthews & Bros., W. N.....11
McLaughlin, James.... .....—
McLaughlin & Co., Jas..... 9
McLennan & Company, K....10
Measured Service Co.....17
Mechanical Appliance Co....—
Mica Insulator Company.....—
Minnesota Electric Co.....—
Miscellaneous Advs.....12
Monon Railroad..... .. ..—
Morrison Lbr. Co., J. W.....—
Mueller Company, William..19
Munsell & Co., Eugene.....10

National Electric Co.....22
National India Rubber Co....—
New England Butt Co..... 1
Newgard & Co., Henry.....11
New York Cent. Ry.....16
New York Ins. Wire Co.....11
Northern Elect'l Mfg. Co.... 3
Northwestern Storage Battery Co.. ... .10

Okonite Co., The..... 1
Olds Gasoline Engine Works.14

Pacific Coast Pole Co.....18
Page & Hill Co.....18
Paragon Fan & Motor Co.....—
Pardridge Shade & Refl. Co..—
Pass & Seymour, Inc.....—
Phelan, D. W.....18
Phillips, Eugene F.....11
Phillips Insulated Wire Co...11
Phœnix Glass Co..... 1
Phosphor-Bronze S. Co.....14
Pignolet, L. M.....10
Pittsburg & L. S. Iron Co....19
Plume & Atwood Mfg. Co....—
Porter Cedar Company.....18

Reisinger, Hugo..... 9
Reynolds El. Flasher Mfg. Co. 1
Roebling's Sons Co., J. A.....22
Ruebel-Schwedtmann-Wells..13
Runzel-Lenz Elec. Mfg. Co...16

Safety Ins. Wire & Cable Co..14
Sargent & Lundy.....—
Sauquoit Silk Mfg. Co.....16
Schott, W. H.....13
Sears, Roebuck & Co.....—
Simplex Electrical Co., The.. 1
Simplex Elec. Heating Co.... 1
Speer Carbon Co..... .19
Sprague Electric Company... 1
Squire Electric Co.....—
Standard Elec. Mfg. Co.....11
Standard Underg. Cable Co.... 1
Stanley Elec. Mfg. Co., The 10
Stanley Instrument Co..... 4
Stanton, LeRoy W.....13
Sterling & Son, W. C.....18
Sterling Electrical Mfg. Co.... 3
Sterling Varnish Co., The.... 4
Stow Mfg. Company..... 9
Stromberg-Carlson Tel. Mfg. Company.....17
Sturtevant Company, B. F...22

Torrey Cedar Company.....18
Trumbull Elec. Mfg. Co..... 5
Turner Brass Works.....

Union Electric Mfg. Co.....—

Valentine-Clark Co., The....19
Vulcanized Fibre Company..22

Wabash R. R.....18
Wagner Electric Mfg. Co.....—
Walsh's Sons & Company..... 1
Warren Elec. Mfg. Co.....15
Wesco Supply Co.....—
Western Electric Company... 7
Westinghouse Electric & Manufacturing Co.....20
Weston Electrical Inst. Co... 1
Whitehead Machinery Co... —
Whitney Electrical Inst. Co..—
Wilmerding, C. H.....13
Wisconsin Central Ry.....19
Woolley Fdy. & Mach. Wks..—
Worcester Company, C. H....18

Yesbera Mfg. Co..... .. —
Yost Electric Mfg. Co 11

Zero Marx Sign Works 11

For Classified Index of Advertisements See Page 6.

If you want Wires or Cables insulated with the HIGHEST CLASS INDIA RUBBER INSULATION you should buy . . . . . .

HABIRSHAW

Complete stock of all sizes constantly on hand and for sale at lowest market prices by

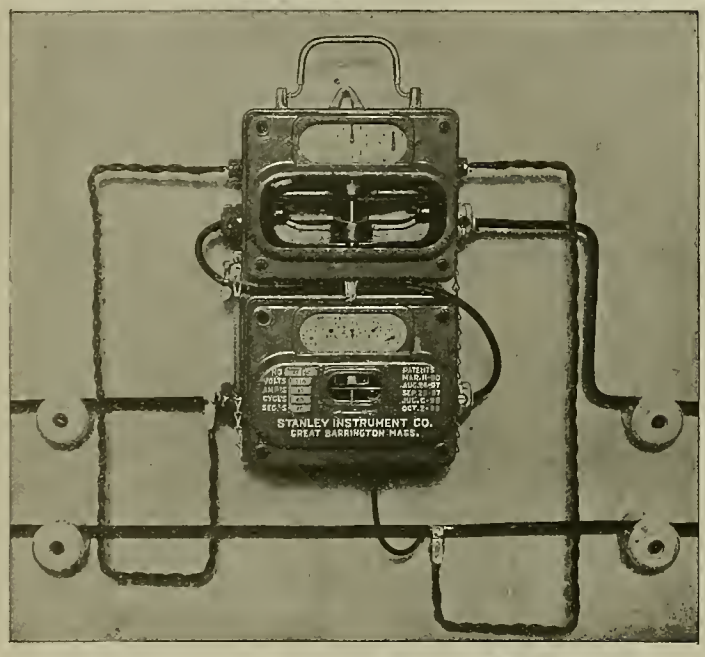
CHICAGO EDISON COMPANY,

WRITE FOR PRICES. 139 ADAMS STREET, CHICAGO.

Sterling Black Plastic Insulator.

One hundred days' continuous baking at 180° F. will not make it brittle. Water repellent. Oil proof.

THE STERLING VARNISH CO., - - Pittsburg, Pa.



TESTING WATTMETER

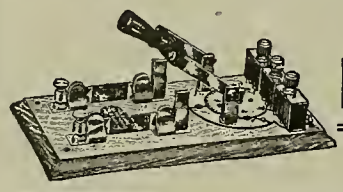
ACCURATE TESTS

in a few minutes, anywhere, by one man alone without regulation of VOLTAGE, LOAD OR FREQUENCY

STANLEY INSTRUMENT CO.

GREAT BARRINGTON, MASS.

SOMETHING DOING IN A STORM



WITHOUT A

King of Protectors

Better Buy a

"TORNQUIST"

COMBINATION LIGHTNING ARRESTER GROUND SWITCH FUSE AND LEVER CUT-OUT.

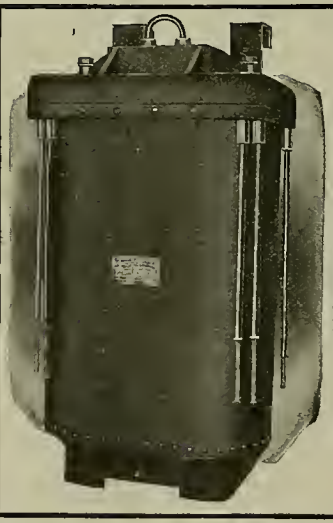
THE ONLY SAFE PROTECTOR MADE. ORDER SAMPLE NOW.

BABY KNIFE SWITCHES — STAMPING AND PLATING. — SOLD BY ALL JOBBERS.

Clinton Stamping & Electric Co.,

CLINTON, IA.

HART & CO., Chicago, General Agents.



HORNBERGER-IRWIN Transformers

(LARGE AND SMALL)

½ K. W. to 500 K. W.

This transformer represents the latest improvements in transformer construction; made in three types; multi-coil construction; ventilated cores; built for all commercial voltages and frequencies; **higher efficiencies together with lower temperatures than have heretofore been attained are guaranteed.**

Catalogue just issued explains details.

Manufactured by

Crawfordsville Electric Co.

CRAWFORDSVILLE, INDIANA, U. S. A.

There is No Higher-Class India-Rubber Insulation For Wires and Cables than

HABIRSHAW.

Authorized Manufacturers of the

ATTIX FLEXIBLE TUBE WIRE.

The India-Rubber and Gutta-Percha Insulating Co.,

MAIN OFFICE, Glenwood Works,

Sales Office, 15 Cortlandt St., New York.

YONKERS, N. Y.

(10928)

WE DON'T WANT TO MAKE YOU BUY IT

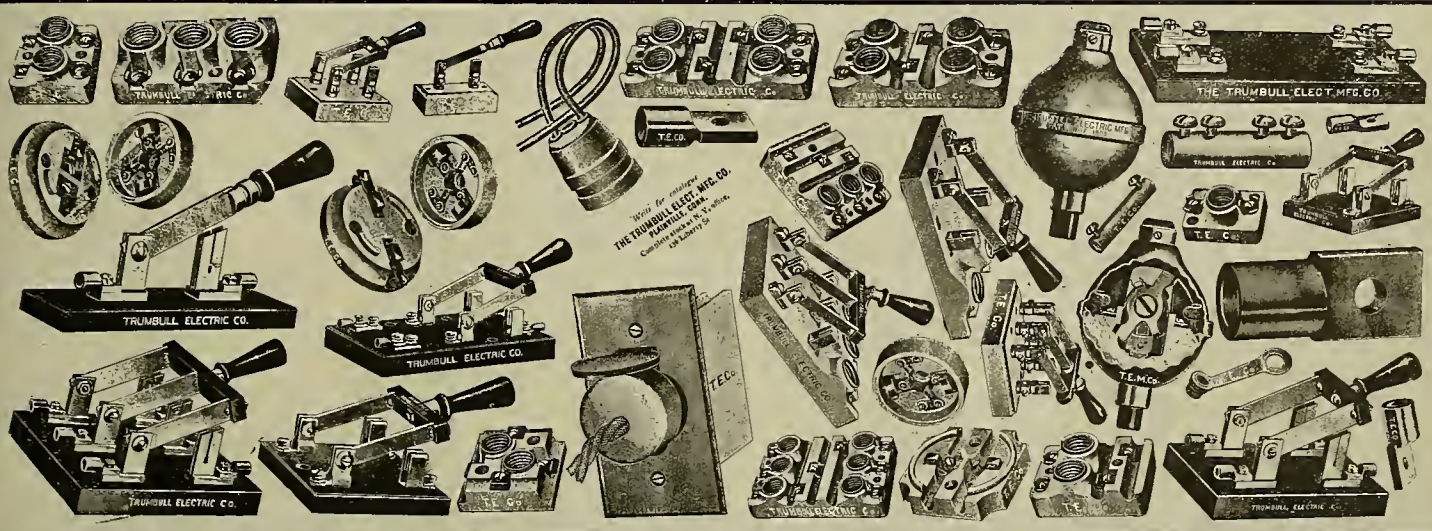
OKONITE TRADE MARK.

But we do want to convince you of its superior qualities, which are sure to appeal to every buyer who wants the best for the money.

OKONITE TRADE MARK.

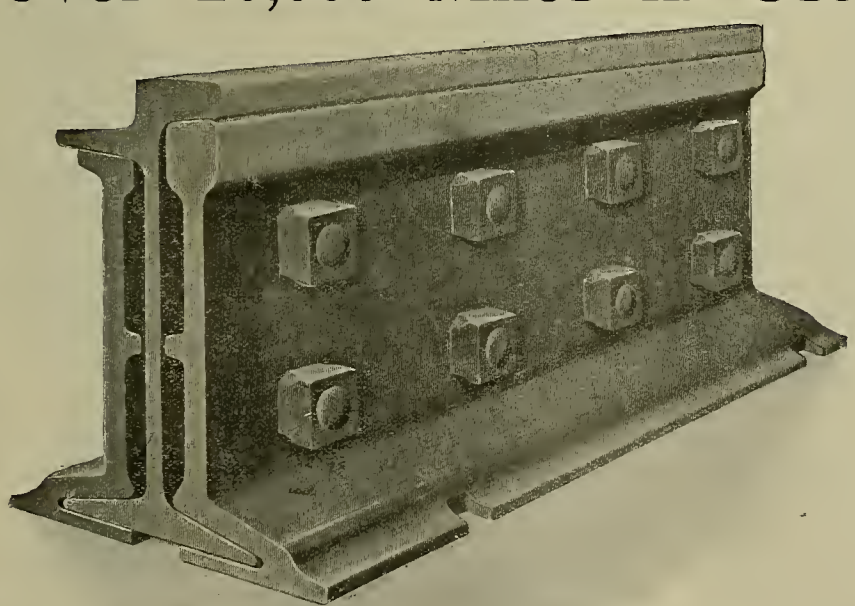
OKONITE IS FOR GENERAL USE WHERE AN INSULATED WIRE IS REQUIRED.

Central Electric Company, 264-266-268-270 FIFTH AVE., CHICAGO.



Over 20,000 Miles in Use

SEE OUR EXHIBIT AT THE WORLD'S FAIR
ST. LOUIS, MO.
Transportation Bldg., Aisle "C," Posts 7 and 8



PERFECTLY willing to give you an estimate on rail joints or any track material.

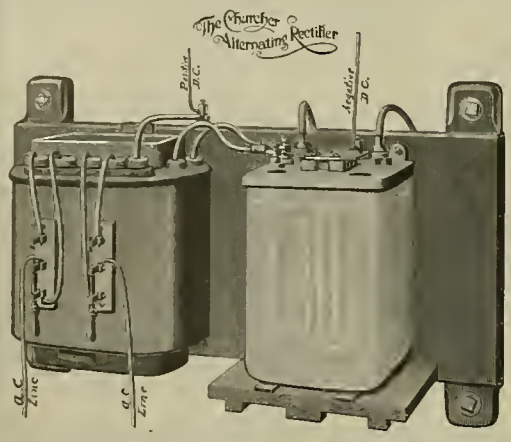
DO justice to yourself and Company by asking our quotations before placing your orders.

QUESTIONS answered and prices quoted for special rolling, angles, rounds, flats, tramangles, etc.

ROLLED FROM BEST QUALITY STEEL

For RAIL JOINTS address
CONTINUOUS RAIL JOINT CO. OF AMERICA, Century Building NEWARK, N. J.

For Special and other Track Material address
ALBANY IRON AND STEEL WORKS, 142 Market St., NEWARK, N. J



CHURCHER ALTERNATING CURRENT RECTIFIERS

Transform any cycle of alternating current into direct current and will at the same time, if desired, convert the potential of the direct current produced to a higher or lower voltage.

SOLD ON 30 DAYS' APPROVAL.

Guaranteed to be cheaper to install, have lower maintenance cost and higher efficiency than a motor-generator.

Send for Bulletin No. 11.

THE ELECTRICAL APPLIANCE CO., - - Cincinnati, Ohio

CLASSIFIED INDEX OF ADVERTISEMENTS.

Accountants and Auditors.
Audit Co. of Illinois

Adjusters, Cord.
Incandes. El. Lt. Manip. Co.

Adjusters, Inc. Lamps.
Inc. El. Lt. Manipulator Co.

Anchors (Tel. & Tel.)
Matthews & Bro., W. N.

Annunciators.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Moon Mfg. Co.
Wesco Supply Co.
Western Electric Co.

Batteries and Jars.
Bissell Co., The F.
Central Electric Co.
Edison Mfg. Co.
Edwards & Company.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.

Bells, Buzzers, Etc.
Central Electric Co.
Edwards & Co.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.

Belt Dressing.
Dixon Crucible Co., Jos.
Leather Preserver Mfg. Corp.

Belting.
Leather Preserver Mfg. Corp

Blow Pipes.
Turner Brass Works

Blowers.
Sturtevant Co., B. F.

Boiler Compounds.
Dearborn Drug & Chem. Wks.

Boilers.
Allis-Chalmers Company.
Babcock & Wilcox Co.

Books, Electrical.
Cantwell Press, The.
Electrician Publishing Co.

Booths, Telephone.
Yesbera Mfg. Co.

Brackets.
Faries Mfg. Co.

Brushes.
Central Electric Co.
Hobart Elec. Mfg. Co.
Holmes Fibre-Graphite Co.
Speer Carbon Co.
Western Electric Company.

Cable Hangers.
Bissell Co., B. F.
Western Electric Co.

Cables (See Wires and Cables)

Canopies.
Faries Mfg. Co.

Carbons, Points and Plates.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
Reisinger, Hugo.
Speer Carbon Co.
Wesco Supply Co.

Castings.
Faries Mfg. Co.
New England Butt Co.
National Electric Co.

Chains.
Jeffrey Mfg. Co.

Chandeliers.
Faries Mfg. Co.

Circuit Breakers.
Cutler-Hammer Mfg. Co.
Cutter Elec. & Mfg. Co.
Ft. Wayne Elec. Wks. Inc.
Union Electric Mfg. Co.
Western Electric Company.
Westinghouse El. & Mfg. Co.

Clusters.
Faries Mfg. Co.

Coal and Ashes Handling Machinery.
Jeffrey Mfg. Co.

Coils and Magnets.
Western Electric Co.

Commutator Compound
Egan, J. J.
McLaughlin & Co., Jas.
McLennan & Co., K.

Condensers, Electric.
Stanley Elec. Mfg. Co.

Conduit and Conduits.
American Circular Loom Co.
American Conduit Company
Central Electric Co.
Electric Appliance Co.
Sprague Electric Co.
Standard Vitrified Cond. Co.
Wesco Supply Co.

Contractors and Electric Light Plants.
Allis-Chalmers Company.
Bullock El. Mfg. Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
National Electric Co.
Northern Electrical Mfg. Co.
Sprague Electric Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Controllers, Crane.
Amer. Elec. Fuse Co.

Cord.
Runzel-Lenz Elec. Mfg. Co.

Cross-Arms, Pins and Brackets.
Berthold & Jennings.
Central Electric Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Company.

Cut-Outs and Switches.
Bissell Co., The F.
Bossert Elec. Const. Co.
Central Electric Co.
Chicago Edison Co.
Clinton Stamping & Elec. Co.
Crouse-Hinds Co.
Cutter Elec. & Mfg. Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
General Inc. Arc Light Co.
Hart Manufacturing Co.
Manhattan Elec. Supply Co.
Trumbull Elec. Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Dynamos and Motors.
Allis-Chalmers Company.
Bissell Co., The F.
Bullock Elec. Mfg. Co.
Central Electric Co.
Century Electric Co.
Crawfordsville Electric Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks. Inc.
General Elec. Co.
General Inc. Arc Light Co.
Gregory Electric Co.
Hobart Elec. Mfg. Co.
Mechanical Appliance Co.
National Electric Co.
Northern Electrical Mfg. Co.
Sprague Electric Co.
Stanley Elec. Mfg. Co.
Stow Manufacturing Co.
Sturtevant Co., B. F.
Wagner Electric Mfg. Co.
Warren Elec. Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Economizers, Fuel.
Green Fuel Economizer Co.

Electric Heating Appl.
Simplex Elec. Heating Co.
Western Electric Co.

Electric Railways.
Crocker-Wheeler Co.
General Electric Co.
Sprague Electric Co.
Westinghouse El. & Mfg. Co.

Electrical and Mechanical Engineers.
Arnold Elec. Power Stat'n Co.
Badt, F. B.
Baker & Co., W. E.
Bryan, Wm. H.
Butterfield, J. F.
Hyllesby & Co., H. M.
Evans, Almirall & Co.
General Engineering Co., The.
Hallberg, J. H.
Hornaday, J. P. & Co.
Humphrey, Henry H.
Hunt & Co., Robt. W.
Jackson, D. C. & W. B.
Kemp, R. W.
Kohler Brothers.
McLaughlin, James
Newgard & Co., Henry.
Northern Electrical Mfg. Co.
Ruebel, Schwedtman, Wells.
Sargent & Lundy.
Schott, W. H.
Squire Electric Co.
Stanley Elec. Mfg. Co.
Stanton, LeRoy W.
Wilmerding, C. B.

Electrical Instruments.
(Recording and Testing.)
Bissell Co., The F.
Central Electric Co.
Diamond Meter Co.
Duncan Elec. Mfg. Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
General Inc. Arc Light Co.
Jewell Electrical Inst. Co.
Machado & Roller.
Pignolet, L. M.
Stanley Elec. Mfg. Co.
Stanley Instrument Co.
Wagner Electric Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co
Weston Electrical Inst. Co.
Whitney Electl. Inst. Co.

Electro-Plating Mach'y
Crocker-Wheeler Company.
General Electric Co.

Elevators-Conveyors.
Jeffrey Mfg. Co.

Engines, Gas and Gasoline.
Allis-Chalmers Company.
Marinette Gas Engine Co.
Olds Gasoline Engine Works.
Woolley Fdy. & Mach. Wks.

Engines, Steam.
Allis-Chalmers Company.
Sturtevant Co., B. F.

Fans and Fan Motors.
Central Electric Co.
Crocker-Wheeler Company.
Edison Mfg. Co.
General Electric Co.
General Inc. Arc Light Co.
Sprague Electric Co.
Sturtevant Co., B. F.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Fibre.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Files.
Barnett Co., G. & H.

Fittings.
Faries Mfg. Co.

Fixtures, Gas and Elec.
Beardslee Chandeller Mfg. Co.

Flashers.
Bissell Co., The F.
Haller Machine Co.
Reynolds El. Flasher Mfg. Co

Flexible Shafts.
Stow Mfg. Co.

Forges.
Sturtevant Co., B. F.

Fuses and Fuse Wire.
Amer. Elec. Fuse Co.
Bissell Co., The F.
Central Electric Co.
Central Tel. & El. Co.
Chicago Die & Electric Co.
Chicago Fuse Wire & Mfg. Co.
Clinton Stamping & Elec. Co.
D. & W. Fuse Company.
Electric Appliance Co.
Johns-Manville Co., H. W.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Company.

Globes, Reflectors and Shades.
Fostoria Incan. Lamp Co.
Haller Machine Co.
Holophane Glass Co.
Pardridge Shade & Refl. Co.
Phœnix Glass Co.
Wesco Supply Co.
Western Electric Co.

Graphite Specialties.
Dixon Crucible Co., Jos.
Holmes Fibre-Graphite Co.

Heating (Exhaust Steam).
Amer. District Steam Co.

Heating and Ventilating Apparatus.
Sturtevant Co., B. F.

Heating, Hot Water.
Evans, Almirall & Co.

Holders, Inc. Lamps.
Incandescent Electric Light Manipulator Co.

Inspection & Insurance
Hartford Steam Boiler Inspection & Insurance Co.

Insulating Machinery.
New England Butt Co.

Insulators and Insulating Materials.
American Electrical Works.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Inc. Arc Light Co.
Indiana Rub. & Ins. Wire Co.
Johns-Manville Co., H. W.
Kurtavert Mfg. Co.
Manhattan Elec. Supply Co.
Mica Insulator Co.
Munsell & Co., Eugene.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Standard Vitrified Cond. Co.
Sterling Varnish Co.
Vulcanized Fibre Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Junction Boxes.
Bossert Elect. Const. Co.
General Inc. Arc Light Co.

Lamps, Arc.
Bissell Co., The F.
Central Electric Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
General Inc. Arc Lt. Co.
Gregory Electric Co.
Hipwell Manufacturing Co
Manhattan Elec. Supply Co.
Stanley Elec. Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Lamps, Incandescent.
Bissell Co., The F.
Bryan-Marsh Company.
Buckeye Electric Company.
Central Electric Co.
Chicago Edison Co.
Columbia Incan. Lamp Co.
Edison Decorative & Miniature Lamp Dept.
Electric Appliance Co.
Fostoria Incand. Lamp Co.
Franklin Electric Mfg. Co.
General Electric Co.
General Inc. Arc Light Co.
Standard Elec'l Mfg. Co.
Sterling Electrical Mfg. Co.
Wesco Supply Co.
Western Electric Co.

Lamps, Incandescent—Replacers & Cleaners.
Inc. El. Lt. Manipulator Co.

Letters, Metal.
Haller Machine Co.

Lightning Arresters.
Central Electric Co.
Clinton Stamping & Elec. Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
Manhattan Elec. Supply Co.
Minnesota Electric Co.
Stanley Elec. Mfg. Co.
Western Electric Co.

Linemen's Climbers.
Klein & Sons, Mathias.

Magnet Wires.
(See Wires and Cables.)

Measured Service.
Measured Service Co.

Mechanical Draft.
Sturtevant Co., B. F.

Mica.
Chicago Mica Co.
Mica Insulator Co.
Munsell & Co., Eugene.

Mining Apparatus, Elec.
Allis-Chalmers Company.
Crocker-Wheeler Company.
General Electric Co.
Jeffrey Mfg. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Motors. (See Dynamos and Motors.)

Nippers and Pliers.
Klein & Sons, Mathias.

Nozzles.
Faries Mfg. Co.

Paints.
Dielectric Mfg. Co.

Patent Attorneys.
Bain, Foree.

Phosphor Bronze.
Phosphor Bronze Sm. Co. Ltd.

Platinum, Wire and Sheet.
Baker & Company Inc.

Poles and Ties.
Berthold & Jennings.
Brooks, Hall L.
Columbia Mfg. Co.
Fowler, John H.
Fowler-Jacobs Company.
Kellogg Switch. & Sup. Co.
Lindsley Bros. Co.
Loud's Sons Co., H. M.
Maltby Cedar Co.
Morrison Lbr. Co., J. W.
Mueller Company, William.
Pacific Coast Pole Co.
Page & Hill Company.
Phelan, D. W.
Pittsburg & L. S. Iron Co.
Porter Cedar Company.
Sterling & Son, W. C.
Torrey Cedar Co.
Valentine-Clark Co., The.
Worcester Co., C. H.

Polish (Metal).
Allen Co., Inc., L. B.
Hoffman, Geo. W.

Portables.
Faries Mfg. Co.

Power Transmission Machinery.
Jeffrey Mfg. Co.

Rail Joints.
Continuous Rail Joint Company of America.

Rectifiers.
Electrical Appliance Co.

Refiners.
Gt. West Smelt. & Refining Co

Re-Winding—Repairs.
Chicago Edison Co.
Gregory Electric Co.

Rheostats.
Cutler-Hammer Mfg. Co.
General Electric Co.
Gen'l Inc. Arc Lt. Co.
Union Electric Mfg. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Rods, Conduit.
Cope, T. J.

Safes.
Sears, Roebuck & Co.

Schools and Colleges.
Electrical Engineer Inst.
Highland Park College

Second-Hand Mach'y.
Bissell Co., The F.
Cent. Stat. Improvement Co.
Gregory Electric Co.
Matthews & Bro., W. N.
Walsh's Sons & Co.

Shades, Lamp.
Faries Mfg. Co.

Sheet Brass & Copper.
Plume & Atwood Mfg. Co.

Signs, Electric.
Haller Machine Co.
Hermann Mfg. Co.
Zero Marx Sign Works.

Silks, Insulating and Braiding.
Sauquoit Silk Mfg. Co.

Sockets & Receptacles.
Puss & Seymour.
Yost Elec. Mfg. Co.

Soldering Sticks, Salts and Paste.
Allen Co., L. B.
Crescent Co.
Kester Elec. Mfg. Co.
Western Electric Co.

Speaking Tubes.
Central Electric Co.
Edwards & Co.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.

Specialties, Electrical Mfrs. and Designers.
Haller Machine Co.

Speed Indicators.
Weston Electrical Inst. Co.

Storage Batteries.
American Battery Co.
Electric Storage Battery Co.
Gould Storage Battery Co.

Supplies, General Elec.
Bissell Co., The F.
Central Electric Co.
Century Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Electric Co.
Manhattan Elect'l Supply Co
Wesco Supply Co.
Western Electric Co.

Switchboards.
Bissell Co., The F.
Crouse-Hinds Co.
Gen. Incan. Arc Light Co.

Telephones, Telephone Material and Switchboards.
American El. Telephone Co
Automatic Electric Co.
Bissell Co., The F.
Central Electric Co.
Central Tel. & El. Co.
International Tel. Mfg. Co.
Kellogg Switchb. & Sup. Co.
Manhattan Elec. Supply Co.
Stromberg-Carlson Tel. M. Co
Wesco Supply Co.
Western Electric Co.

Time Switches.
Bissell Co, The F.

Tools.
Klein & Sons, Mathias.
Western Electric Co.

Transformers.
Central Electric Co.
Crawfordsville Electric Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Works, Inc.
General Electric Co.
Gregory Electric Co.
Kuhlman Electric Co.
Manhattan Elec. Supply Co.
National Electric Co.
Stanley Elec. Mfg. Co.
Wagner Electric Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Trucks, Electric Car.
General Electric Co.
Westinghouse El. & Mfg. Co.

Turbines, Steam.
Allis-Chalmers Co.
General Electric Co.
Westinghouse El. & Mfg. Co

Turbine Water Wheels
Leffel & Co., Jas.

Varnishes.
Dielectric Mfg. Co.
Sterling Varnish Co.

Vulcanized Fibre.
Vulcanized Fibre Co.

Whistles, Electric.
Electrical Appliance Co.

Wires & Cables—Magnet Wires.
American Electrical Works.
Bissell Co., The F.
Central Electric Co.
Chicago Insulated Wire Co.
Crescent Ins. Wire & Cble. Co.
Electric Appliance Co.
General Electric Co.
Hazard Manufacturing Co.
Indiana Rub. & Ins. Wire Co
India Rubber & Gutta Percha Insulating Co.
Kellogg Switch. & Sup. Co.
Manhattan Elec. Supply Co.
National India Rubber Co
New York Insulated Wire Co.
Okonite Co., The.
Phillips, Eugene F.
Phillips Insulated Wire Co
Roebling's Sons Co., J. A.
Runzel-Lenz Elec. Mfg. Co.
Safety Ins. Wire & Cable Co.
Simplex Electrical Co.
Standard Underground C. Co
Wesco Supply Co.
Western Electric Company.

For Alphabetical Index of Advertisements See Page 3.

THE ELECTRIC STORAGE BATTERY CO.

PHILADELPHIA, PA.

MANUFACTURER OF

The "Chloride Accumulator"

318 INSTALLATIONS AGGREGATING 193,889 K. W. HOURS IN STREET RAILWAY SERVICE

SALES OFFICES: Philadelphia, New York, Boston, Chicago, St. Louis, Cleveland, San Francisco, Toronto, Canada.

DIRECT CURRENT

MOTOR DRIVEN GRINDERS

Bulletin 3050 on Request

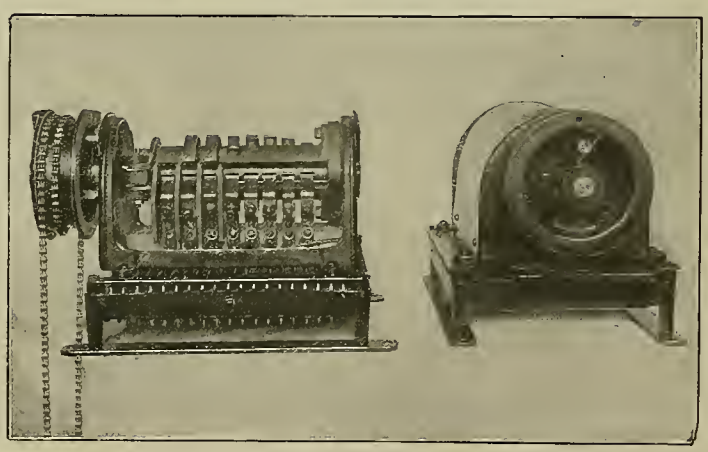
WESTERN ELECTRIC COMPANY

CHICAGO NEW YORK

And Other Leading Cities

Space 17
Electricity Building
Louisiana Purchase Exposition

Rope-Operated, Reversible Drum Controller.



The ideal controller for small cranes and hoists where it is desired to operate from the floor.

Built to stand the most severe usage. Automatic return to "off" position when operator releases chain or rope.

Brushes and contacts are renewable and are made of hard drawn copper.

SPEED—Normal at full load to 50 per cent. at half load.
Specially built for reduction of 90 per cent. regardless of load.

The Cutler-Hammer Mfg. Co.

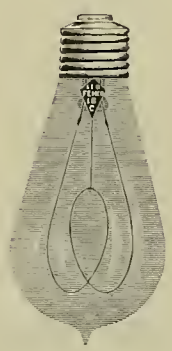
MILWAUKEE, WIS.

New York Boston Chicago Pittsburg

"FEMCO" INCANDESCENT LAMPS

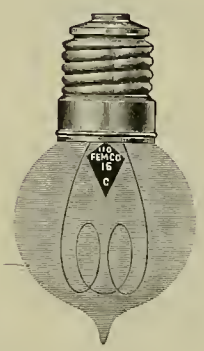
A Complete Line

Regular Type
Reflector Type
Tipless Type
Miniature Type



Quality
Highest

Street Series



Guarantees
Highest

GUARANTEED AS TO VOLTAGE, CANDLEPOWER, EFFICIENCY AND USEFUL LIFE.

Selling Agents Wanted in Western Territory

Prices the Lowest
Consistent with Quality

Write for Catalogue No. 7 and Prices

Shipments Prompt

THE FRANKLIN ELECTRIC MFG. CO.

Licensed Manufacturers

NEW YORK
815 Havemeyer Bldg.

Factory and General Offices
HARTFORD, CONN.

BALTIMORE
2230 Guilford Ave.

Southwestern Representative: **THE SACHS ELECTRIC CO., ST. LOUIS, MO.**

It Will Interest You to Know What the **Western Electric Company** Have to Say Regarding

HIGHEST GRADE NUERNBERG

CARBONS

in their circular, dated November 23, 1903, which in part reads as follows:

"The Western Electric Company have made an exhaustive test of carbons of all kinds and have found that the 'ELECTRA' Carbons cannot be equaled in quality or efficiency, produce practically no dust and give an excellent and steady light. They produce the highest standard of candlepower in proportion to the current consumed, and are the most economical carbons manufactured."

HUGO REISINGER, Sole Importer, 11 Broadway, NEW YORK CITY.

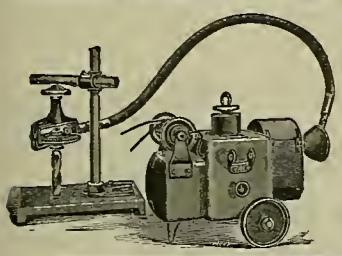
Our Compound Stops Sparking and Saves Commutators.

14 Years' Use on Street Ry., Light and Power Commutators Has Proven its Worth. WE GUARANTEE RESULTS.

Send Your Address for FREE SAMPLE THAT CONVINCES.

JAS. McLAUGHLIN & CO., ELECTRICAL ENGINEERS

586 Fulton Street, - - Chicago, Ill.



ESTABLISHED 1875.

COMBINATION OF

Stow Flexible Shaft

—AND—

MULTI-SPEED MOTOR

Practically dust and water proof. For Portable Drilling, Tapping, Reaming, Emery Grinding, etc. Write for Catalogue and Prices.

STOW MFG. CO., Binghamton, N. Y.

Gen'l European Agents, Selig, Sonnenthal & Co., 85 Queen Victoria Street, London, England

ADJUST YOUR LIGHT

by means of our

Wall, Desk, Floor or Ceiling Adjustable Fixtures

TO ANY DESIRED POSITION INSTANTLY.

Many shapes and styles—plain and ornamental—for shop, factory, store, office, residence—in fact, wherever the incandescent lamp is used.

Catalog mailed upon request.

FARIES MFG. CO.,

DECATUR, ILL.

General Electric Company

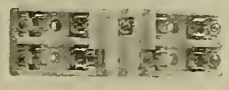
NEW ENCLOSED FUSE CUTOUTS

4" x 2 5/16" x 1 1/8"
Cat. No. 29397

3 7/16" x 3" x 1 1/4"
Cat. No. 29396

4 3/4" x 3 7/16" x 1 1/4"
Cat. No. 29393

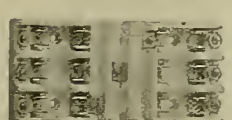
6 7/16" x 2 5/16" x 1 1/4"
Cat. No. 29392



7 7/16" x 2 5/16" x 1 1/4"
Cat. No. 29391

3" x 2 5/16" x 1 1/4"
Cat. No. 29395

3" x 3" x 1 1/4"
Cat. No. 29394



7 7/16" x 3 7/16" x 1 1/4"
Cat. No. 29390

15 Amperes, 250 Volts

Their SMALL SIZE makes them particularly suitable for house wiring

Require LESS WALL SPACE than any other form of Cutout

Furnished in ALL THE STYLES of the 30-ampere plug type

Fuses 1 3-4" in length; 3 to 15 amperes

Write for Flyer 2138

Principal Offices, Schenectady, N. Y.

Chicago Office, Monadnock Block — Sales Offices in all Large Cities

A SUPPLY HOUSE
IS KNOWN BY THE SPECIALTIES IT HANDLES

Have you looked our line over?
Have you copies of our Catalogues and Price Lists?

ELECTRIC APPLIANCE COMPANY
EVERYTHING IN ELECTRICAL SUPPLIES
CHICAGO and SAN FRANCISCO

EDISON MINIATURE LAMPS

Have been for twenty years
The Standard of the World

and are to-day more largely used than all other makes combined.

Serviceable, Economical, Reliable.

Miniature and Candelabra Sockets and Receptacles.

EDISON DECORATIVE & MINIATURE LAMP DEPT.,
General Electric Company, Harrison, N. J.

MICA
Of all Qualities, in any Form at Lowest Prices
EUGENE MUNSELL AND CO.
NEW YORK and CHICAGO

INSULATION That Is.
Micanite, Linotape, M. I. C. Compound, Empire Cloth and Paper. For Years the Standard.

MICA INSULATOR CO., Originators
NEW YORK and CHICAGO

BEARDSLEE CHANDELIER M'F'G CO. 256 AND 257 S. CANAL ST. CHICAGO
GAS & ELECTRIC FIXTURES FOR THE TRADE.
CATALOG SENT PREPAID TO DEALERS MENTION THIS PAPER

YOU NEED IT!

Gale's Commutator Compound.
The Only Article That Will Prevent Sparking.
Will keep the Commutator in good condition and prevent cutting. Absolutely will not gum the brushes.
50c. per stick. $5.00 per dozen Send 50c. for trial stick.
FOR SALE BY ALL SUPPLY HOUSES OR
K. McLENNAN & CO., Sole Manufacturers, Room 411 Inter Ocean Bldg., 130 Dearborn Street CHICAGO

Whitney Instruments

are made in many styles and types. We have a complete line of switchboard and portable

VOLTMETERS, AMMETERS, OHMMETERS, WATTMETERS,

for direct and for alternating current. All of our apparatus is thoroughly guaranteed.

Write for Catalogue and discounts to

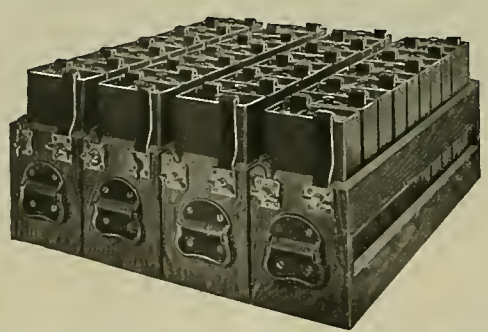
Machado & Roller
203 Broadway,
NEW YORK CITY, N. Y.
Or to your nearest SUPPLY HOUSE.

MICA-BOND
Notice how our competitors try gradually to raise Cut Mica prices—same thing would occur in manufactured mica if we were not the leaders

CHICAGO MICA CO
"PERFECTORS" VALPARAISO, IND.

VOLT - AMMETERS,
POCKET SIZE.
For Testing Batteries and Battery Circuits, Locating Faults, Grounds, etc.
RELIABLE. ACCURATE.
Send for Circular.
L. M. PIGNOLET,
78-80 Cortlandt St., NEW YORK, N. Y.

ALL THE ESSENTIALS



of a good storage battery are found in the

NORTHWESTERN
Large Capacity, Light, Efficient, Compact.

To have your order filled promptly, send to us at once.

Northwestern Storage Battery Co.,
285 Madison St., - - - Chicago, Ill.

DON'T BUY ELECTRICAL SUPPLIES

Until you have seen our new Catalogue and new Price List.
Free to the trade.

Manhattan Electrical Supply Co.
NEW YORK: 32 Cortlandt St.
CHICAGO: 188 Fifth Ave.

Engineering TAUGHT BY CORRESPONDENCE

Our system of training by mail has helped thousands hold down in poor positions to rise to better salaries and situations. Your chance to rise is just as good as others. Write for our free illustrated book, "Can I Become An Electrical Engineer?" We teach by mail, Electrical Engineering, Mechanical Engineering, Steam Engineering, Mechanical Drawing, Electric Lighting, Electric Railways. ELECTRICAL ENGINEER INSTITUTE, Dept. K 240 West 23rd St., New York.

THE B. O. TRANSFORMER

Do you expect to need new transformers this fall? If you do, the B. O. will interest you.

Low Losses
High Efficiencies
High Insulation
Low Price.

Are you familiar with oil duct transformers?
Send us your address and we will tell you about our insulation and the advantages of slab windings in connection with oil ducts.

THE STANLEY ELECTRIC MANUFACTURING COMPANY
PITTSFIELD, MASSACHUSETTS

Atlanta, Ga., Empire Building
CHICAGO, ILL., MONADNOCK BLOCK
New York, N. Y., 29 Broadway
St. Louis, Mo., Century Bldg.
Boston, Mass., Oliver Building
Denver, Col., Hendrie & Bolthoff Mfg. & Supply Co.
Philadelphia, Pa., North American Building
San Francisco, Cal., 69-75 New Montgomery St.
Seattle, Wash., Pioneer Bldg.

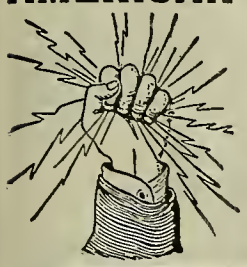
Representatives for the Dominion of Canada, THE CANADIAN GENERAL ELECTRIC CO. of Toronto

"THE S. K. C. SYSTEM"

FRANK N. PHILLIPS, President. O. H. WADENSEIL, Treasurer. EUGENE F. PHILLIPS, General Manager. E. ROWLAND PHILLIPS, Vice-Pres. O. R. REMINGTON, Jr., Sec.

AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.

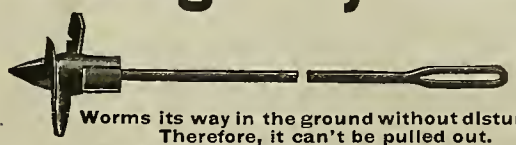


BARE AND INSULATED ELECTRIC WIRE,
ELECTRIC LIGHT LINE WIRE,
INCANDESCENT AND FLEXIBLE CORDS,
Railway Feeder and Trolley Wire,
AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR WIRES.
CABLES FOR AERIAL AND UNDERGROUND USE.

New York Store, W. J. Watson, 26 Cortlandt St.
Chicago Store, F. E. Dunohoe, 82 Lake St.
Montreal Branch, Eugene F. Phillips' Electrical Works.
MAIN OFFICES AND FACTORIES, PHILLIPSDALE, R.I.

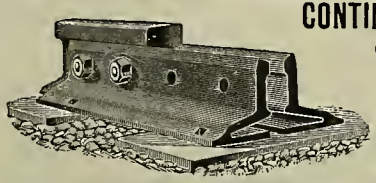
SINGLE AND POLYPHASE
TRANSFORMERS
KUHLMAN ELECTRIC CO., - - Elkhart, Ind.

Simply Screw Them In.
THAT'S ALL
THERE IS TO THE INSTALLATION OF THE
Stombaugh Guy Anchor



Worms its way in the ground without disturbing it.
Therefore, it can't be pulled out.
WRITE FOR FURTHER INFORMATION TO
W. N. MATTHEWS & BRO., Distributors
603 Carleton Building, St. Louis

EXPERT IN ELECTRICITY MECHANICS PATENT CAUSES
SOLICITOR OF U. S. & FOREIGN PATENTS
FOREE BAIN, 1652-3 Monadnock Blk., CHICAGO



CONTINUOUS RAIL JOINT CO. OF AM.
GENL. OFFICES: CENTURY BLDG., NEWARK, N.J.
OVER 20,000 MILES IN USE
See our exhibit, World's Fair, St. Louis, Mo., Transportation Bldg., Aisle "C," Posts 7 and 8.

Engineering MECHANICAL, ELECTRICAL, STEAM, CIVIL.
Complete and short courses. Thoroughly equipped engineering shops. Shop work from the beginning. Short courses in Steam and Electrical Engineering. Expenses low. Accommodations the best. School all year. Students may enter any time. Correspondence steam and electrical courses. Send for catalogue. Mention course in which interested.
HIGHLAND PARK COLLEGE, DES MOINES, IOWA.

"STAR" INCANDESCENT LAMPS

LONG LIFE
GUARANTEED CANDLEPOWER,
HIGHEST EFFICIENCY.
MADE BY THE MOST SKILLED WORKMEN.
STANDARD ELECTRICAL MFG. COMPANY, : Niles, Ohio.

HENRY NEWGARD & CO.
ELECTRICAL CONSTRUCTION
Power and Light Plants. Switchboards and Panel Boards.
We install Municipal and Isolated Electric Lighting Plants.
We manufacture Switchboards, Table boards, Iron Cutout Boxes and Electrical Specialties.
We sell Dynamos, Motors and Electrical Supplies.
We wire old as well as new Residences, Factory Buildings, School and College Buildings.
87 Fifth Avenue, Chicago, Illinois.

YOST SPECIALTIES.

Sookets, Wall Sockets, Weatherproof Sockets, Rosettes, Receptacles, Cord Adjusters.
Catalogue for the asking.
THE YOST ELECTRIC MFG. CO.
TOLEDO, OHIO.

Crimshaw

Raven White Core

Raven Black Core

ALL OUR WIRES pass inspection and carry the above TRADE-MARKS on our tags. We also manufacture Crimshaw and Competition Tapes and Splicing Compounds.

NEW YORK INSULATED WIRE COMPANY.

MAIN OFFICE: 114, 116 & 118 Liberty St., New York.
BRANCHES: CHICAGO: 192 Desplaines St. BOSTON: 7 Otis St. SAN FRANCISCO: 33 Second St.

NATIONAL CODE STANDARD

"O. K." Weatherproof Wire.
Slow-Burning Weatherproof and Ideal Wire.
Prices and Samples on Application.

Phillips Insulated Wire Co.
Office and Factory: PAWTUCKET, R. I.

ELECTRIC SIGNS
INCREASE YOUR CURRENT CONSUMPTION.
Assist us to sell ELECTRIC SIGNS to the best merchants in your city.
No repair bills with our signs we furnish the best—all metal raised letters equipped with removable copper shell sockets. WRITE US, we will conscientiously study your sign wants and gladly submit drawings with very low quotations for the best work.
ZEROMARX SIGN WORKS
CHICAGO, ILL.

WANTED, FOR SALE *and similar* **WANT COLUMN** *advertisements (50 words or less), $1.50 an insertion; additional words 3c each.* **POSITION WANTED** *advertisements (50 words or less), $1.00 an insertion; additional words 2c each.*

POSITION WANTED.

By practical electrician and dynamo man with a good firm. Am competent in any capacity. Married, sober and reliable. At liberty January 1st. Prefer western states or Mexico. Address BOX 404, care Western Electrician, 510 Marquette Building, Chicago.

POSITION WANTED.

As superintendent, electrician or engineer, in electric-light or water-works plant; have had 16 years' experience with dynamos, motors, arc lamps, meters, inside wiring and coostruction work; have had 20 years with boilers, engines and water-works machinery. Will guarantee results. Address BOX 394, care Western Electrician, 510 Marquette Bldg., Chicago.

POSITION WANTED.

As superintendent of electric plant. Experienced in both A. C. and D. C. systems and polyphase work. Can design and construct complete plants. Address BOX 406, care Western Electrician, 510 Marquette Bldg., Chicago, Ill.

WANTED.

Have option for purchase of wholesale electrical supply house in Indianapolis. Established, profitable trade, average business $100,000 per year. Only one competing house in Indiana. Want practical man with capital to join in purchase. W. A. ROYSE, Electrical Contractor, 16 E. Market St., Indianapolis, Ind.

WANTED.

Competent, energetic, designing engineer, one who is thoroughly familiar with up-to-date transformer designing. Give age and experience in detail. Communication strictly confidential. Address BOX 405, care Western Electrician, 510 Marquette Bldg., Chicago, Ill.

MOTOR FOR SALE.

One 50-H. P., 220-volt motor, built by Card Electric Manufacturing Co., Mansfield, Ohio. Address

C. H. DEMPWOLF,
YORK, PA.

FACTORY

FOR SALE AT GREAT BARGAIN.

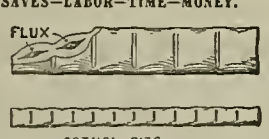
One of the most complete factory properties in the United States, situated in Massachusetts, midway between Boston and Providence. 10 acres of land with new substantial brick buildings, containing over 100,000 square feet of floor space. Boilers and engines of 750 horsepower. Sturtevant heating system, gas plant, electric plant, elevators, etc. ALL IN PERFECT ORDER and having direct connection with the New Haven & Hartford Railway System. Abundance of cheap labor of all kinds. WILL BEAR THE STRICTEST INVESTIGATION. Immediate possession and terms to suit.

NICHOLSON & CO.,
FACTORY BROKERS, SOLE AGENTS,
150 BROADWAY, NEW YORK.

KESTER SELF FLUXING SOLDER

A Tube of Solder Filled with Flux.
Requires no Acid.

SAVES—LABOR—TIME—MONEY.



ACTUAL SIZE

PATENTED.

Send for Free Samples.

L. F. Mahler Co., R. 1008 Chemical Bldg., St. Louis, Mo., Gen. Western Agent.

KESTER ELECTRIC M'F'G CO.,
46 N. UNION STREET, CHICAGO, ILL.

FOR SALE

1 Stanley generator, two-phase, 16,000 alternations, 1,000-2,000 volts, 40 K. W., 1333 R. P. M. and exciter.
1 Stanley generator, two-phase, 16,000 alternations, 1,000-2,000 volts, 60 K. W., 1,000 R. P. M. with exciter.
Complete marble switchboard with new instruments for above.
1 Westinghouse generator, 76 K. W., single-phase, 1,100 volts, 7,200 alternations, exciter, switchboard, new instruments complete, 750 R. P. M.
2 New belts.
1 Russell 13x20 4-valve engine, 200 R. P. M.
1 Ball 9½x10 engine, 350 R. P. M.
2 Boilers, 16x54 inch, 42 4-inch tubes, allowed 110 lbs. pressure, complete with 50-foot stack.
1 Hoppes heater. All steam pipe, valves, etc.

All in good condition. Can be seen running until December 15th. We are abandoning this plant on account of removal, and will sell all or in part. For further information, address

TIBBE ELECTRIC CO., Washington, Mo., or
RUEBEL-SCHWEDTMANN-WELLS, St. Louis.

REPAIRING RECALIBRATING

ELECTRIC METERS.

INTERNATIONAL ELECTRIC METER CO.
167 S. CANAL STREET, CHICAGO.

FOR SALE.

ALTERNATORS.

1-360 K. W. General Electric 3-phase.
1-120 " " " "
1-75 " Westinghouse 2-phase.

250-VOLT GENERATORS.

1-250 K. W. Western Electric M. P.
1-200 " Eddy M. P.

125-VOLT GENERATORS.

1-125 K. W. Western Electric M. P.

Immediate shipment.

GREGORY ELECTRIC CO.
54-62 S. CLINTON ST. CHICAGO

INDUSTRIES ARE OFFERED LOCATIONS WITH

Satisfactory Inducements,
Favorable Freight Rates,
Good Labor Conditions,
Healthful Communities,

ON THE LINES OF

THE ILLINOIS CENTRAL R. R.
AND THE
YAZOO & MISSISSIPPI VALLEY R. R.

For full information and descriptive pamphlet address

J. C. CLAIR,
Industrial Commissioner,
1 Park Row, Chicago, Ill.

ELECTRICAL BOOKS.

All Kinds.
ELECTRICIAN PUBLISHING COMPANY,
Suite 510 Marquette, CHICAGO.

All Supply Houses

J. J. EGAN'S "ACME" COMMUTATOR COMPOUND.

J. J. EGAN'S "ACME" COMMUTATOR COMPOUND absolutely prevents sparking or cutting. One stick of "Acme" is equal to one gallon of oil for lubricating commutators. Free Sample. AGENTS WANTED. 50c per Stick. $5.00 per doz.

J. J. Egan Sale Mfg., 317 Austin Ave., Tel. Polk, 1779 Chicago

EDWARDS AND CO.
New York, N.Y. U.S.A.

ELECTRO-MECHANICAL GONG

Is entirely encased in iron and is weather-proof. The mechanism is very powerful and gives 375 blows to each winding. Continuous ringing or single stroke.

Western Electric Co., Selling Agents.

BOILERS.

One 42-in. x 16 ft. 9-in., 250 H. P. Worthington Water Tube.
One 60-in. x 16 ft., John Mohr Return Tubular Boiler.
One 54-in. x 16 ft., John Mohr Return Tubular Boiler.
One 54-in. x 16 ft., Devine Tubular Boiler.

ENGINES.

One 600 H. P., 21 x 36 x 30, Williams Tandem Horizontal Compound, 140 R. P. M.
Two 600 H. P., 20 x 30 x 24, Porter-Allen Tandem Compound, 200 R. P. M.
One 250 H. P., 12 x 24 x 18 Williams Tandem Compound, 250 R. P. M.
Two 100 H. P., 13 x 12, Dick & Church, High Speed Automatic.

PARTIAL LIST ONLY.

Send for latest Catalogue for bargains in Engines, Boilers, Dynamos and Motors.

CENTRAL STATION IMPROVEMENT CO., 938 Monadnock Block, Chicago

WANTED

ELECTRIC LIGHT PLANTS

ELECTRIC STREET CAR LINES

They are wanted by some good towns in Illinois, Missouri, Kansas and Nebraska.
If you really "mean business," you can get particulars by writing

Burlington Route

W. H. MANSS,
Industrial Commissioner,
209 Adams Street - - CHICAGO

N456

WORKS QUICK AND EASY. KEEPS ITS LUSTER. HOLDS OLD TRADE AND MAKES NEW. DOES NOT DETERIORATE. ESTABLISHED 16 YEARS. SOLD BY AGENTS AND DEALERS ALL OVER THE WORLD

U.S. METAL POLISH GEO. W. HOFFMAN

3 OUNCE BOX 10 CENTS. SAMPLES SENT FREE

POLISHES ALL METALS. BRANCHES NEW YORK, CHICAGO, SAN FRANCISCO. 295 E. WASHINGTON ST. INDIANAPOLIS, IND.

OFFICE OF
Town Clerk
A. R. KAUFMAN, CLERK

BOARD OF TRUSTEES
GEO. A. PAINTER
A. Y. FINKBONER
J. J. HEREN
F. VAN NUYS, ATTY.

Summitville Ind. Nov 23 1903

Western Electrician
Chicago Ill.

Gentlemen: You may discontinue our Want Advertisement with the One issue. As I have already received about 40 answers to same. Send me your bill and I will remit same to you Thanking you very kindly for your promptness
I am Yours Resp.

A. R. Kaufman
Clerk.

CHICAGO EDISON COMPANY REPAIR SHOPS

76 MARKET STREET, CHICAGO. TELEPHONE MAIN 1280.

Machine and Carpenter Work of All Kinds
Correspondence Solicited.

OPEN DAY AND NIGHT.

FIRST-CLASS EQUIPMENT THROUGHOUT.

Dynamos Armatures, Motors, Arc Lamps, Fans, Instruments.

ARNOLD ELECTRIC POWER STATION Co.
Engineers, Constructors for Complete Electric Plants. Results Guaranteed.
SUITE 1539, MARQUETTE BLDG., CHICAGO.
NEW YORK OFFICE: 711 TRANSIT BLDG.

BYLLESBY, H. M. & Co.
(Incorporated)
ENGINEERS
Design, Construct and Operate Railway, Light, Power and Hydraulic Plants.
Examinations and Reports.
New York Life Building, - CHICAGO, ILL.

HORNADAY, J. P. & Co.
SUITE 1108 TRACTION BUILDING
CINCINNATI, O.
WATERWORKS, ELECTRIC RAILWAY, LIGHT, TRACTION, INDUSTRIAL AND MINERAL PROPERTIES BOUGHT AND SOLD

RUEBEL - SCHWEDTMANN-WELLS,
CONSULTING, MECHANICAL AND ELECTRICAL ENGINEERS,
Suite 801 Chemical Building, ST. LOUIS, U. S. A.

F. B. BADT,
Monadnock, Chicago.

EVANS, ALMIRALL & CO.,
Central Station Heating, High Pressure Piping.
1057 Monadnock Blk., Chicago.

ROBERT W. HUNT & Co.,
ENGINEERS
1121 The Rookery, Chicago. 66 Broadway, New York.
Monongahela Bank Bldg., Pittsburg.
Norfolk House, Cannon St., London.

Long Distance Phone Central 2148.
SCHOTT, W. H.,
ENGINEER AND CONTRACTOR,
SPECIALTIES—Central Station Heating Plants, Water Works Steam Plants, Electric Light, Gas and Street Railway Plants.
1220-21 MARQUETTE BUILDING, CHICAGO.

W. E. BAKER. H. B. BISHOP.
BAKER, W. E. & CO.
ENGINEERS,
ELECTRIC RAILWAYS.
27 William St., NEW YORK.

E. W Hammer, Pres. and Treas. H. J. Minhinnick, Sec. and Gen'l Sup't.
GENERAL ENGINEERING Co., THE Consulting and Contracting Engineers.
Telephones, Electric Light, Power Transmission
Suite 1112, 135 ADAMS ST., CHICAGO.
Long Distance Telephone Central 478.

KEMP, R. W.
Consulting and Contracting Telephone Engineer.
Plans and specification for complete plants. Old plants overhauled and placed on paying basis. Territory, Kansas, Oklahoma and Indian Territory.
WELLINGTON, - - - KANSAS.

TRY IT.
Keep your name and address in this directory where it will be seen by possible clients.

ENGINEERS
Represented in this "Directory" are enabled to come in touch with many prospective customers who cannot be reached through any other source.

A WEEKLY REPRESENTATION
in this "Directory" enables engineers to keep before all possible customers.

KOHLER BROS.,
Contracting Electrical Engineers, Lighting Power Railways,
1804-1806-1808-1810-1812 Fisher Building, CHICAGO.

STANTON, LE ROY W.
Consulting Telephone Engineer
Plans, Specifications and Supervision of Installation of Complete Telephone Plants
Special Reports on Telephone Properties and Apparatus
411 Electrical Bldg., Cleveland, Ohio

BRYAN, WILLIAM H.
M. Am. Soc. M. E.,
Consulting Mechanical and Electrical Engineer.
Lincoln Trust Building, ST. LOUIS.

J. H. HALLBERG
Consulting Engineer
Electric Light, Power and Railway Plants
Suggestions to secure Economy, Specifications, Examinations and Reports
45 Broadway, NEW YORK
Long Distance Telephone 4578 Broad

IT WILL PAY
engineers not represented in this department to carry a card regularly.

Telephone Main 3123.
WILMERDING, C. H.
CONSULTING ENGINEER
1100 Old Colony Bldg., CHICAGO.

DUGALD C. JACKSON, C. E.
WILLIAM B. JACKSON, M. E.
MEMBERS
AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS
AMERICAN SOCIETY OF MECHANICAL ENGINEERS
AMERICAN SOCIETY OF CIVIL ENGINEERS
ENGINEERS. EXPERTS.
MADISON, WIS.

ALL Live men read the WESTERN ELECTRICIAN Each Week. Do You?

PLACE YOUR "Want" and "For Sale" advertisements in the WESTERN ELECTRICIAN. Immediate Returns.

STREET RAILWAY CONVENTION.

The WESTERN ELECTRICIAN of October 22nd will contain the remainder of the report of the American Street Railway Association meeting held in St. Louis this week. An attractive advertising announcement in this number would undoubtedly prove beneficial to those wishing to increase their business with the street railways of the world.

Send in your copy TO-DAY

WESTERN ELECTRICIAN,
510 Marquette Building. CHICAGO

BOILER WATERS CORRECTED

to remove and prevent scale and to stop corrosion. DEARBORN TREATMENT does the work. Send gallon sample for analysis. Booklet "R" now ready.

DEARBORN DRUG & CHEMICAL WORKS,

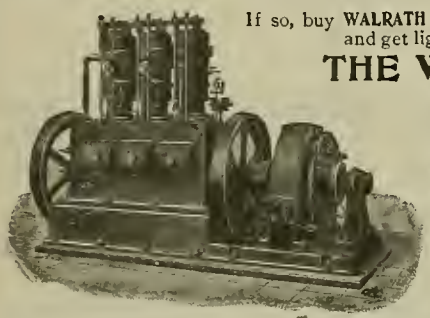
27-34 RIALTO BUILDING, CHICAGO, ILL. WM. H EDGAR, President Telephone: Harrison 3930 and 3931.

Dixon's Traction Belt Dressing *Has a 27 Years' Record* in restoring and preserving the clinging power of leather belts. Descriptive booklet 125E and sample upon request.
JOSEPH DIXON CRUCIBLE CO., JERSEY CITY, N. J.

JEFFREY Elevating, Conveying, Power Transmission, Screening, Crushing Dredging, Rock and Coal Drilling, Coal Cutting, Hauling and Washing Machinery.
OUR CATALOGUES ARE YOURS FOR THE ASKING.
The JEFFREY MANUFACTURING CO., Columbus, O., U. S. A.

REG. TRADE MARKS
"Phosphor Bronze" DELTA
THE PHOSPHOR BRONZE SMELTING CO. LIMITED,
2200 WASHINGTON AVE., PHILADELPHIA.
"ELEPHANT BRAND PHOSPHOR-BRONZE"
INGOTS, CASTINGS, WIRE, RODS, SHEETS, ETC.
— DELTA METAL —
CASTINGS, STAMPINGS AND FORGINGS
ORIGINAL AND SOLE MAKERS IN THE U.S.

FIBRE-GRAPHITE COMMUTATOR BRUSH
SELF-LUBRICATING NOISELESS
There's No Friction
with the Fibre-Graphite Commutator Brush. Being 90 per cent. pure graphite, it insures low resistance, no sparking under a varying load, and longer wear. There is no greasing required. The Fibre-Graphite is therefore the most economic brush on the market. Send for price list.
HOLMES FIBRE-GRAPHITE MFG. CO.
5155 Wakefield St., Germantown, PHILADELPHIA.

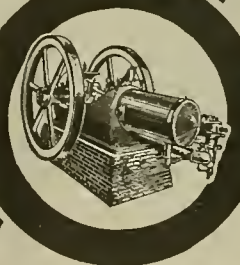
ARE YOU LOOKING FOR MONEY?
If so, buy WALRATH GAS OR GASOLINE ENGINES and get light on the subject.

THE WALRATH
Received the Highest Award at the Pan-American Exposition.
It will produce as good a commercial light as that of an automatic steam engine, either belted or direct-connected generator. Simple, Economical and Reliable
Send for Catalogue W
MARINETTE GAS ENGINE CO.,
CHICAGO HEIGHTS, ILL.
AGENCIES:
Keystone Engineering Co., Farmer's Bank Bldg., Pittsburg, Pa.
Strong, Carlisle & Hammond Co., 61-67 Frankfort St., Cleveland, Ohio
Mackay Engineering Co., 149 Broadway, N. Y.
C. H. Seidenglanz., 52 Wben Bldg., Indianapolis, Ind.

USE
"SAFETY" RUBBER COVERED WIRE AND CABLE
FOR EVERY ELECTRICAL SERVICE.
M. B. AUSTIN & CO.,
CHICAGO REPRESENTATIVE.
THE SAFETY INSULATED WIRE & CABLE CO.,
WORKS: Bayonne, N. J. 114-116 LIBERTY STREET, N. Y.

ARE YOU LOOKING FOR TROUBLE?
IF SO, GET A COPY OF
TELEPHONE TROUBLES
AND HOW TO FIND THEM
—IN—
BOTH MAGNETO AND COMMON BATTERY SYSTEMS.
9th Edition Just Out. Price, 25c.
Electrician Publishing Co.,
510 Marquette Building,
CHICAGO.

"MANROSS"
HAIR SPRINGS
For Electric Indicating and Recording Gauges, Steam Gauges, Etc

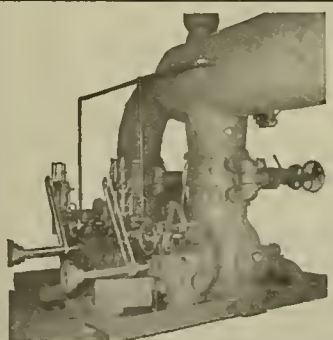
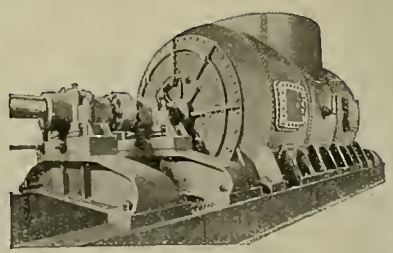
LARGEST MANUFACTURER OF HAIR SPRINGS in the United States.
F. N. MANROSS,
FORESTVILLE, CONN.

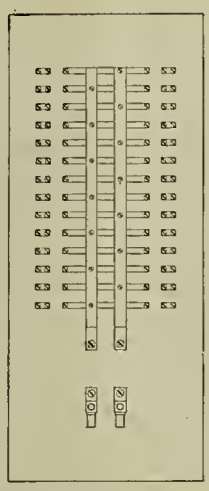

Olds Gas and Gasoline Engines
are backed by a broad guarantee that absolutely protects the purchaser against faults or breakage due to construction or material used. Its liberal terms are made possible by the experience of years which have established the success of the Olds' patents.
STATIONARY ENGINES - - 2 to 100 H. P.
PORTABLE ENGINES - - - 8 to 18 H. P.
Our new illustrated catalog will be sent on request
OLDS GASOLINE ENGINE WORKS,
252 River Street., - - Lansing, Mich.
No. 979

BOOKS.
BUY YOUR BOOKS FROM THE
ELECTRICIAN PUBLISHING COMPANY,
510 Marquette Bldg., CHICAGO.

THE TELEPHONE HAND-BOOK
BY
HERBERT LAWS WEBB.
Price $1.00.
A complete and practical work in handy pocket size.
PUBLISHED BY
THE ELECTRICIAN PUBLISHING CO.,
Suite 510 Marquette Building, Chicago.

HARTFORD STEAM BOILER INSPECTION AND INSURANCE CO.
HARTFORD, CONN.


SAMSON TURBINE
We construct the gates on the SAMSON so that all movable parts will have a maximum wearing surface. As we use only the best material in their construction, we are assured that the life of the gate will be prolonged and there will be no trouble from leakage.

THE JAMES LEFFEL & CO., SPRINGFIELD, OHIO, U. S. A.



PANEL BOARDS

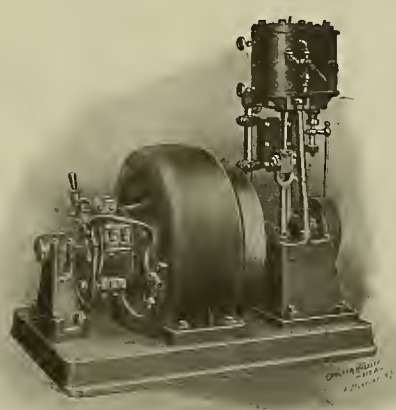
New illustrated Bulletin 20w on Panels, Boxes and Covers will be mailed on request.

THE F. BISSELL COMPANY
TOLEDO, O.

BRYAN-MARSH INCANDESCENT LAMPS, JANDUS ARC LAMPS, NORTHERN MOTORS, CHAPMAN VOLTAGE REGULATORS, EVERYTHING ELECTRICAL.

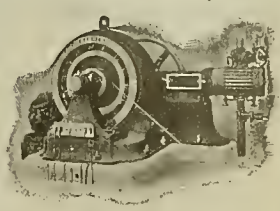
Small Units in Electric Generating Sets.

Write for our estimates and prices.



Crocker-Wheeler Company
Manufacturers of
Generators and Motors
Electrical Engineers
AMPERE, N. J.
Branch Offices in Sixteen Principal Cities

Warren Alternator



Designed and made to

Earn Money with

not to

Spend Money on

WE GUARANTEE WHAT WE SELL

and

SELL WHAT WE GUARANTEE

WARREN ELECTRIC MFG. CO.

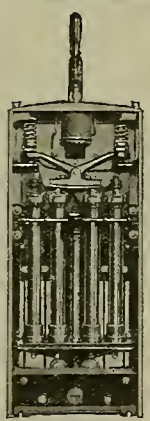
Sandusky, O.

Allen-Bradley Electric Crane Controllers

Patented

Manufactured by AMERICAN ELECTRIC FUSE CO., Chicago

Front View—before starting



Rear View

Front View—all resistance out

A New Controller. Positively No Sparking. No Repairs. Guaranteed for One Year. Three Months' Free Trial. Perfect Control.

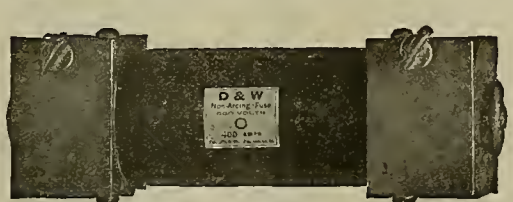
OUR GUARANTEE: Ask any Other Manufacturer to Duplicate It.

THE AMERICAN ELECTRIC FUSE COMPANY hereby guarantees to..... that it will at any time within three months from this date upon demand repay to said..... the sum of..... .....Dollars, being the full purchase price paid (or agreed to be paid) by said..... to the American Electric Fuse Company for one..... horsepower Allen-Bradley Crane Controller, number.....upon delivery within three months after this date of said controller, freight prepaid and in good condition, ordinary wear and tear from use excepted, at the office of the American Electric Fuse Company, Chicago, Illinois, together with a written statement that said controller has proved unsatisfactory to said .....

FURTHERMORE, the said American Electric Fuse Company agrees that it will at any time within one year from this date replace, without charge, any part of said controller which may prove defective or wear out during the ordinary use of said controller, provided that it is a condition of this guarantee that said..... hereby agrees to use ordinary care in the operation of said controller, and that said controller will be operated by some person, or persons, familiar with the use of crane controllers, and further that said controller will not be wilfully or maliciously injured while in the possession of said.....

"SURVIVAL OF THE FITTEST"

THIS IS THE FUSE
ADAPTED BY
INTERBOROUGH RAPID TRANSIT CO.
OF NEW YORK.



FOR ENTIRE FUSE EQUIPMENT OF THE MANHATTAN ELEVATED AND SUBWAY DIVISIONS.

After competitive tests in which the *"D & W"* was THE ONLY FUSE capable of fulfilling all of the conditions imposed upon it.

D. & W. FUSE COMPANY, PROVIDENCE, R. I.

A. HALL BERRY, New York Representative, 97 Warren Street.

AGENCIES:

BOSTON, Pettingell-Andrews Co.
CHICAGO, Central Electric Co.
CINCINNATI, Standard Electric Co.
NEW YORK, Western Electric Co.
PITTSBURG, Western Electric Co.
DENVER, Western Electric Co.
SAN FRANCISCO, California Electrical Works.
KANSAS CITY, Western Electric Co.
PHILADELPHIA, Western Electric Co.
ST. PAUL, American Electric Co.
ST. LOUIS, Western Electric Co.

SAUQUOIT SILK MFG. COMPANY.

INSULATING and BRAIDING SILKS

MILLS:
BETHLEHEM, PA.
PHILADELPHIA, PA.
SCRANTON, PA.

NEW YORK REPRESENTATIVES:
WILLIAM RYLE & COMPANY
54 Howard St.

PHILADELPHIA OFFICE:
4015 Clarissa St.

CHICAGO OFFICE:
210 Monroe St.

BOSTON OFFICE:
78 Chauncy St

CORDS AND CABLES

We manufacture Cords of all descriptions used in conjunction with Telephone and Switchboard work, also Cables for Switchboard and Interior Purposes.

Write us for Prices

RUNZEL-LENZ ELECTRIC MFG. CO.
97-101 S. CLINTON STREET CHICAGO

"The King's Highway."

TO THE
GATEWAYS OF COMMERCE
THROUGH THE
CENTERS OF POPULATION,

adding greatly to the interest of your journey, without increasing its expense beyond what you would expect to pay for the "best," which you secure if you travel by the

NEW YORK CENTRAL LINES.

A Copy of "Four-Track Series" No. 13. "Urban Population in 1900," will be sent free, on receipt of a two-cent stamp by George H. Daniels, General Passenger Agent, New York Central & Hudson River R. R., Grand Central Station, New York.

ROBT. FERRIS' BOOK ON METERS

IS SO SIMPLE THAT ONE WONDERS AT THE COURAGE OF THE AUTHOR

IT TELLS JUST WHAT SOME PEOPLE THINK THEY KNOW.

Written expressly for the men who handle the pliers.
Sent prepaid on receipt of $1.00. Address

ELECTRICIAN PUB. CO.,
510 Marquette Bldg., CHICAGO.

127 FULTON STREET CHICAGO

SIGNS

For Signs, Letters, Flashers, Dimmers, Timeswitches, Lamps, Rubberrings and anything pertaining to Signs,
—WRITE TO—

HALLER MACHINE COMPANY
Designers and Manufacturers, of Sheetmetal, Electric and Machinery Specialties

"Practical and to the Point"

IS ALL THAT NEED BE SAID OF

THE TELEPHONE HAND-BOOK

By HERBERT LAWS WEBB.

160 Pages, 133 Illustrations, Cloth, Price $1.00.

The book for those interested in telephony.

ELECTRICIAN PUBLISHING CO.,
510 Marquette Bldg.,
CHICAGO.

BITUMINIZED FIBER CONDUIT

FOR UNDERGROUND CONSTRUCTION

Combines the **good features** of other conduits.
Eliminates the **bad features** existing in many kinds.
Has valuable features not found in any other ducts.

Made in 7-foot lengths with male and female joints, making construction very rapid and simple, with consequent low cost.

Alignment is perfect and permanent without tedious care and skill required in laying of butt-joint conduits.

Users are astonished by the ease and rapidity with which cables can be drawn in, and this without the slightest scratching or injury to the lead covering thereof.

Made in sizes from 1-inch to 10-inch diameter.

Bends of any radius and any angle.

Write us for further information and prices, stating sizes and quantities required.

American Conduit Co.
Main Offices: 1005-6 Manhattan Building, Chicago
Other Offices:
170 Broadway, New York. 336 Macy St., Los Angeles

We introduced successful 4-party lines

LEICH SELECTIVE SYSTEM

INDEPENDENT TELEPHONE

Write for our booklet—"Selective W."

CENTRAL ENERGY OR MAGNETO

Impedance Coil for Selectives. No Springs.

AMERICAN ELECTRIC TELEPHONE CO.
CHICAGO, ILLINOIS

INDEPENDENT TELEPHONE

INTERNATIONAL

Mechanical Self-Restoring Drop Switchboard.

A PERFECT APPARATUS.

Made in any desired capacity.
Sample parts and quotations on request.

INTERNATIONAL TELEPHONE MANUFACTURING CO.
CHICAGO, U. S. A.

Standard three-bar generator, same as used in our series telephones. We have manufactured generators since we first started in business. What this experience means to you enables us to sell the best generator made at a price slightly above the ordinary. The difference is caused by the better grade of material used and the superior workmanship.

You pay nothing for our experience. Our Bulletin No. 11-E explains fully this apparatus. Mailed free.

Stromberg-Carlson Telephone Mfg. Co.

GENERAL AND EASTERN OFFICE
ROCHESTER, N. Y.

SALES DEPT.
CHICAGO, ILL.

"JUST AS GOOD AS KELLOGG APPARATUS"

cannot be bought outside our factories for the same price we ask—for a higher price or for a lower price.

Our customers never think Kellogg prices high.

We are quoting attractive magneto prices. Write us for quotations on everything in the magneto line.

Send for our new bulletins Nos. 8 to 13.

Do not miss visiting the Kellogg exhibit at the St. Louis Exposition, Electricity Building.

Kellogg Switchboard & Supply Co.,

GREEN AND CONGRESS STREETS, CHICAGO

Electric Building, Cleveland — Keystone Telephone Building, Philadelphia

NUMBER?—REGISTER. (That's all the operator says!)

TAKES STATEMENT OVER THE WIRE. Ask us for particulars.

Measured Service Company, 153 to 159 S. Jefferson St., Chicago.

TELEPHONE PRINCIPLES AND PRACTICE

A NEW BOOK IN TELEPHONY

By
GEORGE WALKER WILDER, PH. D.
Professor in Telephony in the Armour Institute of Technology

Complete and up-to-date, written by a practical man. All about modern telephone apparatus, their principles and use:

I. Fundamental Ideas
II. Telephone Apparatus
III. Systems of Communication
IV. Construction and Equipment

IN 32 CHAPTERS, 450 PAGES, 375 ILLUSTRATIONS. PRICE $2.00 POSTPAID.

Send Postal Money Order to

THE CANTWELL PRESS - Madison, Wis.

100 SUBSCRIBERS of the Citizens' Telephone Company of Grand Rapids, Michigan, were selected at random by a disinterested party and asked how they liked that company's Automatic Telephone Service in comparison with the manual service, which it replaced.

95 OF THEM said it was so perfect that there could be no comparison, they greatly preferred it;

4 OF THEM said they "didn't care which they had;"

1 OF THEM preferred the manual service.

The above percentages indicate the attitude of 6,000 subscribers to Automatic Telephone Service in Grand Rapids.

MR. TELEPHONE MANAGER, if you are trying to satisfy the public and give your patrons the sort of service they appreciate most you will take the hint that this conveys and give them Automatic Service.

AUTOMATIC ELECTRIC CO., Van Buren and Morgan Sts. CHICAGO, U. S. A.

PRODUCERS AND WHOLESALERS OF WHITE CEDAR PRODUCTS

CEDAR POLES

SPECIAL PRICES ON SMALL POLES.
Write for a copy of our TELEGRAPH CODE FOR CEDAR PRODUCTS

YARDS
KOSS MICH.
L'ANSE "
MUNISING "
ONTONAGON
WAGNER, WIS
PESHTIGO "

C. H. WORCESTER CO.
SUITE 1206 TRIBUNE BLDG. CHICAGO.

Cedar TORREY CEDAR CO., CLINTONVILLE, WIS. Poles
Large Stock Constantly on Hand

BRACKETS—X ARMS—PINS
little things it is true, but they cut a big figure in line construction.
OUR MOTTO IS:
Prompt Shipment Quality Satisfaction Right Price
COLUMBIA MFG. CO. ANTIGO, WIS.

MICHIGAN AND WESTERN CEDAR POLES
ALL LENGTHS AND SIZES
LINDSLEY BROS CO.
TRIBUNE BLDG., CHICAGO

Idaho Cedar Poles
PACIFIC COAST POLE CO. SPOKANE, WASH.

POLES W. C. STERLING & SON, MONROE, MICH. TIES.
Eleven Pole Yards in Michigan.
Wholesale Producers for 20 years

POLES, TIES, POSTS. THE PORTER CEDAR CO., SAGINAW, MICH.
PRODUCERS. We want your inquiries always.

WHITE CEDAR POLES
HALL L. BROOKS
52 WISCONSIN AVENUE
TOMAHAWK, WIS.

WHITE CEDAR POLES
Don't forget our Minnesota Transfer Yard—midway between St. Paul and Minneapolis, where we load in forty-eight hours from the time we have your order.
PAGE & HILL CO. 1003 Lumber Exchange, MINNEAPOLIS, MINN.

TO WORLD'S FAIR VISITORS

Certain other Chicago-St. Louis lines have advertised freely in Chicago and elsewhere that they land their passengers at the World's Fair Grounds. Up to a short time ago they were using the Rock Island road to reach the Fair Grounds. A recent order of the United States Court prohibits the Rock Island from handling the trains of other lines. The Wabash is, therefore, the only line that can handle World's Fair travel between Union Station, Page Ava. and the World's Fair Grounds. The Chicago-St. Louis lines referred to have applied for permission tn run their passengers over the Wabash tracks, which permission has been refused. They will be obliged to land their passengers at Union Station, which is over five miles from the World's Fair Grounds.

ALL WABASH TRAINS

to and from St. Louis, both regular and special, pass and stop at the World's Fair main entrance, where the Wabash has its own magnificent passenger station, with every facility for rapid handling of passengers and baggage.

Between Chicago and St. Louis the Wabash has

FOUR DAILY TRAINS

leaving Chicago at 8:45 a. m., 11:03 a. m., 9:17 p. m. and 11:30 p. m. The 11:03 a. m. train is the **Banner Blue Limited** "the latest and only finest day train on earth." This train makes the run from Chicago to St. Louis in seven hours, reducing the usual running time by one hour.

WORLD'S FAIR EXCURSION RATES

from Chicago are: For coach tickets (good only in coaches or free reclining chair cars), with return limit of seven days from date of sale, $6.00. These tickets are on sale every day except Friday and Saturday.

Ten-day tickets, good in coaches, chair cars and sleepers, $8.00. Sold only Oct. 12th, 16th and 17th.

Sixty-day tickets, good in coaches, chair cars or sleepers, $10.00. Sold every day.

Further information promptly furnished upon request.

City ticket office, 97 Adams St., Chicago, Ill.

C. S. CRANE, G. P. & T. A., St. Louis, Mo. F. A. PALMER, A. G. P. A., Chicago, Ill.

Southern Cedar POLES Are the Best.
NO ROTTEN BUTTS. D. W. PHELAN, 277 Broadway, New York

The business of the Western Electrician for the year 1903 was the largest in its history of 17 years.

CENTRAL STATION HEATING

We are the originators and builders of the underground system of live and exhaust steam heating. Our system is used for the utilization and distribution of exhaust steam from electric and power plants for heating purposes. 250 Plants in successful operation. We have the only Meter System. Also manufacturers of Wooden Water Pipe, Steam Pipe Casing, Steam Traps, Condensation Meters, Valves, Economizing Coils, Separators and full line of Steam Fitters' Supplies.

WRITE FOR PAMPHLET AND PRICE LIST

AMERICAN DISTRICT STEAM COMPANY
MENTION WESTERN ELECTRICIAN. LOCKPORT, N.Y. CHICAGO, ILL.

SPEER HIGH GRADE CARBON BRUSHES
MOTOR AND GENERATOR CARBON BRUSHES
SPEER CARBON CO., - St. Marys, Pa.

YOUR TIE ORDER is about due, or is it POLES? We can ship one as quick as the other and it's "Maltby" quality every time. Specials on 8-inch top poles just now.
MALTBY CEDAR COMPANY, 509 Phoenix Block, Bay City, Michigan.
Pittsburg Agents, Tipper & Patton, 509 Bessemer Building.

POLES. WHITE CEDAR. IDAHO CEDAR up to 80 ft.
BERTHOLD & JENNINGS, ST. LOUIS. Chemical Building.
CROSS ARMS. LONG LEAF PINE AND FIR.

Cedar Poles.
Pittsburg and Lake Superior Iron Co. Producers and Wholesalers. Escanaba, Mich.

Locations for Industries
Erie Railroad
Chicago to New York
The Erie Railroad Company's Industrial Department has all the territory traversed by the railroad districted in relation to resources, adaptability, markets and advantages for manufacturing, and can advise with manufacturers in relation to the most suitable locations. For full information address
LUIS JACKSON
Industrial Commissioner, Erie Railroad Company
21 Cortlandt Street, New York

CEDAR POLES
THE
Valentine-Clark Co.
234 La Salle Street, CHICAGO
YARDS:
Pinconning, Mich. : Green Bay, Wis. : New London, Wis.

Poles and Ties
The Fowler Companies
TRADE MARK
Fisher Bldg. Chicago

POLE DEALERS ADVERTISING IN THE WESTERN ELECTRICIAN OBTAIN MOST EXCELLENT RESULTS BECAUSE IT PLACES THEM IN TOUCH WITH ACTUAL BUYERS OF POLES. TRY A CARD.

CEDAR POLES, POSTS, TIES,
H. M. LOUD'S SONS CO., Au Sable, Mich.

CEDAR POLES
ESTABLISHED 1862
WM. MUELLER COMPANY
1211-12-13 MARQUETTE BLDG. CHICAGO.
EIGHT DISTRIBUTING YARDS

Telephone Troubles and How to Find Them.
A complete hand-book for telephone inspectors, by Wm. H Hyde and J. A. McManman.
NINTH EDITION. 52 PAGES. PRICE, 25 CENTS.
The large number of telephone exchange managers and employes will find this book a great help in locating telephone troubles and remedies therefor. Considerable new matter has been added in this edition.
Sent prepaid on receipt of price by the
Electrician Publishing Co., 510 Marquette Building, CHICAGO.

STUDENTS
Will find that the WESTERN ELECTRICIAN can help them wonderfully in the study of electricity. Subscribe now.
$3.00 per year, in advance.
Electrician Publishing Co.,
Suite 510 Marquette Bldg., - CHICAGO

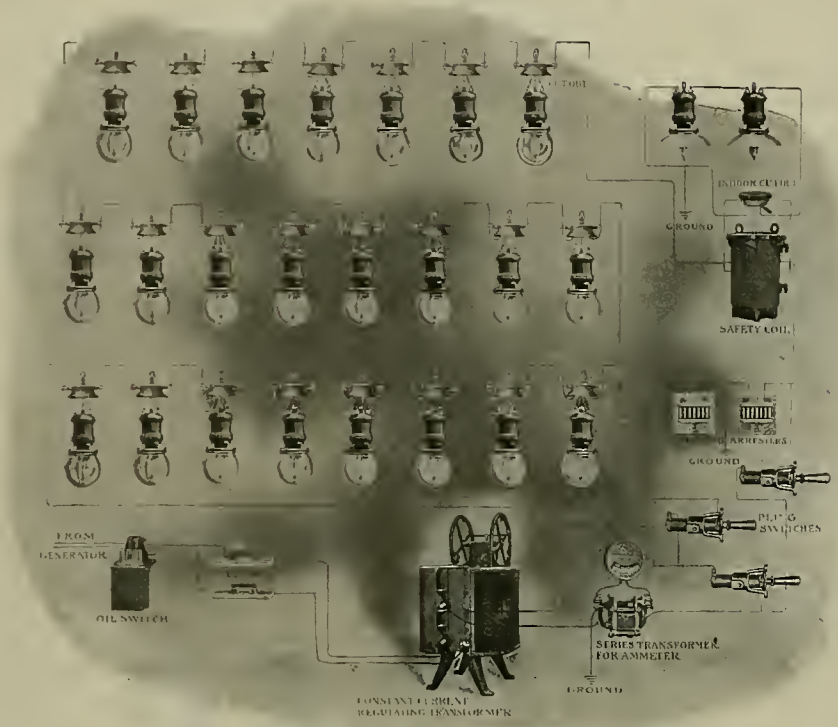
Points in Wisconsin and the Northwest
are covered by Wisconsin Central Railway's convenient, solid, wide vestibuled trains, equipped with Pullman sleepers, free reclining chair cars and modern coaches which leave Central Station, 12th Street and Park Row (Lake Front), Chicago for St. Paul, Minneapolis, Ashland and Duluth, connecting with all western lines. Meals in dining and cafe cars served a la carte.
For tickets and further information apply to nearest ticket agent, or write
JAS. C. POND, Gen'l Pass. Agt., Milwaukee, Wis.

The Electrician Publishing Co., 510 Marquette Bldg., Chicago. Headquarters for all latest Electrical Books. Write for Catalogue.

MICHIGAN WHITE CEDAR POLES LARGE STOCK.
PROMPT SHIPMENTS. KELLOGG SWITCHBOARD & SUPPLY CO., Chicago.

Westinghouse

A. C. Series Arc Lighting System



Gives maximum light for amount of energy used.
Maintenance and operating costs exceptionally low.

Circular 1084 gives full particulars, write for it

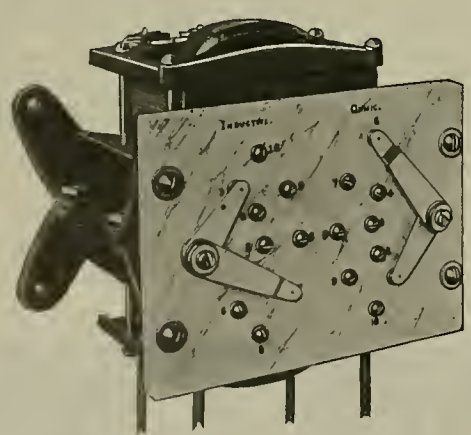
Westinghouse Electric & Mfg. Co.

Pittsburg, Pa.

Address our nearest District Office

New York, Atlanta, Dallas, Baltimore, Boston, Buffalo, Chicago, Cincinnati, Cleveland, Detroit, Los Angeles, Minneapolis, New Orleans, Philadelphia, Pittsburg, St. Louis, Salt Lake City, San Francisco, Syracuse, Seattle, Denver, Mountain Electric Co.

Canada: Canadian Westinghouse Co., Limited, Hamilton, Ontario. Mexico: G. & O. & Braniff Co., City of Mexico.



The Mershon Compensator

Especially recommended for use on circuits supplying power to motors where it is desired to regulate from the central station the voltage at the point of load.

For particulars address

Westinghouse Electric & Mfg. Co.

Sales Offices in all Large Cities. **Pittsburg, Pa.**

For Canada: Canadian Westinghouse Co., Ltd., Hamilton, Ontario.

Type A Insurance

The superior insulation of Type A transformers is merely a matter of insurance.

Every Type A user is the holder of an insurance policy that costs nothing and is as good as a gold bond.

FORT WAYNE ELECTRIC WORKS
WOOD LIGHTING & POWER SYSTEMS
Fort Wayne, Ind.

269

Worth Having!

STEVENS' MECHANICAL CATECHISM

PRACTICAL KNOWLEDGE
FOR
Stationary and Marine Engineers, Firemen, Electricians, Motormen, Ice Machine Men and Mechanics in General.

New and Original. All Modern Machinery fully described and explained. Technical Points made Clear by Word and Drawing. Questions and Answers for Civil Service Examinations, etc.

SUBJECTS TREATED:

WATER, STEAM, COMBUSTION, SMOKE PREVENTION, BOILERS, BOILER CONSTRUCTION, TESTING AND MANAGEMENT, SAFETY VALVES, INJECTORS, PUMPS AND GOVERNORS, STEAM GAUGES, LUBRICATORS, ENGINES, COMMON SLIDE VALVE, TANDEM COMPOUND, CROSS COMPOUND, RECEIVER ENGINES, HOT AIR AND COMPRESSED AIR ENGINES, TRACTION ENGINES, ELECTRIC ENGINES, AUTOMATIC AND CORLISS ENGINES, CONDENSERS, JET AND SURFACE, ECCENTRIC, BALANCED SLIDE VALVE, LINK MOTION, HORSE POWERS IN DETAIL, INDICATOR, REFRIGERATION, ABSORPTION AND COMPRESSION METHODS, BRINE AND DIRECT EXPANSION SYSTEMS, PUMPS, VALVES, TESTS, TABLES, AMMONIA, AMMONIA FITTINGS, LIQUID AIR, MACHINE SHOP PRACTICE, STANDARD NUMBERS AND RULES, PULLEY SPEED CALCULATION, SQUARE ROOT, LEVERAGE, ELECTRICITY, DYNAMOS, ACCUMULATOR, RHEOSTAT, TRANSFORMER, VARIETIES OF DYNAMOS, PARALLEL AND SERIES WIRING, THREE-WIRE SYSTEM, MANAGEMENT AND CARE OF ELECTRIC PLANT, REPAIRS, ELECTRICAL MEASUREMENTS, MOTORS, STATIONARY, TROLLEY AND THIRD RAIL SYSTEMS, CONTROLLER, ELECTRIC LOCOMOTIVE, ELECTRIC HEATING AND COOKING, HOUSE WIRING, DIFFERENTIAL GEAR, FRICTION CLUTCH, COMPOUND CYLINDERS, REVERSING GEAR, THE STACKER. ALSO, THE ELEMENTS OF ALGEBRA MADE EASY.

336 Pages. 240 Illustrations.

PRICE, $1.00. Sent anywhere prepaid on receipt of price.

ELECTRICIAN PUBLISHING COMPANY,
510 Marquette Bldg., Chicago.

Good Advice

No. 12

A station manager is penny wise and pound foolish who uses every precaution to prevent the theft of material from his plant, but allows meters on his lines that are robbing him blind, on account of their not registering all the energy passing through them. If he installs Duncan Direct Current Wattmeters on his circuits, then his losses are at an end with peace and profit as his reward.

Good Advice No. 13 Next Week

Send for Bulletin and Prices

DUNCAN ELECTRIC MFG. CO.
LAFAYETTE, IND.

"Diamond H" Switches

Trade H Mark

This Trade-Mark guarantees quality.

The Hart Mfg. Co., Hartford, Conn.

New York Boston Chicago Toronto, Ont.

KARTAVERT.

HARD AND FLEXIBLE FIBER IN SHEETS, RODS AND TUBING.

For Electrical and Mechanical Purposes, Railway Dust Guards, Washers and Packings. Patent Insulating Cleats.

MANUFACTURED BY

THE KARTAVERT MANUFACTURING CO. Wilmington, Del.

VULCANIZED FIBRE

Highest grades for electrical insulation and mechanical purposes, in sheets, tubes, rods and special shapes. Catalogues and samples on application.

VULCANIZED FIBRE CO., - Wilmington, Del.

WIRES AND CABLES

HIGH-GRADE, RUBBER-COVERED, WEATHER-PROOF

MAGNET, OFFICE, ANNUNCIATOR WIRE.

HAZARD MANUFACTURING CO.,

GENERAL OFFICE AND WORKS, Wilkesbarre, Pa. NEW YORK OFFICE, 50 Dey St. CHICAGO OFFICE, 71 and 73 Wes

Plant of the Independent Light & Power Co., Quincy, Ill.
Equipped with National Revolving Field Alternators.

Direct and Alternating Current

GENERATORS

built in all capacities

for

Central Stations and Railway Power Plants

National Electric Company

GENERAL SALES OFFICE & WORKS:

Philadelphia: 1509 Land Title Bldg.
New York: 135 Broadway
Chicago: Old Colony Bldg.
Pittsburg: Oellatly & Co.

Milwaukee

Charleston, W. Va.: Agnew Elect. Co.
Seattle and San Francisco: Kilbourne & Clark Co.

STURTEVANT MOTORS

All Types, Sizes and Capacities to Meet Any Requirements

B. F. STURTEVANT CO.

Boston, Massachusetts

General Office and Works: Hyde Park, Mass.

New York Philadelphia Chicago London

Black Diamond File Works

Est. 1863. Inc. 1895.

Twelve Medals Awarded at International Expositions

TRADE MARK

Special Prize Gold Medal at Atlanta, 1895.

OUR GOODS ARE ON SALE IN EVERY LEADING HARDWARE STORE IN THE UNITED STATES AND CANADA.

C. & H. BARNETT COMPANY,

PHILADELPHIA, PA.

JOHN A. ROEBLING'S SONS CO.

Insulated Wire of All Kinds

Bare Copper Wire

MAIN OFFICE AND WORKS TRENTON, N. J.

AGENCIES AND BRANCHES

New York Chicago Cleveland San Francisco Philadelphia Atlanta

Western Electrician

Vol. XXXV. $3.00 Per Annum. Copyright, 1903, by Electrician Publishing Company, Chicago. CHICAGO, OCTOBER 22, 1904. Entered at Chicago Postoffice as mail matter of the second class. 10 Cents a Copy. No. 17.

Technology Quarterly
Mass. Inst. of Technology
Boston Mass.

SIMPLEX INSULATED WIRES AND CABLES.
RUBBER COVERED, WEATHERPROOF, UNDERGROUND AND SUBMARINE.
WESTERN SELLING AGENT, H. P. WILSON, 114 Dearborn Street, CHICAGO.
The Simplex Electrical Co., 110 State Street, BOSTON, MASS.

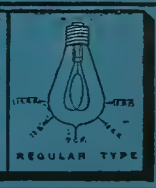
National India Rubber Co.'s
RUBBER COVERED
WIRES AND CABLES.
OFFICE AND FACTORY: BRISTOL, R. I.

OKONITE
TRADE MARK
1889—Paris Exposition, Medal for Rubber Insulation.
1893—World's Fair, Medal for Rubber Insulation.
THE STANDARD FOR RUBBER INSULATION.
Sole Manufacturers of
Okonite Wires, Okonite Tape, Manson Tape, Candee Weather-proof Wires.
THE OKONITE CO., LTD.
Willard L. Candee, W. Dorant Cheever, } Managers. 253 Broadway, New York. Geo. T. Manson, Gen'l Supt. W. H. Hodgins, Secy.

TRADE MARK
CRESCENT INSULATED WIRE & CABLE CO. TRENTON, N.J.
CRESCENT RUBBER INSULATED WIRES AND CABLES
National Code Standard.
CRESCENT INSULATED WIRE AND CABLE CO.,
New York Office, 63 BARCLAY STREET.
Main Office and Factory, TRENTON, N. J.

STERLING SPECIAL

DO YOU?
BUY LAMPS—OR—BUY CANDLE POWER
16 { THIS LAMP AVERAGES } 12
THE STERLING ELECTRICAL MANUFACTURING CO.
NEW YORK, N. Y. WARREN, O. CHICAGO, ILL.


REGULAR TYPE

INDIANA RUBBER AND INSULATED WIRE CO.,
MANUFACTURERS OF
Paranite Rubber Covered Wires and Cables,
UNDERGROUND, AERIAL, SUBMARINE AND INSIDE USE.
TELEPHONE, TELEGRAPH AND FIRE ALARM CABLES.
All Wires are tested at Factory. JONESBORO, IND.

W. D. PAINT.
A PERMANENT INSULATING PROTECTION FOR WOOD OR METAL. A quick drying, moisture-proofing, black paint. An elastic anti-rust coating. A jet black finishing paint, efficient and not expensive.
Write for "Data on Insulating Materials."
DIELECTRIC MANUFACTURING CO., SAINT LOUIS.

"CIRCULAR LOOM" THE FLEXIBLE CONDUIT
AMERICAN CIRCULAR LOOM CO.
TRADE MARK
REGISTERED
CONDUITS FOR INTERIOR WIRING.
American Circular Loom Co.
Chelsea, Mass., New York, Chicago, San Francisco.

THERMOPILES 1½ VOLTS 1½ AMPERES
For Electrolytic analysis, charging storage batteries, and other constant current requirements. $3 Each.
WALSH'S SONS & CO.,
264 Washington Street. Newark, N. J.

THOUSANDS IN USE.
Motors, ⅛ h. p. to 100 h. p.
Dynamos, 1 k. w. to 75 k. w.
Highest Quality. Reasonable Price.
THE HOBART ELECTRIC MFG. CO.
TROY, OHIO.

All Supply Houses
J. J. EGAN'S "ACME" COMMUTATOR COMPOUND.
J. J. EGAN'S "ACME" COMMUTATOR COMPOUND absolutely prevents sparking or cutting. One stick of "Acme" is equal to one gallon of oil for lubricating commutators. Free Sample. AGENTS WANTED.
50c per Stick. $5.00 per doz.
J. J. Egan Sole Mfg., 317 Austin Ave., Tel. Polk, 1779 Chicago

SAUQUOIT SILK MFG. COMPANY,
INSULATING and BRAIDING SILKS
MILLS:
BETHLEHEM, PA.
PHILADELPHIA, PA.
SCRANTON, PA.
NEW YORK REPRESENTATIVES:
WILLIAM RYLE & COMPANY
54 Howard St.
PHILADELPHIA OFFICE:
4015 Clarissa St.
CHICAGO OFFICE:
210 Monroe St.
BOSTON OFFICE:
7B Chauncy St

"STAR" INCANDESCENT LAMPS

LONG LIFE
GUARANTEED CANDLEPOWER,
HIGHEST EFFICIENCY.
MADE BY THE MOST SKILLED WORKMEN.
STANDARD ELECTRICAL MFG. COMPANY, : Niles, Ohio.

SINGLE AND POLYPHASE
TRANSFORMERS
KUHLMAN ELECTRIC CO., - - Elkhart, Ind.

USE
"SAFETY" RUBBER COVERED WIRE AND CABLE
FOR EVERY ELECTRICAL SERVICE.
M. B. AUSTIN & CO.,
CHICAGO REPRESENTATIVE.
THE SAFETY INSULATED WIRE & CABLE CO.,
WORKS: Bayonne, N. J. 114-116 LIBERTY STREET, N. Y.

I-T-E
CIRCUIT BREAKERS
CUTTER ELECTRICAL CO., PHILADELPHIA

WESTON Electrical Instrument Co.,
Waverly Park, NEWARK, N. J.
Weston Standard Portable Direct Reading
Voltmeters, Millivoltmeters, Voltammeters, Ammeters, Milammeters, Ground Detectors and Circuit Testers, Ohmmeters, Portable Galvanometers.

Weston Standard Portable Direct Reading Millivoltmeter.

Our Portable Instruments are recognized as The Standard the world over. The Semi-Portable Laboratory Standards are still better.
Our Station Voltmeters and Ammeters are unsurpassed in point of extreme accuracy and lowest consumption of energy.
LONDON—Elliott Bros., Ceotury Works, Lewisham.
BERLIN—European Weston Electrical Instrument Co., Bitterstrasse No. 88.
Paris, France—E. H. Cadiot, 12 Rue St. Georges
New York Office—74 Cortlandt Street.

SATISFACTION ASSURED

Every battery has its own guarantee.
Lighting Batteries,
Automobile Sparkers.
Prompt delivery made on all orders.
We work night and day
Northwestern Storage Battery Co.,
285 Madison St., - - - Chicago, Ill.

SWEPT THE FIELD!

Three Grand Prizes

Highest Awards

at

World's Fair, St. Louis

One—for 5,000 horsepower Allis-Chalmers Engine

One—for 5,000 horsepower Bullock Generator

One—for Allis-Chalmers Mining Exhibit including Breakers and Hoists

The Big Reliable

The Big Reliable

Gold Medal

for

Bullock Multiple Voltage Balancing Sets

Silver Medal

for

Bullock Street Railway Apparatus.

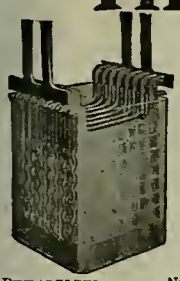
The Engineering Triumph of the World's Fair.

Allis-Chalmers Co. Milwaukee, Wis.

The Bullock Electric Mfg. Co. Cincinnati.

THE ELECTRIC STORAGE BATTERY CO.

PHILADELPHIA



MANUFACTURER OF THE

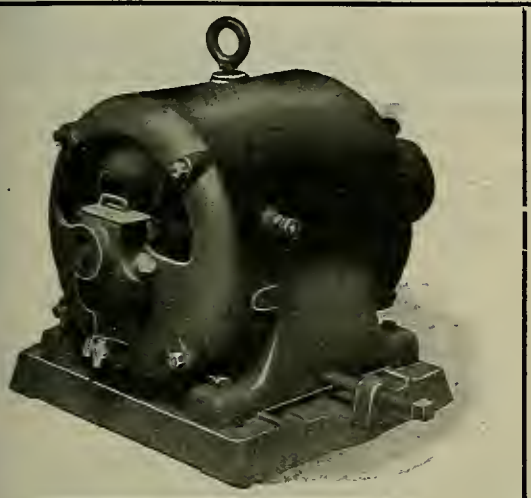
"Chloride Accumulator"

For Central Stations, Electric Railways, Isolated Lighting and Power Stations, Fire Alarm, Telegraph, Train Lighting, etc., etc.

PRICE LISTS AND DESCRIPTIVE BULLETINS FORWARDED UPON REQUEST.

SALES OFFICES:

PHILADELPHIA, Allegheny Ave. and 19th St. | NEW YORK, 100 Broadway, | BOSTON, 60 State St. | CHICAGO, Marquette Bldg. | ST. LOUIS, Wainwright Bldg. | SAN FRANCISCO, Rialto Bldg. | CLEVELAND, Citizens Bldg. | CANADA, Canadian General Electric Co., Ltd. Toronto | HAVANA, CUBA, G. F. Greenwood, Manager 34 Empedrado St.



SINGLE-PHASE, SELF-STARTING

Alternating Current Motors

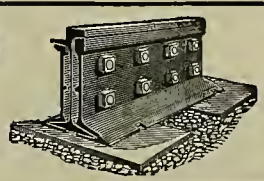
For any place where a constant speed motor can be used. Get our prices before buying. They will interest you.

CENTURY ELECTRIC CO.

1007-9-11 Locust Street, - - St. Louis, Mo.

REPAIRING RECALIBRATING ELECTRIC METERS.
INTERNATIONAL ELECTRIC METER CO.
167 S. CANAL STREET, CHICAGO.

CONTINUOUS RAIL JOINT CO. OF AM.
GENERAL OFFICES: CENTURY BUILDING
NEWARK, N. J.
OVER 20,000 MILES IN USE
Highest Award at Paris Exposition, 1900, Buffalo, 1901



Electric Heating Apparatus
SEND FOR 32-PAGE CATALOGUE.
UNIT" ENAMELED RHEOSTATS
SIMPLEX ELECTRIC HEATING CO.,
Cambridgeport, Mass.

PLATINUM
PLATINUM RIVETS FOR CONTACT POINTS IN TELEPHONES—SPARK COILS AND OTHER ELECTRICAL APPARATUS. PLATINUM SHEET AND WIRE IN ANY FORM AND DEGREE OF HARDNESS. PLATINUM SCRAP PURCHASED.

BAKER & COMPANY, Inc.
ARTISANS IN PLATINUM
408-410-412-414 N. J. R. R. AVE. - NEWARK, N. J.
New York Office: 120 Liberty St.

ALPHABETICAL INDEX TO ADVERTISEMENTS.

Adams-Bagnall Electric Co...—
Allis-Chalmers Company..... 2
American Battery Co.....10
Amer. Circular Loom Co.... ...1
American Conduit Co.....14
Amer. District Steam Co.....17
Amer. Elec. Fuse Co..... 9
Amer. El. Telephone Co.....14
American Electrical Works..11
Arnold Elec. Power Station Co..... 13
Audit Co. of Ill., The..... —
Automatic Electric Co..... 15

Babcock & Wilcox Co.....—
Badt, F. H..... 13
Bain, Furéc..... 11
Baker & Company 3
Baker & Co., W. E.....13
Barnett Company, G. & H....20
Beardslee Chandelier Mfg. Co..... .....—
Bennett, L. A.....17
Berthold & Jennings.....16
Big Four Route.....—
Bissell Co., The F..... 7
Bossert Electric Construction Co..... 20
Brooks, Hall L.....16
Bryan-Marsh Co.....—
Bryan, Wm. H.....13
Buckeye Electric Co.....—
Bullock Elec. Mfg. Co..... 2
Burlington R. R 14
Butterfield, J. F.....13
Byllesby & Co., H. M.....13

Cantwell Press, The.....—
Central Electric Co..... 5
Cent. Stat. Improvement Co.....12
Central Tel. & El. Co.....15
Century Electric Co..... 3
Chicago Dia & Electric Co....11
Chicago Edison Co.....4, 12
Chic. Fuse Wire & Mfg. Co...12
Chicago Insulated Wire Co..—
Chicago Mica Co.....10
Clinton Stamping & Elec Co.15
Columbia Incand. Lamp Co..—
Columbia Mfg. Co.....17
Continuous Rail Joint Company of America..... 3
Cope, T. J..... 8
Crawfordsville Electric Co..—
Crescent Ins. Wire & Cbl. Co. 1
Crocker-Wheeler Company...20
Cutler-Hammer Mfg. Co..... 5
Cutter Elec. & Mfg. Company 1

D. & W. Fuse Company.....—
Dearborn Drug & Chem. Wks.18
Diamond Meter Company....16
Dielectric Manufacturing Co. 1
Directory of Engineers..... 13
Dixon Crucible Co., Joseph..18
Duncan Elec. Mfg. Co.....19

Edison Decorative & Miniature Lamp Deparm't.....10
Edison Mfg. Company.....—
Edwards & Co.....11
Egan, J. J..... 1
Electric Appliance Co..... 10
Electric Storage Battery Co.. 3
Electrical Appliance Co.....—
Electrical Engineer Institute.—
Electrician Pub. Company...13
Erie Ry.....16
Evans, Almirall & Co..... ..13

Faries Mfg. Co..... 8
"For Sale" Advertisements..12
Ft. Wayne Elec. Works, Inc..19
Fostoria Incand. Lamp Co...—
Fowler, John H.....17
Fowler-Jacobs Company.....17
Franklin Elec. Mfg. Co 10

Gates, S. A.....16
General Electric Co..... 9
General Engineering Co., The 13
General Incandescent Arc Light Company.....—
General Incand. Lamp Co....—
Gould Storage Battery Co.... 6
Green Fuel Economizer Co..18
Gregory Electric Company...12

Hallberg, J. H 13
Haller Machine Co.....—
Hart Mfg. Co..... 7
Hartford Steam Boiler Inspection & Insurance Co....—
Hazard Manufacturing Co....—
Hermann Mfg Co.....—
Highland Park College. ... 11
Hipwell Mfg. Co..... 4
Hobart Elec. Mfg. Co..... 1
Hoffman, G. W.....20
Holmes Fibre-Graph. Co.....—
Holophane Glass Co.....—
Hornaday & Co., J. P.....13
Humphrey, Henry H.....13
Hunt & Co., Robt. W.....13

Illinois Central Ry.....12
Incandescent Electric Light Manipulator Company.....—
Indiana Rub. & Ins. W. Co.... 1
India Rubber & Gutta Percha Insulating Company.....—
International Elec. Meter Co 3
International Tel. Mfg. Co...14
Jackson, D. C. & W. B.....13
Jeffrey Manufacturing Co....18
Jewell Electrical Inst. Co....—
Johns-Manville Co., H. W..... 5

Kartavert Manufacturing Co.—
Kellogg Switchboard & Supply Company.....15, 17
Kemp, R. W..... 13
Kester Elec. Mfg. Co.....11
Klein & Sons, Mathias.... ...10
Kuhler Brothers.....13
Kuhlman Electric Co..... 1

Leather Preserv. M. Corp....11
Leffel & Co., James..... 18
Lindsley Brothers Company..17
Loud's Sons Co., H. M.....—

Machado & Roller .....—
Maltby Cedar Company.....17
Manhattan El. Supply Co....17
Manross, F. N. ....—
Marinette Gas Engine Co.....18
Matthews & Bros., W. N.....11
McLaughlin, James.... .....—
McLaughlin & Co., Jas..... 8
McLennan & Company, K....10
Measured Service Co.....—
Mechanical Appliance Co....12
Mica Insulator Company.....—
Minnesota Electric Co.....—
Miscellaneous Advs.....12
Monon Railroad..... ..12
Morrison Lbr. Co., J. W.....16
Mueller Company, William..17
Munsell & Co., Eugene.....10

National Electric Co..... 7
National India Rubber Co.... 1
New England Butt Co.....18
Newgard & Co., Henry..... 8
New York Cent Ry.....17
New York Ins. Wire Co.....11
Northern Elect'l Mfg. Co....10
Northwestern Storage Battery Co.. 1

Okonite Co., The..... 1
Olds Gasoline Engine Works.18

Pacific Coast Pole Co.....16
Page & Hill Co.....—
Paragon Fan & Motor Co.....—
Pardridge Shade & Refl. Co..—
Pass & Seymour, Inc..... 8
Phelan, D. W.....16
Phillips, Eugene F.....11
Phillips Insulated Wire Co...11
Phœnix Glass Co.....—
Phosphor-Bronze S. Co.....18
Pignolet, L. M.....10
Pittsburg & L. S. Iron Co....16
Plume & Atwood Mfg. Co.... 4
Porter Cedar Company.....17

Reisinger, Hugo..... 9
Reynolds El. Flasher Mfg. Co.20
Roebling's Sons Co., J. A.....20
Ruebel-Schwedtmann-Wells..13
Runzel-Lenz Elec. Mfg. Co...—

Safety Ins. Wire & Cable Co.. 1
Sargent & Lundy.....13
Sauquoit Silk Mfg. Co..... 1
Schott, W. H.....13
Simplex Electrical Co., The.. 1
Simplex Elec. Heating Co.... 3
Speer Carbon Co..... .—
Sprague Electric Company... 8
Squire Electric Co.....—
Standard Elec. Mfg. Co..... 1
Standard Underg. Cable Co...—
Stanley Elec. Mfg. Co., The 8
Stanley Instrument Co..... 4
Stanton, LeRoy W..... 13
Sterling & Son, W. C.....16
Sterling Electrical Mfg. Co... 1
Sterling Varnish Co., The....16
Stow Mfg. Company.....—
Stromberg-Carlson Tel. Mfg. Company.....14
Sturtevant Company, B. F...20

Torrey Cedar Company.....17
Trumbull Elec. Mnfg. Co.....—
Turner Brass Works..... 7

Union Electric Mfg. Co.....—

Valentine-Clark Co., The....—
Vulcanized Fibre Company..20

Wagner Electric Mfg. Co..... 7
Walsh's Sons & Company..... 1
Warren Elec. Mfg. Co..... 7
Wesco Supply Co.....10
Western Electric Company... 4
Westinghouse Electric & Manufacturing Co.....—
Weston Electrical Inst. Co... 1
Whitehead Machinery Co... 12
Whitney Electrical Inst. Co..—
Wilmerding, C. H.....—
Wisconsin Central Ry.....17
Woolley Fdy. & Mach. Wks..18
Worcester Company, C. H....16

Yesbera Mfg. Co..... .. 14
Yost Electric Mfg. Co 10

Zero Marx Sign Works 11

For Classified Index of Advertisements See Page 6.

Motors,
Switches,
Arc Lamps,
Circuit Breakers, Etc., Etc.

ALWAYS IN STOCK.

MANUFACTURED BY

G. I. Co.

CHICAGO EDISON COMPANY, 139 Adams Street, CHICAGO.

ARC LAMPS

DIRECT OR ALTERNATING CURRENT

SERIES OR MULTIPLE FOR INDOOR OR OUTDOOR USE

BULLETINS ON REQUEST

WESTERN ELECTRIC COMPANY

CHICAGO NEW YORK
AND OTHER LEADING CITIES

Space 17
Electricity Building, Louisiana Purchase Exposition

Sheet Brass, All Tempers
Brass and Bronze Drill Rods
Brass and Copper Wire
German Silver Sheet and Rod
Brazed and Seamless Tubing

Eagle Brand Copper Rivets and Burrs, Brass Escutcheon Pins

Brass Butts, Desk Narrow, Broad Middle, Ball Tipped and Water Closet

Brass and Iron Jack Chain, Brass Safety Chain, Etc.
Catalogues on Application

THE PLUME & ATWOOD MFG. CO.
New York Boston San Francisco Chicago

"HIPWELL"
ENCLOSED
ARC LAMP
"MARVEL OF MECHANICAL SIMPLICITY"
MADE FOR ALL CIRCUITS—DIRECT AND ALTERNATING
SAMPLES SENT ON 30 DAYS' TRIAL—COSTS NOTHING TO TRY THEM.
HIPWELL MNFG. CO.
ALLEGHENY, PA.

ELECTRICITY FOR ENGINEERS. 424 PAGES. ILLUSTRATED. PRICE $2.50.
ELECTRICIAN PUBLISHING CO., 510 Marquette Building, CHICAGO

STANLEY RECORDING WATTMETERS
FOR ALTERNATING-CURRENT CIRCUITS

BALANCED THRUST
No Jewel Wear from Hammer or Side Thrust. Glass or Metal Covers, Second Alone to the
STANLEY MAGNETIC SUSPENSION WATTMETERS

Missouri, Kansas, Arkansas
FRANK ADAM ELECTRIC CO.
St. Louis

Colorado, Idaho, Montana, Wyoming
New Mexico, Utah
HENDRIE-BOLTHOFF MFG. AND SUPPLY CO.
Denver

SEND FOR BULLETINS AND INFORMATION ABOUT METERS TO
STANLEY INSTRUMENT CO.
GREAT BARRINGTON MASS., U. S. A.

Mexico
VICTOR M. BRASHI & CO.
Mexico City

California, Oregon, Washington
Nevada, Arizona
BROOKS-FOLLIS ELECTRIC CORP.
San Francisco

"COLUMBIA"

NOTED FOR

Efficiency, Long Life, Maintenance of Candlepower

All Candlepowers and Voltages carried in Chicago Stock

ALSO COLUMBIA CRYSTAL LAMPS
WITH PRISMO GLASS SHADES
AND METAL REFLECTORS

GIVE THEM A TRIAL

OKONITE IT NEVER DISAPPOINTS

Central Electric Company,

GENERAL WESTERN AGENTS
264-266-268-270 FIFTH AVENUE, CHICAGO

OKONITE IT NEVER DISAPPOINTS

AFFORD ABSOLUTE SAFETY AS PROTECTIVE DEVICES
AND
FREEDOM FROM ALL

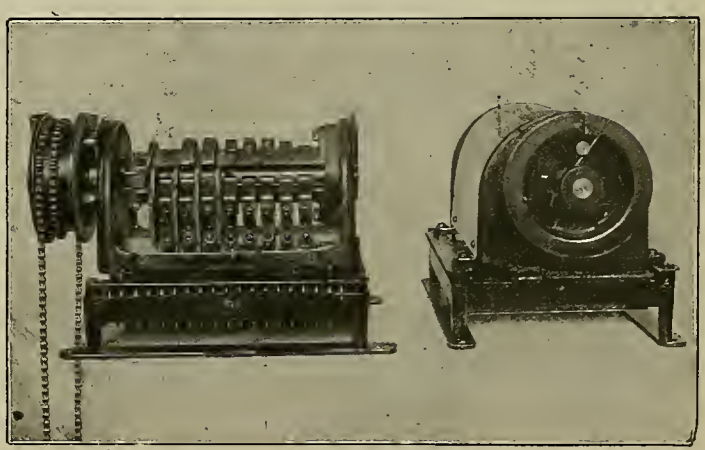
FIRE HAZARD

ASK YOUR SUPPLY DEALER FOR "NOARK"

H. W. JOHNS-MANVILLE CO.
100 William St., NEW YORK

New York, Milwaukee, Chicago, St. Louis, Boston, Philadelphia, Pittsburg, Cleveland, New Orleans, London, Paris, Bruesels

Rope-Operated, Reversible Drum Controller.



The ideal controller for small cranes and hoists where it is desired to operate from the floor.

Built to stand the most severe usage. Automatic return to "off" position when operator releases chain or rope.

Brushes and contacts are renewable and are made of hard drawn copper.

SPEED—Normal at full load to 50 per cent. at half load.
Specially built for reduction of 90 per cent. regardless of load.

The Cutler-Hammer Mfg. Co.
MILWAUKEE, WIS.

New York Boston Chicago Pittsburg

Gould Storage Battery Co.

Complete Storage Battery Plants

Railway Line and Regulating
Isolated and Train Lighting
Central Lighting and Power
Electric Vehicle and Telephone

GOULD COUNTER E. M. F. BOOSTER SYSTEMS

Sales Offices { NEW YORK, 1 W. 34th Street. BOSTON, 89 State Street. CHICAGO, The "Rookery." SAN FRANCISCO, Century Electric Co.

WORKS: DEPEW, N. Y.

Bulletins.

CLASSIFIED INDEX OF ADVERTISEMENTS.

Accountants and Auditors.
Audit Co. of Illinois

Adjusters, Cord.
Incandes. El. Lt. Manip. Co.

Adjusters, Inc. Lamps.
Inc. El. Lt. Manipulator Co.

Anchors (Tel. & Tel.)
Hennett, I. A.
Matthews & Bro., W. N.

Annunciators.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Moon Mfg. Co.
Wesco Supply Co.
Western Electric Co.

Batteries and Jars.
Bissell Co., The F.
Central Electric Co.
Edison Mfg. Co.
Edwards & Company.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.

Bells, Buzzers, Etc.
Central Electric Co.
Edwards & Co.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.

Belt Dressing.
Dixon Crucible Co., Jos.
Leather Preserver Mfg. Corp.

Belting.
Leather Preserver Mfg. Corp

Blow Pipes.
Turner Brass Works

Blowers.
Sturtevant Co., B. F.

Boiler Compounds.
Dearborn Drug & Chem. Wks.

Boilers.
Allis-Chalmers Company.
Babcock & Wilcox Co.

Books, Electrical.
Cantwell Press, The.
Electrician Publishing Co.

Booths, Telephone.
Yesbera Mfg. Co.

Brackets.
Faries Mfg. Co.

Brushes.
Central Electric Co.
Hobart Elec. Mfg. Co.
Holmes Fibre-Graphite Co.
Speer Carbon Co.
Western Electric Company.

Cable Hangers.
Bissell Co., B. F.
Western Electric Co.

Cables (See Wires and Cables)

Canopies.
Faries Mfg. Co.

Carbons, Points and Plates.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
Reisinger, Hugo.
Speer Carbou Co.
Wesco Supply Co.

Castings.
Faries Mfg. Co.
New England Butt Co.
National Electric Co.

Chains.
Jeffrey Mfg. Co.

Chandeliers.
Faries Mfg. Co.

Circuit Breakers.
Cutler-Hammer Mfg. Co.
Cutter Elec. & Mfg. Co.
Ft. Wayne Elec. Wks. Inc.
Union Electric Mfg. Co.
Western Electric Company.
Westinghouse El. & Mfg. Co.

Cinders.
Faries Mfg. Co.

Coal and Ashes Handling Machinery.
Jeffrey Mfg. Co.

Coils and Magnets.
Western Electric Co.

Commutator Compound
Egan, J. J.
McLaughlin & Co., Jas.
McLennan & Co., K.

Condensers, Electric.
Stanley Elec. Mfg. Co.

Conduit and Conduits.
American Circular Loom Co.
American Conduit Company
Central Electric Co.
Electric Appliance Co.
Sprague Electric Co.
Standard Vitrified Cond. Co.
Wesco Supply Co.

Contractors and Electric Light Plants.
Allis-Chalmers Company.
Bullock El. Mfg. Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
National Electric Co.
Northern Electrical Mfg. Co.
Sprague Electric Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Controllers, Crane.
Amer. Elec. Fuse Co.

Cord.
Runzel-Lenz Elec. Mfg. Co.

Cross-Arms, Pins and Brackets.
Berthold & Jennings.
Central Electric Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Company.

Cut-Outs and Switches.
Bissell Co., The F.
Bossert Elec. Const. Co.
Central Electric Co.
Chicago Edison Co.
Clinton Stamping & Elec. Co.
Crouse-Hinds Co.
Cutter Elec. & Mfg. Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
General Inc. Arc Light Co.
Hart Manufacturing Co.
Manhattan Elec. Supply Co.
Trumbull Elec. Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Dynamos and Motors.
Allis-Chalmers Company.
Bissell Co., The F.
Bullock Elec. Mfg. Co.
Central Electric Co.
Century Electric Co.
Crawfordsville Electric Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks. Inc.
General Elec. Co.
General Inc. Arc Light Co.
Gregory Electric Co.
Hobart Elec. Mfg. Co.
Mechanical Appliance Co.
National Electric Co.
Northern Electrical Mfg. Co.
Sprague Electric Co.
Stanley Elec. Mfg. Co.
Stow Manufacturing Co.
Sturtevant Co., B. F.
Wagner Electric Mfg. Co.
Warren Elec. Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Economizers, Fuel.
Green Fuel Economizer Co.

Electric Heating Appl.
Simplex Elec. Heating Co.
Western Electric Co.

Electric Railways.
Crocker-Wheeler Co.
General Electric Co.
Sprague Electric Co.
Westinghouse El. & Mfg. Co.

Electrical and Mechanical Engineers.
Arnold Elec. Power Stat'n Co.
Badt, F. B.
Baker & Co., W. E.
Bryan, Wm. H.
Butterfield, J. F.
Byllesby & Co., H. M.
Evans, Almirall & Co.
General Engineering Co., The.
Hallberg, J. H.
Hornaday, J. P. & Co.
Humphrey, Henry H.
Hunt & Co., Robt. W.
Jackson, D. C. & W. B.
Kemp, R. W.
Kohler Brothers.
McLaughlin, James
Newgard & Co., Henry.
Northern Electrical Mfg. Co.
Ruebel, Schwedtman, Wells.
Sargent & Lundy.
Schott, W. H.
Squire Electric Co.
Stanley Elec. Mfg. Co.
Stanton, LeRoy W.
Wilmerding, C. H.

Electrical Instruments. (Recording and Testing.)
Bissell Co., The F.
Central Electric Co.
Diamond Meter Co.
Duncan Elec. Mfg. Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
General Inc. Arc Light Co.
Jewell Electrical Inst. Co.
Machado & Roller.
Pigoolet, L. M.
Stanley Elec. Mfg. Co.
Stanley Instrument Co.
Wagner Electric Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co
Weston Electrical Inst. Co.
Whitney Electl. Inst. Co.

Electro-Plating Mach'y
Crocker-Wheeler Company.
General Electric Co.

Elevators-Conveyors.
Jeffrey Mfg. Co.

Engines, Gas and Gasoline.
Allis-Chalmers Company.
Marinette Gas Engine Co.
Olds Gasoline Engine Works.
Woolley Fdy. & Mach. Wks.

Engines, Steam.
Allis-Chalmers Company.
Sturtevant Co., B. F.

Fans and Fan Motors.
Central Electric Co.
Crocker-Wheeler Company.
Edison Mfg. Co.
General Electric Co.
General Inc. Arc Light Co.
Sprague Electric Co.
Sturtevant Co., B. F.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Fibre.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Files.
Barnett Co., G. & H.

Fittings.
Faries Mfg. Co.

Fixtures, Gas and Elec.
Beardslee Chandelier Mfg. Co.

Flashers.
Bissell Co., The F.
Haller Machine Co.
Reynolds El. Flasher Mfg. Co

Flexible Shafts.
Stow Mfg. Co.

Forges.
Sturtevant Co., B. F.

Fuses and Fuse Wire.
Amer. Elec. Fuse Co.
Bissell Co., The F.
Central Electric Co.
Central Tel. & El. Co.
Chicago Dle & Electric Co.
Chicago Fuse Wire & Mfg. Co.
Clinton Stamping & Elec. Co.
D. & W. Fuse Company.
Electric Appliance Co.
Johns-Manville Co., H. W.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Company.

Globes, Reflectors and Shades.
Fostoria Incan. Lamp Co.
Haller Machine Co.
Holophane Glass Co.
Pardridge Shade & Refl. Co.
Phœnix Glass Co.
Wesco Supply Co.
Western Electric Co.

Graphite Specialties.
Dixon Crucible Co., Jos.
Holmes Fibre-Graphite Co.

Heating (Exhaust Steam).
Amer. District Steam Co.

Heating and Ventilating Apparatus.
Sturtevant Co., B. F.

Heating, Hot Water.
Evans, Almirall & Co.

Holders, Inc. Lamps.
Incandesent Electric Light Manipulator Co.

Inspection & Insurance
Hartford Steam Boiler Inspection & Insurance Co.

Insulating Machinery.
New England Butt Co.

Insulators and Insulating Materials.
American Electrical Works.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Inc. Arc Light Co.
Indiana Rub. & Ins. Wire Co.
Johns-Manville Co., H. W.
Kartavert Mfg. Co.
Manhattan Elec. Supply Co.
Mica Insulator Co.
Munsell & Co., Eugene.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Standard Vitrified Cond. Co.
Sterling Varnish Co.
Vulcanized Fibra Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Junction Boxes.
Bossert Elect. Const. Co.
General Inc. Arc Light Co.

Lamps, Arc.
Bissell Co., The F.
Central Electric Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
General Inc. Arc Lt. Co.
Gregory Electric Co.
Hipwell Manufacturing Co
Manhattan Elec. Supply Co.
Stanley Elec. Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Lamps, Incandescent.
Bissell Co., The F.
Bryan-Marsh Company.
Buckeye Electric Company.
Central Electric Co.
Chicago Edison Co.
Columbia Incan. Lamp Co.
Edison Decorative & Miniature Lamp Dept.
Electric Appliance Co.
Fostoria Incand. Lamp Co.
Franklin Electric Mfg. Co.
General Electric Co.
General Inc. Arc Light Co.
Standard Elec'l Mfg Co.
Sterling Electrical Mfg. Co.
Wesco Supply Co.
Western Electric Co.

Lamps, Incandescent—Replacers & Cleaners.
Inc. El. Lt. Manipulator Co.

Letters, Metal.
Haller Machine Co.

Lightning Arresters.
Central Electric Co.
Clinton Stamping & Elec. Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
Manhattan Elec. Supply Co.
Minnesota Electric Co.
Stanley Elec. Mfg. Co.
Western Electric Co.

Linemen's Climbers.
Klein & Sons, Mathias.

Magnet Wires.
(See Wires and Cables.)

Measured Service.
Measured Service Co.

Mechanical Draft.
Sturtevant Co., B. F.

Mica.
Chicago Mica Co.
Mica Insulator Co.
Munsell & Co., Eugene.

Mining Apparatus, Elec.
Allis-Chalmers Company.
Crocker-Wheeler Company.
General Electric Co.
Jeffrey Mfg. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Motors. (See Dynamos and Motors.)

Nippers and Pliers.
Klein & Sons, Mathias.

Nozzles.
Faries Mfg. Co.

Paints.
Dielectric Mfg. Co.

Patent Attorneys.
Baln, Force.

Phosphor Bronze.
Phosphor Bronze Sm. Co. Ltd.

Platinum, Wire and Sheet.
Baker & Company Inc.

Poles and Ties.
Berthold & Jennings.
Brooks, Hall L.
Columbia Mfg. Co.
Fowler, John H.
Fowler-Jacobs Company.
Gates, S. A.
Kellogg Switch. & Sup. Co.
Lindsley Bros. Co.
Loud's Sons Co., H. M.
Maltby Cedar Co.
Morrison Lbr. Co., J. W.
Mueller Company, William.
Pacific Coast Pole Co.
Page & Hill Company.
Phelan, D. W.
Pittsburg & L. S. Iron Co.
Porter Cedar Company.
Sterling & Son, W. C.
Torrey Cedar Co.
Valentine-Clark Co., The.
Worcester Co., C. H.

Polish (Metal).
Allen Co., Inc., L. B.
Hoffman, Geo. W.

Portables.
Faries Mfg. Co.

Power Transmission Machinery.
Jeffrey Mfg. Co.

Rail Joints.
Continuous Rail Joint Company of America.

Rectifiers.
Electrical Appliance Co.

Refiners.
Gt. West Smelt. & Refining Co

Re-Winding—Repairs.
Chicago Edison Co.
Gregory Electric Co.

Rheostats.
Cutler-Hammer Mfg. Co.
General Electric Co.
Gen'l Inc. Arc Lt. Co.
Union Electric Mfg. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Rods, Conduit.
Cope, T. J.

Safes.
Sears, Roebuck & Co.

Schools and Colleges.
Electrical Engineer Inst.
Highland Park College

Second-Hand Mach'y.
Bissell Co., The F.
Cent. Stat. Improvement Co.
Gregory Electric Co.
Matthews & Bro., W. N.
Walsh's Sons & Co.

Shades, Lamp.
Faries Mfg. Co.

Sheet Brass & Copper.
Plume & Atwood Mfg. Co.

Signs, Electric.
Haller Machine Co.
Hermann Mfg. Co.
Zero Marx Sign Works.

Silks, Insulating and Braiding.
Sauquoit Silk Mfg. Co.

Sockets & Receptacles.
Pass & Seymour.
Yost Elec. Mfg. Co.

Soldering Sticks, Salts and Paste.
Allen Co., L. B.
Crescent Co.
Kester Elec. Mfg. Co.
Western Electric Co.

Speaking Tubes.
Central Electric Co.
Edwards & Co.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.

Specialties, Electrical Mfrs. and Designers.
Haller Machine Co.

Speed Indicators.
Weston Electrical Inst. Co.

Storage Batteries.
American Battery Co.
Electric Storage Battery Co.
Gould Storage Battery Co.

Supplies, General Elec.
Bissell Co., The F.
Central Electric Co.
Century Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Electric Co.
Manhattan Elect'l Supply Co
Wesco Supply Co.
Western Electric Co.

Switchboards.
Bissell Co., The F.
Crouse-Hinds Co.
Gen. Incan. Arc Light Co.

Telephones, Telephone Material and Switchboards.
American El. Telephone Co
Automatic Electric Co.
Bissell Co., The F.
Central Electric Co.
Central Tel. & El. Co.
International Tel. Mfg. Co.
Kellogg Switchb. & Sup. Co.
Manhattan Elec. Supply Co.
Stromberg-Carlson Tel. M. Co
Wesco Supply Co.
Western Electric Co.

Time Switches.
Bissell Co., The F.

Tools.
Klein & Sons, Mathias.
Western Electric Co.

Transformers.
Central Electric Co.
Crawfordsville Electric Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Works, Inc.
General Electric Co.
Gregory Electric Co.
Kuhlman Electric Co.
Manhattan Elec. Supply Co.
National Electric Co.
Stanley Elec. Mfg Co.
Wagner Electric Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Trucks, Electric Car.
General Electric Co.
Westinghouse El. & Mfg. Co.

Turbines, Steam.
Allis-Chalmers Co.
General Electric Co.
Westinghouse El. & Mfg. Co

Turbine Water Wheels
Leffel & Co., Jas.

Varnishes.
Dielectric Mfg. Co.
Sterling Varnish Co.

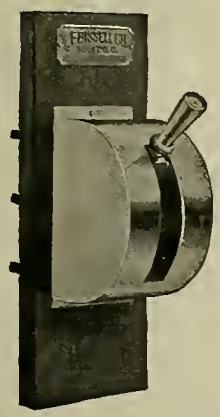
Vulcanized Fibre.
Vulcanized Fibre Co.

Whistles, Electric.
Electrical Appliance Co.

Wires & Cables—Magnet Wires.
American Electrical Works.
Bissell Co., The F.
Central Electric Co.
Chicago Insulated Wire Co.
Crescent Ins. Wire & Cble. Co.
Electric Appliance Co.
General Electric Co.
Hazard Manufacturing Co.
Indiana Rub. & Ins. Wire Co
India Rubber & Gutta Percha Insulating Co.
Kellogg Switch. & Sup. Co.
Manhattan Elec. Supply Co.
National India Rubber Co
New York Insulated Wire Co.
Okonite Co., The.
Phillips, Eugene F.
Phillips Insulated Wire Co
Roebling's Sons Co., J. A.
Runzel-Lenz Elec. Mfg Co.
Safety Ins. Wire & Cable Co.
Simplex Electrical Co.
Standard Underground C. Co
Wesco Supply Co.
Western Electric Company.

For Alphabetical Index of Advertisements See Page 3.

"SECURITY"



Special Theater Switch
(Concealing flash)

We build

**Switches,
Switchboards
Panel Boards**

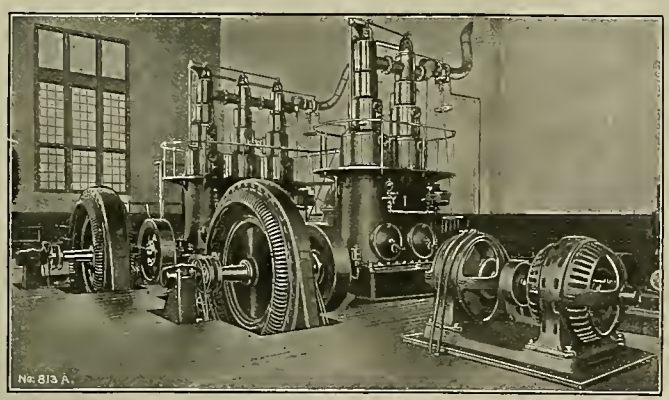
"SECURITY SPECIALTIES"

Correspondence invited.
Ask for special catalogs
and prices.

THE F. BISSELL COMPANY
MANUFACTURERS AND JOBBERS OF
ELECTRICAL GOODS,
226-228-230 HURON STREET,
TOLEDO, O.

Direct and Alternating Current

GENERATORS



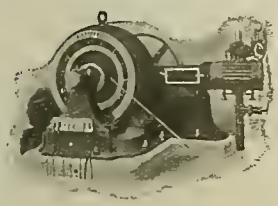
Plant of the Independent Light & Power Co., Quincy, Ill.
Equipped with National Revolving Field Alternators.

We build in all capacities
for
Central Stations and
Railway Power Plants

National Electric Company

GENERAL SALES OFFICE & WORKS:
Philadelphia: 1809 Land Title Bldg. Charleston, W. Va.: Agnew Elect. Co.
New York: 135 Broadway
Chicago: Old Colony Bldg.
Pittsburg: Gellatly & Co. Milwaukee Seattle and San Francisco: Kilbourne & Clark Co.

Warren
Alternator



No
Collector Rings

No Brushes

WE GUARANTEE
WHAT WE SELL

and

SELL WHAT WE
GUARANTEE

WARREN ELECTRIC MFG. CO.

Sandusky, O.

"Diamond H"
Switches

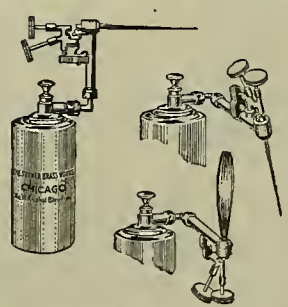
Trade H Mark

This Trade-Mark guarantees quality.

The Hart Mfg. Co., Hartford, Conn.

New York Boston Chicago Toronto, Ont.

SEE THAT FLAME



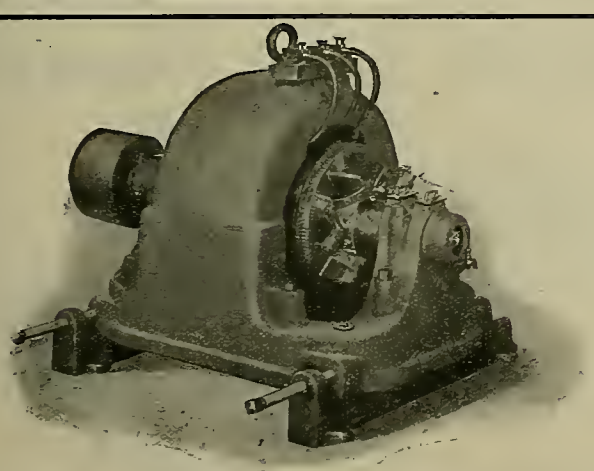
No. 10 Alcohol Blow Pipe. $4.50 each.
Express prepaid upon receipt of cash.
DISCOUNT TO DEALERS.

IT'S JUST WHAT YOU NEED
for fine soldering for internal wiring and switchboard work, storage battery, lead burning, etc.

The Turner Double Jet Alcohol Blow Pipe No. 10.

Burns wood alcohol and produces a clean non-oxidizing needle pointed or a brush flame of over 3,000 degrees of heat. The burner can be turned in any position. Reservoir 2½ x 5 inches. Capacity ¾ pint. Shipping weight 2 lbs.

THE
Turner Brass Works
23 N. FRANKLIN ST., CHICAGO



CENTRAL STATION MANAGERS

Don't Be Afraid

of the Gas Plant

WORK UP A MOTOR LOAD

We can furnish you

SINGLE PHASE MOTORS

that will start under full load in
sizes ranging from ⅛ to 35 H. P.

Wagner Electric Mfg. Co.
ST. LOUIS, MO., U. S. A.

THE B. O. TRANSFORMER

Do you expect to need new transformers this fall? If you do, the B. O. will interest you.

Low Losses
High Efficiencies
High Insulation
Low Price.

Are you familiar with oil duct transformers?
Send us your address and we will tell you about our insulation and the advantages of slab windings in connection with oil ducts.

THE STANLEY ELECTRIC MANUFACTURING COMPANY
PITTSFIELD, MASSACHUSETTS

Atlanta, Ga., Empire Building
CHICAGO, ILL., MONADNOCK BLOCK
New York, N. Y., 29 Broadway
St. Louis, Mo., Century Bldg.
Boston, Mass., Oliver Building
Denver, Col., Hendrie & Bolthoff Mfg. & Supply Co.
Philadelphia, Pa., North American Building
San Francisco, Cal., 69-75 New Montgomery St.
Seattle, Wash., Pioneer Bldg.

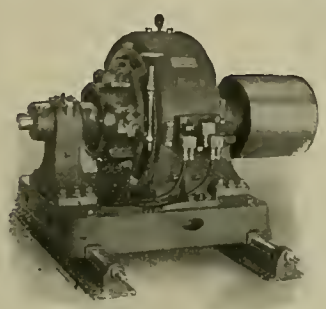
Representatives for the Dominion of Canada, THE CANADIAN GENERAL ELECTRIC CO. of Toronto

"THE S. K. C. SYSTEM"

DIRECT CURRENT

GENERATORS

FOR LIGHT AND POWER



Our generators have a high efficiency and great endurance under the most exacting conditions of service. Sizes up to 1,000 K. W.
Write for bulletin No. 10514.

SPRAGUE
ELECTRIC COMPANY
General Offices:
527 West 34th Street, New York
Chicago Office: Fisher Building

Our Compound Stops Sparking and Saves Commutators.
14 Years' Use on Street Ry., Light and Power Commutators Has Proven its Worth. WE GUARANTEE RESULTS.
Send Your Address for FREE SAMPLE THAT CONVINCES.
JAS. McLAUGHLIN & CO., ELECTRICAL ENGINEERS
586 Fulton Street, - - Chicago, Ill.

HENRY NEWGARD & CO.

ELECTRICAL CONSTRUCTION

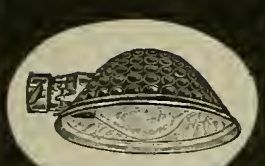
Power and Light Plants. Switchboards and Panel Boards.

We install Municipal and Isolated Electric Lighting Plants.
We manufacture Switchboards, Table boards, Iron Cutout Boxes and Electrical Specialties.
We sell Dynamos, Motors and Electrical Supplies.
We wire old as well as new Residences, Factory Buildings, School and College Buildings.

87 Fifth Avenue, Chicago, Illinois.

FARIES FIXTURES

Shades
Brackets
Clusters
Portables
Canopies
Chandeliers
Nozzles
Fittings
Castings



are UNIVERSALLY USED

Catalog Mailed on Application

FARIES MFG. CO.
DECATUR, ILL.

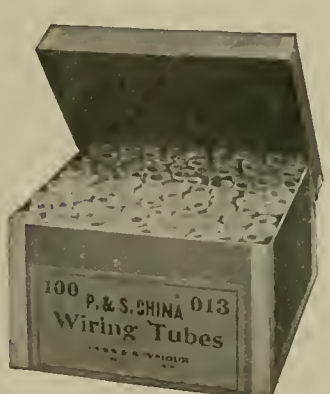
Cope's Patent Quick Coupling Conduit Rod

Remember these rods have no lost motion.
These Couplings are of Steel and are made in the best possible manner.

Write for list of persons using these rods—26,000 sold since May 1902. Made in 3 ft. and 4 ft. lengths. Price, 3 ft. 75 cents, 4 ft. 85 cents. Patented February 24, 1903.

T. J. COPE
3244 North Fifteenth Street PHILADELPHIA, PA.

If you use P. & S. tubes and cleats



You Will Save in Labor, Breakage and Quantity.

Sold by Number, Not by Weight.

PASS & SEYMOUR, Inc.
SOLVAY, N. Y.
NEW YORK CHICAGO SAN FRANCISCO

It Will Interest You to Know What the **Western Electric Company** Have to Say Regarding

ELECTRA
·TRADE MARK·

HIGHEST GRADE NUERNBERG

CARBONS

in their circular, dated November 23, 1903, which in part reads as follows:

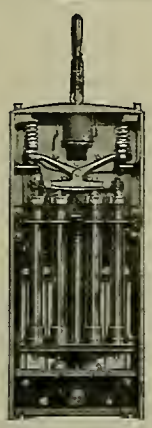
"The Western Electric Company have made an exhaustive test of carbons of all kinds and have found that the 'ELECTRA' Carbons cannot be equaled in quality or efficiency, produce practically no dust and give an excellent and steady light. They produce the highest standard of candlepower in proportion to the current consumed, and are the most economical carbons manufactured."

HUGO REISINGER, Sole Importer, 11 Broadway, NEW YORK CITY.

Allen-Bradley Electric Crane Controllers

Patented

Front View—before starting


Rear View

Front View—all resistance out

Manufactured by AMERICAN ELECTRIC FUSE CO., Chicago

A New Controller. Positively No Sparking. No Repairs. Guaranteed for One Year. Three Months' Free Trial. Perfect Control.

OUR GUARANTEE: Ask any Other Manufacturer to Duplicate It.

THE AMERICAN ELECTRIC FUSE COMPANY hereby guarantees to..... that it will at any time within three months from this date upon demand repay to said..... the sum of..... .....Dollars, being the full purchase price paid (or agreed to be paid) by said..... to the American Electric Fuse Company for one..... horsepower Allen-Bradley Crane Controller, number.....upon delivery within three months after this date of said controller, freight prepaid and in good condition, ordinary wear and tear from use excepted, at the office of the American Electric Fuse Company, Chicago, Illinois, together with a written statement that said controller has proved unsatisfactory to said .....

FURTHERMORE, the said American Electric Fuse Company agrees that it will at any time within one year from this date replace, without charge, any part of said controller which may prove defective or wear out during the ordinary use of said controller, provided that it is a condition of this guarantee that said..... hereby agrees to use ordinary care in the operation of said controller, and that said controller will be operated by some person, or persons, familiar with the use of crane controllers, and further that said controller will not be willfully or maliciously injured while in the possession of said.....

General Electric Company

THREE-PHASE TRANSFORMERS

ARE

CHEAPER, LIGHTER, MORE COMPACT AND MORE READILY INSTALLED

than an equal capacity of Single-Phase Transformers

50 Kw. 40 Kw. 30 Kw. 20 Kw. 15 Kw. 10 Kw. 7.5 Kw. 5 Kw.

Principal Offices, Schenectady, N. Y.

Chicago Office: Monadnock Block. Sales Offices in all Large Cities.

A SUPPLY HOUSE
IS KNOWN BY THE SPECIALTIES IT HANDLES

Have you looked our line over?
Have you copies of our Catalogues and Price Lists?

ELECTRIC APPLIANCE COMPANY
EVERYTHING IN ELECTRICAL SUPPLIES
CHICAGO and SAN FRANCISCO

WANTED
You Who are Troubled with Sparking and Cutting of Commutators to Use

The only article that will PREVENT SPARKING. Will keep the commutator in good condition and PREVENT CUTTING.

Absolutely will Not Gum The Brushes . . .

It will put that high gloss on the commutator you have so long sought after.

50 Cts. per Stick. $5.00 per Dozen.
For Sale by all Supply Houses, or
FREE, Sample Stick.

K. McLENNAN & CO.,
Sole Manufacturers,
Room 411 Inter Ocean Bldg., 130 Dearborn St., CHICAGO, ILL.

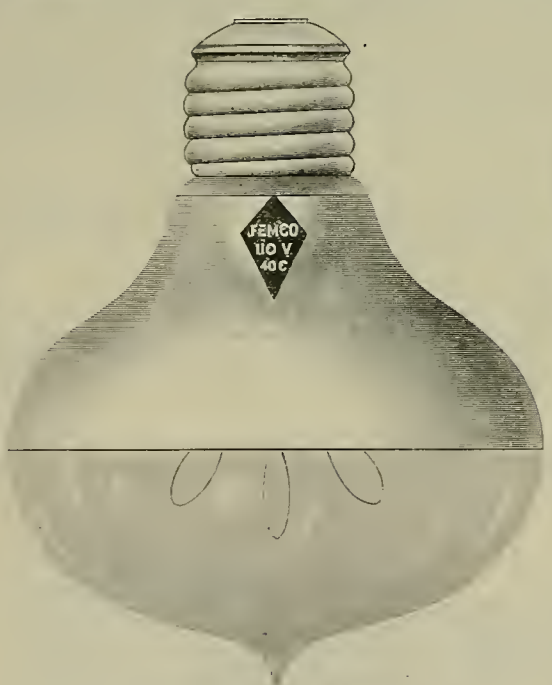
Northern direct-current dynamos and motors are operated daily in a wide range of successful American industries and providing the requisite economy and convenience of operation.

Get Bulletin No. 2533.

CHICAGO SALES OFFICE, SUITE 425 MONADNOCK BLOCK

NORTHERN ELECTRICAL MFG. CO., Madison, Wis., U. S. A.
Engineers, Manufacturers. 248H

The FEMCO Reflector Lamp



40 Candlepower at 48 or 56 watts.

Consumes no more current than an ordinary 16 candlepower lamp.

DO YOU WANT THE AGENCY?

THE FRANKLIN ELECTRIC MFG. CO.,
LICENSED MANUFACTURERS.
Factory and General Offices, Hartford, Conn.

NEW YORK, 815 Havemeyer Bldg.
BALTIMORE, MD., 2230 Guilford Ave.

You've Heard of the

PEERLESS
WESCO

INCANDESCENT LAMPS

If you don't koow them you are missing a great light giving bulb of incandesceoce that is electrically and mechanically perfect and rightly named "Peerless."

They are not labeled **one way** and rated **another.** Rest assured when you are buying "Peerless" lamps you are getting full rated candlepower.

The Wesco guaran'ee stands behiod every "Peerless" lamp for efficiency, sustained candlepower, current-consumptiou and life.

On yearly contracts we are prepared to make the lowest price that has ever been made on a strictly high grade lamp.

ELECTRICAL MACHINERY AND SUPPLIES
WESCO SUPPLY CO, ST. LOUIS, MO. U. S. A.

MICA
Of all Qualities, in any Form at Lowest Prices
EUGENE MUNSELL AND CO.
NEW YORK and CHICAGO

INSULATION That Is.

Micanite, Linotape, M. I. C. Compound, Empire Cloth and Paper. For Years the Standard.

MICA INSULATOR CO., Originators
NEW YORK and CHICAGO

MICABOND
CHICAGO MICA CO.,
"PERFECTORS" VALPARAISO, IND.
THE PEER OF INSULATORS.

VOLT - AMMETERS,
POCKET SIZE.
For Testing Batteries and Battery Circuits, Locating Faults, Grounds, etc.
RELIABLE. ACCURATE.
Send for Circular.
L. M. PIGNOLET,
78-80 Cortlandt St., NEW YORK, N. Y.

"AMERICAN" STORAGE CELLS
ARE THE BEST. Send for descriptive Circular.
AMERICAN BATTERY CO.,
ECT'D 1886. 171 S. Clinton St., Chicago.

M. KLEIN & SON.
Send 2c stamp for new catalogue No. 6 of
KLEIN'S TOOLS
For Electrical Workers and Line Builders.
MATHIAS KLEIN & SONS,
Chicago, Ill.

YOST SPECIALTIES.

Sockets, Wall Sockets, Weatherproof Sockets, Rosettes, Receptacles, Cord Adjusters.

Catalogue for the asking.

THE YOST ELECTRIC MFG. CO.
TOLEDO, OHIO.

EDISON MINIATURE LAMPS

Over 400,000 Annually Shipped to Users.

All types—every variety.
Prompt shipment—in any quantity.

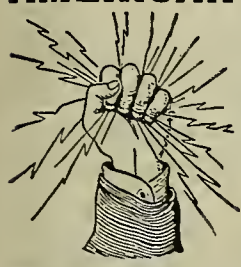
Miniature and Candelabra Sockets and Receptacles.

EDISON DECORATIVE & MINIATURE LAMP DEPT.,
General Electric Company, Harrison, N. J.

FRANK N. PHILLIPS, PRESIDENT. O. H. WAGENSEIL, TREASURER. EUGENE F. PHILLIPS, GENERAL MANAGER. E. HOWLAND PHILLIPS, VICE-PRES. C. R. REMINGTON, JR., SEC

AMERICAN ELECTRICAL WORKS,

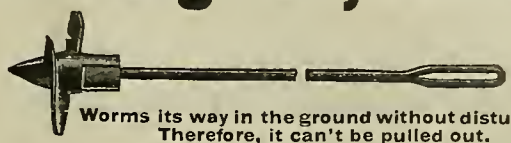
PROVIDENCE, R. I.



BARE AND INSULATED ELECTRIC WIRE,
ELECTRIC LIGHT LINE WIRE,
INCANDESCENT AND FLEXIBLE CORDS,
Railway Feeder and Trolley Wire,
AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR WIRES.
CABLES FOR AERIAL AND UNDERGROUND USE.

NEW YORK STORE, W. J. Watson, 26 Cortlandt St.
CHICAGO STORE, F. E. Donohoe, 82 Lake St.
MONTREAL BRANCH, Eugene F. Phillips' Electrical Works.
MAIN OFFICES AND FACTORIES, PHILLIPSDALE, R.I.

Simply Screw Them In.
THAT'S ALL
THERE IS TO THE INSTALLATION OF THE
Stombaugh Guy Anchor



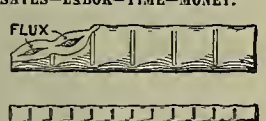
Worms its way in the ground without disturbing it. Therefore, it can't be pulled out.
WRITE FOR FURTHER INFORMATION TO
W. N. MATTHEWS & BRO., Distributors
603 Carleton Building, St. Louis

WE BUY OLD BELTS
OR SCRAPS, ANY SIZE OR CONDITION.
WE CLEAN, REPAIR AND RENEW OLD BELTS.
LEATHER PRESERVER MFG. CORP.
27 W. MONROE ST., CHICAGO

Engineering MECHANICAL, ELECTRICAL, STEAM, CIVIL.
Complete and short courses. Thoroughly equipped engineering shops. Shop work from the beginning. Short courses in Steam and Electrical Engineering. Expenses low. Accommodations the best. School all year. Students may enter any time. Correspondence steam and electrical courses. Send for catalogue. Mention course in which interested.
HIGHLAND PARK COLLEGE, DES MOINES, IOWA.

EXPERT IN ELECTRICITY MECHANICS PATENT CAUSES
SOLICITOR OF **PATENTS**
U. S. & FOREIGN
FORÉE BAIN, 1652-3 Monadnock Blk., CHICAGO

KESTER
SELF FLUXING SOLDER
A Tube of Solder Filled with Flux.
Requires no Acid.
SAVES—LABOR—TIME—MONEY.



PATENTED.
Send for Free Samples.
L. F. Mahler Co., R. 1008 Chemical Bldg., St. Louis, Mo., Gen. Western Agent.
KESTER ELECTRIC M'F'G CO.,
46 N. UNION STREET, CHICAGO, ILL.

YOU BUY
Maxstadt Patent Mica Fuses,
Maxstadt Patent Copper and Steel Wire Joints,
Maxstadt Patent Fuse Blocks and Lightning Arresters—Fuse Wire, Fuse Links, Etc.
We manufacture and
WE SELL THEM
TO THE WISE BUYER THE ABOVE IS SUFFICIENT.
CHICAGO DIE AND ELECTRIC CO.,
87-89-91 W. LAKE STREET,
CHICAGO, - - - - - ILLINOIS.

EDWARDS AND CO
THE "RECTI" BELL
FOR AUTOMOBILES AND ELECTROMOBILES.

No. 100.
This Bell may be placed on the outside of the vehicle without being cased. The gong is adjusted with the concavity downward, so that mud and dust can not collect and deaden the sound.
WESTERN ELECTRIC CO., Selling Agts.
NEW YORK N.Y

Crimshaw

Raven White Core

Raven Black Core

ALL OUR WIRES pass inspection and carry the above TRADE-MARKS on our tags. We also manufacture Crimshaw and Competition Tapes and Splicing Compounds.

NEW YORK INSULATED WIRE COMPANY,

MAIN OFFICE: 114, 116 & 118 Liberty St., New York.
BRANCHES: CHICAGO: 192 Desplaines St. BOSTON: 7 Otis St. SAN FRANCISCO: 33 Secood St.

NATIONAL CODE STANDARD

"O. K." Weatherproof Wire.
Slow-Burning Weatherproof and Ideal Wire.
Prices and Samples on Application.
Phillips Insulated Wire Co.
Office and Factory: PAWTUCKET, R. I.

ELECTRIC SIGNS
INCREASE YOUR CURRENT CONSUMPTION.
Assist us to sell ELECTRIC SIGNS to the best merchants in your city.
No repair bills with our signs we furnish the best—all metal raised letters equipped with removable copper shell sockets. WRITE US, we will conscientiously study your sign wants and gladly submit drawings with very low quotations for the best work.
ZEROMARX SIGN WORKS
CHICAGO, ILL.

WANTED, FOR SALE *and similar* **WANT COLUMN** *advertisements (50 words or less), $1.50 an insertion; additional words 3c each.* **POSITION WANTED** *advertisements (50 words or less), $1.00 an insertion; additional words 2c each.*

POSITION WANTED.

As superintendent or manager of electric light or power plant. Have had 15 years experience in installing and operating light and power plants. Am familiar with all systems and all construction work, also with high speed and Corliss engines, boilers, pumps, etc. Can furnish first-class references. Correspondence solicited. Address BOX 407, care of Western Electrician, 510 Marquette Bldg., Chicago, Ill.

POSITION WANTED.

By an ambitious young man. Would like position with some electrical construction concern or an engineer where he can gain experience. Student of I. C. S. in electric lighting and railways. Salary $40.00 a month. Address BOX 409, care of Western Electrician, 510 Marquette Bldg., Chicago, Ill.

WANTED.

Have option for purchase of wholesale electrical supply house in Indianapolis. Established, profitable trade, average business $100,000 per year. Only one competing house in Indiana. Want practical man with capital to join in purchase. W. A. ROYSE, Electrical Contractor, 16 E. Market St., Indianapolis, Ind.

FOR SALE

1 Stanley generator, two-phase, 16,000 alternations, 1,000-2,000 volts, 40 K. W., 1333 R. P. M. and exciter.

1 Stanley generator, two-phase, 16,000 alternations, 1,000-2,000 volts, 60 K. W., 1,000 R. P. M. with exciter.
Complete marble switchboard with new instruments for above.

1 Westinghouse generator, 75 K. W., single-phase, 1,100 volts, 7,200 alternations, exciter, switchboard, new instruments complete, 750 R. P. M.

2 New belts.

1 Russell 13x20 4-valve engine, 200 R. P. M.

1 Ball 9½x10 engine, 350 R. P. M.

2 Boilers, 16x54 inch, 42 4-inch tubes, allowed 110 lbs. pressure, complete with 50-foot stack.

1 Hoppes heater. All steam pipe, valves, etc.

All in good condition. Can be seen running until December 15th. We are abandoning this plant on account of removal, and will sell all or in part. For further information, address

TIBBE ELECTRIC CO., Washington, Mo., or RUEBEL-SCHWEDTMANN-WELLS, St. Louis.

ELECTRICAL AND OTHER INDUSTRIES ARE OFFERED LOCATIONS WITH

Satisfactory Inducements,
Favorable Freight Rates,
Good Labor Conditions,
Healthful Communities,
ON THE LINES OF
THE ILLINOIS CENTRAL R. R.
AND THE
YAZOO & MISSISSIPPI VALLEY R. R.

For full information and descriptive pamphlet address

J. C. CLAIR,
Industrial Commissioner,
1 Park Row, Chicago, Ill.

ELECTRICAL BOOKS.
All Kinds.

ELECTRICIAN PUBLISHING COMPANY,
Suite 510 Marquette Bldg., CHICAGO

Corliss Engines.

900 h. p., 34x60, International.
900 h. p., 22x42x48, Hamilton Tand. Comp.
750 h. p., 32x54, Hamilton, 1890 Frame.
650 h. p., 30x54, St. Louis, 1890 Frame.
600 h. p., 28x60, Philadelphia.
500 h. p., 16x32x42, Corliss Cross Comp., latest type.
450 h. p., 16x30x42, Allis Cross Comp.
400 h. p., 23½x60, Geo. H. Corliss.
450 h. p., 24x48, Harris, latest type.
450 h. p., 24x48, Brown.
350 h. p., 22x42, Allis, 1890 Frame.
350 h. p., 22x42, Slater, 1890 Frame.
300 h. p., 20x48, Harris.
300 h. p., 20x42, Hamilton.
225 h. p., 12x22x42, Atlas Tandem Comp.
225 h. p., 18x42, Hamilton.
175 h. p., 16x42, Allis.
165 h. p., 16x36, Sioux, 1902.
150 h. p., 15x38, Brown.
140 h. p., 14x42, Allis, 1890 Frame.
125 h. p., 14x36, Putnam.
90 h. p., 12x36, Harris.
600 h. p., 28½x52, Buckeye Automatic.
500 h.p., 17½x30½x27, Buckeye Cross Comp.
450 h.p., 16½x28½x27, Buckeye Cross Comp.
450 h. p., 24x48, Buckeye Automatic.
350 h. p., 16x26x18, Ideal Tandem Comp.
275 h. p., 14x22x16, Ideal Tandem Comp.
250 h. p., 16x27x16, Westinghouse Comp.
200 h. p., 18x24, Meyer Automatic.
150 h. p., 15x24, Cummer.
150h.p., 10½x18x18, Williams' Tandem Comp.
100 h. p., 12½x15, Taylor Beck.

Whitehead Machinery Company,
DAVENPORT, IOWA.

MOTOR FOR SALE.

One 50-H. P., 220-volt motor, built by Card Electric Manufacturing Co., Mansfield, Ohio. Address

C. H. DEMPWOLF,
YORK, PA.

FOR SALE.
ALTERNATORS.

1-360 K. W. General Electric 3-phase.
1-120 " " " "
1-75 " Westinghouse 2-phase.

250-VOLT GENERATORS.

1-250 K. W. Western Electric M. P.
1-200 " Eddy M. P.

125-VOLT GENERATORS.

1-125 K. W. Western Electric M. P.

Immediate shipment.

GREGORY ELECTRIC CO.
54-62 S. CLINTON ST. CHICAGO

Western Electrician WANT ADS Bring Results.

Louisville and Chicago

And the places north
And the places south
And the places between are reached by the quick day and night trains of THE

MONON ROUTE
CHICAGO, INDIANAPOLIS & LOUISVILLE RAILWAY

Also the celebrated health resorts, French Lick and West Baden Springs, are reached only by this road.

Booklets about the Springs, their wonderful waters and the fine hotels, sent free.

CHAS. H. ROCKWELL, Traffic Manager
FRANK J. REED, Gen. Pass. Agt.
202 Custom House Place, Chicago

BOILERS.

One 42-in. x 15 ft. 9-in., 250 H. P. Worthington Water Tube.
One 60-in. x 16 ft., John Mohr Return Tubular Boiler.
One 64-in. x 16 ft., John Mohr Return Tubular Boiler.
One 54-in. x 16 ft., Devine Tubular Boiler.

ENGINES.

One 600 H. P., 21 x 36 x 30, Williams Tandem Horizontal Compound, 140 R. P. M.
Two 600 H. P., 20 x 30 x 24, Porter-Allen Tandem Compound, 200 R. P. M.
One 250 H. P., 12 x 24 x 18 Williams Tandem Compound, 250 R. P. M.
Two 100 H. P., 13 x 12, Dick & Church, High Speed Automatic.

PARTIAL LIST ONLY.

Send for latest Catalogue for bargains in Engines, Boilers, Dynamos and Motors.

CENTRAL STATION IMPROVEMENT CO., 938 Monadnock Block, Chicago

"UNION" SWITCH OUTLET BOX

For Finished House Work

Approved by Underwriters' National Electric Association.

Construction 14-gauge steel, dovetailed joints, finished in black enamel.
Takes all makes of switches and receptacles.
Made to conform to the latest Underwriters' rules, and is approved.
Gangs of 2, 3, 4, 5 and 6 carried in stock.
Spacing in gang boxes 1 13-16" between centers.
Provided with clamps for holding Sprague Cable.
Tandem boxes made to order.
Dimensions at bottom of single box, 3 1-16"x2". Takes plate 4¼" and longer. Outlet holes ⅝".

Takes all makes of Switches and Receptacles

CHICAGO FUSE WIRE & MFG. CO.

358 Dearborn Street, CHICAGO
Mutual Life Building, BUFFALO
853 Broadway, NEW YORK

Watson Motors

If you want a small motor for a special purpose, Write us.
Mechanical Appliance Co.
Milwaukee, Wis.

OFFICE OF Town Clerk
A. R. KAUFMAN, Clerk

BOARD OF TRUSTEES
GEO. A. PAINTER
A. V. PARKHURST
J. J. BERRY
F. VAN NUYS, ATTY.

Summitville Ind. Nov. 23 1903

Western Electrician
Chicago Ill.

Gentlemen: You may discontinue our Want Advertisement with the One issue. as I have already received about 40 answers to same. Send me your bill and I will remit same to you Thanking you very kindly for your promptness
I am Yours Resp.

A. R. Kaufman
Clerk.

CHICAGO EDISON COMPANY REPAIR SHOPS

76 MARKET STREET, CHICAGO. TELEPHONE MAIN 1280.

Machine and Carpenter Work of All Kinds
Correspondence Solicited.

OPEN DAY AND NIGHT.

FIRST-CLASS EQUIPMENT THROUGHOUT.

Dynamos Armatures, Motors, Arc Lamps, Fans, Instruments.

ARNOLD ELECTRIC POWER STATION Co.
Engineers, Constructors for Complete Electric Plants. Results Guaranteed.
SUITE 1539, MARQUETTE BLDG., CHICAGO. NEW YORK OFFICE: 711 TRANSIT BLDG.

BYLLESBY, H. M. & Co.
(Incorporated)
ENGINEERS
Design, Construct and Operate Railway, Light, Power and Hydraulic Plants. Examinations and Reports.
New York Life Building, - CHICAGO, ILL.

HUMPHREY, HENRY H., CONSULTING ENGINEER.
Central Lighting Stations, Electric Power Transmission.
SUITE 1305, CHEMICAL BLDG., ST. LOUIS.

RUEBEL · SCHWEDTMANN-WELLS,
CONSULTING, MECHANICAL AND ELECTRICAL ENGINEERS,
Suite 801 Chemical Building, ST. LOUIS, U. S. A.

F. B. BADT,
Monadnock, Chicago.

EVANS, ALMIRALL & CO.,
Central Station Heating, High Pressure Piping.
1057 Monadnock Blk., Chicago.

ROBERT W. HUNT & Co.,
ENGINEERS
1121 The Rookery, Chicago. 66 Broadway, New York.
Monongahela Bank Bldg., Pittsburg. Norfolk House, Cannon St., London.

SARGENT & LUNDY,
ENGINEERS,
RAILWAY EXCHANGE,
Cor. Jackson and Michigan Boulevards, CHICAGO.
FREDERICK SARGENT. A. D. LUNDY.

W. E BAKER. H. B. BISHOP.
BAKER, W. E. & CO.
ENGINEERS,
ELECTRIC RAILWAYS.
27 William St., NEW YORK.

E. W Hammer, Pres. and Treas. H. J. Minhinnick, Sec. and Gen'l Sup't.
GENERAL ENGINEERING Co., THE Consulting and Contracting Engineers.
Telephones, Electric Light, Power Transmission
Suite 1112, 135 ADAMS ST., CHICAGO.
Long Distance Telephone Central 1478.

A WEEKLY REPRESENTATION
in this "Directory" enables engineers to keep before all possible customers.

Long Distance Phone Central 2148.
SCHOTT, W. H.,
ENGINEER AND CONTRACTOR,
SPECIALTIES—Central Station Heating Plants, Water Works Steam Plants, Electric Light, Gas and Street Railway Plants.
1220-21 MARQUETTE BUILDING, CHICAGO.

BRYAN, WILLIAM H.
M. Am. Soc. M. E.,
Consulting Mechanical and Electrical Engineer.
Lincoln Trust Building, ST. LOUIS.

J. H. HALLBERG
Consulting Engineer
Electric Light, Power and Railway Plants
Suggestions to secure Economy, Specifications, Examinations and Reports
45 Broadway, NEW YORK
Long Distance Telephone 4578 Broad

KEMP, R. W.
Consulting and Contracting Telephone Engineer.
Plans and Specification for complete plants. Old plants overhauled and placed on paying basis. Territory, Kansas, Oklahoma and Indian Territory.
WELLINGTON, - - - KANSAS.

TRY IT.
Keep your name and address in this directory where it will be seen by possible clients.

BUTTERFIELD, J. F.
ELECTRICAL ENGINEER AND CONTRACTOR.
Complete Telephone Exchanges Built and Material Furnished.
Cable Construction and Underground Conduit Construction a Specialty.
Room 595, 118 Adams Street. CHICAGO, ILL.

HORNADAY, J. P. & Co.
SUITE 1108 TRACTION BUILDING
CINCINNATI, O.
WATERWORKS, ELECTRIC RAILWAY, LIGHT, TRACTION, INDUSTRIAL AND MINERAL PROPERTIES BOUGHT AND SOLD

KOHLER BROS.,
Contracting Electrical Engineers, Lighting Power Railways,
1804-1806-1808-1810-1812 Fisher Building,
CHICAGO.

STANTON, LE ROY W.
Consulting Telephone Engineer
Plans, Specifications and Supervision of Installation of Complete Telephone Plants
Special Reports on Telephone Properties and Apparatus
411 Electrical Bldg., Cleveland, Ohio

DUGALD C. JACKSON, C. E.
WILLIAM B. JACKSON, M. E.
MEMBERS
AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS
AMERICAN SOCIETY OF MECHANICAL ENGINEERS
AMERICAN SOCIETY OF CIVIL ENGINEERS
ENGINEERS. EXPERTS.
MADISON, WIS.

ALL Live men read the WESTERN ELECTRICIAN Each Week. Do You?

Practical Running of Dynamos.
A little booklet on the care and the locating and remedying of troubles in dynamos and motors.
Price, 10 Cents.
Catalogue of mechanical and electrical books free.
ELECTRICIAN PUBLISHING COMPANY,
510 Marquette Bldg. Chicago.

ELECTRICAL BOOKS

Make your book purchases from the only large stock of electrical books carried in the West. Prompt shipments guaranteed. If you do not find what you want in the following list, write for complete and up-to-date book catalogue.

	Price.
Webb's Telephone Hand Book, cloth binding	$1.00
Badt's New Dynamo Tender's Hand Book, cloth binding	1.00
Badt's Incandescent Wiring Hand Book, cloth binding	1.00
Badt's Bell Hanger's Hand Book, cloth binding	1.00
Badt's Electric Transmission Hand Book, cloth binding	1.00
Dobb's The Inspector and Trouble Man, cloth binding	1.00
Steven's Mechanical Catechism, cloth binding	1.00
Hawkins' Catechism of Electricity, leather binding	2.00
Practical Electricity, leather binding	2.00
Thompson's Polyphase Electric Currents, cloth binding	3.50
Varley's Electro-Magnet, cloth binding	1.00
Buckley's Electric Lighting Plants, cloth binding	2.00
Haskins' Electricity Made Simple, cloth binding	1.00
Haskins' Transformer, cloth binding	1.25
Houston's 2-volume Electrical Dictionary, half leather, very cheap, half price	6.00
Watson's Electrician's Handy Book, cloth binding	2.50
Trevert's Armature and Magnet Winding, cloth binding	1.50
Trevert's How to Build Dynamo Electric Machinery, cloth binding	2.50
Trevert's Experimental Electricity, cloth binding	1.00
Trevert's Electricity for Students, cloth binding	1.00
Trevert's Electric Railway Engineering, cloth binding	2.00
Allsop's Bell Construction, cloth binding	1.25

	Price.
Trevert's Electrical Measurements for Amateurs, cloth binding	$1.00
Allsop's Telephones, Their Construction and Fitting, cloth binding	1.25
Allsop's Bell Fitting, cloth binding	1.25
Allsop's Induction Coils, cloth binding	1.25
Bell's Electric Power Transmission, cloth binding	3.00
Bell's Distribution for Electric Railroads, cloth binding	2.50
Cushing's Standard Wiring for Electric Light and Power, leather binding	1.00
Hanchett's Modern Electric Railway Motors, cloth binding	2.00
Houston & Kennelly's Electric Transmission of Intelligence, cloth binding	1.00
Houston & Kennelly's Electrical Measurements, cloth binding	1.00
Houston & Kennelly's Electric Heating, cloth binding	1.00
Houston & Kennelly's Electric Arc Lighting, cloth binding	1.00
Houston & Kennelly's Electric Motor, cloth binding	1.00
Houston & Kennelly's Electric Street Railways, cloth binding	1.00
Houston & Kennelly's Electric Telegraphy, cloth binding	1.00
Houston & Kennelly's Electro Therapeutics, cloth binding	1.00
Houston & Kennelly's Electricity Made Easy, cloth binding	1.50
Merill's Electric Light Specifications, cloth binding	1.50
Wiener's Dynamo Electric Machines, cloth binding	3.00

ANY OF THE ABOVE BOOKS SENT PREPAID ON RECEIPT OF PRICE.

ELECTRICIAN PUBLISHING CO.

SUITE 510 MARQUETTE BUILDING, CHICAGO.

BITUMINIZED FIBER CONDUIT

FOR UNDERGROUND CONSTRUCTION

Combines the **good features** of other conduits.
Eliminates the **bad features** existing in many kinds.
Has valuable features not found in any other ducts.

Made in 7-foot lengths with male and female joints, making construction very rapid and simple, with consequent low cost.

Alignment is perfect and permanent without tedious care and skill required in laying of butt-joint conduits.

Users are astonished by the ease and rapidity with which cables can be drawn in, and this without the slightest scratching or injury to the lead covering thereof.

Made in sizes from 1-inch to 10-inch diameter.

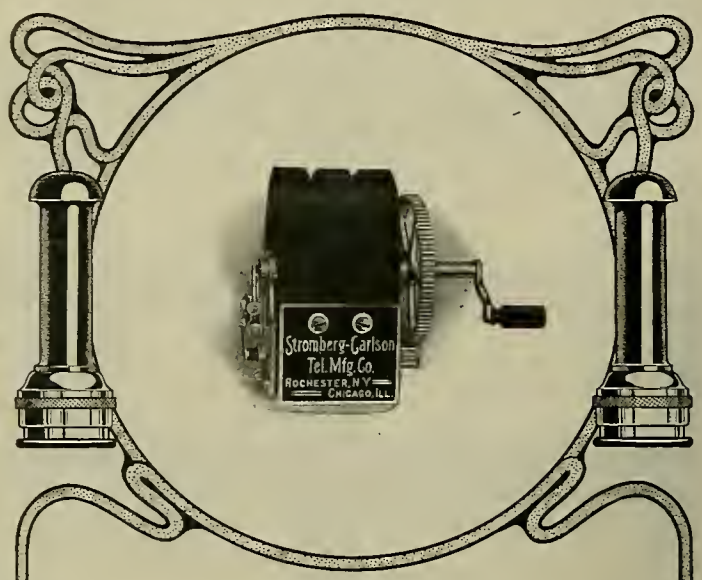
Bends of any radius and any angle.

Write us for further information and prices, stating sizes and quantities required.

American Conduit Co.

Main Offices: 1005-6 Manhattan Building, Chicago

Other Offices:
170 Broadway, New York. 336 Macy St., Los Angeles



Standard three-bar generator, same as used in our series telephones. We have manufactured generators since we first started in business. What this experience means to you enables us to sell the best generator made at a price slightly above the ordinary. The difference is caused by the better grade of material used and the superior workmanship.

You pay nothing for our experience. Our Bulletin No. 11-E explains fully this apparatus. Mailed free.

Stromberg-Carlson Telephone Mfg. Co.

GENERAL AND EASTERN OFFICE
ROCHESTER, N. Y.

SALES DEPT.
CHICAGO, ILL.

We introduced successful 4-party lines

LEICH SELECTIVE SYSTEM

INDEPENDENT TELEPHONE

Write for our booklet—"Selective W."

CENTRAL ENERGY OR MAGNETO

Impedance Coil for Selectives. No Springs.

AMERICAN ELECTRIC TELEPHONE CO.

CHICAGO, ILLINOIS

INDEPENDENT TELEPHONE

WANTED

ELECTRIC LIGHT PLANTS
ELECTRIC STREET CAR LINES

They are wanted by some good towns in Illinois, Missouri, Kansas and Nebraska.
If you really "mean business," you can get particulars by writing

Burlington Route

N456

W. H. MANSS,
Industrial Commissioner,
209 Adams Street - - - CHICAGO

INTERNATIONAL

Mechanical Self-Restoring Drop Switchboard.

A PERFECT APPARATUS.
Made in any desired capacity.
Sample parts and quotations on request.

INTERNATIONAL TELEPHONE MANUFACTURING CO.
CHICAGO, U. S. A.

TELEPHONE BOOTHS

When in want of the Right Kind write us.

Catalogue Free

Yesbera Mfg. Co.
TOLEDO, OHIO.

The Kellogg Switchboard & Supply Co.

has received the

GRAND PRIZE

at the LOUISIANA PURCHASE EXPOSITION for

TELEPHONE SYSTEMS AND APPARATUS

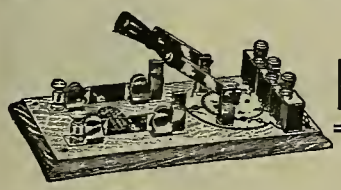
THE HIGHEST AWARD GIVEN

KELLOGG SWITCHBOARD & SUPPLY CO.

CONGRESS AND GREEN STS., CHICAGO

Seymour Building LOS ANGELES | Electric Building CLEVELAND | Keystone Telephone Building PHILADELPHIA

SOMETHING DOING IN A STORM



WITHOUT A

King of Protectors

Better Buy a

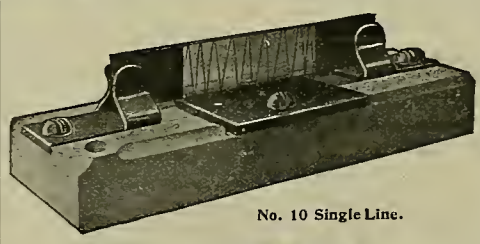
"TORNQUIST"

COMBINATION LIGHTNING ARRESTER GROUND SWITCH FUSE AND LEVER CUT-OUT.

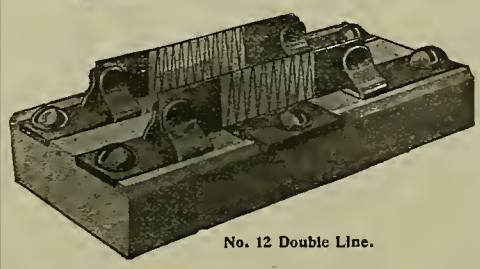
THE ONLY SAFE PROTECTOR MADE. ORDER SAMPLE NOW.

BABY KNIFE SWITCHES
STAMPING AND PLATING.
SOLD BY ALL JOBBERS.

Clinton Stamping & Electric Co.,
CLINTON, IA.
HART & CO., Chicago, General Agents.



No. 10 Single Line.



No. 12 Double Line.

PROTECTORS THAT PROTECT.

Our patent wrapped fuse used in our protectors are an insurance policy against lightning.

Sample free by mail to any Exchange or Toll Line

CENTRAL TELEPHONE AND ELECTRIC CO.,
909 Market St.,
ST. LOUIS, U. S. A.

---

100 SUBSCRIBERS of the Citizens' Telephone Company of Grand Rapids, Michigan, were selected at random by a disinterested party and asked how they liked that company's Automatic Telephone Service in comparison with the manual service, which it replaced.

95 OF THEM said it was so perfect that there could be no comparison, they greatly preferred it;

4 OF THEM said they "didn't care which they had;"

1 OF THEM preferred the manual service.

The above percentages indicate the attitude of 6,000 subscribers to Automatic Telephone Service in Grand Rapids.

MR. TELEPHONE MANAGER, if you are trying to satisfy the public and give your patrons the sort of service they appreciate most you will take the hint that this conveys and give them Automatic Service.

AUTOMATIC ELECTRIC CO., Van Buren and Morgan Sts. CHICAGO, U. S. A.

PRODUCERS AND WHOLESALERS OF WHITE CEDAR PRODUCTS

CEDAR POLES

YARDS
KOSS MICH.
L'ANSE "
MUNISING "
ONTONAGON
WAGNER, WIS
PESHTIGO "

SPECIAL PRICES ON SMALL POLES.
Write for a copy of our TELEGRAPH CODE FOR CEDAR PRODUCTS

C. H. WORCESTER CO.
SUITE 1206 TRIBUNE BLDG. CHICAGO.

TELEPHONE POLES

Yards at Red Cliff, Wis., Aitkin, Feeley, Cohasset, Deer River, Tenstrike and Black Duck, Minnesota.
Large stocks. Prompt shipments. Carefully inspected stock at low prices.
J. W. MORRISON LUMBER CO., 918-19 Lumber Exchange MINNEAPOLIS, MINN.

POLES.

WHITE CEDAR.
IDAHO CEDAR up to 80 ft.

BERTHOLD & JENNINGS,
ST. LOUIS.
Chemical Building.

CROSS ARMS.

LONG LEAF PINE AND FIR.

Cedar Poles.

Pittsburg and Lake Superior Iron Co. Producers and Wholesalers. Escanaba, Mich.

POLES TIES.

W. C. STERLING & SON,
MONROE, MICH.
Eleven Pole Yards in Michigan.
Wholesale Producers for 20 years

Sterling Black Plastic Insulator.

One hundred days' continuous baking at 180° F. will not make it brittle. Water repellent. Oil proof.

THE STERLING VARNISH CO., - - Pittsburg, Pa.

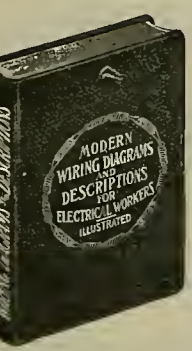
Idaho Cedar Poles

PACIFIC COAST POLE CO. SPOKANE, WASH.

SEND YOUR ORDERS FOR THE MARYLAND CHESTNUT POLES To S. A. GATES
Gapland, Washington Co., Maryland
Prompt Shipments

Southern Cedar POLES Are the Best.

NO ROTTEN BUTTS.
D. W. PHELAN,
277 Broadway, New York



A PRACTICAL BOOK FOR PRACTICAL MEN

"MODERN WIRING DIAGRAMS AND DESCRIPTIONS FOR ELECTRICAL WORKERS."

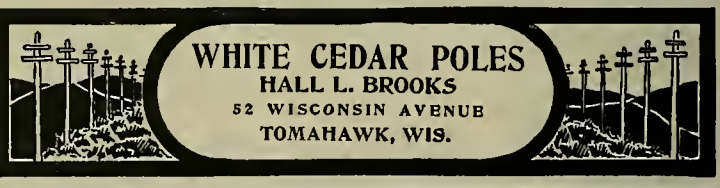
By Henry C. Horstmann and Victor H. Tousley. 160 pages, over 200 illustrations. Full leather binding, red edges. Pocket size 4 x 6. Price, net, $1.50.

A work that not only tells you how to do it, but shows you.

THIS BOOK tells how to wire for call and alarm bells. For burglar and fire alarm. How to run bells from dynamo current. How to install and manage batteries. How to test batteries. How to test circuits. How to wire for enunciators; for telegraph and gas lighting. It tells how to locate "trouble" and "ring out" circuits. It tells about meters and transformers. It contains 30 diagrams of electric light circuits alone. It explains dynamos and motors; alternating and direct current. It gives 10 diagrams of ground detectors alone. It gives "Compensator" and Storage Battery installation. It gives simple and explicit explanations of the "Wheatstone Bridge" and its uses as well as volt-meter and other testing. It gives a new and simple wiring table, covering all voltages and all losses or distances, etc., etc.

SENT PREPAID ON RECEIPT OF PRICE

ELECTRICIAN PUBLISHING CO.
510 Marquette Building, Chicago



"Practical and to the Point"

IS ALL THAT NEED BE SAID OF

THE TELEPHONE HAND-BOOK

By HERBERT LAWS WEBB.

160 Pages, 133 Illustrations, Cloth, Price $1.00.

The book for those interested in telephony.

ELECTRICIAN PUBLISHING CO.,
510 Marquette Bldg.,
CHICAGO.

Locations for Industries

Erie Railroad

Chicago to New York

The Erie Railroad Company's Industrial Department has all the territory traversed by the railroad districted in relation to resources, adaptability, markets and advantages for manufacturing, and can advise with manufacturers in relation to the most suitable locations. For full information address

LUIS JACKSON
Industrial Commissioner, Erie Railroad Company
21 Cortlandt Street, New York

TYPE E.

ALTERNATING CURRENT.

SCHEEFFER INTEGRATING WATTMETER

Type E for Alternating Current — Type F for Direct Current Circuits

DUST AND BUG PROOF IMPROVED CONSTRUCTION

MOVING PARTS ARE EXTREMELY LIGHT, INSURING A HIGHLY SENSITIVE AND ACCURATE METER.

WRITE FOR PRICES AND DESCRIPTIVE LITERATURE.

DIAMOND METER COMPANY,
PEORIA, ILL., - - - - U. S. A.

TYPE F.

DIRECT CURRENT.

ANCHORS

That are cheaper to install because of the simple method of burying and the great strain that can be applied – **American Bull-Tongue Anchors** reduce the cost of the process of guying a pole by reduction in labor, they **stay solid,** they do not slip no take up required. 21 cents worth holds 8,713 pounds, 42 cents worth holds 10,521 pounds, other money's worth in proportion.

I. A. BENNETT,
529 and 530 Monadnock Block - - - CHICAGO

OUR TIE SHIPMENTS are just as prompt as on Poles. That's saying a good deal, for we have a high reputation on Poles. Won't you let us quote you now, so you'll be ready to order?

MALTBY CEDAR COMPANY, 509 Phoenix Block, Bay City, Michigan.
Pittsburg Agents: TIPPER & PATTON, 509 Bessemer Building.

BRACKETS—X ARMS—PINS
little things it is true, but they cut a big figure in line construction.
OUR MOTTO IS:
Prompt Shipment Quality Satisfaction Right Price
COLUMBIA MFG. CO. **ANTIGO, WIS.**

MICHIGAN WHITE LARGE STOCK.
CEDAR POLES
PROMPT SHIPMENTS. KELLOGG SWITCHBOARD & SUPPLY CO., Chicago.

"The King's Highway."

TO THE
GATEWAYS OF COMMERCE
THROUGH THE
CENTERS OF POPULATION,

adding greatly to the interest of your journey, without increasing its expense beyond what you would expect to pay for the "best," which you secure if you travel by the

NEW YORK CENTRAL LINES.

A Copy of "Four-Track Series" No. 13. "Urban Population in 1900," will be sent free, on receipt of a two-cent stamp by George H. Daniels, General Passenger Agent, New York Central & Hudson River R. R., Grand Central Station, New York.

POLES, TIES, POSTS. THE PORTER CEDAR CO., SAGINAW, MICH.
PRODUCERS. We want your inquiries always.

MICHIGAN AND WESTERN **CEDAR POLES**
ALL LENGTHS AND SIZES
LINDSLEY BROS CO.
TRIBUNE BLDG., CHICAGO

Poles and Ties

The Fowler Companies
TRADE MARK
Fisher Bldg. Chicago

Cedar TORREY CEDAR CO., CLINTONVILLE, WIS. **Poles**
Large Stock Constantly on Hand

DON'T BUY ELECTRICAL SUPPLIES
Until you have seen our new Catalogue and new Price List.
Free to the trade.
Manhattan Electrical Supply Co.
NEW YORK: 32 Cortlandt St. CHICAGO: 188 Fifth Ave.

CEDAR POLES
ESTABLISHED 1862
WM. MUELLER COMPANY
1211-12-13 MARQUETTE BLDG. CHICAGO.
EIGHT DISTRIBUTING YARDS

THE TELEPHONE HAND-BOOK
BY
HERBERT LAWS WEBB.
Price $1.00.
A complete and practical work in handy pocket size.
PUBLISHED BY
THE ELECTRICIAN PUBLISHING CO.,
Suite 510 Marquette Building, Chicago.

Points in Wisconsin and the Northwest
are covered by Wisconsin Central Railway's convenient, solid, wide vestibuled trains, equipped with Pullman sleepers, free reclining chair cars and modern coaches which leave Central Station, 12th Street and Park Row (Lake Front), Chicago for St. Paul, Minneapolis, Ashland and Duluth, connecting with all western lines. Meals in dining and cafe cars served a la carte.
For tickets and further information apply to nearest ticket agent, or write
JAS. C. POND, Gen'l Pass. Agt., Milwaukee, Wis.

CENTRAL STATION HEATING

We are the originators and builders of the underground system of live and exhaust steam heating. Our system is used for the utilization and distribution of exhaust steam from electric and power plants for heating purposes. 250 Plants in successful operation. We have the only Meter System. Also manufacturers of Wooden Water Pipe, Steam Pipe Casing, Steam Traps, Condensation Meters, Valves, Economizing Coils, Separators and full line of Steam Fitters' Supplies.

WRITE FOR PAMPHLET AND PRICE LIST

AMERICAN DISTRICT STEAM COMPANY
MENTION WESTERN ELECTRICIAN. LOCKPORT, N.Y. CHICAGO, ILL.

BOILER WATERS CORRECTED

to remove and prevent scale and to stop corrosion. DEARBORN TREATMENT does the work. Send gallon sample for analysis. Booklet "R" now ready.

DEARBORN DRUG & CHEMICAL WORKS,

27-34 RIALTO BUILDING, CHICAGO, ILL. WM. H EDGAR, President Telephone: Harrison 3930 and 3931.

Dixon's Graphite Pipe Joint Compound

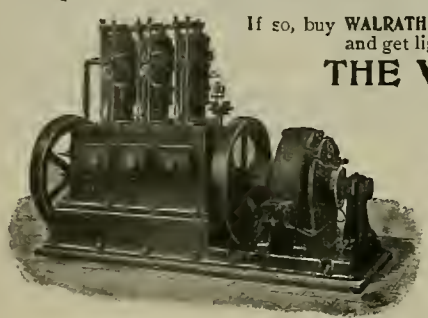
Makes the tightest joints that remain free from rust and come apart easily at any time.

Write for Booklet 125D and a sample.

JOSEPH DIXON CRUCIBLE CO., JERSEY CITY, N. J.

JEFFREY CHAIN BUCKET DREDGES FOR CATALOGUE, ADDRESS THE JEFFREY MFG. CO. COLUMBUS, OHIO.

ARE YOU LOOKING FOR MONEY?



If so, buy WALRATH GAS OR GASOLINE ENGINES and get light on the subject.

THE WALRATH

Received the Highest Award at the Pan-American Exposition.

It will produce as good a commercial light as that of an automatic steam engine, either belted or direct-connected generator. Simple, Economical and Reliable

Send for Catalogue W

MARINETTE GAS ENGINE CO.,

CHICAGO HEIGHTS, ILL.

AGENCIES:
Keystone Engineering Co., Farmer's Bank Bldg., Pittsburg, Pa.
Strong, Carlisle & Hammond Co., 61-67 Frankfort St., Cleveland, Ohio
Mackay Engineering Co., 149 Broadway, N. Y.
C. H. Seidenglanz., 52 When Bldg., Indianapolis, Ind.

BEST ON EARTH.

BURGER AUTOMATIC.

For Electric Work

REGULATION AND ECONOMY OF FUEL UNSURPASSED.

WRITE FOR CATALOGUE H

Then compare it with some Gas Engine hand books that cost $1.00.

Woolley Foundry & Mach. Works

Box 400, Anderson, Ind. U. S. A.

REG. TRADE MARKS

THE PHOSPHOR BRONZE SMELTING CO. LIMITED, 2200 WASHINGTON AVE., PHILADELPHIA.
"ELEPHANT BRAND PHOSPHOR-BRONZE"
INGOTS, CASTINGS, WIRE, RODS, SHEETS, ETC.
— DELTA METAL —
CASTINGS, STAMPINGS AND FORGINGS
ORIGINAL AND SOLE MAKERS IN THE U.S.

H. N. FENNER, President J. F. BLAUVELT, Agent RUSSELL W. KNIGHT, Treasurer

NEW ENGLAND BUTT COMPANY

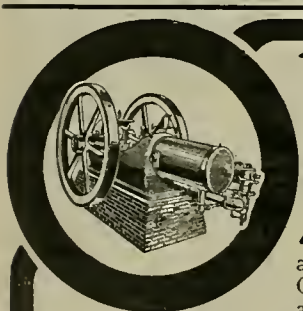
MANUFACTURERS OF

Machinery for Insulating Electrical Wires

Braiding, Taping, Winding, Twinning, Cabling, Stranding, Polishing and Measuring Machines. Cable Covering Braiders

FINE CASTINGS A SPECIALTY

304 PEARL STREET, - - - PROVIDENCE, R. I., U. S. A.



Olds Gas and Gasoline Engines

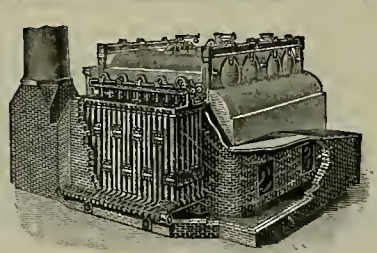
are strong and simple in construction. Parts are few and easily understood. Olds engines can be readily operated by any man of ordinary intelligence without previous experience. Repairs, though seldom necessary, can be quickly and economically made.

Stationary Engines - - 2 to 100 H. P.
Portable Engines - - 8 to 18 H. P.

For complete information and new illustrated catalog write

OLDS GASOLINE ENGINE WORKS

252 River Street - - - Lansing, Mich.



In supplying boilers with hot purified water, thus keeping a larger heating surface, as well as meeting sudden demands for power, the

GREEN'S ECONOMIZER

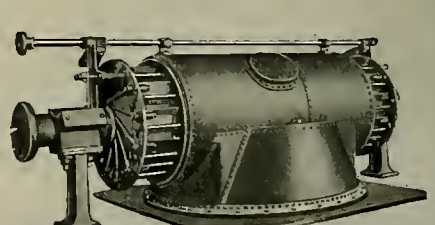
is but beginning its savings to plant owners. What has been, and possibly will again be—cost of fuel—one of the greatest expenses of a plant, is reduced from 10 to 20 per cent. ELECTRIC LIGHT AND POWER PLANTS having a Green's Economizer realize the greatest saving. We will be pleased to send our free booklet showing construction and how applied.

THE GREEN FUEL ECONOMIZER CO.

Sole Manufacturers in the U. S. A. MATTEAWAN, N. Y.

SAMSON TURBINE

The QUICKER the SPEED of a GENERATOR the LOWER its COST. The SAMSON has a quicker speed for a given power, than any other turbine built. If you expect to DIRECT CONNECT generator to turbine shaft we can certainly SAVE you considerable EXPENSE in your installation.



THE JAMES LEFFEL & CO., SPRINGFIELD, OHIO, U. S. A.

No Premiums

Users of Type A

Transformers

pay no premiums for the business insurance that goes with every Type A, because their perfect insulation is obtained without a reduction in transformer efficiency.

FORT WAYNE ELECTRIC WORKS
WOOD LIGHTING & POWER SYSTEMS
Fort Wayne, Ind.

267

Worth Having!

STEVENS' MECHANICAL CATECHISM

PRACTICAL KNOWLEDGE
FOR
Stationary and Marine Engineers, Firemen, Electricians, Motormen, Ice Machine Men and Mechanics in General.

New and Original. All Modern Machinery fully described and explained. Technical Points made Clear by Word and Drawing. Questions and Answers for Civil Service Examinations, etc.

SUBJECTS TREATED:

WATER, STEAM, COMBUSTION, SMOKE PREVENTION, BOILERS, BOILER CONSTRUCTION, TESTING AND MANAGEMENT, SAFETY VALVES, INJECTORS, PUMPS AND GOVERNORS, STEAM GAUGES, LUBRICATORS, ENGINES, COMMON SLIDE VALVE, TANDEM COMPOUND, CROSS COMPOUND, RECEIVER ENGINES, HOT AIR AND COMPRESSED AIR ENGINES, TRACTION ENGINES, ELECTRIC ENGINES, AUTOMATIC AND CORLISS ENGINES, CONDENSERS, JET AND SURFACE, ECCENTRIC, BALANCED SLIDE VALVE, LINK MOTION, HORSE POWERS IN DETAIL, INDICATOR, REFRIGERATION, ABSORPTION AND COMPRESSION METHODS, BRINE AND DIRECT EXPANSION SYSTEMS, PUMPS, VALVES, TESTS, TABLES, AMMONIA, AMMONIA FITTINGS, LIQUID AIR, MACHINE SHOP PRACTICE, STANDARD NUMBERS AND RULES, PULLEY SPEED CALCULATION, SQUARE ROOT, LEVERAGE, ELECTRICITY, DYNAMOS, ACCUMULATOR, RHEOSTAT, TRANSFORMER, VARIETIES OF DYNAMOS, PARALLEL AND SERIES WIRING, THREE-WIRE SYSTEM, MANAGEMENT AND CARE OF ELECTRIC PLANT, REPAIRS, ELECTRICAL MEASUREMENTS, MOTORS, STATIONARY, TROLLEY AND THIRD RAIL SYSTEMS, CONTROLLER, ELECTRIC LOCOMOTIVE, ELECTRIC HEATING AND COOKING, HOUSE WIRING, DIFFERENTIAL GEAR, FRICTION CLUTCH, COMPOUND CYLINDERS, REVERSING GEAR, THE STACKER. ALSO, THE ELEMENTS OF ALGEBRA MADE EASY.

336 Pages. 240 Illustrations.

PRICE, $1.00. Sent anywhere prepaid on receipt of price.

ELECTRICIAN PUBLISHING COMPANY,
510 Marquette Bldg., Chicago.

Good Advice

No. 13.

Good wines improve with age, but not so with all Direct Current Wattmeters. The former is sometimes used as an antidote for the disappointing and discouraging behavior of the latter. We do not know it to be general that some meters are conducive to making the meterman form the acquaintance of John Barleycorn, but we do know it to be generally acknowledged that Duncan Meters, as part of a plant's equipment, keep it in a sober, healthy and money-making condition.

Good Advice No. 14 Next Week.

Send for Bulletin and Prices.

DUNCAN ELECTRIC MFG. CO.
LAFAYETTE, IND.

THERE'S MONEY IN FLASHERS

ELECTRICAL CONTRACTOR

Every [illegible] can make [illegible] by selling Reynolds' Flashers [illegible] etc.

CENTRAL STATION

By talking Reynolds' Flashers you can interest many people in electric signs and window displays who were never interested before.

[illegible] Reynolds Flasher proposition successful every use.

[illegible] for particulars, prices, etc.

REYNOLDS ELECTRIC FLASHER MFG. CO.

221 FIFTH AVENUE, CHICAGO

WORKS QUICK AND EASY. KEEPS ITS LUSTER. HOLDS OLD TRADE AND MAKES NEW. DOES NOT DETERIORATE. ESTABLISHED 18 YEARS. SOLD BY AGENTS AND DEALERS ALL OVER THE WORLD

U.S. METAL POLISH GEO. W. HOFFMAN

3 OUNCE BOX 10 CENTS. SAMPLES SENT FREE

POLISHES ALL METALS. BRANCHES: NEW YORK CHICAGO SAN FRANCISCO 295 E. WASHINGTON ST. INDIANAPOLIS, IND.

VULCANIZED FIBRE

Highest grades for electrical insulation and mechanical purposes, in sheets, tubes, rods and special shapes. Catalogues and samples on application.

VULCANIZED FIBRE CO., - Wilmington, Del.

1 **1 Point for the Monitor Bushing** 1

is the fact that it is made with a perfectly rounded [illegible] making this the 1 bushing that will not cut insulation on wires. 1 other point is its covering of installating enamel producing the smoothest and safest surface possible. 1 minute spent investigating this bushing will prove profitable to any 1. Only 1 house in the U.S. has the right to manufacture them and that 1, the 1 which owns the patent.

BOSSERT ELECTRIC CONSTRUCTION CO.,

Write for Catalog. UTICA, N. Y., U. S. A

Small Units in Electric Generating Sets.

Write for our estimates and prices.

Crocker-Wheeler Company

Manufacturers of

Generators and Motors

Electrical Engineers

AMPERE, N. J.

Branch Offices in Sixteen Principal Cities

STURTEVANT GENERATING SETS

For Lighting and Power

All Types and Sizes
Between 1½ and 250 K. W.

We Build Both Engine and Generator

B. F. STURTEVANT CO.

BOSTON, MASS.

General Office and Works, Hyde Park, Mass.

NEW YORK PHILADELPHIA CHICAGO LONDON

Black Diamond File Works

Est. 1863. Inc. 1895.

Twelve Medals Awarded at International Expositions

Special Prize Gold Medal at Atlanta, 1895.

OUR GOODS ARE ON SALE IN EVERY LEADING HARDWARE STORE IN THE UNITED STATES AND CANADA.

G. & H. BARNETT COMPANY,

PHILADELPHIA, PA.

JOHN A. ROEBLING'S SONS CO.

Insulated Wire of All Kinds

Bare Copper Wire

MAIN OFFICE AND WORKS **TRENTON, N. J.**

AGENCIES AND BRANCHES

New York Chicago Cleveland San Francisco Philadelphia Atlanta

Western Electrician

Vol. XXXV. $3.00 Per Annum. Copyright, 1903, by Electrician Publishing Company, Chicago. CHICAGO, OCTOBER [illegible] Postoffice as mail matter of the second class. 10 Cents a Copy. No. 18.

Technology Quarterly
Mass. Inst. of Technology
Boston Mass

SIMPLEX INSULATED WIRES AND CABLES.
RUBBER COVERED, WEATHERPROOF, UNDERGROUND AND SUBMARINE.
WESTERN SELLING AGENT, M. R. HERSON, [illegible] CHICAGO.
The Simplex Electrical Co., 110 State Street, BOSTON, MASS.

CHICAGO INSULATED WIRE CO.
152-154 LAKE ST., CHICAGO
1108-1110 PINE ST., ST. LOUIS, MO.
Bare and Insulated Wires and Cables
Galvanized Steel Strands

OKONITE
TRADE MARK
1889—Paris Exposition, Medal for Rubber Insulation.
1893—World's Fair, Medal for Rubber Insulation.
THE STANDARD FOR RUBBER INSULATION.
Sole Manufacturers of
Okonite Wires, Okonite Tape, Manson Tape, Candee Weather-proof Wires.
THE OKONITE CO., LTD.
Willard L. Candee, W. Durant Cheever, } Managers. 253 Broadway, New York. Geo. T. Manson, Gen'l Supt. W. H. Hodgins, Secy.

TRADE MARK
CRESCENT INSULATED WIRE & CABLE CO. TRENTON, N. J.
CRESCENT RUBBER INSULATED WIRES AND CABLES
National Code Standard.
CRESCENT INSULATED WIRE AND CABLE CO.,
New York Office, 83 BARCLAY STREET. Main Office and Factory, TRENTON, N. J.

STANDARD
STANDARD UNDERGROUND CABLE CO.
322 The Rookery, Chicago. Westinghouse Bldg., Pittsburg. 56 Liberty St., New York City. 1225 Betz Bldg., Philadelphia, Pa.
Crossley Bldg., San Francisco. 10 Post Office Square, Boston.
BARE AND WEATHERPROOF WIRES AND CABLES.
Rubber Covered Wires and Cables. Underground Cables for all Purposes.

INDIANA RUBBER AND INSULATED WIRE CO.,
MANUFACTURERS OF
Paranite Rubber Covered Wires and Cables,
UNDERGROUND, AERIAL, SUBMARINE AND INSIDE USE;
TELEPHONE, TELEGRAPH AND FIRE ALARM CABLES.
All Wires are tested at Factory. JONESBORO, IND.

THE PHOENIX GLASS CO. Pittsburg, New York, Chicago
Manufacturers of
Electric Globes and Shades, both Arc and Incandescent
Inner and Outer Globes for all enclosed arc systems
CATALOGUES SENT ON REQUEST

"CIRCULAR LOOM" THE FLEXIBLE CONDUIT
AMERICAN CIRCULAR LOOM CO.
TRADE MARK
REGISTERED
CONDUITS FOR INTERIOR WIRING.
American Circular Loom Co.
Chelsea, Mass., New York, Chicago, San Francisco.

WHAT DID THE WOGGLE BUG SAY?
J. J. ECAN'S "ACME" COMMUTATOR COMPOUND.
Agents Wanted.
YOU CAN'T DO LESS than give a good thing a trial. FREE SAMPLE J. J. Egan's Acme Commutator Compound, the only article that will absolutely prevent sparking, cutting or unnecessary wear of the commutator. Commutator always bright.
50 CENTS PER STICK ALL SUPPLY HOUSES OR $5.00 PER DOZEN
J. J. ECAN, 317 Austin Ave., CHICAGO

THERMOPILES 1½ VOLTS 1½ AMPERES
For Electrolytic analysis, charging storage batteries, and other constant current requirements. $3 Each.
WALSH'S SONS & CO.,
264 Washington Street. Newark, N. J.

ELECTRIC SIGN
FLASHER

BEST IN THE WORLD
Write for full particulars
Reynolds Elec. Flasher Mfg. Co.
221 Fifth Ave., Chicago.

THOUSANDS IN USE.
Motors, ¼ h. p. to 100 h. p.
Dynamos, 1 k. w. to 75 k. w.
Highest Quality. Reasonable Price.
THE HOBART ELECTRIC MFG. CO.
TROY, OHIO.

ESTABLISHED 1875.
COMBINATION OF
Stow Flexible Shaft
—AND—
MULTI-SPEED MOTOR
Practically dust and water proof. For Portable Drilling, Tapping, Reaming, Emery Grinding, etc. Write for Catalogue and Prices.
STOW MFG. CO., Binghamton, N. Y.
Gen'l European Agents, Selig, Sonnenthal & Co., 85 Queen Victoria Street, London, England

Cope's Patent Quick Coupling Conduit Rod
Remember these rods have no lost motion.
These Couplings are of Steel and are made in the best possible manner.
PATENTED
NO LOST MOTION
Write for list of persons using these rods—26,000 sold since May 1902. Made in 3 ft. and 4 ft. lengths.
Price, 3 ft. 75 cents, 4 ft. 85 cents.
Patented February 24, 1903.
T. J. COPE
3244 North Fifteenth Street PHILADELPHIA, PA.

H. N. FENNER, President J. F. BLAUVELT, Agent RUSSELL W. KNIGHT, Treasurer
NEW ENGLAND BUTT COMPANY
MANUFACTURERS OF
Machinery for Insulating Electrical Wires
Braiding, Taping, Winding, Twinning, Cabling, Stranding, Polishing and Measuring Machines. Cable Covering Braiders
FINE CASTINGS A SPECIALTY
304 PEARL STREET, - - - PROVIDENCE, R. I., U. S. A.

WESTON Electrical Instrument Co.,
Waverly Park, NEWARK, N. J.

Illuminated Dial Station Instruments.
These instruments are constructed upon the same general principle as our regular Standard Portable Direct Current Voltmeters and Ammeters, but are much larger, and the working parts are inclosed in a neatly designed, dust-proof cast-iron case which effectively shields the instruments from disturbing influences of external magnetic fields.

Weston Standard Illuminated Dial Station Ammeter, Style B.

Weston Standard
Portable Direct Reading Voltmeters and Millivoltmeters. Ammeters and Millammeters, Wattmeters and Voltmeters, for Alternating and Direct Current Circuits.
Our portable instruments are recognized as standards throughout the civilized world.
Our Semi-Portable Laboratory Standard Voltmeters and Ammeters are still better.
They are the most reliable, absolute standards for Laboratory use.

LONDON—Elliott Bros., Century Works, Lewisham.
PARIS, FRANCE—E. H. Cadiot, 12 Rue St. Georges.
BERLIN—European Weston Electrical Instrument Co., Ritterstrasse No. 83
New York Office—74 Cortlandt St.

HENRY NEWGARD & CO.
ELECTRICAL CONSTRUCTION
Power and Light Plants. Switchboards and Panel Boards.
We install Municipal and Isolated Electric Lighting Plants.
We manufacture Switchboards, Table boards, Iron Cutout Boxes and Electrical Specialties.
We sell Dynamos, Motors and Electrical Supplies.
We wire old as well as new Residences, Factory Buildings, School and College Buildings.
87 Fifth Avenue, Chicago, Illinois.

The Power of the Subway

Nine 12,000-Horsepower Allis-Chalmers Engines

The largest aggregation of Steam Engines in the world

Daily output to reach 1,250,000 h. p. hours.

"The Talk of the Times"

Interior of power house of New York Subway, showing five of the nine 12,000-horsepower Allis-Chalmers Engines.

The three largest power plants in America are equipped with Allis-Chalmers Engines:
New York Subway—108,000-horsepower
Manhattan Elevated, New York City—96,000-horsepower
New York City Railway Co., formerly Metropolitan—61,000-horsepower

Allis-Chalmers Co.

Milwaukee, Wis., U. S. A.

THE ELECTRIC STORAGE BATTERY CO.

PHILADELPHIA

MANUFACTURER OF THE

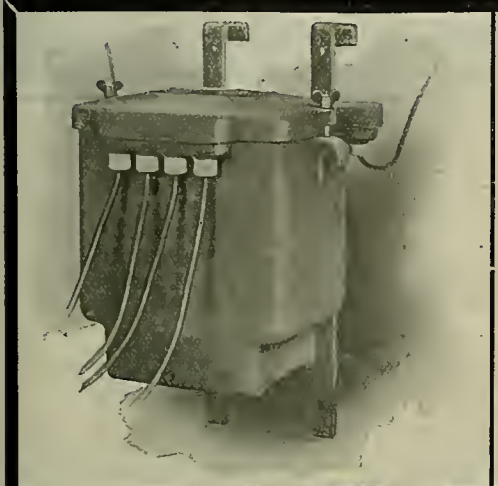
"Chloride Accumulator"

For Central Stations, Electric Railways, Isolated Lighting and Power Stations, Fire Alarm, Telegraph, Train Lighting, etc., etc.

PRICE LISTS AND DESCRIPTIVE BULLETINS FORWARDED UPON REQUEST.

SALES OFFICES:

PHILADELPHIA, Allegheny Ave. and 19th St. | NEW YORK, 100 Broadway, | BOSTON, 60 State St. | CHICAGO Marquette Bldg. | ST. LOUIS, Wainwright Bldg. | SAN FRANCISCO, Rialto Bldg. | CLEVELAND, Citizens Bldg. | CANADA, Canadian General Electric Co., Ltd. Toronto | HAVANA, CUBA, G. F. Greenwood, Manager 34 Empedrado St.



THE B. O. TRANSFORMER

Do you expect to need new transformers this fall? If you do, the B. O. will interest you.

Low Losses
High Efficiencies
High Insulation
Low Price.

Are you familiar with oil duct transformers?
Send us your address and we will tell you about our insulation and the advantages of slab windings in connection with oil ducts.

THE STANLEY ELECTRIC MANUFACTURING COMPANY
PITTSFIELD, MASSACHUSETTS

Atlanta, Ga., Empire Building
CHICAGO, ILL., MONADNOCK BLOCK
New York, N. Y., 29 Broadway
St. Louis, Mo., Century Bldg.
Boston, Mass., Oliver Building
Denver, Col., Hendrie & Bolthoff Mfg. & Supply Co.
Philadelphia, Pa., North American Building
San Francisco, Cal., 69-75 New Montgomery St.
Seattle, Wash., Pioneer Bldg.

Representatives for the Dominion of Canada, THE CANADIAN GENERAL ELECTRIC CO. of Toronto

"THE S. K. C. SYSTEM"

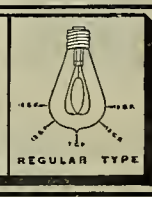
W. D. PAINT.

A PERMANENT INSULATING PROTECTION FOR WOOD OR METAL. A quick drying, moisture-proofing, black paint. An elastic anti-rust coating. A jet black finishing paint, efficient and not expensive.

Write for "Data on Insulating Materials."

DIELECTRIC MANUFACTURING CO., SAINT LOUIS.

DO YOU?
BUY LAMPS-OR-BUY CANDLE POWER
16 {THIS LAMP AVERAGES} 12
THE STERLING ELECTRICAL MANUFACTURING CO.
NEW YORK, N. Y. WARREN, O. CHICAGO, ILL.



PLATINUM

PLATINUM RIVETS FOR CONTACT POINTS IN TELEPHONES—SPARK COILS AND OTHER ELECTRICAL APPARATUS. PLATINUM SHEET AND WIRE IN ANY FORM AND DEGREE OF HARDNESS. PLATINUM SCRAP PURCHASED.

BAKER & COMPANY, Inc.

ARTISANS IN PLATINUM

408-410-412-414 N. J. R. R. AVE. - NEWARK, N. J.

New York Office: 120 Liberty St.

ALPHABETICAL INDEX TO ADVERTISEMENTS.

Adams-Hagnall Electric Co...—
Allis-Chalmers Company..... 2
American Battery Co.....—
Amer. Circular Loom Co..... 1
American Conduit Co.....16
Amer. District Steam Co.....18
Amer. Elec. Fuse Co..... 4
Amer. EL Telephone Co.....16
American Electrical Works..11
Arnold Elec. Power Station Co..... 14
Audit Co. of Ill., The..... —
Automatic Electric Co..... 17

Babcock & Wilcox Co.....—
Badt, F. B..... 14
Bain, Forée..... 11
Baker & Company..... 3
Baker & Co., W. E..... 14
Barnett Company, G. & H....22
Beardslee Chandelier Mfg. Co..... 10
Bennett, I. A..... 10
Berthold & Jennings.....19
Big Four Route.....—
Bissell Co., The F..... 7
Bossert Electric Construction Co..... 4
Brooks, Hall L.....18
Bryan-Marsh Co.....—
Bryan, Wm. H.....14
Buckeye Electric Co.....—
Bullock Elec. Mfg. Co..... 2
Burlington R. R.....12
Butterfield, J. F.....—
Byllesby & Co., H. M.....14

Cantwell Press, The.....16
Central Electric Co..... 5
Cent. Stat. Improvement Co.....12
Central Tel. & El. Co.....—
Century Electric Co.....—
Chicago Die & Electric Co....—
Chicago Edison Co.....4, 12
Chic. Fusé Wire & Mfg. Co...—
Chicago Insulated Wire Co.. 1
Chicago Mica Co.....10
Clinton Stamping & Elec Co.16
Columbia Incand. Lamp Co..—
Columbia Mfg. Co.....18
Continuous Rail Joint Company of America.....10
Cope, T. J..... 1
Crawfordsville Electric Co.. 7
Crescent Ins. Wire & Chl. Co. 1
Crocker-Wheeler Company...21
Cutler-Hammer Mfg. Co..... 7
Cutter Elec. & Mfg. Company—

D. & W. Fuse Company.....—
Dearborn Drng & Chem. Wks.15
Diamond Meter Company....—
Dielectric Manufacturing Co. 3
Directory of Engineers..... 14
Dixon Crucible Co., Joseph..15
Duncan Elec. Mfg. Co.....22

Edison Decorative & Miniature Lamp Departm't.....10
Edison Mfg. Company.....10
Edwards & Co.....12
Egan, J. J..... 1
Electric Appliance Co..... 10
Electric Storage Battery Co.. 3
Electrical Appliance Co..... 6
Electrical Engineer Institute.—
Electrician Pub. Company...14
Erie Ry.....19
Evans, Almirall & Co.....14

Faries Mfg. Co..... 22
"For Sale" Advertisements..12
Ft. Wayne Elec. Works, Inc..21
Fostoria Incand. Lamp Co...—
Fowler, John B.....19
Fowler-Jacobs Company.....19
Franklin Elec. Mfg. Co 7

Gates, S. A.....19
General Electric Co..... 8, 9
General Engineering Co., The 14
General Incandescent Arc Light Company.....—
General Incand. Lamp Co....—
Gould Storage Battery Co....—
Green Fuel Economizer Co...—
Gregory Electric Company...12

Hallberg, J. H 14
Haller Machine Co.....—
Hart Mfg. Co..... 7
Hartford Steam Boiler Inspection & Insurance Co....15
Hazard Manufacturing Co...22
Highland Park College. ... 11
Hipwell Mfg. Co..... .... —
Hobart Elec. Mfg. Co..... 1
Hoffman, G. W.....12
Holmes Fibre-Graph. Co.....15
Holophane Glass Co.....—
Hornaday & Co., J. P.....14
Humphrey, Henry H.....—
Hunt & Co., Robt. W.....14

Illinois Central Ry.....18
Incandescent Electric Light Manipulator Company.....—
Indiana Rub. & Ins. W. Co.... 1
India Rubber & Gutta Percha Insulating Company.....19
International Elec. Meter Co 12
International Tel. Mfg. Co...16
Jackson, D. C. & W. B.....14
Jeffrey Manufacturing Co....15
Jewell Electrical Inst. Co....—
Johns-Manville Co., H. W.....—

Kartavert Manufacturing Co.22
Kellogg Switchboard & Supply Company.....17, 18
Kemp, R. W..... 14
Kester Elec. Mfg. Co..... 8
Klein & Sons, Mathias..... .11
Kohler Brothers.....14
Kuhlman Electric Co..... 5

Leather Preserv. M. Corp....—
Leffel & Co., James.....15
Lindsley Brothers Company..19
Lond's Sons Co., H. M.....19

Machado & Roller .....—
Maltby Cedar Company.....19
Manhattan El. Supply Co....15
Manross, F. N. 12
Marinette Gas Engine Co.....15
Matthews & Bros., W. N.....11
McLaughlin, James..... .....—
McLaughlin & Co., Jas..... 4
McLennan & Company, K....10
Measured Service Co.....—
Mechanical Appliance Co....—
Mica Insulator Company.....—
Minnesota Electric Co.....—
Miscellaneous Advs.....12
Monon Railroad..... .. ..—
Morrison Lbr. Co., J. W.....—
Mueller Company, William..19
Munsell & Co., Eugene.....10

National Electric Co.....13
National India Rubber Co....—
New England Butt Co..... 1
Newgard & Co., Henry..... 1
New York Cent. Ry.....18
New York Ins. Wire Co.....11
Northern Elect'l Mfg. Co.... 8
Northwestern Storage Battery Co.. 4

Okonite Co., The..... 1
Olds Gasoline Engine Works.15

Pacific Coast Pole Co.....19
Paragon Fan & Motor Co.....—
Pardridge Shade & Refl. Co..—
Pass & Seymour, Inc.....—
Phelan, D. W.....18
Phillips, Eugene F.....11
Phillips Insulated Wire Co...11
Phoenix Glass Co..... 1
Phosphor-Bronze S. Co.....15
Pignolet, L. M.....10
Pittsburg & L. S. Iron Co....19
Plume & Atwood Mfg. Co....—
Porter Cedar Company.....18

Reisinger, Hugo..... 5
Reynolds El. Flasher Mfg. Co. 1
Roebling's Sons Co., J. A.....22
Roebel-Schwedtmann-Wells..14
Runzel-Lenz Elec. Mfg. Co...17

Safety Ins. Wire & Cable Co..10
Sargent & Lundy.....—
Sauquoit Silk Mfg. Co.....11
Schott, W. H.....14
Simplex Electrical Co., The.. 1
Simplex Elec. Heating Co....10
Speer Carbon Co..... .16
Sprague Electric Company...11
Squire Electric Co.....—
Standard Elec. Mfg. Co.....11
Standard Underg. Cable Co.... 1
Stanley Elec. Mfg. Co., The 3
Stanley Instrument Co..... 4
Stanton, LeRoy W..... 14
Sterling & Son, W. C.....18
Sterling Electrical Mfg. Co.... 3
Sterling Varnish Co., The....11
Stow Mfg. Company..... 1
Stromberg-Carlson Tel. Mfg. Company.....17
Sturtevant Company, B. F...22

Torrey Cedar Company.....18
Trumbull Elec. Mnfg. Co.....—
Turner Brass Works.....—

Union Electric Mfg. Co.....—

Valentine-Clark Co., The....18
Vulcanized Fibre Company..22

Wagner Electric Mfg. Co.....—
Walsh's Sons & Company..... 1
Warren Elec. Mfg. Co..... 7
Wesco Supply Co.....—
Western Electric Company... 8
Westinghouse Electric & Manufacturing Co.....20
Weston Electrical Inst. Co... 1
Whitehead Machinery Co... 12
Whitney Electrical Inst. Co..—
Wilmerding, C. H.....14
Wisconsin Central Ry.....19
Woolley Fdy. & Mach. Wks..—
Worcester Company, C. H....18

Yesbera Mfg. Co..... .. —
Yost Electric Mfg. Co 8

Zero Marx Sign Works 11

For Classified Index of Advertisements See Page 6.

Motors,
Switches,
Arc Lamps,
Circuit Breakers, Etc., Etc.

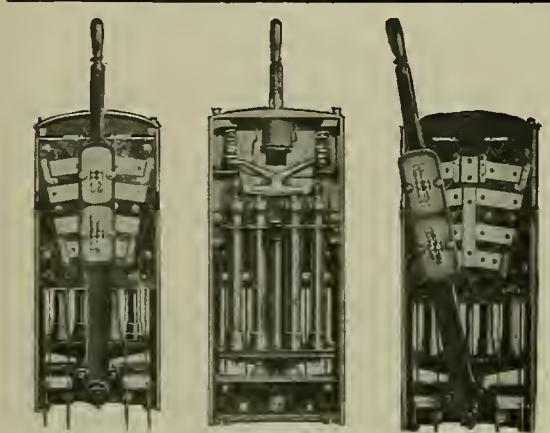
ALWAYS IN STOCK.

MANUFACTURED BY
G. E. Co.

CHICAGO EDISON COMPANY, 139 Adams Street. CHICAGO.

Allen-Bradley Electric Crane Controllers

Patented



Front View—before starting Rear View Front View—all resistance out

Manufactured by AMERICAN ELECTRIC FUSE CO., Chicago

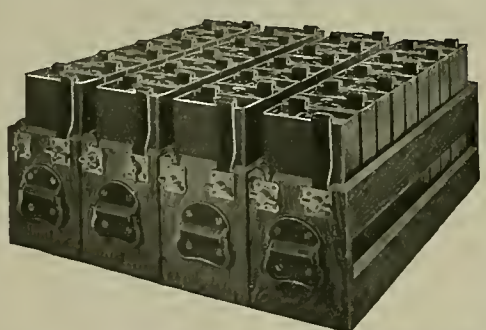
A New Controller. Positively No Sparking. No Repairs. Guaranteed for One Year. Three Months' Free Trial. Perfect Control.

OUR GUARANTEE: Ask any Other Manufacturer to Duplicate It.

THE AMERICAN ELECTRIC FUSE COMPANY hereby guarantees to..... that it will at any time within three months from this date upon demand repay to said..... the sum of..... .....Dollars, being the full purchase price paid (or agreed to be paid) by said..... to the American Electric Fuse Company for one..... horsepower Allen-Bradley Crane Controller, number.....upon delivery within three months after this date of said controller, freight prepaid and in good condition, ordinary wear and tear from use excepted, at the office of the American Electric Fuse Company, Chicago, Illinois, together with a written statement that said controller has proved unsatisfactory to said .....

FURTHERMORE, the said American Electric Fuse Company agrees that it will at any time within one year from this date replace, without charge, any part of said controller which may prove defective or wear out during the ordinary use of said controller, provided that it is a condition of this guarantee that said..... hereby agrees to use ordinary care in the operation of said controller, and that said controller will be operated by some person, or persons, familiar with the use of crane controllers, and further that said controller will not be wilfully or maliciously injured while in the possession of said.....

HIGH CLASS WORK



is assured when you use the

NORTHWESTERN STORAGE BATTERY

on all low-tension work.

Great Capacity, Light, Efficient and Compact.

Send for catalogue. Let us figure with you.

Northwestern Storage Battery Co.,
285 Madison St., - - - Chicago, Ill.

Our Compound Stops Sparking and Saves Commutators.

14 Years' Use on Street Ry., Light and Power Commutators Has Proven its Worth. WE GUARANTEE RESULTS.

Send Your Address for FREE SAMPLE THAT CONVINCES.

JAS. McLAUGHLIN & CO., ELECTRICAL ENGINEERS

586 Fulton Street, - - Chicago, Ill.

1 **1 Point for the Monitor Bushing** 1

is the fact that it is made with a perfectly rounded orifice, making this the 1 bushing that will not cut insulation on wires. 1 other point is its covering of insulating enamel—producing the smoothest and safest surface possible. 1 minute spent in investigating this bushing will prove profitable to any 1. Only 1 house in the U. S. has the right to manufacture them and that 1, the 1 which owns the patent.

BOSSERT ELECTRIC CONSTRUCTION CO.,

Write for Catalog. UTICA, N. Y., U. S. A

ELECTRICITY FOR ENGINEERS. 424 PAGES. ILLUSTRATED. PRICE $2.50.

ELECTRICIAN PUBLISHING CO.,
510 Marquette Building, • • CHICAGO.

STANLEY RECORDING WATTMETERS

FOR ALTERNATING-CURRENT CIRCUITS

BALANCED THRUST No Jewel Wear from Hammer or Side Thrust. Glass or Metal Covers, Second Alone to the

STANLEY MAGNETIC SUSPENSION WATTMETERS

Missouri, Kansas, Arkansas
FRANK ADAM ELECTRIC CO.
St. Louis

Colorado, Idaho, Montana, Wyoming
New Mexico, Utah
HENORIE-BOLTHOFF MFG. AND SUPPLY CO.
Denver

SEND FOR BULLETINS AND INFORMATION ABOUT METERS TO

STANLEY INSTRUMENT CO.

GREAT BARRINGTON MASS., U. S. A.

Mexico
VICTOR M. BRASHI & CO.
Mexico City

California, Oregon, Washington
Nevada, Arizona
BROOKS-FOLLIS ELECTRIC CORP.
San Francisco

It Will Interest You to Know What the **Western Electric Company** Have to Say Regarding

ELECTRA
TRADE MARK

HIGHEST GRADE NUERNBERG

CARBONS

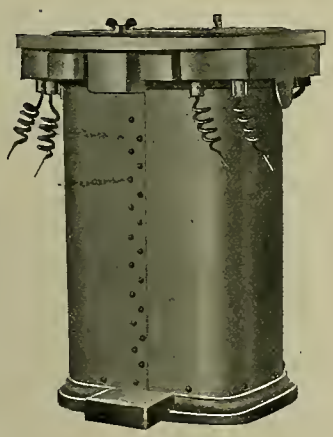
in their circular, dated November 23, 1903, which in part reads as follows:

"The Western Electric Company have made an exhaustive test of carbons of all kinds and have found that the 'ELECTRA' Carbons cannot be equaled in quality or efficiency, produce practically no dust and give an excellent and steady light. They produce the highest standard of candlepower in proportion to the current consumed, and are the most economical carbons manufactured."

HUGO REISINGER, Sole Importer, 11 Broadway, NEW YORK CITY.

1893——1904

STANDARD TRANSFORMERS
SERIES ARC TRANSFORMERS
POLYPHASE TRANSFORMERS



Before placing our 1905 type transformers on the market we offer the following standard type transformers subject to our regular 5 years' guarantee at a bargain.

1,000 or 2,000 volts primary and 100 or 200 volts secondary.

130	30	Light.	16	150	Light
60	40	"	18	200	"
40	50	"	24	300	"
36	60	"	17	400	"
28	80	"	8	500	"
56	100	"			

Quick shipments. If you want the latest and best write us about the 1905 type.

KUHLMAN ELECTRIC CO.,

ELKHART, IND., U. S. A.

TYPE K TRANSFORMER

A GOOD REPUTATION

Is a peculiar thing. In the first place it is hard to get and merit and time alone can get it. In the second place it is easy to lose. PITTSBURGH TRANSFORMERS have earned their reputation—earned it and kept it—which means a good deal nowadays.

CAN'T WE HAVE YOUR NEXT TRANSFORMER ORDER?

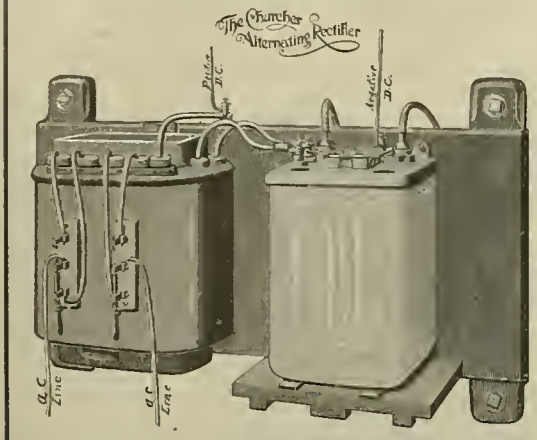
OKONITE IT NEVER DISAPPOINTS

Central Electric Company,

SALES AGENT

264-266-268-270 Fifth Ave., Chicago

OKONITE IT NEVER DISAPPOINTS



CHURCHER ALTERNATING CURRENT RECTIFIERS

Transform any cycle of alternating current into direct current and will at the same time, if desired, convert the potential of the direct current produced to a higher or lower voltage.

SOLD ON 30 DAYS' APPROVAL.

Guaranteed to be cheaper to install, have lower maintenance cost and higher efficiency than a motor-generator.

Send for Bulletin No. 11.

THE ELECTRICAL APPLIANCE CO., - - Cincinnati, Ohio

CLASSIFIED INDEX OF ADVERTISEMENTS.

Accountants and Auditors.
Audit Co. of Illinois

Adjusters, Cord.
Incandes. El. Lt. Manfp. Co.

Adjusters, Inc. Lamps.
Inc. El. Lt. Manipulator Co.

Anchors (Tel. & Tel.)
Bennett, I. A.
Matthews & Bro., W. N.

Annunciators.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Moon Mfg. Co.
Wesco Supply Co.
Western Electric Co.

Batteries and Jars.
Bissell Co., The F.
Central Electric Co.
Edison Mfg. Co.
Edwards & Company.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.

Bells, Buzzers, Etc.
Central Electric Co.
Edwards & Co.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.

Belt Dressing.
Dixon Crucible Co., Jos.
Leather Preserver Mfg. Corp.

Belting.
Leather Preserver Mfg. Corp

Blow Pipes.
Turner Brass Works

Blowers.
Sturtevant Co., B. F.

Boiler Compounds.
Dearborn Drug & Chem. Wks.

Boilers.
Allis-Chalmers Company.
Babcock & Wilcox Co.

Books, Electrical.
Cantwell Press, The.
Electrician Publishing Co.

Booths, Telephone.
Yesbera Mfg. Co.

Brackets.
Faries Mfg. Co.

Brushes.
Central Electric Co.
Hobart Elec. Mfg. Co.
Holmes Fibre-Graphite Co.
Speer Carbon Co.
Western Electric Company.

Cable Hangers.
Bissell Co., B. F.
Western Electric Co.

Cables (See Wires and Cables)

Canopies.
Faries Mfg. Co.

Carbons, Points and Plates.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
Raisinger, Hugo.
Speer Carbon Co.
Wesco Supply Co.

Castings.
Faries Mfg. Co.
New England Butt Co.
National Electric Co.

Chains.
Jeffrey Mfg. Co.

Chandeliers.
Faries Mfg. Co.

Circuit Breakers.
Cutler-Hammer Mfg. Co.
Cutter Elec. & Mfg. Co.
Ft. Wayne Elec. Wks. Inc.
Union Electric Mfg. Co.
Western Electric Company.
Westinghouse El. & Mfg. Co.

Clusters.
Faries Mfg. Co.

Coal and Ashes Handling Machinery.
Jeffrey Mfg. Co.

Coils and Magnets.
Western Electric Co.

Commutator Compound
Egan, J. J.
McLaughlin & Co., Jas.
McLennan & Co., K.

Condensers, Electric.
Stanley Elec. Mfg. Co.

Conduit and Conduits.
American Circular Loom Co.
American Conduit Company
Central Electric Co.
Electric Appliance Co.
Sprague Electric Co.
Standard Vitrified Cond. Co.
Wesco Supply Co.

Contractors and Electric Light Plants.
Allis-Chalmers Company.
Bullock El. Mfg. Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
National Electric Co.
Northern Electrical Mfg. Co.
Sprague Electric Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Controllers, Crane.
Amer. Elec. Fuse Co.

Cord.
Ruozel-Lenz Elec. Mfg. Co.

Cross-Arms, Pins and Brackets.
Berthold & Jennings.
Central Electric Co.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Company.

Cut-Outs and Switches.
Bissell Co., The F.
Bossert Elec. Const. Co.
Central Electric Co.
Chicago Edison Co.
Clinton Stamping & Elec. Co.
Cruse-Hinds Co.
Cutter Elec. & Mfg. Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
General Inc. Arc Light Co.
Hart Manufacturing Co.
Manhattan Elec. Supply Co.
Trumbull Elec. Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Dynamos and Motors.
Allis-Chalmers Company.
Bissell Co., The F.
Bullock Elec. Mfg. Co.
Central Electric Co.
Century Electric Co.
Crawfordsville Electric Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks. Inc.
General Elec. Co.
General Inc. Arc Light Co.
Gregory Electric Co.
Hobart Elec. Mfg. Co.
Mechanical Appliance Co.
National Electric Co.
Northern Electrical Mfg. Co.
Sprague Electric Co.
Stanley Elec. Mfg. Co.
Stow Manufacturing Co.
Sturtevant Co., B. F.
Wagner Electric Mfg. Co.
Warren Elec. Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Economizers, Fuel.
Green Fuel Economizer Co.

Electric Heating Appl.
Electric Appliance Co.
Simplex Elec. Heating Co.
Western Electric Co.

Electric Railways.
Crocker-Wheeler Co.
General Electric Co.
Sprague Electric Co.
Westinghouse El. & Mfg. Co.

Electrical and Mechanical Engineers.
Arnold Elec. Power Stat'n Co.
Badt, F. B.
Baker & Co., W. E.
Bryan, Wm. H.
Butterfield, J. F.
Byllesby & Co., H. M.
Evans, Almirall & Co.
General Engineering Co., The.
Hallberg, J. H.
Hornaday, J. P. & Co.
Humphrey, Henry H.
Hunt & Co., Robt. W.
Jackson, D. C. & W. B.
Kemp, R. W.
Kohler Brothers.
McLaughlin, James
Newgard & Co., Henry.
Northern Electrical Mfg. Co.
Ruebel, Schwedtman, Wells.
Sargent & Lundy.
Schott, W. H.
Squire Electric Co.
Stanley Elec. Mfg. Co.
Stanton, LeRoy W.
Wilmerding, C. H.

Electrical Instruments.
(Recording and Testing.)
Bissell Co., The F.
Central Electric Co.
Diamond Meter Co.
Duncan Elec. Mfg. Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
General Inc. Arc Light Co.
Jewell Electrical Inst. Co.
Machado & Roller.
Pignolet, L. M.
Stanley Elec. Mfg. Co.
Stanley Instrument Co.
Wagner Electric Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co
Weston Electrical Inst. Co.
Whitney Electl. Inst. Co.

Electro-Plating Mach'y
Crocker-Wheeler Company.
General Electric Co.

Elevators-Conveyors.
Jeffrey Mfg. Co.

Engines, Gas and Gasoline.
Allis-Chalmers Company.
Marinette Gas Engine Co.
Olds Gasoline Engine Works.
Woolley Fdy. & Mach. Wks.

Engines, Steam.
Allis-Chalmers Company.
Sturtevant Co., B. F.

Fans and Fan Motors.
Central Electric Co.
Crocker-Wheeler Company.
Edison Mfg. Co.
General Electric Co.
General Inc. Arc Light Co.
Sprague Electric Co.
Sturtevant Co., B. F.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Fibre.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Files.
Barnett Co., G. & H.

Fittings.
Faries Mfg. Co.

Fixtures, Gas and Elec.
Beardslee Chandelier Mfg. Co.

Flashers.
Bissell Co., The F.
Haller Machine Co.
Reynolds El. Flasher Mfg. Co

Flexible Shafts.
Stow Mfg. Co.

Forges.
Sturtevant Co., B. F.

Fuses and Fuse Wire.
Amer. Elec. Fuse Co.
Bissell Co., The F.
Central Electric Co.
Central Tel. & El. Co.
Chicago Dle & Electric Co.
Chicago Fuse Wire & Mfg. Co.
Clinton Stamping & Elec. Co.
D. & W. Fuse Company.
Electric Appliance Co.
Johns-Manville Co., H. W.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Company.

Globes, Reflectors and Shades.
Fostoria Incan. Lamp Co.
Haller Machine Co.
Holophane Glass Co.
Pardridge Shade & Refl. Co.
Phœnix Glass Co.
Wesco Supply Co.
Western Electric Co.

Graphite Specialties.
Dixon Crucible Co., Jos.
Holmes Fibre-Graphite Co.

Heating (Exhaust Steam).
Amer. District Steam Co.

Heating and Ventilating Apparatus.
Sturtevant Co., B. F.

Heating, Hot Water.
Evans, Almirall & Co.

Holders, Inc. Lamps.
Electric Appliance Co.
Incandescent Electric Light Manipulator Co.

Inspection & Insurance
Hartford Steam Boiler Inspection & Insurance Co.

Insulating Machinery.
New England Butt Co.

Insulators and Insulating Materials.
American Electrical Works.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Inc. Arc Light Co.
Indiana Rub. & Ins. Wire Co.
Johns-Manville Co., H. W.
Kartavert Mfg. Co.
Manhattan Elec. Supply Co.
Mica Insulator Co.
Munsell & Co., Eugene.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Standard Vitrified Cond. Co.
Sterling Varnish Co.
Vulcanized Fibre Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Junction Boxes.
Bossert Elect. Const. Co.
General Inc. Arc Light Co.

Lamps, Arc.
Bissell Co., The F.
Central Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
General Inc. Arc Lt. Co.
Gregory Electric Co.
Hipwell Manufacturing Co
Manhattan Elec. Supply Co.
Stanley Elec. Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Lamps, Incandescent.
Bissell Co., The F.
Bryan-Marsh Company.
Buckeye Electric Company.
Central Electric Co.
Chicago Edison Co.
Columbia Incan. Lamp Co.
Edison Decorative & Miniature Lamp Dept.
Electric Appliance Co.
Fostoria Incand. Lamp Co.
Franklin Electric Mfg. Co.
General Electric Co.
General Inc. Arc Light Co.
Standard Elec'l Mfg Co.
Sterling Electrical Mfg. Co.
Wesco Supply Co.
Western Electric Co.

Lamps, Incandescent—Replacers & Cleaners.
Inc. El. Lt. Manipulator Co.

Letters, Metal.
Haller Machine Co.

Lightning Arresters.
Central Electric Co.
Clinton Stamping & Elec. Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
Manhattan Elec. Supply Co.
Minnesota Electric Co.
Stanley Elec. Mfg. Co.
Western Electric Co.

Linemen's Climbers.
Klein & Sons, Mathias.

Magnet Wires.
(See Wires and Cables.)

Measured Service.
Measured Service Co.

Mechanical Draft.
Sturtevant Co., B. F.

Mica.
Chicago Mica Co.
Mica Insulator Co.
Munsell & Co., Eugene.

Mining Apparatus, Elec.
Allis-Chalmers Company.
Crocker-Wheeler Company.
General Electric Co.
Jeffrey Mfg. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Motors. (See Dynamos and Motors.)

Nippers and Pliers.
Klein & Sons, Mathias.

Nozzles.
Faries Mfg. Co.

Paints.
Dielectric Mfg. Co.

Patent Attorneys.
Bain, Foree.

Phosphor Bronze.
Phosphor Bronze Sm. Co. Ltd.

Platinum, Wire and Sheet.
Baker & Company Inc.

Poles and Ties.
Berthold & Jennings.
Brooks, Hall L.
Columbia Mfg. Co.
Fowler, John H.
Fowler-Jacobs Company.
Gates, S. A.
KeBogg Switch. & Sup. Co.
Lindsley Bros. Co.
Loud's Sons Co., H. M.
Maltby Cedar Co.
Morrison Lbr. Co., J. W.
Mueller Company, William.
Pacific Coast Pole Co.
Phelan, D. W.
Pittsburg & L. S. Iron Co.
Porter Cedar Company.
Sterling & Son, W. C.
Torrey Cedar Co.
Valentine-Clark Co., The.
Worcester Co., C. H.

Polish (Metal).
Allen Co., Inc., L. B.
Huffman, Geo. W.

Portables.
Faries Mfg. Co.

Power Transmission Machinery.
Jeffrey Mfg. Co.

Rail Joints.
Continuous Rail Joint Company of America.

Rectifiers.
Electrical Appliance Co.

Refiners.
Gt. West Smelt. & Refining Co

Re-Winding—Repairs.
Chicago Edison Co.
Gregory Electric Co.

Rheostats.
Cutler-Hammer Mfg. Co.
General Electric Co.
Gen'l Inc. Arc Lt. Co.
Union Electric Mfg. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Rods, Conduit.
Cope, T. J.

Safes.
Sears, Roebuck & Co.

Schools and Colleges.
Electrical Engineer Inst.
Highland Park College

Second-Hand Mach'y.
Bissell Co., The F.
Cent. Stat. Improvement Co.
Gregory Electric Co.
Matthews & Bro., W. N.
Walsh's Sons & Co.

Shades, Lamp.
Faries Mfg. Co.

Sheet Brass & Copper.
Plume & Atwood Mfg. Co.

Signs, Electric.
Baller Machine Co.
Zero Marx Sign Works.

Silks, Insulating and Braiding.
Sauquoit Silk Mfg. Co.

Sockets & Receptacles.
Pass & Seymour.
Yost Elec. Mfg. Co.

Soldering Sticks, Salts and Paste.
Allen Co., L. B.
Crescent Co.
Kester Elec. Mfg. Co.
Western Electric Co.

Speaking Tubes.
Central Electric Co.
Edwards & Co.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.

Specialties, Electrical Mfrs. and Designers.
Haller Machine Co.

Speed Indicators.
Weston Electrical Inst. Co.

Storage Batteries.
American Battery Co.
Electric Storage Battery Co.
Gould Storage Battery Co.

Supplies, General Elec.
Bissell Co., The F.
Central Electric Co.
Century Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Electric Co.
Manhattan Elect'l Supply Co
Wesco Supply Co.
Western Electric Co.

Switchboards.
Bissell Co., The F.
Crouse-Hinds Co.
Geo. Incan. Arc Light Co.

Telephones, Telephone Material and Switchboards.
American El. Telephone Co
Automatic Electric Co.
Bissell Co., The F.
Central Electric Co.
Central Tel. & El. Co.
Electric Appliance Co.
International Tel. Mfg. Co.
Kellogg Switchb. & Sup. Co.
Manhattan Elec. Supply Co.
Stromberg-Carlson Tel. M. Co
Wesco Supply Co.
Western Electric Co.

Time Switches.
Bissell Co, The F.

Tools.
Klein & Sons, Mathias.
Western Electric Co.

Transformers.
Central Electric Co.
Crawfordsville Electric Co.
Crocker-Wheeler Co.
Electric Appliance Co.
Ft. Wayne Elec. Works, Inc.
General Electric Co.
Gregory Electric Co.
Kuhlman Electric Co.
Manhattan Elec. Supply Co.
National Electric Co.
Stanley Elec. Mfg. Co.
Wagner Electric Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Trucks, Electric Car.
General Electric Co.
Westinghouse El. & Mfg. Co.

Turbines, Steam.
Allis-Chalmers Co.
General Electric Co.
Westinghouse El. & Mfg. Co

Turbine Water Wheels
Leffel & Co., Jas.

Varnishes.
Dielectric Mfg. Co.
Sterling Varnish Co.

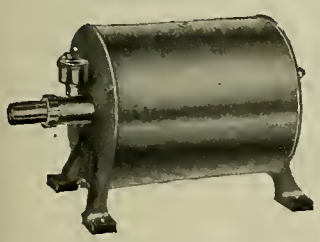
Vulcanized Fibre.
Vulcanized Fibre Co.

Whistles, Electric.
Electrical Appliance Co.

Wires & Cables—Magnet Wires.
American Electrical Works.
Bissell Co., The F.
Central Electric Co.
Chicago Insulated Wire Co.
Crescent Ins. Wire & Cble. Co.
Electric Appliance Co.
General Electric Co.
Hazard Manufacturing Co.
Indiana Rub. & Ins. Wire Co
India Rubber & Gutta Percha Insulating Co.
Kellogg Switch. & Sup. Co.
Manhattan Elec. Supply Co.
National India Rubber Co
New York Insulated Wire Co.
Okonita Co., The.
Phillips, Eugene F.
Phillips Insulated Wire Co
Roebling's Sons Co., J. A.
Runzel-Lenz Elec. Mfg. Co.
Safety Ins. Wire & Cable Co
Simplex Electrical Co.
Standard Underground C. Co
Wesco Supply Co.
Western Electric Company.

For Alphabetical Index of Advertisements See Page 3.

FOR GAS and GASOLINE ENGINES



THE SECURITY INDUCTION SPARKER

when used for butt sparks is an induction dynamo furnishing an alternating current. It has no motor or brushes with their attendant troubles.

Price **$14.00** Each

which includes the dynamo, both sprockets, one split and bored 2½ inches or less to fit your engine valve rod or main shaft and six feet of chain.

Write for Bulletin 124 W.

THE F. BISSELL COMPANY

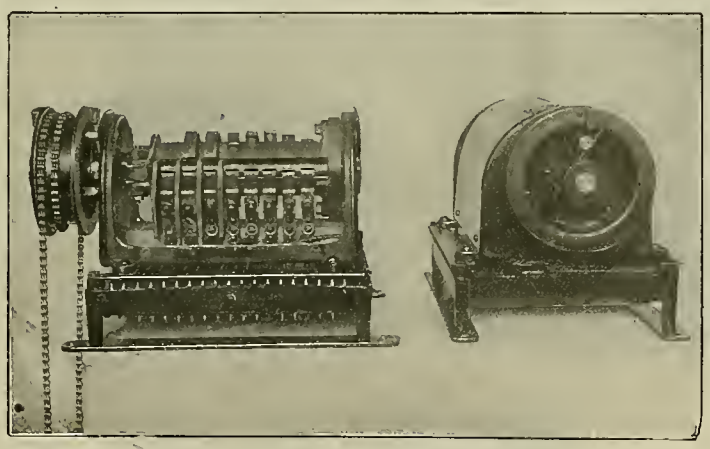
MANUFACTURERS AND JOBBERS OF

ELECTRICAL GOODS,

226-228-230 HURON STREET,

TOLEDO, O.

Rope-Operated, Reversible Drum Controller.



The ideal controller for small cranes and hoists where it is desired to operate from the floor.

Built to stand the most severe usage. Automatic return to "off" position when operator releases chain or rope.

Brushes and contacts are renewable and are made of hard drawn copper.

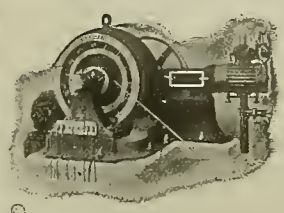
SPEED—Normal at full load to 50 per cent. at half load. Specially built for reduction of 90 per cent. regardless of load.

The Cutler-Hammer Mfg. Co.

MILWAUKEE, WIS.

New York Boston Chicago Pittsburg

Warren Alternator



Acme of
Electrical Perfection,
Mechanical
Simplicity,
Regulation,
Efficiency.

WE GUARANTEE
WHAT WE SELL
and
SELL WHAT WE
GUARANTEE

WARREN ELECTRIC MFG. CO.

Sandusky, O.

"Diamond H" Switches

Trade H Mark

This Trade-Mark guarantees quality.

The Hart Mfg. Co., Hartford, Conn.

New York Boston Chicago Toronto, Ont.

HORNBERGER-IRWIN

Transformers

(LARGE AND SMALL)

½ K. W. to 500 K. W.

This transformer represents the latest improvements in transformer construction; made in three types; multi-coil construction; ventilated cores; built for all commercial voltages and frequencies; **higher efficiencies together with lower temperatures than have heretofore been attained are guaranteed.**

Catalogue just issued explains details.

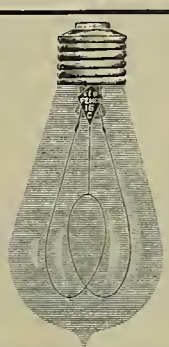
Manufactured by

Crawfordsville Electric Co.

CRAWFORDSVILLE,
INDIANA, U. S. A.

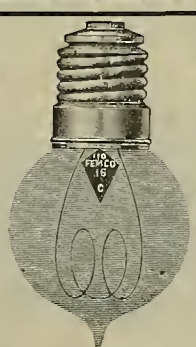
FEMCO

Lamps are the standard ALWAYS have been ALWAYS will be.



FEMCO

Lamps are sold at the smallest possible margin over actual cost.



FEMCO

Lamps are fully guaranteed as to voltage, candlepower, efficiency, and useful life.

THE FRANKLIN ELECTRIC MFG. CO.

LICENSED MANUFACTURERS.

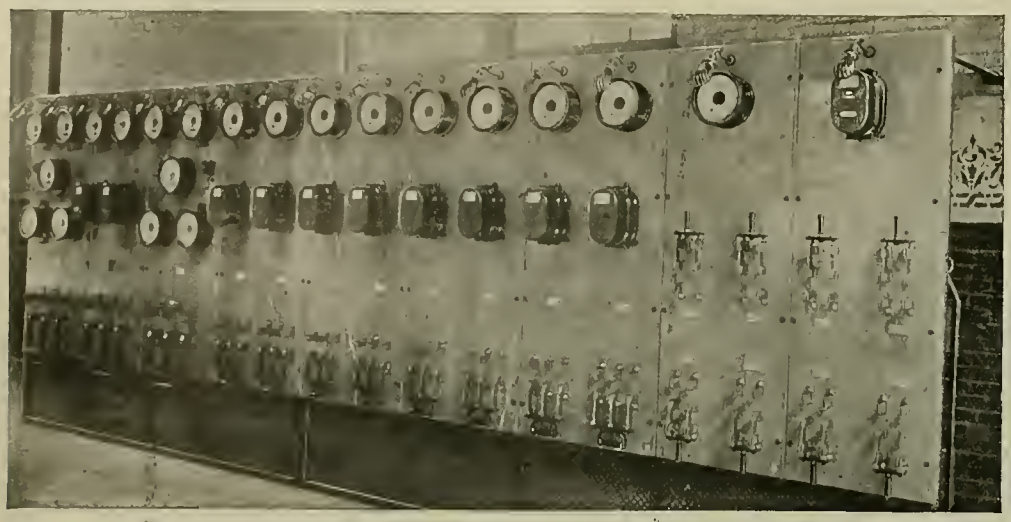
NEW YORK
815 Havemeyer Bldg.

Factory and General Office,
HARTFORD, CONN.

BALTIMORE, MD.
2230 Guilford Ave.

Agents Wanted.

Southwestern Representative: THE SACHS ELECTRIC CO., St. Louis, Mo.



SWITCHBOARDS

FOR ALL SERVICES

WESTERN ELECTRIC COMPANY

CHICAGO NEW YORK

AND OTHER LEADING CITIES

Space 17, Electricity Bldg., Louisiana Purchase Exposition

YOST SPECIALTIES.

Sockets, Wall Sockets, Weatherproof Sockets, Rosettes, Receptacles, Cord Adjusters.

Catalogue for the asking.

THE YOST ELECTRIC MFG. CO.

TOLEDO, OHIO.

155

NORTHERN SMALL MOTORS

Compact....Efficient....Superior

High type of construction....susceptible of good speed variation....multipolar....form-wound armatures....simple....hardy....trustworthy.

Booklet No. 3325

NORTHERN ELECTRICAL MFG. CO.

Engineers...Manufacturers Madison, Wis., U. S. A.

KESTER SELF FLUXING SOLDER

A Tube of Solder Filled with Flux. Requires no Acid.

SAVES—LABOR—TIME—MONEY.

ACTUAL SIZE

PATENTED.

Send for Free Samples.

L. F. Mahler Co., R. 1008 Chemical Bldg., St. Louis, Mo., Gen. Western Agent.

KESTER ELECTRIC M'F'G CO., 46 N. UNION STREET, CHICAGO, ILL.

General Electric Company

THREE-PHASE TRANSFORMERS

ARE

CHEAPER, LIGHTER, MORE COMPACT AND MORE READILY INSTALLED

than an equal capacity of Single-Phase Transformers

50 Kw. 40 Kw. 30 Kw. 20 Kw. 15 Kw. 10 Kw. 7.5 Kw. 5 Kw.

Principal Offices, Schenectady, N. Y.

Chicago Office: Monadnock Block. Sales Offices in all Large Cities.

General Electric Company

St. Louis Exposition Awards

FIVE GRAND PRIZES and TEN GOLD MEDALS

The General Electric Company has received the following awards at the Louisiana Purchase Exposition:

GRAND PRIZES

1—Curtis Steam Turbine.
2—Alternating-current Turbo-generator Installation, Alternating-current Generator and Motors, Static Transformers and Rotary Converters.
3—Direct-current Generator and Motors.
4—Electric Railway Motors and the Control System for single and multiple-unit operation and for mining and industrial locomotives.
5—Arc and Incandescent Lamp and Arc-lighting Systems.

GOLD MEDALS

1—Complete switchboard and controlling apparatus and application of electric motors for mechanical purposes.
2—Mercury Arc Rectifier.
3—Wires and Cables for Lighting and Power.
4—Electric Measuring Instruments.
5—Electric Laboratory Apparatus.
6—War Ship Turret Handling and Controlling Apparatus.
7—Sewing Machine Motors.
8—Best Exhibit in Electrical Department. Only medal awarded for best and most complete exhibit.
9—Mining Locomotives.
10—Social betterment of employes.

SILVER MEDALS

1—Sockets, Switches and Wiring Appliances.
2—Balance Light Distributing Concentric Diffuser Steel Ceiling.
3—Electric Searchlights.
4—Sockets, Switches and Wiring Appliances.
5—Lemp Irreversible Automobile Steering Check.

BRONZE MEDALS

1—Lumichromoscope.
2—Porcelain Wares.

General Office: Schenectady, N. Y.

New York Office: 44 Broad St. London Office: 83 Cannon St., E. C.

SALES OFFICES IN ALL LARGE CITIES

Never was lamp like the Zenith

More than an incandescent
Less than an arc
And more adaptable than either

The Packard Zenith lamp can be used where it is not practicable to use an arc lamp, and when used in place of a cluster of incandescents it gives better light at less cost.

Made in 25 and 55 C. P. and for all standard voltages. Do you want prices?

Electric Appliance Company
CHICAGO and SAN FRANCISCO

EDISON MINIATURE LAMPS

are made in more than 10,000 varieties,

for all classes of work in Candelabra and Decorative Lighting, Multiple and Series Burning and in all types of Battery Lamps.

Miniature Sockets and Receptacles,

EDISON DECORATIVE & MINIATURE LAMP DEPT.,
General Electric Company, Harrison, N. J.

VOLT - AMMETERS,
POCKET SIZE.
For Testing Batteries and Battery Circuits, Locating Faults, Grounds, etc.
RELIABLE. ACCURATE.
Send for Circular.
L. M. PIGNOLET,
78-80 Cortlandt St. NEW YORK, N. Y

Electric Heating Apparatus
SEND FOR 32-PAGE CATALOGUE.
UNIT" ENAMELED RHEOSTATS
SIMPLEX ELECTRIC HEATING CO.,
Cambridgeport, Mass.

BEARDSLEE CHANDELIER M'F'G CO. 256 AND 257 5TH CANAL ST. CHICAGO
GAS & ELECTRIC FIXTURES FOR THE TRADE.
CATALOG SENT PREPAID TO DEALERS — MENTION THIS PAPER

MICA—BOND
Notice how our competitors try gradually to raise Cut Mica prices—same thing would occur in manufactured mica if we were not the leaders
CHICAGO MICA CO
"PERFECTORS" VALPARAISO, IND.

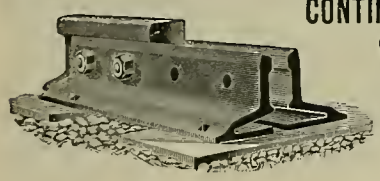
MICA Of all Qualities, in any Form at Lowest Prices
EUGENE MUNSELL AND CO.
NEW YORK and CHICAGO

INSULATION That Is.
Micanite, Linotape, M. I. C. Compound, Empire Cloth and Paper. For Years the Standard.
MICA INSULATOR CO., Originators
NEW YORK and CHICAGO

SPARKING *Reduces the working capacity of a motor or dynamo, wears out the commutator, wastes power and may cause a fire. All this may be avoided if you use . . . . . .*

The only article that will PREVENT SPARKING. Will keep the Commutator in good condition and PREVENT CUTTING.
Absolutely Will Not Gum The Brushes.
It will put that high gloss on the Commutator you have so long sought after.
50 Cents per Stick. $5.00 per Dozen.
SEND FOR FREE SAMPLE STICK.
For sale by all supply houses, or
K. McLENNAN & CO. Sole Mfrs., Room 411 Inter Ocean Bldg., 130 Dearborn St., CHICAGO

USE
"SAFETY" RUBBER COVERED WIRE AND CABLE
FOR EVERY ELECTRICAL SERVICE.
M. B. AUSTIN & CO.,
CHICAGO REPRESENTATIVE.
THE SAFETY INSULATED WIRE & CABLE CO.,
WORKS: Bayonne, N. J. 114-116 LIBERTY STREET, N. Y.



CONTINUOUS RAIL JOINT CO. OF AM.
GENL. OFFICES: CENTURY BLDG., NEWARK, N. J.
OVER 20,000 MILES IN USE
See our exhibit, World's Fair, St. Louis, Mo., Transportation Bldg., Aisle "C," Posts 7 and 8.

ANCHORS That are cheaper to install because of the simple method of burying and the great strain that can be applied **American Bull-Tongue Anchors** reduce the cost of the process of guying a pole by reduction in labor, they **stay solid,** they do not slip no take up required. 21 cents worth holds 8,713 pounds, 42 cents worth holds 10,521 pounds, other money's worth in proportion.

I. A. BENNETT,
529 and 530 Monadnock Block - - - CHICAGO

EDISON PRIMARY BATTERIES
FORMERLY EDISON-LALANDE

There is no deterioration in the permanent parts of these batteries. It follows, therefore, that each time a cell is re-charged it will last as long a time and deliver as heavy a current as the original charge, when the cell was first put into service. Our Catalogue No. 7 will tell you more about this. Let us send it.

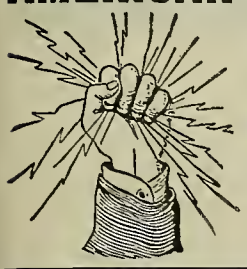
TRADE Thomas A. Edison PARIS

EDISON MFG. CO.
Factory, ORANGE, N. J.
NEW YORK: 83 Chambers Street
CHICAGO: 304 Wabash Avenue

FRANK N. PHILLIPS, PRESIDENT. C. H. WAGENSEIL, TREASURER. EUGENE F. PHILLIPS, GENERAL MANAGER. E. ROWLAND PHILLIPS, VICE-PRES. C. R. REMINGTON, JR., SEC.

AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.

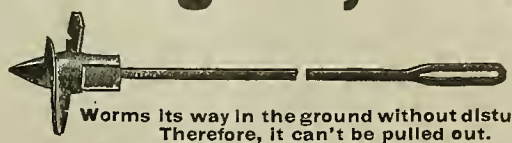


BARE AND INSULATED ELECTRIC WIRE,

ELECTRIC LIGHT LINE WIRE,
INCANDESCENT AND FLEXIBLE CORDS,
Railway Feeder and Trolley Wire,
AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR WIRES.
CABLES FOR AERIAL AND UNDERGROUND USE.

NEW YORK STORE, W. J. Watson, 26 Cortlandt St.
CHICAGO STORE, F. E. Donohoe, 82 Lake St.
MONTREAL BRANCH, Eugene F. Phillips' Electrical Works.
MAIN OFFICES AND FACTORIES, PHILLIPSDALE, R. I.

Simply Screw Them In.
THAT'S ALL
THERE IS TO THE INSTALLATION OF THE
Stombaugh Guy Anchor



Worms its way in the ground without disturbing it.
Therefore, it can't be pulled out.

WRITE FOR FURTHER INFORMATION TO
W. N. MATTHEWS & BRO., Distributors
603 Carleton Building, St. Louis

M. KLEIN & SON.
Send 2c stamp for new catalogue No. 6 of
KLEIN'S TOOLS
For Electrical Workers and Line Builders.
MATHIAS KLEIN & SONS,
81 W. Van Buren St., Chicago, Ill.

Engineering MECHANICAL, ELECTRICAL, STEAM, CIVIL.
Complete and short courses. Thoroughly equipped engineering shops. Shop work from the beginning. Short courses in Steam and Electrical Engineering. Expenses low. Accommodations the best. School all year. Students may enter any time. Correspondence steam and electrical courses. Send for catalogue. Mention course in which interested.
HIGHLAND PARK COLLEGE, DES MOINES, IOWA.

EXPERT IN ELECTRICITY MECHANICS PATENT CAUSES
SOLICITOR OF **PATENTS**
U. S. & FOREIGN
FORÉE BAIN, 1652-3 Monadnock Blk., CHICAGO

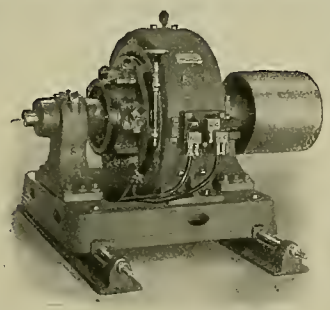
Sterling Black Plastic Insulator.
One hundred days' continuous baking at 180° F. will not make it brittle. Water repellent. Oil proof.
THE STERLING VARNISH CO., - - Pittsburg, Pa.

"STAR" INCANDESCENT LAMPS

LONG LIFE
GUARANTEED CANDLEPOWER,
HIGHEST EFFICIENCY.

MADE BY THE MOST SKILLED WORKMEN.
STANDARD ELECTRICAL MFG. COMPANY, : Niles, Ohio.

DIRECT CURRENT
GENERATORS
FOR LIGHT AND POWER



Our generators have a high efficiency and great endurance under the most exacting conditions of service. Sizes up to 1,000 K. W.
Write for bulletin No. 10514.

SPRAGUE
ELECTRIC COMPANY
General Offices:
527 West 34th Street, New York
Chicago Office: Fisher Building

SAUQUOIT SILK MFG. COMPANY,
INSULATING and BRAIDING SILKS
MILLS:
BETHLEHEM, PA.
PHILADELPHIA, PA.
SCRANTON, PA.
NEW YORK REPRESENTATIVES:
WILLIAM RYLE & COMPANY
54 Howard St.
PHILADELPHIA OFFICE:
4015 Clarissa St.
CHICAGO OFFICE:
210 Monroe St.
BOSTON OFFICE:
78 Chauncy St

Crimshaw

Raven White Core

Raven Black Core

ALL OUR WIRES pass inspection and carry the above TRADE-MARKS on our tags. We also manufacture Crimshaw and Competition Tapes and Splicing Compounds.

NEW YORK INSULATED WIRE COMPANY,

MAIN OFFICE: 114, 116 & 118 Liberty St., New York.
BRANCHES: CHICAGO: 192 Desplaines St. BOSTON: 7 Otis St. SAN FRANCISCO: 33 Second St.

NATIONAL CODE STANDARD

"O. K." Weatherproof Wire.
Slow-Burning Weatherproof and Ideal Wire.
Prices and Samples on Application.

Phillips Insulated Wire Co.
Office and Factory: PAWTUCKET, R. I.

ELECTRIC SIGNS
INCREASE YOUR CURRENT CONSUMPTION.
Assist us to sell ELECTRIC SIGNS to the best merchants in your city.

No repair bills with our signs we furnish the best—all metal raised letters equipped with removable copper shell sockets. WRITE US, we will conscientiously study your sign wants and gladly submit drawings with very low quotations for the best work.

ZEROMARX SIGN WORKS
CHICAGO, ILL.

WANTED, FOR SALE *and similar* **WANT COLUMN** *advertisements (50 words or less), $1.50 an insertion; additional words 3c each.*
POSITION WANTED *advertisements (50 words or less), $1.00 an insertion; additional words 2c each.*

POSITION WANTED.

By a wide-awake electrical salesman, 28 years of age, technical education, with a very wide acquaintance in the electrical fraternity throughout the southern, western and northwestern states, acquainted with all electrical supplies and appliances and can secure good trade to a reliable house. Best of references furnished. Address BOX 409, care of Western Electrician, 510 Marquette Bldg., Chicago, Ill.

WANTED.

A solicitor in contracting department. Must be a practical man with some knowledge of electricity. Applicants will give references, state experience and wages. Address BOX 410, care of Western Electrician, 510 Marquette Bldg., Chicago, Ill.

WANTED.

Have option for purchase of wholesale electrical supply house in Indianapolis. Established profitable trade, average business $100,000 per year. Only one competing house in Indiana. Want practical man with capital to join in purchase. W. A. ROYSE, Electrical Contractor, 16 E. Market St., Indianapolis, Ind.

AGENCY WANTED.

A firm of Engineers with good trade connections is open to represent Manufacturers of Electrical and Mechanical commodities in Chicago and vicinity. Address BOX 411, care of Western Electrician, 510 Marquette Building, Chicago, Ill.

FOR SALE.

Gas and electric plant in one of the best towns in Tennessee. Population 4,500; no competition. Price $40,000 cash. Address BOX 412, care Western Electrician, 510 Marquette Bldg., Chicago.

FOR SALE

1 Stanley generator, two-phase, 16,000 alternations, 1,000-2,000 volts, 40 K. W., 1333 R. P. M. and exciter.
1 Stanley generator, two-phase, 16,000 alternations, 1,000-2,000 volts, 60 K. W., 1,000 R. P. M. with exciter.
Complete marble switchboard with new instruments for above.
1 Westinghouse generator, 76 K. W., single-phase, 1,100 volts, 7,200 alternations, exciter, switchboard, new instruments complete, 750 R. P. M.
2 New belts.
1 Russell 13x20 4-valve engine, 200 R. P. M.
1 Ball 9½x10 engine, 360 R. P. M.
2 Boilers, 16x54 inch, 42 4-inch tubes, allowed 110 lbs. pressure, complete with 50-foot stack.
1 Hoppes heater. All steam pipe, valves, etc.

All in good condition. Can be seen running until December 16th. We are abandoning this plant on account of removal, and will sell all or in part. For further information, address

TIBBE ELECTRIC CO., Washington, Mo., or RUEBEL-SCHWEDTMANN-WELLS, St. Louis.

"MANROSS"
HAIR SPRINGS
For Electric Indicating and Recording Gauges, Steam Gauges, Etc
LARGEST MANUFACTURER OF
HAIR SPRINGS in the United States.
F. N. MANROSS,
FORESTVILLE, CONN.

Western Electrician
WANT ADS
Bring Results.

Corliss Engines.

900 h. p., 34x60, International.
900 h. p., 22x42x48, Hamilton Tand. Comp.
750 h. p., 32x54, Hamilton, 1890 Frame.
650 h. p., 30x54, St. Louis, 1890 Frame.
600 h. p., 28x60, Philadelphia.
500 h. p., 16x32x42, Corliss Cross Comp., latest type.
450 h. p., 16x30x42, Allis Cross Comp.
400 h. p., 23½x60, Geo. H. Corliss.
450 h. p., 24x48, Harris, latest type.
450 h. p., 24x48, Brown.
350 h. p., 22x42, Allis, 1890 Frame.
350 h. p., 22x42, Slater, 1890 Frame.
300 h. p., 20x48, Harris.
300 h. p., 20x42, Hamilton.
225 h. p., 12x22x42, Atlas Tandem Comp.
225 h. p., 18x42, Hamilton.
175 h. p., 16x42, Allis.
165 h. p., 16x36, Sioux, 1902.
150 h. p., 15x38, Brown.
140 h. p., 14x42, Allis, 1890 Frame.
125 h. p., 14x36, Putnam.
90 h. p., 12x36, Harris.
600 h. p., 28½x52, Buckeye Automatic.
500 h.p., 17½x30½x27, Buckeye Cross Comp.
450 h.p., 16½x28½x27, Buckeye Cross Comp.
450 h. p., 24x48, Buckeye Automatic.
350 h. p., 16x26x18, Ideal Tandem Comp.
275 h. p., 14x22x16, Ideal Tandem Comp.
250 h. p., 16x27x16, Westinghouse Comp.
200 h. p., 18x24, Meyer Automatic.
150 h. p., 15x24, Cummer.
150h.p., 10½x18x18, Williams' Tandem Comp.
100 h. p., 12½x15, Taylor Beck.

Whitehead Machinery Company,
DAVENPORT, IOWA.

REPAIRING RECALIBRATING
ELECTRIC METERS.
INTERNATIONAL ELECTRIC METER CO.
167 S. CANAL STREET, CHICAGO.

EDWARDS AND CO

The R. E.-A. L. Monitor Bell.
(Patented.)

Hammer rod supported in two places and thrown straight out and in by the armature, striking gong on inside, near edge, thus giving a full, clear tone.
All springs made of Phosphor Bronze and so formed that there is least possible strain.
Contacts are platinized, adjustment is made by pressure on the standard which supports one contact. No screws or nuts being used in the adjustment, bell does not get out of order by operation.
Ordinarily the weak point is the pivot, the unreliable one the adjusting screw and nut. As these defects have been eliminated, this bell will stand hard usage and operate under adverse conditions.
The hammer entirely concealed by gong and cannot be tampered with.
It is especially adapted for use on street cars, as in addition to the advantages mentioned, it is dust, insect and moisture proof.
WESTERN ELECTRIC COMPANY,
SELLING AGENTS,
NEW YORK N.Y.

FOR SALE.
ALTERNATORS.
1-360 K. W. General Electric 3-phase.
1-120 " " " "
1-75 " Westinghouse 2-phase.
250-VOLT GENERATORS.
1-250 K. W. Western Electric M. P.
1-200 " Eddy M. P.
125-VOLT GENERATORS.
1-125 K. W. Western Electric M. P.
Immediate shipment.
GREGORY ELECTRIC CO.
54-62 S. CLINTON ST. CHICAGO

WORKS QUICK AND EASY. KEEPS ITS LUSTER. HOLDS OLD TRADE AND MAKES NEW. DOES NOT DETERIORATE. ESTABLISHED 16 YEARS. SOLD BY AGENTS AND DEALERS ALL OVER THE WORLD
U.S. METAL POLISH 3 OUNCE BOX 10 CENTS SAMPLES SENT FREE
GEO. W. HOFFMAN
POLISHES ALL METALS. BRANCHES NEW YORK, CHICAGO, SAN FRANCISCO 295 E. WASHINGTON ST. INDIANAPOLIS, IND.

BOILERS.
One 42-in. x 16 ft. 9-in., 250 H. P. Worthington Water Tube.
One 60-in. x 16 ft., John Mohr Return Tubular Boiler.
One 64-in. x 16 ft., John Mohr Return Tubular Boiler.
One 54-in. x 16 ft., Devine Tubular Boiler.
ENGINES.
One 600 H. P., 21 x 36 x 80, Williams Tandem Horizontal Compound, 140 R. P. M.
Two 600 H. P., 20 x 30 x 24, Porter-Allen Tandem Compound, 200 R. P. M.
One 250 H. P., 12 x 24 x 18 Williams Tandem Compound, 250 R. P. M.
Two 100 H. P., 13 x 12, Dick & Church, High Speed Automatic.
PARTIAL LIST ONLY.
Send for latest Catalogue for bargains in Engines, Boilers, Dynamos and Motors.
CENTRAL STATION IMPROVEMENT CO., 938 Monadnock Block, Chicago

WANTED
ELECTRIC LIGHT PLANTS
ELECTRIC STREET CAR LINES

They are wanted by some good towns in Illinois, Missouri, Kansas and Nebraska.
If you really "mean business," you can get particulars by writing

Burlington Route
N466

W. H. MANSS,
Industrial Commissioner,
209 Adams Street - - CHICAGO

OFFICE OF
Town Clerk
A. R. KAUFMAN, CLERK

BOARD OF TRUSTEES
GEO. A. PAINTER
M. V. PANKHONER
J. J. KERER
P. VAN NUYS, ATTY.

Summitville Ind. Nov. 23 1903

Western Electrician
Chicago Ill.

Gentlemen: You may discontinue our Want Advertisement with the one issue. as I have already received about 40 answers to same. Send me your bill and I will remit same to you Thanking you very kindly for your promptness
I am Yours Resp.
A. R. Kaufman
Clerk.

CHICAGO EDISON COMPANY REPAIR SHOPS
76 MARKET STREET, CHICAGO. TELEPHONE MAIN 1280.
Machine and Carpenter Work of All Kinds
Correspondence Solicited.
OPEN DAY AND NIGHT.
FIRST-CLASS EQUIPMENT THROUGHOUT.
Dynamos Armatures, Motors, Arc Lamps, Fans, Instruments.

GENERAL OFFICES AND WORKS.

National Electric Company

By an arrangement with Mr. Robert Lundell we will manufacture and market the new motors and generators covered by Mr. Lundell's latest patents. Our Direct and Alternating Units for Lighting, Power and Railway Service are built in all capacities and have been installed in some of the most representative power stations of this country.

General Sales Office and Works

MILWAUKEE

New York: 135 Broadway
Philadelphia: 1509 Land Title Bldg.
Charleston, W. Va.: Agnew Electric Co.

Pittsburg: Gellatly & Co.
Chicago: Old Colony Building
Seattle and San Francisco: Kilbourne & Clark Co.

ARNOLD ELECTRIC POWER STATION Co.
Engineers, Constructors for Complete Electric Plants. Results Guaranteed.
SUITE 1530, MARQUETTE BLDG., CHICAGO. NEW YORK OFFICE: 711 TRANSIT BLDG.

BYLLESBY, H. M. & Co.
(Incorporated)
ENGINEERS
Design, Construct and Operate Railway, Light, Power and Hydraulic Plants. Examinations and Reports.
New York Life Building, - CHICAGO, ILL.

HORNADAY, J. P. & Co.
SUITE 1108 TRACTION BUILDING
CINCINNATI, O.
WATERWORKS, ELECTRIC RAILWAY, LIGHT, TRACTION, INDUSTRIAL AND MINERAL PROPERTIES BOUGHT AND SOLD

RUEBEL - SCHWEDTMANN-WELLS,
CONSULTING, MECHANICAL AND ELECTRICAL ENGINEERS,
Suite 801 Chemical Building, ST. LOUIS, U. S. A.

F. B. BADT,
Monadnock. Chicago.

EVANS, ALMIRALL & CO.,
Central Station Heating, High Pressure Piping.
1057 Monadnock Blk., Chicago.

ROBERT W. HUNT & Co.,
ENGINEERS
1121 The Rookery, Chicago. 66 Broadway, New York.
Monongahela Bank Bldg., Pittsburg. Norfolk House, Cannon St., London.

Long Distance Phone Central 1248.
SCHOTT, W. H.,
ENGINEER AND CONTRACTOR,
SPECIALTIES—Central Station Heating Plants, Water Works Steam Plants, Electric Light, Gas and Street Railway Plants.
1220-21 MARQUETTE BUILDING, CHICAGO.

W. E. BAKER. E. B. BISHOP.
BAKER, W. E. & CO.
ENGINEERS,
ELECTRIC RAILWAYS.
27 William St., NEW YORK.

E. W Hammer, Pres. and Treas. H. J. Minhinnick, Sec. and Gen'l Sup't.
GENERAL ENGINEERING Co., THE Consulting and Contracting Engineers.
Telephones, Electric Light, Power Transmission
Suite 1112, 135 ADAMS ST., CHICAGO.
Long Distance Telephone Central 473.

KEMP, R. W.
Consulting and Contracting Telephone Engineer.
Plans and Specification for complete plants. Old plants overhauled and placed on paying basis. Territory, Kansas, Oklahoma and Indian Territory.
WELLINGTON, - - - KANSAS.

TRY IT.
Keep your name and address in this directory where it will be seen by possible clients.

ENGINEERS
Represented in this "Directory" are enabled to come in touch with many prospective customers who cannot be reached through any other source.

A WEEKLY REPRESENTATION
in this "Directory" enables engineers to keep before all possible customers.

KOHLER BROS.,
Contracting Electrical Engineers, Lighting Power Railways,
1804-1806-1808-1810-1812 Fisher Building, CHICAGO.

STANTON, LE ROY W.
Consulting Telephone Engineer
Plans, Specifications and Supervision of Installation of Complete Telephone Plants
Special Reports on Telephone Properties and Apparatus
411 Electrical Bldg., Cleveland, Ohio

BRYAN, WILLIAM H.
M. Am. Soc. M. E.,
Consulting Mechanical and Electrical Engineer.
Lincoln Trust Building, ST. LOUIS.

J. H. HALLBERG
Consulting Engineer
Electric Light, Power and Railway Plants
Suggestions to secure Economy, Specifications, Examinations and Reports
45 Broadway, NEW YORK
Long Distance Telephone 4578 Broad

IT WILL PAY
engineers not represented in this department to carry a card regularly.

Telephone Main 3123.
WILMERDING, C. H.
CONSULTING ENGINEER
1100 Old Colony Bldg., CHICAGO.

DUGALD C. JACKSON, C. E.
WILLIAM B. JACKSON, M. E.
MEMBERS
AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS
AMERICAN SOCIETY OF MECHANICAL ENGINEERS
AMERICAN SOCIETY OF CIVIL ENGINEERS
ENGINEERS. EXPERTS.
MADISON, WIS.

ALL Live men read the WESTERN ELECTRICIAN Each Week. Do You?

PLACE YOUR
"Want" and "For Sale" advertisements in the
WESTERN ELECTRICIAN,
Immediate Returns.

ELECTRICITY FOR ENGINEERS.

Latest Edition, Now Published in One Complete Volume, 424 Pages, Profusely Illustrated. Just the Work for Engineers, Electricians, Dynamo Tenders, etc.

PART I. CONTENTS.—CHAPTER I: Electricity; Positive and Negative; Conducters, Non-Conductors and Insulators; Electro-Motive Force; Volts; Resistance; Ohms; Current; Amperes.—CHAPTER II: Dynames; Magnets; Field Cells; Electro Magnets; Permanent Magnets.—CHAPTER III: Armatures, Construction of, Different Kinds of; Commutators, How Made and Connected; Heating of Armatures; Eddy Currents.—CHAPTER IV: The Current: How Produced; Induction; Series Wound Dynamos; Shunt Weund Dynames; Exciting the Fields; Constant Current and Constant Potential Dynames; Series and Parallel; Parallel or Multiple Arc System.—CHAPTER V: Incandescent Lamps; Filaments; Connections; Flashing; Exhausting; Testing; Candle Power; Operated in Series; Automatic Cut-Out; In Multiple Arc or Parallel; Multiple Series; Multiple Series Cut-Out; Three Wire System.—CHAPTER VI: The Arc Light; How Formed: Causes of Unsteadiness; Remedy; Effect of Shades or Globes; Shape of Carbons Under Different Conditions of Burning; Arc Lamps; Regulating and Cut-Out Mechanism; Action of Current; Clutch Lamps; Clockwork Lamps; Double Lamps; Troubles in Lamps.—CHAPTER VII: Commutators and Brushes; The Brush Commutators; Brushes; Different Styles of Brushes; Double Brushes; Single Brushes; Troubles with Commutators and Brushes; Correct Position of Brushes; Sparking at Brushes; Care of Brushes and Commutators; Flashing.—CHAPTER VIII: Current Regulation; Hand Regulation; By Position of Brushes; Resistance Box; Resistance Coils.—CHAPTER IX: American System of Automatic Current Regulation; The Dynamo; Regulator; Action of Regulator. CHAPTER X: Brush System of Automatic Current Regulation; Brush Armature; Diagram of Circuits through Dynamo, Regulator and Lamps; Dial or Regulator; Care and Adjustment of Dial; Dial Controller; Circuits and Connections of No. 8 Brush Dynamo; Circuits of Compound Wound Constant Potential Brush Dynamo.—CHAPTER XI: The Edison System; Automatic Regulator; Circuits of Regulator: Circuits of Dyname; Action of Regulator; Howell Pressure Indicator; Diagram of Circuits; Description of Parts and Operation.—CHAPTER XII: Excelsior System of Automatic Current Regulation; Dynamo; Armature; Diagram of Circuits; The Regulater and Meter; Action of Regulator.—CHAPTER XIII: Schuyler System of Automatic Current Regulation; Dynamo; Armature, Commutator and Brushes; Diagram of Circuits in Armature and Field; Regulator; Circuits in Regulator.—CHAPTER XIV: Thomson-Houston System of Automatic Current Regulation; Dynamo; Armature; Commutator and Brushes; Controlling Magnet; Wall Controller; Diagram of Circuits; Air Blast.—CHAPTER XV: Waterhouse System of Three-Brush Automatic Current Regulation; Dynamo; Extra Brush; Resistance Coils and Regulator. CHAPTER XVI: Ampere Meters; Tangential Scale; Solenoid Meters.—CHAPTER XVII: Voltmeters; Pressure and Potential Indicaters.—CHAPTER XVIII: Testing; Galvanometers; Astatic Needle; Differential Apparatus.—CHAPTER XIX: Wheatstone Bridge or Electrical Balance; Diagram of Circuits and Methods of use; Bridge and Rheostat; Reund Form; Square Form.—CHAPTER XX: The Magneto as a Testing Instrument; Armature; Field; Bell; Diagram of Circuits.—CHAPTER XXI: Coupling Dynamos Together; In Series; In Shunt; Series, Shunt and Compeund Wound Machines.—CHAPTER XXII: Switches and Switchheards; Loop Switch; Plug and Socket; Change Over Plug and Socket: Conclusion. CHAPTER XXXIII: Electric Motors; General Principles the Same as in Dynamos; Types; Shunt and Series Meters Suitable for all General Purposes; Regulation of Shunt Motors; Of Series Motors; Counter E. M. F.; Direction of Rotation and Direction of Current; Starting Motors; Diagram of Connection.

PART II. CONTENTS.—CHAPTER I: Alternate Current Dynamos; Principles of the Field; Field Current Armature; Winding; Connections; Lamination; Different Types of Alternators; Regulation; Leading Systems; The Brush Generators; Magnets; Armature; Principles of Induction.—CHAPTER II: Dynames, Continued; The Mordey Alternator; Stationary Armatures. Field Magnets; Ferranti Armature; Field Magnets; Winding; Collectors.—CHAPTER III: Dynamos Concluded; Siemens Dynamo; Best Magnetic Circuits; Stanley Constant Current Dynamo: The Armature; Self Induction; Regulation.—CHAPTER IV: Induction Coils; Converters; Transformers; Economy of Distribution; An Electrical H. P.; Losses in Conducter; Induction Coils; Effect of Induction; Transformers.—CHAPTER V: Transformers Continued; Induction Coils; Converters; Transforming Up and Down; Design of Transformers; The Static Charge; Protection Against; Grounding the Secondary; Other Devices; The Foil Protector; Different Types of Transformers.—CHAPTER VI: Transformers, Concluded; Fuses; Regulation; Winding of Transformers, Connecting to Circuit; Regulation; Safety Fuses.—CHAPTER VII: Parallel System; Series Arc Light System; Diagram of Circuits; Parallel System; Primary Circuit; Secondary Circuit; Placing of Transformers; Fuses; Diagram of Series Arc Light Circuit.—CHAPTER VIII: Lines of Force; Hysteresis; Magnetic Penetration; The Circuit of Lines of Force; Experiments with Magnet; Rapidity of Reversals and Hysteresis.—CHAPTER IX: Arc Lamps; In Series; The Westinghouse Arc Lamp; Diagram of Circuits in Lamp; Action of the Mechanism; Flat Carbons.—CHAPTER X: Arc Lamps, In Multiple; Slattery Differential Lamp; Mechanism of Lamp; Its Operation.—CHAPTER XI: Measuring and Indicating Apparatus; Instruments for Use with Alternating Currents Differ from those used with Continuous Currents; Ammeters; Voltmeters; Description of Several Forms of Instruments.—CHAPTER XII: Measuring Instruments, Continued; Hot Wire Instruments; The Cardew Voltmeter; Details of the Instrument; Low Potential Voltmeter.—CHAPTER XIII: Voltmeters; Double Coil Voltmeter; Two Types.—CHAPTER XIV: Spring Meters; Curled Spring Meter.—CHAPTER XV: Twisted Strip Instruments; Diagram of Connections and Operation of Instrument.—CHAPTER XVI: Recording Meters; Stanley Meter; Construction and Principles of Operation; Diagrams of Parts; Slattery Induction Meter; Description of Parts and Principles of Operation; Watt Meter; Thomsen Meter.—CHAPTER XVII: Generators in Parallel; Difficulties in Operating; Alternate Current Generators in Parallel; Arrangements of Circuits and Machines for Operating in Parallel; Diagram of Common Arrangement of Machines and Circuits.—CHAPTER XVIII: Ohm's Law; Strength of Current; Formulas and Examples; Power and Heating Effects of Currents.—CHAPTER XIX: Ground Alarms and Leak Detectors.

PRICE, $2.50.

Orders for above book, or any electrical work published promptly sent on receipt of price, postage prepaid.

ELECTRICIAN PUBLISHING CO., 510 Marquette Bldg., CHICAGO.

BOILER WATERS CORRECTED

to remove and prevent scale and to stop corrosion. DEARBORN TREATMENT does the work. Send gallon sample for analysis. Booklet "R" now ready.

DEARBORN DRUG & CHEMICAL WORKS,

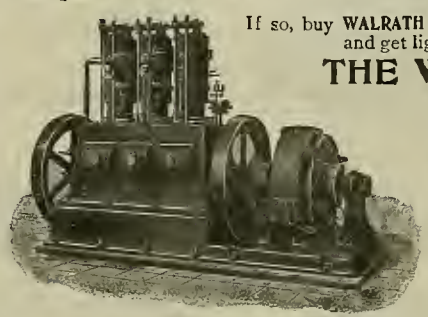
27-34 RIALTO BUILDING, CHICAGO, ILL. WM. H EDGAR, President Telephone: Harrison 3930 and 3931.

Dixon's Solid Belt Dressing *In Handy 1-lb. Bars* ends all slipping, without hardening or otherwise injuring the leather. Circular 125O and free samples upon request.
JOSEPH DIXON CRUCIBLE CO., JERSEY CITY, N. J.

JEFFREY ELEVATING, CONVEYING, POWER TRANSMISSION **MACHINERY** FOR CATALOGUE, ADDRESS THE JEFFREY MFG. CO. COLUMBUS, O.

REG. TRADE MARKS "Phosphor Bronze" DELTA
THE PHOSPHOR BRONZE SMELTING CO. LIMITED, 2200 WASHINGTON AVE., PHILADELPHIA.
"ELEPHANT BRAND PHOSPHOR-BRONZE" INGOTS, CASTINGS, WIRE, RODS, SHEETS, ETC.
— DELTA METAL —
CASTINGS, STAMPINGS AND FORGINGS
ORIGINAL AND SOLE MAKERS IN THE U.S.

ARE YOU LOOKING FOR MONEY?



If so, buy WALRATH GAS OR GASOLINE ENGINES and get light on the subject.

THE WALRATH

Received the Highest Award at the Pan-American Exposition.

It will produce as good a commercial light as that of an automatic steam engine, either belted or direct-connected generator. Simple, Economical and Reliable

Send for Catalogue W

MARINETTE GAS ENGINE CO.,
CHICAGO HEIGHTS, ILL.

AGENCIES:
Keystone Engineering Co., Farmer's Bank Bldg., Pittsburg, Pa.
Strong, Carlisle & Hammond Co., 61-67 Frankfort St., Cleveland, Ohio
Mackay Engineering Co., 149 Broadway, N. Y.
C. H. Seidenglanz., 52 When Bldg., Indianapolis, Ind.

DON'T BUY ELECTRICAL SUPPLIES

Until you have seen our new Catalogue and new Price List. Free to the trade.

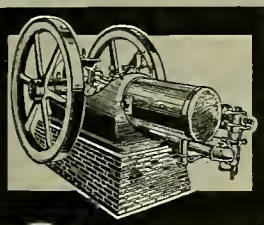
Manhattan Electrical Supply Co.
NEW YORK: 32 Cortlandt St. CHICAGO: 188 Fifth Ave.

ARE YOU LOOKING FOR TROUBLE?
IF SO, GET A COPY OF
TELEPHONE TROUBLES
AND HOW TO FIND THEM
—IN—
BOTH MAGNETO AND COMMON BATTERY SYSTEMS.
9th Edition Just Out. Price, 25c.
Electrician Publishing Co.,
510 Marquette Building,
CHICAGO.

FIBRE-GRAPHITE COMMUTATOR BRUSH — NOISELESS — SELF-LUBRICATING

There's No Friction
with the Fibre-Graphite Commutator Brush. Being 90 per cent. pure graphite, it insures low resistance, no sparking under a varying load, and longer wear. There is no greasing required. The Fibre-Graphite is therefore the most economic brush on the market. Send for price list.
HOLMES FIBRE-GRAPHITE MFG. CO.
5155 Wakefield St., Germantown, PHILADELPHIA.

BOOKS. BUY YOUR BOOKS FROM THE ELECTRICIAN PUBLISHING COMPANY,
510 Marquette Bldg., CHICAGO.



Olds Gas and Gasoline Engines

Each engine is fully tested before it leaves our factory to its full indicated horsepower. Its simplicity of construction and perfection of mechanical principles have been amply demonstrated during the past 23 years. Olds engines are standard the world over.

Stationary Engines - 2 to 100 H. P.
Portable Engines - 8 to 18 H. P.

We will send full information and new illustrated catalog upon request

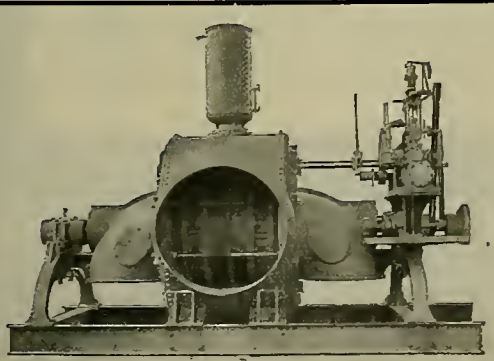
Olds Gasoline Engine Works
252 River Street, - Lansing, Mich.
6 980

Preserve Your Copies OF THE WESTERN ELECTRICIAN.

BINDERS $1.00 EACH.
ELECTRICIAN PUBLISHING CO.,
Suite 510 Marquette Building,

THE TELEPHONE HAND-BOOK
BY
HERBERT LAWS WEBB.
Price $1.00.
A complete and practical work in handy pocket size.
PUBLISHED BY
THE ELECTRICIAN PUBLISHING CO.,
Suite 510 Marquette Building, Chicago.

HARTFORD STEAM BOILER INSPECTION AND INSURANCE CO. HARTFORD, CONN.



SAMSON TURBINE

The bearings which carry the gates are made extra LONG and HEAVY giving liberal wearing surfaces and consequently prolonging the wear of the gates. ALL SAMSON gates are carefully BALANCED and fitted with STEEL CONNECTIONS.

Write Dept. D. for Catalog.

THE JAMES LEFFEL & CO., Springfield, Ohio, U.S.A.

SPEER HIGH GRADE CARBON BRUSHES

MOTOR AND GENERATOR CARBON BRUSHES

SPEER CARBON CO., - St. Marys, Pa.

We introduced successful 4-party lines

LEICH SELECTIVE SYSTEM

Write for our booklet—"Selective W."

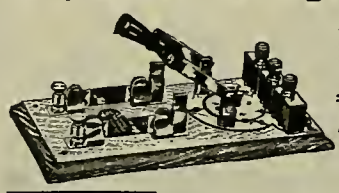
CENTRAL ENERGY OR MAGNETO

Impedance Coil for Selectives. No Springs.

AMERICAN ELECTRIC TELEPHONE CO.

CHICAGO, ILLINOIS

They Are All Talking About The "Tornquist"



King of Protectors

The Only Sure Protector Made

HIGH GRADE BABY KNIFE SWITCHES

None Better Made

STAMPING AND PLATING

Better buy a **"Tornquist"** it is the greatest success in the telephone field. Order sample now. Sold by all jobbers.

Clinton Stamping & Electric Co.

CLINTON, IOWA

TELEPHONE PRINCIPLES AND PRACTICE

A NEW BOOK IN TELEPHONY

By

GEORGE WALKER WILDER, PH. D.

Professor in Telephony in the Armour Institute of Technology

Complete and up-to-date, written by a practical man. All about modern telephone apparatus, their principles and use:

I. Fundamental Ideas
II. Telephone Apparatus
III. Systems of Communication
IV. Construction and Equipment

IN 32 CHAPTERS, 450 PAGES, 375 ILLUSTRATIONS. PRICE $2.00 POSTPAID.

Send Postal Money Order to

THE CANTWELL PRESS - Madison, Wis.

The Electrician Publishing Co., 510 Marquette Bldg., Chicago. Headquarters for all latest Electrical Books. Write for Catalogue.

A VALUABLE BOOK OF REFERENCE.

TELEPHONES—Their CONSTRUCTION and FITTING.

A Practical Treatise on the Fitting-up and Maintenance of Telephones and the Auxiliary Apparatus.

BY F. C. ALLSOP.

CONTENTS:

CHAPTER I.—Receivers; II.—Transmitters; III.—Magneto Switch-Bells; IV.—Battery Switch-Bells; V.—Complete Instruments; VI.—Switches, Switchboards and Extension Bells; VII.—Batteries for Telephone Work; VIII.—Erecting Wires, Instruments, Etc.; IX.—Arranging the Circuits; X.—Intercommunicating System; XI.—Testing for and Removing Faults.

184 PAGES. 156 ILLUSTRATIONS AND FOLDING PLATES. PRICE, $1.25.

Sent prepaid on receipt of price.

ELECTRICIAN PUBLISHING CO., 510 Marquette Bldg., Chicago.

BITUMINIZED FIBER CONDUIT

FOR UNDERGROUND CONSTRUCTION

One view of our exhibit at World's Fair showing Bituminized Fiber Conduit in a piece of actual construction.

American Conduit Co.

Main Offices: 1005-6 Manhattan Building, Chicago

Other Offices:

170 Broadway, New York. 336 Macy St., Los Angeles

INTERNATIONAL

Mechanical Self-Restoring

Drop Switchboard.

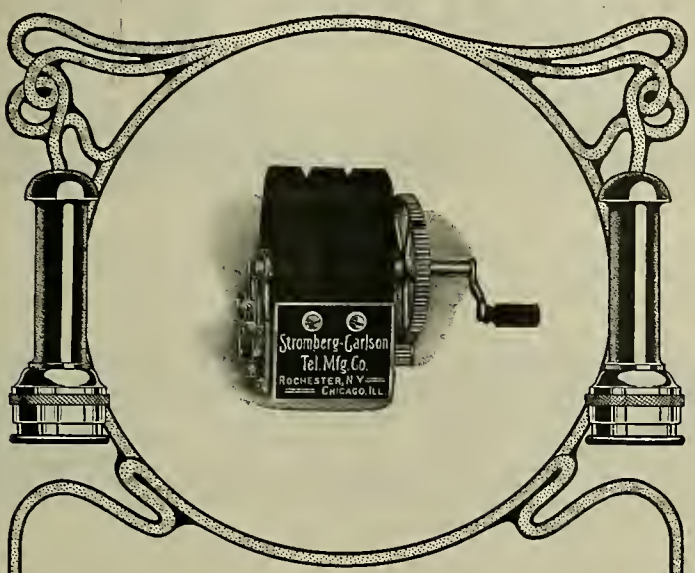
A PERFECT APPARATUS.

Made in any desired capacity.

Sample parts and quotations on request.

INTERNATIONAL TELEPHONE MANUFACTURING CO.

CHICAGO, U. S. A.



Standard three-bar generator, same as used in our series telephones. We have manufactured generators since we first started in business. What this experience means to you enables us to sell the best generator made at a price slightly above the ordinary. The difference is caused by the better grade of material used and the superior workmanship.

You pay nothing for our experience. Our Bulletin No. 11-E explains fully this apparatus. Mailed free.

Stromberg-Carlson Telephone Mfg. Co.

GENERAL AND EASTERN OFFICE
ROCHESTER, N. Y.

SALES DEPT.
CHICAGO, ILL.

"JUST AS GOOD AS KELLOGG APPARATUS"

cannot be bought outside our factories for the same price we ask—for a higher price or for a lower price.

Our customers never think Kellogg prices high.

We are quoting attractive magneto prices. Write us for quotations on everything in the magneto line.

Send for our new bulletins Nos. 8 to 13.

Do not miss visiting the Kellogg exhibit at the St. Louis Exposition, Electricity Building.

Kellogg Switchboard & Supply Co.,

GREEN AND CONGRESS STREETS, CHICAGO

Electric Building, Cleveland — Keystone Telephone Building, Philadelphia

A PRACTICAL BOOK FOR PRACTICAL MEN

"MODERN WIRING DIAGRAMS AND DESCRIPTIONS FOR ELECTRICAL WORKERS."

By Henry C. Horstmann and Victor H. Tousley. 160 pages, over 200 illustrations. Full leather binding, red edges. Pocket size 4 x 6. Price, net, $1 50.

A work that not only tells you how to do it, but shows you.

THIS BOOK tells how to wire for call and alarm bells. For burglar and fire alarm. How to run bells from dynamo current. How to install and manage batteries. How to test batteries. How to test circuits. How to wire for annunciators; for telegraph and gas lighting. It tells how to locate "trouble" and "ring out" circuits. It tells about meters and transformers. It contains 30 diagrams of electric lighting circuits alone. It explains dynamos and motors; alternating and direct current. It gives 10 diagrams of ground detectors alone. It gives "Compensator" and Storage Battery installation. It gives simple and explicit explanations of the "Wheatstone Bridge" and its uses as well as volt meter and other testing. It gives a new and simple wiring table, covering all volteges and all losses or distances, etc., etc.

SENT PREPAID ON RECEIPT OF PRICE

ELECTRICIAN PUBLISHING CO.

510 Marquette Building, Chicago

CORDS AND CABLES

We manufacture Cords of all descriptions used in conjunction with Telephone and Switchboard work, also Cables for Switchboard and Interior Purposes.

Write us for Prices

RUNZEL-LENZ ELECTRIC MFG. CO.

97-101 S. CLINTON STREET — CHICAGO

100 SUBSCRIBERS of the Citizens' Telephone Company of Grand Rapids, Michigan, were selected at random by a disinterested party and asked how they liked that company's Automatic Telephone Service in comparison with the manual service, which it replaced.

95 OF THEM said it was so perfect that there could be no comparison, they greatly preferred it;

4 OF THEM said they "didn't care which they had;"

1 OF THEM preferred the manual service.

The above percentages indicate the attitude of 6,000 subscribers to Automatic Telephone Service in Grand Rapids.

MR. TELEPHONE MANAGER, if you are trying to satisfy the public and give your patrons the sort of service they appreciate most you will take the hint that this conveys and give them Automatic Service.

AUTOMATIC ELECTRIC CO., Van Buren and Morgan Sts. CHICAGO, U. S. A.

PRODUCERS AND WHOLESALERS OF WHITE CEDAR PRODUCTS

CEDAR POLES

SPECIAL PRICES ON SMALL POLES.
Write for a copy of our TELEGRAPH CODE FOR CEDAR PRODUCTS

C. H. WORCESTER CO.
SUITE 1206 TRIBUNE BLDG. CHICAGO.

YARDS
KOSS MICH.
L'ANSE "
MUNISING "
ONTONAGON
WAGNER, WIS
PESHTIGO "

POLES, TIES, POSTS. THE PORTER CEDAR CO., SAGINAW, MICH.
PRODUCERS. We want your inquiries always.

Southern Cedar POLES Are the Best.
NO ROTTEN BUTTS. D. W. PHELAN, 277 Broadway, New York

MICHIGAN WHITE LARGE STOCK.
CEDAR POLES
PROMPT SHIPMENTS. KELLOGG SWITCHBOARD & SUPPLY CO., Chicago.

Cedar TORREY CEDAR CO., CLINTONVILLE, WIS. Poles
Large Stock Constantly on Hand

BRACKETS—X ARMS—PINS
little things it is true, but they cut a big figure in line construction.
OUR MOTTO IS:
Prompt Shipment Quality Satisfaction Right Price
COLUMBIA MFG. CO. ANTIGO, WIS.

"All roads lead to Rome."

And all business in New York seems to tend toward

Grand Central Station

This great building, which covers the space of four city blocks, beginning at the corner of 4th Avenue and 42d Street, is the Metropolitan terminus of the

NEW YORK CENTRAL LINES

and is the center of the hotel, residence, club and theater district of the second city of the world. To reach it, see that your ticket reads by the New York Central

A copy of the 40-page Illustrated Catalogue of the "Four-Track Series," New York Central's books of travel and education, will be sent free, postpaid, to any address on receipt of postage stamp, by George H. Daniels, General Passenger Agent, New York Central and Hudson River Railroad, Grand Central Station, New York.

POLES W. C. STERLING & SON, MONROE, MICH. TIES.
Eleven Pole Yards in Michigan.
Wholesale Producers for 20 years

WHITE CEDAR POLES
HALL L. BROOKS
52 WISCONSIN AVENUE
TOMAHAWK, WIS.

CEDAR POLES
THE
Valentine-Clark Co.
234 La Salle Street, CHICAGO
YARDS:
Pinconning, Mich. : Green Bay, Wis. : New London, Wis.

ELECTRICAL AND OTHER INDUSTRIES ARE OFFERED LOCATIONS WITH
Satisfactory Inducements,
Favorable Freight Rates,
Good Labor Conditions,
Healthful Communities,
ON THE LINES OF
THE ILLINOIS CENTRAL R. R.
AND THE
YAZOO & MISSISSIPPI VALLEY R. R.
For full information and descriptive pamphlet address
J. C. CLAIR,
Industrial Commissioner
1 Park Row, Chicago, Ill

READ THE BLUE ELECTRICAL PAPER.

CENTRAL STATION HEATING

We are the originators and builders of the underground system of live and exhaust steam heating. Our system is used for the utilization and distribution of exhaust steam from electric and power plants for heating purposes. 250 Plants in successful operation. We have the only Meter System. Also manufacturers of Wooden Water Pipe, Steam Pipe Casing, Steam Traps, Condensation Meters, Valves, Economizing Coils, Separators and full line of Steam Fitters' Supplies.
WRITE FOR PAMPHLET AND PRICE LIST

AMERICAN DISTRICT STEAM COMPANY
MENTION WESTERN ELECTRICIAN. LOCKPORT, N.Y. CHICAGO, ILL.

Cedar Poles.

Pittsburg and Lake Superior Iron Co. Producers and Wholesalers. Escanaba, Mich.

SIX-INCH THIRTIES. If you're going to buy any this year get our price; 7-inch 25s are on the same list. Of course we have every size you ever needed, but we have too many of these two sizes.

MALTBY CEDAR COMPANY, 509 Phoenix Block, Bay City, Michigan.
Pittsburg Agents, Tipper & Patton, 509 Bessemer Building.

Idaho Cedar Poles

PACIFIC COAST POLE CO. SPOKANE, WASH.

CEDAR POLES, POSTS, TIES,

H. M. LOUD'S SONS CO., Au Sable, Mich.

POLES. WHITE CEDAR. IDAHO CEDAR up to 80 ft.

BERTHOLD & JENNINGS, ST. LOUIS. Chemical Building.

CROSS ARMS. LONG LEAF PINE AND FIR.

Locations for Industries
Erie Railroad
Chicago to New York

The Erie Railroad Company's Industrial Department has all the territory traversed by the railroad districted in relation to resources, adaptability, markets and advantages for manufacturing, and can advise with manufacturers in relation to the most suitable locations. For full information address

LUIS JACKSON
Industrial Commissioner, Erie Railroad Company
21 Cortlandt Street, New York

SEND YOUR ORDERS FOR THE MARYLAND CHESTNUT **POLES** To S. A. GATES Gapland, Washington Co., Maryland Prompt Shipments

CEDAR POLES
ESTABLISHED 1862
WM. MUELLER COMPANY
1211-12-13 MARQUETTE BLDG. CHICAGO.
EIGHT DISTRIBUTING YARDS

Poles and Ties
The Fowler Companies
TRADE MARK
Fisher Bldg. Chicago

BOOK ORDERS
GIVEN PROMPT ATTENTION.
Electrician Publishing Co.,
Suite 510 Marquette Bldg., CHICAGO.

Points in Wisconsin and the Northwest

are covered by Wisconsin Central Railway's convenient, solid, wide vestibuled trains, equipped with Pullman sleepers, free reclining chair cars and modern coaches which leave Central Station, 12th Street and Park Row (Lake Front), Chicago for St. Paul, Minneapolis, Ashland and Duluth, connecting with all western lines. Meals in dining and cafe cars served a la carte.

For tickets and further information apply to nearest ticket agent, or write

JAS. C. POND, Gen'l Pass. Agt., Milwaukee, Wis.

ELECTRICAL BOOKS.
All Kinds.
ELECTRICIAN PUBLISHING COMPANY,
Suite 510 Marquette, CHICAGO

POLE DEALERS ADVERTISING IN THE WESTERN ELECTRICIAN OBTAIN MOST EXCELLENT RESULTS BECAUSE IT PLACES THEM IN TOUCH WITH ACTUAL BUYERS OF POLES. TRY A CARD.

MICHIGAN AND WESTERN **CEDAR POLES**
ALL LENGTHS AND SIZES
LINDSLEY BROS CO.
TRIBUNE BLDG., CHICAGO

There is No Higher-Class India-Rubber Insulation For Wires and Cables than

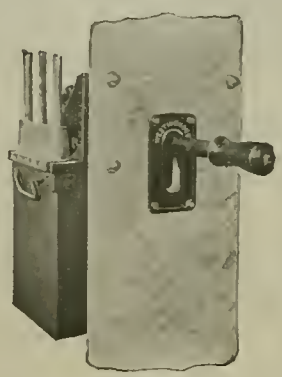
HABIRSHAW.

Authorized Manufacturers of the
ATTIX FLEXIBLE TUBE WIRE.

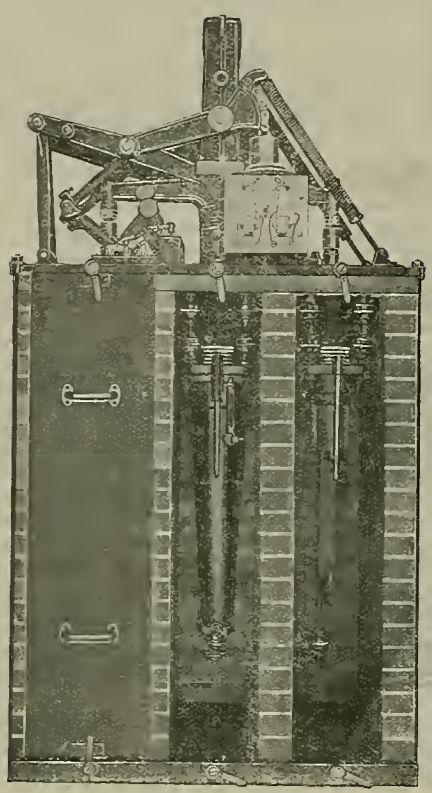
The India-Rubber and Gutta-Percha Insulating Co.,
MAIN OFFICE, Glenwood Works,
Sales Office, 15 Cortlandt St., New York.
YONKERS, N. Y.
(10823)

Westinghouse

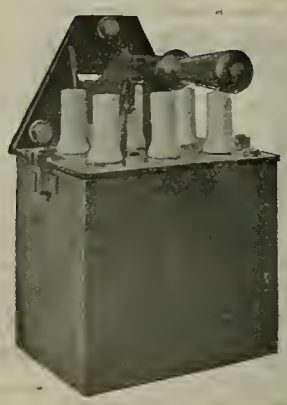
Oil Switches and Circuit-Breakers



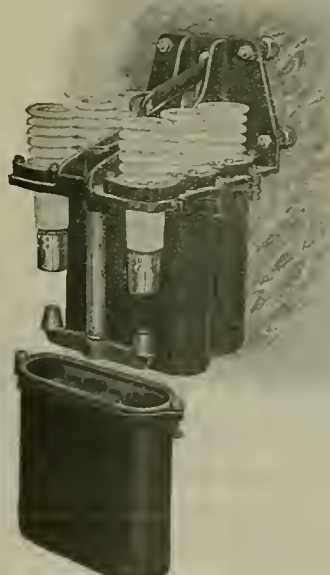
Type A Oil Switch
Switchboard Mounting
For Potentials not exceeding 6,600 Volts



Type C Oil Circuit-Breaker
Electrically Operated—Remote Control
For Potentials from 3,300 to 33,000 Volts



Type D Oil Switch
Wall Mounting
For Potentials not exceeding 3,300 Volts



Type B Oil Circuit-Breaker
Switchboard Mounting—Rear View
For Potentials from 3,300 to 22,000 Volts

Designed to reduce the oil to a minimum consistent with safe operation

Contacts thoroughly insulated

PARTICULARS IN FOLDER 4015

Type D Oil Switch
Switchboard Mounting—Rear View
For Potentials not exceeding 3,300 Volts

Westinghouse Electric & Mfg. Co.

Pittsburg, Pa.

Address our nearest District Office

New York, Atlanta, Dallas, Baltimore, Boston, Buffalo, Chicago, Cincinnati, Cleveland, Detroit, Los Angeles, Minneapolis, New Orleans, Philadelphia, Pittsburg, St. Louis, Salt Lake City, San Francisco, Syracuse, Seattle, Denver, Mountain Electric Co.

Canada: Canadian Westinghouse Co., Limited, Hamilton, Ontario. Mexico: G. & O. & Braniff Co., City of Mexico.

TYPIC AL OF INSURANCE
TYPE A INSULATION

Insulation implies insurance; in fact, nearly half of insurance lies in insulation.

Therefore, to insure against interruption of transformer service, it is necessary to secure insulation.

Type A insulation is close to perfection, with efficiency and regulation above the average of other transformers.

FORT WAYNE ELECTRIC WORKS
WOOD LIGHTING & POWER SYSTEMS
Fort Wayne, Ind.

WE shall be glad to supply any of the books catalogued below upon receipt of your order and remittance. We prepay charges.

THE PRINCIPLES OF THE TRANSFORMER. By Frederick Bedell	$3.25
INDUCTION COILS. By G. E. Bonney	1.00
ELECTRICITY AND MAGNETISM. By S. R. Bottone	.90
ELECTRICITY, ELECTROMETER, MAGNETISM AND ELECTROLYSIS. By G. Chrystal and W. N. Shaw	1.60
THEORY OF ELECTRICITY. By L. Cumming	2.25
THEORY OF ELECTRICITY AND MAGNETISM. By Charles Emerson Curry	2.50
THE ELEMENTS OF ALTERNATING CURRENTS. By W. S. Franklin and R. B. Williamson	2.50
PRACTICAL EXERCISES IN MAGNETISM AND ELECTRICITY. By H. E. Hadley	.60
MISCELLANEOUS PAPERS. By Heinrich Hertz	3.25
A TEXT-BOOK ON ELECTROMAGNETISM AND THE CONSTRUCTION OF DYNAMOS. By Dugald C. Jackson	2.25
ALTERNATING CURRENTS AND ALTERNATING CURRENT MACHINERY. By D. C. Jackson and John Price Jackson	3.50
AN ELEMENTARY BOOK ON ELECTRICITY AND MAGNETISM AND THEIR APPLICATIONS. By D. C. Jackson and John Price Jackson	1.40
A FIRST-BOOK OF ELECTRICITY AND MAGNETISM. By W. P. Maycock	.60
ALTERNATING CURRENTS OF ELECTRICITY AND THE THEORY OF TRANSFORMERS. By Alfred Still	1.50
PRACTICAL ELECTRIC LIGHT FITTING. By A. C. Allsop	1.50
ELECTRICAL EXPERIMENTS. By G. E. Bonney	.75
RADIOGRAPHY AND THE "X" RAYS IN PRACTICE AND THEORY. By S. R. Bottone	1.00
THE DYNAMO: HOW MADE AND HOW USED. By S. R. Bottone	.90
HOW TO MANAGE THE DYNAMO. By S. R. Bottone	.60
A GUIDE TO ELECTRIC LIGHTING. By S. R. Bottone	.75
ELECTRIC LIGHT ARITHMETIC. By R. E. Day	.40
THE DYNAMO: ITS THEORY, DESIGN AND MANUFACTURE. By C. C. Hawkins and F. Wallis	3.00
THE ALTERNATING CURRENT CIRCUIT. By W. P. Maycock	1.00
ELECTRIC WIRING FITTINGS, ETC. By W. P. Maycock	1.75
ELECTRIC WIRING TABLE. By W. P. Maycock	1.50
A MANUAL OF TELEPHONY. By W. H. Preece and A. J. Stubbs	4.50
PRACTICAL TELEPHONE HANDBOOK AND GUIDE TO THE TELEPHONIC EXCHANGE. By Joseph Poole	1.50
ELECTRIC WIRING. By Russell Robb	2.50
ELECTRIC LIGHT CABLES AND THE DISTRIBUTION OF ELECTRICITY. By Stuart A. Russell	3.00
ELECTRICITY IN TOWN AND COUNTRY HOUSES. By Percy E. Scrutton	1.00
THE STORAGE BATTERY. By Augustus Treadwell	1.75

Electrician Publishing Company
510 Marquette Building, Chicago

Small Units
in Electric Generating Sets.

Write for our estimates and prices.

Crocker-Wheeler Company
Manufacturers of
Generators and Motors
Electrical Engineers
AMPERE, N. J.
Branch Offices in Sixteen Principal Cities

REFLECTIONS ON FARIES REFLECTORS

Fit any socket.
Quickly attached or detached.
Made of aluminum or steel.
Very light and will not rack socket to pieces.
Finish not affected by heat.
Made in many styles and finishes.

Catalogue mailed upon application.

FARIES MFG. CO.
DECATUR, ILL.

WIRES AND CABLES

HIGH-GRADE, RUBBER-COVERED, WEATHER-PROOF
MAGNET, OFFICE, ANNUNCIATOR WIRE.
HAZARD MANUFACTURING CO.,
GENERAL OFFICE AND WORKS, Wilkesbarre, Pa. NEW YORK OFFICE, 50 Dey St. CHICAGO OFFICE, 71 and 73 West Adams St

VULCANIZED FIBRE

Highest grades for electrical insulation and mechanical purposes, in sheets, tubes, rods and special shapes. Catalogues and samples on application.

VULCANIZED FIBRE CO., - Wilmington, Del.

KARTAVERT.

HARD AND FLEXIBLE FIBER IN SHEETS, RODS AND TUBING.

For Electrical and Mechanical Purposes, Railway Dust Guards, Washers and Packings. Patent Insulating Cleats.

MANUFACTURED BY
THE KARTAVERT MANUFACTURING CO. Wilmington, Del.

Good Advice

No. 14

One of the foremost doctors of electrical engineering was recently called upon to examine into the ills of a profitless direct-current light and power plant and, after making a diagnosis, he immediately prescribed Duncan Meters, with instructions that the remedy should be continued indefinitely to prevent a recurrence of the malady

Good Advice No. 15 Next Week

Send for Bulletin and Prices

DUNCAN ELECTRIC MFG. CO.
LAFAYETTE, IND.

CUT YOUR COAL BILL

By using the

STURTEVANT SYSTEM OF MECHANICAL DRAFT

Costs only 20 to 40 per cent. as much as a chimney.
Increases steaming capacity of boilers.
Is independent of the wind and weather.

B. F. STURTEVANT CO.
BOSTON, MASSACHUSETTS
New York Philadelphia Chicago London

Black Diamond File Works

Est. 1863. Inc. 1895.

Twelve Medals Awarded at International Expositions

Special Prize Gold Medal at Atlanta, 1895.

OUR GOODS ARE ON SALE IN EVERY LEADING HARDWARE STORE IN THE UNITED STATES AND CANADA.

G. & H. BARNETT COMPANY,
PHILADELPHIA, PA.

JOHN A. ROEBLING'S SONS CO.

Insulated Wire of All Kinds

Bare Copper Wire

MAIN OFFICE AND WORKS **TRENTON, N. J.**

AGENCIES AND BRANCHES
New York Chicago Cleveland San Francisco Philadelphia Atlanta

Western Electrician

Vol. XXXV. $3.00 Per Annum. Copyright, 1904, by Electrician Publishing Company, Chicago. CHICAGO, NOVEMBER 5, 1904. Entered at Chicago Postoffice as mail matter of the second class. 10 Cents a Copy. No. 19.

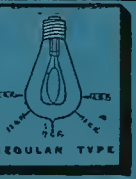
Quarterly Technology Journ. Inst. of Technology Boston Mass

SIMPLEX INSULATED WIRES AND CABLES.
RUBBER COVERED, WEATHERPROOF, UNDERGROUND AND SUBMARINE.
WESTERN SELLING AGENT, H. B. HIXSON, CHICAGO.
The Simplex Electrical Co., 110 State Street, BOSTON, MASS.

N. I. R.
National India Rubber Co.'s
RUBBER COVERED
WIRES AND CABLES.
OFFICE AND FACTORY: BRISTOL, R. I.

OKONITE
TRADE MARK
1889—Paris Exposition, Medal for Rubber Insulation.
1893—World's Fair, Medal for Rubber Insulation.
THE STANDARD FOR RUBBER INSULATION.
Sole Manufacturers of
Okonite Wires, Okonite Tape, Manson Tape, Candee Weather-proof Wires.
THE OKONITE CO., LTD.
Willard L. Candee, H. Dorant Cheaver, } Managers. 253 Broadway, New York. Geo. T. Menson, Gen'l Supt. W. H. Hodgins, Secy.

TRADE MARK
CRESCENT INSULATED WIRE & CABLE CO. TRENTON, N. J.
CRESCENT RUBBER INSULATED WIRES AND CABLES
National Code Standard.
CRESCENT INSULATED WIRE AND CABLE CO.,
New York Office, 83 BARCLAY STREET. Main Office and Factory, TRENTON, N. J.

STERLING SPECIAL
DO YOU?
BUY LAMPS-OR-BUY CANDLE POWER
16 THIS LAMP AVERAGES 12
THE STEHLING ELECTRICAL MANUFACTURING CO.
NEW YORK, N. Y. WARREN, O. CHICAGO, ILL.

REGULAR TYPE

INDIANA RUBBER AND INSULATED WIRE CO.,
MANUFACTURERS OF
Paranite Rubber Covered Wires and Cables,
UNDERGROUND, AERIAL, SUBMARINE AND INSIDE USE.
TELEPHONE, TELEGRAPH AND FIRE ALARM CABLES.
All Wires are tested at Factory. JONESBORO, IND.

I-T-E
CIRCUIT BREAKERS
CUTTER ELECTRICAL CO., PHILADELPHIA

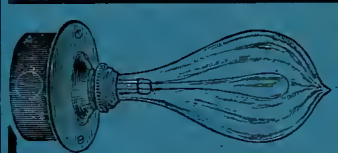
THOUSANDS IN USE.
Motors, ¼ h. p. to 100 h. p.
Dynamos, 1 k. w. to 75 k. w.
Highest Quality. Reasonable Prices.
THE HOBART ELECTRIC MFG. CO.
TROY, OHIO.

THERMOPILES 1½ VOLTS 1½ AMPERES
For Electrolytic analysis, charging storage batteries, and other constant current requirements. $3 Each.
WALSH'S SONS & CO.,
264 Washington Street. Newark, N. J.

Sterling Black Plastic Insulator.
One hundred days' continuous baking at 180° F. will not make it brittle. Water repellent. Oil proof.
THE STERLING VARNISH CO., - - Pittsburg, Pa.

"CIRCULAR LOOM"
THE FLEXIBLE CONDUIT
AMERICAN CIRCULAR LOOM CO.
TRADE MARK
REGISTERED
CONDUITS FOR INTERIOR WIRING.
American Circular Loom Co.
Chelsea, Mass., New York, Chicago, San Francisco.

M. KLEIN & SON.
Send 2c stamp for new catalogue No. 6 of
KLEIN'S TOOLS
For Electrical Workers and Line Builders.
MATHIAS KLEIN & SONS,
81 W. Van Buren St. Chicago, Ill.


Some More Light on our Drawn Steel Junction Boxes
Take time to figure out the cost of cast iron boxes plus the loss from breakage and time used in producing a round hole. Compare with this the cost of drawn steel boxes.
NO BREAKAGE,
Clean round hole produced with one blow of a hammer. Write for catalog and see what you can save.
BOSSERT ELECTRIC CONSTRUCTION CO. - - UTICA, N. Y.

YOST SPECIALTIES.

Sockets, Wall Sockets, Weatherproof Sockets, Rosettes, Receptacles, Cord Adjusters.
Catalogue for the asking.
THE YOST ELECTRIC MFG. CO.
TOLEDO, OHIO.

USE
"SAFETY" RUBBER COVERED
WIRE AND CABLE
FOR EVERY ELECTRICAL SERVICE.
M. B. AUSTIN & CO.,
CHICAGO REPRESENTATIVE.
THE SAFETY INSULATED WIRE & CABLE CO.,
WORKS: Bayonne, N. J. 114-116 LIBERTY STREET, N. Y.

KESTER
SELF FLUXING SOLDER
A Tube of Solder Filled with Flux.
Requires no Acid.
SAVES—LABOR—TIME—MONEY.

ACTUAL SIZE
PATENTED.
Send for Free Samples.
L. F. Mahler Co., R. 1008 Chemical Bldg., St. Louis, Mo., Gen. Western Agent.
KESTER ELECTRIC M'F'G CO.,
46 N. UNION STREET, CHICAGO, ILL.

WESTON Electrical Instrument Co.,
Waverly Park, NEWARK, N. J.
Weston Standard Portable Direct Reading
Voltmeters, Millivoltmeters, Voltammeters, Ammeters, Milammeters, Ground Detectors and Circuit Testers, Ohmmeters, Portable Galvanometers.

Weston Standard Portable Direct Reading Mil-Ammeter.
Our portable Instruments are recognized as The Standard the world over. The Semi-Portable Laboratory Standards are still better.
Our Station Voltmeters and Ammeters are unsurpassed in point of extreme accuracy and lowest consumption of energy.
BERLIN—European Weston Electrical Instrument Co., Ritterstrasse No. 88.
LONDON—Elliott Bros., Century Works, Lewisham.
PARIS, FRANCE—E. B. Cedlot, 12 Rue St. Georges.
New York Office—74 Cortlandt St.

SEE THAT FLAME

IT'S JUST WHAT YOU NEED
for fine soldering for internal wiring and switchboard work, storage battery, lead burning, etc.
The Turner Double Jet Alcohol Blow Pipe No. 10.
Burns wood alcohol and produces a clean non-oxidizing needle pointed or a brush flame of over 3,000 degrees of heat. The burner can be turned in any position. Reservoir 2½ x 5 inches. Capacity ¾ pint. Shipping weight 2 lbs.
No. 10 Alcohol Blow Pipe, $4.50 each. Express prepaid upon receipt of cash.
DISCOUNT TO DEALERS.
THE Turner Brass Works
23 N. FRANKLIN ST., CHICAGO

Have you read it?

Free
Send for it

THE ELECTRIC STORAGE BATTERY CO.

PHILADELPHIA

MANUFACTURER OF THE

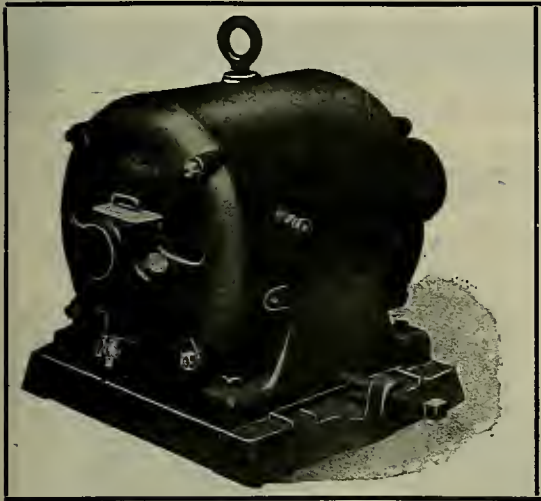
"Chloride Accumulator"

For Central Stations, Electric Railways, Isolated Lighting and Power Stations, Fire Alarm, Telegraph, Train Lighting, etc., etc.

PRICE LISTS AND DESCRIPTIVE BULLETINS FORWARDED UPON REQUEST.

SALES OFFICES:

PHILADELPHIA, Allegheny Ave. and 19th St. | NEW YORK, 100 Broadway, | BOSTON, 60 State St. | CHICAGO, Marquette Bldg. | ST. LOUIS, Wainwright Bldg. | SAN FRANCISCO, Rialto Bldg. | CLEVELAND, Citizens Bldg. | CANADA, Canadian General Electric Co., Ltd. Toronto | HAVANA, CUBA, G. F. Greenwood, Manager 34 Empedrado St.



WE believe that we are making a Single-Phase Self-Starting Motor that is just a little better than any other on the market, so do our customers. Are you among them? :: :: ::

CENTURY ELECTRIC COMPANY

1007-9-11 LOCUST ST. ST. LOUIS, MO.

W. D. PAINT.

A PERMANENT INSULATING PROTECTION FOR WOOD OR METAL. A quick drying, moisture-proofing, black paint. An elastic anti-rust coating. A jet black finishing paint, efficient and not expensive.

Write for "Data on Insulating Materials."

DIELECTRIC MANUFACTURING CO., SAINT LOUIS.

SINGLE AND POLYPHASE

TRANSFORMERS

KUHLMAN ELECTRIC CO., - - Elkhart, Ind.

PLATINUM

PLATINUM RIVETS FOR CONTACT POINTS IN TELEPHONES—SPARK COILS AND OTHER ELECTRICAL APPARATUS. PLATINUM SHEET AND WIRE IN ANY FORM AND DEGREE OF HARDNESS. PLATINUM SCRAP PURCHASED.

BAKER & COMPANY, Inc.

ARTISANS IN PLATINUM

408-410-412-414 N. J. R. R. AVE. - NEWARK, N. J.

New York Office: 120 Liberty St.

ALPHABETICAL INDEX TO ADVERTISEMENTS.

Adams-Bagnall Electric Co...—
Allis-Chalmers Company..... 2
American Battery Co.....12
Amer. Circular Loom Co..... 1
American Conduit Co.....16
Amer. District Steam Co.....19
Amer. Elec. Fuse Co..... 9
Amer. El. Telephone Co.....17
American Electrical Works..11
Arnold Elec. Power Station Co..... 15
Audit Co. of Ill., The..... —
Automatic Electric Co..... 17

Babcock & Wilcox Co.....15
Badt, F. B..... 15
Baln, Forée.....11
Baker & Company..... 3
Baker & Co., W. E.....15
Barnett Company, G. & H....22
Beardslee Chandelier Mfg. Co..... —
Benjamin Electric Mfg. Co..10
Bennett, I. A..... 7
Berthold & Jennings.....18
Big Four Route.....18
Bissell Co., The F.....22
Bossert Electric Construction Co..... 1
Brooks, Hall L.....19
Bryan-Marsh Co.....—
Bryan, Wm. H.....15
Buckeye Electric Co.....—
Bullock Elec. Mfg. Co..... 2
Burlington R. R 16
Butterfield, J. F.....15
Byllesby & Co., H. M.....15

Cantwell Press, The.....—
Carhartt & Co., Hamilton...13
Central Electric Co..... 5
Cent. Stat. Improvement Co.....12
Central Tel. & El. Co.....17
Century Electric Co..... 3
Chicago Die & Electric Co....—
Chicago Edison Co.....4, 12
Chic. Fuse Wire & Mfg. Co...—
Chicago Insulated Wire Co..—
Chicago Mica Co.....10
Clinton Stamping & Elec Co.17
Columbia Incand. Lamp Co..—
Columbia Mfg. Co.....19
Continuous Rail Joint Company of America..... 11
Cope, T. J..... 5
Crawfordsville Electric Co..—
Crescent Ins. Wire & Cbl. Co. 1
Crocker-Wheeler Company...21
Cutler-Hammer Mfg. Co..... 4
Cutter Elec. & Mfg. Company 1

D. & W. Fuse Company.....—
Dearborn Drug & Chem. Wks.14
Diamond Meter Company....18
Dielectric Manufacturing Co. 3
Directory of Engineers..... 15
Dixon Crucible Co., Joseph..14
Duncan Elec. Mfg. Co.....21

Edison Decorative & Miniature Lamp Departm't.....10
Edison Mfg. Company.....—
Edwards & Co.....19
Egan, J. J.....19
Electric Appliance Co..... 10
Electric Storage Battery Co.. 3
Electrical Appliance Co.....—
Electrical Engineer Institute.18
Electrician Pub. Company...15
Erie Ry.....19
Evans, Almirall & Co..... .15

Faries Mfg. Co..... 7
"For Sale" Advertisements..12
Ft. Wayne Elec. Works, Inc..21
Fostoria Incand. Lamp Co...—
Fowler, John H.....19
Fowler-Jacobs Company.....19
Franklin Elec. Mfg. Co .....—

General Electric Co..... 9
General Engineering Co., The 15
General Incandescent Arc Light Company..... 7
General Incand. Lamp Co....—
Gould Storage Battery Co.... 6
Green Fuel Economizer Co..14
Gregory Electric Company...12

Hallberg, J. H 15
Haller Machine Co.....—
Hart Mfg. Co.:.....11
Hartford Steam Boiler Inspection & Insurance Co....—
Hazard Manufacturing Co...—
Highland Park College. . 10
Hipwell Mfg. Co..... 7
Hobart Elec. Mfg. Co..... 1
Hoffman, G. W.....12
Holmes Fibre-Graph. Co.....—
Holophane Glass Co.....—
Hornaday & Co., J. P.....15
Humphrey, Henry H.....—
Hunt & Co., Robt. W.....15

Illinois Central Ry.....19
Incandescent Electric Light Manipulator Company.....15
Indiana Rub. & Ins. W. Co.... 1
India Rubber & Gutta Percha Insulating Company.....—
International Elec. Meter Co 12
International Tel. Mfg. Co...16
Jackson, D. C. & W. B.....15
Jeffrey Manufacturing Co....14
Jewell Electrical Inst. Co....—
Johns-Manville Co., H. W..... 4

Kartavert Manufacturing Co.—
Kellogg Switchboard & Supply Company.....16, 19
Kemp, R. W..... 15
Kester Elec. Mfg. Co..... 1
Klein & Sons, Mathias..... . 1
Kohler Brothers.....15
Kuhlman Electric Co..... 3

Leather Preserv. M. Corp....12
Leffel & Co., James.....14
Lindsley Brothers Company..18
Loud's Sons Co., H. M.....—

Machado & Roller..... 7
Maltby Cedar Company.....19
Manhattan El. Supply Co....12
Manross, F. N..... .....—
Marinette Gas Engine Co.....14
Matthews & Bros., W. N.....11
McLaughlin, James..... .....—
McLaughlin & Co., Jas..... 5
McLennan & Company, K....10
Measured Service Co.....—
Mechanical Appliance Co.... 8
Mica Insulator Company.....—
Minnesota Electric Co.....—
Miscellaneous Advs.....12
Monon Railroad..... 18
Morrison Lbr. Co., J. W.....19
Mueller Company, William..19
Munsell & Co., Eugene.....10

National Electric Co..... 8
National India Rubber Co.... 1
New England Butt Co.....14
Newgard & Co., Henry..... 8
New York Cent. Ry.....18
New York Ins. Wire Co.....11
Northern Elect'l Mfg. Co....10
Northern Wire & Cable Co...11
Northwestern Storage Battery Co.. 5

Okonite Co., The..... 1
Olds Gasoline Engine Works.14

Pacific Coast Pole Co.....18
Paragon Fan & Motor Co.....—
Pardridge Shade & Refl. Co..—
Pass & Seymour, Inc..... 8
Phelan, D. W.....19
Phillips, Eugene F.....11
Phillips Insulated Wire Co...11
Phœnix Glass Co.....—
Phosphor-Bronze S. Co.....14
Pignolet, L. M.....10
Pittsburg & L. S. Iron Co....18
Plume & Atwood Mfg. Co....11
Porter Cedar Company.....18

Reisinger, Hugo..... 9
Reynolds El. Flasher Mfg. Co.12
Roebling's Sons Co., J. A.....22
Ruebel-Schwedtmann-Wells..15
Runzel-Lenz Elec. Mfg. Co...—

Safety Ins. Wire & Cable Co.. 1
Sargent & Lundy.....—
Sauquoit Silk Mfg. Co.....12
Schott, W. H.....15
Signaloid Chemical Works...12
Simplex Electrical Co., The.. 1
Simplex Elec. Heating Co....11
Speer Carbon Co..... .—
Sprague Electric Company...22
Squire Electric Co.....—
Standard Elec. Mfg. Co.....19
Standard Underg. Cable Co....—
Stanley Elec. Mfg. Co., The 4
Stanley Instrument Co..... 5
Stanton, LeRoy W..... . 15
Sterling & Son, W. C.....19
Sterling Electrical Mfg. Co... 1
Sterling Varnish Co., The.... 1
Stow Mfg. Company.....—
Stromberg-Carlson Tel. Mfg. Company.....16
Sturtevant Company, B. F...22

Temple Pump Co.....10
Torrey Cedar Company.....18
Trumbull Elec. Mnfg. Co.....—
Turner Brass Works..... 1

Union Electric Mfg. Co.....22

Valentine-Clark Co., The....—
Vulcanized Fibre Company..22

Wagner Electric Mfg. Co..... 8
Walsh's Sons & Company..... 1
Warren Elec. Mfg. Co.....22
Wesco Supply Co.....10
Western Electric Company... 5
Westinghouse Electric & Manufacturing Co.....20
Weston Electrical Inst. Co... 1
Whitehead Machinery Co... 12
Whitney Electrical Inst. Co..—
Wilmerding, C. H.....—
Wisconsin Central Ry.....19
Woolley Fdy. & Mach. Wks..14
Worcester Company, C. H....18

Yesbera Mfg. Co..... .. 17
Yost Electric Mfg. Co 1

Zero Marx Sign Works 11

For Classified Index of Advertisements See Page 6.

If you want Wires or Cables insulated with the HIGHEST CLASS INDIA RUBBER INSULATION you should buy . . . . . .

HABIRSHAW

Complete stock of all sizes constantly on hand and for sale at lowest market prices by

CHICAGO EDISON COMPANY,

WRITE FOR PRICES.

139 ADAMS STREET, CHICAGO.

AFFORD ABSOLUTE SAFETY AS PROTECTIVE DEVICES AND FREEDOM FROM ALL

FIRE HAZARD

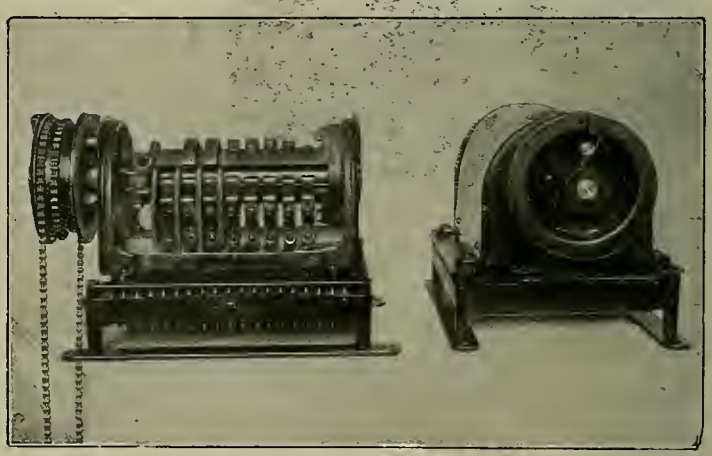
ASK YOUR SUPPLY DEALER FOR "NOARK"

H. W. JOHNS-MANVILLE CO.

100 William St., NEW YORK

New York, Milwaukee, Chicago, St. Louis, Boston, Philadelphia, Pittsburg, Cleveland, New Orleans, London, Paris, Brussels

Rope-Operated, Reversible Drum Controller.



The ideal controller for small cranes and hoists where it is desired to operate from the floor.

Built to stand the most severe usage. Automatic return to "off" position when operator releases chain or rope.

Brushes and contacts are renewable and are made of hard-drawn copper.

SPEED—Normal at full load to 50 per cent. at half load.
Specially built for reduction of 90 per cent. regardless of load.

The Cutler-Hammer Mfg. Co.

MILWAUKEE, WIS.

New York Boston Chicago Pittsburg

THE B. O. TRANSFORMER

Do you expect to need new transformers this fall? If you do, the B. O. will interest you.

Low Losses
High Efficiencies
High Insulation
Low Price.

Are you familiar with oil duct transformers?
Send us your address and we will tell you about our insulation and the advantages of slab windings in connection with oil ducts.

THE STANLEY ELECTRIC MANUFACTURING COMPANY

PITTSFIELD, MASSACHUSETTS

Atlanta, Ga., Empire Building
CHICAGO, ILL., MONADNOCK BLOCK
New York, N. Y., 29 Broadway
St. Louis, Mo., Century Bldg.
Boston, Mass., Oliver Building
Denver, Col., Hendrie & Bolthoff Mfg. & Supply Co.
Philadelphia, Pa., North American Building
San Francisco, Cal., 69-75 New Montgomery St.
Seattle, Wash., Pioneer Bldg.

Representatives for the Dominion of Canada, THE CANADIAN GENERAL ELECTRIC CO. of Toronto

"THE S. K. C. SYSTEM"

D. & W. BABY CARTRIDGE FUSE, spring clip contact.

D. & W. PANEL CARTRIDGE FUSE, screw clamp contact.

D. & W. PANEL FUSES

work equally well under all temperatures and changing atmospheric conditions. They are so reliable that underwriters do not require them to be enclosed in fireproof cabinets, thus making it possible to install a cheaper tablet than when using ordinary fuses. Our prices on D. & W. PANEL FUSES also are lower than those of other dealers.

WE SOLICIT YOUR ORDER AND WILL SHIP FROM CHICAGO STOCK.

OKONITE IT NEVER DISAPPOINTS

Central Electric Company,

GENERAL WESTERN AGENTS

264-266-268-270 Fifth Avenue, Chicago

OKONITE IT NEVER DISAPPOINTS

Cope's Patent Quick Coupling Conduit Rod

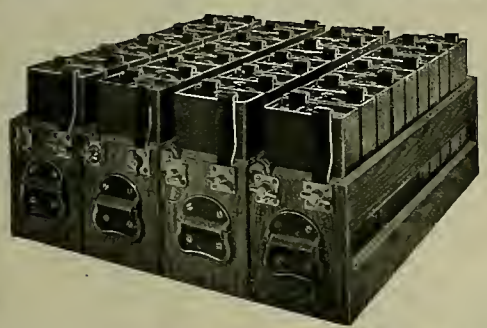
Remember these rods have no lost motion. These Couplings are of Steel and are made in the best possible manner.

Write for list of persons using these rods—26,000 sold since May 1902. Made in 3 ft. and 4 ft. lengths. Price, 3 ft. 75 cents, 4 ft. 85 cents. Patented February 24, 1903.

T. J. COPE

3244 North Fifteenth Street PHILADELPHIA, PA.

ALL THE ESSENTIALS



of a good storage battery are found in the

NORTHWESTERN

Large Capacity, Light, Efficient, Compact.

To have your order filled promptly, send to us at once.

Northwestern Storage Battery Co.,

285 Madison St., - - - Chicago, Ill.

Our Compound Stops Sparking and Saves Commutators.

14 Years' Use on Street Ry., Light and Power Commutators Has Proven its Worth. WE GUARANTEE RESULTS

Send Your Address for FREE SAMPLE THAT CONVINCES.

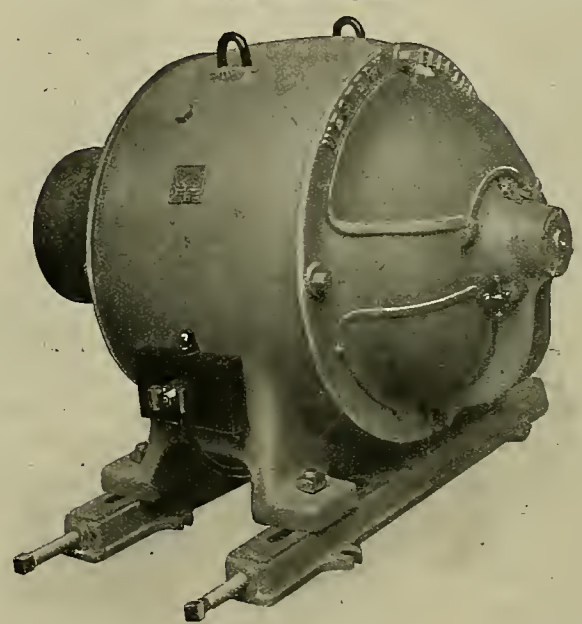
JAS. McLAUGHLIN & CO., ELECTRICAL ENGINEERS

586 Fulton Street, - - Chicago, Ill.

DIRECT CURRENT

Motors *and* Generators

Bulletins on Request.



DUSTPROOF MOTOR, TYPE "D"

Western Electric Company

CHICAGO NEW YORK

AND OTHER LARGE CITIES

Space 17 Electricity Building, Louisiana Purchase Exposition

ELECTRICITY FOR ENGINEERS.

424 PAGES. ILLUSTRATED. PRICE $2.50.

ELECTRICIAN PUBLISHING CO.,

510 Marquette Building, • • CHICAGO

STANLEY RECORDING WATTMETERS

FOR ALTERNATING-CURRENT CIRCUITS

BALANCED THRUST

No Jewel Wear from Hammer or Side Thrust. Glass or Metal Covers, Second Alone to the

STANLEY MAGNETIC SUSPENSION WATTMETERS

Missouri, Kansas, Arkansas
FRANK ADAM ELECTRIC CO.
St. Louis

Colorado, Idaho, Montana, Wyoming
New Mexico, Utah
HENDRIE-BOLTHOFF MFG. AND SUPPLY CO.
Denver

SEND FOR BULLETINS AND INFORMATION ABOUT METERS TO

STANLEY INSTRUMENT CO.

GREAT BARRINGTON MASS., U. S. A.

Mexico
VICTOR M. BRASHI & CO.
Mexico City

California, Oregon, Washington
Nevada, Arizona
BROOKS-FOLLIS ELECTRIC CORP.
San Francisco

Gould Storage Battery Co.

Complete Storage Battery Plants

Railway Line and Regulating Isolated and Train Lighting Central Lighting and Power Electric Vehicle and Telephone

GOULD COUNTER E. M. F. BOOSTER SYSTEMS

Sales Offices { NEW YORK, 1 W. 34th Street. BOSTON, 89 State Street. CHICAGO, The "Rookery." SAN FRANCISCO, Century Electric Co.

WORKS: DEPEW, N. Y.

Bulletins.

CLASSIFIED INDEX OF ADVERTISEMENTS.

Accountants and Auditors.
Audit Co. of Illinois

Adjusters, Cord.
Incandes. El. Lt. Manip. Co.

Adjusters, Inc. Lamps.
Inc. El. Lt. Manipulator Co.

Anchors (Tel. & Tel.)
Bennett, I. A.
Matthews & Bro., W. N.

Annunciators.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Moon Mfg. Co.
Wesco Supply Co.
Western Electric Co.

Batteries and Jars.
Bissell Co., The F.
Central Electric Co.
Edison Mfg. Co.
Edwards & Company.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.

Bells, Buzzers, Etc.
Central Electric Co.
Edwards & Co.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.

Belt Dressing.
Dixon Crucible Co., Jos.
Leather Preserver Mfg. Corp.

Belting.
Leather Preserver Mfg. Corp.

Blow Pipes.
Turner Brass Works

Blowers.
Sturtevant Co., B. F.

Boiler Compounds.
Dearborn Drug & Chem. Wks.

Boilers.
Allis-Chalmers Company.
Babcock & Wilcox Co.

Books, Electrical.
Cantwell Press, The.
Electrician Publishing Co.

Booths, Telephone.
Yesbera Mfg. Co.

Brackets.
Faries Mfg. Co.

Brushes.
Central Electric Co.
Hobart Elec. Mfg. Co.
Holmes Fibre-Graphite Co.
Speer Carbon Co.
Western Electric Company.

Cable Hangers.
Bissell Co., B. F.
Westaro Electric Co.

Cables (See Wires and Cables)

Canopies.
Faries Mfg. Co.

Carbons, Points and Plates.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
Reisinger, Hugo.
Speer Carbon Co.
Wesco Supply Co.

Castings.
Faries Mfg. Co.
New England Butt Co.
National Electric Co.

Chains.
Jeffrey Mfg. Co.

Chandeliers.
Faries Mfg. Co.

Circuit Breakers.
Cutler-Hammer Mfg. Co.
Cutter Elec. & Mfg. Co.
Ft. Wayne Elec. Wks. Inc.
Union Electric Mfg. Co.
Western Electric Company.
Westinghouse El. & Mfg. Co.

Clusters.
Benjamin Elec. Mfg. Co.
Faries Mfg. Co.

Coal and Ashes Handling Machinery.
Jeffrey Mfg. Co.

Coils and Magnets.
Western Electric Co.

Coloring, Lamp.
Signaloid Chemical Works.

Commutator Compound
Egan, J. J.
McLaughlin & Co., Jas.
McLennan & Co., K.

Condensers, Electric.
Stanley Elec. Mfg. Co.

Conduit and Conduits.
American Circular Loom Co.
American Conduit Company
Central Electric Co.
Electric Appliance Co.
Sprague Electric Co.
Standard Vitrified Cond. Co.
Wesco Supply Co.

Contractors and Electric Light Plants.
Allis-Chalmers Company.
Bullock El. Mfg. Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
National Electric Co.
Northern Electrical Mfg. Co.
Sprague Electric Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Controllers, Crane.
Amer. Elec. Fuse Co.

Cord.
Runzel-Lenz Elec. Mfg. Co.

Cross-Arms, Pins and Brackets.
Berthold & Jennings.
Central Electric Co.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Company.

Cut-Outs and Switches.
Bissell Co., The F.
Bossert Elec. Const. Co.
Central Electric Co.
Chicago Edison Co.
Clinton Stamping & Elec. Co.
Crouse-Hinds Co.
Cutter Elec. & Mfg. Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
General Inc. Arc Light Co.
Hart Manufacturing Co.
Manhattan Elec. Supply Co.
Trumbull Elec. Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Dynamos and Motors.
Allis-Chalmers Company.
Bissell Co., The F.
Bullock Elec. Mfg. Co.
Central Electric Co.
Century Electric Co.
Crawfordsville Electric Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks. Inc.
General Elec. Co.
General Inc. Arc Light Co.
Gregory Electric Co.
Hobart Elec. Mfg. Co.
Mechanical Appliance Co.
National Electric Co.
Northern Electrical Mfg. Co.
Sprague Electric Co.
Stanley Elec. Mfg. Co.
Stow Manufacturing Co.
Sturtevant Co., B. F.
Wagner Electric Mfg. Co.
Warren Elec. Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Economizers, Fuel.
Green Fuel Economizer Co.

Electric Heating Appl.
Electric Appliance Co.
Simplex Elec. Heating Co.
Western Electric Co.

Electric Railways.
Crocker-Wheeler Co.
General Electric Co.
Sprague Electric Co.
Westinghouse El. & Mfg. Co.

Electrical and Mechanical Engineers.
Arnold Elec. Power Stat'n Co.
Badt, F. B.
Baker & Co., W. E.
Bryan, Wm. H.
Butterfield, J. F.
Bylesby & Co., H. M.
Evans, Almirall & Co.
General Engineering Co., The.
Hallberg, J. H.
Borosday, J. P. & Co.
Humphrey, Henry H.
Bunt & Co., Robt. W.
Jackson, D. C. & W. B.
Kemp, R. W.
Kohler Brothers.
McLaughlin, James
Newgard & Co., Henry.
Northern Electrical Mfg. Co.
Ruebel, Schwedtman, Wells.
Sargent & Lundy.
Schott, W. H.
Squire Electric Co.
Stanley Elec. Mfg. Co.
Stanton, LeRoy W.
Wilmerding, C. H.

Electrical Instruments.
(Recording and Testing.)
Bissell Co., The F.
Central Electric Co.
Diamond Meter Co.
Duncan Elec. Mfg. Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
General Inc. Arc Light Co.
Jewell Electrical Inst. Co.
Machado & Roller.
Pignolet, L. M.
Stanley Elec. Mfg. Co.
Stanley Instrument Co.
Wagner Electric Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co
Weston Electrical Inst. Co.
Whitney Electl. Inst. Co.

Electro-Plating Mach'y
Crocker-Wheeler Company.
General Electric Co.

Elevators-Conveyors.
Jeffrey Mfg. Co.

Engines, Gas and Gasoline.
Allis-Chalmers Company.
Marinette Gas Engine Co.
Olds Gasoline Engine Works.
Temple Pump Co.
Woolley Edy. & Mach. Wks.

Engines, Steam.
Allis-Chalmers Company.
Sturtevant Co., B. F.

Fans and Fan Motors.
Central Electric Co.
Crocker-Wheeler Company.
Edison Mfg. Co.
General Electric Co.
General Inc. Arc Light Co.
Sprague Electric Co.
Sturtevant Co., B. F.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Fibre.
Karlavert Mfg. Co.
Vulcanized Fibre Co.

Files.
Harnett Co., G. & H.

Fittings.
Faries Mfg. Co.

Fixtures, Gas and Elec.
Beardslee Chandelier Mfg. Co.

Flashers.
Hissell Co., The F.
Haller Machine Co.
Reynolds El. Flasher Mfg. Co

Flexible Shafts.
Stow Mfg. Co.

Forges.
Sturtevant Co., B. F.

Fuses and Fuse Wire.
Amer. Elec. Fuse Co.
Bissell Co., The F.
Central Electric Co.
Central Tel. & El. Co.
Chicago Die & Electric Co.
Chicago Fuse Wire & Mfg. Co.
Clinton Stamping & Elec. Co.
D. & W. Fuse Company.
Electric Appliance Co.
Johns-Manville Co., H. W.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Company.

Globes, Reflectors and Shades.
Fostoria Incan. Lamp Co.
Haller Machine Co.
Holophane Glass Co.
Partridge Shade & Refl. Co.
Phœnix Glass Co.
Wesco Supply Co.
Western Electric Co.

Graphite Specialties.
Dixon Crucible Co., Jos.
Holmes Fibre-Graphite Co.

Heating (Exhaust Steam).
Amer. District Steam Co.

Heating and Ventilating Apparatus.
Sturtevant Co., B. F.

Heating, Hot Water.
Evans, Almirall & Co.

Holders, Inc. Lamps.
Electric Appliance Co.
Incandescent Electric Light Manipulator Co.

Inspection & Insurance
Hartford Steam Boiler Inspection & Insurance Co.

Insulating Machinery.
New England Butt Co.

Insulators and Insulating Materials.
American Electrical Works.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Inc. Arc Light Co.
Indiana Rub. & Ins. Wire Co.
Johns-Manville Co., H. W.
Kartavert Mfg. Co.
Manhattan Elec. Supply Co.
Mica Insulator Co.
Munsell & Co., Eugene.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Standard Vitrified Cond. Co.
Sterling Varnish Co.
Vulcanized Fibre Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Junction Boxes.
Hossert Elect. Const. Co.
General Inc. Arc Light Co.

Lamps, Arc.
Hissell Co., The F.
Central Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
General Inc. Arc Lt. Co.
Gregory Electric Co.
Hipwell Manufacturing Co
Manhattan Elec. Supply Co.
Stanley Elec. Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Lamps, Incandescent.
Bissell Co., The F.
Bryan-Marsh Company.
Buckeye Electric Company.
Central Electric Co.
Chicago Edison Co.
Columbia Incan. Lamp Co.
Edison Decorative & Miniature Lamp Dept.
Electric Appliance Co.
Fostoria Incand. Lamp Co.
Franklin Electric Mfg. Co.
General Electric Co.
General Inc. Arc Light Co.
Standard Elec'l Mfg. Co.
Sterling Electrical Mfg. Co.
Wesco Supply Co.
Western Electric Co.

Lamps, Incandescent—Replacers & Cleaners.
Inc. El. Lt. Manipulator Co.

Letters, Metal.
Haller Machine Co.

Lightning Arresters.
Central Electric Co.
Clinton Stamping & Elec. Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
Manhattan Elec. Supply Co.
Minnesota Electric Co.
Stanley Elec. Mfg. Co.
Western Electric Co.

Linemen's Climbers.
Klein & Sons, Mathias.

Magnet Wires.
(See Wires and Cables.)

Measured Service.
Measured Service Co.

Mechanical Draft.
Sturtevant Co., B. F.

Mica.
Chicago Mica Co.
Mica Insulator Co.
Munsell & Co., Eugene.

Mining Apparatus, Elec.
Allis-Chalmers Company.
Crocker-Wheeler Company.
General Electric Co.
Jeffrey Mfg. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Motors. (See Dynamos and Motors.)

Nippers and Pliers.
Klein & Sons, Mathias.

Nozzles.
Faries Mfg. Co.

Overalls.
Carhartt & Co., Hamilton.

Paints.
Dielectric Mfg. Co.

Patent Attorneys.
Hain, Force.

Phosphor Bronze.
Phosphor Bronze Sm. Co. Ltd.

Platinum, Wire and Sheet.
Baker & Company Inc.

Poles and Ties.
Berthold & Jennings.
Brooks, Hall L.
Columbia Mfg. Co.
Fowler, John H.
Fowler-Jacobs Company.
Kellogg Switch. & Sup. Co.
Lindsley Bros. Co.
Loud's Sons Co., H. M.
Maltby Cedar Co.
Morrison Lbr. Co., J. W.
Mueller Company, William.
Pacific Coast Pole Co.
Phelan, D. W.
Pittsburg & L. S. Iron Co.
Porter Cedar Company.
Sterling & Son, W. C.
Torrey Cedar Co.
Valentine-Clark Co., The.
Worcester Co., C. H.

Polish (Metal).
Alleo Co., Inc., L. B.
Hoffman, Geo. W.

Portables.
Faries Mfg. Co.

Power Transmission Machinery.
Jeffrey Mfg. Co.

Rail Joints.
Continuous Rail Joint Company of America.

Rectifiers.
Electrical Appliance Co.

Refiners.
Gt. West Smelt. & Refining Co

Re-Winding—Repairs.
Chicago Edison Co.
Gregory Electric Co.

Rheostats.
Cutler-Hammer Mfg. Co.
General Electric Co.
Gen'l Inc. Arc Lt. Co.
Union Electric Mfg. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Rods, Conduit.
Cope, T. J.

Safes.
Sears, Roebuck & Co.

Schools and Colleges.
Electrical Engineer Inst.
Highland Park College

Second-Hand Mach'y.
Bissell Co., The F.
Cent. Stat. Improvement Co.
Gregory Electric Co.
Matthews & Bro., W. N.
Walsh's Sons & Co.

Shades, Lamp.
Faries Mfg. Co.

Sheet Brass & Copper.
Plume & Atwood Mfg. Co.

Signs, Electric.
Haller Machine Co.
Zero Marx Sign Works.

Silks, Insulating and Braiding.
Sauquoit Silk Mfg. Co.

Sockets & Receptacles.
Pass & Seymour.
Yost Elec. Mfg. Co.

Soldering Sticks, Salts and Paste.
Allen Co., L. B.
Crescent Co.
Kester Elec. Mfg. Co.
Western Electric Co.

Speaking Tubes.
Central Electric Co.
Edwards & Co.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.

Specialties, Electrical Mfrs. and Designers.
Haller Machine Co.

Speed Indicators.
Weston Electrical Inst. Co.

Storage Batteries.
American Battery Co.
Electric Storage Battery Co.
Gould Storage Battery Co.

Supplies, General Elec.
Bissell Co., The F.
Central Electric Co.
Century Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Electric Co.
Manhattan Elect'l Supply Co
Wesco Supply Co.
Western Electric Co.

Switchboards.
Bissell Co., The F.
Crouse-Hinds Co.
Gen. Incan. Arc Light Co.

Telephones, Telephone Material and Switchboards.
American El. Telephone Co
Automatic Electric Co.
Bissell Co., The F.
Central Electric Co.
Central Tel. & El. Co.
Electric Appliance Co.
International Tel. Mfg. Co.
Kellogg Switchb. & Sup. Co.
Manhattan Elec. Supply Co.
Stromberg-Carlson Tel. M. Co
Wesco Supply Co.
Western Electric Co.

Time Switches.
Bissell Co., The F.

Tools.
Klein & Sons, Mathias.
Western Electric Co.

Transformers.
Central Electric Co.
Crawfordsville Electric Co.
Crocker-Wheeler Co.
Electric Appliance Co.
Ft. Wayne Elec. Works, Inc.
General Electric Co.
Gregory Electric Co.
Kuhlman Electric Co.
Manhattan Elec. Supply Co.
National Electric Co.
Stanley Elec. Mfg. Co.
Wagner Electric Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Trucks, Electric Car.
General Electric Co.
Westinghouse El. & Mfg. Co.

Turbines, Steam.
Allis-Chalmers Co.
General Electric Co.
Westinghouse El. & Mfg. Co

Turbine Water Wheels
Leffel & Co., Jas.

Varnishes.
Dielectric Mfg. Co.
Sterling Varnish Co.

Vulcanized Fibre.
Vulcanized Fibre Co.

Whistles, Electric.
Electrical Appliance Co.

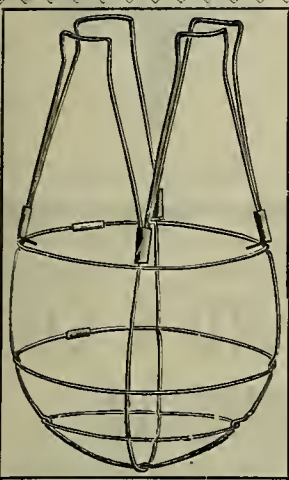
Wires & Cables—Magnet Wires.
American Electrical Works.
Bissell Co., The F.
Central Electric Co.
Chicago Insulated Wire Co.
Crescent Ins. Wire & Cble. Co.
Electric Appliance Co.
General Electric Co.
Bazard Manufacturing Co.
Indiana Rub. & Ins. Wire Co
India Rubber & Gutta Percha Insulating Co.
Kellogg Switch. & Sup. Co.
Manhattan Elec. Supply Co.
National India Rubber Co
New York Insulated Wire Co.
Northern Wire & Cable Co.
Okonite Co., The.
Phillips, Eugene F.
Phillips Insulated Wire Co
Roebling's Sons Co., J. A.
Runzel-Lenz Elec. Mfg. Co.
Safety Ins. Wire & Cable Co.
Simplex Electrical Co.
Standard Underground C. Co
Wesco Supply Co.
Western Electric Company.

For Alphabetical Index of Advertisements See Page 3.

ANCHORS

That are cheaper to install because of the simple method of burying and the great strain that can be applied—**American Bull-Tongue Anchors** reduce the cost of the process of guying a pole by reduction in labor, they **stay solid**, they do not slip—no take up required. 21 cents worth holds 8,713 pounds, 42 cents worth holds 10,521 pounds, other money's worth in proportion.

I. A. BENNETT,
529 and 530 Monadnock Block - - - CHICAGO



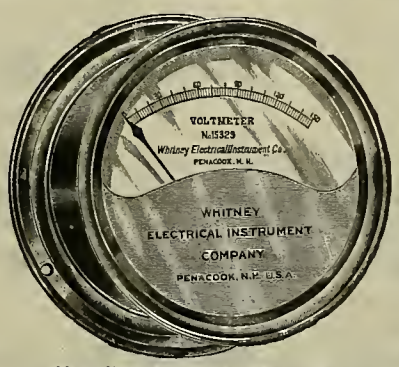
HIPWELL

Expanding Wire Guard; also manufacturer of high-grade, long-distance

TELEPHONES

Switchboards and Cable Terminals.

Hipwell Mfg. Co.
ALLEGHENY, PA.



Diam. of body, 6 in., of base flange 7½ in.

THE
"I. P." (ISOLATED PLANT) TYPE
DIRECT-CURRENT INSTRUMENTS

Are winners. Scales are equally divided, indications are dead beat, high range ammeters have separate shunts and the cases are of heavy polished brass.

Prices are right, the list figure for the meter illustrated, for instance, being $16.50.

WRITE FOR DISCOUNTS TO

MACHADO & ROLLER,
203 BROADWAY, NEW YORK CITY, N. Y., Or Your Nearest Supply House.

FARIES

ADJUSTABLE LAMP HOLDERS, SHADES, PORTABLES, ELECTRIC and COMBINATION FIXTURES

CATALOGUE WILL BE SENT ON REQUEST

FARIES MFG. CO., - DECATUR, ILL.

WHY ARE

BOSTON
BUTTE
CHICAGO
CINCINNATI
DENVER

NEW YORK
PHILADELPHIA
SAN FRANCISCO
SAINT LOUIS
SEATTLE

G. I. Goods Winning Cards?

BECAUSE THEY ARE MADE THEY OPERATE THE PRICE IS RIGHT

GENERAL INCANDESCENT ARC LIGHT CO.
529 West 34th Street, NEW YORK

604
CONCEALED WORK

PATENT ALLOWED

P. & S.
Fuseless Rosettes

National Code

PASS & SEYMOUR, Inc.
SOLVAY, N. Y.

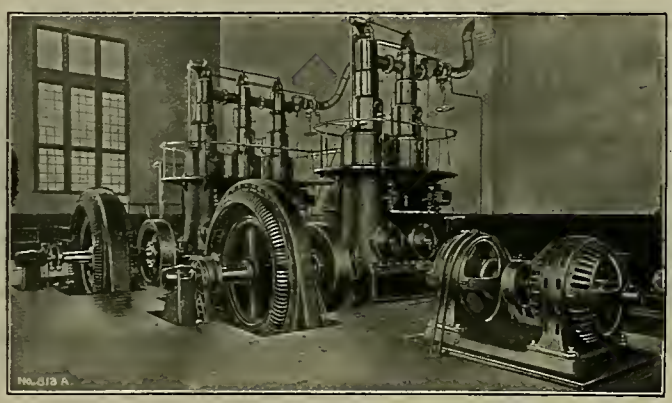
NEW YORK CHICAGO SAN FRANCISCO

602
CLEAT WORK

PATENTED MAY 2, 1899.

Direct and Alternating Current

GENERATORS



Plant of the Independent Light & Power Co., Quincy, Ill.
Equipped with National Revolving Field Alternators,

We build in all capacities
for
Central Stations and
Railway Power Plants

National Electric Company

GENERAL SALES OFFICE & WORKS:
Philadelphia: 1509 Land Title Bldg.
New York: 135 Broadway
Chicago: Old Colony Bldg.
Pittsburg: Gellatly & Co.
Milwaukee
Charleston, W. Va.: Agnew Elect. Co.
Seattle and San Francisco: Kilbourne & Clark Co.

HENRY NEWGARD & CO.

ELECTRICAL CONSTRUCTION

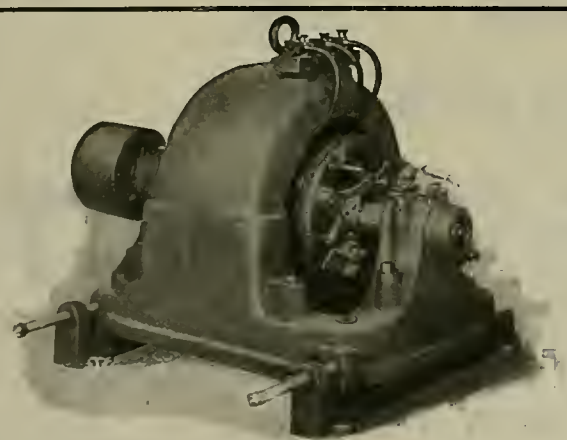
Power and Light Plants. Switchboards and Panel Boards.

We install Municipal and Isolated Electric Lighting Plants.
We manufacture Switchboards, Table boards, Iron Cutout Boxes and Electrical Specialties.
We sell Dynamos, Motors and Electrical Supplies.
We wire old as well as new Residences, Factory Buildings, School and College Buildings.

87 Fifth Avenue, Chicago, Illinois.

Watson Motors

If you want a small motor for a special purpose - Write us - Mechanical Appliance Co. - Milwaukee - Wis.



CENTRAL STATION MANAGERS

Don't Be Afraid

of the Gas Plant

WORK UP A MOTOR LOAD

We can furnish you

SINGLE PHASE MOTORS

that will start under full load in sizes ranging from 1/8 to 35 H. P.

Wagner Electric Mfg. Co.
ST. LOUIS, MO., U. S. A.

It Will Interest You to Know What the **Western Electric Company** Have to Say Regarding

HIGHEST GRADE NUERNBERG CARBONS

in their circular, dated November 23, 1903, which in part reads as follows:

"The Western Electric Company have made an exhaustive test of carbons of all kinds and have found that the 'ELECTRA' Carbons cannot be equaled in quality or efficiency, produce practically no dust and give an excellent and steady light. They produce the highest standard of candlepower in proportion to the current consumed, and are the most economical carbons manufactured."

HUGO REISINGER, Sole Importer, 11 Broadway, NEW YORK CITY.

Allen-Bradley Electric Crane Controllers

Patented

Front View—before starting

Rear View

Front View—all resistance out

Manufactured by AMERICAN ELECTRIC FUSE CO., Chicago

A New Controller. Positively No Sparking. No Repairs. Guaranteed for One Year. Three Months' Free Trial. Perfect Control.

OUR GUARANTEE: Ask any Other Manufacturer to Duplicate It.

THE AMERICAN ELECTRIC FUSE COMPANY hereby guarantees to..... that it will at any time within three months from this date upon demand repay to said..... the sum of..... .....Dollars, being the full purchase price paid (or agreed to be paid) by said..... to the American Electric Fuse Company for one..... horsepower Allen-Bradley Crane Controller, number.....upon delivery within three months after this date of said controller, freight prepaid and in good condition, ordinary wear and tear from use excepted, at the office of the American Electric Fuse Company, Chicago, Illinois, together with a written statement that said controller has provad unsatisfactory to said .....

FURTHERMORE, the said American Electric Fuse Company agrees that it will at any time within one year from this date replace, without charge, any part of said controller which may prove defective or wear out during the ordinary use of said controller, provided that it is a condition of this guarantee that said..... hereby agrees to use ordinary care in the operation of said controller, and that said controller will be operated by some person, or persons, familiar with the use of crane controllers, and further that said controller will not be wilfully or maliciously injured while in the possession of said.....

General Electric Company

FIELD RHEOSTATS

Field Rheostat with 400 Steps.

MOISTURE PROOF

Write for Further INFORMATION

General Office: SCHENECTADY, N. Y.

Chicago Office: Monadnock Block Sales Offices in all Large Cities

Never was lamp like the Zenith

More than an incandescent
Less than an arc
And more adaptable than either

The Packard Zenith lamp can be used where it is not practicable to use an arc lamp, and when used in place of a cluster of incandescents it gives better light at less cost.

Made in 25 and 55 C. P. and for all standard voltages. Do you want prices?

Electric Appliance Company
CHICAGO and SAN FRANCISCO

VOLT - AMMETERS,
POCKET SIZE.
For Testing Batteries and Battery Circuits, Locating Faults, Grounds, etc.
RELIABLE. ACCURATE.
Send for Circular.
L. M. PIGNOLET,
78-80 Cortlandt St., NEW YORK, N. Y

Engineering MECHANICAL, ELECTRICAL, STEAM, CIVIL.
Complete and short courses. Thoroughly equipped engineering shops. **Shop work from the beginning.** Short courses in Steam and Electrical Engineering. Expenses low. Accommodations the best. School all year. Students may enter any time. Correspondence steam and electrical courses. Send for catalogue. Mention course in which interested.
HIGHLAND PARK COLLEGE, DES MOINES, IOWA.

YOU NEED IT!

Gale's Commutator Compound.
The Only Article That Will Prevent Sparking.
Will keep the Commutator in good condition and prevent cutting. Absolutely will not gum the brushes.
50c. per stick. $5.00 per dozen Send 50c. for trial stick.
FOR SALE BY ALL SUPPLY HOUSES OR
K. McLENNAN & CO., Sole Manufacturers, Room 411 Inter Ocean Bldg., 130 Dearborn Street CHICAGO

MICA
Of all Qualities, in any Form at Lowest Prices
EUGENE MUNSELL AND CO.
NEW YORK and CHICAGO

INSULATION That Is.
Micanite, Linotape, M. I. C. Compound, Empire Cloth and Paper. For Years the Standard.
MICA INSULATOR CO., Originators
NEW YORK and CHICAGO

LAMPS

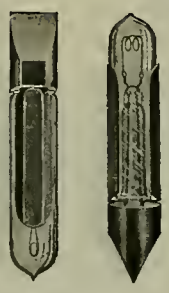
Get acquainted with the
PEERLESS—MONEY SAVERS
MADE RIGHT
PRICED RIGHT
ARE RIGHT
THE WESCO SUPPLY CO., ST. LOUIS, MO.
"EVERYTHING ELECTRICAL"

Northern apparatus is built to give constant satisfactory service—to be relied upon—to have long useful life.

Get Bulletin No. 2533.
Chicago Sales Office, Suite 425 Monadnock Block.
NORTHERN ELECTRICAL MFG. CO., Madison, Wis., U. S. A.
Engineers, Manufacturers.
248 I

MICABOND
CHICAGO MICA CO.,
"PERFECTORS" VALPARAISO, IND.
THE PEER OF INSULATORS.

EDISON TELEPHONE LAMPS



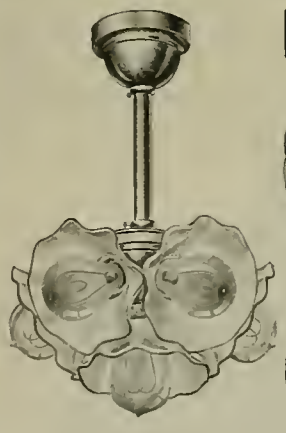
ARE
The Standard for Visual Signals.

They save the "Exchange" time and money; because every lamp is perfect. Sure to fit. Sure to burn. The life is extremely long—running into years.

Be sure to get the EDISON.

EDISON DECORATIVE & MINIATURE LAMP DEPT.,
General Electric Company, Harrison, N. J.
CHICAGO OFFICE, MONADNOCK BLOCK.

BENJAMIN CLUSTERS



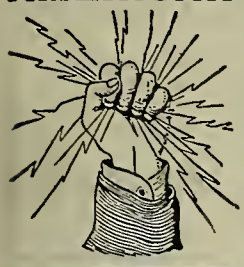
Protected by Numerous Strong Patents
BENJAMIN ELECTRIC MFG. CO.
CHICAGO NEW YORK

GASOLINE ENGINES FOR ELECTRIC LIGHTING.

Don't buy until you have investigated the "Master Workman," a two-cylinder gasoline engine, superior to all one-cylinder engines for electric lighting; quick and easy started. Has little or no vibration. Maintains a steady unflickering light. Weighs less than half of one-cylinder engine and furnishes the following sizes: 4, 5, 6, 8, 10, 12, 16 and 18 horsepower. Ten 16-candlepower lights to the horse. Solely manufactured by the TEMPLE PUMP COMPANY. Established 51 years ago.
Please mention this paper. 15th Street and 15th Place near Canal Street, Chicago.

FRANK N. PHILLIPS, President. EUGENE F. PHILLIPS, General Manager. E. ROWLAND PHILLIPS, Vice-Pres. O. H. WAGENSEIL, Treasurer. C. R. REMINGTON, Jr., Sec

AMERICAN ELECTRICAL WORKS,



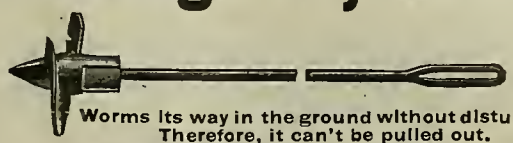
PROVIDENCE, R. I.

BARE AND INSULATED ELECTRIC WIRE,
ELECTRIC LIGHT LINE WIRE,
INCANDESCENT AND FLEXIBLE CORDS,
Railway Feeder and Trolley Wire,
AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR WIRES.
CABLES FOR AERIAL AND UNDERGROUND USE.

New York Store, W. J. Watson, 26 Cortlandt St.
Chicago Store, F. E. Donohoe, 82 Lake St.
Montreal Branch, Eugene F. Phillips' Electrical Works.
MAIN OFFICES AND FACTORIES, PHILLIPSDALE, R.I.

INSULATED WIRES
COTTON AND SILK
NORTHERN WIRE & CABLE CO.
OFFICES: Milwaukee, 740-742 Wells Bldg. Chicago, 1202 Marquette Bldg.
MAGNET WIRES
South Milwaukee Wis.

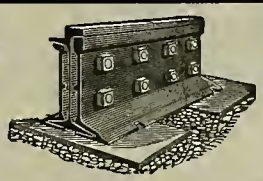
Simply Screw Them In.
THAT'S ALL
THERE IS TO THE INSTALLATION OF THE
Stombaugh Guy Anchor



Worms its way in the ground without disturbing it. Therefore, it can't be pulled out.
WRITE FOR FURTHER INFORMATION TO
W. N. MATTHEWS & BRO., Distributors
603 Carleton Building, St. Louis

EXPERT IN ELECTRICITY MECHANICS PATENT CAUSES
SOLICITOR OF U. S. & FOREIGN PATENTS
FORÉE BAIN, 1652-3 Monadnock Blk., CHICAGO

CONTINUOUS RAIL JOINT CO. OF AM.
General Offices: Century Building
NEWARK, N. J.
OVER 20,000 MILES IN USE
Highest Award at Paris Exposition, 1900, Buffalo, 1901



Electric Heating Apparatus
SEND FOR 32-PAGE CATALOGUE.
UNIT" ENAMELED RHEOSTATS
SIMPLEX ELECTRIC HEATING CO.,
Cambridgeport, Mass.

"Diamond H"
Switches
Trade H Mark
This Trade-Mark guarantees quality.
The Hart Mfg. Co., Hartford, Conn.
New York Boston Chicago Toronto, Ont.

ELECTRIC SIGNS
INCREASE YOUR CURRENT CONSUMPTION.
Assist us to sell ELECTRIC SIGNS to the best merchants in your city.
No repair bills with our signs we furnish the best—all metal raised letters equipped with removable copper shell sockets. WRITE US, we will conscientiously study your sign wants and gladly submit drawings with very low quotations for the best work.
ZEROMARX SIGN WORKS
CHICAGO, ILL.

Crimshaw

Raven White Core

Raven Black Core

ALL OUR WIRES pass inspection and carry the above TRADE-MARKS on our tags. We also manufacture Crimshaw and Competition Tapes and Splicing Compounds.

NEW YORK INSULATED WIRE COMPANY.

MAIN OFFICE: 114, 116 & 118 Liberty St., New York.
BRANCHES: CHICAGO: 192 Desplaines St. BOSTON: 7 Otis St. SAN FRANCISCO: 33 Second St.

NATIONAL CODE STANDARD

"O. K." Weatherproof Wire.
Slow-Burning Weatherproof and Ideal Wire.
Prices and Samples on Application.
Phillips Insulated Wire Co.
Office and Factory: PAWTUCKET, R. I.

BRASS & BRASS GOODS
ASK FOR CATALOG
THE PLUME & ATWOOD MFG. CO.
New York Boston San Francisco Chicago

WANTED, FOR SALE *and similar* **WANT COLUMN** *advertisements (50 words or less), $1.50 an insertion; additional words 3c each.* **POSITION WANTED** *advertisements (50 words or less), $1.00 an insertion; additional words 2c each.*

POSITION WANTED.

By a wide-awake electrical salesman, 28 years of age, technical education, with a very wide acquaintance in the electrical fraternity throughout the southern, western and northwestern states, acquainted with all electrical supplies and appliances and can secure good trade to a reliable house. Best of references furnished. Address BOX 409, care of Western Electrician, 510 Marquette Bldg., Chicago, Ill.

POSITION WANTED.

As superintendent of street railway system. Have had eleven years' experience. Am all around practical street car man. Can furnish the best of references. Address BOX 414, care Western Electrician, 510 Marquette Bldg., Chicago, Ill.

POSITION WANTED.

By competent all around electric-light man. Twenty years' experience in construction, station work, and inside wiring, or would like to know of a good location for an up-to-date contractor on inside wiring. Address BOX 415, care Western Electrician, 510 Marquette Bldg., Chicago, Ill.

WANTED.

A first-class telephone electrician having had experience from bottom up; able to handle all troubles on exchange, both inside and outside; well up on toll line troubles. Write giving reference, etc.

THE SOLOMON VALLEY TELEPHONE CO.
Beloit, Kansas.

AGENCY WANTED.

A firm of Engineers with good trade connections is open to represent Manufacturers of Electrical and Mechanical commodities in Chicago and vicinity. Address BOX 411, care of Western Electrician, 510 Marquette Building, Chicago, Ill.

FOR SALE.

Gas and electric plant in one of the best towns in Tennessee. Population 4,500; no competition. Price $40,000 cash. Address BOX 412, care Western Electrician, 510 Marquette Bldg., Chicago.

FOR SALE

1 Stanley generator, two-phase, 16,000 alternations, 1,000-2,000 volts, 40 K. W., 1333 R. P. M. and exciter.

1 Stanley generator, two-phase, 16,000 alternations, 1,000-2,000 volts, 60 K. W., 1,000 R. P. M. with exciter.
Complete marble switchboard with new instruments for above.

1 Westinghouse generator, 76 K. W., single-phase, 1,100 volts, 7,200 alternations, exciter, switchboard, new instruments complete, 750 R. P. M.

2 New belts.

1 Russell 13x20 4-valve engine, 200 R. P. M.

1 Ball 9½x10 engine, 350 R. P. M.

2 Boilers, 16x54 inch, 42 4-inch tubes, allowed 110 lbs. pressure, complete with 50-foot stack.

1 Hoppes heater. All steam pipe, valves, etc.

All in good condition. Can be seen running until December 15th. We are abandoning this plant on account of removal, and will sell all or in part. For further information, address

TIBBE ELECTRIC CO., Washington, Mo., or RUEBEL-SCHWEDTMANN-WELLS, St. Louis.

FOR SALE

1-360	K. W.	General Electric	Alternator,	Three	Phase
1-240	"	Westinghouse	"	Single	"
2-150	"	Warren	"	"	"
1-150	"	Westinghouse	"	"	"
1-150	"	Wood	"	"	"
1-150	"	Stanley	"	"	"
1-120	"	General Electric	"	Three	"
1-120	"	General Electric	"	Single	"
1-120	"	Westinghouse	"	"	"
1- 90	"	General Electric	"	"	"
1- 75	"	Westinghouse	"	Two	"
1- 75	"	Westinghouse	"	Single	"
1- 75	"	Westinghouse	"	Two	"

Direct connected to Gates' Engine.

Send for our **Monthly Bargain Sheet** with complete list and net prices.

GREGORY ELECTRIC CO.
54-62 S. Clinton St., Chicago, Ill.

"AMERICAN" STORAGE CELLS

ARE THE BEST. Send for descriptive Circular.

AMERICAN BATTERY CO.,
171 S. Clinton St., Chicago.

Corliss Engines.

1000 h. p., 36x48, Allis Corliss, 1890 heavy duty.
900 h. p., 34x60, International.
825 h. p., 32x48, Allis Corliss, 1890 heavy duty.
900 h. p., 22x42x48, Hamilton, Tand. Comp.
750 h. p., 32x54, Hamilton, 1890 Frame.
650 h. p., 30x54, St. Louis, 1890 Frame.
600 h. p., 28x60, Philadelphia.
500 h. p., 16x32x42, Corliss Cross Comp., latest type.
450 h. p., 16x30x42, Allis Cross Comp.
400 h. p., 23½x60, Geo. H. Corliss.
450 h. p., 24x48, Harris, latest type.
450 h. p., 24x48, Brown.
350 h. p., 22x42, Allis, 1890 Frame.
350 h. p., 22x42, Slater, 1890 Frame.
300 h. p., 20x48, Harris.
300 h. p., 20x42, Hamilton.
225 h. p., 12x22x42, Atlas Tandem Comp.
225 h. p., 18x42, Hamilton.
175 h. p., 16x42, Allis.
165 h. p., 16x36, Sioux, 1902.
150 h. p., 15x38, Brown.
140 h. p., 14x42, Allis.
125 h. p., 14x36, Putnam.
90 h. p., 12x36, Harris.
600 h. p., 28½x52, Buckeye Automatic.
500 h. p., 17½x30½x27, Buckeye Cross Comp.
450 h. p., 16½x28½x27, Buckeye Cross Comp.
450 h. p., 24x48, Buckeye Automatic.
350 h. p., 16x26x18, Ideal Tandem Comp.
275 h. p., 14x22x16, Ideal Tandem Comp.
250 h. p., 16x27x16, Westinghouse Comp.
150 h. p., 15x24, Cummer.
150 h. p., 10½x18x18, Williams Tandem Comp.

Whitehead Machinery Company,
DAVENPORT, IOWA.

REPAIRING RECALIBRATING ELECTRIC METERS.

INTERNATIONAL ELECTRIC METER CO.
167 S. CANAL STREET, CHICAGO.

SAUQUOIT SILK MFG. COMPANY

INSULATING and BRAIDING SILKS

MILLS:
BETHLEHEM, PA.
PHILADELPHIA, PA.
SCRANTON, PA.

NEW YORK REPRESENTATIVES:
WILLIAM RYLE & COMPANY
54 Howard St.

PHILADELPHIA OFFICE:
4015 Clarissa St.

CHICAGO OFFICE:
210 Monroe St.

BOSTON OFFICE:
78 Chauncy St

WE BUY OLD BELTS

OR SCRAPS, ANY SIZE OR CONDITION.
WE CLEAN, REPAIR AND RENEW OLD BELTS.
LEATHER PRESERVER MFG. CORP.
27 W. MONROE ST., CHICAGO

COLOR YOUR OWN LAMPS WITH "Signaloid"

Signaloid Chemical Works
KLIEGL BROS., Props.
1393-5 BROADWAY, NEW YORK

DON'T BUY ELECTRICAL SUPPLIES

Until you have seen our new Catalogue and new Price List.
Free to the trade.

Manhattan Electrical Supply Co.
NEW YORK: 82 Cortlandt St.
CHICAGO: 188 Fifth Ave.

ELECTRIC SIGN FLASHERS

BEST IN THE WORLD
Write for full particulars
Reynolds Elec. Flasher Mfg. Co.
221 Fifth Ave., Chicago.

BOILERS.

One 42-in. x 15 ft. 9-in., 250 H. P. Worthington Water Tube.
One 60-in. x 16 ft., John Mohr Return Tubular Boiler.
One 54-in. x 16 ft., John Mohr Return Tubular Boiler.
One 54-in. x 16 ft., Devine Tubular Boiler.

ENGINES.

One 600 H. P., 21 x 36 x 80, Williams Tandem Horizontal Compound, 140 R. P. M.
Two 600 H. P., 20 x 30 x 24, Porter-Allen Tandem Compound, 200 R. P. M.
One 250 H. P., 12 x 24 x 18 Williams Tandem Compound, 260 R. P. M.
Two 100 H. P., 13 x 12, Dick & Church, High Speed Automatic.

PARTIAL LIST ONLY.

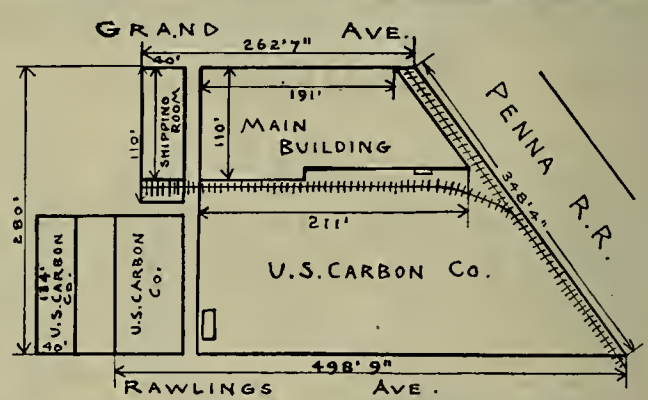
Send for latest Catalogue for bargains in Engines, Boilers, Dynamos and Motors.

CENTRAL STATION IMPROVEMENT CO., 938 Monadnock Block, Chicago

WORKS QUICK AND EASY. KEEPS ITS LUSTER. HOLDS OLD TRADE AND MAKES NEW. DOES NOT DETERIORATE. ESTABLISHED 16 YEARS. SOLD BY AGENTS AND DEALERS ALL OVER THE WORLD

U.S. METAL POLISH

3 OUNCE BOX 10 CENTS. SAMPLES SENT FREE
GEO. W. HOFFMAN
POLISHES ALL METALS. BRANCHES: NEW YORK, CHICAGO, SAN FRANCISCO. 295 E. WASHINGTON ST. INDIANAPOLIS, IND.



FOR SALE.

PLANT OF THE UNITED STATES CARBON COMPANY including land, buildings, machinery, etc., situated on the Pennsylvania Railroad within the city limits of Cleveland, Ohio.

LAND—Vacant and covered by buildings about 2½ acres, bounded on two sides by streets and having a frontage of 348 ft. 4 in. on the Pennsylvania Railroad.

BUILDINGS—Main building is a two and one story brick building with gravel roof, the two-story part having a frontage of 191 ft. on Grand Ave., by about 50 ft. The one-story part having a frontage of 211 ft. on the switch from the Pennsylvania Railroad by about 55 ft. The shipping room is 40 ft. front on Grand Ave., by 110 ft. deep to a switch from the Pennsylvania Railroad and is a two-story brick building, with gravel roof; the second floor, however, only covers a space of 14 by 40 ft. in the front part of the building. See diagram of land and buildings above.

MACHINERY—Pulleys, shafting, belting and complete machinery for the manufacture of electric-light carbons and for furnishing power, heat and light for the plant. Capacity of plant about 50,000 carbons per day.

For information address,

THE GUARDIAN SAVINGS & TRUST COMPANY,
CLEVELAND, OHIO.

CHICAGO EDISON COMPANY REPAIR SHOPS

76 MARKET STREET, CHICAGO. TELEPHONE MAIN 1280.

Machine and Carpenter Work of All Kinds
Correspondence Solicited.

OPEN DAY AND NIGHT.

FIRST-CLASS EQUIPMENT THROUGHOUT.

Dynamos Armatures, Motors, Arc Lamps, Fans, Instruments.

UNJUST BOYCOTT

The factory of HAMILTON CARHARTT, manufacturer of the Celebrated Carhartt Overall, is operated upon Union principles, absolutely and exclusively, and it is an outrageous injustice that he should be made to suffer, instead of being commended for the manly course he has pursued towards Organized Labor.—*Locomotive Firemen's Magazine, Indianapolis, Ind., July 1st.*

Common justice demands the statement that Hamilton Carhartt is conducting a Union establishment under Union conditions, placing the Union Label on his entire product, and sympathetically as well as practically demonstrating his friendship to the cause of Organized Labor.—*American Federationist, Samuel Gompers, Editor, Washington, D. C., July 1st.*

It would be the basest ingratitude for Union men not to show their appreciation of the manly stand you have taken regarding Organized Labor.—*Henry White, General Secretary United Garment Workers of America, New York City, June 25th.*

Your friendliness towards Organized Labor is too well known at home and abroad to be disputed, yet should any one doubt it, we will consider it a duty as well as a pleasure to place them right in the matter under the seal of this Council.—*Samuel A. Watrous, President Detroit Council Trade and Labor Unions, June 15th.*

Mr. Carhartt was the first manufacturer to advertise and push our Union Label, and Organized Labor owes him a debt of gratitude that they never can repay.—*Josephine E. Walsh, Secretary Local Union, No. 74, U. G. W. A., May 31st.*

I cannot condemn too strongly those who are seeking to besmirch the name of Hamilton Carhartt, manufacturer of the Celebrated Carhartt Overall. No man belonging to Organized Labor would be guilty of such a thing.—*H. W. Sherman, Grand Secretary International Brotherhood Electrical Workers, Washington, D. C., June 23d.*

While I firmly believe that there is no man worthy the name, or with an ounce of red blood in his veins, but what would resent the dastardly attempt to destroy my business by circulating malicious libels saying I am unfair to Organized Labor, still, that no one shall be misled, I present the above extracts from endorsements selected from the hundreds that have come to my desk. Yours Fraternally,

DETROIT, MICH.

SEPTEMBER 1st, 1904.

Hamilton Carhartt

MANUFACTURER.

BOILER WATERS CORRECTED

to remove and prevent scale and to stop corrosion. DEARBORN TREATMENT does the work. Send gallon sample for analysis. Booklet "R" now ready.

DEARBORN DRUG & CHEMICAL WORKS,

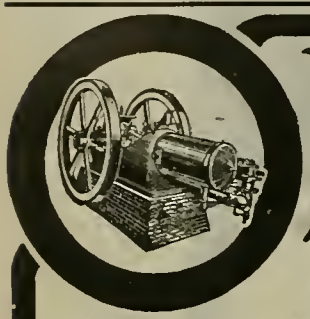
27-34 RIALTO BUILDING, CHICAGO, ILL. WM. H EDGAR, President Telephone: Harrison 3930 and 3931.

Dixon's Pure Flake Graphite

"The Perfect Solid Lubricant," saves shut-downs and repairs due to imperfect lubrication. Booklet 125C and sample upon request.

JOSEPH DIXON CRUCIBLE CO., JERSEY CITY, N. J.

JEFFREY CHAIN BUCKET DREDGES FOR CATALOGUE, ADDRESS THE JEFFREY MFG. CO. COLUMBUS, OHIO.



Olds Gas and Gasoline Engines

Competitive tests have established the superiority of the Olds in point of economy over any other engine. The maximum of power is obtained from a minimum of fuel, the cost averaging ¼ of a cent an hour for each horsepower.

Stationary Engines - - - 2 to 100 H. P.
Portable Engines - - - 8 to 10 H. P.

Our new illustrated catalog should be in the hands of every power user. Write to day for a copy.

OLDS GASOLINE ENGINE WORKS,
252 River Street - - - - Lansing, Mich.
No. 981

BEST ON EARTH.

BURGER AUTOMATIC.

For Electric Work

REGULATION AND ECONOMY OF FUEL UNSURPASSED.

WRITE FOR CATALOGUE H

Then compare it with some Gas Engine hand books that cost $1.00.

Woolley Foundry & Mach. Works
Box 400, Anderson, Ind. U. S. A.

REG TRADE MARKS

THE PHOSPHOR BRONZE SMELTING CO. LIMITED, 2200 WASHINGTON AVE., PHILADELPHIA.
"ELEPHANT BRAND PHOSPHOR-BRONZE"
INGOTS, CASTINGS, WIRE, RODS, SHEETS, ETC.
— DELTA METAL —
CASTINGS, STAMPINGS AND FORGINGS
ORIGINAL AND SOLE MAKERS IN THE U.S.

H. N. FENNER, President J. F. BLAUVELT, Agent RUSSELL W. KNIGHT, Treasurer

NEW ENGLAND BUTT COMPANY

MANUFACTURERS OF

Machinery for Insulating Electrical Wires

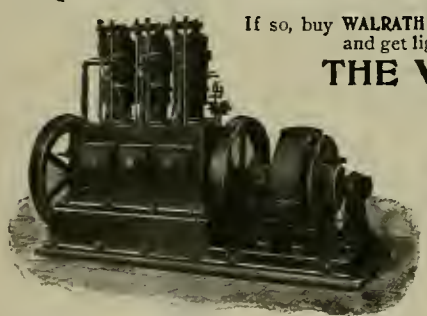
Braiding, Taping, Winding, Twinning, Cabling, Stranding, Polishing and Measuring Machines. Cable Covering Braiders

FINE CASTINGS A SPECIALTY

304 PEARL STREET, - - - PROVIDENCE, R. I., U. S. A.

ARE YOU LOOKING FOR MONEY?

If so, buy WALRATH GAS OR GASOLINE ENGINES and get light on the subject.



THE WALRATH

Received the Highest Award at the Pan-American Exposition.

It will produce as good a commercial light as that of an automatic steam engine, either belted or direct-connected generator. Simple, Economical and Reliable

Send for Catalogue W

MARINETTE GAS ENGINE CO.,
CHICAGO HEIGHTS, ILL.

AGENCIES:
Keystone Engineering Co., Farmer's Bank Bldg., Pittsburg, Pa.
Strong, Carlisle & Hammond Co., 61-67 Frankfort St., Cleveland, Ohio
Mackay Engineering Co., 149 Broadway, N. Y.
C. H. Seidenglanz., 52 When Bldg., Indianapolis, Ind.

Fuel Reduced 10 to 20 Per Cent.

Steam + Fuel

Steam Gained 20 to 40 Per Cent.

GREEN'S ECONOMIZER

Has accomplished these results in many of the largest and most successful Electric Light and Power Plants in the world by simply utilizing the waste gases before entering the chimney

CATALOGUE EXPLAINS — FREE

THE GREEN FUEL ECONOMIZER CO., Matteawan, N.Y.

SAMSON TURBINE

We show below, record of tests of a 56-inch SAMSON TURBINE installed in the official testing flume at Holyoke. This turbine was built from the same patterns as those we sell to our customers.

Gateage	Head	R. P. M.	Cu. Ft. per Sec.	H. P.	Efficiency
Full	13 27	109	247	310	83.58%
15/16	13.50	104	235	304	84.60%
7/8	13.79	101	223	296	85.01%
13/16	14.18	100	209	280	83.56%
3/4	14.69	100	189	254	81.06%
11/16	15.12	102	174	239	80.36%

Write Dept. D for Catalog.

THE JAMES LEFFEL & CO., Springfield, Ohio, U. S. A.

ARNOLD ELECTRIC POWER STATION Co.
Engineers, Constructors for Complete Electric Plants. Results Guaranteed.
SUITE 1539, MARQUETTE BLDG., CHICAGO, NEW YORK OFFICE: 711 TRANSIT BLDG.

BUTTERFIELD, J. F.
ELECTRICAL ENGINEER AND CONTRACTOR.
Complete Telephone Exchanges Built and Material Furnished.
Cable Construction and Underground Conduit Construction a Specialty.
Room 595, 113 Adams Street. CHICAGO, ILL.

J. H. HALLBERG
Consulting Engineer
Electric Light, Power and Railway Plants
Suggestions to secure Economy, Specifications, Examinations and Reports
45 Broadway, NEW YORK
Long Distance Telephone 4578 Broad

KOHLER BROS.,
Contracting Electrical Engineers, Lighting Power Railways,
1804-1806-1808-1810-1812 Fisher Building, CHICAGO.

F. B. BADT,
Monadnock, Chicago.

BYLLESBY, H. M. & Co.
(Incorporated)
ENGINEERS
Design, Construct and Operate Railway, Light, Power and Hydraulic Plants.
Examinations and Reports.
New York Life Building, - CHICAGO, ILL.

HORNADAY, J. P. & Co.
SUITE 1108 TRACTION BUILDING
CINCINNATI, O.
WATERWORKS, ELECTRIC RAILWAY, LIGHT, TRACTION, INDUSTRIAL AND MINERAL PROPERTIES BOUGHT AND SOLD

RUEBEL - SCHWEDTMANN-WELLS,
CONSULTING, MECHANICAL AND ELECTRICAL ENGINEERS,
Suite 801 Chemical Building, ST. LOUIS, U. S. A.

IT WILL PAY
engineers not represented in this department to carry a card regularly.

EVANS, ALMIRALL & CO.,
Central Station Heating, High Pressure Piping.
1057 Monadnock Blk., Chicago.

ROBERT W. HUNT & Co.,
ENGINEERS
1121 The Rookery, Chicago. 66 Broadway, New York.
Monongahela Bank Bldg., Pittsburg.
Norfolk House, Cannon St., London.

Long Distance Phone Central 2118.
SCHOTT, W. H.,
ENGINEER AND CONTRACTOR,
SPECIALTIES—Central Station Heating Plants, Water Works Steam Plants, Electric Light, Gas and Street Railway Plants.
1220-21 MARQUETTE BUILDING, CHICAGO.

W. E. BAKER. H. B. BISHOP.
BAKER, W. E. & CO.
ENGINEERS,
ELECTRIC RAILWAYS.
27 William St., NEW YORK.

E. W Hammer, Pres. and Treas. H. J. Minhinnick, Sec. and Gen'l Sup't.
GENERAL ENGINEERING Co., THE Consulting and Contracting Engineers.
Telephones, Electric Light, Power Transmission
Suite 1112, 135 ADAMS ST., CHICAGO.
Long Distance Telephone Central 478.

A WEEKLY REPRESENTATION
in this "Directory" enables engineers to keep before all possible customers.

TRY IT.
Keep your name and address in this directory where it will be seen by possible clients.

BRYAN, WILLIAM H.
M. Am. Soc. M. E.,
Consulting Mechanical and Electrical Engineer.
Lincoln Trust Building, ST. LOUIS.

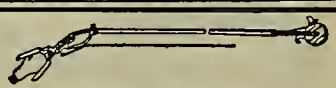
ENGINEERS
Represented in this "Directory" are enabled to come in touch with many prospective customers who cannot be reached through any other source.

KEMP, R. W.
Consulting and Contracting Telephone Engineer.
Plans and specification for complete plants.
Old plants overhauled and placed on paying basis. Territory, Kansas, Oklahoma and Indian Territory.
WELLINGTON, - - - KANSAS.

STANTON, LE ROY W.
Consulting Telephone Engineer
Plans, Specifications and Supervision of Installation of Complete Telephone Plants
Special Reports on Telephone Properties and Apparatus
411 Electrical Bldg., Cleveland, Ohio

DUGALD C. JACKSON, C. E.
WILLIAM B. JACKSON, M. E.
MEMBERS
AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS
AMERICAN SOCIETY OF MECHANICAL ENGINEERS
AMERICAN SOCIETY OF CIVIL ENGINEERS
ENGINEERS. EXPERTS.
MADISON, WIS.

ALL Live men read the **WESTERN ELECTRICIAN** Each Week. Do You?



The Incandescent Lamp Replacer and Cleaner replaces and cleans any c. p. lamp at any height or angle.
Incandescent Electric Light Manipulator Co.,
116 Bedford St.. Boston, Mass.

IMPORTANT TELEPHONE BOOKS.

THE TELEPHONE HANDBOOK. By Herbert Laws Webb. 16mo, 150 pp. Price $1.00.
This handbook is a reliable treatise on telephony, and a practical book on telephone working and management, based entirely on standard American practice. It is extremely useful to telephone inspectors and operators.

AMERICAN TELEPHONE PRACTICE. By Kempster B. Miller, M. E. 510 pp. 380 illustrations. Price $3.00.
This is the first complete treatise on telephony in the English language. The text is profusely illustrated by cuts of commercial apparatus and carefully prepared diagrams of circuits. No diagram is given without a full explanation. The apparatus, circuits and methods of the American Bell Telephone Company and of the various independent companies are fully described. The apparatus and methods used in making all of the tests required in commercial telephone work are fully treated.

THE INSPECTOR AND TROUBLE MAN. By A. E. Dobbs. 106 pp. Price $1.00.
A practical book, written in plain language. Full of information and diagrams for the operator, exchange manager, inspector, trouble man and lineman. A complete description of telephones, how to find and remedy their troubles, together with working plans for exchange construction, complete with diagrams of all up-to-date telephones and switchboards.

A, B, C, OF THE TELEPHONE. By J. E. Homans, A. M. 352 pp. 269 illustrations. Price $1.00.
Owing to the demand for a comprehensive book giving a clear, terse idea of the principles governing the construction, installation, care and management of telephones and their appliances, this book has been compiled. It has been the aim of the author to make this the most complete elementary book on the subject for the practical electrician, wireman, lineman and engineer, and it is written in a clear and careful style.

THE PRACTICAL TELEPHONE HANDBOOK. By Joseph Poole, A. I. E. E. Second edition, revised and enlarged. 360 pp. 288 illustrations. Price $1.50.
In this work the writer has endeavored to produce a manual of moderate size and cost, but thoroughly practical, and detailing, as far as space will allow, the most recent methods of telephone working. While the requirements of telephone employes have been kept constantly in view it is fully intended also that the book shall be of service as a source of information on telephonic matters to users of the telephone and to the public generally.

PRACTICAL FEATURES OF TELEPHONE WORK. By A. E. Dobbs. 134 pp. Price 75 cents.
A simple, plain-speaking handbook for the practical telephone man.

TELEPHONE TROUBLES AND HOW TO FIND THEM. A complete handbook for telephone inspectors. By W. Hyde and J. H. McMahon, edited by Prof. C. H. Haskins. Eighth edition. 16mo, 48 pp. Price 25 cents.
This little volume is an extremely practical work for telephone employes, written in a popular style and devoid of technicalities.

TELEPHONE LINES AND THEIR PROPERTIES. By Wm. J. Hopkins. Sixth edition. 272 pp. Illustrated. Price $1.50.

A MANUAL OF TELEPHONY. A new and large edition. By W. H. Preece, F. R. S., and A. J. Stubbs. 508 pp. 333 illustrations. Price $4.50.

TELEPHONES, THEIR CONSTRUCTION AND FITTING. A Practical Manual on the Fitting Up and Maintenance of Telephone and Auxiliary Apparatus. By F. C. Allsop. 191 pp. 163 illustrations. Price $1.25.

PATENTED TELEPHONY. A Review of the Patents Pertaining to Telephones and Telephonic Apparatus. Published by the American Electrical Engineering Association Cloth bound; fully illustrated. Price, $1.50.

THE ELECTRIC TELEPHONE. By E. J. Houston, Ph. D., and A. E. Kennelly, Sc. D.; 12mo, cloth, 422 pp., 142 illustrations. Price $1.00.

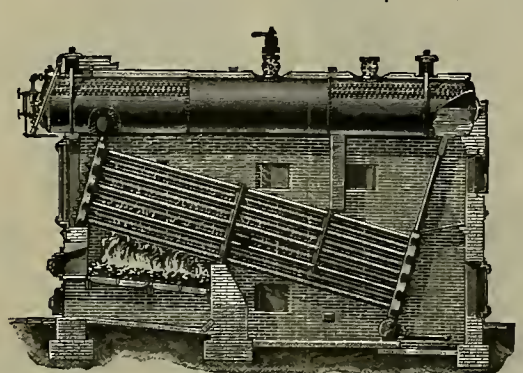
HOW TO MAKE AND USE THE TELEPHONE. By Geo. H. Cary. 136 pp.; illustrated. Price $1.00.

The Above, or Any Other Electrical Work Published, Sent on Receipt of Price.

ELECTRICIAN PUBLISHING CO., 510 MARQUETTE BLDG., CHICAGO.

THE BABCOCK & WILCOX CO., 85 LIBERTY ST., N. Y.

BRANCH OFFICES:
BOSTON, 35 FEDERAL STREET.
PHILADELPHIA, 1110-1112 NORTH AM. BLDG.
SAN FRANCISCO, 63 FIRST STREET.
PITTSBURG, 1218 FRICK BUILDING.
NEW ORLEANS, 338 CARONDELET STREET.
CHICAGO, 1215 MARQUETTE BLDG.
ATLANTA, EMPIRE BLDG.
CLEVELAND, 706 NEW ENGLAND BLDG.
MEXICO CITY, 7 AVENIDA JUAREZ.
HAVANA, CUBA, 116 1-2 CALLE DE LA HABANA



200 Pounds Working Pressure

WATER TUBE STEAM BOILERS

STEAM SUPERHEATERS

Our Book, STEAM, mailed free on application.

Standard three-bar generator, same as used in our series telephones. We have manufactured generators since we first started in business. What this experience means to you enables us to sell the best generator made at a price slightly above the ordinary. The difference is caused by the better grade of material used and the superior workmanship.

You pay nothing for our experience. Our Bulletin No. 11-E explains fully this apparatus. Mailed free.

Stromberg-Carlson Telephone Mfg. Co.

GENERAL AND EASTERN OFFICE
ROCHESTER, N. Y.

SALES DEPT.
CHICAGO, ILL.

"JUST AS GOOD AS KELLOGG APPARATUS"

cannot be bought outside our factories for the same price we ask—for a higher price or for a lower price.

Our customers never think Kellogg prices high.

We are quoting attractive magneto prices. Write us for quotations on everything in the magneto line.

Send for our new bulletins Nos. 8 to 13.

Do not miss visiting the Kellogg exhibit at the St. Louis Exposition, Electricity Building.

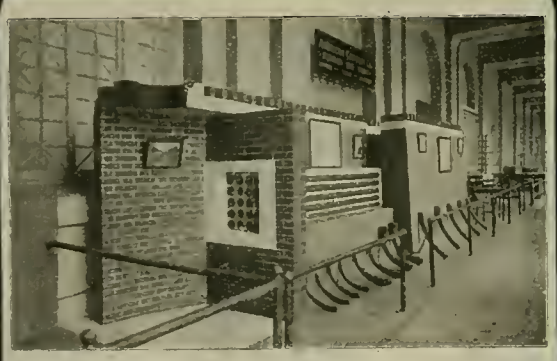
Kellogg Switchboard & Supply Co.,

GREEN AND CONGRESS STREETS, CHICAGO

Electric Building, Cleveland — Keystone Telephone Building, Philadelphia

BITUMINIZED FIBER CONDUIT

FOR UNDERGROUND CONSTRUCTION



One view of our exhibit at World's Fair showing Bituminized Fiber Conduit in a piece of actual construction.

American Conduit Co.

Main Offices: 1005-6 Manhattan Building, Chicago

Other Offices:
170 Broadway, New York. 336 Macy St., Los Angeles

WANTED

ELECTRIC LIGHT PLANTS

ELECTRIC STREET CAR LINES

They are wanted by some good towns in Illinois, Missouri, Kansas and Nebraska.
If you really "mean business," you can get particulars by writing

Burlington Route
N456

W. H. MANSS,
Industrial Commissioner,
209 Adams Street - - CHICAGO

INTERNATIONAL

Mechanical Self-Restoring Drop Switchboard.

A PERFECT APPARATUS.

Made in any desired capacity.
Sample parts and quotations on request.

INTERNATIONAL TELEPHONE MANUFACTURING CO.
CHICAGO, U. S. A.

Our

AUTOMATIC TELEPHONE SYSTEM

Wins

THE GRAND PRIZE

At the WORLD'S FAIR, St. Louis

In Open Competition with the World

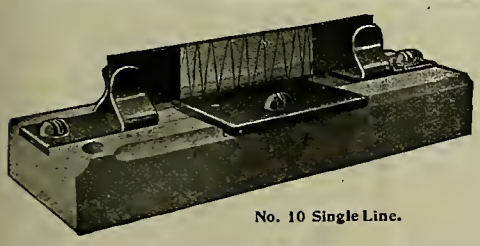
We are the only **INDEPENDENT** Telephone Manufacturers to receive this, the highest honor the officials could confer.

The same superiority of equipment which won this award for us has caused the adoption of our apparatus by Independent companies in the following cities:

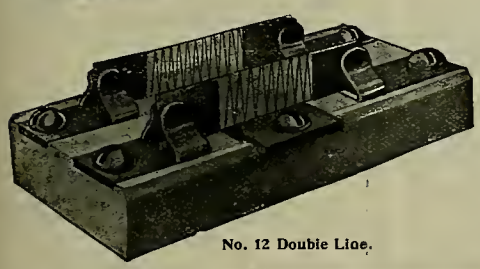
Chicago, Ill.	Lewiston, Maine	Sioux City, Iowa	Westerly, R. I.	Pentwater, Mich.
Grand Rapids, Mich.	Auburn, Maine	Cleburne, Texas	Manchester, Iowa	Toronto Jct., Can.
Columbus, Ohio	Fall River, Mass.	Columbus, Ga.	Princeton, N. J.	Wilmington, Del.
Dayton, Ohio	New Bedford, Mass.	Augusta, Ga.	Albuquerque, N. M.	Riverside, Cal.
Lincoln, Neb.	Los Angeles, Cal.	Medford, Wis.	Van Wert, Ohio	Traverse City, Mich.
Portland, Maine	San Diego, Cal.	St. Marys, Ohio	Battle Creek, Mich.	and
Auburn, N. Y.	Hopkinsville, Ky.	Woodstock, N. B.	Clayton, Mo.	Berlin, Germany

AUTOMATIC ELECTRIC COMPANY

CHICAGO, U. S. A.



No. 10 Single Line.



No. 12 Double Line.

PROTECTORS THAT PROTECT.

Our patent wrapped fuse used in our protectors are an insurance policy against lightning.

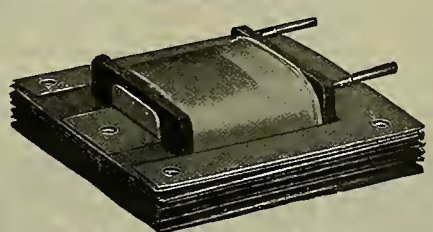
Sample free by mail to any Exchange or Toll Line

CENTRAL TELEPHONE AND ELECTRIC CO.,
909 Market St.,
ST. LOUIS, U. S. A.

We introduced successful 4-party lines

LEICH SELECTIVE SYSTEM

Write for our booklet—"Selective W."



Impedance Coil for Selectives. No Springs.

CENTRAL ENERGY OR MAGNETO

AMERICAN ELECTRIC TELEPHONE CO.
CHICAGO, ILLINOIS

They Are All Talking About The "Tornquist"

King of Protectors

The Only Sure Protector Made

HIGH GRADE BABY KNIFE SWITCHES

None Better Made

STAMPING AND PLATING

Better buy a "Tornquist" it is the greatest success in the telephone field. Order sample now. Sold by all jobbers.

Clinton Stamping & Electric Co.
CLINTON, IOWA

TELEPHONE BOOTHS

When in want of the Right Kind write us.

Catalogue Free

Yesbera Mfg. Co.
TOLEDO, OHIO.

PRODUCERS AND WHOLESALERS OF WHITE CEDAR PRODUCTS

CEDAR POLES

YARDS
KOSS MICH.
L'ANSE "
MUNISING "
ONTONAGON
WAGNER, WIS
PESHTIGO "

SPECIAL PRICES ON SMALL POLES.
Write for a copy of our TELEGRAPH CODE FOR CEDAR PRODUCTS

C. H. WORCESTER CO.
SUITE 1206 TRIBUNE BLDG. CHICAGO.

Cedar Poles

TORREY CEDAR CO., CLINTONVILLE, WIS.
Large Stock Constantly on Hand

POLES. WHITE CEDAR. IDAHO CEDAR up to 80 ft.

BERTHOLD & JENNINGS, ST. LOUIS. Chemical Building.

CROSS ARMS. LONG LEAF PINE AND FIR.

Cedar Poles.

Pittsburg and Lake Superior Iron Co. Producers and Wholesalers. Escanaba, Mich.

"By two or three witnesses shall a matter be established."

FIVE POINTS OF EXCELLENCE

Leaving the center of the city from which you start; reaching the center of the city of your destination, over smooth and level tracks; giving rest and comfort; riding beside running waters most of the way; through the centers of population to the gateways of commerce; when you travel by the

NEW YORK CENTRAL LINES

A copy of the Illustrated Catalogue of the "Four Track Series" will be sent free upon receipt of a two-cent stamp by George H. Daniels, General Passenger Agt., Grand Central Station, New York.

MICHIGAN AND WESTERN CEDAR POLES
ALL LENGTHS AND SIZES
LINDSLEY BROS CO.
TRIBUNE BLDG., CHICAGO

POLES, TIES, POSTS. THE PORTER CEDAR CO., SAGINAW, MICH.
PRODUCERS. We want your inquiries always.

Engineering TAUGHT BY CORRESPONDENCE

Our system of training by mail has helped thousands held down in poor positions to rise to better salaries and situations. Your chance to rise is just as good as others. Write for our free illustrated book, "Can I Become An Electrical Engineer?" We teach by mail, Electrical Engineering, Mechanical Engineering, Steam Engineering, Mechanical Drawing, Electric Lighting, Electric Railways. ELECTRICAL ENGINEER INSTITUTE, Dept. K 240 West 23rd St., New York.

Send your Book Orders to
ELECTRICIAN PUBLISHING CO.,
510 Marquette Bldg., Chicago.

Louisville and Chicago

And the places north
And the places south
And the places between are reached by the quick day and night trains of THE

MONON ROUTE
CHICAGO, INDIANAPOLIS & LOUISVILLE RAILWAY

Also the celebrated health resorts, French Lick and West Baden Springs, are reached only by this road.

Booklets about the Springs, their wonderful waters and the fine hotels, sent free.

CHAS. H. ROCKWELL, Traffic Manager
FRANK J. REED, Gen. Pass. Agt.
202 Custom House Place, Chicago

The "WAY of the WORLD" to the WORLD'S FAIR.
BIG FOUR ROUTE to ST. LOUIS.
1904
Write for Folders & Booklets
M. E. INGALLS, PRESIDENT, CINCINNATI
WARREN J. LYNCH, C. P. & T. A.

Idaho Cedar Poles

PACIFIC COAST POLE CO. SPOKANE, WASH.

....BINDERS....
FOR THE
Western Electrician
$1.00 EACH.
ELECTRICIAN PUB. CO.,
CHICAGO.

TYPE E.

ALTERNATING CURRENT.

SCHEEFFER INTEGRATING WATTMETER

Type E for Alternating Current — Type F for Direct Current Circuits

DUST AND BUG PROOF
IMPROVED CONSTRUCTION

MOVING PARTS ARE EXTREMELY LIGHT, INSURING A HIGHLY SENSITIVE AND ACCURATE METER.

WRITE FOR PRICES AND DESCRIPTIVE LITERATURE.

DIAMOND METER COMPANY,
PEORIA, ILL., - - - - U. S. A.

TYPE F.

DIRECT CURRENT.

MICHIGAN WHITE
CEDAR POLES
LARGE STOCK.
PROMPT SHIPMENTS. KELLOGG SWITCHBOARD & SUPPLY CO., Chicago.

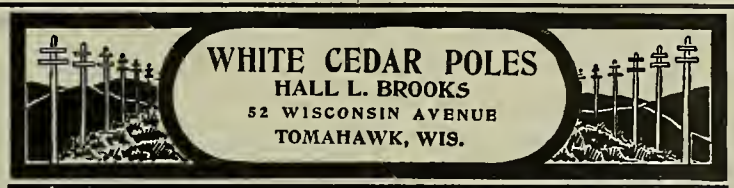
SIX-INCH THIRTIES. If you're going to buy any this year get our price; 7-inch 25s are on the same list. Of course we have every size you ever needed, but we have too many of these two sizes.
MALTBY CEDAR COMPANY, 509 Phoenix Block, Bay City, Michigan.
Pittsburg Agents, Tipper & Patton, 509 Bessemer Building.

BRACKETS—X ARMS—PINS
little things it is true, but they cut a big figure in line construction.
OUR MOTTO IS:
Prompt Shipment Quality Satisfaction Right Price
COLUMBIA MFG. CO. ANTIGO, WIS.

POLES W. C. STERLING & SON, MONROE, MICH. Eleven Pole Yards in Michigan. Wholesale Producers for 20 years **TIES.**

Southern Cedar **POLES** Are the Best.
NO ROTTEN BUTTS.
D. W. PHELAN, 277 Broadway, New York

Points in Wisconsin and the Northwest
are covered by Wisconsin Central Railway's convenient, solid, wide vestibuled trains, equipped with Pullman sleepers, free reclining chair cars and modern coaches which leave Central Station, 12th Street and Park Row (Lake Front), Chicago for St. Paul, Minneapolis, Ashland and Duluth, connecting with all western lines. Meals in dining and cafe cars served a la carte.
For tickets and further information apply to nearest ticket agent, or write
JAS. C. POND, Gen'l Pass. Agt., Milwaukee, Wis.



Poles and Ties

The Fowler Companies
TRADE MARK
Fisher Bldg. Chicago

Locations for Industries
Erie Railroad
Chicago to New York
The Erie Railroad Company's Industrial Department has all the territory traversed by the railroad districted in relation to resources, adaptability, markets and advantages for manufacturing, and can advise with manufacturers in relation to the most suitable locations. For full information address
LUIS JACKSON
Industrial Commissioner, Erie Railroad Company
21 Cortlandt Street, New York

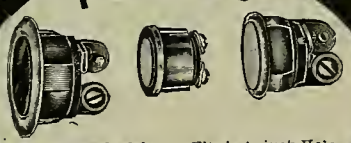
TELEPHONE POLES
Yards at Red Cliff, Wis., Aitkin, Feeley, Cohasset, Deer River, Tenstrike and Black Duck, Minnesota.
Large stocks. Prompt shipments. Carefully inspected stock at low prices.
J. W. MORRISON LUMBER CO., 918-19 Lumber Exchange MINNEAPOLIS, MINN.

CEDAR POLES
ESTABLISHED 1862
WM. MUELLER COMPANY
1211-12-13 MARQUETTE BLDG. CHICAGO.
EIGHT DISTRIBUTING YARDS

ELECTRICAL AND OTHER INDUSTRIES ARE OFFERED LOCATIONS WITH
Satisfactory Inducements,
Favorable Freight Rates,
Good Labor Conditions,
Healthful Communities,
ON THE LINES OF
THE ILLINOIS CENTRAL R. R.
AND THE
YAZOO & MISSISSIPPI VALLEY R. R.
For full information and descriptive pamphlet address
J. C. CLAIR, Industrial Commissioner
1 Park Row, Chicago, Ill

"STAR" INCANDESCENT LAMPS

LONG LIFE
GUARANTEED CANDLEPOWER,
HIGHEST EFFICIENCY.
MADE BY THE MOST SKILLED WORKMEN.
STANDARD ELECTRICAL MFG. COMPANY, : Niles, Ohio.

EDWARDS AND CO. New York, N.Y. U.S.A.
PUSHES

Fits in ¾-inch Hole. Fits in ½-inch Hole
Fits in ⅝-inch Hole.
No screws needed to fasten them as the spring clips hold them securely in place.
WESTERN ELECTRIC CO., SELLING AGENTS

BUY YOUR BOOKS
FROM THE
Electrician Pub. Co., 510 Marquette Bldg., Chicago.

All Supply Houses
J. J. EGAN'S "ACME" COMMUTATOR COMPOUND.
J. J. EGAN'S "ACME" COMMUTATOR COMPOUND absolutely prevents sparking or cutting. One stick of "Acme" is equal to one gallon of oil for lubricating commutators. Free Sample. AGENTS WANTED.
50c per Stick. $5.00 per doz.
J. J. Egan Sole Mfg., 317 Austin Ave., Tel. Polk, 1779 Chicago

CENTRAL STATION HEATING
We are the originators and builders of the underground system of live and exhaust steam heating. Our system is used for the utilization and distribution of exhaust steam from electric and power plants for heating purposes. 250 Plants in successful operation. We have the only Meter System. Also manufacturers of Wooden Water Pipe, Steam Pipe Casing, Steam Traps, Condensation Meters, Valves, Economizing Coils, Separators and full line of Steam Fitters' Supplies.
WRITE FOR PAMPHLET AND PRICE LIST
AMERICAN DISTRICT STEAM COMPANY
LOCKPORT, N.Y. CHICAGO, ILL.
MENTION WESTERN ELECTRICIAN.

A Special Award

Was given by the Department of Machinery of the Louisiana Purchase Exposition to the

Westinghouse Companies

For the Best, Most Complete and Most Attractive Installation

Besides numerous Gold, Silver and Bronze Medals, the following

Grand Prizes Were Awarded

Westinghouse Electric & Mfg. Co.

For Direct and Alternating Current Electric Railway Motors

For Direct and Alternating Current Generators and Motors

For Alternating Current Turbo-Generator Installation

For Static Transformers and Rotary Converters

For Mining and Industrial Electric Locomotives

For Control Systems for Single and Multiple-Unit Operation

The Name "Westinghouse" is a Guarantee

TYPE A INSULATION OF INSURANCE

Insulation implies insurance; in fact, nearly half of insurance lies in insulation.

Therefore, to insure against interruption of transformer service, it is necessary to secure insulation.

Type A insulation is close to perfection, with efficiency and regulation above the average of other transformers.

FORT WAYNE ELECTRIC WORKS
WOOD LIGHTING & POWER SYSTEMS
Fort Wayne, Ind.

WE shall be glad to supply any of the books catalogued below upon receipt of your order and remittance. We prepay charges.

THE PRINCIPLES OF THE TRANSFORMER. By Frederick Bedell	$3.25
INDUCTION COILS. By G. E. Bonney	1.00
ELECTRICITY AND MAGNETISM. By S. R. Bottone	.90
ELECTRICITY, ELECTROMETER, MAGNETISM AND ELECTROLYSIS. By G. Chrystal and W. N. Shaw	1.60
THEORY OF ELECTRICITY. By L. Cumming	2.25
THEORY OF ELECTRICITY AND MAGNETISM. By Charles Emerson Curry	2.50
THE ELEMENTS OF ALTERNATING CURRENTS. By W. S. Franklin and R. B. Williamson	2.50
PRACTICAL EXERCISES IN MAGNETISM AND ELECTRICITY. By H. E. Hadley	.60
MISCELLANEOUS PAPERS. By Heinrich Hertz	3.25
A TEXT-BOOK ON ELECTROMAGNETISM AND THE CONSTRUCTION OF DYNAMOS. By Dugald C. Jackson	2.25
ALTERNATING CURRENTS AND ALTERNATING CURRENT MACHINERY. By D. C. Jackson and John Price Jackson	3.50
AN ELEMENTARY BOOK ON ELECTRICITY AND MAGNETISM AND THEIR APPLICATIONS. By D. C. Jackson and John Price Jackson.	1.40
A FIRST-BOOK OF ELECTRICITY AND MAGNETISM. By W. P. Maycock	.60
ALTERNATING CURRENTS OF ELECTRICITY AND THE THEORY OF TRANSFORMERS. By Alfred Still	1.50
PRACTICAL ELECTRIC LIGHT FITTING. By A. C. Allsop	1.50
ELECTRICAL EXPERIMENTS. By G. E. Bonney	.75
RADIOGRAPHY AND THE "X" RAYS IN PRACTICE AND THEORY. By S. R. Bottone	1.00
THE DYNAMO: HOW MADE AND HOW USED. By S. R. Bottone	.90
HOW TO MANAGE THE DYNAMO. By S. R. Bottone	.60
A GUIDE TO ELECTRIC LIGHTING. By S. R. Bottone	.75
ELECTRIC LIGHT ARITHMETIC. By R. E. Day	.40
THE DYNAMO: ITS THEORY, DESIGN AND MANUFACTURE. By C. C. Hawkins and F. Wallis	3.00
THE ALTERNATING CURRENT CIRCUIT. By W. P. Maycock	1.00
ELECTRIC WIRING FITTINGS, ETC. By W. P. Maycock	1.75
ELECTRIC WIRING TABLE. By W. P. Maycock	1.50
A MANUAL OF TELEPHONY. By W. H. Preece and A. J. Stubbs	4.50
PRACTICAL TELEPHONE HANDBOOK AND GUIDE TO THE TELEPHONIC EXCHANGE. By Joseph Poole	1.50
ELECTRIC WIRING. By Russell Robb	2.50
ELECTRIC LIGHT CABLES AND THE DISTRIBUTION OF ELECTRICITY. By Stuart A. Russell	3.00
ELECTRICITY IN TOWN AND COUNTRY HOUSES. By Percy E. Scrutton	1.00
THE STORAGE BATTERY. By Augustus Treadwell	1.75

Electrician Publishing Company
510 Marquette Building, Chicago

Good Advice

No. 14

One of the foremost doctors of electrical engineering was recently called upon to examine into the ills of a profitless direct-current light and power plant and, after making a diagnosis, he immediately prescribed Duncan Meters, with instructions that the remedy should be continued indefinitely to prevent a recurrence of the malady.

Good Advice No. 15 Next Week

Send for Bulletin and Prices

DUNCAN ELECTRIC MFG. CO.
LAFAYETTE, IND.

DIRECT CURRENT

GENERATORS

FOR LIGHT AND POWER

Our generators have a high efficiency and great endurance under the most exacting conditions of service. Sizes up to 1,000 K W.
Write for bulletin No. 10514.

SPRAGUE
ELECTRIC COMPANY
General Offices:
527 West 34th Street, New York
Chicago Office: Fisher Building

VULCANIZED FIBRE

Highest grades for electrical insulation and mechanical purposes, in sheets, tubes, rods and special shapes. Catalogues and samples on application.

VULCANIZED FIBRE CO., - Wilmington, Del.

Motor Starter with Automatic Release. Manufactured under our own patents.

MOTOR STARTERS, SPEED REGULATORS, FIELD REGULATORS

And Special Controlling Devices of all kinds. Send for catalogue and discounts.

UNION ELECTRIC MFG. CO.,
Milwaukee, Wis.

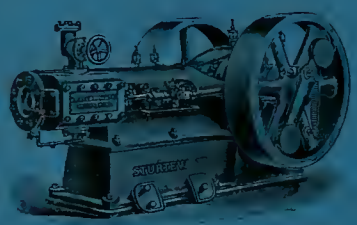
SWITCHBOARDS

Prices on the spot land orders—with good goods.

Engineers and contractors will find our Hand Book, 117 W, a great convenience.

THE F. BISSELL COMPANY
BUILDERS OF SWITCHBOARDS
TOLEDO, O.

10,000
STURTEVANT ENGINES



Are in use throughout the world.

We build all types and sizes from 2 to 400 H. P.

B. F. STURTEVANT CO.
BOSTON, MASS.
General Works and Office, HYDE PARK, MASS.
New York Philadelphia Chicago London
357

Warren Alternator

NINETY-NINE PER CENT.

of thought goes into the making of the Warren Alternator to render it efficient, reliable and easy to care for.

WE GUARANTEE WHAT WE SELL
and
SELL WHAT WE GUARANTEE

WARREN ELECTRIC MFG. CO.
Sandusky, O.

Black Diamond File Works

Est. 1863. Inc. 1895.

Twelve Medals Awarded at International Expositions

Special Prize Gold Medal at Atlanta, 1895.

OUR GOODS ARE ON SALE IN EVERY LEADING HARDWARE STORE IN THE UNITED STATES AND CANADA.

G. & H. BARNETT COMPANY,
PHILADELPHIA, PA.

JOHN A. ROEBLING'S SONS CO.

Insulated Wire of All Kinds

Bare Copper Wire

MAIN OFFICE AND WORKS TRENTON, N. J.

AGENCIES AND BRANCHES
New York Chicago Cleveland San Francisco Philadelphia Atlanta

Western Electrician

Vol. XXXV. $3.00 Per Annum. Copyright, 1904, by Electrician Publishing Company, Chicago. CHICAGO, NOVEMBER 12, 1904. 10 Cents a Copy. No. 20.

SIMPLEX INSULATED WIRES AND CABLES.
RUBBER COVERED, WEATHERPROOF, UNDERGROUND AND SUBMARINE.
WESTERN SELLING AGENT: H. A. HIXSON, 1154 Monadnock Block, CHICAGO.
The Simplex Electrical Co., 110 State Street, BOSTON, MASS.

CHICAGO ... D WIRE CO.
... HICAGO
1108-1110 PINE ST. ... LOUIS, MO.
Bare and Insulated Wires and Cables
Galvanized Steel Strands

OKONITE
TRADE MARK
1889—Paris Exposition, Medal for Rubber Insulation.
1893—World's Fair, Medal for Rubber Insulation.
THE STANDARD FOR RUBBER INSULATION.
Sole Manufacturers of
Okonite Wires, Okonite Tape, Manson Tape, Candee Weather-proof Wires.
THE OKONITE CO., LTD.
Willard L. Candee, Durant Cheever, Managers. 253 Broadway, New York. Geo. T. Manson, Gen'l Supt. W. H. Hodgins, Secy.

CRESCENT INSULATED WIRE & CABLE CO. TRENTON, N.J.
CRESCENT RUBBER INSULATED WIRES AND CABLES
National Code Standard.
CRESCENT INSULATED WIRE AND CABLE CO.,
New York Office, 63 BARCLAY STREET. Main Office and Factory, TRENTON, N. J.

STANDARD UNDERGROUND CABLE CO.
322 The Rookery, Chicago. Westinghouse Bldg., Pittsburg. 56 Liberty St., New York City. 1225 Betz Bldg., Philadelphia, Pa.
Crossley Bldg., San Francisco. 10 Post Office Square, Boston.
BARE AND WEATHERPROOF WIRES AND CABLES.
Rubber Covered Wires and Cables. Underground Cables for all Purposes.

INDIANA RUBBER AND INSULATED WIRE CO.,
MANUFACTURERS OF
Paranite Rubber Covered Wires and Cables,
UNDERGROUND, AERIAL, SUBMARINE AND INSIDE USE:
TELEPHONE, TELEGRAPH AND FIRE ALARM CABLES.
All Wires are tested at Factory. JONESBORO, IND.

"CIRCULAR LOOM" THE FLEXIBLE CONDUIT
AMERICAN CIRCULAR LOOM CO. TRADE MARK REGISTERED
CONDUITS FOR INTERIOR WIRING.
American Circular Loom Co.
Chelsea, Mass., New York, Chicago, San Francisco.

SAUQUOIT SILK MFG. COMPANY
INSULATING and BRAIDING SILKS
MILLS:
BETHLEHEM, PA.
PHILADELPHIA, PA.
SCRANTON, PA.
NEW YORK REPRESENTATIVES:
WILLIAM RYLE & COMPANY
54 Howard St.
PHILADELPHIA OFFICE:
4015 Clarissa St.
CHICAGO OFFICE:
210 Monroe St.
BOSTON OFFICE:
78 Chauncy St

THOUSANDS IN USE.
Motors, ¼ h. p. to 100 h. p.
Dynamos, 1 k. w. to 75 k. w.
Highest Quality. Reasonable Price.
THE HOBART ELECTRIC MFG. CO.
TROY, OHIO.

Electric Heating Apparatus
SEND FOR 62-PAGE CATALOGUE.
UNIT" ENAMELED RHEOSTATS
SIMPLEX ELECTRIC HEATING CO.,
Cambridgeport, Mass.

THE PHOENIX GLASS CO. Pittsburg New York Chicago
Manufacturers of
Electric Globes and Shades, both Arc and Incandescent
Inner and Outer Globes for all enclosed arc systems
CATALOGUES SENT ON REQUEST

ELECTRIC SIGN FLASHERS
BEST IN THE WORLD
Write for full particulars
Reynolds Elec. Flasher Mfg. Co.
221 Fifth Ave., Chicago.

Cope's Patent Quick Coupling Conduit Rod
Remember these rods have no lost motion.
These Couplings are of Steel and are made in the best possible manner.

Write for list of persons using these rods—26,000 sold since May 1902. Made in 3 ft. and 4 ft. lengths.
Price, 3 ft. 75 cents, 4 ft. 85 cents.
Patented February 24, 1903.
T. J. COPE
3244 North Fifteenth Street PHILADELPHIA, PA.

THERMOPILES 1½ VOLTS 1½ AMPERES
For Electrolytic analysis, charging storage batteries, and other constant current requirements. $3 Each.
WALSH'S SONS & CO.
264 Washington Street. Newark, N. J.

H. M. FENNER, President J. F. BLAUVELT, Agent RUSSELL W. KNIGHT, Treasurer
NEW ENGLAND BUTT COMPANY
MANUFACTURERS OF
Machinery for Insulating Electrical Wires
Braiding, Taping, Winding, Cabling, Stranding, Polishing and Measuring Machines. Cable Covering Braiders
FINE CASTINGS A SPECIALTY
304 PEARL STREET, - - - PROVIDENCE, R. I., U. S. A.

WESTON Electrical Instrument Co.,
Waverly Park, NEWARK, N. J.

Weston Standard Portable Direct Reading Wattmeter.
The Weston Standard Portable Direct Reading
Voltmeters and Wattmeters
—FOR—
Alternating and Direct Current Circuits
Are the only standard portable instruments of the type deserving this name. Write for circular and price lists.
BERLIN: European Weston Electrical Instrument Co., No. 88 Ritterstrasse.
LONDON: Elliott Bros., Century Works, Lewisham.
PARIS, FRANCE—E. H. Cadiot, 12 Rue St. Georges.
NEW YORK OFFICE—74 Cortlandt St.

GIVES BEST RESULTS

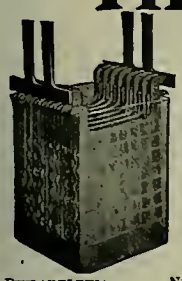
Northwestern Storage Battery
Cannot be equaled for
Great Capacity, Lightness and Efficiency
LOW TENSION WORK
Write for Catalogue.
Northwestern Storage Battery Co.,
285 Madison Street, - - - - Chicago, Ill.

Have you read it?

Free
Send for it

Canadian Representatives, Allis-Chalmers-Bullock, Ltd., Montreal

THE ELECTRIC STORAGE BATTERY CO.



PHILADELPHIA

MANUFACTURER OF THE

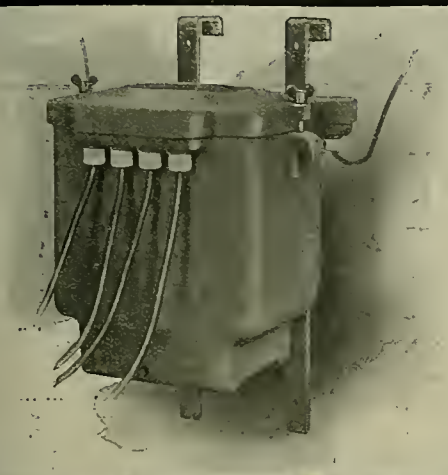
"Chloride Accumulator"

For Central Stations, Electric Railways, Isolated Lighting and Power Stations, Fire Alarm, Telegraph, Train Lighting, etc., etc.

PRICE LISTS AND DESCRIPTIVE BULLETINS FORWARDED UPON REQUEST.

SALES OFFICES:

PHILADELPHIA, Allegheny Ave. and 19th St. | NEW YORK, 100 Broadway, | BOSTON, 60 State St. | CHICAGO, Marquette Bldg. | ST. LOUIS, Wainwright Bldg. | SAN FRANCISCO, Rialto Bldg. | CLEVELAND, Citizens Bldg. | CANADA, Canadian General Electric Co., Ltd. Toronto | HAVANA, CUBA, G. F. Greenwood, Manager 34 Empedrado St.



THE B. O. TRANSFORMER

Do you expect to need new transformers this fall? If you do, the B. O. will interest you.

Low Losses
High Efficiencies
High Insulation
Low Price.

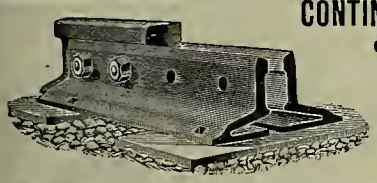
Are you familiar with oil duct transformers?
Send us your address and we will tell you about our insulation and the advantages of slab windings in connection with oil ducts.

THE STANLEY ELECTRIC MANUFACTURING COMPANY
PITTSFIELD, MASSACHUSETTS

Atlanta, Ga., Empire Building
CHICAGO, ILL., MONADNOCK BLOCK
New York, N. Y., 29 Broadway
St. Louis, Mo., Century Bldg.
Boston, Mass., Oliver Building
Denver, Col., Hendrie & Bolthoff Mfg. & Supply Co.
Philadelphia, Pa., North American Building
San Francisco, Cal., 69-75 New Montgomery St.
Seattle, Wash., Pioneer Bldg.

Representatives for the Dominion of Canada, THE CANADIAN GENERAL ELECTRIC CO. of Toronto

"THE S. K. C. SYSTEM"



CONTINUOUS RAIL JOINT CO. OF AM.

GENL. OFFICES: CENTURY BLDG., NEWARK, N.J.

OVER 20,000 MILES IN USE

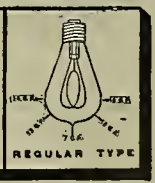
See our exhibit, World's Fair, St. Louis, Mo., Transportation Bldg., Aisle "C," Posts 7 and 8.

DO YOU?

BUY LAMPS-OR-BUY CANDLE POWER

16 {THIS LAMP AVERAGES} 12

THE STERLING ELECTRICAL MANUFACTURING CO.
NEW YORK, N. Y. WARREN, O. CHICAGO, ILL.



PLATINUM

PLATINUM RIVETS FOR CONTACT POINTS IN TELEPHONES—SPARK COILS AND OTHER ELECTRICAL APPARATUS. PLATINUM SHEET AND WIRE IN ANY FORM AND DEGREE OF HARDNESS. PLATINUM SCRAP PURCHASED.

BAKER & COMPANY, Inc.

ARTISANS IN PLATINUM

408-410-412-414 N. J. R. R. AVE. - NEWARK, N. J.

New York Office: 120 Liberty St.

ALPHABETICAL INDEX TO ADVERTISEMENTS.

Adams-Bagnall Electric Co...—
Allis-Chalmers Company..... 2
American Battery Co.....—
Amer. Circular Loom Co.... ...1
American Conduit Co.....16
Amer. District Steam Co.....18
Amer. Elec. Fuse Co..... 4
Amer. El. Telephone Co.....17
American Electrical Works..11
Arnold Elec. Power Station Co.....15
Audit Co. of Ill., The..... 5
Automatic Electric Co..... 17

Babcock & Wilcox Co.....—
Badt, F. B.....15
Bain, Forée.....11
Baker & Company..... 3
Baker & Co., W. E.....15
Barnett Company, G. & H....22
Beardslee Chandelier Mfg. Co.....10
Benjamin Electric Mfg. Co...—
Bennett, I. A..... 5
Berthold & Jennings.....18
Big Four Route.....—
Bissell Co., The F.....22
Bossart Electric Construction Co..... 8
Brooks, Hall L.....19
Bryan-Marsh Co.....—
Bryan, Wm. H.....15
Buckeye Electric Co.....—
Bullock Elec. Mfg. Co..... 2
Burlington R. R.....12
Butterfield, J. F.....—
Byllesby & Co., H. M.....15

Cantwell Press, The.....17
Carhartt & Co., Hamilton....—
Central Electric Co..... 5
Cent. Stat. Improvement Co.....12
Central Tel. & El. Co.....—
Century Electric Co.....—
Chicago Dia & Electric Co....—
Chicago Edison Co.....4, 12
Chic. Fuse Wire & Mfg. Co...10
Chicago Insulated Wire Co.. 1
Chicago Mica Co.....10
Clinton Stamping & Elec Co. 8
Columbia Incaod. Lamp Co.. 7
Columbia Mfg. Co.....18
Continuous Rail Joint Company of America..... 3
Cooper-Hewitt Elec. Co..... 8
Cope, T. J..... 1
Crawfordsville Electric Co..12
Crescent Ins. Wire & Cbl. Co. 1
Crocker-Wheeler Company... 4
Cutler-Hammer Mfg. Co.....10
Cutter Elec. & Mfg. Company—

D. & W. Fuse Company.....—
Dearborn Drug & Chem. Wks.14
Diamond Meter Company....—
Dielectric Manufacturing Co.11
Directory of Engineers..... 15
Dixon Crucible Co., Joseph..14
Duncan Elec. Mfg. Co.....21

Edison Decorative & Miniature Lamp Departm't.....10
Edison Mfg. Company..... 8
Edwards & Co.....11
Egan, J. J.....11
Electric Appliance Co..... 10
Electric Storage Battery Co.. 3
Electrical Appliance Co..... 6
Electrical Engineer Institute.—
Electrician Pub. Company...15
Erie Ry.....19
Evans, Almirall & Co..... ..15

Faries Mfg. Co..... 6
"For Sale" Advertisements..12
Ft. Wayne Elec. Works, Inc..21
Fostoria Incand. Lamp Co...—
Fowler, John H.....19
Fowler-Jacobs Company.....19
Franklin Elec. Mfg. Co .....—

General Electric Co..... 9
General Engineering Co., The 15
General Incandescent Arc Light Company.....—
General Incand. Lamp Co....—
Gould Storage Battery Co....—
Green Fuel Economizer Co...—
Gregory Electric Company...12

Hallberg, J. H 15
Haller Machine Co.....—
Hart Mfg. Co.....22
Hartford Steam Boiler Inspection & Insurance Co....14
Hazard Manufacturing Co...22
Highland Park College. ... 12
Hipwell Mfg. Co..... .... —
Hobart Elec. Mfg. Co..... 1
Hoffman, G. W.....12
Holmes Fibre-Graph. Co.....14
Holophane Glass Co.....—
Humphrey, Henry H.....—
Hunt & Co., Robt. W.....15

Illinois Central Ry.....12
Incandescent Electric Light Manipulator Company.....—
Indiana Bub. & Ins. W. Co.... 1
India Rubber & Gutta Percha Insulating Company.....19
International Elec. Meter Co 12
International Tel. Mfg. Co...16
Jackson, D. C. & W. B.....15
Jeffrey Manufacturing Co....14
Jewell Electrical Inst. Co....—
Johns-Manville Co., H. W.....—

Kartavert Manufacturing Co.22
Kellogg Switchboard & Supply Company.....16, 18
Kemp, R. W.....15
Kester Elec. Mfg. Co..... 9
Klein & Sons, Mathias..... 10
Kohler Brothers.....15
Kuhlman Electric Co.....10

Leather Preserv. M. Corp....—
Leffel & Co., James.....14
Lindsley Brothers Company..19
Loud's Sons Co., H. M.....18

Machado & Roller.....—
Maltby Cedar Company.....19
Manhattan El. Supply Co....12
Manross, F. N..... 12
Marinette Gas Engine Co.....14
Matthews & Bros., W. N.....11
McLaughlin, James..... .....—
McLaughlin & Co., Jas.....11
McLennan & Company, K....10
Measured Service Co.....—
Mechanical Appliance Co....—
Mica Insulator Company.....10
Minnesota Electric Co.....—
Miscellaneous Advs.....12
Monon Railroad..... .. ..—
Morrison Lbr. Co., J. W.....—
Mueller Company, William..18
Munsell & Co., Eugene.....10

National Electric Co.....13
National India Rubber Co....—
New England Butt Co..... 1
Newgard & Co., Henry.....12
New York Cent. Ry.....19
New York Ins. Wire Co.....11
Northern Elect'l Mfg. Co.... 5
Northern Wire & Cable Co....—
Northwestern Storage Battery Co.. 1

Okonite Co., The..... 1
Olds Gasoline Engine Works.14
Oshura Flexible Conduit Co. 5

Pacific Coast Pole Co.....19
Paragon Fan & Motor Co.....—
Pardridge Shade & Refl. Co..—
Pass & Seymour, Inc.....—
Phelan, D. W.....18
Phillips, Eugene F.....11
Phillips Insulated Wire Co...11
Phœnix Glass Co..... 1
Phosphor-Bronze S. Co.....14
Pignolet, L. M.....10
Pittsburg & L. S. Iron Co....19
Plume & Atwood Mfg. Co....—
Porter Cedar Company.....18

Reisinger, Hugo..... 9
Reynolds El. Flasher Mfg. Co. 1
Roehling's Sons Co., J. A.....22
Ruebel-Schwedtmann-Wells..15
Runzel-Lenz Elec. Mfg. Co...17

Safety Ins. Wire & Cable Co..10
Sargent & Lundy.....—
Sauquoit Silk Mfg. Co..... 1
Schott, W. H.....15
Signaloid Chemical Works...—
Simplex Electrical Co., The.. 1
Simplex Elec. Heating Co.... 1
Speer Carbon Co..... . 5
Sprague Electric Company... 9
Squire Electric Co.....15
Standard Elec. Mfg. Co.....11
Standard Underg. Cable Co.... 1
Stanley Elec. Mfg. Co., The 3
Stanley Instrument Co..... 5
Stanton, LeRoy W..... 15
Sterling & Son, W. C.....18
Sterling Electrical Mfg. Co.... 3
Sterling Varnish Co., The.... 8
Stow Mfg. Company.....11
Stromberg-Carlson Tel. Mfg. Company.....16
Sturtevant Company, B. F...22

Temple Pump Co.....—
Torrey Cedar Company.....19
Trumbull Elec. Mfg. Co.....—
Turner Brass Works.....—

Union Electric Mfg. Co.....—

Valentine-Clark Co., The....19
Vulcanized Fibre Company..22

Wagner Electric Mfg. Co.....—
Walsh's Sons & Company..... 1
Warren Elec. Mfg. Co.....22
Wesco Supply Co.....—
Western Electric Company... 4
Westinghouse Electric & Manufacturing Co.....20
Weston Electrical Inst. Co... 1
Whitehead Machinery Co... —
Whitney Electrical Inst. Co..—
Wilmerding, C. H.....15
Wisconsin Central Ry.....18
Woolley Fdy. & Mach. Wks...—
Worcester Company, C. H....18

Yesbera Mfg. Co..... .. —
Yost Electric Mfg. Co 9

Zero Marx Sign Works 11

For Classified Index of Advertisements See Page 6.

Motors, Switches, Arc Lamps, Circuit Breakers, Etc., Etc.

ALWAYS IN STOCK.

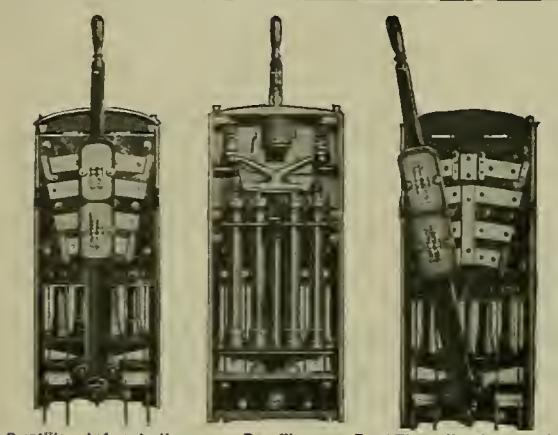
MANUFACTURED BY

G. I. Co.

CHICAGO EDISON COMPANY, 139 Adams Street, CHICAGO.

Allen-Bradley Electric Crane Controllers

Patented



Front View—before starting Rear View Front View—all resistance out

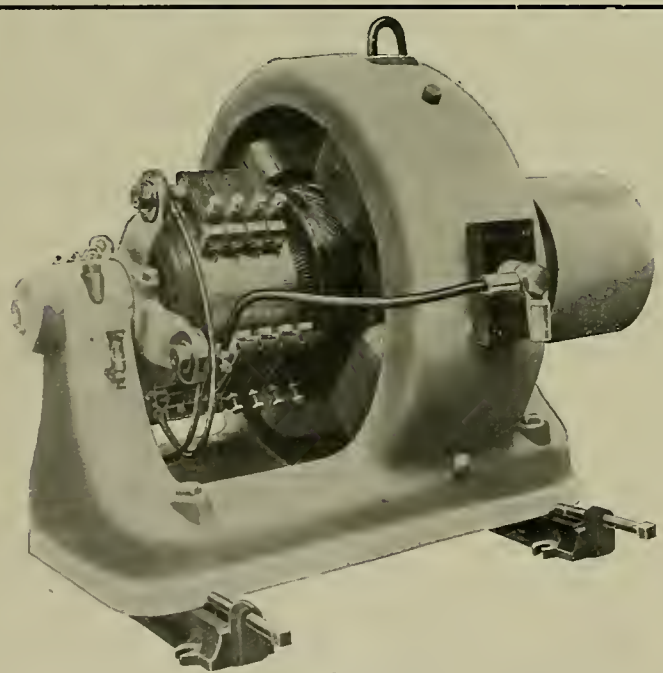
Manufactured by AMERICAN ELECTRIC FUSE CO., Chicago

A New Controller. Positively No Sparking. No Repairs. Guaranteed for One Year. Three Months' Free Trial. Perfect Control.

OUR GUARANTEE: Ask any Other Manufacturer to Duplicate It.

THE AMERICAN ELECTRIC FUSE COMPANY hereby guarantees to..... that it will at any time within three months from this date upon demand repay to said..... the sum of..... .....Dollars, being the full purchase price paid (or agreed to be paid) by said..... to the American Electric Fuse Company for one..... horsepower Allen-Bradley Crane Controller, number.....upon delivery within three months after this date of said controller, freight prepaid and in good condition, ordinary wear and tear from use excepted, at the office of the American Electric Fuse Company, Chicago, Illinois, together with a written statement that said controller has proved unsatisfactory to said .....

FURTHERMORE, the said American Electric Fuse Company agrees that it will at any time within one year from this date replace, without charge, any part of said controller which may prove defective or wear out during the ordinary use of said controller, provided that it is a condition of this guarantee that said..... hereby agrees to use ordinary care in the operation of said controller, and that said controller will be operated by some person, or persons, familiar with the use of crane controllers, and further that said controller will not be wilfully or maliciously injured while in the possession of said.....



TYPE "G"

DIRECT CURRENT

GENERATORS and MOTORS

BULLETINS ON REQUEST

Western Electric Company

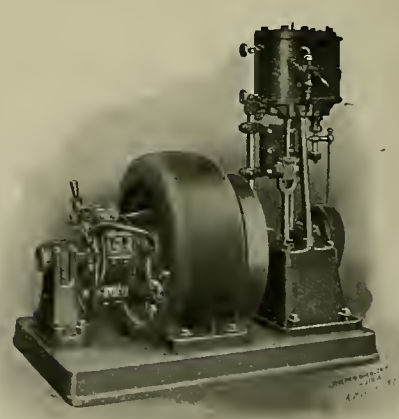
CHICAGO NEW YORK

Other Large Cities

Space 17 Electricity Building, Louisiana Purchase Exposition

Small Units in Electric Generating Sets.

Write for our estimates and prices.



Crocker-Wheeler Company

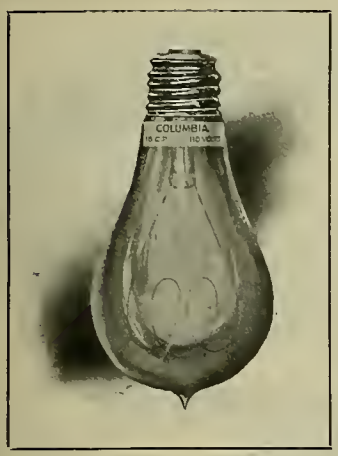
Manufacturers of

Generators and Motors

Electrical Engineers

AMPERE, N. J.

Branch Offices in Sixteen Principal Cities



COLUMBIA LAMPS

The cheapest way to buy Columbia Lamps is under yearly contract. A postal card will bring one of our proposal forms. Shall we send one?

OHONITE IT NEVER DISAPPOINTS

Central Electric Company,

ELECTRICAL SUPPLIES

264-266-268-270 FIFTH AVENUE, CHICAGO.

OHONITE IT NEVER DISAPPOINTS

SPEER HIGH GRADE CARBON BRUSHES

MOTOR AND GENERATOR CARBON BRUSHES

SPEER CARBON CO., - St. Marys, Pa.

OFFICERS.

L. A. WALTON, President. F. W. LITTLE, Vice-President.
C. D. ORGAN, Sec'y and Treasurer.

DIRECTORS.

A. G. BECKER. A. G. Becker & Co., Chicago.
F. W. LITTLE, Vice-Pres. Peoria Gas & Electric Co., Peoria.
G. A. RYTHER, Cashier National Live Stock Bank, Chicago.
J. R. WALSH, President Chicago National Bank, Chicago.
L. A. WALTON, Vice-Pres. The Equitable Trust Co., Chicago.

C. W. KNISELY, Manager.

THE

AUDIT COMPANY OF ILLINOIS

635-642 Marquette Building, Chicago.

Public Accountants and Auditors

Regular and Special Audits for Corporations, Firms and Individuals.
Financial and Physical Examinations by Experienced Auditors and Engineers.
Takes Entire Charge of Accounts for Guardians, Trustees, Executors and Receivers.

ECONOMICAL ELECTRIC LIGHTING

219

NORTHERN DYNAMOS

SIMPLE COMPACT

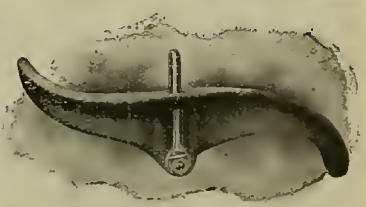
We build them for direct connection to any type of engine, or to be driven by belt. Northern Apparatus readily adapted to any service

Bulletin No. 2530

NORTHERN ELECTRICAL MFG. CO., - Madison, Wis., U. S. A.
Engineers Manufacturers

ANCHORS

That are cheaper to install because of the simple method of burying and the great strain that can be applied—**American Bull-Tongue Anchors** reduce the cost of the process of guying a pole by reduction in labor, they **stay solid,** they do not slip—no take up required. 21 cents worth holds 8,713 pounds, 42 cents worth holds 10,521 pounds, other money's worth in proportion.



I. A. BENNETT,
529 and 530 Monadnock Block - - - CHICAGO

ELECTRICITY FOR ENGINEERS.

424 PAGES. ILLUSTRATED. PRICE $2.50.

ELECTRICIAN PUBLISHING CO.,
510 Marquette Building, CHICAGO

STANLEY RECORDING WATTMETERS

FOR ALTERNATING-CURRENT CIRCUITS

BALANCED THRUST

No Jewel Wear from Hammer or Side Thrust. Class or Metal Covers, Second Alone to the

STANLEY MAGNETIC SUSPENSION WATTMETERS

Missouri, Kansas, Arkansas
FRANK ADAM ELECTRIC CO.
St. Louis

Colorado, Idaho, Montana, Wyoming
New Mexico, Utah
HENDRIE-BOLTHOFF MFG. AND SUPPLY CO.
Denver

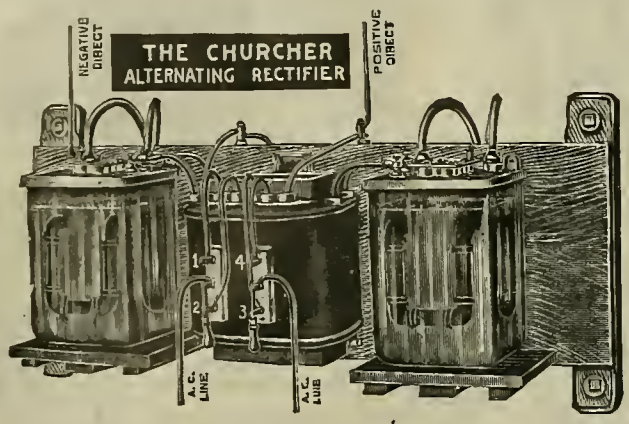
SEND FOR BULLETINS AND INFORMATION ABOUT METERS TO

STANLEY INSTRUMENT CO.

GREAT BARRINGTON MASS., U. S. A.

Mexico
VICTOR M. BRASHI & CO.
Mexico City

California, Oregon, Washington
Nevada, Arizona
BROOKS-FOLLIS ELECTRIC CORP.
San Francisco



CHURCHER ALTERNATING-CURRENT RECTIFIER

will not only transform any cycle of alternating current into direct current, but will, at the same time, if desired, convert the potential of the direct current produced to a higher or lower voltage.

SOLD ON 30 DAYS' APPROVAL

Cheaper to install and operate than a motor generator. Very slight renewal costs. **Guaranteed net efficiency of 50 per cent.** Full particulars in Bulletin No. 18.

THE ELECTRICAL APPLIANCE CO.

CINCINNATI, OHIO

CLASSIFIED INDEX OF ADVERTISEMENTS.

Accountants and Auditors.
Audit Co. of Illinois

Adjusters, Cord.
Incandes. El. Lt. Manip. Co.

Adjusters, Inc. Lamps.
Inc. El. Lt. Manipulator Co.

Anchors (Tel. & Tel.)
Bennett, I. A.
Matthews & Bro., W. N.

Annunciators.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Moon Mfg. Co.
Wesco Supply Co.
Western Electric Co.

Batteries and Jars.
Bissell Co., The F.
Central Electric Co.
Edison Mfg. Co.
Edwards & Company.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.

Bells, Buzzers, Etc.
Central Electric Co.
Edwards & Co.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.

Belt Dressing.
Dixon Crucible Co., Jos.
Leather Preserver Mfg. Corp.

Belting.
Leather Preserver Mfg. Corp.

Blow Pipes.
Turner Brass Works

Blowers.
Sturtevant Co., B. F.

Boiler Compounds.
Dearborn Drug & Chem. Wks.

Boilers.
Allis-Chalmers Company.
Babcock & Wilcox Co.

Books, Electrical.
Cantwell Press, The.
Electrician Publishing Co.

Booths, Telephone.
Yesbera Mfg. Co.

Brackets.
Faries Mfg. Co.

Brushes.
Central Electric Co.
Hobart Elec. Mfg. Co.
Holmes Fibre-Graphite Co.
Speer Carbon Co.
Western Electric Company.

Cable Hangers.
Bissell Co., B. F.
Western Electric Co.

Cables (See Wires and Cables)

Canopies.
Faries Mfg. Co.

Carbons, Points and Plates.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
Reisinger, Hugo.
Speer Carbon Co.
Wesco Supply Co.

Castings.
Faries Mfg. Co.
New England Butt Co.
National Electric Co.

Chains.
Jeffrey Mfg. Co.

Chandeliers.
Faries Mfg. Co.

Circuit Breakers.
Cutler-Hammer Mfg. Co.
Cutter Elec. & Mfg. Co.
Ft. Wayne Elec. Wks. Inc.
Union Electric Mfg. Co.
Western Electric Company.
Westinghouse El. & Mfg. Co.

Clusters.
Benjamin Elec. Mfg. Co.
Faries Mfg. Co.

Coal and Ashes Handling Machinery.
Jeffrey Mfg. Co.

Coils and Magnets.
Western Electric Co.

Coloring, Lamp.
Signaloid Chemical Works.

Commutator Compound
Egan, J. J.
McLaughlin & Co., Jas.
McLennan & Co., K.

Condensers, Electric.
Stanley Elec. Mfg. Co.

Conduit and Conduits.
American Circular Loom Co.
American Conduit Company
Central Electric Co.
Electric Appliance Co.
Osburn Flexible Conduit Co.
Sprague Electric Co.
Standard Vitrified Cond. Co.
Wesco Supply Co.

Contractors and Electric Light Plants.
Allis-Chalmers Company.
Bullock El. Mfg. Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
National Electric Co.
Northern Electrical Mfg. Co.
Sprague Electric Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Controllers, Crane.
Amer. Elec. Fuse Co.

Cord.
Runzel-Lenz Elec. Mfg. Co.

Cross-Arms, Pins and Brackets.
Berthold & Jennings.
Central Electric Co.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Company.

Cut-Outs and Switches.
Bissell Co., The F.
Bossert Elec. Const. Co.
Central Electric Co.
Chicago Edison Co.
Clinton Stamping & Elec. Co.
Crouse-Hinds Co.
Cutter Elec. & Mfg. Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
General Inc. Arc Light Co.
Hart Manufacturing Co.
Manhattan Elec. Supply Co.
Trumbull Elec. Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Dynamos and Motors.
Allis-Chalmers Company.
Bissell Co., The F.
Bullock Elec. Mfg. Co.
Central Electric Co.
Century Electric Co.
Crawfordsville Electric Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks. Inc.
General Elec. Co.
General Inc. Arc Light Co.
Gregory Electric Co.
Hobart Elec. Mfg. Co.
Mechanical Appliance Co.
National Electric Co.
Northern Electrical Mfg. Co.
Sprague Electric Co.
Stanley Elec. Mfg. Co.
Stow Manufacturing Co.
Sturtevant Co., B. F.
Wagner Electric Mfg. Co.
Warren Elec. Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Economizers, Fuel.
Green Fuel Economizer Co.

Electric Heating Appl.
Electric Appliance Co.
Simplex Elec. Heating Co.
Western Electric Co.

Electric Railways.
Crocker-Wheeler Co.
General Electric Co.
Sprague Electric Co.
Westinghouse El. & Mfg. Co.

Electrical and Mechanical Engineers.
Arnold Elec. Power Stat'n Co.
Badt, F. B.
Baker & Co., W. E.
Bryan, Wm. B.
Butterfield, J. F.
Byllesby & Co., H. M.
Evans, Almirall & Co.
General Engineering Co., The.
Hallberg, J. B.
Humphrey, Henry H.
Hunt & Co., Robt. W.
Jackson, D. C. & W. B.
Kemp, R. W.
Kohler Brothers.
McLaughlin, James
Newgard & Co., Henry.
Northern Electrical Mfg. Co.
Ruebel, Schwedtman, Wells.
Sargent & Lundy.
Schott, W. H.
Squire Electric Co.
Stanley Elec. Mfg. Co.
Stanton, LeRoy W.
Wilmerding, C. H.

Electrical Instruments.
(Recording and Testing.)
Bissell Co., The F.
Central Electric Co.
Diamond Meter Co.
Duncan Elec. Mfg. Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
General Inc. Arc Light Co.
Jewell Electrical Inst. Co.
Machado & Roller.
Pignolet, L. M.
Stanley Elec. Mfg. Co.
Stanley Instrument Co.
Wagner Electric Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co
Weston Electrical Inst. Co.
Whitney Electl. Inst. Co.

Electro-Plating Mach'y
Crocker-Wheeler Company.
General Electric Co.

Elevators-Conveyors.
Jeffrey Mfg. Co.

Engines, Gas and Gasoline.
Allis-Chalmers Company.
Marinette Gas Engine Co.
Olds Gasoline Engine Works.
Temple Pump Co.
Woolley Fdy. & Mach. Wks.

Engines, Steam.
Allis-Chalmers Company.
Sturtevant Co., B. F.

Fans and Fan Motors.
Central Electric Co.
Crocker-Wheeler Company.
Edison Mfg. Co.
General Electric Co.
General Inc. Arc Light Co.
Sprague Electric Co.
Sturtevant Co., B. F.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Fibre.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Files.
Barnett Co., G. & H.

Fittings.
Faries Mfg. Co.

Fixtures, Gas and Elec.
Beardslee Chandelier Mfg. Co.

Finishers.
Bissell Co., The F.
Haller Machine Co.
Reynolds El. Flasher Mfg. Co

Flexible Shafts.
Stow Mfg. Co.

Forges.
Sturtevant Co., B. F.

Fuses and Fuse Wire.
Amer. Elec. Fuse Co.
Bissell Co., The F.
Central Electric Co.
Central Tel. & El. Co.
Chicago Die & Electric Co.
Chicago Fuse Wire & Mfg. Co.
Clinton Stamping & Elec. Co.
D. & W. Fuse Company.
Electric Appliance Co.
Johns-Manville Co., H. W.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Company.

Globes, Reflectors and Shades.
Fostoria Incan. Lamp Co.
Haller Machine Co.
Holophane Glass Co.
Pardridge Shade & Refl. Co.
Phœnix Glass Co.
Wesco Supply Co.
Western Electric Co.

Graphite Specialties.
Dixon Crucible Co., Jos.
Holmes Fibre-Graphite Co.

Heating (Exhaust Steam).
Amer. District Steam Co.

Heating and Ventilating Apparatus.
Sturtevant Co., B. F.

Heating, Hot Water.
Evans, Almirall & Co.

Holders, Inc. Lamps.
Electric Appliance Co.
Incandescent Electric Light Manipulator Co.

Inspection & Insurance
Hartford Steam Boiler Inspection & Insurance Co.

Insulating Machinery.
New England Butt Co.

Insulators and Insulating Materials.
American Electrical Works.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Inc. Arc Light Co.
Indiana Rub. & Ins. Wire Co.
Johns-Manville Co., H. W.
Kartavert Mfg. Co.
Manhattan Elec. Supply Co.
Mica Insulator Co.
Munsell & Co., Eugene.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Standard Vitrified Cond. Co.
Sterling Varnish Co.
Vulcanized Fibre Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Junction Boxes.
Bossert Elect. Const. Co.
General Inc. Arc Light Co.

Lamps, Arc.
Bissell Co., The F.
Central Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
General Inc. Arc Lt. Co.
Gregory Electric Co.
Hipwell Manufacturing Co
Manhattan Elec. Supply Co.
Stanley Elec. Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Lamps, Incandescent.
Bissell Co., The F.
Bryan-Marsh Company.
Buckeye Electric Company.
Central Electric Co.
Chicago Edison Co.
Columbia Incan. Lamp Co.
Edison Decorative & Miniature Lamp Dept.
Electric Appliance Co.
Fostoria Incand. Lamp Co.
Franklin Electric Mfg. Co.
General Electric Co.
General Inc. Arc Light Co.
Standard Elec'l Mfg. Co.
Sterling Electrical Mfg. Co.
Wesco Supply Co.
Western Electric Co.

Lamps, Incandescent—Replacers & Cleaners.
Inc. El. Lt. Manipulator Co.

Lamps, Vapor.
Cooper, Hewitt Elec. Co.

Letters, Metal.
Haller Machine Co.

Lightning Arresters.
Central Electric Co.
Clinton Stamping & Elec. Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
Manhattan Elec. Supply Co.
Minnesota Electric Co.
Stanley Elec. Mfg. Co.
Western Electric Co.

Linemen's Climbers.
Klein & Sons, Mathias.

Magnet Wires.
(See Wires and Cables.)

Measured Service.
Measured Service Co.

Mechanical Draft.
Sturtevant Co., B. F.

Mica.
Chicago Mica Co.
Mica Insulator Co.
Munsell & Co., Eugene.

Mining Apparatus, Elec.
Allis-Chalmers Company.
Crocker-Wheeler Company.
General Electric Co.
Jeffrey Mfg. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Motors. (See Dynamos and Motors.)

Nippers and Pliers.
Klein & Sons, Mathias.

Nozzles.
Faries Mfg. Co.

Overalls.
Carhartt & Co., Hamilton.

Paints.
Dielectric Mfg. Co.

Patent Attorneys.
Bain, Foree.

Phosphor Bronze.
Phosphor Bronze Sm. Co. Ltd.

Platinum, Wire and Sheet.
Baker & Company Inc.

Poles and Ties.
Berthold & Jennings.
Brooks, Hall L.
Columbia Mfg. Co.
Fowler, John H.
Fowler-Jacobs Company.
Kellogg Switch. & Sup. Co.
Lindsley Bros. Co.
Loud's Sons Co., H. M.
Maltby Cedar Co.
Morrison Lbr. Co., J. W.
Mueller Company, William.
Pacific Coast Pole Co.
Phelan, D. W.
Pittsburg & L. S. Iron Co.
Porter Cedar Company.
Sterling & Son, W. C.
Torrey Cedar Co.
Valentine-Clark Co., The.
Worcester Co., C. H.

Polish (Metal).
Allen Co., Inc., L. B.
Hoffman, Geo. W.

Portables.
Faries Mfg. Co.

Power Transmission Machinery.
Jeffrey Mfg. Co.

Rail Joints.
Continuous Rail Joint Company of America.

Rectifiers.
Electrical Appliance Co.

Refiners.
Gt. West Smelt. & Refining Co

Re-Winding—Repairs.
Chicago Edison Co.
Gregory Electric Co.

Rheostats.
Cutler-Hammer Mfg. Co.
General Electric Co.
Gen'l Inc. Arc Lt. Co.
Union Electric Mfg. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Rods, Conduit.
Cope, T. J.

Safes.
Sears, Roebuck & Co.

Schools and Colleges.
Electrical Engineer Inst.
Highland Park College

Second-Hand Mach'y.
Bissell Co., The F.
Cent. Stat. Improvement Co.
Gregory Electric Co.
Matthews & Bro., W. N.
Walsh's Sons & Co.

Shades, Lamp.
Faries Mfg. Co.

Sheet Brass & Copper.
Plume & Atwood Mfg. Co.

Signs, Electric.
Baller Machine Co.
Zero Marx Sign Works.

Silks, Insulating and Braiding.
Sauquoit Silk Mfg. Co.

Sockets & Receptacles.
Pass & Seymour.
Yost Elec. Mfg. Co.

Soldering Sticks, Salts and Paste.
Allen Co., L. B.
Crescent Co.
Kester Elec. Mfg. Co.
Western Electric Co.

Speaking Tubes.
Central Electric Co.
Edwards & Co.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.

Specialties, Electrical Mfrs. and Designers.
Haller Machine Co.

Speed Indicators.
Weston Electrical Inst. Co.

Storage Batteries.
American Battery Co.
Electric Storage Battery Co.
Gould Storage Battery Co.

Supplies, General Elec.
Bissell Co., The F.
Central Electric Co.
Century Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Electric Co.
Manhattan Elect'l Supply Co
Wesco Supply Co.
Western Electric Co.

Switchboards.
Bissell Co., The F.
Crouse-Hinds Co.
Gen. Incan. Arc Light Co.

Telephones, Telephone Material and Switchboards.
American El. Telephone Co
Automatic Electric Co.
Bissell Co., The F.
Central Electric Co.
Central Tel. & El. Co.
Electric Appliance Co.
International Tel. Mfg. Co.
Kellogg Switchb. & Sup. Co.
Manhattan Elec. Supply Co.
Stromberg-Carlson Tel. M.Co
Wesco Supply Co.
Western Electric Co.

Time Switches.
Bissell Co., The F.

Tools.
Klein & Sons, Mathias.
Western Electric Co.

Transformers.
Central Electric Co.
Crawfordsville Electric Co.
Crocker-Wheeler Co.
Electric Appliance Co.
Ft. Wayne Elec. Works, Inc.
General Electric Co.
Gregory Electric Co.
Kuhlman Electric Co.
Manhattan Elec. Supply Co.
National Electric Co.
Stanley Elec. Mfg. Co.
Wagner Electric Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Trucks, Electric Car.
General Electric Co.
Westinghouse El. & Mfg. Co.

Turbines, Steam.
Allis-Chalmers Co.
General Electric Co.
Westinghouse El. & Mfg. Co

Turbine Water Wheels
Leffel & Co., Jas.

Varnishes.
Dielectric Mfg. Co.
Sterling Varnish Co.

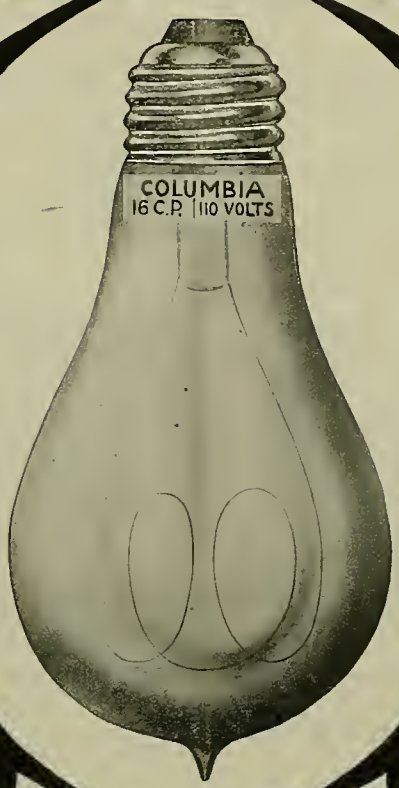
Vulcanized Fibre.
Vulcanized Fibre Co.

Whistles, Electric.
Electrical Appliance Co.

Wires & Cables—Magnet Wires.
American Electrical Works.
Bissell Co., The F.
Central Electric Co.
Chicago Insulated Wire Co.
Crescent Ins. Wire & Cble. Co.
Electric Appliance Co.
General Electric Co.
Hazard Manufacturing Co.
Indiana Rub. & Ins. Wire Co
India Rubber & Gutta Percha Insulating Co.
Kellogg Switch. & Sup. Co.
Manhattan Elec. Supply Co.
National India Rubber Co
New York Insulated Wire Co.
Northern Wire & Cable Co.
Okonite Co., The.
Phillips, Eugene F.
Phillips Insulated Wire Co
Roebling's Sons Co., J. A.
Runzel-Lanz Elec. Mfg. Co.
Safety Ins. Wire & Cable Co.
Simplex Electrical Co.
Standard Underground C. Co
Wesco Supply Co.
Western Electric Company.

For Alphabetical Index of Advertisements See Page 3.

COLUMBIA-LAMPS GIVE MOST LIGHT



Why Central Station Managers Buy Columbia Lamps They Get Most Light for Least Current.

Highest Efficiency Full Candle-Power Uniform Voltage No Experiment Fifteen Years of Unbroken Success.

THEY

INCREASE PROFITS. **DECREASE EXPENSES.**
INCREASE SALES. **DECREASE COMPLAINTS.**
INCREASE CUSTOMERS. **DECREASE EQUIPMENT.**

Send for our catalogue of Crystal Lamps (meridian type). We are prepared to furnish a complete line of Pagoda Reflectors and Holophane Globes. Write for prices. Copy of our "Wallet Full of Wisdom" mailed on request.

Columbia Lamps are manufactured under a License to use the Chemical Exhaust Process of exhausting lamps. This process is vitally necessary in the production of the highest quality of lamp. Every package of Columbia Lamps carries a label reading

Licensed Under { Patent No. 537,693, April 16, '95. Patent No. 726,293, April 28, '03.
{ Patent No. 444,530, Jan. 13, '91. Patent No. 532,760, Jan. 22, '95.

The Columbia Incandescent Lamp Co.

ST. LOUIS, MO., U. S. A.

New York Office, 1311 Havemeyer Bldg.
San Francisco, Paul Seller Electric Works.
Memphis, Tenn., 35 Equitable Bldg.
Chicago, Central Electric Co.
Mexico, Monterey, Van Veorhis, Hnos.
Philadelphia, 1227 Real Estate Trust Bldg.
Minneapolis, 638 Boston Block.

"The Light To Work By"

FOR USE ON ALL DIRECT-CURRENT LIGHTING SYSTEMS

TYPE H-6 LAMP.

The Cooper Hewitt Mercury Vapor Lamp

gives twice the efficiency of Arc Lamps, from 7 to 9 times the efficiency of the incandescent lamp, and its wide diffusion makes it especially adapted to use in drafting rooms, machine shop, factories, offices, freight depots, etc. SEND FOR BOOKLET.

We were awarded by the Louisiana Purchase Exposition a Gold Medal for Vapor Lamps for Photo-Eograving and also the Grand Prize for Electric Lighting Work in the development of the Mercury Vapor Lamp.

Cooper Hewitt Electric Co.
220 W. 29th St. New York City

TO THE TRADE

Regarding the action brought by the American Circular Loom Company on the pretense of our product, FLEXDUCT, being an alleged infringement of the Herrick Patent, No. 456,271, under which they have been operating, would state, briefly, that their conduit made under this Herrick Patent, is known on the market as that form of Flexible Conduit in which the insides can be readily removed, and consists in construction of a coil of fiber with a wrapping of tape covering the openings in said coil, and an outside woven covering, while FLEXDUCT is a woven product throughout and does not resemble in construction the structure of the Herrick Patent in any respect.

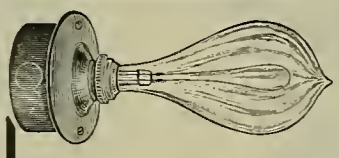
We are advised by our Attorneys, who are thoroughly familiar with the art, that we do not infringe and that ours is a broad patent fully covering and protecting our form of construction.

This action, brought at this particular time, in our opinion is simply for commercial effects, that it may confuse those who are not well informed of the facts.

The trade should not be coerced to purchase material by any threats as we will protect and defend the trade against any loss whatsoever, under any suit brought on account of the use, purchase, or sale of our product, FLEXDUCT.

Yours very truly,

OSBURN FLEXIBLE CONDUIT COMPANY
New York, 21 Park Row *Chicago, 529-30 Monadnock Block*



Some More Light on our Drawn Steel Junction Boxes

Take time to figure out the cost of cast iron boxes plus the loss from breakage and time used in producing a round hole. Compare with this the cost of drawn steel boxes.

NO BREAKAGE,

Clean round hole produced with one blow of a hammer. Write for catalog and see what you can save.

BOSSERT ELECTRIC CONSTRUCTION CO. - - UTICA, N. Y.

Sterling Black Plastic Insulator.

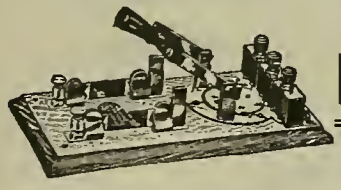
One hundred days' continuous baking at 180° F. will not make it brittle. Water repellent. Oil proof.

THE STERLING VARNISH CO., - - Pittsburg, Pa.

BOOKS.

BUY YOUR BOOKS FROM THE ELECTRICIAN PUBLISHING COMPANY,
510 Marquette Bldg., CHICAGO.

SOMETHING DOING IN A STORM



WITHOUT A

King of Protectors

Better Buy a

"TORNQUIST"

COMBINATION LIGHTNING ARRESTER GROUND SWITCH FUSE AND LEVER CUT-OUT.

THE ONLY SAFE PROTEGTOR MADE. ORDER SAMPLE NOW.

BABY KNIFE SWITCHES
STAMPING AND PLATING.
SOLD BY ALL JOBBERS.

Clinton Stamping & Electric Co.,
CLINTON, IA.
HART & CO., Chicago, General Agents.

ADJUST YOUR LIGHT

by means of our

Wall, Desk, Floor or Ceiling Adjustable Fixtures

TO ANY DESIRED POSITION INSTANTLY.

Many shapes and styles—plain and ornamental—for shop, factory, store, office, residence—in fact, wherever the incandescent lamp is used.

Catalog mailed upon request.

FARIES MFG. CO.,
DECATUR, ILL.

EDISON PRIMARY BATTERIES

FORMERLY EDISON-LALANDE

These batteries are free from objection on the score of either polarization or local action, and can be conveniently applied to sewing machine motors, fan motors, electric cauteries, gas engine igniters, small electric lamps, and other purposes calling for moderate supplies of electrical power, in addition to the needs of telegraphy, telephony and railroad semaphore signals and crossing bells. Send for catalogue No. 7.

TRADE Thomas A Edison MARK

EDISON MFG. CO.
Factory, ORANGE, N. J.

NEW YORK: 83 Chambers Street
CHICAGO: 304 Wabash Avenue

It Will Interest You to Know What the **Western Electric Company** Have to Say Regarding

ELECTRA
TRADE MARK

HIGHEST GRADE NUERNBERG

CARBONS

in their circular, dated November 23, 1903, which in part reads as follows:

"The Western Electric Company have made an exhaustive test of carbons of all kinds and have found that the 'ELECTRA' Carbons cannot be equaled in quality or efficiency, produce practically no dust and give an excellent and steady light. They produce the highest standard of candlepower in proportion to the current consumed, and are the most economical carbons manufactured."

HUGO REISINGER, Sole Importer, 11 Broadway, NEW YORK CITY.

YOST SPECIALTIES.

Sockets, Wall Sockets, Weatherproof Sockets, Rosettes, Receptacles, Cord Adjusters.

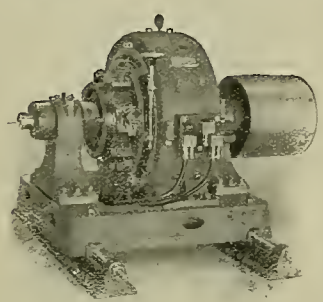
Catalogue for the asking.

THE YOST ELECTRIC MFG. CO.
TOLEDO, OHIO.

DIRECT CURRENT

GENERATORS

FOR LIGHT AND POWER



Our generators have a high efficiency and great endurance under the most exacting conditions of service. Sizes up to 1,000 K. W.
Write for bulletin No. 10514.

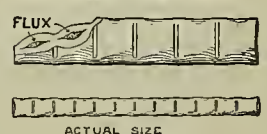
SPRAGUE
ELECTRIC COMPANY

General Offices:
527 West 34th Street, New York
Chicago Office: Fisher Building

KESTER
SELF FLUXING SOLDER

A Tube of Solder Filled with Flux.
Requires no Acid.

SAVES—LABOR—TIME—MONEY.



PATENTED.

Send for Free Samples.

L. F. Mahler Co., R. 1008 Chemical Bldg., St. Louis, Mo., Gen. Western Agent.

KESTER ELECTRIC M'F'G CO.,
45 N. UNION STREET, CHICAGO, ILL.

General Electric Company

FIELD RHEOSTATS

Field Rheostat with 400 Steps.

MOISTURE PROOF

Write for Further INFORMATION

General Office: SCHENECTADY, N. Y.

Chicago Office: Monadnock Block — Sales Offices in all Large Cities

Never was lamp like the Zenith

More than an incandescent
Less than an arc
And more adaptable than either

The Packard Zenith lamp can be used where it is not practicable to use an arc lamp, and when used in place of a cluster of incandescents it gives better light at less cost.

Made in 25 and 55 C. P. and for all standard voltages. Do you want prices?

Electric Appliance Company
CHICAGO and SAN FRANCISCO

Made in four sizes { 8 lights, 16 "", 24 "", 32 "" } $5.00 and upwards

Electric Lighting Outfits

READY FOR USE

Very popular for electric lighting decorations and especially adapted to the lighting of Christmas trees.

Safe, Simple and Convenient

EDISON DECORATIVE & MINATURE LAMP DEPARTMENT,
GENENAL ELECTRIC COMPANY,
Harrison, N. J.

BEARDSLEE CHANDELIER MF'G CO. 256 and 257 So. CANAL ST. CHICAGO
GAS & ELECTRIC FIXTURES FOR THE TRADE.
CATALOG SENT PREPAID TO DEALERS MENTION THIS PAPER

VOLT - AMMETERS,
POCKET SIZE.
For Testing Batteries and Battery Circuits, Locating Faults, Grounds, etc.
RELIABLE. ACCURATE.
Send for Circular.
L. M. PIGNOLET,
78-80 Cortlandt St. NEW YORK, N. Y.

M. KLEIN & SON.
Send 2c stamp for new catalogue No. 6 of
KLEIN'S TOOLS
For Electrical Workers and Line Builders.
MATHIAS KLEIN & SONS,
81 W. Van Buren St., Chicago, Ill.

WANTED

You Who are Troubled with Sparking and Cutting of Commutators to Use

The only article that will PREVENT SPARKING. Will keep the commutator in good condition and PREVENT CUTTING.

Absolutely will Not Gum The Brushes . . .

It will put that high gloss on the commutator you have so long sought after.

50 Cts. per Stick. $5.00 per Dozen.
For Sale by all Supply Houses, or
FREE, Sample Stick.

K. McLENNAN & CO.,
Sole Manufacturers,
Room 411 Inter Ocean Bldg., 130 Dearborn St., CHICAGO, ILL.

SINGLE AND POLYPHASE
TRANSFORMERS
KUHLMAN ELECTRIC CO., - - Elkhart, Ind.

MICA—BOND

Notice how our competitors try gradually to raise Cut Mica prices—same thing would occur in manufactured mica if we were not the leaders

CHICAGO MICA CO
"PERFECTORS" VALPARAISO, IND.

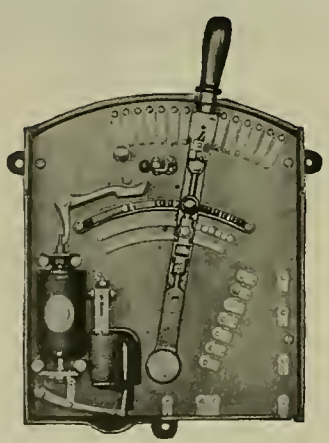
MICA
Of all Qualities, in any Form at Lowest Prices
EUGENE MUNSELL AND CO.
NEW YORK and CHICAGO

INSULATION That Is.

Micanite, Linotape, M. I. C. Compound, Empire Cloth and Paper. For Years the Standard.

MICA INSULATOR CO., Originators
NEW YORK and CHICAGO

Flat Bed and Small Rotary Press Controllers



One of the six "Carpenter" types.

The "Carpenter" system gives such a wide range of speed and such perfect control that a press can be moved an eighth of an inch at a time, and from that to top speed, with every desirable intermediate speed.

Six types, alike in principle, different in detail. Bulletins 81 to 86 explain. We'll send them if you let us know that you want them.

The Cutler-Hammer Mfg. Co.,
Electric Controller Manufacturers and Electrical Engineers.
MILWAUKEE, WIS.
New York, Boston, Chicago, Pittsburg.

USE
"SAFETY" RUBBER COVERED WIRE AND CABLE
FOR EVERY ELECTRICAL SERVICE.
M. B. AUSTIN & CO.,
CHICAGO REPRESENTATIVE.
THE SAFETY INSULATED WIRE & CABLE CO.,
WORKS: Bayonne, N. J. 114-116 LIBERTY STREET, N. Y.

"UNION" SWITCH OUTLET BOX

For Finished House Work

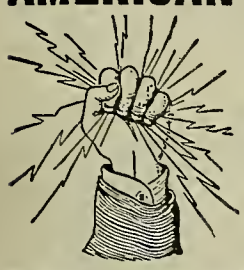
Approved by Underwriters' National Electric Association.

CHICAGO FUSE WIRE & MFG. CO.
CHICAGO BUFFALO NEW YORK

FRANK N. PHILLIPS, President. O. H. WAGENSEIL, Treasurer. EUGENE F. PHILLIPS, General Manager. E. ROWLAND PHILLIPS, Vice-Pres. C. R. REMINGTON, Jr., Sec.

AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.



BARE AND INSULATED ELECTRIC WIRE,
ELECTRIC LIGHT LINE WIRE,
INCANDESCENT AND FLEXIBLE CORDS,
Railway Feeder and Trolley Wire,
AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR WIRES.
CABLES FOR AERIAL AND UNDERGROUND USE.

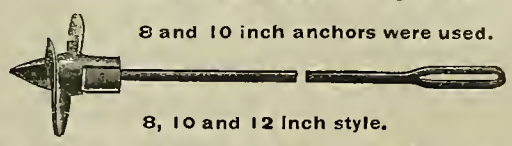
New York Store, W. J. Watson, 26 Cortlandt St.
Chicago Store, F. E. Donohoe, 82 Lake St.
Montreal Branch, Eugene F. Phillips' Electrical Works.
MAIN OFFICES AND FACTORIES, PHILLIPSDALE, R. I.

WHAT DID THE WOGGLE BUG SAY?

YOU CAN'T DO LESS than give a good thing a trial. FREE SAMPLE J. J. Egan's Acme Commutator Compound, the only article that will absolutely prevent sparking, cutting or unnecessary wear of the commutator. Commutator always bright.

Agents Wanted.
50 CENTS PER STICK ALL SUPPLY HOUSES OR $5.00 PER DOZEN
J. J. ECAN, 317 Austin Ave., CHICAGO

THE UNITED STATES GOVERNMENT
USED
Stombaugh Guy Anchors
EXCLUSIVELY FOR
Anchoring their Wireless Telegraph Masts in Porto Rico, Cuba, Panama and Key West.

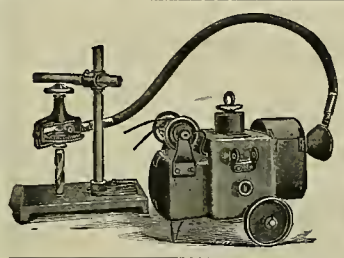


8 and 10 inch anchors were used.
8, 10 and 12 inch style.
W. N. MATTHEWS & BRO., Manufacturers
603 Carleton Building, St. Louis

EXPERT IN ELECTRICITY MECHANICS PATENT CAUSES
SOLICITOR OF **PATENTS**
U. S. & FOREIGN
FORÉE BAIN, 1662-3 Monadnock Blk., CHICAGO

"STAR" INCANDESCENT LAMPS

LONG LIFE
GUARANTEED CANDLEPOWER,
HIGHEST EFFICIENCY.
MADE BY THE MOST SKILLED WORKMEN.
STANDARD ELECTRICAL MFG. COMPANY, : Niles, Ohio.



ESTABLISHED 1875.
COMBINATION OF
Stow Flexible Shaft
AND
MULTI-SPEED MOTOR
Practically dust and water proof. For Portable Drilling, Tapping, Reaming, Emery Grinding, etc. Write for Catalogue and Prices.
STOW MFG. CO., Binghamton, N. Y.
Gen'l European Agents, Selig, Sonnenthal & Co., 85 Queen Victoria Street, London, England

W. D. PAINT.
A PERMANENT INSULATING PROTECTION FOR WOOD OR METAL. A quick drying, moisture-proofing, black paint. An elastic anti-rust coating. A jet black finishing paint, efficient and not expensive.
Write for "Data on Insulating Materials."
DIELECTRIC MANUFACTURING CO., SAINT LOUIS.

Our Compound Stops Sparking and Saves Commutators.
14 Years' Use on Street Ry., Light and Power Commutators Has Proven its Worth. WE GUARANTEE RESULTS.
Send Your Address for FREE SAMPLE THAT CONVINCES.
JAS. McLAUGHLIN & CO., ELECTRICAL ENGINEERS
586 Fulton Street, - - Chicago, Ill.

EDWARDS AND CO.
ELECTRO-MECHANICAL GONG.

Is entirely encased in iron and is weatherproof. The mechanism is very powerful and gives 375 blows to each winding. Continuous ringing or single stroke.
WESTERN ELECTRIC CO.
Selling Agents.
NEW YORK N.Y.

Crimshaw

Raven White Core

Raven Black Core

ALL OUR WIRES pass inspection and carry the above TRADE-MARKS on our tags. We also manufacture Crimshaw and Competition Tapes and Splicing Compounds.

NEW YORK INSULATED WIRE COMPANY,

MAIN OFFICE: 114, 116 & 118 Liberty St., New York.
BRANCHES: CHICAGO: 192 Desplaines St. BOSTON: 7 Otis St. SAN FRANCISCO: 33 Second St.

NATIONAL CODE STANDARD

"O. K." Weatherproof Wire.
Slow-Burning Weatherproof and Ideal Wire.
Prices and Samples on Application.

Phillips Insulated Wire Co.
Office and Factory: PAWTUCKET, R. I.

ELECTRIC SIGNS
INCREASE YOUR CURRENT CONSUMPTION.
Assist us to sell ELECTRIC SIGNS to the best merchants in your city.

No repair bills with our signs we furnish the best—all metal raised letters equipped with removable copper shell sockets. WRITE US, we will conscientiously study your sign wants and gladly submit drawings with very low quotations for the best work.

ZEROMARX SIGN WORKS
CHICAGO, ILL.

WANTED, FOR SALE *and similar* **WANT COLUMN** *advertisements (50 words or less), $1.50 an insertion; additional words 3c each.* **POSITION WANTED** *advertisements (50 words or less), $1.00 an insertion; additional words 2c each.*

POSITION WANTED.

First-class man for street railway repair shop, Electrician, machinest, engineer, mechanical draftsman, sober, industrious, trustworthy. Married. Lost job on account of sickness. Best references; salary reasonable. Address BOX 413, care Western Electrician, 510 Marquette Bldg., Chicago, Ill.

WANTED.

A young man familiar with both theory and practice in the manufacture of motors and dynamos. Prefer graduate from some technical school. State experience and salary expected. Address BOX 416, care Western Electrician, 510 Marquette Bldg., Chicago, Ill.

WANTED.

Good electrician who understands polyphase electric apparatus and water wheel. Shifts are 12 hours long and work every day in the year. Wages $60.00 a month. Address BOX 417, care Western Electrician, 510 Marquette Building, Chicago.

WANTED.

A first-class telephone electrician having had experience from bottom up; able to handle all troubles on exchange, both inside and outside; well up on toll line troubles. Write giving reference, etc.

THE SOLOMON VALLEY TELEPHONE CO.
Beloit, Kansas.

AGENCY WANTED.

A firm of Engineers with good trade connections is open to represent Manufacturers of Electrical and Mechanical commodities in Chicago and vicinity. Address BOX 411, care of Western Electrician, 510 Marquette Building, Chicago, Ill.

FOR SALE

1 Stanley generator, two-phase, 16,000 alternations, 1,000-2,000 volts, 40 K. W., 1333 R. P. M. and exciter.

1 Stanley generator, two-phase, 16,000 alternations, 1,000-2,000 volts, 60 K. W., 1,000 R. P. M. with exciter.
Complete marble switchboard with new instruments for above.

1 Westinghouse generator, 75 K. W., single-phase, 1,100 volts, 7,200 alternations, exciter, switchboard, new instruments complete, 750 R. P. M.

2 New belts.

1 Russell 13x20 4-valve engine, 200 R. P. M.

1 Ball 9¾x10 engine, 350 R. P. M.

2 Boilers, 16x54 inch, 42 4-inch tubes, allowed 110 lbs. pressure, complete with 50-foot stack.

1 Hoppes heater. All steam pipe, valves, etc.

All in good condition. Can be seen running until December 15th. We are abandoning this plant on account of removal, and will sell all or in part. For further information, address

TIBBE ELECTRIC CO., Washington, Mo., or RUEBEL-SCHWEDTMANN WELLS, St. Louis.

FOR SALE

1-360	K. W.	General Electric	Alternator,	Three	Phase
1-240	"	Westinghouse	"	Single	"
2-150	"	Warren	"	"	"
1-150	"	Westinghouse	"	"	"
1-150	"	Wood	"	"	"
1-150	"	Stanley	"	"	"
1-120	"	General Electric	"	Three	"
1-120	"	General Electric	"	Single	"
1 120	"	Westinghouse	"	"	"
1- 90	"	General Electric	"	"	"
1- 75	"	Westinghouse	"	Two	"
1- 75	"	Westinghouse	"	Single	"
1- 75	"	Westinghouse	"	Two	"

Direct connected to Gates' Engine.

Send for our **Monthly Bargain Sheet** with complete list and net prices.

GREGORY ELECTRIC CO.
54-62 S. Clinton St., Chicago, Ill.

BOOK ORDERS

GIVEN PROMPT ATTENTION.

Electrician Publishing Co.,

Suite 510 Marquette Bldg., CHICAGO.

WORKS QUICK AND EASY. KEEPS ITS LUSTER. HOLDS OLD TRADE AND MAKES NEW. DOES NOT DETERIORATE. ESTABLISHED 16 YEARS. SOLD BY AGENTS AND DEALERS ALL OVER THE WORLD

U.S. METAL POLISH

3 OUNCE BOX 10 CENTS
SAMPLES SENT FREE
GEO. W. HOFFMAN

POLISHES ALL METALS. BRANCHES NEW YORK, CHICAGO, SAN FRANCISCO. 295 E. WASHINGTON ST. INDIANAPOLIS, IND.

BOILERS.

One 42-in. x 15 ft. 9-in., 250 H. P. Wortbington Water Tube.
One 60-in. x 16 ft., John Mohr Return Tubular Boiler.
One 54-in. x 16 ft., John Mohr Return Tubular Boiler.
One 54-in. x 16 ft., Devine Tubular Boiler.

ENGINES.

One 600 H. P., 21 x 36 x 30, Williams Tandem Horizontal Compound, 140 R. P. M.
Two 600 H. P., 20 x 30 x 24, Porter-Allen Tandem Compound, 200 R. P. M.
One 250 H. P., 12 x 24 x 18 Williams Tandem Compound, 250 R. P. M.
Two 100 H. P., 13 x 12, Dick & Church, High Speed Automatic.

PARTIAL LIST ONLY.

Send for latest Catalogue for bargains in Engines, Boilers, Dynamos and Motors.

CENTRAL STATION IMPROVEMENT CO., 938 Monadnock Block, Chicago

FACTORIES WANTED

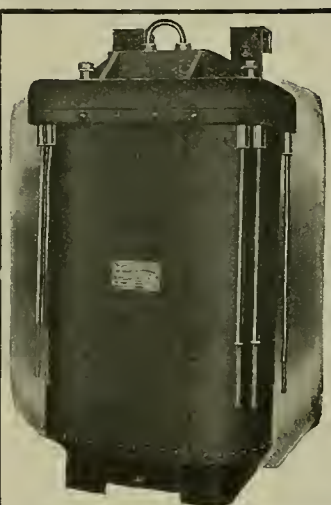
ALONG THE

BURLINGTON ROUTE

to supply the demand
for Electrical Goods.

Burlington Route
N 548

W. H. MANSS.
INDUSTRIAL COMMISSIONER,
209 ADAMS STREET, CHICAGO.



HORNBERGER-IRWIN
Transformers
(LARGE AND SMALL)

½ K. W. to 500 K. W.

This transformer represents the latest improvements in transformer construction; made in three types; multi-coil construction; ventilated cores; built for all commercial voltages and frequencies; **higher efficiencies together with lower temperatures than have heretofore been attained are guaranteed.**

Catalogue just issued explains details.

Manufactured by

Crawfordsville Electric Co.
CRAWFORDSVILLE, INDIANA, U. S. A.

HENRY NEWGARD & CO.

ELECTRICAL CONSTRUCTION

Power and Light Plants. Switchboards and Panel Boards.

We install Municipal and Isolated Electric Lighting Plants.
We manufacture Switchboards, Table boards, Iron Cutout Boxes and Electrical Specialties.
We sell Dynamos, Motors and Electrical Supplies.
We wire old as well as new Residences, Factory Buildings, School and College Buildings.

87 Fifth Avenue, Chicago, Illinois.

REPAIRING
RECALIBRATING
ELECTRIC METERS.
INTERNATIONAL ELECTRIC METER CO.
167 S. CANAL STREET, CHICAGO.

Engineering

MECHANICAL, ELECTRICAL, STEAM, CIVIL.

Complete and short courses. Thoroughly equipped engineering shops. **Shop work from the beginning.** Short courses in Steam and Electrical Engineering. Expenses low. Accommodations the best. School all year. Students may enter any time. Correspondence steam and electrical courses. Send for catalogue. Mention course in which interested.

HIGHLAND PARK COLLEGE, DES MOINES, IOWA.

ELECTRICAL AND OTHER INDUSTRIES ARE OFFERED LOCATIONS

WITH
Satisfactory Inducements,
Favorable Freight Rates,
Good Labor Conditions,
Healthful Communities,
ON THE LINES OF
THE ILLINOIS CENTRAL R. R.
AND THE
YAZOO & MISSISSIPPI VALLEY R. R.

For full information and descriptive pamphlet address

J. C. CLAIR,
Industrial Commissioner
1 Park Row, Chicago, Ill

DON'T BUY ELECTRICAL SUPPLIES

Until you have seen our new Catalogue and new Price List.
Free to the trade.

Manhattan Electrical Supply Co.

NEW YORK: 32 Cortlandt St.
CHICAGO: 188 Fifth Ave.

"MANROSS" HAIR SPRINGS

For Electric Indicating and Recording Gauges, Steam Gauges, Etc

LARGEST MANUFACTURER OF HAIR SPRINGS in the United States.

F. N. MANROSS,
FORESTVILLE, CONN.

Western Electrician WANT ADS

Bring Results.

CHICAGO EDISON COMPANY REPAIR SHOPS

76 MARKET STREET, CHICAGO. TELEPHONE MAIN 1280.

Machine and Carpenter Work of All Kinds
Correspondence Solicited.

OPEN DAY AND NIGHT.

FIRST-CLASS EQUIPMENT THROUGHOUT.

Dynamos Armatures, Motors, Arc Lamps, Fans, Instruments.

National Electric Company

TRADE MARK

Milwaukee

DEARBORN WATER TREATMENT

Stops that expense and worry over scale in boilers.
We correct waters of all classes for boiler purposes.

Send gallon sample to Chicago Laboratory for Analysis.
Write for Booklet "R."

DEARBORN DRUG & CHEMICAL WORKS,

27-34 RIALTO BUILDING, CHICAGO, ILL. WM. H EDGAR, President Telephone: Harrison 3930 and 3931.

Dixon's Pure Flake Graphite

As a Cylinder Lubricant

Makes cylinders, valves and rods wonderfully smooth and bright. Reduces friction, saving oil and packing.
Booklet 125C and sample upon request.

JOSEPH DIXON CRUCIBLE CO., JERSEY CITY, N. J.

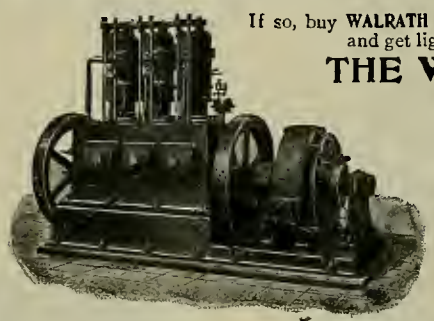
JEFFREY DETACHABLE STEEL ROLLER SPECIAL **CHAINS** FOR CATALOGUE, ADDRESS THE JEFFREY MFG. CO COLUMBUS, OHIO.

REG. TRADE MARKS

THE PHOSPHOR BRONZE SMELTING CO. LIMITED,
2200 WASHINGTON AVE., PHILADELPHIA.
"ELEPHANT BRAND PHOSPHOR-BRONZE"
INGOTS, CASTINGS, WIRE, RODS, SHEETS, ETC.
— DELTA METAL —
CASTINGS, STAMPINGS AND FORGINGS
ORIGINAL AND SOLE MAKERS IN THE U.S.

ARE YOU LOOKING FOR MONEY?

If so, buy WALRATH GAS OR GASOLINE ENGINES and get light on the subject.



THE WALRATH

Received the Highest Award at the Pan-American Exposition.

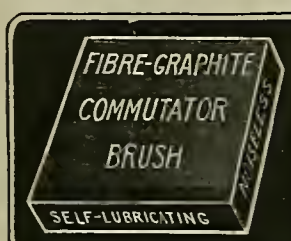
It will produce as good a commercial light as that of an automatic steam engine, either belted or direct-connected generator. Simple, Economical and Reliable

Send for Catalogue W

MARINETTE GAS ENGINE CO.,
CHICAGO HEIGHTS, ILL.

AGENCIES:
Keystone Engineering Co., Farmer's Bank Bldg., Pittsburg, Pa.
Strong, Carlisle & Hammond Co., 61-67 Frankfort St., Cleveland, Ohio
Mackay Engineering Co., 149 Broadway, N. Y.
C. H. Seidenglanz., 52 When Bldg., Indianapolis, Ind.

BUY Your Electrical Books of the **Electrician Publishing Co., Suite 510 Marquette Bldg., Chicago.** You will save **TIME** and **MONEY** by doing so. . . . . .



There's No Friction

with the Fibre-Graphite Commutator Brush. Being 90 per cent. pure graphite, it insures low resistance, no sparking under a varying load, and longer wear. There is no greasing required. The Fibre-Graphite is therefore the most economic brush on the market. Send for price list.

HOLMES FIBRE-GRAPHITE MFG. CO.
5155 Wakefield St., Germantown, PHILADELPHIA.

MECHANICAL

Engineers interested in electricity should send for our complete Catalogue (mailed free to any address). Any electrical book published sent prepaid on receipt of price.

ELECTRICIAN PUBLISHING CO., - 510 Marquette Bldg., Chicago.

"Practical and to the Point"

IS ALL THAT NEED BE SAID OF

THE TELEPHONE HAND-BOOK

By HERBERT LAWS WEBB.

160 Pages, 133 Illustrations, Cloth, Price $1.00.

The book for those interested in telephony.

ELECTRICIAN PUBLISHING CO.,
510 Marquette Bldg.,
CHICAGO.

ROBT. FERRIS' BOOK ON METERS

IS SO SIMPLE THAT ONE WONDERS AT THE COURAGE OF THE AUTHOR

IT TELLS JUST WHAT SOME PEOPLE THINK THEY KNOW.

Written expressly for the men who handle the pliers.
Sent prepaid on receipt of $1.00. Address

ELECTRICIAN PUB. CO.,
510 Marquette Bldg., CHICAGO.

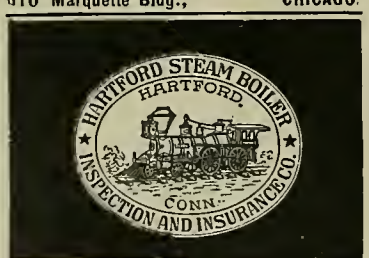
THE TELEPHONE HAND-BOOK

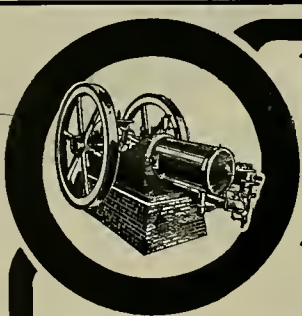
BY
HERBERT LAWS WEBB.

Price $1.00.

A complete and practical work in handy pocket size.

PUBLISHED BY
THE ELECTRICIAN PUBLISHING CO.,
Suite 510 Marquette Building, Chicago.





Olds Gas and Gasoline Engines

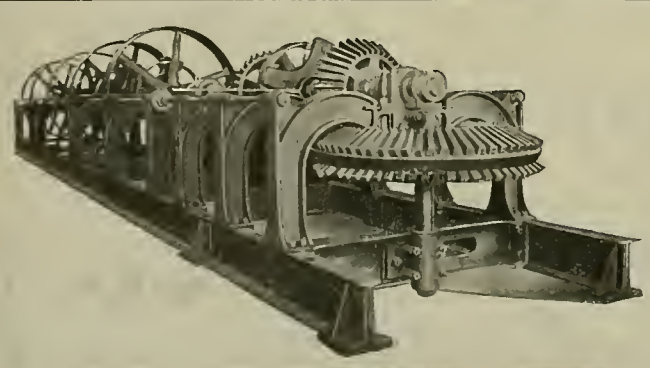
When gasoline is used for fuel it can be pumped up only a fast as it is used. Perfect mechanical appliances make for absolute safety and economy.

STATIONARY ENGINES - - 2 to 100 H. P.
PORTABLE ENGINES - - - 8 to 18 H. P.

We have a new catalog, fully describing and illustrating our line, which will be sent on request.

OLDS GASOLINE ENGINE WORKS,
252 River Street., : - Lansing, Mich.

2 No. 983



SAMSON TURBINE

Aside from TURBINE WATER WHEELS we build a complete line of TRANSMISSION MACHINERY in the way of GEARS, SHAFTS, BRIDGETREES, BEARING BOXES, PULLEYS, ETC.

Write Dept. D for Catalog

THE JAMES LEFFEL & CO.
Springfield, Ohio, U. S. A.

ARNOLD ELECTRIC POWER STATION Co.
Engineers, Constructors for Complete Electric Plants. Results Guaranteed.
SUITE 1539, MARQUETTE BLDG., CHICAGO. NEW YORK OFFICE: 711 TRANSIT BLDG.

BYLLESBY, H. M. & Co.
(Incorporated)
ENGINEERS
Design, Construct and Operate Railway, Light, Power and Hydraulic Plants.
Examinations and Reports.
New York Life Building, - CHICAGO, ILL.

J. H. HALLBERG
Consulting Engineer
Electric Light, Power and Railway Plants
Suggestions to secure Economy, Specifications, Examinations and Reports
45 Broadway, NEW YORK
Long Distance Telephone 4578 Broad

RUEBEL - SCHWEDTMANN-WELLS,
CONSULTING, MECHANICAL AND ELECTRICAL ENGINEERS,
Suite 801 Chemical Building, ST. LOUIS, U. S. A.

F. B. BADT,
Monadnock, Chicago.

EVANS, ALMIRALL & CO.,
Central Station Heating, High Pressure Piping.
1057 Monadnock Blk., Chicago.

ROBERT W. HUNT & Co.,
ENGINEERS
1121 The Rookery, Chicago. 66 Broadway, New York.
Monongahela Bank Bldg., Pittsburg.
Norfolk House, Cannon St., London.

Long Distance Phone Central 2448.
SCHOTT, W. H.,
ENGINEER AND CONTRACTOR,
SPECIALTIES—Central Station Heating Plants, Water Works Steam Plants, Electric Light, Gas and Street Railway Plants.
1220-21 MARQUETTE BUILDING, CHICAGO.

W. E BAKER. H. B. BISHOP.
BAKER, W. E. & CO.
ENGINEERS,
ELECTRIC RAILWAYS.
27 William St., NEW YORK.

TRY IT. Keep your name and address in this directory where it will be seen by possible clients.

KEMP, R. W.
Consulting and Contracting Telephone Engineer.
Plans and Specification for complete plants. Old plants overhauled and placed on paying basis. Territory, Kansas, Oklahoma and Indian Territory.
WELLINGTON, - - - KANSAS.

SQUIRE ELECTRIC CO.
Engineers and Contractors
113 E. Eighth St., KANSAS CITY, MO.
Consulting, Designing and Supervising Engineers.
Plans and Specifications Furnished.

ENGINEERS
Represented in this "Directory" are enabled to come in touch with many prospective customers who cannot be reached through any other source.

E. W Hammer, Pres. and Treas. H. J. Minhinnick, Sec. and Gen'l Sup't.
GENERAL ENGINEERING Co., THE Consulting and Contracting Engineers.
Telephones, Electric Light, Power Transmission
Suite 1112, 135 ADAMS ST., CHICAGO.
Long Distance Telephone Central 1478.

KOHLER BROS.,
Contracting Electrical Engineers, Lighting Power Railways,
1804-1806-1808-1810-1812 Fisher Building, CHICAGO.

STANTON, LE ROY W.
Consulting Telephone Engineer
Plans, Specifications and Supervision of Installation of Complete Telephone Plants
Special Reports on Telephone Properties and Apparatus
411 Electrical Bldg., Cleveland, Ohio

BRYAN, WILLIAM H.
M. Am. Soc. M. E.,
Consulting Mechanical and Electrical Engineer.
Lincoln Trust Building, ST. LOUIS.

A WEEKLY REPRESENTATION in this "Directory" enables engineers to keep before all possible customers.

IT WILL PAY engineers not represented in this department to carry a card regularly.

Telephone Main 3123.
WILMERDING, C. H.
CONSULTING ENGINEER
1100 Old Colony Bldg., CHICAGO.

DUGALD C. JACKSON, C. E.
WILLIAM B. JACKSON, M. E.
MEMBERS
AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS
AMERICAN SOCIETY OF MECHANICAL ENGINEERS
AMERICAN SOCIETY OF CIVIL ENGINEERS
ENGINEERS. EXPERTS.
MADISON, WIS.

ALL Live men read the WESTERN ELECTRICIAN Each Week. Do You?

PLACE YOUR "Want" and "For Sale" advertisements in the WESTERN ELECTRICIAN. Immediate Returns.

ELECTRICAL BOOKS

Make your book purchases from the only large stock of electrical books carried in the West. Prompt shipments guaranteed. If you do not find what you want in the following list, write for complete and up-to-date book catalogue.

	Price.
Webb's Telephone Hand Book, cloth binding	$1.00
Badt's New Dynamo Tender's Hand Book, cloth binding	1.00
Badt's Incandescent Wiring Hand Book, cloth binding	1.00
Badt's Bell Hanger's Hand Book, cloth binding	1.00
Badt's Electric Transmission Hand Book, cloth binding	1.00
Dobb's The Inspector and Trouble Man, cloth binding	1.00
Steven's Mechanical Catechism, cloth binding	1.00
Hawkins' Catechism of Electricity, leather binding	2.00
Practical Electricity, leather binding	2.00
Thompson's Polyphase Electric Currents, cloth binding	3.50
Varley's Electro-Magnet, cloth binding	1.00
Buckley's Electric Lighting Plants, cloth binding	2.00
Haskins' Electricity Made Simple, cloth binding	1.00
Haskins' Transformer, cloth binding	1.25
Houston's 2-volume Electrical Dictionary, half leather, very cheap, half price	6.00
Watson's Electrician's Handy Book, cloth binding	2.50
Trevert's Armature and Magnet Winding, cloth binding	1.50
Trevert's How to Build Dynamo Electric Machinery, cloth binding	2.50
Trevert's Experimental Electricity, cloth binding	1.00
Trevert's Electricity for Students, cloth binding	1.00
Trevert's Electric Railway Engineering, cloth binding	2.00
Allsop's Bell Construction, cloth binding	1.25

	Price.
Trevert's Electrical Measurements for Amateurs, cloth binding	$1.00
Allsop's Telephones, Their Construction and Fitting, cloth binding	1.25
Allsop's Bell Fitting, cloth binding	1.25
Allsop's Induction Coils, cloth binding	1.25
Bell's Electric Power Transmission, cloth binding	3.00
Bell's Distribution for Electric Railroads, cloth binding	2.50
Cushing's Standard Wiring for Electric Light and Power, leather binding	1.00
Hanchett's Modern Electric Railway Motors, cloth binding	2.00
Houston & Kennelly's Electric Transmission of Intelligence, cloth binding	1.00
Houston & Kennelly's Electrical Measurements, cloth binding	1.00
Houston & Kennelly's Electric Heating, cloth binding	1.00
Houston & Kennelly's Electric Arc Lighting, cloth binding	1.00
Houston & Kennelly's Electric Motor, cloth binding	1.00
Houston & Kennelly's Electric Street Railways, cloth binding	1.00
Houston & Kennelly's Electric Telegraphy, cloth binding	1.00
Houston & Kennelly's Electro Therapeutics, cloth binding	1.00
Houston & Kennelly's Electricity Made Easy, cloth binding	1.50
Merill's Electric Light Specifications, cloth binding	1.50
Wiener's Dynamo Electric Machines, cloth binding	3.00

ANY OF THE ABOVE BOOKS SENT PREPAID ON RECEIPT OF PRICE.

ELECTRICIAN PUBLISHING CO.

SUITE 510 MARQUETTE BUILDING, CHICAGO.

STROMBERG-CARLSON

GENERATOR-CALL

VISUAL SIGNAL SWITCHBOARDS

are inexpensive to maintain and nearly as rapid as a lamp signal switchboard.

SIGNALS SELF-CONTAINED

NO WORKING PARTS EXPOSED

This illustrates our No. A-1249 cabinet equipped with 100 line signals and 10 clearing-out signals. Our standard cabinets have a capacity for 50, 60, 70, 100, 140, 180 and 200 line signals of the above type.

Bulletins No. 6 and 7-E describe these boards very thoroughly. Mailed free upon request.

STROMBERG-CARLSON TELEPHONE MFG. CO.,

GENERAL OFFICES, ROCHESTER, N. Y. **WESTERN SALES OFFICE, CHICAGO, ILL.**

Kellogg Telephone Apparatus

A glance at the Kellogg desk set will prejudice you in its favor, but its working, wearing and lasting qualities are what have made its name.

It helped to win the Grand Prize at the St Louis Exposition—the highest award. Write us for catalogues telling you all about it.

Kellogg Switchboard and Supply Company

Green and Congress Streets, CHICAGO

LOS ANGELES Seymour Building — CLEVELAND Electric Building — PHILADELPHIA Keystone Telephone Building

BITUMINIZED FIBER CONDUIT

FOR UNDERGROUND CONSTRUCTION

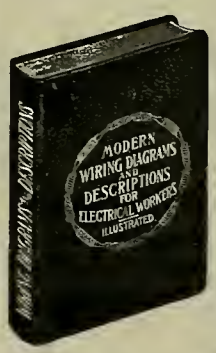
One view of our exhibit at World's Fair showing full length samples of conduit and bends.

American Conduit Co.

Main Offices: 1005-6 Manhattan Building, Chicago

Other Offices:

170 Broadway, New York. 336 Macy St., Los Angeles



A PRACTICAL BOOK FOR PRACTICAL MEN

"MODERN WIRING DIAGRAMS AND DESCRIPTIONS FOR ELECTRICAL WORKERS."

By Henry C. Horstmann and Victor H. Tousley. 160 pages, over 200 illustrations. Full leather binding, red edges. Pocket size 4 x 6. Price, net, $1 50.

A work that not only tells you how to do it, but shows you.

THIS BOOK tells how to wire for call and alarm bells. For burglar and fire alarm. How to run bells from dynamo current. How to install and manage batteries. How to test batteries. How to test circuits. How to wire for annunciators; for telegraph and gas lighting. It tells how to locate "trouble" and "ring out" circuits. It tells about meters and transformers It contains 30 diagrams of electric lighting circuits alone. It explains dynamos and motors; alternating and direct current. It gives 10 diagrams of ground detectors alone. It gives "Compensator" and Storage Battery installation. It gives simple and explicit explanations of the "Wheatstone Bridge" and its uses as well as volt meter and other testing. It gives a new and simple wiring table, covering all voltages and all losses or distances, etc., etc.

SENT PREPAID ON RECEIPT OF PRICE

ELECTRICIAN PUBLISHING CO.

510 Marquette Building, Chicago

INTERNATIONAL

Mechanical Self-Restoring Drop Switchboard.

A PERFECT APPARATUS.

Made in any desired capacity.

Sample parts and quotations on request.

INTERNATIONAL TELEPHONE MANUFACTURING CO.

CHICAGO, U. S. A.

Our

AUTOMATIC TELEPHONE SYSTEM

Wins

THE GRAND PRIZE

At the WORLD'S FAIR, St. Louis

In Open Competition with the World

We are the only **INDEPENDENT** Telephone Manufacturers to receive this, the highest honor the officials could confer.

The same superiority of equipment which won this award for us has caused the adoption of our apparatus by Independent companies in the following cities:

Chicago, Ill.	Lewiston, Maine	Sioux City, Iowa	Westerly, R. I.	Pentwater, Mich.
Grand Rapids, Mich.	Auburn, Maine	Cleburne, Texas	Manchester, Iowa	Toronto Jct., Can.
Columbus, Ohio	Fall River, Mass.	Columbus, Ga.	Princeton, N. J.	Wilmington, Del.
Dayton, Ohio	New Bedford, Mass.	Augusta, Ga.	Albuquerque, N. M.	Riverside, Cal.
Lincoln, Neb.	Los Angeles, Cal.	Medford, Wis.	Van Wert, Ohio	Traverse City, Mich.
Portland, Maine	San Diego, Cal.	St. Marys, Ohio	Battle Creek, Mich.	and
Auburn, N. Y.	Hopkinsville, Ky.	Woodstock, N. B.	Clayton, Mo.	Berlin, Germany

AUTOMATIC ELECTRIC COMPANY

CHICAGO, U. S. A.

PRACTICAL FEATURES OF TELEPHONE WORK.

By A. E. DOBBS.

Cloth, 7 by 5 1-4 Inches. Illustrated. 134 pages. Appendix. 75 Cents.

THIS work is designed as a simple, plain-speaking handbook for the practical telephone man. Its author, Mr. Dobbs, has been eminently fitted by fourteen years' experience in telephony to deal with the subject in a thoroughly competent manner. This he has done, and the result is a mine of information, clearly and concisely presented, and invaluable to the manager, operator and lineman alike. The appendix contains reliable data regarding wires, resistance, inductive capacity, etc.

This or any other book on telephony or electricity sent to any address, postpaid, on receipt of price.

ELECTRICIAN PUBLISHING CO.,
510 MARQUETTE BUILDING, CHICAGO.

CORDS AND CABLES

We manufacture Cords of all descriptions used in conjunction with Telephone and Switchboard work, also Cables for Switchboard and Interior Purposes.

Write us for Prices

RUNZEL-LENZ ELECTRIC MFG. CO.
97-101 S. CLINTON STREET CHICAGO

We introduced successful 4-party lines

LEICH SELECTIVE SYSTEM

Write for our booklet—"Selective W."

Impedance Coil for Selectives. No Springs.

CENTRAL ENERGY OR MAGNETO

AMERICAN ELECTRIC TELEPHONE CO.
CHICAGO, ILLINOIS

TELEPHONE PRINCIPLES AND PRACTICE

A NEW BOOK IN TELEPHONY

By
GEORGE WALKER WILDER, PH. D.
Professor in Telephony in the Armour Institute of Technology

Complete and up-to-date, written by a practical man. All about modern telephone apparatus, their principles and use:

I. Fundamental Ideas
II. Telephone Apparatus
III. Systems of Communication
IV. Construction and Equipment

IN 32 CHAPTERS, 450 PAGES, 375 ILLUSTRATIONS. PRICE $2.00 POSTPAID.

Send Postal Money Order to

THE CANTWELL PRESS - Madison, Wis.

PRODUCERS AND WHOLESALERS OF WHITE CEDAR PRODUCTS

CEDAR POLES

SPECIAL PRICES ON SMALL POLES.
Write for a copy of our TELEGRAPH CODE FOR CEDAR PRODUCTS

YARDS
KOSS MICH.
L'ANSE "
MUNISING "
ONTONAGON
WAGNER, WIS
PESHTIGO "

C. H. WORCESTER CO.
SUITE 1206 TRIBUNE BLDG. CHICAGO.

POLES W. C. STERLING & SON, MONROE, MICH. Eleven Pole Yards in Michigan. Wholesale Producers for 20 years TIES.

Southern Cedar POLES Are the Best.
NO ROTTEN BUTTS. D. W. PHELAN, 277 Broadway, New York

MICHIGAN WHITE LARGE STOCK.
CEDAR POLES
PROMPT SHIPMENTS. KELLOGG SWITCHBOARD & SUPPLY CO., Chicago.

POLES. WHITE CEDAR. IDAHO CEDAR up to 80 ft.
BERTHOLD & JENNINGS, ST. LOUIS. Chemical Building.
CROSS ARMS. LONG LEAF PINE AND FIR.

BRACKETS—X ARMS—PINS
little things it is true, but they cut a big figure in line construction.
OUR MOTTO IS:
Prompt Shipment Quality Satisfaction Right Price
COLUMBIA MFG. CO. ANTIGO, WIS.

Points in Wisconsin and the Northwest
are covered by Wisconsin Central Railway's convenient, solid, wide vestibuled trains, equipped with Pullman sleepers, free reclining chair cars and modern coaches which leave Central Station, 12th Street and Park Row (Lake Front), Chicago for St. Paul, Minneapolis, Ashland and Duluth, connecting with all western lines. Meals in dining and cafe cars served a la carte.
For tickets and further information apply to nearest ticket agent, or write
JAS. C. POND, Gen'l Pass. Agt., Milwaukee, Wis.

CEDAR POLES, POSTS, TIES,
H. M. LOUD'S SONS CO., Au Sable, Mich.

STUDENTS
Will find that the WESTERN ELECTRICIAN can help them wonderfully in the study of electricity. Subscribe now.
$3.00 per year, in advance.
Electrician Publishing Co.,
suite 510 Marquette Bldg., - CHICAGO

CEDAR POLES
ESTABLISHED 1862
WM. MUELLER COMPANY
1211-12-13 MARQUETTE BLDG. CHICAGO.
EIGHT DISTRIBUTING YARDS

POLES, TIES, POSTS. THE PORTER CEDAR CO., SAGINAW, MICH.
PRODUCERS. We want your inquiries always.

The Electrician Publishing Co., 510 Marquette Bldg., Chicago. Headquarters for all latest Electrical Books. Write for Catalogue.

POLE DEALERS ADVERTISING IN THE WESTERN ELECTRICIAN OBTAIN MOST EXCELLENT RESULTS BECAUSE IT PLACES THEM IN TOUCH WITH ACTUAL BUYERS OF POLES. TRY A CARD.

CENTRAL STATION HEATING

We are the originators and builders of the underground system of live and exhaust steam heating. Our system is used for the utilization and distribution of exhaust steam from electric and power plants for heating purposes. 250 Plants in successful operation. We have the only Meter System. Also manufacturers of Wooden Water Pipe, Steam Pipe Casing, Steam Traps, Condensation Meters, Valves, Economizing Coils, Separators and full line of Steam Fitters' Supplies.

WRITE FOR PAMPHLET AND PRICE LIST

AMERICAN DISTRICT STEAM COMPANY
MENTION WESTERN ELECTRICIAN. LOCKPORT, N.Y. CHICAGO, ILL.

Cedar Poles.

Pittsburg and Lake Superior Iron Co. Producers and Wholesalers. Escanaba, Mich.

SIX-INCH THIRTIES. If you're going to buy any this year get our price; 7-inch 25s are on the same list. Of course we have every size you ever needed, but we have too many of these two sizes.

MALTBY CEDAR COMPANY, 509 Phoenix Block, Bay City, Michigan.
Pittsburg Agents, Tipper & Patton, 509 Bessemer Building.

Cedar TORREY CEDAR CO., CLINTONVILLE, WIS. **Poles**
Large Stock Constantly on Hand

MICHIGAN AND WESTERN **CEDAR POLES**
ALL LENGTHS AND SIZES
LINDSLEY BROS CO.
TRIBUNE BLDG., CHICAGO

Idaho Cedar Poles
PACIFIC COAST POLE CO. SPOKANE, WASH.

Poles and Ties
The Fowler Companies
TRADE MARK
Fisher Bldg. Chicago

CEDAR POLES
THE
Valentine-Clark Co.
234 La Salle Street, CHICAGO
YARDS:
Pinconning, Mich. : Green Bay, Wis. : New London, Wis.

....BINDERS....
FOR THE
Western Electrician
$1.00 EACH.
ELECTRICIAN PUB. CO.,
CHICAGO.

Locations for Industries
Erie Railroad
Chicago to New York

The Erie Railroad Company's Industrial Department has all the territory traversed by the railroad districted in relation to resources, adaptability, markets and advantages for manufacturing, and can advise with manufacturers in relation to the most suitable locations. For full information address

LUIS JACKSON
Industrial Commissioner, Erie Railroad Company
21 Cortlandt Street, New York

WHITE CEDAR POLES
HALL L. BROOKS
52 WISCONSIN AVENUE
TOMAHAWK, WIS.

"By two or three witnesses shall a matter be established."

FIVE POINTS OF EXCELLENCE

Leaving the center of the city from which you start; reaching the center of the city of your destination, over smooth and level tracks; giving rest and comfort; riding beside running waters most of the way; through the centers of population to the gateways of commerce; when you travel by the

NEW YORK CENTRAL LINES

A copy of the Illustrated Catalogue of the "Four Track Series" will be sent free upon receipt of a two-cent stamp by George H. Daniels, General Passenger Agt., Grand Central Station, New York.

Practical Running of Dynamos.
A little booklet on the care and the locating and remedying of troubles in dynamos and motors.
Price, 10 Cents.
Catalogue of mechanical and electrical books free.
ELECTRICIAN PUBLISHING COMPANY,
510 Marquette Bldg., Chicago.

Telephone Troubles and How to Find Them.
A complete hand-book for telephone inspectors, by Wm. H Hyde and J. A. McManman.
NINTH EDITION. 52 PAGES. PRICE, 25 CENTS.
The large number of telephone exchange managers and employes will find this book a great help in locating telephone troubles and remedies therefor. Considerable new matter has been added in this edition.
Sent prepaid on receipt of price by the
Electrician Publishing Co., 510 Marquette Building, CHICAGO.

There is No Higher-Class India-Rubber Insulation For Wires and Cables than

HABIRSHAW.

Authorized Manufacturers of the
ATTIX FLEXIBLE TUBE WIRE.

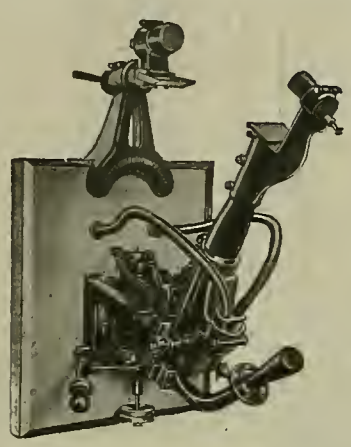
The India-Rubber and Gutta-Percha Insulating Co.,
MAIN OFFICE, Glenwood Works,
YONKERS, N. Y.
Sales Office,
16 Cortlandt St., New York.
(10925)

Westinghouse

Carbon Break Circuit-Breakers

Types

B C D

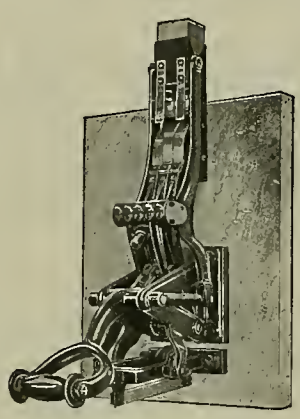


Alternating Current

For High-Potential Circuits
From 2,200 to 6,600 Volts.

Carrying Capacity
From 50 to 1,000 Amperes.

Operates successfully under any condition of inductive or non-inductive load



Direct and Alternating Current

For Circuits
not exceeding 750 Volts.

Carrying Capacity
From 200 to 10,000 Amperes.

Accurate as an Ammeter

Direct and Alternating Current

For Circuits
250 Volts D. C., 440 Volts A. C.

Carrying Capacity
From 10 to 400 Amperes.

For all methods of tripping Small, compact design, occupying little space

For particulars address nearest office of

Westinghouse Electric & Mfg. Co.

Pittsburg, Pa.

New York, Atlanta, Dallas, Baltimore, Boston, Buffalo, Chicago, Cincinnati, Cleveland, Detroit, Los Angeles, Minneapolis, New Orleans, Philadelphia, Pittsburg, St. Louis, Salt Lake City, San Francisco, Syracuse, Seattle, Denver, Mountain Electric Co.
For Canada: Canadian Westinghouse Co., Limited, Hamilton, Ontario. Mexico: G. & O. Braniff Co., City of Mexico.

THE POPULAR WATTMETER

TALKING POINTS THAT WORK
WORKING POINTS THAT TALK
Make the Type K Meter
the Popular Wattmeter

FORT WAYNE ELECTRIC WORKS
WOOD LIGHTING & POWER SYSTEMS
Fort Wayne, Ind.

POPULAR with consumers because it looks right

POPULAR with inspectors because "tamper" proof

POPULAR with managers because it registers right

POPULAR with repairmen because it stays right

POPULAR with treasurers because price is right

WE shall be glad to supply any of the books catalogued below upon receipt of your order and remittance. We prepay charges.

THE PRINCIPLES OF THE TRANSFORMER. By Frederick Bedell	$3.25
INDUCTION COILS. By G. E. Bonney	1.00
ELECTRICITY AND MAGNETISM. By S. R. Bottone	.90
ELECTRICITY, ELECTROMETER, MAGNETISM AND ELECTROLYSIS. By G. Chrystal and W. N. Shaw	1.60
THEORY OF ELECTRICITY. By L. Cumming	2.25
THEORY OF ELECTRICITY AND MAGNETISM. By Charles Emerson Curry	2.50
THE ELEMENTS OF ALTERNATING CURRENTS. By W. S. Franklin and R. B. Williamson	2.50
PRACTICAL EXERCISES IN MAGNETISM AND ELECTRICITY. By H. E. Hadley	.60
MISCELLANEOUS PAPERS. By Heinrich Hertz	3.25
A TEXT-BOOK ON ELECTROMAGNETISM AND THE CONSTRUCTION OF DYNAMOS. By Dugald C. Jackson	2.25
ALTERNATING CURRENTS AND ALTERNATING CURRENT MACHINERY. By D. C. Jackson and John Price Jackson	3.50
AN ELEMENTARY BOOK ON ELECTRICITY AND MAGNETISM AND THEIR APPLICATIONS. By D. C. Jackson and John Price Jackson	1.40
A FIRST-BOOK OF ELECTRICITY AND MAGNETISM. By W. P. Maycock	.60
ALTERNATING CURRENTS OF ELECTRICITY AND THE THEORY OF TRANSFORMERS. By Alfred Still	1.50
PRACTICAL ELECTRIC LIGHT FITTING. By A. C. Allsop	1.50
ELECTRICAL EXPERIMENTS. By G. E. Bonney	.75
RADIOGRAPHY AND THE "X" RAYS IN PRACTICE AND THEORY. By S. R. Bottone	1.00
THE DYNAMO: HOW MADE AND HOW USED. By S. R. Bottone	.90
HOW TO MANAGE THE DYNAMO. By S. R. Bottone	.60
A GUIDE TO ELECTRIC LIGHTING. By S. R. Bottone	.75
ELECTRIC LIGHT ARITHMETIC. By R. E. Day	.40
THE DYNAMO: ITS THEORY, DESIGN AND MANUFACTURE. By C. C. Hawkins and F. Wallis	3.00
THE ALTERNATING CURRENT CIRCUIT. By W. P. Maycock	1.00
ELECTRIC WIRING FITTINGS, ETC. By W. P. Maycock	1.75
ELECTRIC WIRING TABLE. By W. P. Maycock	1.50
A MANUAL OF TELEPHONY. By W. H. Preece and A. J. Stubbs	4.50
PRACTICAL TELEPHONE HANDBOOK AND GUIDE TO THE TELEPHONIC EXCHANGE. By Joseph Poole	1.50
ELECTRIC WIRING. By Russell Robb	2.50
ELECTRIC LIGHT CABLES AND THE DISTRIBUTION OF ELECTRICITY. By Stuart A. Russell	3.00
ELECTRICITY IN TOWN AND COUNTRY HOUSES. By Percy E. Scrutton	1.00
THE STORAGE BATTERY. By Augustus Treadwell	1.75

Electrician Publishing Company
510 Marquette Building, Chicago

Good Advice

One of the foremost doctors of electrical engineering was recently called upon to examine into the ills of a profitless direct-current light and power plant and, after making a diagnosis, he immediately prescribed Duncan Meters, with instructions that the remedy should be continued indefinitely to prevent a recurrence of the malady.

Send for Bulletin and Prices

DUNCAN ELECTRIC MFG. CO.
LAFAYETTE, IND.

"Diamond H" Switches

Trade H Mark

This Trade-Mark guarantees quality.

The Hart Mfg. Co., Hartford, Conn.

New York Boston Chicago Toronto, Ont.

WIRES AND CABLES

HIGH-GRADE, RUBBER-COVERED, WEATHER-PROOF

MAGNET, OFFICE, ANNUNCIATOR WIRE.

HAZARD MANUFACTURING CO.,

GENERAL OFFICE AND WORKS, Wilkesbarre, Pa. NEW YORK OFFICE, 50 Dey St. CHICAGO OFFICE, 71 and 73 West Adams St.

VULCANIZED FIBRE

Highest grades for electrical insulation and mechanical purposes, in sheets, tubes, rods and special shapes. Catalogues and samples on application.

VULCANIZED FIBRE CO., - Wilmington, Del.

KARTAVERT.

HARD AND FLEXIBLE FIBER IN SHEETS, RODS AND TUBING.

For Electrical and Mechanical Purposes, Railway Dust Guards, Washers and Packings. Patent Insulating Cleats.

MANUFACTURED BY

THE KARTAVERT MANUFACTURING CO. Wilmington, Del.

Always Ready
Reliable and Strong
Long Lived.

WRITE FOR PRICES.

THE F. BISSELL COMPANY

MANUFACTURERS AND JOBBERS OF

ELECTRICAL GOODS,

228-228-230 HURON STREET,

TOLEDO, O.

STURTEVANT MOTORS

All Types, Sizes and Capacities to Meet Any Requirements

B. F. STURTEVANT CO.

Boston, Massachusetts

General Office and Works: Hyde Park, Mass.

New York Philadelphia Chicago London

364

Warren Alternator

It's not the Old-Fashioned

kind that revolves a bundle of copper wire and a mysterious set of copper rings one or two thousand revolutions a minute, and takes brushes and intricate apparatus to collect the current and get it out on the circuit wires.

WE GUARANTEE WHAT WE SELL

and

SELL WHAT WE GUARANTEE

WARREN ELECTRIC MFG. CO.

Sandusky, O.

Black Diamond File Works

Est. 1863. Inc. 1895.

Twelve Medals Awarded at International Expositions

Special Prize Gold Medal at Atlanta, 1895.

OUR GOODS ARE ON SALE IN EVERY LEADING HARDWARE STORE IN THE UNITED STATES AND CANADA.

G. & H. BARNETT COMPANY,

PHILADELPHIA, PA.

JOHN A. ROEBLING'S SONS CO.

Insulated Wire of All Kinds

Bare Copper Wire

MAIN OFFICE AND WORKS TRENTON, N. J.

AGENCIES AND BRANCHES

New York Chicago Cleveland San Francisco Philadelphia Atlanta

Western Electrician

Vol. XXXV. $3.00 Per Annum. Copyright, 1904, by Electrician Publishing Company, Chicago. CHICAGO, NOVEMBER 19, 1904. 10 Cents a Copy. No. 21.

Technology Quarterly Mass. Inst. of Technology Boston Mass

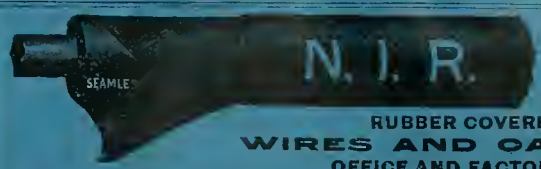
mail matter of the second class.

SIMPLEX INSULATED WIRES AND CABLES.

RUBBER COVERED, WEATHERPROOF, UNDERGROUND AND SUBMARINE.

WESTERN SELLING AGENT, H. R. HIXSON, Monadnock Block, CHICAGO.

The Simplex Electrical Co., 110 State Street, BOSTON, MASS.



National India Rubber Co.'s

RUBBER COVERED WIRES AND CABLES.

OFFICE AND FACTORY: BRISTOL, R. I.

TRADE MARK.

1889—Paris Exposition, Medal for Rubber Insulation.

1893—World's Fair, Medal for Rubber Insulation.

THE STANDARD FOR RUBBER INSULATION.

Sole Manufacturers of

Okonite Wires, Okonite Tape, Manson Tape, Candee Weather-proof Wires.

THE OKONITE CO., LTD.

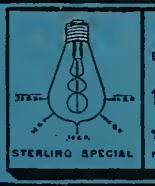
Willard L. Candee, Durant Cheavar, Managers. 253 Broadway, New York. Geo. T. Manson, Gen'l Supt. W. H. Hodgins, Secy.

CRESCENT RUBBER INSULATED WIRES AND CABLES

National Code Standard.

CRESCENT INSULATED WIRE AND CABLE CO.,

New York Office, 63 BARCLAY STREET. Main Office and Factory, TRENTON, N. J.



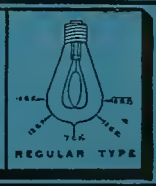
DO YOU?

BUY LAMPS—OR—BUY CANDLE POWER

16 {THIS LAMP AVERAGES} 12

THE STERLING ELECTRICAL MANUFACTURING CO.

NEW YORK, N. Y. WARREN, O. CHICAGO, ILL.



INDIANA RUBBER AND INSULATED WIRE CO.,

MANUFACTURERS OF

Paranite Rubber Covered Wires and Cables,

UNDERGROUND, AERIAL, SUBMARINE AND INSIDE USE;

TELEPHONE, TELEGRAPH AND FIRE ALARM CABLES.

All Wires are tested at Factory. JONESBORO, IND.

I-T-E

CIRCUIT BREAKERS

CUTTER ELECTRICAL CO., PHILADELPHIA

THOUSANDS IN USE.

Motors, ½ h. p. to 100 h. p. Dynamos, 1 k. w. to 75 k. w. Highest Quality. Reasonable Price. THE HOBART ELECTRIC MFG. CO. TROY, OHIO.

THERMOPILES 1½ VOLTS 1½ AMPERES

For Electrolytic analysis, charging storage batteries, and other constant current requirements. $3 Each.

WALSH'S SONS & CO., 264 Washington Street. Newark, N. J.

SINGLE AND POLYPHASE

TRANSFORMERS

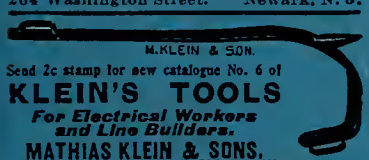
KUHLMAN ELECTRIC CO., - - Elkhart, Ind.

COLOR YOUR OWN LAMPS WITH "Signaloid"

Signaloid Chemical Works

KLIEGL BROS., Props.

1393-5 BROADWAY, NEW YORK



M. KLEIN & SON.

Send 2c stamp for new catalogue No. 6 of

KLEIN'S TOOLS

For Electrical Workers and Line Builders.

MATHIAS KLEIN & SONS, 81 W. Van Buren St., Chicago, Ill.

"CIRCULAR LOOM"

THE FLEXIBLE CONDUIT

AMERICAN CIRCULAR LOOM CO.

TRADE MARK

REGISTERED

CONDUITS FOR INTERIOR WIRING.

American Circular Loom Co.

Chelsea, Mass., New York, Chicago, San Francisco.

DON'T BUY ELECTRICAL SUPPLIES

Until you have seen our new Catalogue and new Price List.

Free to the trade.

Manhattan Electrical Supply Co.

NEW YORK: 32 Cortlandt St. CHICAGO: 188 Fifth Ave.

KESTER SELF FLUXING SOLDER

A Tube of Solder Filled with Flux. Requires no Acid.

SAVES—LABOR—TIME—MONEY.

PATENTED.

Send for Free Samples.

L. F. Mabler Co., R. 1008 Chemical Bldg., St. Louis, Mo., Gen. Western Agent.

KESTER ELECTRIC M'F'G CO., 46 N. UNION STREET, CHICAGO, ILL.

"STAR" INCANDESCENT LAMPS

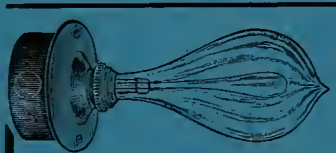
LONG LIFE

GUARANTEED CANDLEPOWER,

HIGHEST EFFICIENCY.

MADE BY THE MOST SKILLED WORKMEN.

STANDARD ELECTRICAL MFG. COMPANY, : Niles, Ohio.



Some More Light on our Drawn Steel Junction Boxes

Take time to figure out the cost of cast iron boxes plus the loss from breakage and time used in producing a round hole. Compare with this the cost of drawn steel boxes.

NO BREAKAGE,

Clean round hole produced with one blow of a hammer. Write for catalog and see what you can save.

BOSSERT ELECTRIC CONSTRUCTION CO. - - UTICA, N. Y.

WESTON Electrical Instrument Co.,

Waverly Park, NEWARK, N. J.

Weston Portable Galvanometer for Bridge Work.

Weston Standard Portable Direct Reading

Voltmeters, Millivoltmeters, Voltammeters, Ammeters, Milammeters,

Ground Detectors and Circuit Testers,

Ohmmeters, Portable Galvanometers.

Our Portable Instruments are recognized as **The Standard** the world over. The **Semi-Portable Laboratory Standards** are still better

Our **Station Voltmeters and Ammeters** are unsurpassed in point of extreme accuracy and lowest consumption of energy.

BERLIN—European Weston Electrical Instrument Co., Bitterstrasse No. 88.

LONDON—Elliott Bros., Century Works, Lewisham.

PARIS, FRANCE—E. H. Cadiot, 12 Rue St. Georges.

New York Office—74 Cortlandt St.

HIPWELL

Expanding Wire Guard; also manufacturer of high-grade, long-distance

TELEPHONES

Switchboards and Cable Terminals.

Hipwell Mfg. Co.

ALLEGHENY, PA.

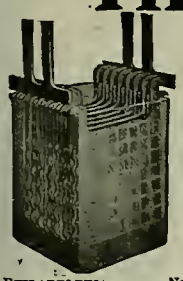
Have you read it ?

Free
Send for it

Canadian Representatives, Allis-Chalmers-Bullock, Ltd., Montreal

THE ELECTRIC STORAGE BATTERY CO.

PHILADELPHIA



MANUFACTURER OF THE

"Chloride Accumulator"

For Central Stations, Electric Railways, Isolated Lighting and Power Stations, Fire Alarm, Telegraph, Train Lighting, etc., etc.

PRICE LISTS AND DESCRIPTIVE BULLETINS FORWARDED UPON REQUEST.

SALES OFFICES:

PHILADELPHIA, Allegheny Ave. and 19th St. | NEW YORK, 100 Broadway, | BOSTON, 60 State St. | CHICAGO, Marquette Bldg. | ST. LOUIS, Wainwright Bldg. | SAN FRANCISCO, Rialto Bldg. | CLEVELAND, Citizens Bldg. | CANADA, Canadian General Electric Co., Ltd. Toronto | HAVANA, CUBA, G. F. Greenwood, Manager 34 Empedrado St.

"Diamond H" Switches

Trade H Mark

This Trade-Mark guarantees quality.

The Hart Mfg. Co., Hartford, Conn.

New York Boston Chicago Toronto, Ont.

TO THE TRADE

Regarding the action brought by the American Circular Loom Company on the pretense of our product, FLEXDUCT, being an alleged infringement of the Herrick Patent, No. 456,271, under which they have been operating, would state, briefly, that their conduit made under this Herrick Patent, is known on the market as that form of Flexible Conduit in which the insides can be readily removed, and consists in construction of a coil of fiber with a wrapping of tape covering the openings in said coil, and an outside woven covering, while FLEXDUCT is a woven product throughout and does not resemble in construction the structure of the Herrick Patent in any respect.

We are advised by our Attorneys, who are thoroughly familiar with the art, that we do not infringe and that ours is a broad patent fully covering and protecting our form of construction.

This action, brought at this particular time, in our opinion is simply for commercial effects, that it may confuse those who are not well informed of the facts.

The trade should not be coerced to purchase material by any threats as we will protect and defend the trade against any loss whatsoever, under any suit brought on account of the use, purchase, or sale of our product, FLEXDUCT.

Yours very truly,

OSBURN FLEXIBLE CONDUIT COMPANY

New York, 21 Park Row *Chicago, 529-30 Monadnock Block*

Electric Heating Apparatus

SEND FOR 62-PAGE CATALOGUE.

UNIT" ENAMELED RHEOSTATS

SIMPLEX ELECTRIC HEATING CO.,

Cambridgeport, Mass.

INSULATED WIRES

COTTON AND SILK

NORTHERN WIRE & CABLE CO.

OFFICES: Milwaukee, 740-742 Wells Bldg. Chicago, 1202 Marquette Bldg.

MAGNET WIRES

South Milwaukee Wis.

Prometheus Electric Heating and Cooking Apparatus.

Send for Illustrated Catalogue.

THE PROMETHEUS ELECTRIC CO.,

39 Cortlandt St., New York

PLATINUM

PLATINUM RIVETS FOR CONTACT POINTS IN TELEPHONES—SPARK COILS AND OTHER ELECTRICAL APPARATUS. PLATINUM SHEET AND WIRE IN ANY FORM AND DEGREE OF HARDNESS. PLATINUM SCRAP PURCHASED.

BAKER & COMPANY, Inc.

ARTISANS IN PLATINUM

408-410-412-414 N. J. R. R. AVE. - NEWARK, N. J.

New York Office: 120 Liberty St.

ALPHABETICAL INDEX TO ADVERTISEMENTS.

Adams-Bagnall Electric Co.. 7
Allis-Chalmers Company..... 2
American Battery Co.....10
Amer. Circular Loom Co.... 1
American Conduit Co.....16
Amer. District Steam Co.....19
Amer. Elec. Fuse Co..... 8
Amer. El. Telephone Co.....16
American Electrical Works..11
Arnold Elec. Power Station Co.....15
Audit Co. of Ill., The.....—
Automatic Electric Co..... 17

Babcock & Wilcox Co.....—
Badt, F. B.....15
Bain, Forée.....11
Baker & Company..... 3
Baker & Co., W. E.....15
Barnett Company, G. & H....22
Beardslee Chandelier Mfg. Co.....—
Benjamin Electric Mfg. Co..—
Bennett, I. A..... 9
Berthold & Jennings.....19
Big Four Route.....—
Bissell Co., The F..... 8
Bossert Electric Construction Co..... 1
Brooks, Hall L.....19
Bryan-Marsh Co.....—
Bryan, Wm. H.....15
Buckeye Electric Co.....—
Bullock Elec. Mfg. Co..... 2
Burlington R. R.....18
Butterfield, J. F.....15
Byllesby & Co., H. M.....15

Cantwell Press, The.....—
Carhartt & Co., Hamilton....—
Central Electric Co..... 5
Cent. Stat. Improvement Co.....12
Central Tel. & El. Co.....16
Century Electric Co.....10
Chicago Die & Electric Co....15
Chicago Edison Co.....4, 12
Chic. Fuse Wire & Mfg. Co...—
Chicago Insulated Wire Co..—
Chicago Mica Co.....10
Clinton Stamping & Elec. Co.16
Columbia Incand. Lamp Co..—
Columbia Mfg. Co.....18
Continuous Rail Joint Company of America..... 11
Cooper-Hewitt Elec. Co..... 8
Cope, T. J..... 9
Crawfordsville Electric Co..—
Crescent Ins. Wire & Chl. Co. 1
Crocker-Wheeler Company...13
Cutler-Hammer Mfg. Co..... 4
Cutter Elec. & Mfg. Company 1

D. & W. Fuse Company.....—
Dearborn Drug & Chem. Wks.14
Detroit Electric Co..... 8
Diamond Meter Company....18
Directory of Engineers..... 15
Dixon Crucible Co., Joseph..14
Duncan Elec. Mfg. Co.....22

Edison Decorative & Miniature Lamp Departm't.....10
Edison Mfg. Company.....—
Edwards & Co.....13
Egan, J. J.....15
Electric Appliance Co..... 10
Electric Storage Battery Co.. 3
Electrical Appliance Co.....—
Electrical Engineer Institute.13
Electrician Pub. Company...17
Erie Ry.....19
Evans, Almirall & Co..... ..15

Faries Mfg. Co.....11
"For Sale" Advertisements..12
Ft. Wayne Elec. Works, Inc..21
Fostoria Incand. Lamp Co...—
Fowler, John H.....19
Fowler-Jacobs Company.....19
Franklin Elec. Mfg. Co .....—

General Electric Co..... 9
General Engineering Co., The 15
General Incandescent Arc Light Company.....—
General Incand. Lamp Co.....—
Gould Storage Battery Co.... 6
Gt. Western Smelting & Refining Co.....12
Green Fuel Economizer Co..14
Gregory Electric Company...12

Hallberg, J. H.....15
Haller Machine Co.....—
Hart Mfg. Co..... 3
Hartford Steam Boiler Inspection & Insurance Co....—
Hazard Manufacturing Co...—
Highland Park College. 15
Hipwell Mfg. Co..... 1
Hobart Elec. Mfg. Co..... 1
Hoffman, G. W.....12
Holmes Fibre-Graph. Co.....—
Holophane Glass Co.....—
Humphrey, Henry H.....15
Hunt & Co., Robt. W.....15

Illinois Central Ry.....12
Incandescent Electric Light Manipulator Company.....—
Indiana Rub. & Ins. W. Co.... 1
India Rubber & Gutta Percha Insulating Company.....—
International Elec. Meter Co 12
International Tel. Mfg. Co...16

Jackson, D. C. & W. B.....15
Jeffrey Manufacturing Co....14
Jewell Electrical Inst. Co....—
Johns-Manville Co., H. W..... 4

Kartavert Manufacturing Co.—
Kellogg Switchboard & Supply Company.....17, 19
Kemp, R. W..... 15
Kester Elec. Mfg. Co..... 1
Klein & Sons, Mathias..... ... 1
Kohler Brothers.....15
Kuhlman Electric Co..... 1

Leather Preserv. M. Corp....19
Leffel & Co., James..... 14
Lindsley Brothers Company..18
Loud's Sons Co., H. M.....—

Machado & Roller..... 8
Malthy Cedar Company.....19
Manhattan El. Supply Co.... 1
Manross, F. N..... .....—
Marinette Gas Engine Co.....14
Matthews & Bros., W. N.....11
McLaughlin, James..... .....—
McLaughlin & Co., Jas..... 9
McLennan & Company, K....10
Measured Service Co.....—
Mechanical Appliance Co....19
Merriam Co., G. & C.....12
Mica Insulator Company.....10
Minnesota Electric Co.....—
Miscellaneous Advs.....12
Monon Railroad..... ..12
Morrison Lbr. Co., J. W.....18
Mueller Company, William..19
Munsell & Co., Eugene.....10

National Electric Co.....15
National India Rubber Co.... 1
New England Butt Co.....14
Newgard & Co., Henry.....13
New York Cent. Ry.....19
New York Ins. Wire Co.....11
Northern Elect'l Mfg. Co....10
Northern Wire & Cable Co... 3
Northwestern Storage Battery Co.. ... .13

Okonite Co., The..... 1
Olds Gasoline Engine Works.14
Osburn Flexible Conduit Co. 3

Pacific Coast Pole Co.....18
Paragon Fan & Motor Co.....—
Pardridge Shade & Refl. Co..—
Pass & Seymour, Inc..... 4
Phelan, D. W.....18
Phillips, Eugene F.....11
Phillips Insulated Wire Co...11
Phœnix Glass Co.....—
Phosphor-Bronze S. Co.....14
Pignolet, L. M.....10
Pittsburg & L. S. Iron Co....18
Plume & Atwood Mfg. Co....22
Porter Cedar Company.....—
Prometheus Electric Co., The 3

Reisinger, Hugo..... 9
Reynolds El. Flasher Mfg. Co.15
Roebling's Sons Co., J. A.....22
Ruebel-Schwedtmann-Wells..15
Runzel-Lenz Elec. Mfg. Co...—

Safety Ins. Wire & Cable Co..22
Sargent & Lundy.....15
Sauquoit Silk Mfg. Co.....11
Schott, W. H.....15
Signaloid Chemical Works... 1
Simplex Electrical Co., The.. 1
Simplex Elec. Heating Co.... 3
Speer Carbon Co..... .—
Sprague Electric Company...11
Squire Electric Co.....—
Standard Elec. Mfg. Co..... 1
Standard Underg. Cable Co....—
Stanley Elec. Mfg. Co., The 8
Stanley Instrument Co..... 5
Stanton, LeRoy W..... 15
Sterling & Son, W. C.....19
Sterling Electrical Mfg. Co.... 1
Sterling Varnish Co., The....11
Stow Mfg. Company.....—
Stromberg-Carlson Tel. Mfg. Company.....17
Sturtevant Company, B. F....22

Temple Pump Co.....10
Torrey Cedar Company.....18
Trumbull Elec. Mnfg. Co.....—
Turner Brass Works.....16

Union Electric Mfg. Co.....—

Valentine-Clark Co., The....—
Vulcanized Fibre Company..22

Wagner Electric Mfg. Co.....13
Walsh's Sons & Company..... 1
Warren Elec. Mfg. Co.....13
Wesco Supply Co.....10
Western Electric Company... 5
Westinghouse Electric & Manufacturing Co.....20
Weston Electrical Inst. Co... 1
Whitehead Machinery Co.... 12
Whitney Electrical Inst. Co..—
Wilmerding, C. H.....—
Wisconsin Central Ry.....19
Woolley Fdy. & Mach. Wks..14
Worcester Company, C. H....18

Yesbera Mfg. Co..... .. 16
Yost Electric Mfg. Co 11

Zero Marx Sign Works .....—

For Classified Index of Advertisements See Page 6.

Motors, Switches, Arc Lamps, Circuit Breakers, Etc., Etc.

ALWAYS IN STOCK.

MANUFACTURED BY

G. E. Co.

CHICAGO EDISON COMPANY, 139 Adams Street. CHICAGO.

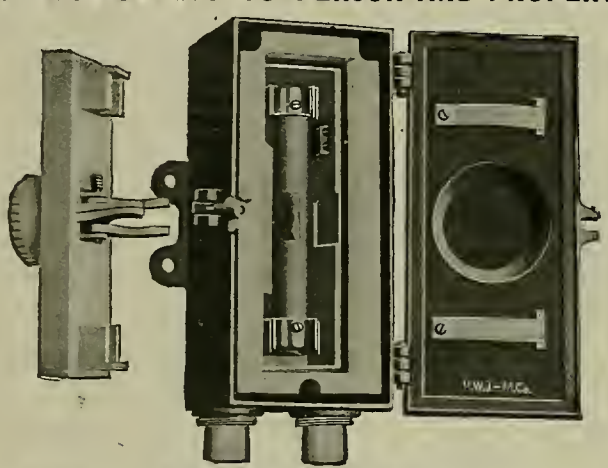
SACHS TRADE NOARK MARK FUSE

PORCELAIN LINED

2,500-VOLT

SERVICE BOXES

ABSOLUTE SAFETY TO PERSON AND PROPERTY.



FOR OVERHEAD CONSTRUCTION
(can be adapted to subway construction)

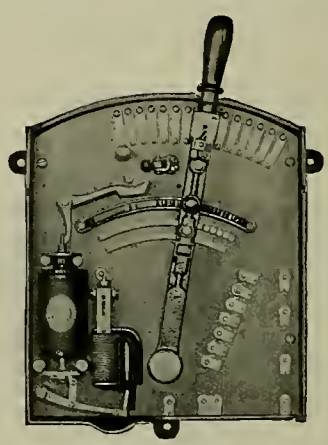
No bending or twisting of line wire in connecting box. Can be mounted directly on cross arms. 1-30 Amp. size now ready. 31-60 and 61-100 Amp. in preparation.

For further particulars and prices write

MILWAUKEE CHICAGO ST. LOUIS CLEVELAND PITTSBURG **H. W. JOHNS-MANVILLE CO.** BOSTON PHILADELPHIA LONDON PARIS BRUSSELS

100 WILLIAM ST., NEW YORK.

Flat Bed and Small Rotary Press Controllers



One of the six "Carpenter" types.

The "Carpenter" system gives such a wide range of speed and such perfect control that a press can be moved an eighth of an inch at a time, and from that to top speed, with every desirable intermediate speed.

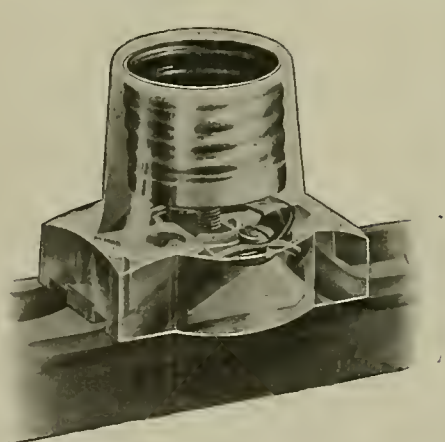
Six types, alike in principle, different in detail. Bulletins 81 to 86 explain. We'll send them if you let us know that you want them.

The Cutler-Hammer Mfg. Co.,

Electric Controller Manufacturers and Electrical Engineers.

MILWAUKEE, WIS.

New York, Boston, Chicago, Pittsburg.



P. & S. Moulding Receptacles

ARE EASILY INSTALLED

Write for Prices

PASS & SEYMOUR, Inc.

Solvay, N. Y.

New York Chicago San Francisco

Type 420

ARC LAMPS

Multiple Series Constant Current
Direct Current Circuit
Bulletin 7030

Multiple Constant Potential
Alternating Current
Bulletin 7035

Multiple Constant Potential
Direct Current
Bulletin 7040

Western Electric Company

CHICAGO NEW YORK

AND OTHER LARGE CITIES

Type 425

OKONITE TRADE MARK.

DON'T BUY TROUBLE

OKONITE TRADE MARK.

It costs you money, time and temper. The best way is to have the work done right at the start. Specify that all wire used in your installation shall be Okonite, that all wire joints shall be taped, first with Okonite rubber tape, then with Manson Friction tape IT IS CHEAPEST IN THE LONG RUN.

Central Electric Company,
GENERAL WESTERN AGENTS

264-266-268-270 FIFTH AVENUE, CHICAGO.

ELECTRICITY FOR ENGINEERS. 424 PAGES. ILLUSTRATED. PRICE $2.50.
ELECTRICIAN PUBLISHING CO., 510 Marquette Building, • • CHICAGO.

STANLEY RECORDING WATTMETERS

FOR ALTERNATING-CURRENT CIRCUITS

BALANCED THRUST No Jewel Wear from Hammer or Side Thrust. Class or Metal Covers, Second Alone to the
STANLEY MAGNETIC SUSPENSION WATTMETERS

Missouri, Kansas, Arkansas
FRANK ADAM ELECTRIC CO.
St. Louis

Colorado, Idaho, Montana, Wyoming
New Mexico, Utah
HENDRIE-BOLTHOFF MFG. AND SUPPLY CO.
Denver

SEND FOR BULLETINS AND INFORMATION ABOUT METERS TO

STANLEY INSTRUMENT CO.

GREAT BARRINGTON MASS., U. S. A.

Mexico
VICTOR M. BRASHI & CO.
Mexico City

California, Oregon, Washington
Nevada, Arizona
BROOKS-FOLLIS ELECTRIC CORP.
San Francisco

Gould Storage Battery Co.

Complete Storage Battery Plants

Railway Line and Regulating Isolated and Train Lighting Central Lighting and Power Electric Vehicle and Telephone

GOULD COUNTER E. M. F. BOOSTER SYSTEMS

Sales Offices { NEW YORK, 1 W. 34th Street. BOSTON, 89 State Street. CHICAGO, The "Rookery." SAN FRANCISCO, Century Electric Co.

WORKS: DEPEW, N. Y.

Bulletins.

CLASSIFIED INDEX OF ADVERTISEMENTS.

Accountants and Auditors.
Audit Co. of Illinois

Adjusters, Cord.
Incandes. El. Lt. Manip. Co.

Adjusters, Inc. Lamps.
Inc. El. Lt. Manipulator Co.

Anchors (Tel. & Tel.)
Bennett, I. A.
Matthews & Bro., W. N.

Annunciators.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Moon Mfg. Co.
Wesco Supply Co.
Western Electric Co.

Batteries and Jars.
Bissell Co., The F.
Central Electric Co.
Edison Mfg. Co.
Edwards & Company.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.

Bells, Buzzers, Etc.
Central Electric Co.
Edwards & Co.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.

Belt Dressing.
Dixon Crucible Co., Jos.
Leather Preserver Mfg. Corp.

Belting.
Leather Preserver Mfg. Corp

Blow Pipes.
Turner Brass Works

Blowers.
Sturtevant Co., B. F.

Boiler Compounds.
Dearborn Drug & Chem. Wks.

Boilers.
Allis-Chalmers Company.
Babcock & Wilcox Co.

Books, Electrical.
Cantwell Press, The.
Electrician Publishing Co.

Booths, Telephone.
Yesbera Mfg. Co.

Brackets.
Faries Mfg. Co.

Brushes.
Central Electric Co.
Hobart Elec. Mfg. Co.
Holmes Fibre-Graphite Co.
Speer Carbon Co.
Western Electric Company.

Cable Hangers.
Bissell Co., B. F.
Western Electric Co.

Cables (See Wires and Cables)

Canopies.
Faries Mfg. Co.

Carbons, Points and Plates.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
Reisinger, Hugo.
Speer Carbon Co.
Wesco Supply Co.

Castings.
Faries Mfg. Co.
New England Butt Co.
National Electric Co.

Chains.
Jeffrey Mfg. Co.

Chandeliers.
Faries Mfg. Co.

Circuit Breakers.
Cutler-Hammer Mfg. Co.
Cutter Elec. & Mfg. Co.
Ft. Wayne Elec. Wks. Inc.
Union Electric Mfg. Co.
Western Electric Company.
Westinghouse El. & Mfg. Co.

Clusters.
Benjamin Elec. Mfg. Co.
Faries Mfg. Co.

Coal and Ashes Handling Machinery.
Jeffrey Mfg. Co.

Coils and Magnets.
Western Electric Co.

Coloring, Lamp.
Signalold Chemical Works.

Commutator Compound
Egan, J. J.
McLaughlin & Co., Jas.
McLennan & Co., K.

Condensers, Electric.
Stanley Elec. Mfg Co.

Conduit and Conduits.
American Circular Loom Co.
American Conduit Company
Central Electric Co.
Electric Appliance Co.
Osburn Flexible Conduit Co.
Sprague Electric Co.
Standard Vitrified Cond. Co.
Wesco Supply Co.

Contractors and Electric Light Plants.
Allis-Chalmers Company.
Bullock El. Mfg. Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
National Electric Co.
Northern Electrical Mfg. Co.
Sprague Electric Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Controllers, Crane.
Amer. Elec. Fuse Co.

Copper, Scrap.
Great Western Smelting & Refining Co.

Cord.
Runzel-Lenz Elec. Mfg. Co

Cross-Arms, Pins and Brackets.
Berthold & Jennings.
Central Electric Co.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Company.

Cut-Outs and Switches.
Bissell Co., The F.
Bossert Elec. Const. Co.
Central Electric Co.
Chicago Edison Co.
Clinton Stamping & Elec. Co.
Crouse-Hinds Co.
Cutter Elec. & Mfg. Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
General Inc. Arc Light Co.
Hart Manufacturing Co.
Manhattan Elec. Supply Co.
Trumbull Elec. Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Dictionaries.
Merriam Co., G. & C.

Dynamos and Motors.
Allis-Chalmers Company.
Bissell Co., The F.
Bullock Elec. Mfg. Co.
Central Electric Co.
Century Electric Co.
Crawfordsville Electric Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks. Inc.
General Elec. Co.
General Inc. Arc Light Co.
Gregory Electric Co.
Hobart Elec. Mfg. Co.
Mechanical Appliance Co.
National Electric Co.
Northern Electrical Mfg. Co.
Sprague Electric Co.
Stanley Elec. Mfg. Co.
Stow Manufacturing Co.
Sturtevant Co., B. F.
Wagner Electric Mfg. Co.
Warren Elec. Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Economizers, Fuel.
Green Fuel Economizer Co.

Electric Heating Appl.
Electric Appliance Co.
Prometheus Electric Co.
Simplex Elec. Heating Co.
Western Electric Co.

Electric Railways.
Crocker-Wheeler Co.
General Electric Co.
Sprague Electric Co.
Westinghouse El. & Mfg. Co.

Electrical and Mechanical Engineers.
Arnold Elec. Power Stat'n Co.
Badt, F. B.
Baker & Co., W. E.
Bryan, Wm. H.
Butterfield, J. F.
Byllesby & Co., H. M.
Evans, Almirall & Co.
General Engineering Co., The.
Hallberg, J. H.
Humphrey, Henry H.
Hunt & Co., Robt. W.
Jackson, D. C. & W. B.
Kemp, R. W.
Kohler Brothers.
McLaughlin, James
Newgard & Co., Henry.
Northern Electrical Mfg. Co.
Ruebel, Schwedtman, Wells.
Sargent & Lundy.
Schott, W. H.
Squire Electric Co.
Stanley Elec. Mfg. Co.
Stanton, LeRoy W.
Wilmerding, C. H.

Electrical Instruments. (Recording and Testing.)
Bissell Co., The F.
Central Electric Co.
Detroit Electric Co.
Diamond Meter Co.
Duncan Elec. Mfg. Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
General Inc. Arc Light Co.
Jewell Electrical Inst. Co.
Machado & Roller.
Pignolet, L. M.
Stanley Elec. Mfg. Co.
Stanley Instrument Co.
Wagner Electric Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co
Weston Electrical Inst. Co.
Whitney Electl. Inst. Co.

Electro-Plating Mach'y
Crocker-Wheeler Company.
General Electric Co.

Elevators-Conveyors.
Jeffrey Mfg. Co.

Engines, Gas and Gasoline.
Allis-Chalmers Company.
Marinette Gas Engine Co.
Olds Gasoline Engine Works.
Temple Pump Co.
Woolley Fdy. & Mach. Wks.

Engines, Steam.
Allis-Chalmers Company.
Sturtevant Co., B. F.

Fans and Fan Motors.
Central Electric Co.
Crocker-Wheeler Company.
Edison Mfg. Co.
General Electric Co.
General Inc. Arc Light Co.
Sprague Electric Co.
Sturtevant Co., B. F.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Fibre.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Files.
Barnett Co., G. & H.

Fittings.
Faries Mfg. Co.

Fixtures, Gas and Elec.
Beardslee Chandelier Mfg. Co.

Flashers.
Bissell Co., The F.
Haller Machine Co.
Reynolds El. Flasher Mfg. Co

Flexible Shafts.
Stow Mfg. Co.

Forges.
Sturtevant Co., B. F.

Fuses and Fuse Wire.
Amer. Elec. Fuse Co.
Bissell Co., The F.
Central Electric Co.
Central Tel. & El. Co.
Chicago Die & Electric Co.
Chicago Fuse Wire & Mfg. Co.
Clinton Stamping & Elec. Co.
D. & W. Fuse Company.
Electric Appliance Co.
Johns-Manville Co., H. W.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Company.

Globes, Reflectors and Shades.
Fostoria Incan. Lamp Co.
Haller Machine Co.
Holophane Glass Co.
Perdridge Shade & Refl. Co.
Phœnix Glass Co.
Wesco Supply Co.
Western Electric Co.

Graphite Specialties.
Dixon Crucible Co., Jos.
Holmes Fibre-Graphite Co.

Heating (Exhaust Steam).
Amer. District Steam Co.

Heating and Ventilating Apparatus.
Sturtevant Co., B. F.

Heating, Hot Water.
Evans, Almirall & Co.

Holders, Inc. Lamps.
Electric Appliance Co.
Incandesent Electric Light Manipulator Co.

Inspection & Insurance
Hartford Steam Boiler Inspection & Insurance Co.

Insulating Machinery.
New England Butt Co.

Insulators and Insulating Materials.
American Electrical Works.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Inc. Arc Light Co.
Indiana Rub. & Ins. Wire Co.
Johns-Manville Co., H. W.
Kartavert Mfg. Co.
Manhattan Elec. Supply Co.
Mica Insulator Co.
Munsell & Co., Eugene.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Standard Vitrified Cond. Co.
Sterling Varnish Co.
Vulcanized Fibre Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Junction Boxes.
Bossert Elect. Const. Co.
General Inc. Arc Light Co.

Lamps, Arc.
Bissell Co., The F.
Central Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
General Inc. Arc Lt. Co.
Gregory Electric Co.
Ripwell Manufacturing Co
Manhattan Elec. Supply Co.
Stanley Elec. Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Lamps, Incandescent.
Bissell Co., The F.
Bryan-Marsh Company.
Buckeye Electric Company.
Central Electric Co.
Chicago Edison Co.
Columbia Incan. Lamp Co.
Edison Decorative & Miniature Lamp Dept.
Electric Appliance Co.
Fostoria Incand. Lamp Co.
Franklin Electric Mfg. Co.
General Electric Co.
General Inc. Arc Light Co.
Standard Elec'l Mfg. Co.
Sterling Electrical Mfg. Co.
Wesco Supply Co.
Western Electric Co.

Lamps, Incandescent—Replacers & Cleaners.
Inc. El. Lt. Manipulator Co.

Lamps, Vapor.
Cooper, Hewitt Elec. Co.

Letters, Metal.
Haller Machine Co.

Lightning Arresters.
Central Electric Co.
Clinton Stamping & Elec. Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
Manhattan Elec. Supply Co.
Minnesota Electric Co.
Stanley Elec. Mfg. Co.
Western Electric Co.

Linemen's Climbers.
Klein & Sons, Mathias.

Magnet Wires.
(See Wires and Cables.)

Measured Service.
Measured Service Co.

Mechanical Draft.
Sturtevant Co., B. F.

Mica.
Chicago Mica Co.
Mica Insulator Co.
Munsell & Co., Eugene.

Mining Apparatus, Elec.
Allis-Chalmers Company.
Crocker-Wheeler Company.
General Electric Co.
Jeffrey Mfg. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Motors. (See Dynamos and Motors.)

Nippers and Pliers.
Klein & Sons, Mathias.

Nozzles.
Faries Mfg. Co.

Overalls.
Carhartt & Co., Hamilton.

Paints.
Dielectric Mfg. Co.

Patent Attorneys.
Bain, Foree.

Phosphor Bronze.
Phosphor Bronze Sm. Co. Ltd.

Platinum, Wire and Sheet.
Baker & Company Inc.

Poles and Ties.
Berthold & Jennings.
Brooks, Hall L.
Columbia Mfg. Co.
Fowler, John H.
Fowler-Jacobs Company.
Kellogg Switch. & Sup. Co.
Lindsley Bros. Co.
Loud's Sons Co., H. M.
Maltby Cedar Co.
Morrison Lbr. Co., J. W.
Mueller Company, William.
Pacific Coast Pole Co.
Phelan, D. W.
Pittsburg & L. S. Iron Co.
Porter Cedar Company.
Sterling & Son, W. C.
Torrey Cedar Co.
Valentine-Clark Co., The.
Worcester Co., C. H.

Polish (Metal).
Allen Co., Inc., L. B.
Hoffman, Geo. W.

Portables.
Faries Mfg. Co.

Power Transmission Machinery.
Jeffrey Mfg. Co.

Rail Joints.
Continuous Rail Joint Company of America.

Rectifiers.
Electrical Appliance Co.

Refiners.
Gt. West Smelt. & Refining Co

Re-Winding—Repairs.
Chicago Edison Co.
Gregory Electric Co.

Rheostats.
Cutler-Hammer Mfg. Co.
General Electric Co.
Gen'l Inc. Arc Lt. Co.
Union Electric Mfg. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Rods, Conduit.
Cope, T. J.

Safes.
Sears, Roebuck & Co.

Schools and Colleges.
Electrical Engineer Inst.
Highland Park College

Second-Hand Mach'y.
Bissell Co., The F.
Cent. Stat. Improvement Co.
Gregory Electric Co.
Matthews & Bro., W. N.
Walsh's Sons & Co.

Shades, Lamp.
Faries Mfg. Co.

Sheet Brass & Copper.
Plume & Atwood Mfg. Co.

Signs, Electric.
Haller Machine Co.
Zero Marx Sign Works.

Silks, Insulating and Braiding.
Sauquoit Silk Mfg. Co.

Sockets & Receptacles.
Pass & Seymour.
Yost Elec. Mfg. Co.

Soldering Sticks, Salts and Paste.
Kester Elec. Mfg. Co.
Western Electric Co.

Speaking Tubes.
Central Electric Co.
Edwards & Co.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.

Specialties, Electrical Mfrs. and Designers.
Haller Machine Co.

Speed Indicators.
Weston Electrical Inst. Co.

Storage Batteries.
American Battery Co.
Electric Storage Battery Co.
Gould Storage Battery Co.

Supplies, General Elec.
Bissell Co., The F.
Central Electric Co.
Century Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Electric Co.
Manhattan Elect'l Supply Co
Wesco Supply Co.
Western Electric Co.

Switchboards.
Bissell Co., The F.
Gen. Incan. Arc Light Co.

Telephones, Telephone Material and Switchboards.
American El. Telephone Co
Automatic Electric Co.
Bissell Co., The F.
Central Electric Co.
Central Tel. & El. Co.
Electric Appliance Co.
International Tel. Mfg. Co.
Kellogg Switchb. & Sup. Co.
Manhattan Elec. Supply Co.
Stromberg-Carlson Tel. M. Co
Wesco Supply Co.
Western Electric Co.

Time Switches.
Bissell Co., The F.

Tools.
Klein & Sons, Mathias.
Western Electric Co.

Transformers.
Central Electric Co.
Crawfordsville Electric Co.
Crocker-Wheeler Co.
Electric Appliance Co.
Ft. Wayne Elec. Works, Inc.
General Electric Co.
Gregory Electric Co.
Kuhlman Electric Co.
Manhattan Elec. Supply Co.
National Electric Co.
Stanley Elec. Mfg. Co.
Wagner Electric Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Trucks, Electric Car.
General Electric Co.
Westinghouse El. & Mfg. Co.

Turbines, Steam.
Allis-Chalmers Co.
General Electric Co.
Westinghouse El. & Mfg. Co

Turbine Water Wheels
Leffel & Co., Jas.

Varnishes.
Sterling Varnish Co.

Vulcanized Fibre.
Vulcanized Fibre Co.

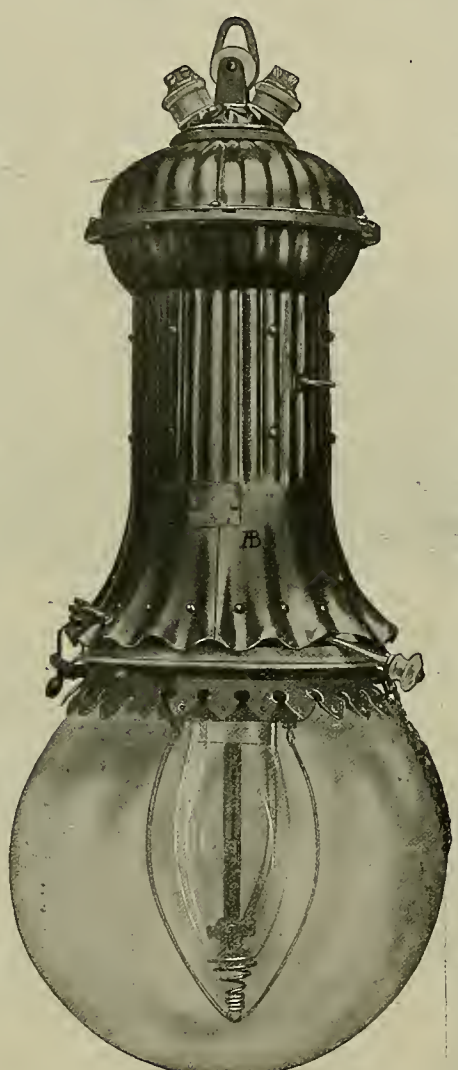
Whistles, Electric.
Electrical Appliance Co.

Wires & Cables—Magnet Wires.
American Electrical Works.
Bissell Co., The F.
Central Electric Co.
Chicago Insulated Wire Co.
Crescent Ins. Wire & Cble. Co.
Electric Appliance Co.
General Electric Co.
Hazard Manufacturing Co.
Indiana Rub. & Ins. Wire Co
India Rubber & Gutta Percha Insulating Co.
Kellogg Switch. & Sup. Co.
Manhattan Elec. Supply Co.
National India Rubber Co
New York Insulated Wire Co.
Northern Wire & Cable Co.
Okonite Co., The.
Phillips, Eugene F.
Phillips Insulated Wire Co
Roebling's Sons Co., J. A.
Runzel-Lenz Elec. Mfg. Co.
Safety Ins. Wire & Cable Co.
Simplex Electrical Co.
Standard Underground C. Co
Wesco Supply Co.
Western Electric Company.

For Alphabetical Index of Advertisements See Page 3.

A-B ARC LAMPS

FOR ALL CIRCUITS



SPECIAL FEATURES

Accessibility of Mechanism,

Ease of Removing Inner and Outer Globe,

Ease of Trimming,

Weatherproof Construction,

Stamped Copper Cases and Simplicity of Mechanism.

THERE IS

A greater number of Adams-Bagnall Constant Direct Current Series Enclosed Arc Lamps used for street lighting throughout the United States, Canada and Mexico than all other makes of this type of lamp combined.

SEND FOR CATALOGUE

AGENCIES

Doubleday-Hill Electric Co., Pittsburg, Pa.
Electric Appliance Co., Chicago, Ill.
The Wesco Supply Co., St. Louis, Mo.
H. C. Roberts Electric Supply Co., Philadelphia, Pa.
Pettingell-Andrews Co., Boston, Mass.
Cia. Benbow-Dutton, S. A., City of Mexico, Mex.
Geo. F. Rohn, Milwaukee, Wis.

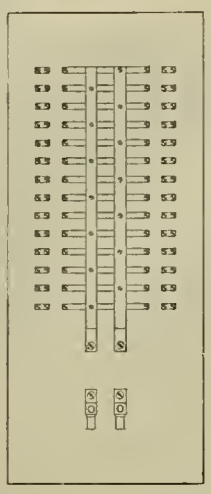
AGENCIES

B-R Electric Co., Kansas City, Mo.
A. J. Michell, Atlanta, Ga.
Interstate Electric Co., New Orleans, La.
Post-Glover Electric Co., Cincinnati, O.
Miller-Seldon Electric Co., Detroit, Mich.
W. G. Nagel Electric Co., Toledo, Ohio.
R. E. T. Pringle Co., Ltd., Montreal Que.

THE ADAMS - BAGNALL ELECTRIC CO.

New York Office: 136 Liberty St. CLEVELAND, OHIO Chicago Office: 303 Dearborn St.

QUICK FIGURES



You can get prices quick if you have our new Bulletin 20w on

PANEL BOARDS

THE F. BISSELL COMPANY

DESIGNERS AND BUILDERS OF SWITCHBOARDS AND PANEL BOARDS

TOLEDO, O.

"The Light To Work By"

FOR USE ON ALL DIRECT-CURRENT LIGHTING SYSTEMS

TYPE H-6 LAMP.

The Cooper Hewitt Mercury Vapor Lamp

gives twice the efficiency of Arc Lamps, from 7 to 9 times the efficiency of the incandescent lamp, and its wide diffusion makes it especially adapted to use in drafting rooms, machine shop, factories, offices, freight depots, etc. SEND FOR BOOKLET.

We were awarded by the Louisiana Purchase Exposition a Gold Medal for Vapor Lamps for Photo-Engraving and also the Grand Prize for Electric Lighting Work in the development of the Mercury Vapor Lamp.

Cooper Hewitt Electric Co.

220 W. 29th St. New York City

ROBERT VOLT-AMMETER

DEAD BEAT
Accurate, Durable, Guaranteed

List Price $6.00
Sample instrument forwarded to you on receipt of $4.50

Discount to Dealers

Detroit Elect. Co.
96 State St., Detroit

Whitney Instruments

are made in many styles and types. We have a complete line of switchboard and portable

VOLTMETERS, AMMETERS, OHMMETERS, WATTMETERS,

for direct and for alternating current. All of our apparatus is thoroughly guaranteed.

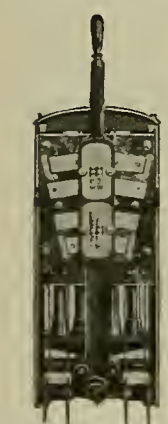
Write for Catalogue and discounts to

Machado & Roller
203 Broadway,
NEW YORK CITY, N. Y.
Or to your nearest SUPPLY HOUSE.

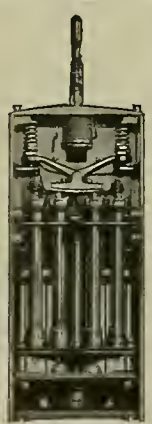
Send your Book Orders to
ELECTRICIAN PUBLISHING CO.,
510 Marquette Bldg., Chicago.

Allen-Bradley Electric Crane Controllers

Patented



Front View—before starting



Rear View

Front View—all resistance out

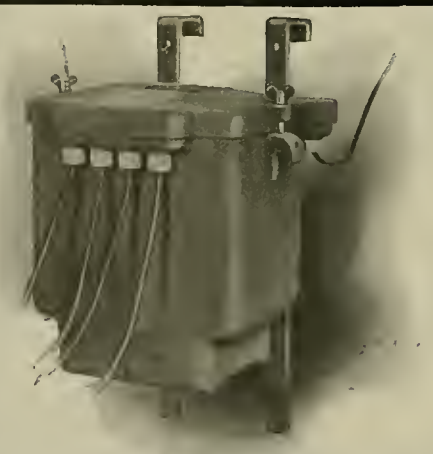
Manufactured by AMERICAN ELECTRIC FUSE CO., Chicago

A New Controller. Positively No Sparking. No Repairs. Guaranteed for One Year. Three Months' Free Trial. Perfect Control.

OUR GUARANTEE: Ask any Other Manufacturer to Duplicate It.

THE AMERICAN ELECTRIC FUSE COMPANY hereby guarantees to..... that it will at any time within three months from this date upon demand repay to said..... the sum of..... .....Dollars, being the full purchase price paid (or agreed to be paid) by said..... to the American Electric Fuse Company for one..... horsepower Allen-Bradley Crane Controller, number.....upon delivery within three months after this date of said controller, freight prepaid and in good condition, ordinary wear and tear from use excepted, at the office of the American Electric Fuse Company, Chicago, Illinois, together with a written statement that said controller has proved unsatisfactory to said .....

FURTHERMORE, the said American Electric Fuse Company agrees that it will at any time within one year from this date replace, without charge, any part of said controller which may prove defective or wear out during the ordinary use of said controller, provided that it is a condition of this guarantee that said..... hereby agrees to use ordinary care in the operation of said controller, and that said controller will be operated by some person, or persons, familiar with the use of crane controllers, and further that said controller will not be wilfully or maliciously injured while in the possession of said.....



THE B. O. TRANSFORMER

Do you expect to need new transformers this fall? If you do, the B. O. will interest you.

Low Losses
High Efficiencies
High Insulation
Low Price.

Are you familiar with oil duct transformers?
Send us your address and we will tell you about our insulation and the advantages of slab windings in connection with oil ducts.

THE STANLEY ELECTRIC MANUFACTURING COMPANY
PITTSFIELD, MASSACHUSETTS

Atlanta, Ga., Empire Building
CHICAGO, ILL., MONADNOCK BLOCK
New York, N. Y., 29 Broadway
St. Louis, Mo., Century Bldg.
Boston, Mass., Oliver Building
Denver, Col., Hendrie & Bolthoff Mfg. & Supply Co.
Philadelphia, Pa., North American Building
San Francisco, Cal., 69-75 New Montgomery St.
Seattle, Wash., Pioneer Bldg.

Representatives for the Dominion of Canada, THE CANADIAN GENERAL ELECTRIC CO. of Toronto

"THE S. K. C. SYSTEM"

It Will Interest You to Know What the **Western Electric Company** Have to Say Regarding

ELECTRA
•TRADE MARK•

HIGHEST GRADE NUERNBERG

CARBONS

in their circular, dated November 23, 1903, which in part reads as follows:

"The Western Electric Company have made an exhaustive test of carbons of all kinds and have found that the 'ELECTRA' Carbons cannot be equaled in quality or efficiency, produce practically no dust and give an excellent and steady light. They produce the highest standard of candlepower in proportion to the current consumed, and are the most economical carbons manufactured."

HUGO REISINGER, Sole Importer, 11 Broadway, NEW YORK CITY.

ANCHORS

That are cheaper to install because of the simple method of burying and the great strain that can be applied—**American Bull-Tongue Anchors** reduce the cost of the process of guying a pole by reduction in labor, they **stay solid,** they do not slip—no take up required. 21 cents worth holds 8,713 pounds, 42 cents worth holds 10,521 pounds, other money's worth in proportion.

I. A. BENNETT,
529 and 530 Monadnock Block - - - CHICAGO

Cope's Patent Quick Coupling Conduit Rod

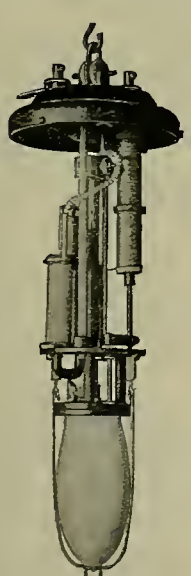
Remember these rods have no lost motion.
These Couplings are of Steel and are made in the best possible manner.

Write for list of persons using these rods—26,000 sold since May 1902. Made in 3 ft. and 4 ft. lengths.
Price, 3 ft. 75 cents, 4 ft. 85 cents.
Patented February 24, 1903.

T. J. COPE
3244 North Fifteenth Street PHILADELPHIA, PA.

Our Compound Stops Sparking and Saves Commutators.
14 Years' Use on Street Ry., Light and Power Commutators Has Proven its Worth. WE GUARANTEE RESULTS.
Send Your Address for FREE SAMPLE THAT CONVINCES.
JAS. McLAUGHLIN & CO., ELECTRICAL ENGINEERS
586 Fulton Street, - - Chicago, Ill.

General Electric Company



Edgewise Wound Enclosed Arc Lamps

FOR 110-VOLT DIRECT CURRENT SERVICE

Embody the latest features of Arc Lamp manufacture.

INDESTRUCTIBLE.
PERFECT REGULATION.
PERMANENT ADJUSTMENT.
COMPOSED OF FEW PARTS.
SIMPLICITY AND RIGIDITY OF CONNECTIONS.

Write for further information.

GENERAL OFFICES: SCHENECTADY, N. Y.

Chicago Office: Monadnock Block. Sales Offices In All Large Cities.

Never was lamp like the Zenith

More than an incandescent
Less than an arc
And more adaptable than either

The Packard Zenith lamp can be used where it is not practicable to use an arc lamp, and when used in place of a cluster of incandescents it gives better light at less cost.

Made in 25 and 55 C. P. and for all standard voltages. Do you want prices?

Electric Appliance Company
CHICAGO and SAN FRANCISCO

LAMPS

Get acquainted with the
PEERLESS—MONEY SAVERS
MADE RIGHT
PRICED RIGHT
ARE RIGHT

WESCO

THE WESCO SUPPLY CO., ST. LOUIS, MO.
"EVERYTHING ELECTRICAL"

MICABOND

CHICAGO MICA CO.,
"PERFECTORS" VALPARAISO, IND.
THE PEER OF INSULATORS.

153

NORTHERN APPARATUS
DIRECT CURRENT
DYNAMOS AND MOTORS
Compact, Simple, Trustworthy, Economical in Operation
Superior
Get Generator Bulletin No. 2530
Northern Electrical Mfg. Co., Madison, Wis., U.S.A.
ENGINEERS :: MANUFACTURERS

SPARKING

Reduces the working capacity of a motor or dynamo, wears out the commutator, wastes power and may cause a fire. All this may be avoided if you use . . . . . .

GALES COMMUTATOR COMPOUND

The only article that will PREVENT SPARKING. Will keep the Commutator in good condition and PREVENT CUTTING.

Absolutely Will Not Gum The Brushes.

50 Cents per Stick. $5.00 per Dozen.
SEND FOR FREE SAMPLE STICK.
For sale by all supply houses, or

It will put that high gloss on the Commutator you have so long sought after.

K. McLENNAN & CO. Sole Mfrs., Room 411 Inter Ocean Bldg., 130 Dearborn St., CHICAGO

VOLT - AMMETERS,
POCKET SIZE.
For Testing Batteries and Battery Circuits, Locating Faults, Grounds, etc.
RELIABLE. ACCURATE.
Send for Circular.
L. M. PIGNOLET,
78-80 Cortlandt St. NEW YORK, N. Y

"AMERICAN" STORAGE CELLS
ARE THE BEST. Send for descriptive Circular.
AMERICAN BATTERY CO.,
ESTD 1888. 171 S. Clinton St., Chicago.

MICA
Of all Qualities, in any Form at Lowest Prices
EUGENE MUNSELL AND CO.
NEW YORK and CHICAGO

INSULATION That Is.

Micanite, Linotape, M. I. C. Compound, Empire Cloth and Paper. For Years the Standard.

MICA INSULATOR CO., Originators
NEW YORK and CHICAGO

Electric Lighting Outfits

READY FOR USE

Very popular for electric lighting decorations and especially adapted to the lighting of Christmas trees.

Safe, Simple and Convenient

EDISON DECORATIVE & MINIATURE LAMP DEPARTMENT

GENERAL ELECTRIC COMPANY,
Harrison, N. J.

Made in four sizes { 8 lights, 16 " , 24 " , 32 " } $5.00 and upwards

SINGLE-PHASE SELF-STARTING ALTERNATING CURRENT MOTORS

That will start under full load are our specialty. Can be mounted on floor, ceiling, or side wall. It is to your interest financially to become acquainted with them before placing your next order.

CENTURY ELECTRIC COMPANY

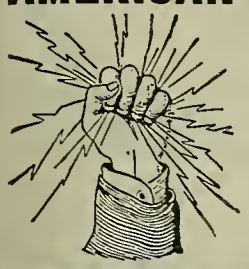
Main Office and Works
1007-9-11 Locust Street St. Louis, Mo.

GASOLINE ENGINES FOR ELECTRIC LIGHTING.

Don't buy until you have investigated the "Master Workman," a two-cylinder gasoline engine, superior to all one-cylinder engines for electric lighting; quick and easy started. Has little or no vibration. Maintains a steady unflickering light. Weighs less than half of one-cylinder engine and furnishes the following sizes: 4, 5, 6, 8, 10, 12, 16 and 18 horsepower. Ten 16-candlepower lights to the horse. Solely manufactured by the TEMPLE PUMP COMPANY. Established 51 years ago.
Please mention this paper. 15th Street and 15th Place near Canal Street, Chicago.

FRANK N. PHILLIPS, President. EUGENE F. PHILLIPS, General Manager. E. ROWLAND PHILLIPS, Vice-Pres. C. H. WAGENSEIL, Treasurer. C. R. REMINGTON, Jr., Sec

AMERICAN ELECTRICAL WORKS,



PROVIDENCE, R. I.

BARE AND INSULATED ELECTRIC WIRE,

ELECTRIC LIGHT LINE WIRE,
INCANDESCENT AND FLEXIBLE CORDS,
Railway Feeder and Trolley Wire,
AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR WIRES.
CABLES FOR AERIAL AND UNDERGROUND USE.

New York Store, W. J. Watson, 26 Cortlandt St.
Chicago Store, F. E. Donohoe, 82 Lake St.
Montreal Branch, Eugene F. Phillips' Electrical Works.

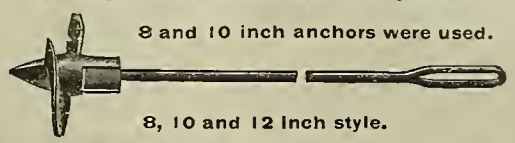
MAIN OFFICES AND FACTORIES, PHILLIPSDALE, R.I.

Sterling Black Plastic Insulator.

One hundred days' continuous baking at 180° F. will not make it brittle. Water repellent. Oil proof.

THE STERLING VARNISH CO., - - Pittsburg, Pa.

THE UNITED STATES GOVERNMENT
USED
Stombaugh Guy Anchors
EXCLUSIVELY FOR
Anchoring their Wireless Telegraph Masts in Porto Rico, Cuba, Panama and Key West.

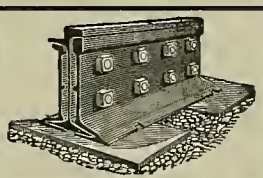


8 and 10 inch anchors were used.
8, 10 and 12 inch style.

W. N. MATTHEWS & BRO., Manufacturers
603 Carleton Building, St. Louis

EXPERT IN ELECTRICITY MECHANICS PATENT CAUSES
SOLICITOR OF U. S. & FOREIGN **PATENTS**
FOREE BAIN, 1652-3 Monadnock Blk., CHICAGO

CONTINUOUS RAIL JOINT CO. OF AM.



General Offices: Century Building
NEWARK, N. J.
OVER 20,000 MILES IN USE
Highest Award at Paris Exposition, 1900, Buffalo, 1901

YOST SPECIALTIES.

Sockets, Wall Sockets, Weatherproof Sockets, Rosettes, Receptacles, Cord Adjusters.

Catalogue for the asking.

THE YOST ELECTRIC MFG. CO.
TOLEDO, OHIO.

FARIES FIXTURES

Shades
Brackets
Clusters
Portables
Canopies
Chandeliers
Nozzles
Fittings
Castings

are UNIVERSALLY USED

Catalog Mailed on Application

FARIES MFG. CO.
DECATUR, ILL.

SAUQUOIT SILK MFG. COMPANY,

INSULATING and BRAIDING SILKS

MILLS:
BETHLEHEM, PA.
PHILADELPHIA, PA.
SCRANTON, PA.

NEW YORK REPRESENTATIVES:
WILLIAM RYLE & COMPANY
54 Howard St.
PHILADELPHIA OFFICE:
4015 Clarissa St.
CHICAGO OFFICE:
210 Monroe St.
BOSTON OFFICE:
78 Chauncy St

Crimshaw

Raven White Core

Raven Black Core

ALL OUR WIRES pass inspection and carry the above TRADE-MARKS on our tags. We also manufacture Crimshaw and Competition Tapes and Splicing Compounds.

NEW YORK INSULATED WIRE COMPANY,

MAIN OFFICE: 114, 116 & 118 Liberty St., New York.
BRANCHES: CHICAGO: 192 Desplaines St. BOSTON: 7 Otis St. SAN FRANCISCO: 33 Second St.

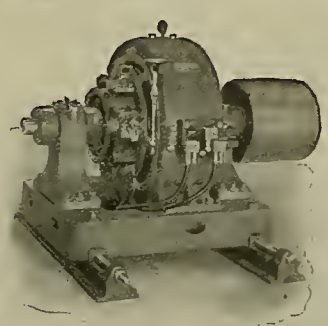
NATIONAL CODE STANDARD

"O. K." Weatherproof Wire.
Slow-Burning Weatherproof and Ideal Wire.

Prices and Samples on Application.

Phillips Insulated Wire Co.
Office and Factory: PAWTUCKET, R. I.

DIRECT CURRENT
GENERATORS
FOR LIGHT AND POWER



Our generators have a high efficiency and great endurance under the most exacting conditions of service. Sizes up to 1,000 K. W.
Write for bulletin No. 10514.

SPRAGUE
ELECTRIC COMPANY
General Offices:
527 West 34th Street, New York
Chicago Office: Fisher Building

WANTED, FOR SALE *and similar* **WANT COLUMN** *advertisements (50 words or less), $1.50 an insertion; additional words 3c each.* **POSITION WANTED** *advertisements (50 words or less), $1.00 an insertion; additional words 2c each.*

WANTED.

A young man familiar with both theory and practice in the manufacture of motors and dynamos. Prefer graduate from some technical school. State experience and salary expected. Address BOX 416, care Western Electrician, 510 Marquette Bldg., Chicago, Ill.

WANTED.

An experienced and up-to-date transformer designer by large and reliable manufacturing company. In reply state experience and salary required; give references. Address BOX 419, care Western Electrician, 510 Marquette Bldg., Chicago.

WANTED.

By a large electrical manufacturing company, a thoroughly experienced man for the design and development of railway motors and electric locomotives. A fine position for the right man. In reply state experience and salary; give testimonials. Address BOX 418, care of Western Electrician, 510 Marquette Bldg., Chicago.

WANTED.

A first-class practical sparking coil man. Give in full experience in the business and salary required. The position would be in Chicago. Address BOX 420, care Western Electrician, 510 Marquette Bldg., Chicago, Ill.

AGENCY WANTED.

A firm of Engineers with good trade connections is open to represent Manufacturers of Electrical and Mechanical commodities in Chicago and vicinity. Address BOX 411, care of Western Electrician, 510 Marquette Building, Chicago, Ill.

FOR SALE

1 Stanley generator, two-phase, 16,000 alternations, 1,000-2,000 volts, 40 K. W., 1333 R. P. M. and exciter.

1 Stanley generator, two-phase, 16,000 alternations, 1,000-2,000 volts, 60 K. W., 1,000 R. P. M. with exciter.
Complete marble switchboard with new instruments for above.

1 Westinghouse generator, 75 K. W., single-phase, 1,100 volts, 7,200 alternations, exciter, switchboard, new instruments complete, 750 R. P. M.

2 New belts.

1 Russell 13x20 4-valve engine, 200 R. P. M.

1 Ball 9½x10 engine, 350 R. P. M.

2 Boilers, 16x54 inch, 42 4-inch tubes, allowed 110 lbs. pressure, complete with 50-foot stack.

1 Hoppes heater. All steam pipe, valves, etc.

All in good condition. Can be seen running until December 15th. We are abandoning this plant on account of removal, and will sell all or in part. For further information, address

TIBBE ELECTRIC CO., Washington, Mo., or RUEBEL-SCHWEDTMANN-WELLS, St. Louis.

FOR SALE

1-360 K. W.	General Electric	Alternator,	Three	Phase
1-240 "	Westinghouse	"	Single	"
2-150 "	Warren	"	"	"
1-150 "	Westinghouse	"	"	"
1-150 "	Wood	"	"	"
1-150 "	Stanley	"	"	"
1-120 "	General Electric	"	Three	"
1-120 "	General Electric	"	Single	"
1-120 "	Westinghouse	"	"	"
1- 90 "	General Electric	"	"	"
1- 75 "	Westinghouse	"	Two	"
1- 75 "	Westinghouse	"	Single	"
1- 75 "	Westinghouse	"	Two	"

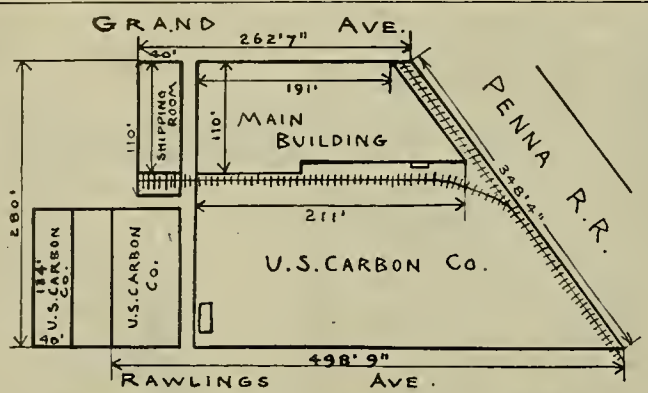
Direct connected to Gates' Engine.

Send for our **Monthly Bargain Sheet** with complete list and net prices.

GREGORY ELECTRIC CO.
54-62 S. Clinton St., Chicago, Ill.

REPAIRING RECALIBRATING

ELECTRIC METERS.
INTERNATIONAL ELECTRIC METER CO.
167 S. CANAL STREET, CHICAGO.



FOR SALE.

PLANT OF THE UNITED STATES CARBON COMPANY including land, buildings, machinery, etc., situated on the Pennsylvania Railroad within the city limits of Cleveland, Ohio.

LAND—Vacant and covered by buildings about 2½ acres, bounded on two sides by streets and having a frontage of 348 ft. 4 in. on the Pennsylvania Railroad.

BUILDINGS—Main building is a two and one story brick building with gravel roof, the two-story part having a frontage of 191 ft. on Grand Ave., by about 50 ft. The one-story part having a frontage of 211 ft. on the switch from the Pennsylvania Railroad by about 55 ft. The shipping room is 40 ft. front on Grand Ave., by 110 ft. deep to a switch from the Pennsylvania Railroad and is a two story brick building, with gravel roof; the second floor, however, only covers a space of 14 by 40 ft. in the front part of the building. See diagram of land and buildings above.

MACHINERY—Pulleys, shafting, belting and complete machinery for the manufacture of electric-light carbons and for furnishing power, heat and light for the plant. Capacity of plant about 50,000 carbons per day.

For information address,

THE GUARDIAN SAVINGS & TRUST COMPANY,
CLEVELAND, OHIO.

WORKS QUICK AND EASY. KEEPS ITS LUSTER. HOLDS OLD TRADE AND MAKES NEW. DOES NOT DETERIORATE. ESTABLISHED 16 YEARS. SOLD BY AGENTS AND DEALERS ALL OVER THE WORLD

U.S. METAL POLISH

3 OUNCE BOX 10 CENTS
SAMPLES SENT FREE
GEO. W. HOFFMAN
295 E. WASHINGTON ST. INDIANAPOLIS, IND

POLISHES ALL METALS. BRANCHES NEW YORK, CHICAGO, SAN FRANCISCO.

BOILERS.

One 42-in. x 15 ft. 9-in., 250 H. P. Worthington Water Tube.
One 60-in. x 16 ft., John Mohr Return Tubular Boiler.
One 54-in. x 16 ft., John Mohr Return Tubular Boiler.
One 54-in. x 16 ft., Devine Tubular Boiler.

ENGINES.

One 600 H. P., 21 x 36 x 30, Williams Tandem Horizontal Compound, 140 R. P. M.
Two 600 H. P., 20 x 30 x 24, Porter-Allen Tandem Compound, 200 R. P. M.
One 250 H. P., 12 x 24 x 18 Williams Tandem Compound, 250 R. P. M.
Two 100 H. P., 13 x 12, Dick & Church, High Speed Automatic.

PARTIAL LIST ONLY.

Send for latest Catalogue for bargains in Engines, Boilers, Dynamos and Motors.

CENTRAL STATION IMPROVEMENT CO., 938 Monadnock Block, Chicago

The Recently Enlarged Edition of

WEBSTER'S INTERNATIONAL DICTIONARY

CONTAINS
25,000 NEW WORDS, Etc.
New Gazetteer of the World
New Biographical Dictionary
New Plates. 2380 Quarto Pages. 5000 Illustrations.

Should be in Every Home, School, and Office

Also **Webster's Collegiate Dictionary** with 1100 pages. 1400 illustrations. Size: 7x10x2½ in.
A Special Thin Paper Edition just issued, printed from same plates as regular edition. It has limp covers and round corners. Size: 5¾x8⅝x1½ in.

FREE, "A Test in Pronunciation," instructive and entertaining. Also illustrated pamphlets.

G. & C. MERRIAM CO.,
Publishers, Springfield, Mass.

Louisville and Chicago

And the places north
And the places south
And the places between are reached by the quick day and night trains of THE

MONON ROUTE
CHICAGO, INDIANAPOLIS & LOUISVILLE RAILWAY

Also the celebrated health resorts, French Lick and West Baden Springs, are reached only by this road.

Booklets about the Springs, their wonderful waters and the fine hotels, sent free.

CHAS. H. ROCKWELL Traffic Manager
FRANK J. REED Gen. Pass. Agt.
202 Custom House Place, Chicago

WE PAY

highest market prices for scrap copper, brass and platinum, also incandescent lamp bases, etc. You can make

BIG MONEY

in scrap of this kind. Save it and send it to the Great Western Smelting and Refining Co., Chicago, headquarters

FOR SCRAP COPPER

Corliss Engines.

1000 h. p., 36x48, Allis Corliss, 1890 heavy duty.
900 h. p., 34x60, International.
825 h. p., 32x48, Allis Corliss, 1890 heavy duty.
900 h. p., 22x42x48, Hamilton, Tand. Comp.
750 h. p., 32x54, Hamilton, 1890 Frame.
650 h. p., 30x54, St. Louis, 1890 Frame.
600 h. p., 28x60, Philadelphia.
500 h. p., 16x32x42, Corliss Cross Comp., latest type.
450 h. p., 16x30x42, Allis Cross Comp.
400 h. p., 23½x60, Geo. H. Corliss.
450 h. p., 24x48, Harris, latest type.
450 h. p., 24x48, Brown.
350 h. p., 22x42, Allis, 1890 Frame.
350 h. p., 22x42, Slater, 1890 Frame.
300 h. p., 20x48, Harris.
300 h. p., 20x42, Hamilton.
225 h. p., 12x22x42, Atlas Tandem Comp.
225 h. p., 18x42, Hamilton.
175 h. p., 16x42, Allis.
165 h. p., 16x36, Sioux, 1902.
150 h. p., 15x38, Brown.
140 h. p., 14x42, Allis.
125 h. p., 14x36, Putnam.
90 h. p., 12x36, Harris.
600 h. p., 28½x52, Buckeye Automatic.
500 h. p., 17½x30½x27, Buckeye Cross Comp.
450 h. p., 16½x28½x27, Buckeye Cross Comp.
450 h. p., 24x48, Buckeye Automatic.
350 h. p., 16x26x18, Ideal Tandem Comp.
275 h. p., 14x22x16, Ideal Tandem Comp.
250 h. p., 16x27x16, Westinghouse Comp.
150 h. p., 15x24, Cummer.
150 h. p., 10½x18x18, Williams Tandem Comp.

Whitehead Machinery Company,
DAVENPORT, IOWA.

ELECTRICAL AND OTHER INDUSTRIES ARE OFFERED LOCATIONS

WITH
Satisfactory Inducements,
Favorable Freight Rates,
Good Labor Conditions,
Healthful Communities,
ON THE LINES OF
THE ILLINOIS CENTRAL R. R.
AND THE
YAZOO & MISSISSIPPI VALLEY R. R.

For full information and descriptive pamphlet address

J. C. CLAIR,
Industrial Commissioner
1 Park Row, Chicago, Ill.

BUY YOUR BOOKS
FROM THE
Electrician Pub. Co., 510 Marquette Bldg., Chicago.

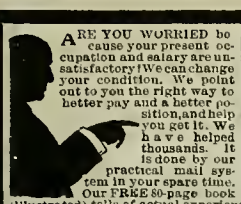
CHICAGO EDISON COMPANY REPAIR SHOPS

76 MARKET STREET, CHICAGO. TELEPHONE MAIN 1280.

Machine and Carpenter Work of All Kinds
Correspondence Solicited.

OPEN DAY AND NIGHT.
FIRST-CLASS EQUIPMENT THROUGHOUT.

Dynamos Armatures, Motors, Arc Lamps, Fans, Instruments.



THE RIGHT WAY TO BETTER PAY

ARE YOU WORRIED because your present occupation and salary are unsatisfactory? We can change your condition. We point out to you the right way to better pay and a better position, and help you get it. We have helped thousands. It is done by our practical mail system in your spare time. Our FREE 80-page book (illustrated) tells of actual experiences, and mentions many examples of how our students have been able to qualify for advancement and good salaried positions. Courses in Electrical Engineering, Steam Engineering, Mechanical Engineering, Telephony, Telegraphy, Electric Lighting, Electric Railways, Electric Motorman's Course, Short Electrical Course, Dynamo Tender's Course, Arithmetic, Algebra. Write TO-DAY for our free book. Mention subject which interests you. ELECTRICAL ENGINEERING INSTITUTE, Dep't K, 240A West 23rd St., New York.

EDWARDS AND CO

Lock Gravity Drop Annunciator.

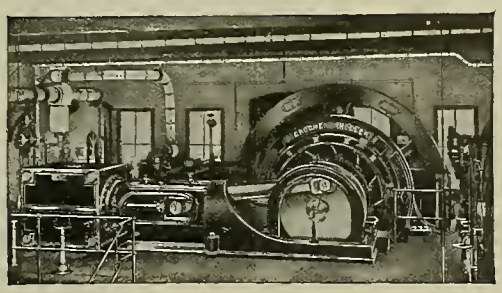
Extra heavy, well finished case of ornamental design.
The drops being fastened to the back-board, the case may be removed without disconnecting wires.

WESTERN ELECTRIC CO.,
Selling Agents.

NEW YORK N.Y

FOR SALE

Railway Generators



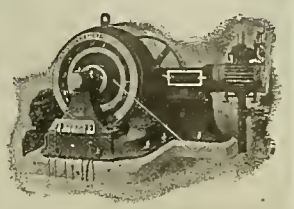
Size 448 Standard Crocker-Wheeler Railway Generator

Six direct-current generators, driven by a variety of prime movers, which supply power for the Intramural Railway at the St. Louis Exposition, will be ready for delivery after January 1. Let us send you further particulars.

Crocker-Wheeler Company

15 Branch Offices:
Chicago, St. Louis, Pittsburg, Etc. Ampere, N. J.

Warren Alternator



WARREN ALTERNATORS
are
profit producers
and
surplus swellers
WE GUARANTEE WHAT WE SELL
and
SELL WHAT WE GUARANTEE

WARREN ELECTRIC MFG. CO.

Sandusky, O.

HENRY NEWGARD & CO.

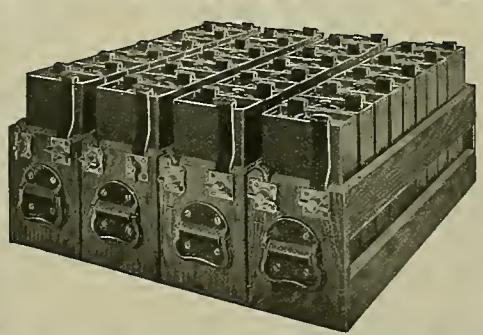
ELECTRICAL CONSTRUCTION

Power and Light Plants. Switchboards and Panel Boards.

We install Municipal and Isolated Electric Lighting Plants.
We manufacture Switchboards, Table boards, Iron Cutout Boxes and Electrical Specialties.
We sell Dynamos, Motors and Electrical Supplies.
We wire old as well as new Residences, Factory Buildings, School and College Buildings.

87 Fifth Avenue, Chicago, Illinois.

SATISFACTION ASSURED

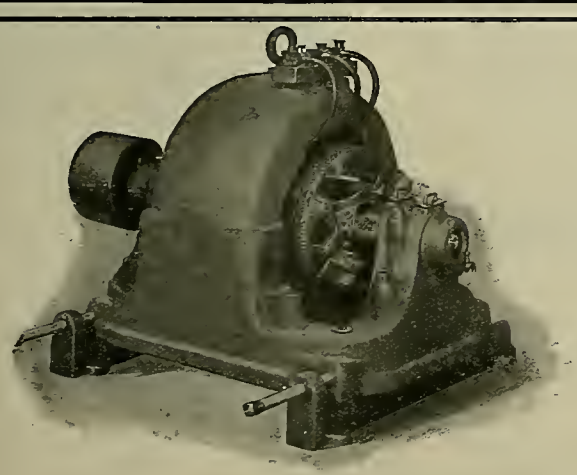


Every battery has its own guarantee.

Lighting Batteries,
Automobile Sparkers.

Prompt delivery made on rush orders.
We work night and day.

Northwestern Storage Battery Co.,
285 Madison St., - - - Chicago, Ill.



CENTRAL STATION MANAGERS

Don't Be Afraid

of the Gas Plant

WORK UP A MOTOR LOAD

We can furnish you

SINGLE PHASE MOTORS

that will start under full load in sizes ranging from 1/8 to 35 H.P.

Wagner Electric Mfg. Co.

ST. LOUIS, MO., U. S. A.

DEARBORN WATER TREATMENT

Stops that expense and worry over scale in boilers.
We correct waters of all classes for boiler purposes.

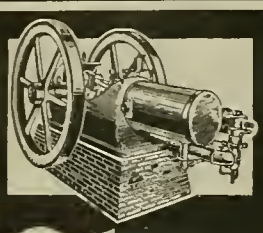
Send gallon sample to Chicago Laboratory for Analysis.
Write for Booklet "R."

DEARBORN DRUG & CHEMICAL WORKS,

27-34 RIALTO BUILDING, CHICAGO, ILL. WM. H EDGAR, President Telephone: Harrison 3930 and 3931.

Dixon's Traction Belt Dressing *Has a 27 Years' Record* in restoring and preserving the clinging power of leather belts. Descriptive booklet 125E and sample upon request.
JOSEPH DIXON CRUCIBLE CO., JERSEY CITY, N. J.

JEFFREY Elevating, Conveying, Power Transmission, Screening, Crushing Dredging, Rock and Coal Drilling, Coal Cutting, Hauling and Washing Machinery.
OUR CATALOGUES ARE YOURS FOR THE ASKING.
The JEFFREY MANUFACTURING CO., Columbus, O., U. S. A.



Olds Gas and Gasoline Engines

Are built on lines of strict originality, and are protected by the Olds patents. The essential parts of our engines combine the highest efficiency with the greatest simplicity of construction and operation. No engine made approaches the Olds for economy and durability.

Stationary Engines - - 2 to 100 H. P.
Portable Engines - - 8 to 18 H. P.

Write to-day for full information and new illustrated catalog.

Olds Gasoline Engine Works
252 River Street, - Lansing, Mich.
3 982

BEST ON EARTH.

BURGER AUTOMATIC.

For Electric Work

REGULATION AND ECONOMY OF FUEL UNSURPASSED.

WRITE FOR CATALOGUE H

Then compare it with some Gas Engine hand books that cost $1.00.

Woolley Foundry & Mach. Works
Box 400, Anderson, Ind. U. S. A.

REG TRADE MARKS

THE PHOSPHOR BRONZE SMELTING CO. LIMITED, 2200 WASHINGTON AVE., PHILADELPHIA.
"ELEPHANT BRAND PHOSPHOR-BRONZE" INGOTS, CASTINGS, WIRE, RODS, SHEETS, ETC.
— DELTA METAL —
CASTINGS, STAMPINGS AND FORGINGS
ORIGINAL AND SOLE MAKERS IN THE U.S.

H. N. FENNER, President J. F. BLAUVELT, Agent RUSSELL W. KNIGHT, Treasurer

NEW ENGLAND BUTT COMPANY

MANUFACTURERS OF

Machinery for Insulating Electrical Wires

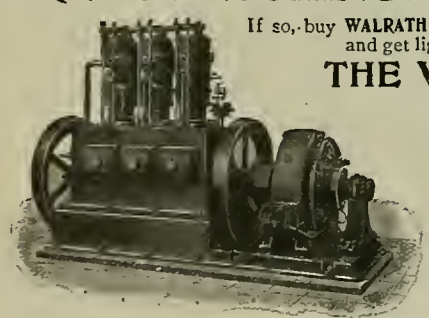
Braiding, Taping, Winding, Twinning, Cabling, Stranding, Polishing and Measuring Machines. Cable Covering Braiders

FINE CASTINGS A SPECIALTY

304 PEARL STREET, - - - PROVIDENCE, R. I., U. S. A.

ARE YOU LOOKING FOR MONEY?

If so, buy WALRATH GAS OR GASOLINE ENGINES and get light on the subject.



THE WALRATH

Received the Highest Award at the Pan-American Exposition.

It will produce as good a commercial light as that of an automatic steam engine, either belted or direct-connected generator. Simple, Economical and Reliable

Send for Catalogue W

MARINETTE GAS ENGINE CO.,
CHICAGO HEIGHTS, ILL.

AGENCIES:
Keystone Engineering Co., Farmer's Bank Bldg., Pittsburg, Pa.
Strong, Carlisle & Hammond Co., 61-67 Frankfort St., Cleveland, Ohio
Mackay Engineering Co., 149 Broadway, N. Y.
C. H. Seidenglanz., 52 When Bldg., Indianapolis, Ind.

Steam + Fuel

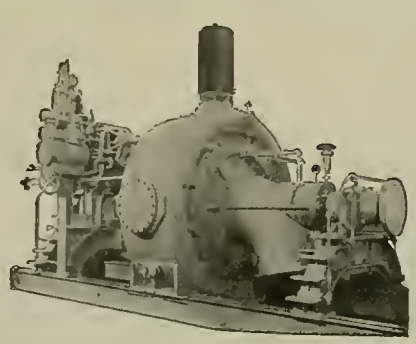
GREEN'S ECONOMIZER

Installed in Electric Light and Power Plants

Saves 10 to 20% in Fuel.
Increases Boiler Efficiency 20 to 40%.

We are doing it all over the country, and would like an opportunity to have our experts look over your plant and explain how the utilization of the waste gases will do it for you.

THE GREEN FUEL ECONOMIZER CO.
Matteawan, N. Y.



SAMSON TURBINE

The GATES on the SAMSON are so nearly BALANCED that a GOVERNOR can operate them with the GREATEST EASE. This assures CLOSE SPEED REGULATION which is desirable because it saves WEAR and TEAR in the electrical equipment

Write Dept. D for Catalogue

THE JAMES LEFFEL & CO.,
Springfield, Ohio, U. S. A.

ARNOLD ELECTRIC POWER STATION Co.
Engineers, Constructors for Complete Electric Plants. Results Guaranteed.
SUITE 1539, MARQUETTE BLDG., CHICAGO. NEW YORK OFFICE: 711 TRANSIT BLDG.

BUTTERFIELD, J. F.
ELECTRICAL ENGINEER AND CONTRACTOR.
Complete Telephone Exchanges Built and Material Furnished.
Cable Construction and Underground Conduit Construction a Specialty.
Room 595, 113 Adams Street, CHICAGO, ILL.

J. H. HALLBERG
Consulting Engineer
Electric Light, Power and Railway Plants
Suggestions to secure Economy, Specifications, Examinations and Reports
45 Broadway, NEW YORK
Long Distance Telephone 4578 Broad

KOHLER BROS.,
Contracting Electrical Engineers, Lighting Power Railways,
1804-1806-1808-1810-1812 Fisher Building, CHICAGO.

F. B. BADT,
Monadnock Chicago

BYLLESBY, H. M. & Co.
(Incorporated)
ENGINEERS
Design, Construct and Operate Railway, Light, Power and Hydraulic Plants.
Examinations and Reports.
New York Life Building, - CHICAGO, ILL.

HUMPHREY, HENRY H.,
CONSULTING ENGINEER.
Central Lighting Stations,
Electric Power Transmission.
SUITE 1305, CHEMICAL BLDG., ST. LOUIS.

RUEBEL - SCHWEDTMANN-WELLS,
CONSULTING, MECHANICAL AND ELECTRICAL ENGINEERS,
Suite 801 Chemical Building, ST. LOUIS, U. S. A.

IT WILL PAY
engineers not represented in this department to carry a card regularly.

ENGINEERS
Represented in this "Directory" are enabled to come in touch with many prospective customers who cannot be reached through any other source.

ROBERT W. HUNT & Co.,
ENGINEERS
1121 The Rookery, Chicago. 66 Broadway, New York.
Monongahela Bank Bldg., Pittsburg.
Norfolk House, Cannon St., London.

SARGENT & LUNDY,
ENGINEERS,
RAILWAY EXCHANGE,
Cor. Jackson and Michigan Boulevards, CHICAGO.
FREDERICK SARGENT. A. D. LUNDY.

W. E. BAKER. H. B. BISHOP.
BAKER, W. E. & CO.
ENGINEERS,
ELECTRIC RAILWAYS.
27 William St., NEW YORK.

EVANS, ALMIRALL & CO.,
Central Station Heating,
High Pressure Piping.
1057 Monadnock Blk., Chicago.

A WEEKLY REPRESENTATION
in this "Directory" enables engineers to keep before all possible customers.

Long Distance Phone Central 2443.
SCHOTT, W. H.,
ENGINEER AND CONTRACTOR.
SPECIALTIES—Central Station Heating Plants, Water Works Steam Plants, Electric Light, Gas and Street Railway Plants.
1220-21 MARQUETTE BUILDING, CHICAGO.

BRYAN, WILLIAM H.
M. Am. Soc. M. E.,
Consulting Mechanical and Electrical Engineer.
Lincoln Trust Building, ST. LOUIS.

E. W. Hammer, Pres. and Treas. H. J. Minhinnick, Sec. and Gen'l Sup't.
GENERAL ENGINEERING Co., THE
Consulting and Contracting Engineers.
Telephones, Electric Light, Power Transmission
Suite 1112, 135 ADAMS ST., CHICAGO.
Long Distance Telephone Central 478.

KEMP, R. W.
Consulting and Contracting Telephone Engineer.
Plans and specification for complete plants. Old plants overhauled and placed on paying basis. Territory, Kansas, Oklahoma and Indian Territory.
WELLINGTON, - - - KANSAS.

STANTON, LE ROY W.
Consulting Telephone Engineer
Plans, Specifications and Supervision of Installation of Complete Telephone Plants
Special Reports on Telephone Properties and Apparatus
411 Electrical Bldg., Cleveland, Ohio

DUGALD C. JACKSON, C. E.
WILLIAM B. JACKSON, M. E.
MEMBERS
AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS
AMERICAN SOCIETY OF MECHANICAL ENGINEERS
AMERICAN SOCIETY OF CIVIL ENGINEERS
ENGINEERS. EXPERTS.
MADISON, WIS.

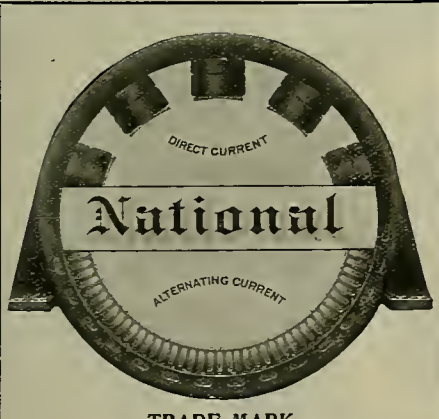
Engineering MECHANICAL, ELECTRICAL, STEAM, CIVIL.
Complete and short courses. Thoroughly equipped engineering shops. Shop work from the beginning. Short courses in Steam and Electrical Engineering. Expenses low. Accommodations the best. School all year. Students may enter any time. Correspondence steam and electrical courses. Send for catalogue. Mention course in which interested.
HIGHLAND PARK COLLEGE, DES MOINES, IOWA.

ELECTRIC SIGN FLASHERS
BEST IN THE WORLD
Write for full particulars
Reynolds Elec. Flasher Mfg. Co.
221 Fifth Ave., Chicago.

All Supply Houses
J. J. EGAN'S "ACME" COMMUTATOR COMPOUND.
J. J. EGAN'S "ACME" COMMUTATOR COMPOUND
absolutely prevents sparking or cutting. One stick of "Acme" is equal to one gallon of oil for lubricating commutators. Free Sample. AGENTS WANTED.
50c per Stick. $5.00 per doz.
J. J. Egan Sole Mfg., 317 Austin Ave., Tel. Polk, 1779 Chicago

PRESERVE YOUR COPIES
OF THE
WESTERN ELECTRICIAN
BINDERS $1.00 EACH.
ELECTRICIAN PUBLISHING CO.,
Suite 510 Marquette Building, - - - CHICAGO.

CHICAGO DIE AND ELECTRIC CO.
87-89-91 WEST LAKE STREET
CHICAGO
Manufacturers of
Patent Improved American Wire Joints
Maxstadt Patent Mica Fuses
Maxstadt Patent Lightning Arresters
Maxstadt Patent Fuse Blocks
Paper Sleeves, Etc.
Expert Die Makers and Machinists



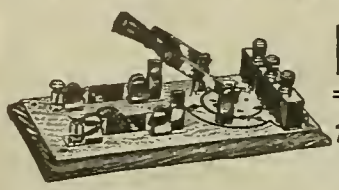
TRADE MARK

Lundell
"Universal"
Apparatus
Represents finality of design. Constant and Variable Speeds. Ratio: 3 to 1.

Direct and Alternating Current
Generators
Built in all capacities for Lighting, Power and Railway Service.

National Electric Company
General Sales Office and Works
MILWAUKEE
New York Philadelphia Charleston, W. Va. Pittsburg Chicago Seattle San Francisco

They Are All Talking About The "Tornquist"



King of Protectors

The Only Sure Protector Made

HIGH GRADE BABY KNIFE SWITCHES

None Better Made

STAMPING AND PLATING

Better buy a "Tornquist" it is the greatest success in the telephone field. Order sample now. Sold by all jobbers.

Clinton Stamping & Electric Co.

CLINTON, IOWA

INTERNATIONAL

Mechanical Self-Restoring Drop Switchboard.

A PERFECT APPARATUS.

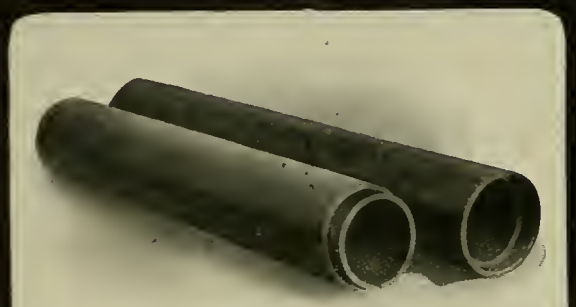
Made in any desired capacity.
Sample parts and quotations on request.

INTERNATIONAL TELEPHONE MANUFACTURING CO.

CHICAGO, U. S. A.

BITUMINIZED FIBER CONDUIT

FOR UNDERGROUND CONSTRUCTION

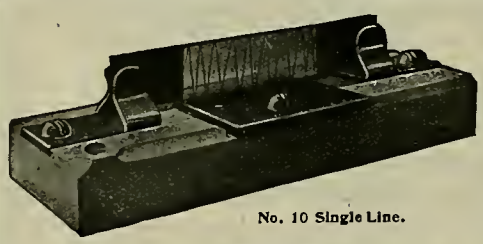


Some of the important features of Bituminized Fiber Conduit: High insulating qualities. Non-abrasive inner surface. Male and female joint. Absolute and permanent self-alignment. Long units. Light weight. Moisture proof. Everlasting.

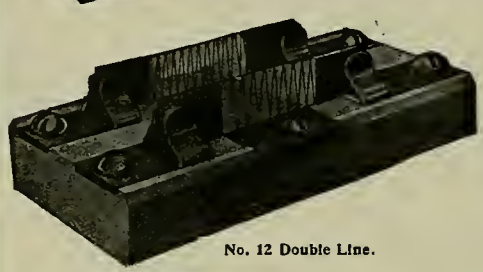
American Conduit Co.

Main Offices: 1005-6 Manhattan Building, Chicago

Other Offices:
170 Broadway, New York. 336 Macy St., Los Angeles



No. 10 Single Line.



No. 12 Double Line.

PROTECTORS THAT PROTECT.

Our patent wrapped fuse used in our protectors are an insurance policy against lightning.

Sample free by mail to any Exchange or Toll Line

CENTRAL TELEPHONE AND ELECTRIC CO.,

909 Market St.,
ST. LOUIS, U. S. A.

We introduced successful 4-party lines

LEICH SELECTIVE SYSTEM

Write for our booklet—"Selective W."

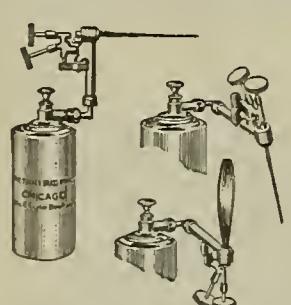
Impedance Coil for Selectives. No Springs.

CENTRAL ENERGY OR MAGNETO

AMERICAN ELECTRIC TELEPHONE CO.

CHICAGO, ILLINOIS

SEE THAT FLAME



IT'S JUST WHAT YOU NEED

for fine soldering for internal wiring and switchboard work, storage battery, lead burning, etc.

The Turner Double Jet Alcohol Blow Pipe No. 10.

Burns wood alcohol and produces a clean non-oxidizing needle pointed or a brush flame of over 3,000 degrees of heat. The burner can be turned in any position. Reservoir 2½ x 5 inches. Capacity ¾ pint. Shipping weight 2 lbs.

No. 10 Alcohol Blow Pipe. $4.50 each. Express prepaid upon receipt of cash. DISCOUNT TO DEALERS.

THE **Turner Brass Works**

23 N. FRANKLIN ST., CHICAGO

TELEPHONE BOOTHS

When in want of the Right Kind write us.

Catalogue Free

Yesbera Mfg. Co.

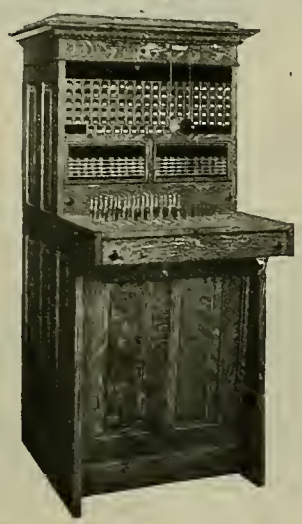
TOLEDO, OHIO.

STROMBERG-CARLSON

GENERATOR-CALL

VISUAL SIGNAL SWITCHBOARDS

are inexpensive to maintain and nearly as rapid as a lamp signal switchboard.



SIGNALS SELF-CONTAINED

NO WORKING PARTS EXPOSED

This illustrates our No. A-1249 cabinet equipped with 100 line signals and 10 clearing-out signals. Our standard cabinets have a capacity for 50, 60, 70, 100, 140, 180 and 200 line signals of the above type.

Bulletins No. 6 and 7-E describe these boards very thoroughly. Mailed free upon request.

STROMBERG-CARLSON TELEPHONE MFG. CO.,

GENERAL OFFICES, ROCHESTER, N. Y. **WESTERN SALES OFFICE, CHICAGO, ILL.**

Kellogg Telephone Apparatus

A glance at the Kellogg desk set will prejudice you in its favor, but its working, wearing and lasting qualities are what have made its name.

It helped to win the Grand Prize at the St. Louis Exposition—the highest award. Write us for catalogues telling you all about it.

Kellogg Switchboard and Supply Company

Green and Congress Streets, CHICAGO

LOS ANGELES Seymour Building | CLEVELAND Electric Building | PHILADELPHIA Keystone Telephone Building

IMPORTANT TELEPHONE BOOKS.

THE TELEPHONE HANDBOOK. By Herbert Laws Webb. 16mo, 150 pp. Price $1.00.
This handbook is a reliable treatise on telephony, and a practical book on telephone working and management, based entirely on standard American practice. It is extremely useful to telephone inspectors and operators.

AMERICAN TELEPHONE PRACTICE. By Kempster B. Miller, M. E. 510 pp. 380 illustrations. Price $3.00.
This is the first complete treatise on telephony in the English language. The text is profusely illustrated by cuts of commercial apparatus and carefully prepared diagrams of circuits. No diagram is given without a full explanation. The apparatus, circuits and methods of the American Bell Telephone Company and of the various independent companies are fully described. The apparatus and methods used in making all of the tests required in commercial telephone work are fully treated.

THE INSPECTOR AND TROUBLE MAN. By A. E. Dobbs. 106 pp. Price $1.00.
A practical book, written in plain language. Full of information and diagrams for the operator, exchange manager, inspector, trouble man and lineman. A complete description of telephones, how to find and remedy their troubles, together with working plans for exchange construction, complete with diagrams of all up-to-date telephones and switchboards.

A, B, C, OF THE TELEPHONE. By J. E. Homans, A. M. 382 pp. 269 illustrations. Price $1.00.
Owing to the demand for a comprehensive book giving a clear, terse idea of the principles governing the construction, installation, care and management of telephones and their appliances, this book has been compiled. It has been the aim of the author to make this the most complete elementary book on the subject for the practical electrician, wireman, lineman and engineer, and it is written in a clear and careful style.

THE PRACTICAL TELEPHONE HANDBOOK. By Joseph Poole, A. I. E. E. Second edition, revised and enlarged. 360 pp. 288 illustrations. Price $1.50.
In this work the writer has endeavored to produce a manual of moderate size and cost, but thoroughly practical, and detailing, as far as space will allow, the most recent methods of telephone working. While the requirements of telephone employes have been kept constantly in view it is fully intended also that the book shall be of service as a source of information on telephonic matters to users of the telephone and to the public generally.

PRACTICAL FEATURES OF TELEPHONE WORK. By A. E. Dobbs. 134 pp. Price 75 cents.
A simple, plain-speaking handbook for the practical telephone man.

TELEPHONE TROUBLES AND HOW TO FIND THEM. A complete handbook for telephone inspectors. By W. Hyde and J. H. McManman, edited by Prof. C. H. Haskins. Eighth edition. 16mo, 48 pp. Price 25 cents.
This little volume is an extremely practical work for telephone employes, written in a popular style and devoid of technicalities.

TELEPHONE LINES AND THEIR PROPERTIES. By Wm. J. Hopkins. Sixth edition. 272 pp. Illustrated. Price $1.50.

A MANUAL OF TELEPHONY. A new and large edition. By W. H. Preece, F. R. S., and A. J. Stubbs. 508 pp. 333 illustrations. Price $4.50.

TELEPHONES, THEIR CONSTRUCTION AND FITTING. A Practical Manual on the Fitting Up and Maintenance of Telephone and Auxiliary Apparatus. By F. C. Allsop. 191 pp. 168 illustrations. Price $1.25.

PATENTED TELEPHONY. A Review of the Patents Pertaining to Telephones and Telephonic Apparatus. Published by the American Electrical Engineering Association. Cloth bound; fully illustrated. Price, $1.50.

THE ELECTRIC TELEPHONE. By E. J. Houston, Ph. D., and A. E. Kennelly, Sc. D.; 12mo, cloth, 422 pp., 142 illustrations. Price $1.00.

HOW TO MAKE AND USE THE TELEPHONE. By Geo. H. Cary. 136 pp.; illustrated. Price $1.00.

The Above, or Any Other Electrical Work Published, Sent on Receipt of Price.

ELECTRICIAN PUBLISHING CO., 510 MARQUETTE BLDG., CHICAGO.

Automatic Telephones.

Privacy

Promptness

Precision

Profits.

Automatic Electric Co., Chicago, U. S. A.

CEDAR POLES

PRODUCERS AND WHOLESALERS OF WHITE CEDAR PRODUCTS

YARDS
KOSS MICH.
L'ANSE "
MUNISING "
ONTONAGON
WAGNER, WIS
PESHTIGO "

SPECIAL PRICES ON SMALL POLES.
Write for a copy of our TELEGRAPH CODE FOR CEDAR PRODUCTS

C. H. WORCESTER CO.
SUITE 1206 TRIBUNE BLDG. CHICAGO.

BRACKETS—X ARMS—PINS
little things it is true, but they cut a big figure in line construction.
OUR MOTTO IS:
Prompt Shipment Quality Satisfaction Right Price
COLUMBIA MFG. CO. ANTIGO, WIS.

Cedar Poles
TORREY CEDAR CO., CLINTONVILLE, WIS.
Large Stock Constantly on Hand

Idaho Cedar Poles
PACIFIC COAST POLE CO. SPOKANE, WASH.

MICHIGAN AND WESTERN **CEDAR POLES**
ALL LENGTHS AND SIZES
LINDSLEY BROS CO.
TRIBUNE BLDG., CHICAGO

Cedar Poles.
Pittsburg and Lake Superior Iron Co. Producers and Wholesalers. Escanaba, Mich.

Southern Cedar POLES Are the Best.
NO ROTTEN BUTTS.
D. W. PHELAN,
277 Broadway, New York

TELEPHONE POLES
Yards at Red Cliff, Wis., Aitkin, Faeley, Cohasset, Deer River, Tenstrike and Black Duck, Minnesota.
Large stocks. Prompt shipments. Carefully inspected stock at low prices.
J. W. MORRISON LUMBER CO., 918-19 Lumber Exchange MINNEAPOLIS, MINN.

FACTORIES WANTED
ALONG THE
BURLINGTON ROUTE
to supply the demand for Electrical Goods.
Burlington Route
N 548
W. H. MANSS.
INDUSTRIAL COMMISSIONER,
209 ADAMS STREET, CHICAGO.

POLE DEALERS ADVERTISING IN THE WESTERN ELECTRICIAN OBTAIN MOST EXCELLENT RESULTS BECAUSE IT PLACES THEM IN TOUCH WITH ACTUAL BUYERS OF POLES. TRY A CARD.

TYPE E.

ALTERNATING CURRENT.

SCHEEFFER INTEGRATING WATTMETER

Type E for Alternating Current Type F for Direct Current Circuits

DUST AND BUG PROOF
IMPROVED CONSTRUCTION

MOVING PARTS ARE EXTREMELY LIGHT, INSURING A HIGHLY SENSITIVE AND ACCURATE METER.

WRITE FOR PRICES AND DESCRIPTIVE LITERATURE.

DIAMOND METER COMPANY,
PEORIA, ILL., - - - - U. S. A.

TYPE F.

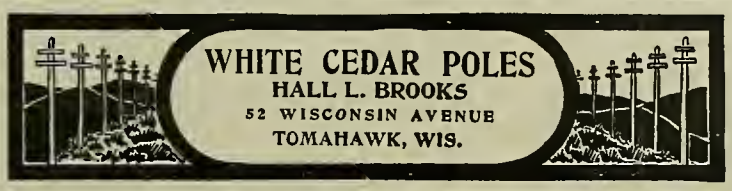
DIRECT CURRENT.

MICHIGAN WHITE LARGE STOCK.
CEDAR POLES
PROMPT SHIPMENTS. KELLOGG SWITCHBOARD & SUPPLY CO., Chicago.

SIX-INCH THIRTIES. If you're going to buy any this year get our price; 7-inch 25s are on the same list. Of course we have every size you ever needed, but we have too many of these two sizes.
MALTBY CEDAR COMPANY, 509 Phoenix Block, Bay City, Michigan.
Pittsburg Agents, Tipper & Patton, 509 Bessemer Building.

POLES. WHITE CEDAR. IDAHO CEDAR up to 80 ft.
BERTHOLD & JENNINGS, ST. LOUIS. Chemical Building.
CROSS ARMS. LONG LEAF PINE AND FIR.

Locations for Industries
Erie Railroad
Chicago to New York
The Erie Railroad Company's Industrial Department has all the territory traversed by the railroad districted in relation to resources, adaptability, markets and advantages for manufacturing, and can advise with manufacturers in relation to the most suitable locations. For full information address
LUIS JACKSON
Indostrial Commissioner, Erie Railroad Company
21 Cortlandt Street, New York



CEDAR POLES
ESTABLISHED 1862
WM. MUELLER COMPANY
1211-12-13 MARQUETTE BLDG. CHICAGO.
EIGHT DISTRIBUTING YARDS

"The King's Highway."

TO THE
GATEWAYS OF COMMERCE
THROUGH THE
CENTERS OF POPULATION,

adding greatly to the interest of your journey, without increasing its expense beyond what you would expect to pay for the "best," which you secure if you travel by the

NEW YORK CENTRAL LINES.

A Copy of "Four-Track Series" No. 13. "Urban Population in 1900," will be sent free, on receipt of a two-cent stamp by George H. Daniels, General Passenger Agent, New York Central & Hudson River R. R., Grand Central Station, New York.

FREE CHRISTMAS DINNERS
for 10,000 of Chicago's Poor
will be supplied by the Salvation Army. Will you help by sending a donation, no matter how Small to the
Salvation Army
CHICAGO
Headquarters
399 State Street
Chicago, Ill.

POLES W. C. STERLING & SON, MONROE, MICH. TIES.
Eleven Pole Yards in Michigan
Wholesale Producers for 20 years.

Points in Wisconsin and the Northwest
are covered by Wisconsin Central Railway's convenient, solid, wide vestibuled trains, equipped with Pullman sleepers, free reclining chair cars and modern coaches which leave Central Station, 12th Street and Park Row (Lake Front), Chicago for St. Paul, Minneapolis, Ashland and Duluth, connecting with all western lines. Meals in dining and cafe cars served a la carte.
For tickets and further information apply to nearest ticket agent, or write
JAS. C. POND, Gen'l Pass. Agt., Milwaukee, Wis.

Watson Motors
If you want a small motor for a special purpose write us
Mechanical Appliance Co.
Milwaukee Wis.

WE BUY OLD BELTS
OR SCRAPS, ANY SIZE OR CONDITION.
WE CLEAN, REPAIR AND RENEW OLD BELTS.
LEATHER PRESERVER MFG. CORP.
27 W. MONROE ST., CHICAGO

Practical Running of Dynamos.
A little booklet on the care and the locating and remedying of troubles in dynamos and motors.
Price, 10 Cents.
Catalogue of mechanical and electrical books free.
ELECTRICIAN PUBLISHING COMPANY,
510 Marquette Bldg., Chicago.

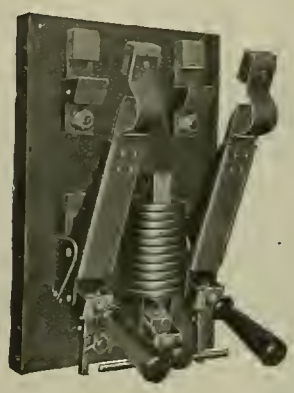
CENTRAL STATION HEATING

We are the originators and builders of the underground system of live and exhaust steam heating. Our system is used for the utilization and distribution of exhaust steam from electric and power plants for heating purposes. 250 Plants in successful operation. We have the only Meter System. Also manufacturers of Wooden Water Pipe, Steam Pipe Casing, Steam Traps, Condensation Meters, Valves, Economizing Coils, Separators and full line of Steam Fitters' Supplies.
WRITE FOR PAMPHLET AND PRICE LIST

AMERICAN DISTRICT STEAM COMPANY
MENTION WESTERN ELECTRICIAN. LOCKPORT, N.Y. CHICAGO, ILL.

Automatic Circuit-Breakers

For Direct and Alternating Current Circuits

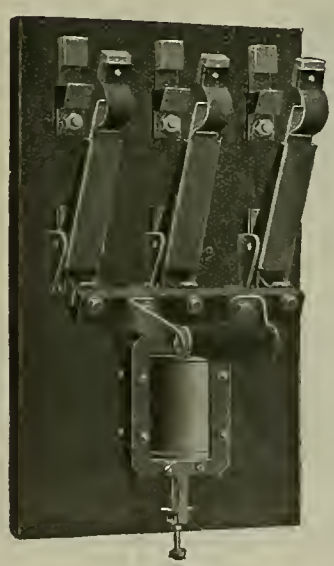


2-Pole, 100 Amp., 250-Volt D. C.
Underload Release.

Westinghouse Type D

Carbon Break Circuit-Breakers

Comprise a complete line of current interrupting devices for almost every possible requirement of practice.



3-Pole, 100 Amp., 440-Volt A. C.
Overload Release.

Strong, neat and simple in construction.

All parts in plain view.

Built in 1, 2, 3 and 4-pole combinations.

For all methods of tripping.

Front or back connection.

Orders promptly filled.

Westinghouse Electric & Mfg. Co.

Pittsburg, Pa.

Address our nearest sales office

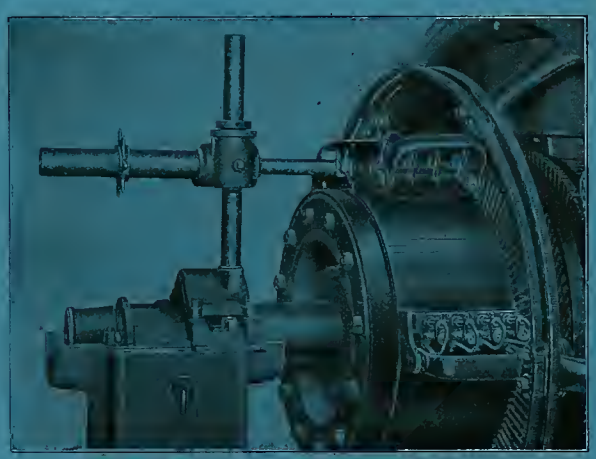
New York, Dallas, Atlanta, Baltimore, Boston, Buffalo, Chicago, Cincinnati, Cleveland, Detroit, Los Angeles, Minneapolis, New Orleans, Philadelphia, Pittsburg, St. Louis, Salt Lake City, San Francisco, Sycamore, Seattle, Denver, Mountain Electric Co.
For Canada: Canadian Westinghouse Co., Limited, Hamilton, Ontario. Mexico, G. & O. Braniff & Co., City of Mexico.

Do you know we sell Incandescent Lamps and carry large stocks in all important cities? Write for our new Lamp Catalogue.

Shaft Type

COMMUTATOR TRUING DEVICES

The use of our truing devices has saved many plants from expensive dismantling of large machines and serious interruption to service.



Pedestal Type

They pay for themselves the first time used.
For arc machines, power generators and motors.
They produce a clean, smooth concentric surface.

Made in three types—Shaft, Pedestal and Yoke.
Are always ready, quickly mounted, easily used.
Simple, durable, strong and rigid mechanically.

FORT WAYNE ELECTRIC WORKS
WOOD LIGHTING & POWER SYSTEMS
Fort Wayne, Ind.

Send for Bulletin 1061 and prices NOW. You may need one next week.

Sheet Brass, All Tempers
Brass and Bronze Drill Rods
Brass and Copper Wire
German Silver Sheet and Rod
Brazed and Seamless Tubing

Eagle Brand Copper Rivets and Burrs, Brass Escutcheon Pins

Brass Butts, Desk Narrow, Broad Middle, Ball Tipped and Water Closet

Brass and Iron Jack Chain, Brass Safety Chain, Etc.
Catalogues on Application

THE PLUME & ATWOOD MFG. CO.
New York Boston San Francisco Chicago

VULCANIZED FIBRE

Highest grades for electrical insulation and mechanical purposes, in sheets, tubes, rods and special shapes. Catalogues and samples on application.

VULCANIZED FIBRE CO., - Wilmington, Del.

USE
"SAFETY" RUBBER COVERED WIRE AND CABLE
FOR EVERY ELECTRICAL SERVICE.
M. B. AUSTIN & CO.,
CHICAGO REPRESENTATIVE.
THE SAFETY INSULATED WIRE & CABLE CO.,
WORKS: Bayonne, N. J. 114-116 LIBERTY STREET, N. Y.

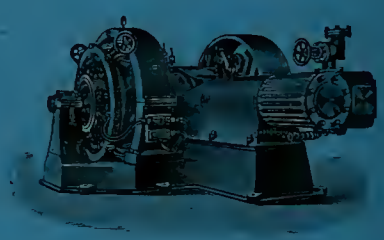
Good Advice

One of the foremost doctors of electrical engineering was recently called upon to examine into the ills of a profitless direct-current light and power plant and, after making a diagnosis, he immediately prescribed Duncan Meters, with instructions that the remedy should be continued indefinitely to prevent a recurrence of the malady.

Send for Bulletin and Prices

DUNCAN ELECTRIC MFG. CO.
LAFAYETTE, IND.

STURTEVANT GENERATING SETS



For Lighting and Power

All Types and Sizes
Between 1½ and 250 K. W.

We Build Both Engine and Generator

B. F. STURTEVANT CO.
BOSTON, MASS.
General Office and Works, Hyde Park, Mass.
NEW YORK PHILADELPHIA CHICAGO LONDON
893

Black Diamond File Works

Est. 1863. Inc. 1895.

Twelve Medals Awarded at International Expositions

Special Prize Gold Medal at Atlanta, 1895.

OUR GOODS ARE ON SALE IN EVERY LEADING HARDWARE STORE IN THE UNITED STATES AND CANADA.

G. & H. BARNETT COMPANY,
PHILADELPHIA, PA.

JOHN A. ROEBLING'S SONS CO.

Insulated Wire of All Kinds

Bare Copper Wire

MAIN OFFICE AND WORKS **TRENTON, N. J.**

AGENCIES AND BRANCHES
New York Chicago Cleveland San Francisco Philadelphia Atlanta

Western Electrician

Vol. XXXV. $3.00 Per Annum. Copyright, 1903, by Electrician Publishing Company, Chicago. CHICAGO, NOVEMBER 26, 1904. Entered at Chicago Postoffice as mail matter of the second class. 10 Cents a Copy. No. 22.

Technology Quarterly
Mass. Inst. of Tech.
Boston Mass

SIMPLEX INSULATED WIRES AND CABLES.
RUBBER COVERED, WEATHERPROOF, UNDERGROUND AND SUBMARINE.
WESTERN SELLING AGENT, H. H. HILSON, 1123 Monadnock Block, CHICAGO.
The Simplex Electrical Co., 110 State Street, BOSTON, MASS.

CHICAGO INSULATED WIRE CO.
152-154 LAKE ST., CHICAGO
1108-1110 PINE ST., ST. LOUIS, MO.
Bare and Insulated Wires and Cables
Galvanized Steel Strands

OKONITE TRADE MARK
1889—Paris Exposition, Medal for Rubber Insulation.
1893—World's Fair, Medal for Rubber Insulation.
THE STANDARD FOR RUBBER INSULATION.
Sole Manufacturers of
Okonite Wires, Okonite Tape, Manson Tape, Candee Weather-proof Wires.
THE OKONITE CO., LTD.
Willard L. Candee, H. Durant Cheever, } Managers. 253 Broadway, New York. Geo. T. Manson, Gen'l Supt. W. H. Hodgins, Secy.

TRADE MARK CRESCENT INSULATED WIRE & CABLE CO. TRENTON, N. J.
CRESCENT RUBBER INSULATED WIRES AND CABLES
National Code Standard.
CRESCENT INSULATED WIRE AND CABLE CO.,
New York Office, 63 BARCLAY STREET. Main Office and Factory, TRENTON, N. J.

STANDARD
STANDARD UNDERGROUND CABLE CO.
322 The Rookery, Chicago. Westinghouse Bldg., Pittsburg. 56 Liberty St., New York City. 1225 Betz Bldg., Philadelphia, Pa.
Crossley Bldg., San Francisco. 10 Post Office Square, Boston.
BARE AND WEATHERPROOF WIRES AND CABLES.
Rubber Covered Wires and Cables. Underground Cables for all Purposes.

PARANITE
INDIANA RUBBER AND INSULATED WIRE CO.,
MANUFACTURERS OF
Paranite Rubber Covered Wires and Cables,
UNDERGROUND, AERIAL, SUBMARINE AND INSIDE USE.
TELEPHONE, TELEGRAPH AND FIRE ALARM CABLES.
All Wires are tested at Factory. JONESBORO, IND.

THE PHOENIX GLASS CO. Pittsburg, New York, Chicago
Manufacturers of
Electric Globes and Shades, both Arc and Incandescent
Inner and Outer Globes for all enclosed arc systems
CATALOGUES SENT ON REQUEST

"CIRCULAR LOOM" THE FLEXIBLE CONDUIT
AMERICAN CIRCULAR LOOM CO. TRADE MARK REGISTERED
CONDUITS FOR INTERIOR WIRING.
American Circular Loom Co.
Chelsea, Mass., New York, Chicago, San Francisco.

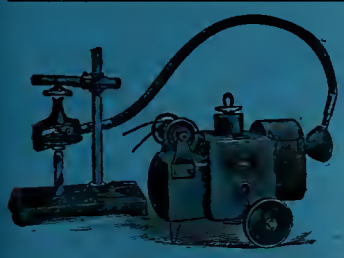
WHAT DID THE WOGGLE BUG SAY?
J. J. EGAN'S "ACME" COMMUTATOR COMPOUND.
YOU CAN'T DO LESS than give a good thing a trial. FREE SAMPLE J. J. Egan's Acme Commutator Compound, the only article that will absolutely prevent sparking, cutting or unnecessary wear of the commutator. Commutator always bright.
Agents Wanted.
50 CENTS PER STICK ALL SUPPLY HOUSES OR $5.00 PER DOZEN
J. J. ECAN, 317 Austin Ave., CHICAGO

THERMOPILES 1½ VOLTS 1½ AMPERES
For Electrolytic analysis, charging storage batteries, and other constant current requirements. $3 Each.
WALSH'S SONS & CO.,
264 Washington Street. Newark, N. J.

ELECTRIC SIGN **FLASHERS**

BEST IN THE WORLD
Write for full particulars
Reynolds Elec. Flasher Mfg. Co.
221 Fifth Ave., Chicago.

THOUSANDS IN USE.
Motors, ⅛ h. p. to 100 h. p.
Dynamos, 1 k. w. to 75 k. w.
Highest Quality. Reasonable Price.
THE HOBART ELECTRIC MFG. CO.
TROY, OHIO.



ESTABLISHED 1875.
COMBINATION OF
Stow Flexible Shaft
—AND—
MULTI-SPEED MOTOR
Practically dust and water proof. For Portable Drilling, Tapping, Reaming, Emery Grinding, etc. Write for Catalogue and Prices.
STOW MFG. CO., Binghamton, N. Y.
Gen'l European Agents, Selig, Sonnenthal & Co., 85 Queen Victoria Street, London, England

Cope's Patent Quick Coupling Conduit Rod
Remember these rods have no lost motion.
These Couplings are of Steel and are made in the best possible manner.

Write for list of persons using these rods—26,000 sold since May 1902. Made in 3 ft. and 4 ft. lengths.
Price, 3 ft. 75 cents, 4 ft. 85 cents.
Patented February 24, 1903.
T. J. COPE
3244 North Fifteenth Street PHILADELPHIA, PA.

H. N. FENNER, President J. F. BLAUVELT, Agent RUSSELL W. KNIGHT, Treasurer
NEW ENGLAND BUTT COMPANY
MANUFACTURERS OF
Machinery for Insulating Electrical Wires
Braiding, Taping, Winding, Twinning, Cabling, Stranding, Polishing and Measuring Machines. Cable Covering Braiders
FINE CASTINGS A SPECIALTY
304 PEARL STREET, - - - PROVIDENCE, R. I., U. S. A.

WESTON Electrical Instrument Co.,
Waverly Park, NEWARK, N. J.
THE WESTON STANDARD PORTABLE
DIRECT READING
Voltmeters and Wattmeters
—FOR—
Alternating and Direct Current Circuits
Are the only standard portable instruments of the type deserving this name.
Write for Circular and Price List.
BERLIN—European Weston Electrical Instrument Co. Ritterstrasse No. 88.
LONDON—Elliott Bros., Century Works, Lewisham.
PARIS, FRANCE—E. H. Cadiot, 12 Rue St. Georges.
NEW YORK OFFICE—74 Cortlandt St.

Weston Standard Portable Direct-Reading Voltmeter for Alternating and Direct-Current Circuits.

HENRY NEWGARD & CO.
ELECTRICAL CONSTRUCTION
Power and Light Plants. Switchboards and Panel Boards.
We install Municipal and Isolated Electric Lighting Plants.
We manufacture Switchboards, Table boards, Iron Cutout Boxes and Electrical Specialties.
We sell Dynamos, Motors and Electrical Supplies.
We wire old as well as new Residences, Factory Buildings, School and College Buildings.
87 Fifth Avenue, Chicago, Illinois.

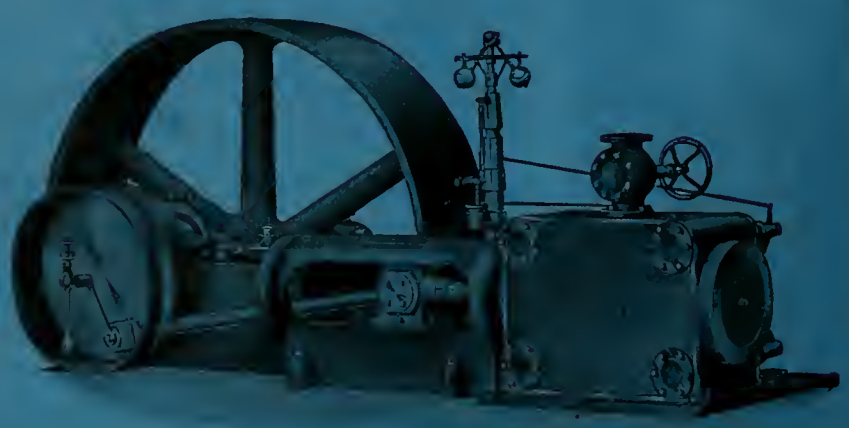
Everybody Knows

We make the largest
Engines in the world

But Do You Know

We make smaller Engines, in sizes
from 25 horsepower upward

?



Allis-Chalmers Standard Corliss Engine

Corliss Engines for all power purposes

Bullock Motors

for operating Machine Tools.

Bullock

(Patented) Three-Wire Multiple Voltage Balancing System
for control of Motors, received the

Highest Award at the St. Louis Exposition

Many of the largest machine shops in the country are operating their tools on the Bullock (Patented) Multiple Voltage System.

When a motor operating on their system is set at any speed, it will run at that speed regardless of the load.

As many as twelve different speeds forward or backward can be secured through this system.

For further particulars address

Allis-Chalmers Co., Milwaukee

Electrical Department

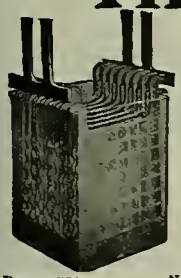
The Bullock Electrical Mfg. Co.

General Sales Offices, New York Life Bldg., Chicago. Electrical Works, Cincinnati, O.

Canadian representatives, Allis-Chalmers-Bullock, Ltd., Montreal

THE ELECTRIC STORAGE BATTERY CO.

PHILADELPHIA



MANUFACTURER OF THE

"Chloride Accumulator"

For Central Stations, Electric Railways, Isolated Lighting and Power Stations, Fire Alarm, Telegraph, Train Lighting, etc., etc.

PRICE LISTS AND DESCRIPTIVE BULLETINS FORWARDED UPON REQUEST.

SALES OFFICES:

PHILADELPHIA, Allegheny Ave. and 19th St. | NEW YORK, 100 Broadway, | BOSTON, 60 State St. | CHICAGO, Marquette Bldg. | ST. LOUIS, Wainwright Bldg. | SAN FRANCISCO, Rialto Bldg. | CLEVELAND, Citizens Bldg. | CANADA, Canadian General Electric Co., Ltd. Toronto | HAVANA, CUBA, G. F. Greenwood, Manager 34 Empedrado St.

TRADE MARK

Lundell

"Universal"

Apparatus

Represents finality of design. Constant and Variable Speeds. Ratio: 3 to 1.

Direct and Alternating Current

Generators

Built in all capacities for Lighting, Power and Railway Service.

National Electric Company

General Sales Office and Works

MILWAUKEE

New York Philadelphia Charleston, W. Va. Pittsburg Chicago Seattle San Francisco

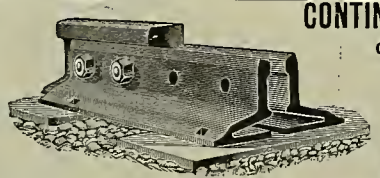
Electric Heating Apparatus

SEND FOR 32-PAGE CATALOGUE.

UNIT" ENAMELED RHEOSTATS

SIMPLEX ELECTRIC HEATING CO.,

Cambridgeport, Mass.



CONTINUOUS RAIL JOINT CO. OF AM.

GENL. OFFICES: CENTURY BLDG., NEWARK, N.J.

OVER 20,000 MILES IN USE

See our exhibit, World's Fair, St. Louis, Mo., Transportation Bldg., Aisle "C," Posts 7 and 8.

M. KLEIN & SON.

Send 2c stamp for new catalogue No. 6 of

KLEIN'S TOOLS

For Electrical Workers and Line Builders.

MATHIAS KLEIN & SONS,

81 W. Van Buren St., Chicago, Ill.

PLATINUM

PLATINUM RIVETS FOR CONTACT POINTS IN TELEPHONES—SPARK COILS AND OTHER ELECTRICAL APPARATUS. PLATINUM SHEET AND WIRE IN ANY FORM AND DEGREE OF HARDNESS. PLATINUM SCRAP PURCHASED.

BAKER & COMPANY, Inc.

ARTISANS IN PLATINUM

408-410-412-414 N. J. R. R. AVE. - NEWARK, N. J.

New York Office: 120 Liberty St.

ALPHABETICAL INDEX TO ADVERTISEMENTS.

Adams-Hagnall Electric Co..—
Allis-Chalmers Company..... 2
American Battery Co.....—
Amer. Circular Loom Co.... 1
American Conduit Co.....14
American Diesel Engine Co..13
Amer. District Steam Co..... 8
Amer. Elec. Fuse Co..... 7
Amer. El. Telephone Co.....14
American Electrical Works..11
Arnold Elec. Power Station Co..... 9
Audit Co. of Ill., The..... —
Automatic Electric Co..... 15

Babcock & Wilcox Co.....—
Badt, F. E..... 9
Bain, Forée.....11
Baker & Company..... 3
Baker & Co., W. E..... 9
Barnett Company, G. & H....20
Beardslee Chandelier Mfg.Co.10
Benjamin Electric Mfg. Co..—
Bennett, L. A.....11
Berthold & Jennings.....17
Big Four Route.....12
Bissell Co., The F..... 7
Bossert Electric Construction Co..... 11
Brooks, Hall L.....16
Bryan-Marsh Co.....—
Bryan, Wm. H..... 9
Buckeye Electric Co.....—
Bullock Elec. Mfg. Co..... 2
Burlington R. R.....16
Butterfield, J. F.....—
Byllesby & Co., H. M..... 9

Cantwell Press, The.....14
Carhartt & Co., Hamilton....—
Central Electric Co..... 5
Cent. Stat. Improvement Co 12
Central Tel. & El. Co.....—
Century Electric Co.....—
Chicago Dis & Electric Co....—
Chicago Edison Co.....4, 12
Chic. Fuse Wire & Mfg. Co... 8
Chicago Insulated Wire Co.. 1
Chicago Mica Co.....10
Clinton Stamping & Elec Co.14
Columbia Incand. Lamp Co..—
Columbia Mfg. Co.....17
Continuous Rail Joint Company of America..... 3
Cooper-Hewitt Elec. Co..... 8
Cope, T. J..... 1
Crawfordsville Electric Co.. 8
Crescent Ins. Wire & Cbl. Co. 1
Crocker-Wheeler Company...20
Cutler-Hammer Mfg. Co..... 5
Cutter Elec. & Mfg. Company—

D. & W. Fuse Company.....—
Dearborn Drug & Chem. Wks.13
Detroit Electric Co.....11
Diamond Meter Company....—
Directory of Engineers..... 9
Dixon Crucible Co., Joseph..13
Duncan Elec. Mfg. Co.....19

Edison Decorative & Miniature Lamp Departm't.....10
Edison Mfg. Company..... 4
Edwards & Co.....10
Egan, J. J..... 1
Electric Appliance Co.....10
Electric Storage Battery Co.. 3
Electrical Appliance Co..... 6
Electrical Engineer Institute.—
Electrician Pub. Company... 4
Erie Ry.....17
Evans, Almirall & Co..... .. 9
Evans & Co., W. R..... 9

Faries Mfg. Co.....20
"For Sale" Advertisements..12
Ft. Wayne Elec. Works, Inc..19
Fostoria Incand. Lamp Co...—
Fowler, John H.....17
Fowler-Jacobs Company.....17
Franklin Elec. Mfg. Co .....—

General Electric Co..... 9
General Engineering Co.,The 9
General Incandescent Arc Light Company.....—
General Incand. Lamp Co....—
Gould Storage Battery Co....—
Gt. Western Smelting & Refining Co .....—
Green Fuel Economizer Co..—
Gregory Electric Company...12

Hallberg, J. H..... 9
Hart Mfg. Co.....16
Hartford Steam Boiler Inspection & Insurance Co....13
Hazard Manufacturing Co...20
Highland Park College. ... 11
Hipwell Mfg. Co..... .... —
Hobart Elec. Mfg. Co..... 1
Hoffman, G. W.....12
Holmes Fibre-Graph. Co.....12
Holophane Glass Co.....—
Humphrey, Henry H.....—
Hunt & Co., Robt. W..... 9

Illinois Central Ry.....12
Incandescent Electric Light Manipulator Company.....—
Indiana Rub. & Ins. W. Co.... 1
India Rubber & Gutta Percha Insulating Company.....17
International Elec. Meter Co 12
International Tel. Mfg. Co...14

Jackson, D. C. & W. B..... 9
Jeffrey Manufacturing Co....13
Johns-Manville Co., H. W.....—

Kartavert Manufacturing Co.20
Kellogg Switchboard & Supply Company.....15, 16
Kemp, R. W..... 9
Kester Elec. Mfg. Co.....17
Klein & Sons, Mathias.... 3
Kohler Brothers..... 9
Kuhlman Electric Co.....13

Leather Preserv. M. Corp....—
Leffel & Co., James.....13
Lindsley Brothers Company..17
Loud's Sons Co., H. M.....16

Machado & Roller.....—
Maltby Cedar Company.....17
Manhattan El. Supply Co....12
Manross, F. N..... 12
Marinette Gas Engine Co....13
Matthews & Bros., W. N.....11
McLaughlin & Co., Jas.....11
McLennan & Company, K....10
Mechanical Appliance Co....—
Merriam Co., G. & C.....12
Mica Insulator Company.....10
Miscellaneous Advs.....12
Monon Railroad..... .. ..—
Morrison Lbr. Co., J. W.....—
Mueller Company, William..17
Munsell & Co., Eugene.....10

National Electric Co..... 3
National India Rubber Co....—
New England Butt Co..... 1
Newgard & Co., Henry..... 1
New York Cent. Ry.....16
New York Ins. Wire Co.....11
Northern Elect'l Mfg. Co.... 5
Northern Wire & Cable Co...-
Northwestern Storage Battery Co.. ... .10

Okonite Co., The..... 1
Osburn Flexible Conduit Co.10

Pacific Coast Pole Co.....17
Paragon Fan & Motor Co.....—
Pardridge Shade & Refl. Co..—
Pass & Seymour, Inc.....—
Phelan, D. W.....16
Phillips, Eugene F.....11
Phillips Insulated Wire Co...11
Phœnix Glass Co..... 1
Phosphor-Bronze S. Co.....13
Pignolet, L. M.....10
Pittsburg & L. S. Iron Co....17
Plume & Atwood Mfg. Co.....—
Porter Cedar Company.....16
Prometheus Electric Co., The10

Reisinger, Hugo..... 7
Reynolds El. Flasher Mfg.Co. 1
Roebling's Sons Co., J. A.....20
Ruebel-Schwedtmann-Wellis.. 9
Runzel-Lenz Elec. Mfg. Co...—

Safety Ins. Wire & Cable Co..10
Sargent & Lundy.....—
Sauquoit Silk Mfg. Co.....10
Schott, W. H..... 9
Signaloid Chemical Works...—
Simplex Electrical Co., The.. 1
Simplex Elec. Heating Co.... 3
Speer Carbon Co.....13
Sprague Electric Company... 5
Squire Electric Co.....—
Standard Elec. Mfg. Co.....16
Standard Underg. Cable Co.... 1
Stanley Elec. Mfg. Co., The 7
Stanley Instrument Co..... 5
Stanton, LeRoy W..... 9
Sterling & Son, W. C.....16
Sterling Electrical Mfg.Co... 11
Sterling Varnish Co., The....17
Stow Mfg. Company..... 1
Stromberg-Carlson Tel. Mfg. Company.....15
Sturtevant Company, H. F...20

Temple Pump Co.....—
Torrey Cedar Company.....16
Trumbull Elec. Mnfg. Co.....—
Turner Brass Works.....—

Union Electric Mfg. Co.....—

Valentine-Clark Co., The....17
Vulcanized Fibre Company..20

Wagner Electric Mfg. Co.....—
Walsh's Sons & Company..... 1
Warren Elec. Mfg. Co..... 7
Wesco Supply Co.....—
Western Electric Company... 8
Westinghouse Electric & Manufacturing Co.....18
Weston Electrical Inst. Co... 1
Whitehead Machinery Co... —
Wilmerding, C. H..... 9
Wisconsin Central Ry.....16
Woolley Fdy. & Mach. Wks...—
Worcester Company, C. H....16

Yesbera Mfg. Co..... .. —
Yost Electric Mfg. Co 17

Zero Marx Sign Works 11

For Classified Index of Advertisements See Page 6.

If you want Wires or Cables insulated with the HIGHEST CLASS INDIA RUBBER INSULATION you should buy . . . . . .

HABIRSHAW

Complete stock of all sizes constantly on hand and for sale at lowest market prices by

CHICAGO EDISON COMPANY,

WRITE FOR PRICES. 139 ADAMS STREET, CHICAGO.

BARGAINS IN SHELF-WORN BOOKS

You may have been looking for some of these volumes for years. Now you can get them and get them at a bargain, too. We have only one or two copies of each of the following:

	List Price	Sale Price
ELECTRICITY AS A MOTIVE POWER, by Count Th. du Moncel, London, 1883..	$3.00	$1.80
DECORATIVE ELECTRICITY, by Mrs. J. E. H. Gordon, London, 1891.....	2.50	1.50
ELECTRICAL APPLIANCES OF THE PRESENT DAY, by Major D. P. Heap, U. S. A., being a report of the Paris Electrical Exhibition of 1881.....	2.00	1.20
TABLES AND MEMORANDA FOR ELECTRICAL ENGINEERS, by Frederick Walker, C.E.	.80	.45
MAGNETISM AND ELECTRICITY, by R. Wormell	1.25	.75
STEAM HEATING DATA, by Wm. J. Baldwin, N. Y., 1897.....	.50	.30
THE TELEGRAPHIST'S GUIDE: THE NEW EXAMINATIONS OF TECHNICAL TELEGRAPHY, by Jas. Bell, A. I. E. E., London, 1895	.50	.30
THE MECHANICAL ARTS SIMPLIFIED, by D. B. Dixon, Chicago, 1897.....	2.50	1.60
ELECTRIC LIGHTING, translated from the French of Count du Moncel, by Robt. Routledge, B. S. C., London, 1883...	1.25	.75
THE ARITHMETIC OF THE STEAM ENGINE, by E. Sherman Gould, N. Y., 1897	1.00	.60
TIPS TO INVENTORS, by Robt. Grimshaw, Ph. D., N. Y., 1893.....	1.00	.60
MECHANICAL GRAPHICS, by Geo. Halliday, London, 1889	2.00	1.20
PHYSICAL UNITS, by Magnus Maclean, D. Sc.	1.00	.60
THE INDICATOR AND DYNAMOMETER, by Thos. J. Main, M. A., Philadelphia, 1883	1.50	.90
HOW TO WORK AND FIX A DYNAMO-ELECTRIC MACHINE, by W. C. Mountain..	.35	.20
THE INDICATOR HANDBOOK, by Chas. N. Pickworth	.75	.45
THE HISTORY AND PROGRESS OF THE ELECTRIC TELEGRAPH, by Robt. Sabine, C. E., London, 1869. Cloth...	1.25	.75
Paper	.75	.25
LOCAL DISTRIBUTION OF ELECTRIC POWER IN WORKSHOPS, by Ernest Kilburn Scott, A. I. E. E.	.50	.30
BEARINGS AND LUBRICATION, by A. J. Wallis-Taylor, C. E.	1.50	.90
FIRST PRINCIPLES OF MECHANICAL ENGINEERING, by Imray & Biggs, London	1.00	.60
ELECTRICITY IN OUR HOMES AND WORKSHOPS, by Sidney F. Walker, London, 1889	1.50	.90
ELECTRICITY IN THE SERVICE OF MAN, by R. Wormell, D. Sc., M. A., New York, 1886	$3.00	$1.80
THE MATHEMATICAL THEORY OF ELECTRICITY AND MAGNETISM, by Watson & Burbury, London, 1885. Vol I, Electrostatics	2.75	1.65
Vol. II, Magnetism and Electrodynamics	2.60	1.60
CHAPTERS ON ELECTRICITY, by Samuel Sheldon, Ph. D.	1.10	.65
ELECTRICITY, ITS THEORY, SOURCES AND APPLICATION, by John T. Sprague, London, 1892	6.00	3.60
MAGNETISM AND ELECTRICITY, by H. C. Tarn, M. C. P., London, 1889.....	.80	.45
ELECTRICITY UP TO DATE, by John B. Verity, M. I. E. E., London, 1896..	1.00	.60
TELEGRAPHY, by W. H. Preece and J. Sivewright, London, 1888.....	2.00	1.20
ELECTRICITY AND THE ELECTRIC TELEGRAPH, in two volumes, by Geo. B. Prescott, New York, 1888.....	7.00	4.20
USEFUL RULES AND TABLES, relating to Mensuration, Engineering, Structures and Machines, by Wm. John Macquorn Rankine, London, 1889.....	4.00	2.40
ELECTRICITY AND MAGNETISM, by Francis Nipher, A. M., St. Louis, 1895..	3.25	2.00
THE ACTION OF LIGHTNING, by Arthur Parnell, London, 1882.....	3.00	1.80
MODERN AMERICAN METHODS OF COPPER SMELTING, by Edw. Dyer Peters, Jr., M. E., New York, 1891.....	5.00	3.00
ELECTRICITY, by Fleming Jenkin, F.R.S.	.40	.25
MAGNETISM AND ELECTRICITY, by Wm. Adler Miller, M. D., LL. D., N. Y., 1888	1.50	.90
THE STEAM-BOILER CATECHISM, by Robt. Grimshaw, M. E.	2.00	1.20
THE STEAM-ENGINE CATECHISM, by Robt. Grimshaw, M. E., New York, 1896	2.00	1.20
ELECTRICAL PAPERS, Vols. I and II, by Oliver Heaviside, New York, 1894..	7.00	4.20
A GUIDE FOR THE ELECTRICAL TESTING OF TELEGRAPH CABLES, by Col. V. Hoskiaer, London, 1889.....	1.50	.90
SOLUTIONS OF THE QUESTIONS IN MAGNETISM AND ELECTRICITY, set at the Intermediate Science and Preliminary Scientific Pass Examinations of the University of London, 1860 to 1884, by F. W. Levander, London, 1885....	1.00	.40
DOMESTIC ELECTRICITY FOR AMATEURS, translated from the French of E. Hospitalier, London, 1889.....	$2.50	$1.50
FOUR LECTURES ON STATIC ELECTRIC INDUCTION, by J. E. H. Gordon, B. A., New York, 1881.....	.80	.45
CONSTRUCTION OF MILL DAMS, Jas. Leffel & Co., Springfield, O., 1874.....	2.50	1.00
A PRACTICAL TREATISE ON ELECTRIC LIGHTING, by J. E. H. Gordon, B. A., New York, 1884.....	4.50	2.70
GRAY'S TREATISE ON MAGNETISM AND ELECTRICITY, Vol. I, by Andrew Gray, LL. D., F. R. S., London, 1898	4.50	2.70
EXERCISES IN ELECTRICAL AND MAGNETIC MEASUREMENTS, by R. E. Day, M. A., London, 1889.....	1.00	.60
ELECTRICITY, by Robt. M. Ferguson, Ph. D., F. R. S. E., London, 1890...	1.50	.90
COIL AND CURRENT, OR THE TRIUMPHS OF ELECTRICITY, by Henry Frith, London, 1897.....	1.25	.75
A CENTURY OF ELECTRICITY, by T. C. Mendenhall, Cambridge, 1887.....	1.25	.75
MAGNETISM AND ELECTRICITY, by Arthur Wm. Poyser, M. A., London, 1890...	.80	.45
POTENTIAL AND ITS APPLICATION POPULARLY TREATED, by Dr. Tumlirz, London, 1889.....	1.50	.90
CONTINENTAL ELECTRIC LIGHT CENTRAL STATIONS, Killingworth Hedges, London, 1892	6.00	3.60
THEORY OF ELECTRICITY, by Linnæus Cumming, M. A., London, 1885.....	2.25	1.35
ELECTRICITY TREATED EXPERIMENTALLY, by Linnæus Cumming, M. A., London, 1891	1.50	.90
POPULAR ELECTRIC LIGHTING, by Capt. E. Ironside Bax, London, 1892.....	1.00	.60
THE AGE OF ELECTRICITY, by Park Benjamin, New York, 1892.....	2.00	1.20
THE LAW RELATING TO ELECTRIC LIGHTING, by G. Spencer Bower, B. A., London, 1889	5.00	3.00
MATHEMATICAL THEORY OF THE STEAM ENGINE, by T. Baker, C. E., London, 1890	.75	.45
ELEMENTARY TREATISE ON NATURAL PHILOSOPHY, by A. Privat Deschanel, Part 3, Electricity and Magnetism, New York, 1893	1.50	.90
ELECTRICITY IN MODERN LIFE, by G. W. De Tunzelmann, London, 1889.....	1.25	.75

ELECTRICIAN PUBLISHING CO., 510 MARQUETTE BLDG, CHICAGO

EDISON PRIMARY BATTERIES

FORMERLY EDISON-LALANDE

Extremely low internal resistance is a strong point in favor of these batteries. The internal resistance in these cells falls during the whole life of the battery. This is because the positive pole (oxide of copper) is continually reduced to metallic copper during the period that the circuit is closed. This action continually increases the size of the positive pole, thereby lowering the internal resistance. Send for Catalog No. 7.

TRADE Thomas A Edison MARK

EDISON MFG. CO.

Factory, ORANGE, N. J.

NEW YORK: 83 Chambers Street

CHICAGO: 304 Wabash Avenue

TYPE K TRANSFORMER

MORE PEOPLE THAN EVER

Are using PITTSBURG TRANSFORMERS which simply goes to show that they are good transformers and are holding up their end in a remarkable manner. This is an important thing to us and should be to you also, as an indication that Pittsburg transformers are safe and good to buy.

WILL YOU NOT SPECIFY THEM IN YOUR NEXT ORDER?

OKONITE IT NEVER DISAPPOINTS

Central Electric Company,

GENERAL WESTERN AGENTS

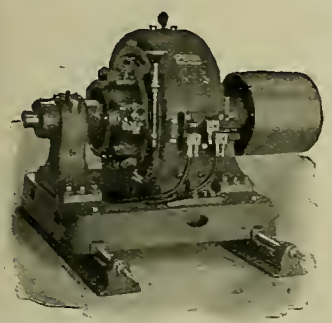
264-266-268-270 Fifth Ave. CHICAGO

OKONITE IT NEVER DISAPPOINTS

DIRECT CURRENT

GENERATORS

FOR LIGHT AND POWER

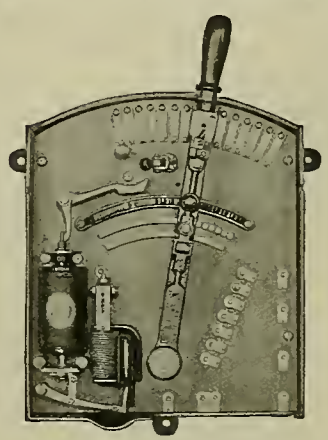


Our generators have a high efficiency and great endurance under the most exacting conditions of service. Sizes up to 1,000 K. W.
Write for bulletin No. 10514.

SPRAGUE ELECTRIC COMPANY

General Offices:
527 West 34th Street, New York
Chicago Office: Fisher Building

Flat Bed and Small Rotary Press Controllers



One of the six "Carpenter" types.

The "Carpenter" system gives such a wide range of speed and such perfect control that a press can be moved an eighth of an inch at a time, and from that to top speed, with every desirable intermediate speed.

Six types, alike in principle, different in detail. Bulletins 81 to 86 explain. We'll send them if you let us know that you want them.

The Cutler-Hammer Mfg. Co.,

Electric Controller Manufacturers and Electrical Engineers.

MILWAUKEE, WIS.

New York, Boston, Chicago, Pittsburg.

Northern Apparatus For Industrial Work

Built for service in industrial plants, to operate in isolated industries, etc. Its simplicity favors Northern Apparatus for this work, and users and those familiar with it favor Northern Apparatus also.

DIRECT CURRENT DYNAMOS AND MOTORS

Get acquainted through Bulletin No. 2535. See Northern Apparatus at Section 14, Palace of Electricity, St. Louis.

211

Northern Electrical Mfg. Co.

Engineers Manufacturers Madison, Wis., U. S. A.

ELECTRICITY FOR ENGINEERS.

424 PAGES. ILLUSTRATED. PRICE $2.50.

ELECTRICIAN PUBLISHING CO.,
510 Marquette Building, • • CHICAGO

STANLEY RECORDING WATTMETERS

FOR ALTERNATING-CURRENT CIRCUITS

BALANCED THRUST

No Jewel Wear from Hammer or Side Thrust. Class or Metal Covers, Second Alone to the

STANLEY MAGNETIC SUSPENSION WATTMETERS

Missouri, Kansas, Arkansas
FRANK ADAM ELECTRIC CO.
St. Louis

Colorado, Idaho, Montana, Wyoming
New Mexico, Utah
MENDRIE-BOLTHOFF MFG. AND SUPPLY CO.
Denver

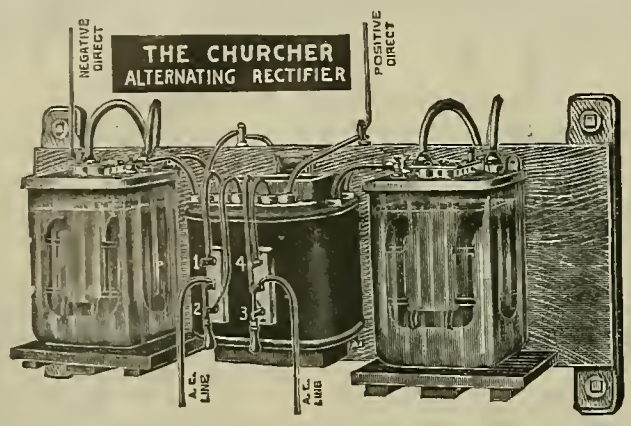
SEND FOR BULLETINS AND INFORMATION ABOUT METERS TO

STANLEY INSTRUMENT CO.

GREAT BARRINGTON MASS., U. S. A.

Mexico
VICTOR M. BRASHI & CO.
Mexico City

California, Oregon, Washington
Nevada, Arizona
BROOKS-FOLLIS ELECTRIC CORP.
San Francisco



CHURCHER ALTERNATING-CURRENT RECTIFIER

will not only transform any cycle of alternating current into direct current, but will, at the same time, if desired, convert the potential of the direct current produced to a higher or lower voltage.

SOLD ON 30 DAYS' APPROVAL

Cheaper to install and operate than a motor generator. Very slight renewal costs. **Guaranteed net efficiency of 50 per cent.** Full particulars in Bulletin No. 18.

THE ELECTRICAL APPLIANCE CO.

CINCINNATI, OHIO

CLASSIFIED INDEX OF ADVERTISEMENTS.

Accountants and Auditors.
Audit Co. of Illinois

Adjusters, Cord.
Incandes. El. Lt. Manip. Co.

Adjusters, Inc. Lamps.
Inc. El. Lt. Manipulator Co.

Anchors (Tel. & Tel.)
Bennett, I. A.
Matthews & Bro., W. N.

Annunciators.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.

Batteries and Jars.
Bissell Co., The F.
Central Electric Co.
Edison Mfg. Co.
Edwards & Company.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.

Bells, Buzzers, Etc.
Central Electric Co.
Edwards & Co.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.

Belt Dressing.
Dixon Crucible Co., Jos.
Leather Preserver Mfg. Corp.

Belting.
Leather Preserver Mfg. Corp

Blow Pipes.
Turner Brass Works

Blowers.
Sturtevant Co., B. F.

Boiler Compounds.
Dearborn Drug & Chem. Wks.

Boilers.
Allis-Chalmers Company.
Babcock & Wilcox Co.

Books, Electrical.
Cantwell Press, The.
Electrician Publishing Co.

Booths, Telephone.
Yesbera Mfg. Co.

Brackets.
Faries Mfg. Co.

Brushes.
Central Electric Co.
Hobart Elec. Mfg. Co.
Holmes Fibre-Graphite Co.
Speer Carbon Co.
Western Electric Company.

Cable Hangers.
Bissell Co., B. F.
Wesco Supply Co.
Western Electric Co.

Cables (See Wires and Cables)

Canopies.
Faries Mfg. Co.

Carbons, Points and Plates.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
Reisinger, Hugo.
Speer Carbon Co.
Wesco Supply Co.

Castings.
Faries Mfg. Co.
New England Butt Co.
National Electric Co.

Chains.
Jeffray Mfg. Co.

Chandeliers.
Faries Mfg. Co.

Circuit Breakers.
Cutler-Hammer Mfg. Co.
Cutter Elec. & Mfg. Co.
Ft. Wayne Elec. Wks. Inc.
Union Electric Mfg. Co.
Wesco Supply Co.
Western Electric Company.
Westinghouse El. & Mfg. Co.

Clusters.
Benjamin Elec. Mfg. Co.
Faries Mfg. Co.

Coal and Ashes Handling Machinery.
Jeffrey Mfg. Co.

Coils and Magnets.
Western Electric Co.

Coloring, Lamp.
Signaloid Chemical Works.

Commutator Compound
Egan, J. J.
McLaughlin & Co., Jas.
McLennan & Co., K.

Condensers, Electric.
Stanley Elec. Mfg Co.

Conduit and Conduits.
American Circular Loom Co.
American Conduit Company
Central Electric Co.
Electric Appliance Co.
Osburn Flexible Conduit Co.
Sprague Electric Co.
Wesco Supply Co.

Contractors and Electric Light Plants.
Allis-Chalmers Company.
Bullock El. Mfg. Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
National Electric Co.
Northern Electrical Mfg. Co.
Sprague Electric Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Controllers, Crane.
Amer. Elec. Fuse Co.

Copper, Scrap.
Great Western Smelting & Refining Co.

Cord.
Runzel-Lenz Elec. Mfg. Co.

Cross-Arms, Pins and Brackets.
Berthold & Jennings.
Central Electric Co.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Company.

Cut-Outs and Switches.
Bissell Co., The F.
Bossert Elec. Const. Co.
Central Electric Co.
Chicago Edison Co.
Clinton Stamping & Elec. Co.
Cutter Elec. & Mfg. Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
General Inc. Arc Light Co.
Hart Manufacturing Co.
Manhattan Elec. Supply Co.
Trumbull Elec. Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Dictionaries.
Merriam Co., G. & C.

Dynamos and Motors.
Allis-Chalmers Company.
Bissell Co., The F.
Bullock Elec. Mfg. Co.
Central Electric Co.
Century Electric Co.
Crawfordsville Electric Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks. Inc.
General Elec. Co.
General Inc. Arc Light Co.
Gregory Electric Co.
Hobart Elec. Mfg. Co.
Mechanical Appliance Co.
National Electric Co.
Northern Electrical Mfg. Co.
Sprague Electric Co.
Stanley Elec. Mfg. Co.
Stow Manufacturing Co.
Sturtevant Co., B. F.
Wagner Electric Mfg. Co.
Warren Elec. Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Economizers, Fuel.
Green Fuel Economizer Co.

Electric Heating Appl.
Electric Appliance Co.
Prometheus Electric Co.
Simplex Elec. Heating Co.
Western Electric Co.

Electric Railways.
Crocker-Wheeler Co.
General Electric Co.
Sprague Electric Co.
Westinghouse El. & Mfg. Co.

Electrical and Mechanical Engineers.
Arnold Elec. Power Stat'n Co.
Badt, F. B.
Baker & Co., W. E.
Bryan, Wm. H.
Butterfield, J. F.
Bylesby & Co., H. M.
Evans, Almirall & Co.
General Engineering Co., The.
Hallberg, J. H.
Humphrey, Henry H.
Hunt & Co., Robt. W.
Jackson, D. C. & W. B.
Kemp, R. W.
Kohler Brothers.
Newgard & Co., Henry.
Northern Electrical Mfg. Co.
Ruebel, Schwedtman, Wells.
Sargent & Lundy.
Schott, W. H.
Squire Electric Co.
Stanley Elec. Mfg. Co.
Stanton, LeRoy W.
Wilmerding, C. H.

Electrical Instruments. (Recording and Testing.)
Bissell Co., The F.
Central Electric Co.
Detroit Electric Co.
Diamond Meter Co.
Duncan Elec. Mfg. Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
General Inc. Arc Light Co.
Machado & Roller.
Pignolet, L. M.
Stanley Elec. Mfg. Co.
Stanley Instrument Co.
Wagner Electric Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co
Weston Electrical Inst. Co.

Electro-Plating Mach'y
Crocker-Wheeler Company.
General Electric Co.

Elevators-Conveyors.
Jeffrey Mfg. Co.

Engines, Gas and Gasoline.
Allis-Chalmers Company.
Marinette Gas Engine Co.
Temple Pump Co.
Woolley Fdy. & Mach. Wks.

Engines, Oil.
American Diesel Engine Co.

Engines, Steam.
Allis-Chalmers Company.
Sturtevant Co., B. F.

Fans and Fan Motors.
Central Electric Co.
Crocker-Wheeler Company.
Edison Mfg. Co.
General Electric Co.
General Inc. Arc Light Co.
Sprague Electric Co.
Sturtevant Co., B. F.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Fibre.
Kartavert Mfg. Co.
Vulcanized Fibra Co.

Files.
Barnett Co., G. & H.

Fittings.
Faries Mfg. Co.

Fixtures, Gas and Elec.
Beardslee Chandelier Mfg. Co.

Flashers.
Bissell Co., The F.
Reynolds El. Flasher Mfg. Co
Wesco Supply Co.

Flexible Shafts.
Stow Mfg. Co.

Forges.
Sturtevant Co., B. F.

Fuses and Fuse Wire.
Amer. Elec. Fuse Co.
Bissell Co., The F.
Central Electric Co.
Central Tel. & El. Co.
Chicago Die & Electric Co.
Chicago Fuse Wire & Mfg. Co.
Clinton Stamping & Elec. Co.
D. & W. Fuse Company.
Electric Appliance Co.
Johns-Manville Co., H. W.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Company.

Globes, Reflectors and Shades.
Fostoria Incan. Lamp Co.
Holophane Glass Co.
Pardridge Shade & Refl. Co.
Phœnix Glass Co.
Wesco Supply Co.
Western Electric Co.

Graphite Specialties.
Dixon Crucible Co., Jos.
Holmes Fibre-Graphite Co.

Heating (Exhaust Steam).
Amer. District Steam Co.

Heating and Ventilating Apparatus.
Sturtevant Co., B. F.

Heating, Hot Water.
Evans, Almirall & Co.

Holders, Inc. Lamps.
Electric Appliance Co.
Incandesent Electric Light Manipulator Co.

Inspection & Insurance
Hartford Steam Boiler Inspection & Insurance Co.

Insulating Machinery.
New England Butt Co.

Insulators and Insulating Materials.
American Electrical Works.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Inc. Arc Light Co.
Indiana Rub. & Ins. Wire Co.
Johns-Manville Co., H. W.
Kartavert Mfg. Co.
Manhattan Elec. Supply Co.
Mica Insulator Co.
Munsell & Co., Eugene.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Sterling Varnish Co.
Vulcanized Fibra Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Junction Boxes.
Bossert Elect. Const. Co.
General Inc. Arc Light Co.

Lamps, Arc.
Bissell Co., The F.
Central Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
General Inc. Arc Lt. Co.
Gregory Electric Co.
Hipwell Manufacturing Co
Manhattan Elec. Supply Co.
Stanley Elec. Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Lamps, Incandescent.
Bissell Co., The F.
Bryan-Marsh Company.
Buckeye Electric Company.
Central Electric Co.
Chicago Edison Co.
Columbia Incan. Lamp Co.
Edison Decorative & Miniature Lamp Dept.
Electric Appliance Co.
Fostoria Incand. Lamp Co.
Franklin Electric Mfg. Co.
General Electric Co.
General Inc. Arc Light Co.
Sawyer-Man Elec. Co.
Standard Elec'l Mfg. Co.
Sterling Electrical Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Lamps, Incandescent—Replacers & Cleaners.
Inc. El. Lt. Manipulator Co.

Lamps, Vapor.
Cooper, Hewitt Elec. Co.

Letters, Metal.
Haller Machine Co.

Lightning Arresters.
Central Electric Co.
Clinton Stamping & Elec. Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
Manhattan Elec. Supply Co.
Stanley Elec. Mfg. Co.
Wesco Supply Co.
Western Electric Co.

Linemen's Climbers.
Klein & Sons, Mathias.

Magnet Wires.
(See Wires and Cables.)

Mechanical Draft.
Sturtevant Co., B. F.

Mica.
Chicago Mica Co.
Mica Insulator Co.
Munsell & Co., Eugene.

Mining Apparatus, Elec.
Allis-Chalmers Company.
Crocker-Wheeler Company.
General Electric Co.
Jeffray Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Motors. (See Dynamos and Motors.)

Nippers and Pliers.
Klein & Sons, Mathias.

Nozzles.
Faries Mfg. Co.

Overalls.
Carhartt & Co., Hamilton.

Patent Attorneys.
Hain, Foree.

Phosphor Bronze.
Phosphor Bronze Sm. Co. Ltd.

Platinum, Wire and Sheet.
Baker & Company Inc.

Poles and Ties.
Berthold & Jennings.
Brooks, Hall L.
Columbia Mfg. Co.
Fowler, John H.
Fowler-Jacobs Company.
Kellogg Switch. & Sup. Co.
Lindsley Bros. Co.
Loud's Sons Co., H. M.
Maltby Cedar Co.
Morrison Lbr. Co., J. W.
Mueller Company, William.
Pacific Coast Pole Co.
Phelan, D. W.
Pittsburg & L. S. Iron Co.
Porter Cedar Company.
Sterling & Son, W. C.
Torrey Cedar Co.
Valentine-Clark Co., The.
Worcester Co., C. H.

Polish (Metal).
Allen Co., Inc., L. B.
Hoffman, Geo. W.

Portables.
Faries Mfg. Co.

Power Transmission Machinery.
Jeffrey Mfg. Co.

Rail Joints.
Continuous Rail Joint Company of America.

Railway Supplies.
Wesco Supply Co.

Rectifiers.
Electrical Appliance Co.

Refiners.
Gt. West Smalt. & Refining Co

Re-Winding—Repairs.
Chicago Edison Co.
Gregory Electric Co.

Rheostats.
Cutler-Hammer Mfg. Co.
General Electric Co.
Gen'l Inc. Arc Lt. Co.
Union Electric Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Rods, Conduit.
Cope, T. J.

Schools and Colleges.
Electrical Engineer Inst.
Highland Park College

Second-Hand Mach'y.
Bissell Co., The F.
Cent. Stat. Improvement Co.
Gregory Electric Co.
Matthews & Bro., W. N.
Walsh's Sons & Co.

Shades, Lamp.
Faries Mfg. Co.

Sheet Brass & Copper.
Plume & Atwood Mfg. Co.

Signs, Electric.
Zero Marx Sign Works.

Silks, Insulating and Braiding.
Sauquoit Silk Mfg. Co.

Sockets & Receptacles.
Pass & Seymour.
Yost Elec. Mfg. Co.

Soldering Sticks, Salts and Paste.
Kester Elec. Mfg. Co.
Western Electric Co.

Speaking Tubes.
Central Electric Co.
Edwards & Co.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.

Speed Indicators.
Weston Electrical Inst. Co.

Storage Batteries.
American Battery Co.
Electric Storage Battery Co.
Gould Storage Battery Co.

Supplies, General Elec.
Bissell Co., The F.
Central Electric Co.
Century Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Electric Co.
Manhattan Elect'l Supply Co
Wesco Supply Co.
Western Electric Co.

Switchboards.
Bissell Co., The F.
Gen. Incan. Arc Light Co.

Telephones, Telephone Material and Switchboards.
American El. Telephone Co
Automatic Electric Co.
Bissell Co., The F.
Central Electric Co.
Central Tel. & El. Co.
Electric Appliance Co.
International Tel. Mfg. Co.
Kellogg Switchb. & Sup. Co.
Manhattan Elec. Supply Co.
Stromberg-Carlson Tel. M.Co
Wesco Supply Co.
Western Electric Co.

Time Switches.
Bissell Co., The F.

Tools.
Klein & Sons, Mathias.
Western Electric Co.

Transformers.
Central Electric Co.
Crawfordsville Electric Co.
Crocker-Wheeler Co.
Electric Appliance Co.
Ft. Wayne Elec. Works, Inc.
General Electric Co.
Gregory Electric Co.
Kuhiman Electric Co.
Manhattan Elec. Supply Co.
National Electric Co.
Stanley Elec. Mfg. Co.
Wagner Electric Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Trucks, Electric Car.
General Electric Co.
Westinghouse El. & Mfg. Co.

Turbines, Steam.
Allis-Chalmers Co.
General Electric Co.
Westinghouse El. & Mfg. Co

Turbine Water Wheels
Leffel & Co., Jas.

Varnishes.
Sterling Varnish Co.

Vulcanized Fibre.
Vulcanized Fibra Co.

Whistles, Electric.
Electrical Appliance Co.

Wires & Cables—Magnet Wires.
American Electrical Works.
Bissell Co., The F.
Central Electric Co.
Chicago Insulated Wire Co.
Crescent Ins. Wire & Cble. Co.
Electric Appliance Co.
General Electric Co.
Hazard Manufacturing Co.
Indiana Rub. & Ins. Wire Co
India Rubber & Gutta Percha Insulating Co.
Kellogg Switch. & Sup. Co.
Manhattan Elec. Supply Co.
National India Rubber Co
New York Insulated Wire Co.
Northern Wire & Cable Co.
Okonite Co., The.
Phillips, Eugene F.
Phillips Insulated Wire Co
Roebling's Sons Co., J. A.
Runzel-Lenz Elec. Mfg. Co.
Safety Ins. Wire & Cable Co.
Simplex Electrical Co.
Standard Underground C. Co
Wesco Supply Co.
Western Electric Company.

For Alphabetical Index of Advertisements See Page 3.

It Will Interest You to Know What the **Western Electric Company** Have to Say Regarding

ELECTRA
TRADE MARK

HIGHEST GRADE NUERNBERG

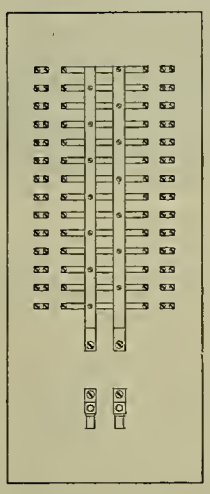
CARBONS

in their circular, dated November 23, 1903, which in part reads as follows:

"The Western Electric Company have made an exhaustive test of carbons of all kinds and have found that the 'ELECTRA' Carbons cannot be equaled in quality or efficiency, produce practically no dust and give an excellent and steady light. They produce the highest standard of candlepower in proportion to the current consumed, and are the most economical carbons manufactured."

HUGO REISINGER, Sole Importer, 11 Broadway, NEW YORK CITY.

QUICK FIGURES



You can get prices quick if you have our new Bulletin 20w on

PANEL BOARDS

THE F. BISSELL COMPANY

DESIGNERS AND BUILDERS OF SWITCHBOARDS AND PANEL BOARDS

TOLEDO, O.

Perfect Control—Indefinite Regulation
No Flashing—No Repairs
Burnouts Impossible—Last Forever

ALLEN-BRADLEY RHEOSTATS

For All Purposes of Electric Current Control

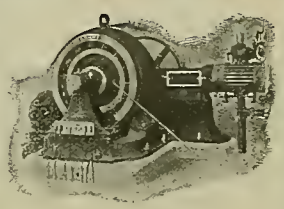
Prices Reasonable—Satisfaction Guaranteed

SEND IN A TRIAL ORDER

Ask your Engineer or Electrician about it.

AMERICAN ELECTRIC FUSE CO.
48-50 West Jackson Boul.
CHICAGO, ILL.

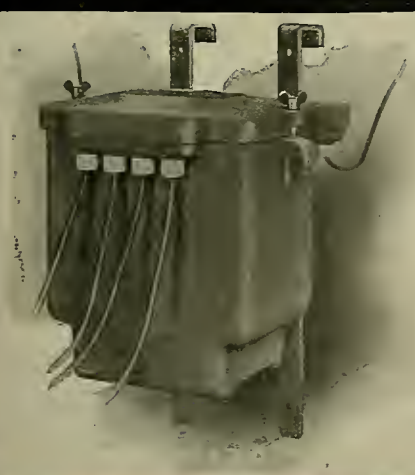
Warren Alternator



Very little attention has been paid to decorating the machine with fancy ornaments and a great deal of thought has been put into making the machine durable; it impresses one with its simplicity and capacity for severe acting service. No commutator, no moving wire, no trouble. As an investment, they are gilt-edged securities. They are "seven league boots" in the chase for the almighty dollar.

WARREN ELECTRIC MFG. CO.

Sandusky, O.



THE B. O. TRANSFORMER

Do you expect to need new transformers this fall? If you do, the B. O. will interest you.

Low Losses
High Efficiencies
High Insulation
Low Price.

Are you familiar with oil duct transformers?
Send us your address and we will tell you about our insulation and the advantages of slab windings in connection with oil ducts.

THE STANLEY ELECTRIC MANUFACTURING COMPANY
PITTSFIELD, MASSACHUSETTS

Atlanta, Ga., Empire Building
CHICAGO, ILL., MONADNOCK BLOCK
New York, N. Y., 29 Broadway
St. Louis, Mo., Century Bldg.
Boston, Mass., Oliver Building
Denver, Col., Hendrie & Bolthoff Mfg. & Supply Co.
Philadelphia, Pa., North American Building
San Francisco, Cal., 69-75 New Montgomery St.
Seattle, Wash., Pioneer Bldg.

Representatives for the Dominion of Canada, THE CANADIAN GENERAL ELECTRIC CO. of Toronto

"THE S. K. C. SYSTEM"

We were awarded the **Grand Prize** by the **Louisiana Purchase Exposition** for Electric Lighting Work in the development of the **Mercury Vapor Lamps** and also a **Gold Medal** for Vapor Lamps for Photo Engraving

Type H-6 Lamp

This is merely proof that our claims for the efficiency of the

Cooper Hewitt Mercury Vapor Lamps

are based upon positive merit of the highest order and assures purchasers that we have long passed the experimental stage of our work and have a proposition of great commercial value.

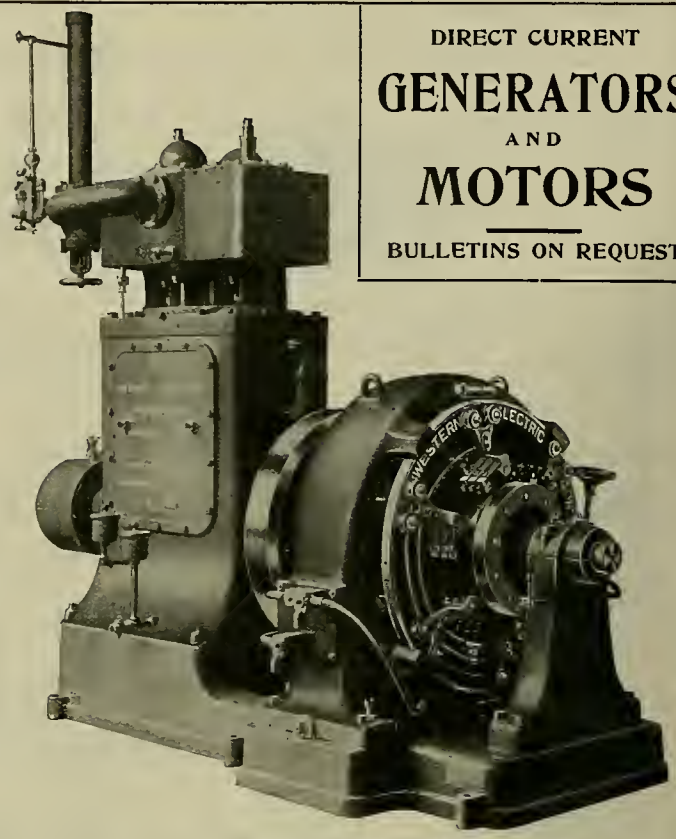
For 35 per cent. of your present lighting cost we can furnish you with a light that is far superior to work by and the extreme diffusion of which overcomes the difficulties heretofore experienced in adequately lighting such places as Machine Shops, Factories, Mills, Offices, Freight Depots, Piers, etc.

SEND FOR BOOKLET

Cooper Hewitt Electric Co.

For Direct Current Systems Only

220 W. 29th Street NEW YORK



DIRECT CURRENT

GENERATORS AND MOTORS

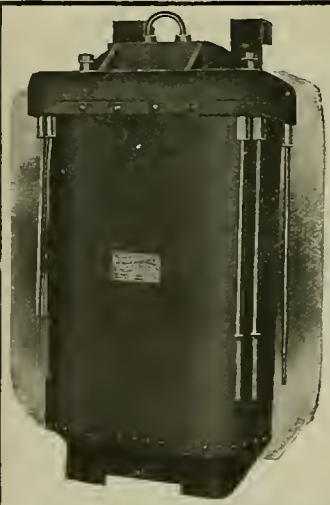
BULLETINS ON REQUEST

TYPE "T" GENERATING SET

Western Electric Company

CHICAGO NEW YORK

And Other Leading Cities



HORNBERGER-IRWIN Transformers

(LARGE AND SMALL)

½ K. W. to 500 K. W.

This transformer represents the latest improvements in transformer construction; made in three types; multi-coil construction; ventilated cores; built for all commercial voltages and frequencies; **higher efficiencies together with lower temperatures than have heretofore been attained are guaranteed.**

Catalogue just issued explains details.

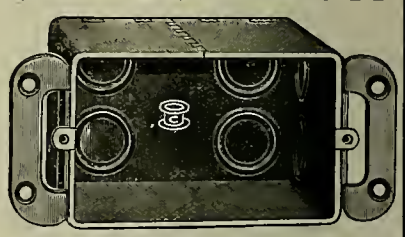
Manufactured by

Crawfordsville Electric Co.

CRAWFORDSVILLE, INDIANA, U. S. A.

"UNION" SWITCH OUTLET BOX

For **Finished House Work**



Approved by Underwriters' National Electric Association.

CHICAGO FUSE WIRE & MFG. CO.

CHICAGO BUFFALO NEW YORK

CENTRAL STATION HEATING

We are the originators and builders of the underground system of live and exhaust steam heating. Our system is used for the utilization and distribution of exhaust steam from electric and power plants for heating purposes. 250 Plants in successful operation. We have the only Meter System. Also manufacturers of Wooden Water Pipe, Steam Pipe Casing, Steam Traps, Condensation Meters, Valves, Economizing Coils, Separators and full line of Steam Fitters' Supplies.

WRITE FOR PAMPHLET AND PRICE LIST

AMERICAN DISTRICT STEAM COMPANY

MENTION WESTERN ELECTRICIAN. LOCKPORT, N.Y. CHICAGO, ILL.

ARNOLD ELECTRIC POWER STATION Co.
Engineers, Coostructors for Complete Electric Plants. Results Guaranteed.
SUITE 1539, MARQUETTE BLDG., CHICAGO, NEW YORK OFFICE: 711 TRANSIT BLDG.

BYLLESBY, H. M. & Co.
(Incorporated)
ENGINEERS
Design, Construct and Operate Railway, Light, Power and Hydraulic Plants.
Examinations and Reports.
New York Life Building, - CHICAGO, ILL.

J. H. HALLBERG
Consulting Engineer
Electric Light, Power and Railway Plants
Suggestions to secure Economy, Specifications, Examinations and Reports
45 Broadway, NEW YORK
Long Distance Telephone 4578 Broad

RUEBEL - SCHWEDTMANN-WELLS,
CONSULTING, MECHANICAL AND ELECTRICAL ENGINEERS,
Suite 801 Chemical Building, ST. LOUIS, U. S. A.

F. B. BADT,
Monadnock Chicago

EVANS, ALMIRALL & CO.,
Central Station Heating,
High Pressure Piping.
1057 Monadnock Blk., Chicago.

ROBERT W. HUNT & Co.,
ENGINEERS
1121 The Rookery, Chicago. 66 Broadway, New York.
Monongahela Bank Bldg., Pittsburg.
Norfolk House, Cannon St., London.

Long Distance Phone Central 2443.
SCHOTT, W. H.,
ENGINEER AND CONTRACTOR,
SPECIALTIES—Central Station Heating Plants, Water Works Steam Plants, Electric Light, Gas and Street Railway Plants.
1220-21 MARQUETTE BUILDING, CHICAGO.

W. E BAKER. H. B. BISHOP.
BAKER, W. E. & CO.
ENGINEERS,
ELECTRIC RAILWAYS.
27 William St., NEW YORK.

TRY IT. Keep your name and address in this directory where it will be seen by possible clients.

IT WILL PAY engineers not represented in this department to carry a card regularly.

TRY IT.
Keep your name and address in this directory where it will be seen by possible clients.

ENGINEERS
Represented in this "Directory" are enabled to come in touch with many prospective customers who cannot be reached through any other source.

E. W Hammer, Pres. and Treas. H. J. Minhinnick, Sec. and Gen'l Sup't.
GENERAL ENGINEERING Co., THE Consulting and Contracting Engineers.
Telephones, Electric Light, Power Transmission
Suite 1112, 135 ADAMS ST., CHICAGO.
Long Distance Telephone Central 478.

KEMP, R. W.
Consulting and Contracting Telephone Engineer.
Plans and Specification for complete plants. Old plants overhauled and placed on paying basis. Territory, Kansas, Oklahoma and Indian Territory.
WELLINGTON, - - - KANSAS.

STANTON, LE ROY W.
Consulting Telephone Engineer
Plans, Specifications and Supervision of Installation of Complete Telephone Plants
Special Reports on Telephone Properties and Apparatus
411 Electrical Bldg., Cleveland, Ohio

BRYAN, WILLIAM H.
M. Am. Soc. M. E.,
Consulting Mechanical and Electrical Engineer.
Lincoln Trust Building, ST. LOUIS.

A WEEKLY REPRESENTATION in this "Directory" enables engineers to keep before all possible customers.

KOHLER BROS.,
Contracting Electrical Engineers,
Lighting Power Railways,
1804-1806-1808-1810-1812 Fisher Building,
CHICAGO.

Telephone Main 3123.
WILMERDING, C. H.
CONSULTING ENGINEER
1100 Old Colony Bldg., CHICAGO.

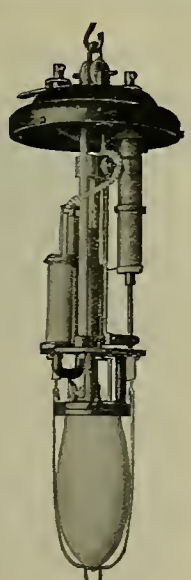
DUGALD C. JACKSON, C. E.
WILLIAM B. JACKSON, M. E.
MEMBERS
AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS
AMERICAN SOCIETY OF MECHANICAL ENGINEERS
AMERICAN SOCIETY OF CIVIL ENGINEERS
ENGINEERS. EXPERTS.
MADISON, WIS.

Reports and Estimates Furnished.
General Contractors
High-Grade Securities Accepted or Negotiated.

W. R. EVANS & COMPANY
Incorporated
Electrical, Civil and Mechanical Engineers
Telephone Main 3153 Traction Bldg., Cincinnati

PLACE YOUR
"Want" and "For Sale" advertisements in the
WESTERN ELECTRICIAN.
immediate Returns.

General Electric Company



Edgewise Wound Enclosed Arc Lamps

FOR 110-VOLT DIRECT CURRENT SERVICE

Embody the latest features of Arc Lamp manufacture.

INDESTRUCTIBLE.
PERFECT REGULATION.
PERMANENT ADJUSTMENT.
COMPOSED OF FEW PARTS.
SIMPLICITY AND RIGIDITY OF CONNECTIONS.

Write for further information.

GENERAL OFFICES: SCHENECTADY, N. Y.

Chicago Office: Monadnock Block. Sales Offices In All Large Cities.

HIGH ECONOMY LIGHTING

Packard

PRISMO ZENITH LAMPS

Two watts per candlepower

Large stock carried in Chicago, Warren (Ohio), and San Francisco. Special attention given to orders, and special prices on quantities.

ELECTRIC APPLIANCE COMPANY,

CHICAGO SAN FRANCISCO

BEARDSLEE CHANDELIER M'F'G. CO. 256 AND 257 SO. CANAL ST. CHICAGO
GAS & ELECTRIC FIXTURES FOR THE TRADE.
CATALOG SENT PREPAID TO DEALERS MENTION THIS PAPER

TO THE TRADE

Regarding the action brought by the American Circular Loom Company on the pretense of our product, FLEXDUCT, being an alleged infringement of the Herrick Patent, No. 456,271, under which they have been operating, would state, briefly, that their conduit made under this Herrick Patent, is known on the market as that form of Flexible Conduit in which the insides can be readily removed, and consists in construction of a coil of fiber with a wrapping of tape covering the openings in said coil, and an outside woven covering, while FLEXDUCT is a woven product throughout and does not resemble in construction the structure of the Herrick Patent in any respect.

We are advised by our Attorneys, who are thoroughly familiar with the art, that we do not infringe and that ours is a broad patent fully covering and protecting our form of construction.

This action, brought at this particular time, in our opinion is simply for commercial effects, that it may confuse those who are not well informed of the facts.

The trade should not be coerced to purchase material by any threats as we will protect and defend the trade against any loss whatsoever, under any suit brought on account of the use, purchase, or sale of our product, FLEXDUCT.

Yours very truly,

OSBURN FLEXIBLE CONDUIT COMPANY

New York, 21 Park Row *Chicago, 529-30 Monadnock Block*

YOU NEED IT!

Gale's Commutator Compound.

The Only Article That Will Prevent Sparking.

Will keep the Commutator in good condition and prevent cutting. Absolutely will not gum the brushes.

50c. per stick. $5.00 per dozen Send 50c. for trial stick.

FOR SALE BY ALL SUPPLY HOUSES OR

K. McLENNAN & CO., Sole Manufacturers, Room 411 Inter Ocean Bldg., 130 Dearborn Street CHICAGO

Made in four sizes { 8 lights, 16 "", 24 "", 32 "" } $5.00 and upwards

Electric Lighting Outfits

READY FOR USE

Very popular for electric lighting decorations and especially adapted to the lighting of Christmas trees.

Safe, Simple and Convenient

EDISON DECORATIVE & MINIATURE LAMP DEPARTMENT

GENERAL ELECTRIC COMPANY, Harrison, N. J.

USE

"SAFETY" RUBBER COVERED WIRE AND CABLE

FOR EVERY ELECTRICAL SERVICE.

M. B. AUSTIN & CO.,

CHICAGO REPRESENTATIVE.

THE SAFETY INSULATED WIRE & CABLE CO.,

WORKS: Bayonne, N. J. 114-116 LIBERTY STREET, N. Y.

Prometheus Electric Heating and Cooking Apparatus.

Send for Illustrated Catalogue.

THE PROMETHEUS ELECTRIC CO.,

39 Cortlandt St., New York

VOLT - AMMETERS,

POCKET SIZE.

For Testing Batteries and Battery Circuits, Locating Faults, Grounds, etc.

RELIABLE. ACCURATE.

Send for Circular.

L. M. PIGNOLET,

78-80 Cortlandt St., NEW YORK, N. Y

MICA

Of all Qualities, in any Form at Lowest Prices

EUGENE MUNSELL AND CO.

NEW YORK and CHICAGO

INSULATION That Is.

Micanite, Linotape, M. I. C. Compound, Empire Cloth and Paper. For Years the Standard.

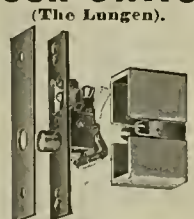
MICA INSULATOR CO., Originators

NEW YORK and CHICAGO

EDWARDS AND CO.

DOOR SWITCH

(The Lungen).



Porcelain Insulation.
Wire Connections in Front.

Style A—Lights when door is open; out when door is closed.

Style B—Lights when door is closed; out when door is open.

THE ECO DOOR SWITCH OPERATES LIGHTS "EVERY OTHER TIME."

Approved by the National Board of Underwriters.

Western Electric Co., Selling Agents

NEW YORK N.Y

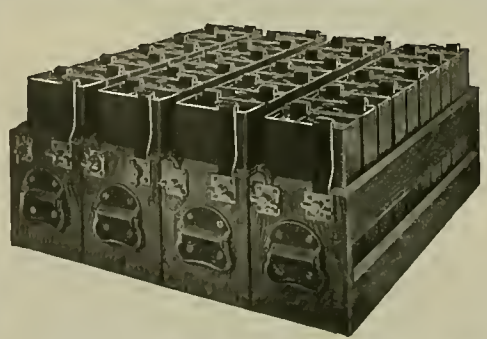
MICA-BOND

Notice how our competitors try gradually to raise Cut Mica prices—same thing would occur in manufactured mica if we were not the leaders

CHICAGO MICA CO

"PERFECTORS" VALPARAISO, IND.

HIGH CLASS WORK



is assured when you use the

NORTHWESTERN STORAGE BATTERY

on all low-tension work.

Great Capacity, Light, Efficient and Compact.

Send for catalogue. Let us figure with you.

Northwestern Storage Battery Co.,

285 Madison St., . . . Chicago, Ill.

SAUQUOIT SILK MFG. COMPANY

INSULATING and BRAIDING SILKS

MILLS:

BETHLEHEM, PA.
PHILADELPHIA, PA.
SCRANTON, PA.

NEW YORK REPRESENTATIVES:
WILLIAM RYLE & COMPANY
54 Howard St.

PHILADELPHIA OFFICE:
4015 Clarissa St.

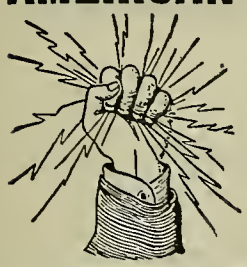
CHICAGO OFFICE:
210 Monroe St.

BOSTON OFFICE:
78 Chauncy St

FRANK N. PHILLIPS, PRESIDENT. EUGENE F. PHILLIPS, GENERAL MANAGER. E. ROWLAND PHILLIPS, VICE-PRES. C. H. WAGENSEIL, TREASURER. C. R. REMINGTON, JR., SEC.

AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.



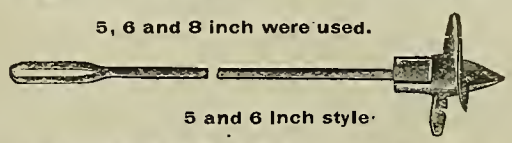
BARE AND INSULATED ELECTRIC WIRE,

ELECTRIC LIGHT LINE WIRE,
INCANDESCENT AND FLEXIBLE CORDS,
Railway Feeder and Trolley Wire,
AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR WIRES.
CABLES FOR AERIAL AND UNDERGROUND USE.

NEW YORK STORE, W. J. Watson, 26 Cortlandt St.
CHICAGO STORE, F. E. Donohoe, 82 Lake St.
MONTREAL BRANCH, Eugene F. Phillips' Electrical Works.
MAIN OFFICES AND FACTORIES, PHILLIPSDALE, R.I.

THE UNITED STATES GOVERNMENT
USED
The Stombaugh Guy Anchor
EXCLUSIVELY FOR
Anchoring Electric Light and Telephone Poles at Our Largest Military Post, Fort Riley, Kan.

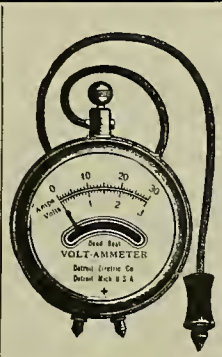
5, 6 and 8 inch were used.



5 and 6 Inch style.

W. N. MATTHEWS & BRO., Manufacturers
603 Carleton Building, St. Louis

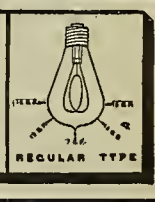
EXPERT IN ELECTRICITY MECHANICS PATENT CAUSES
SOLICITOR OF U. S. & FOREIGN **PATENTS**
FOREE BAIN, 1652-3 Monadnock Blk., CHICAGO



ROBERT VOLT-AMMETER
DEAD BEAT
Accurate, Durable, Guaranteed
List Price $6.00
Incl. Leather Case
Sample instrument forwarded prepaid on receipt of $4 50
Special Discount to Dealers and Jobbers
Detroit Elect. Co.
56 Shelby St., Detroit, Mich.

Engineering MECHANICAL, ELECTRICAL, STEAM, CIVIL.
Complete and short courses. Thoroughly equipped engineering shops. **Shop work from the beginning.** Short courses in Steam and Electrical Engineering. Expenses low. Accommodations the best. School all year. Students may enter any time. Correspondence steam and electrical courses. Send for catalogue. Mention course in which interested.
HIGHLAND PARK COLLEGE, DES MOINES, IOWA.

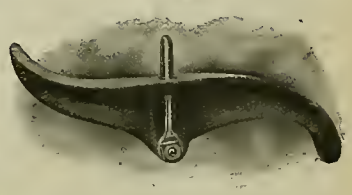
DO YOU?
BUY LAMPS—OR—BUY CANDLE POWER
16 {THIS LAMP AVERAGES} 12
THE STERLING ELECTRICAL MANUFACTURING CO.
NEW YORK, N. Y. WARREN, O. CHICAGO, ILL.
STERLING SPECIAL



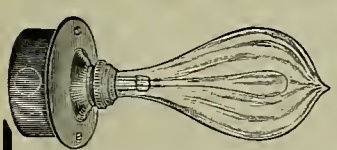
REGULAR TYPE

ANCHORS

That are cheaper to install because of the simple method of burying and the great strain that can be applied—**American Bull-Tongue Anchors** reduce the cost of the process of guying a pole by reduction in labor, they **stay solid,** they do not slip—no take up required. 21 cents worth holds 8,713 pounds, 42 cents worth holds 10,521 pounds, other money's worth in proportion.



I. A. BENNETT,
529 and 530 Monadnock Block - - - CHICAGO



Some More Light on our Drawn Steel Junction Boxes

Take time to figure out the cost of cast iron boxes plus the loss from breakage and time used in producing a round hole. Compare with this the cost of drawn steel boxes.

NO BREAKAGE,

Clean round hole produced with one blow of a hammer. Write for catalog and see what you can save.

BOSSERT ELECTRIC CONSTRUCTION CO. - - UTICA, N. Y.

Our Compound Stops Sparking and Saves Commutators.
14 Years' Use on Street Ry., Light and Power Commutators Has Proven its Worth. WE GUARANTEE RESULTS.
Send Your Address for FREE SAMPLE THAT CONVINCES.
JAS. McLAUGHLIN & CO., ELECTRICAL ENGINEERS
586 Fulton Street, - - Chicago, Ill.

Grimshaw

Raven White Core

Raven Black Core

ALL OUR WIRES pass inspection and carry the above TRADE-MARKS on our tags. We also manufacture Grimshaw and Competition Tapes and Splicing Compounds.

NEW YORK INSULATED WIRE COMPANY,

MAIN OFFICE: 114, 116 & 118 Liberty St., New York.
BRANCHES: CHICAGO: 192 Despleines St. BOSTON: 7 Otis St. SAN FRANCISCO: 33 Second St.

NATIONAL CODE STANDARD

"O. K." Weatherproof Wire.
Slow-Burning Weatherproof and Ideal Wire.
Prices and Samples on Application.

Phillips Insulated Wire Co.
Office and Factory: PAWTUCKET, R. I.

ELECTRIC SIGNS

INCREASE YOUR CURRENT CONSUMPTION.

Assist us to sell ELECTRIC SIGNS to the best merchants in your city.

No repair bills with our signs we furnish the best—all metal raised letters equipped with removable copper shell sockets. WRITE US, we will conscientiously study your sign wants and gladly submit drawings with very low quotations for the best work.

ZEROMARX SIGN WORKS
CHICAGO, ILL.

WANTED, FOR SALE *and similar* **WANT COLUMN** *advertisements (50 words or less), $1.50 an insertion; additional words 3c each.* **POSITION WANTED** *advertisements (50 words or less), $1.00 an insertion; additional words 2c each.*

POSITION WANTED.

As superintendent of electric-light plant in Minnesota or Dakota town, either large or small. Am competent to handle plant from one end to the other and in small plant intend to do the wiring or running. Should my service not be satisfactory, I ask no pay for same. E. HEINRICH, BOX 64, Rugby, North Dakota.

POSITION WANTED.

With an electric-light and power company. I have had sixteen years' experience as manager and superintendent. Am familiar with the care and operation of steam and electrical apparatus; am a hanger, mechanic and hold United States Chief Marine Engineering license; am capable of filling any position which may be offered me (superintendent preferred). Address BOX 421, care Western Electrician, 510 Marquette Bldg., Chicago

WANTED.

An experienced and up-to-date transformer designer by large and reliable manufacturing company. In reply state experience and salary required; give references. Address BOX 419, care Western Electrician, 510 Marquette Bldg., Chicago.

WANTED.

By a large electrical manufacturing company, a thoroughly experienced man for the design and development of railway motors and electric locomotives. A fine position for the right man. In reply state experience and salary; give testimonials. Address BOX 418, care of Western Electrician, 510 Marquette Bldg., Chicago.

WANTED.

A competent and experienced electric lighting superintendent to take charge of canvassing and installation department work of a large lighting company doing business from a number of sub-stations; must have mechanical and electrical education and ability to estimate on all kinds of power work and motor appliances. Address BOX 422, care Western Electrician, 510 Marquette Bldg., Chicago.

FOR SALE.

One 100-H. P. American Engine, 13 x 24 in good repair.

One 100-H. P. Woodberry High-speed engine, 13 x 16 in good repair, must be sold. Address FREDERICK GAS & ELECTRIC CO., Frederick, Md.

FOR SALE

1-360	K. W.	General Electric	Alternator,	Three	Phase
1-240	"	Westinghouse	"	Single	"
2-150	"	Warren	"	"	"
1-150	"	Westinghouse	"	"	"
1-150	"	Wood	"	"	"
1-150	"	Stanley	"	"	"
1-120	"	General Electric	"	Three	"
1-120	"	General Electric	"	Single	"
1 120	"	Westinghouse	"	"	"
1- 90	"	General Electric	"	"	"
1- 75	"	Westinghouse	"	Two	"
1- 75	"	Westinghouse	"	Single	"
1- 75	"	Westinghouse	"	Two	"

Direct connected to Gates' Engine.

Send for our **Monthly Bargain Sheet** with complete list and net prices.

GREGORY ELECTRIC CO.
54-62 S. Clinton St., Chicago, Ill.

YOUR BOOK ORDERS

Will receive
PROMPT and CAREFUL
attention if sent to

Electrician Publishing Company,
510 Marquette Bldg., Chicago.

FOR SALE

1 Stanley generator, two-phase, 16,000 alternations, 1,000-2,000 volts, 40 K. W., 1333 R. P. M. and exciter.

1 Stanley generator, two-phase, 16,000 alternations, 1,000-2,000 volts, 60 K. W., 1,000 R. P. M. with exciter.
Complete marble switchboard with new instruments for above.

1 Westinghouse generator, 75 K. W., single-phase, 1,100 volts, 7,200 alternations, exciter, switchboard, new instruments complete, 750 R. P. M.

2 New belts.

1 Russell 18x20 4-valve engine, 200 R. P. M.

1 Ball 9½x10 engine, 350 R. P. M.

2 Boilers, 16x54 inch, 42 4-inch tubes, allowed 110 lbs. pressure, complete with 50-foot stack.

1 Hoppes heater. All steam pipe, valves, etc.

All in good condition. Can be seen running until December 15th. We are abandoning this plant on account of removal, and will sell all or in part. For further information, address

TIBBE ELECTRIC CO., Washington, Mo., or
RUEBEL-SCHWEDTMANN-WELLS, St. Louis.

"Big Four"

"The Way of the World"

between

St. Louis
and
New York,
Boston
and the
East

W. J. LYNCH
G. P. & T. A., Cincinnati, Ohio

ELECTRICAL AND OTHER INDUSTRIES ARE OFFERED LOCATIONS

WITH
Satisfactory Inducements,
Favorable Freight Rates,
Good Labor Conditions,
Healthful Communities,
ON THE LINES OF
THE ILLINOIS CENTRAL R. R.
AND THE
YAZOO & MISSISSIPPI VALLEY R. R.

For full information and descriptive pamphlet address

J. C. CLAIR,
Industrial Commissioner
1 Park Row, Chicago, Ill

WORKS QUICK AND EASY. KEEPS ITS LUSTER. HOLDS OLD TRADE AND MAKES NEW. DOES NOT DETERIORATE. ESTABLISHED 16 YEARS. SOLD BY AGENTS AND DEALERS ALL OVER THE WORLD

U.S. METAL POLISH

3 OUNCE BOX 10 CENTS
SAMPLES SENT FREE
GEO. W. HOFFMAN
295 E. WASHINGTON ST. INDIANAPOLIS, IND

POLISHES ALL METALS. BRANCHES: NEW YORK, CHICAGO, SAN FRANCISCO.

BOILERS.

One 42-in. x 15 ft. 9-in., 250 H. P. Worthington Water Tube.
One 60-in. x 16 ft., John Mohr Return Tubular Boiler.
One 54-in. x 16 ft., John Mohr Return Tubular Boiler.
One 54-in. x 16 ft., Devine Tubular Boiler.

ENGINES.

One 600 H. P., 21 x 36 x 30, Williams Tandem Horizontal Compound, 140 R. P. M.
Two 600 H. P., 20 x 30 x 24, Porter-Allen Tandem Compound, 200 R. P. M.
One 250 H. P., 12 x 24 x 18 Williams Tandem Compound, 250 R. P. M.
Two 100 H. P., 13 x 12, Dick & Church, High Speed Automatic.

PARTIAL LIST ONLY.

Send for latest Catalogue for bargains in Engines, Boilers, Dynamos and Motors.

CENTRAL STATION IMPROVEMENT CO., 938 Monadnock Block, Chicago

"MANROSS"
HAIR SPRINGS

For Electric Indicating and Recording Gauges, Steam Gauges, Etc

LARGEST MANUFACTURER OF HAIR SPRINGS in the United States.

F. N. MANROSS,
FORESTVILLE, CONN.

REPAIRING RECALIBRATING

ELECTRIC METERS.
INTERNATIONAL ELECTRIC METER CO.
167 S. CANAL STREET, CHICAGO.

DON'T BUY ELECTRICAL SUPPLIES

Until you have seen our new Catalogue and new Price List.
Free to the trade.

Manhattan Electrical Supply Co.

NEW YORK: 32 Cortlandt St.
CHICAGO: 188 Fifth Ave.

The Recently Enlarged Edition of
WEBSTER'S INTERNATIONAL DICTIONARY

CONTAINS
25,000 NEW WORDS, Etc.
New Gazetteer of the World
New Biographical Dictionary
New Plates. 2380 Quarto Pages. 5000 Illustrations.

Should be in Every Home, School, and Office

Also Webster's Collegiate Dictionary with 1100 pages. 1400 illustrations. Size: 7x10x2⅝ in.

A Special Thin Paper Edition just issued, printed from same plates as regular edition. It has limp covers and round corners. Size: 6¾x8⅝x1½ in.

FREE, "A Test in Pronunciation," instructive and entertaining. Also illustrated pamphlets.

G. & C. MERRIAM CO.,
Publishers, Springfield, Mass.

FIBRE-GRAPHITE COMMUTATOR BRUSH
SELF-LUBRICATING

There's No Friction

with the Fibre-Graphite Commutator Brush. Being 90 per cent. pure graphite, it insures low resistance, no sparking under a varying load, and longer wear. There is no greasing required. The Fibre-Graphite is therefore the most economic brush on the market. Send for price list.

HOLMES FIBRE-GRAPHITE MFG. CO.
5155 Wakefield St., Germantown, PHILADELPHIA.

OFFICE OF
Town Clerk
A. R. KAUFMAN, CLERK

BOARD OF TRUSTEES
GEO. A. PAINTER
AS. V. FAMBORNER
J. J. MEEKER
P. VAN NUYS, ATTY.

Summitville Ind. Nov 23 1903

Western Electrician
Chicago Ill.

Gentlemen: You may discontinue our Want Advertisement with the one issue. As I have already received about 40 answers to same. Send me your bill and I will remit same to you Thanking you very kindly for your promptness

I am Yours Resp.

A. R. Kaufman
Clerk.

CHICAGO EDISON COMPANY REPAIR SHOPS

76 MARKET STREET, CHICAGO. TELEPHONE MAIN 1280.

Machine and Carpenter Work of All Kinds
Correspondence Solicited.

OPEN DAY AND NIGHT.

FIRST-CLASS EQUIPMENT THROUGHOUT.

Dynamos Armatures, Motors, Arc Lamps, Fans, Instruments.

DEARBORN WATER TREATMENT

Stops that expense and worry over scale in boilers.
We correct waters of all classes for boiler purposes.

Send gallon sample to Chicago Laboratory for Analysis.
Write for Booklet "R."

DEARBORN DRUG & CHEMICAL WORKS,
27-34 RIALTO BUILDING, CHICAGO, ILL. WM. H EDGAR, President Telephone: Harrison 3930 and 3931.

Dixon's Graphite Pipe Joint Compound

Makes the tightest joints that remain free from rust and come apart easily at any time.
Write for Booklet 125D and a sample.
JOSEPH DIXON CRUCIBLE CO., JERSEY CITY, N. J.

JEFFREY CHAIN BUCKET DREDGES FOR CATALOGUE, ADDRESS THE JEFFREY MFG. CO. COLUMBUS, OHIO.

REG. TRADE MARKS "Phosphor Bronze" DELTA

THE PHOSPHOR BRONZE SMELTING CO. LIMITED.
2200 WASHINGTON AVE., PHILADELPHIA.
"ELEPHANT BRAND PHOSPHOR-BRONZE"
INGOTS, CASTINGS, WIRE, RODS, SHEETS, ETC.
— DELTA METAL —
CASTINGS, STAMPINGS AND FORGINGS
ORIGINAL AND SOLE MAKERS IN THE U.S.

Diesel Engines

Suitable for all stationary power operating on CRUDE or FUEL oil by Gradual Continuous Combustion.

NO EXPLOSIONS

GUARANTEED COST OF FUEL WITH OIL AT 4 CENTS PER GALLON:

3.4 mills per K. W. Hour on the full load.
5.1 mill per K. W. Hour on the half load.

For Further Particulars Apply to

AMERICAN DIESEL ENGINE COMPANY
11 Broadway, - New York

PRESERVE YOUR COPIES
OF THE
WESTERN ELECTRICIAN
BINDERS $1.00 EACH.
ELECTRICIAN PUBLISHING CO.,
Suite 510 Marquette Building, - - - CHICAGO.

SPEER HIGH GRADE CARBON BRUSHES
MOTOR AND GENERATOR CARBON BRUSHES
SPEER CARBON CO., - St. Marys, Pa.

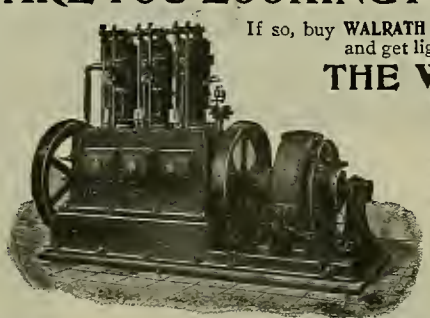
SINGLE AND POLYPHASE
TRANSFORMERS
KUHLMAN ELECTRIC CO., - - Elkhart, Ind.

HARTFORD STEAM BOILER INSPECTION AND INSURANCE CO. HARTFORD, CONN.

BUY YOUR BOOKS
FROM THE
Electrician Pub. Co., 510 Marquette Bldg., Chicago.

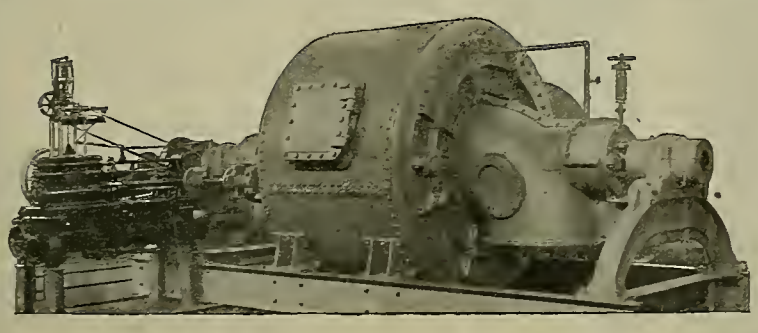
"Practical and to the Point"
IS ALL THAT NEED BE SAID OF
THE TELEPHONE HAND-BOOK
By HERBERT LAWS WEBB.
160 Pages, 133 Illustrations, Cloth, Price $1.00.
The book for those interested in telephony.
ELECTRICIAN PUBLISHING CO.,
510 Marquette Bldg.,
CHICAGO.

ARE YOU LOOKING FOR MONEY?



If so, buy WALRATH GAS OR GASOLINE ENGINES and get light on the subject.
THE WALRATH
Received the Highest Award at the Pan-American Exposition.
It will produce as good a commercial light as that of an automatic steam engine, either belted or direct-connected generator. Simple, Economical and Reliable
Send for Catalogue W
MARINETTE GAS ENGINE CO.,
CHICAGO HEIGHTS, ILL.

AGENCIES:
Keystone Engineering Co., Farmer's Bank Bldg., Pittsburg, Pa.
Strong, Carlisle & Hammond Co., 61-67 Frankfort St., Cleveland, Ohio
Mackay Engineering Co., 149 Broadway, N. Y.
C. H. Seidenglanz., 52 When Bldg., Indianapolis, Ind.



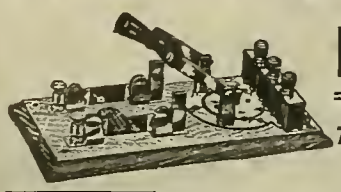
SAMSON TURBINE

HIGH EFFICIENCY at ANY GATEAGE, QUICK SPEED and GREAT POWER are the three essential points demanded of a turbine driving generator. No other turbine maintains these three points to such a high degree of perfection, as the SAMSON. ::

WRITE DEPT. D FOR CATALOGUE

THE JAMES LEFFEL & CO.
Springfield, Ohio, U. S. A.

They Are All Talking About The "Tornquist"



King of Protectors

The Only Sure Protector Made

HIGH GRADE BABY KNIFE SWITCHES

None Better Made

STAMPING AND PLATING

Better buy a "Tornquist" it is the greatest success in the telephone field. Order sample now. Sold by all jobbers.

Clinton Stamping & Electric Co.

CLINTON, IOWA

TELEPHONE PRINCIPLES AND PRACTICE

A NEW BOOK IN TELEPHONY

By

GEORGE WALKER WILDER, PH. D.

Professor in Telephony in the Armour Institute of Technology

Complete and up-to-date, written by a practical man. All about modern telephone apparatus, their principles and use:

I. Fundamental Ideas
II. Telephone Apparatus
III. Systems of Communication
IV. Construction and Equipment

IN 32 CHAPTERS, 450 PAGES, 375 ILLUSTRATIONS. PRICE $2.00 POSTPAID.

Send Postal Money Order to

THE CANTWELL PRESS · Madison, Wis.

AMERICAN ELECTRIC TELEPHONE CO.

LARGEST MANUFACTURERS

This Company Sends Prepaid upon request any of the following bulletins:

Bulletin No. 7—Combined Telephone and Switchboard
" " 8—Wall Switchboard
" " 9—Samson Telephone
" " 10—American Express Switchboards
" " 11—Desks — Toll and Private Branch
" " 12—Visual Signal and Bell Style Switchboards
" " 13—Intercommunicating Systems
" " 14—Line Material and Supplies
" " 15—Bell Express Self-Restoring Switchboards
" " 16—Operator's Set and Accessories
" " 17—Parts of Apparatus
Bulletin No. 18—Magneto Telephones of All Kinds
" " 19—Central Energy Switchboards
" " 20—Central Energy Telephones
" " 21—Protective Apparatus and Terminal Equipment
" " 22—Construction of Country Telephone Lines
" " 23—Eight-Party Selective Ringing Telephones
" " 24—Composite Telephone and Telegraph Lines
" " 25—Four-Party "Leich" Selective Telephone System
" " 26—Telephone Power and Ringing Equipment

CHICAGO, ILL., U. S. A.

The Inspector AND Trouble Man.

By A. E. DOBBS.

Full of information and diagrams for the operator, exchange owner, exchange manager, inspector, trouble man, lineman.

A complete description of telephones and their troubles. How to find and remedy them, together with working plans for exchange construction, complete with diagrams of all up-to-date telephones and switchboards.

This is a practical book, written in **plain language**, and for **anyone** interested in telephony.

Mailed anywhere on receipt of price . . . **ONE DOLLAR.**

No technicalities. Substantially bound in cloth.

ELECTRICIAN PUBLISHING CO.,

510 MARQUETTE BUILDING, CHICAGO.

BITUMINIZED FIBER CONDUIT

FOR UNDERGROUND CONSTRUCTION

Our male and female joint insures perfect and permanent alignment without the time and precaution required in laying butt-joint conduits.

No special leveling of the bed nor wrapping and plastering of the joints are necessary.

American Conduit Co.

Main Offices: 1005-6 Manhattan Building, Chicago

Other Offices:

170 Broadway, New York. 336 Macy St., Los Angeles

INTERNATIONAL

Mechanical Self-Restoring Drop Switchboard.

A PERFECT APPARATUS.

Made in any desired capacity.

Sample parts and quotations on request.

INTERNATIONAL TELEPHONE MANUFACTURING CO.

CHICAGO, U. S. A.

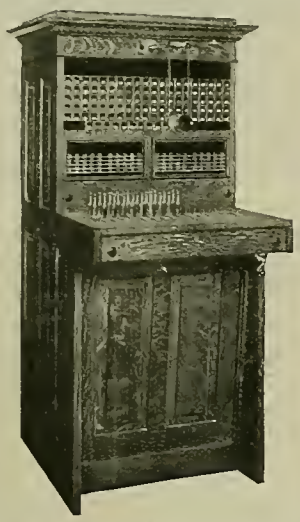
STROMBERG-CARLSON

GENERATOR-CALL

VISUAL SIGNAL SWITCHBOARDS

are inexpensive to maintain and nearly as rapid as a lamp signal switchboard.

SIGNALS SELF-CONTAINED



NO WORKING PARTS EXPOSED

This illustrates our No. A-1249 cabinet equipped with 100 line signals and 10 clearing-out signals. Our standard cabinets have a capacity for 50, 60, 70, 100, 140, 180 and 200 line signals of the above type.

Bulletins No. 6 and 7-E describe these boards very thoroughly. Mailed free upon request.

STROMBERG-CARLSON TELEPHONE MFG. CO.,

GENERAL OFFICES, ROCHESTER, N. Y.

WESTERN SALES OFFICE, CHICAGO, ILL.

Kellogg Telephone Apparatus

A glance at the Kellogg desk set will prejudice you in its favor, but its working, wearing and lasting qualities are what have made its name.

It helped to win the Grand Prize at the St. Louis Exposition—the highest award. Write us for catalogues telling you all about it.

Kellogg Switchboard and Supply Company

Green and Congress Streets, CHICAGO

LOS ANGELES, Seymour Building — CLEVELAND, Electric Building — PHILADELPHIA, Keystone Telephone Building

THE TELEPHONE HAND-BOOK

NEW AND REVISED EDITION, WITH A NEW CHAPTER ON "RECENT PROGRESS," BRINGING THE BOOK UP TO DATE.

BY HERBERT LAWS WEBB.

Member of the American Institute of Electrical Engineers, and of the Institution of Electrical Engineers, London. Author of "A Practical Guide to the Testing of Insulated Wires and Cables." Joint Author of "Electricity in Daily Life."

160 Pages, 133 Illustrations, Cloth, Hand-Book Size, Price $1.00.

Extract from Preface.—"This little book has no pretension to be considered a complete treatise on telephony as it exists in America. The time for such a work is not yet come. But it is felt that there is a demand for a practical book on telephone working and management, and the TELEPHONE HAND-BOOK is an attempt at meeting that demand. With the exception of a few chapters dealing with certain forms of transmitters and receivers used in Europe, which are given for the information of those who may wish to engage in the manufacture of telephones, the book is based entirely on standard American practice; and most of the material, apparatus and methods described are peculiar to or have originated in this country."

No pains have been spared to make it the best book of its kind. It is right up to date, intensely practical, and so plain and clear in its language that anyone can understand and learn from it everything regarding telephone work and management. It conforms in size and style to our other Hand-Books which have been so favorably received by the entire electrical fraternity.

CONTENTS

CHAPTER 1. The Invention of the Telephone.
2. Sound Waves. Articulate Speech.
3. Electric Telephony. The Bell Telephone.
4. The Microphone.
5. Current Induction. Electromagnetic Induction.
6. The Induction Coil: Its Use in the Telephone Transmitter.
7. The Complete Telephone Circuit.
8. Magnet Telephones.
9. The Bell Telephone Receiver.
10. Other forms of Magnet Telephones.
11. The Gower, Ader and D'Arsonval Receivers, Mercadier's Bi-Telephone.
12. The Siemens, Kotyra, Neumayer and Böttcher Receivers.

CHAPTER 13. Carbon Transmitters.
14. The Blake Transmitter.
15. The Long Distance Transmitter.
16. The Solid-back Transmitter.
17. The Berliner Transmitter.
18. The Cuttriss Transmitter.
19. Various European Transmitters.
20. The Efficiency of Carbon Transmitters.
21. Batteries for Telephone Work.
22. Open Circuit Batteries.
23. Closed Circuit Batteries.
24. The Practical Management of Batteries.
25. Magneto Bell.
26. Automatic Switches.
27. Telephone Line Construction.

CHAPTER 28. Metallic Circuit.
29. Underground Wires
30. Lightning Arresters.
31. Inside Wiring.
32. Installation of Telephone Instruments.
33. Inspection and Maintenance.
34. The Condenser; Its Use in Telephony.
35. Electromagnetic Retardation.
36. Exchange Working.
37. Small Exchanges.
38. Party Lines: The Bridging Bell.
39. Long Distance Telephony.
40. Duplex Telephony.
41. Simultaneous Telegraphy and Telephony.
42. Recent Progress. Appendix.

Published and for sale by ELECTRICIAN PUBLISHING CO., 510 Marquette Building, Chicago

THE AUTOMATIC

is the recognized competitive system of telephony. Its manifold advantages over the manual system, mechanically, financially and commercially, make it so. Automatic telephone service is more prompt and more accurate and absolutely secret. It can be furnished at less cost to both company and patrons than any other. Progressive Independent telephone companies all over the country are rapidly adopting it; the new ones in preference to manual and the old ones to replace manual equipment. It is a success everywhere.

Among the cities in which it has been adopted are:

Chicago, Ill.
Grand Rapids, Mich.
Columbus, Ohio
Dayton, Ohio
Lincoln, Neb.
Portland, Maine

Auburn, N. Y.
Lewiston, Maine
Auburn, Maine
Fall River, Mass.
New Bedford, Mass.
Los Angeles, Cal.

San Diego, Cal.
Hopkinsville, Ky.
Sioux City, Iowa
Cleburne, Texas
Columbus, Ga.
Augusta, Ga.

Medford, Wis.
St. Mary's, Ohio
Woodstock, N. B.
Westerly, R. I.
Berlin, Germany
Manchester, Iowa

Princeton, N. J.
Albuquerque, N. M.
Van Wert, Ohio
Battle Creek, Mich.
Clayton, Mo.

Pentwater, Mich.
Toronto Junction, Can.
Wilmington, Del.
Riverside, Cal.
Traverse City, Mich.

AUTOMATIC ELECTRIC COMPANY

Van Buren and Morgan Streets, CHICAGO, U. S. A.

CEDAR POLES

PRODUCERS AND WHOLESALERS OF WHITE CEDAR PRODUCTS

YARDS
KOSS MICH.
L'ANSE "
MUNISING "
ONTONAGON
WAGNER, WIS
PESHTIGO "

SPECIAL PRICES ON SMALL POLES.
Write for a copy of our TELEGRAPH CODE FOR CEDAR PRODUCTS

C. H. WORCESTER CO.
SUITE 1206 TRIBUNE BLDG. CHICAGO.

Southern Cedar POLES Are the Best.
NO ROTTEN BUTTS.
D. W. PHELAN,
277 Broadway, New York

POLES, TIES, POSTS. THE PORTER CEDAR CO., SAGINAW, MICH.
PRODUCERS. We want your inquiries always.

WHITE CEDAR POLES
HALL L. BROOKS
52 WISCONSIN AVENUE
TOMAHAWK, WIS.

Cedar TORREY CEDAR CO., CLINTONVILLE, WIS. **Poles**
Large Stock Constantly on Hand

Practical Running of Dynamos.
A little booklet on the care and the locating and remedying of troubles in dynamos and motors.
Price, 10 Cents.
Catalogue of mechanical and electrical books free.
ELECTRICIAN PUBLISHING COMPANY.
510 Marquette Bldg., Chicago.

"The King's Highway."

TO THE
GATEWAYS OF COMMERCE
THROUGH THE
CENTERS OF POPULATION,

adding greatly to the interest of your journey, without increasing its expense beyond what you would expect to pay for the "best," which you secure if you travel by the

NEW YORK CENTRAL LINES.

A Copy of "Four-Track Series" No. 13, "Urban Population in 1900," will be sent free, on receipt of a two-cent stamp by George H. Daniels, General Passenger Agent, New York Central & Hudson River R. R., Grand Central Station, New York.

CEDAR POLES, POSTS, TIES,
H. M. LOUD'S SONS CO., Au Sable, Mich.

POLES W. C. STERLING & SON, MONROE, MICH. **TIES.**
Eleven Pole Yards in Michigan
Wholesale Producers for 20 years.

"Diamond H" Switches
Trade H Mark
This Trade-Mark guarantees quality.
The Hart Mfg. Co., Hartford, Conn.
New York Boston Chicago Toronto, Ont.

"STAR" INCANDESCENT LAMPS

LONG LIFE
GUARANTEED CANDLEPOWER,
HIGHEST EFFICIENCY.
MADE BY THE MOST SKILLED WORKMEN.
STANDARD ELECTRICAL MFG. COMPANY, : Niles, Ohio.

FREE CHRISTMAS DINNERS
for 10,000 of Chicago's Poor
will be supplied by the Salvation Army. Will you help by sending a donation, no matter how Small to the
Salvation Army
CHICAGO
Headquarters
399 State Street
Chicago, Ill.

FACTORIES WANTED
ALONG THE
BURLINGTON ROUTE
to supply the demand for Electrical Goods.
Burlington Route
N 548
W. H. MANSS.
INDUSTRIAL COMMISSIONER,
209 ADAMS STREET, CHICAGO.

POLE DEALERS ADVERTISING IN THE WESTERN ELECTRICIAN OBTAIN MOST EXCELLENT RESULTS BECAUSE IT PLACES THEM IN TOUCH WITH ACTUAL BUYERS OF POLES. TRY A CARD.

STUDENTS
Will find that the WESTERN ELECTRICIAN can help them wonderfully in the study of electricity. Subscribe now. $3.00 per year, in advance.
ELECTRICIAN PUBLISHING CO.,
Suite 510 Marquette Bldg., CHICAGO.

Points in Wisconsin and the Northwest
are covered by Wisconsin Central Railway's convenient, solid, wide vestibuled trains, equipped with Pullman sleepers, free reclining chair cars and modern coaches which leave Central Station, 12th Street and Park Row (Lake Front), Chicago for St. Paul, Minneapolis, Ashland and Duluth, connecting with all western lines. Meals in dining and cafe cars served a la carte.
For tickets and further information apply to nearest ticket agent, or write
JAS. C. POND, Gen'l Pass. Agt., Milwaukee, Wis.

MICHIGAN WHITE **CEDAR POLES** LARGE STOCK.
PROMPT SHIPMENTS. KELLOGG SWITCHBOARD & SUPPLY CO., Chicago.

Cedar Poles.

Pittsburg and Lake Superior Iron Co. Producers and Wholesalers. Escanaba, Mich.

SIX-INCH THIRTIES. If you're going to buy any this year get our price; 7-inch 25s are on the same list. Of course we have every size you ever needed, but we have too many of these two sizes.

MALTBY CEDAR COMPANY, 509 Phoenix Block, Bay City, Michigan.
Pittsburg Agents, Tipper & Patton, 509 Bessemer Building.

BRACKETS—X ARMS—PINS
little things it is true, but they cut a big figure in line construction.
OUR MOTTO IS:
Prompt Shipment Quality Satisfaction Right Price
COLUMBIA MFG. CO. **ANTIGO, WIS.**

CEDAR POLES
ESTABLISHED 1862
WM. MUELLER COMPANY
1211-12-13 MARQUETTE BLDG. CHICAGO.
EIGHT DISTRIBUTING YARDS—

CEDAR POLES
THE
Valentine-Clark Co.
234 La Salle Street, CHICAGO
YARDS:
Pinconning, Mich. : Green Bay, Wis. : New London, Wis.

KESTER
SELF FLUXING SOLDER
A Tube of Solder Filled with Flux.
Requires no Acid.
SAVES—LABOR—TIME—MONEY.

PATENTED.
Send for Free Samples.
L. F. Mahler Co., R. 1008 Chemical Bldg., St. Louis, Mo., Gen. Western Agent.
KESTER ELECTRIC M'F'G CO.,
46 N. UNION STREET, CHICAGO, ILL.

POLES.
WHITE CEDAR.
IDAHO CEDAR up to 80 ft.

BERTHOLD & JENNINGS,
ST. LOUIS.
Chemical Building.

CROSS ARMS.
LONG LEAF PINE AND FIR.

Idaho Cedar Poles
PACIFIC COAST POLE CO. SPOKANE, WASH.

Poles and Ties
The Fowler Companies
Fisher Bldg. Chicago

YOST SPECIALTIES.

Sockets, Wall Sockets, Weatherproof Sockets, Rosettes, Receptacles, Cord Adjusters.
Catalogue for the asking.
THE YOST ELECTRIC MFG. CO.
TOLEDO, OHIO.

Sterling Black Plastic Insulator.
One hundred days' continuous baking at 180° F. will not make it brittle. Water repellent. Oil proof.
THE STERLING VARNISH CO., - - Pittsburg, Pa.

Locations for Industries
Erie Railroad
Chicago to New York

The Erie Railroad Company's Industrial Department has all the territory traversed by the railroad districted in relation to resources, adaptability, markets and advantages for manufacturing, and can advise with manufacturers in relation to the most suitable locations. For full information address

LUIS JACKSON
Industrial Commissioner, Erie Railroad Company
21 Cortlandt Street, New York

MICHIGAN AND WESTERN **CEDAR POLES**
ALL LENGTHS AND SIZES
LINDSLEY BROS CO.
TRIBUNE BLDG., CHICAGO

There is No Higher-Class India-Rubber Insulation For Wires and Cables than

HABIRSHAW.

Authorized Manufacturers of the
ATTIX FLEXIBLE TUBE WIRE.

The India-Rubber and Gutta-Percha Insulating Co.,
MAIN OFFICE, Glenwood Works,
Sales Office, 15 Cortlandt St., New York.
YONKERS, N. Y.
(10823)

Standard Double-Truck Car, Equipped With Four 100 H. P. Westinghouse Single-Phase Railway Motors.
The above car is one of the equipment in regular service on the Interworks Railway Trafford City———Wilmerding, Pa.

The Westinghouse Single-Phase Railway System

Is no experiment, but an accomplished fact

Ten roads are now in course of construction, the cars being equipped with a total of 218 motors, representing 15,435 H. P.

The system has many advantages; two of them are:

1. High trolley voltages are allowable. This means saving in copper and power.
2. The transforming points contain no machinery with moving parts, rendering constant attendance unnecessary.

For particulars address nearest office of

Westinghouse Electric & Mfg. Co.

Pittsburg, Pa.

New York, Atlanta, Dallas, Baltimore, Boston, Buffalo, Chicago, Cincinnati, Cleveland, Detroit, Los Angeles, Minneapolis, New Orleans, Philadelphia, Pittsburg, St. Louis, Salt Lake City, San Francisco, Syracuse, Seattle, Denver, Mountain Electric Co.
For Canada: Canadian Westinghouse Co., Limited, Hamilton, Ontario. Mexico: O. & O. Braniff Co., City of Mexico.

Contested Elections

do not include those in which the Type K integrating watt-meter is concerned. It was long ago elected to life service by a popular vote of all parties and is still in satisfactory service.

All Sizes for All Voltages

Single or Multiphase Switchboard or Service

272

WE shall be glad to supply any of the books catalogued below upon receipt of your order and remittance. We prepay charges.

THE PRINCIPLES OF THE TRANSFORMER. By Frederick Bedell	$3.25
INDUCTION COILS. By G. E. Bonney	1.00
ELECTRICITY AND MAGNETISM. By S. R. Bottone	.90
ELECTRICITY, ELECTROMETER, MAGNETISM AND ELECTROLYSIS. By G. Chrystal and W. N. Shaw	1.60
THEORY OF ELECTRICITY. By L. Cumming	2.25
THEORY OF ELECTRICITY AND MAGNETISM. By Charles Emerson Curry	2.50
THE ELEMENTS OF ALTERNATING CURRENTS. By W. S. Franklin and R. B. Williamson	2.50
PRACTICAL EXERCISES IN MAGNETISM AND ELECTRICITY. By H. E. Hadley	.60
MISCELLANEOUS PAPERS. By Heinrich Hertz	3.25
A TEXT-BOOK ON ELECTROMAGNETISM AND THE CONSTRUCTION OF DYNAMOS. By Dugald C. Jackson	2.25
ALTERNATING CURRENTS AND ALTERNATING CURRENT MACHINERY. By D. C. Jackson and John Price Jackson	3.50
AN ELEMENTARY BOOK ON ELECTRICITY AND MAGNETISM AND THEIR APPLICATIONS. By D. C. Jackson and John Price Jackson.	1.40
A FIRST-BOOK OF ELECTRICITY AND MAGNETISM. By W. P. Maycock	.60
ALTERNATING CURRENTS OF ELECTRICITY AND THE THEORY OF TRANSFORMERS. By Alfred Still	1.50
PRACTICAL ELECTRIC LIGHT FITTING. By A. C. Allsop	1.50
ELECTRICAL EXPERIMENTS. By G. E. Bonney	.75
RADIOGRAPHY AND THE "X" RAYS IN PRACTICE AND THEORY. By S. R. Bottone	1.00
THE DYNAMO: HOW MADE AND HOW USED. By S. R. Bottone	.90
HOW TO MANAGE THE DYNAMO. By S. R. Bottone	.60
A GUIDE TO ELECTRIC LIGHTING. By S. R. Bottone	.75
ELECTRIC LIGHT ARITHMETIC. By R. E. Day	.40
THE DYNAMO: ITS THEORY, DESIGN AND MANUFACTURE. By C. C. Hawkins and F. Wallis	3.00
THE ALTERNATING CURRENT CIRCUIT. By W. P. Maycock	1.00
ELECTRIC WIRING FITTINGS, ETC. By W. P. Maycock	1.75
ELECTRIC WIRING TABLE. By W. P. Maycock	1.50
A MANUAL OF TELEPHONY. By W. H. Preece and A. J. Stubbs	4.50
PRACTICAL TELEPHONE HANDBOOK AND GUIDE TO THE TELEPHONIC EXCHANGE. By Joseph Poole	1.50
ELECTRIC WIRING. By Russell Robb	2.50
ELECTRIC LIGHT CABLES AND THE DISTRIBUTION OF ELECTRICITY. By Stuart A. Russell	3.00
ELECTRICITY IN TOWN AND COUNTRY HOUSES. By Percy E. Scrutton	1.00
THE STORAGE BATTERY. By Augustus Treadwell	1.75

Electrician Publishing Company
510 Marquette Building, Chicago

Good Advice

One of the foremost doctors of electrical engineering was recently called upon to examine into the ills of a profitless direct-current light and power plant and, after making a diagnosis, he immediately prescribed Duncan Meters, with instructions that the remedy should be continued indefinitely to prevent a recurrence of the malady.

Send for Bulletin and Prices

DUNCAN ELECTRIC MFG. CO.
LAFAYETTE, IND.

REFLECTIONS ON FARIES REFLECTORS

Fit any socket
Quickly attached or detached.
Made of aluminum or steel.
Very light and will not rack socket to pieces.
Finish not affected by heat.
Made in many styles and finishes.

Catalogue mailed upon application.

FARIES MFG. CO.
DECATUR, ILL.

WIRES AND CABLES

HIGH-GRADE, RUBBER-COVERED, WEATHER-PROOF
MAGNET, OFFICE, ANNUNCIATOR WIRE.
HAZARD MANUFACTURING CO.,
GENERAL OFFICE AND WORKS, Wilkesbarre, Pa. NEW YORK OFFICE, 50 Dey St. CHICAGO OFFICE, 71 and 73 West Adams St.

VULCANIZED FIBRE

Highest grades for electrical insulation and mechanical purposes, in sheets, tubes, rods and special shapes. Catalogues and samples on application.

VULCANIZED FIBRE CO., - Wilmington, Del.

KARTAVERT.

HARD AND FLEXIBLE FIBER IN SHEETS, RODS AND TUBING.
For Electrical and Mechanical Purposes, Railway Dust Guards, Washers and Packings. Patent Insulating Cleats.
MANUFACTURED BY
THE KARTAVERT MANUFACTURING CO. Wilmington, Del

STURTEVANT HAND BLOWERS

an improved type for blowing forges of all kinds; used also as portable ventilating apparatus. We make complete

FORGE SHOP EQUIPMENTS

Including Forges, Blowers, Exhausters, Galvanized Iron Piping, Etc.

B. F. STURTEVANT CO.
BOSTON, MASS.

General Office and Works, Hyde Park, Mass.
New York Philadelphia Chicago London
894

FOR SALE

Railway Generators

Size 44S Standard Crocker-Wheeler Railway Generator

Six direct-current generators, driven by a variety of prime movers, which supply power for the Intramural Railway at the St. Louis Exposition, will be ready for delivery after January 1. Let us send you further particulars.

Crocker-Wheeler Company
15 Branch Offices:
Chicago, St. Louis, Pittsburg, Etc. **Ampere, N. J.**

Black Diamond File Works

Est. 1803. Inc. 1895.

Twelve Medals Awarded at International Expositions

Special Prize Gold Medal at Atlanta, 1895.

OUR GOODS ARE ON SALE IN EVERY LEADING HARDWARE STORE IN THE UNITED STATES AND CANADA.

G. & H. BARNETT COMPANY,
PHILADELPHIA, PA.

JOHN A. ROEBLING'S SONS CO.

Insulated Wire of All Kinds

Bare Copper Wire

MAIN OFFICE AND WORKS **TRENTON, N. J.**

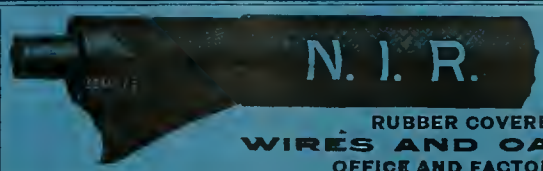
AGENCIES AND BRANCHES
New York Chicago Cleveland San Francisco Philadelphia Atlanta

Western Electrician

Vol. XXXV. $3.00 Per Annum. Copyright, 1903, by Electrician Publishing Company, Chicago. CHICAGO, DECEMBER 3, 1904. Entered at Chicago Postoffice as mail matter of the second class. 10 Cents a Copy. No. 23.

Technology Quarterly
Mass. Inst. of Technology
Boston Mass

SIMPLEX INSULATED WIRES AND CABLES.
RUBBER COVERED, WEATHERPROOF, UNDERGROUND AND SUBMARINE.
WESTERN SELLING AGENT, H. B. HIXSON, 1448 Monadnock Block, CHICAGO.
The Simplex Electrical Co., 110 State Street, BOSTON, MASS.



National India Rubber Co.'s
RUBBER COVERED
WIRES AND CABLES.
OFFICE AND FACTORY: BRISTOL, R. I.

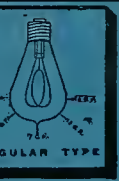
OKONITE
TRADE MARK
1889—Paris Exposition, Medal for Rubber Insulation.
1893—World's Fair, Medal for Rubber Insulation.
THE STANDARD FOR RUBBER INSULATION.
Sole Manufacturers of
Okonite Wires, Okonite Tape, Manson Tape, Candee Weather-proof Wires.
THE OKONITE CO., LTD.
Willard L. Candee, N. Durant Cheever, } Managers. 253 Broadway, New York. Geo. T. Manson, Gen'l Supt. W. H. Hodgins, Secy.

TRADE MARK
CRESCENT INSULATED WIRE & CABLE CO. TRENTON, N.J.
CRESCENT RUBBER INSULATED WIRES AND CABLES
National Code Standard.
CRESCENT INSULATED WIRE AND CABLE CO.,
New York Office, 83 BARCLAY STREET.
Main Office and Factory, TRENTON, N. J.

PARANITE
INDIANA RUBBER AND INSULATED WIRE CO.,
MANUFACTURERS OF
Paranite Rubber Covered Wires and Cables,
UNDERGROUND, AERIAL, SUBMARINE AND INSIDE USE:
TELEPHONE, TELEGRAPH AND FIRE ALARM CABLES.
All Wires are tested at Factory. JONESBORO, IND.

SINGLE AND POLYPHASE
TRANSFORMERS
KUHLMAN ELECTRIC CO., - - Elkhart, Ind.

THOUSANDS IN USE.
Motors, ⅛ h. p. to 100 h. p.
Dynamos, 1 k. w. to 75 k. w.
Highest Quality. Reasonable Price.
THE HOBART ELECTRIC MFG. CO.
TROY, OHIO.

DO YOU?
BUY LAMPS-OR-BUY CANDLE POWER
16 {THIS LAMP AVERAGES} 12
THE STERLING ELECTRICAL MANUFACTURING CO.
NEW YORK, N. Y. WARREN, O. CHICAGO, ILL.
STERLING SPECIAL

REGULAR TYPE

"CIRCULAR LOOM"
THE FLEXIBLE CONDUIT
AMERICAN CIRCULAR LOOM CO.
TRADE MARK
REGISTERED
CONDUITS FOR INTERIOR WIRING.
American Circular Loom Co.
Chelsea, Mass., New York, Chicago, San Francisco.

I-T-E
CIRCUIT BREAKERS
CUTTER ELECTRICAL CO., PHILADELPHIA

THERMOPILES 1½ VOLTS 1½ AMPERES
For Electrolytic analysis, charging storage batteries, and other constant current requirements. $3 Each.
WALSH'S SONS & CO.
264 Washington Street. Newark, N. J.

Some More Light on our Drawn Steel Junction Boxes
Take time to figure out the cost of cast iron boxes plus the loss from breakage and time used in producing a round hole. Compare with this the cost of drawn steel boxes.
NO BREAKAGE,
Clean round hole produced with one blow of a hammer. Write for catalog and see what you can save.
BOSSERT ELECTRIC CONSTRUCTION CO. - - UTICA, N. Y.

SAUQUOIT SILK MFG. COMPANY
INSULATING and BRAIDING SILKS
MILLS:
BETHLEHEM, PA.
PHILADELPHIA, PA.
SCRANTON, PA.
NEW YORK REPRESENTATIVES:
WILLIAM RYLE & COMPANY
54 Howard St.
PHILADELPHIA OFFICE:
4015 Clarissa St.
CHICAGO OFFICE:
210 Monroe St.
BOSTON OFFICE:
78 Chauncy St

"STAR" INCANDESCENT LAMPS

LONG LIFE
GUARANTEED CANDLEPOWER,
HIGHEST EFFICIENCY.
MADE BY THE MOST SKILLED WORKMEN.
STANDARD ELECTRICAL MFG. COMPANY, : Niles, Ohio.

USE
"SAFETY" RUBBER COVERED
WIRE AND CABLE
FOR EVERY ELECTRICAL SERVICE.
M. B. AUSTIN & CO.,
CHICAGO REPRESENTATIVE.
THE SAFETY INSULATED WIRE & CABLE CO.,
WORKS: Bayonne, N. J. 114-116 LIBERTY STREET, N. Y.

WESTON Electrical Instrument Co.,
114-120 William St., NEWARK, N. J., U. S. A.
We are now offering our
New Model Low Priced Portable Instruments, Model E,
for use where the extreme accuracy peculiar to our Portable Standard Instruments is not necessary or desired.
VOLTMETERS
in ranges from 3 to 300 Volts.
AMMETERS
in ranges from 1 to 25 Amperes.
Self contained and for any capacity desired in connection with external shunts, within practical limit.
Send for Bulletin No. 1 describing these instruments.
BERLIN—European Weston Electrical Instrument Co., Ritterstrasse, No. 88.
LONDON—Elliott Bros., Century Works, Lewisham.
PARIS, FRANCE—E. H. Cadiot, 12 Rue St. Georges.
NEW YORK OFFICE—74 Cortlandt St.

Weston Portable Type E Voltmeter.

ALL THE ESSENTIALS

of a good storage battery are found in the
NORTHWESTERN
Large Capacity, Light, Efficient, Compact.
To have your order filled promptly send to us at once.
Northwestern Storage Battery Co.,
285 Madison St., - - - Chicago, Ill.

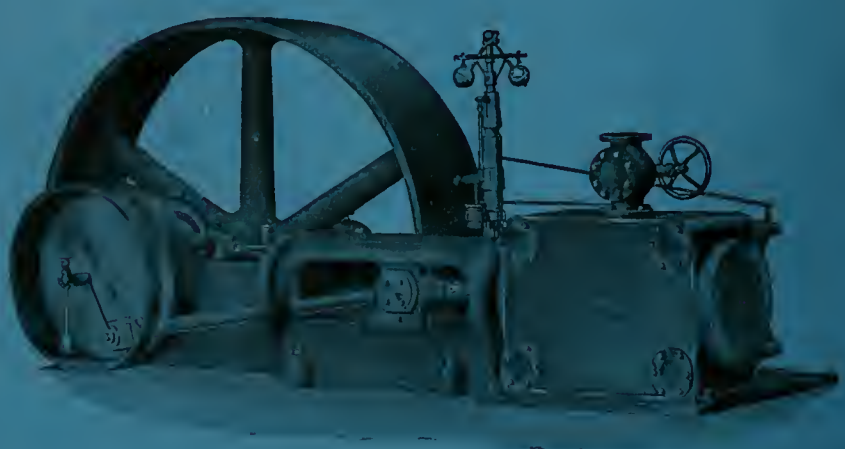
Everybody Knows

We make the largest
Engines in the world

But Do You Know

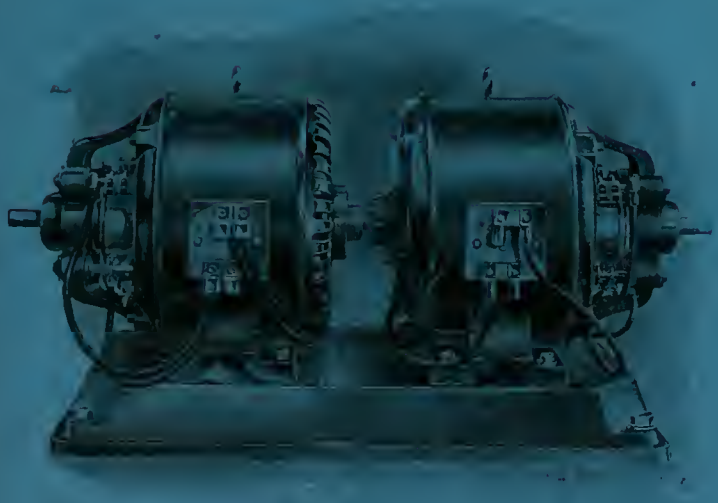
We make smaller Engines, in sizes from 25 Horsepower upward

?



Allis-Chalmers Standard Corliss Engine

Corliss Engines for all power purposes



Bullock Motors

for operating Machine Tools.

Bullock

(Patented) Three-Wire Multiple Voltage Balancing System for control of Motors, received the

Highest Award at the St. Louis Exposition

Many of the largest machine shops in the country are operating their tools on the Bullock (Patented) Multiple Voltage System.

When a motor operating on their system is set at any speed, it will run at that speed regardless of the load.

As many as twelve different speeds forward or backward can be secured through this system.

For further particulars address

Allis-Chalmers Co., Milwaukee

Electrical Department

The Bullock Electric Mfg. Co.

General Sales Offices, New York Life Bldg., Chicago.

Electrical Works, Cincinnati, O.

Canadian representatives, Allis-Chalmers-Bullock, Ltd., Montreal

THE ELECTRIC STORAGE BATTERY CO.

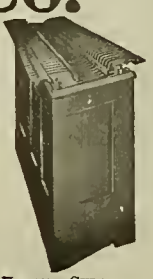
PHILADELPHIA

MANUFACTURER OF THE

"Chloride Accumulator"

For Central Stations, Electric Railways, Isolated Lighting and Power Stations, Fire Alarm, Telegraph, Train Lighting, etc., etc.

PRICE LIATS AND OESCRIPTIVE BULLETINS FORWARDED UPON REQUEST.



SALES OFFICES:

PHILADELPHIA, Allegheny Ave. and 19th St. | NEW YORK, 100 Broadway. | BOSTON, 60 State St. | CHICAGO, Marquette Bldg. | ST. LOUIS, Wainwright Bldg. | SAN FRANCISCO, Rialto Bldg. | CLEVELAND, Citizens Bldg. | CANADA, Canadian General Electric Co., Ltd. Toronto | HAVANA, CUBA, G. F. Greenwood, Manager 34 Empedrado St.

Will you ever again buy cables as cheap as now?

Not unless copper takes a long drop—and none of us looks for that. On the present copper market we are selling cables way below what we should. That is plain to any man who figures it. Advances are certain, and coming quick.

Big orders are coming in, and more in sight. Every one needs cable—mostly big lots. Deliveries will be choked as badly as in 1902 and 1903. (Remember them?)

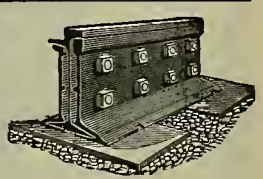
Business is already heavier than most buyers think. Those now under cover are wise, because they will get *their* cables on time, and at present prices.

Profitable contracts for future delivery may be made now if you send us your specifications. Buy enough for all of 1905. It will be good property.

Toledo, Ohio **THE F. BISSELL COMPANY**

INSULATED WIRES
COTTON AND SILK
NORTHERN WIRE & CABLE CO.
OFFICES: Milwaukee, 710-712 Wells Bldg. Chicago, 1202 Marquette Bldg.
MAGNET WIRES
South Milwaukee Wis.

CONTINUOUS RAIL JOINT CO. OF AM.
GENERAL OFFICES: CENTURY BUILDING
NEWARK, N. J.
OVER 20,000 MILES IN USE
Highest Award at Paris Exposition, 1900, Buffalo, 1901



PLATINUM
PLATINUM RIVETS FOR CONTACT POINTS IN TELEPHONES—SPARK COILS AND OTHER ELECTRICAL APPARATUS. PLATINUM SHEET AND WIRE IN ANY FORM AND DEGREE OF HARDNESS. PLATINUM SCRAP PURCHASED.

BAKER & COMPANY, Inc.
ARTISANS IN PLATINUM
408-410-412-414 N. J. R. R. AVE. - NEWARK, N. J.
New York Office: 120 Liberty St.

ALPHABETICAL INDEX TO ADVERTISEMENTS.

Adams-Bagnall Electric Co..—
Allis-Chalmers Company..... 2
American Battery Co.....11
Amer. Circular Loom Co.... ...1
American Conduit Co.....16
American Diesel Engine Co..14
Amer. District Steam Co.....19
Amer. Elec. Fuse Co.....22
Amer. El. Telephone Co.....17
American Electrical Works..11
Arnold Elec. Power Station Co.....13
Audit Co. of Ill., The..... —
Automatic Electric Co..... 17

Babcock & Wilcox Co.....18
Badt, F. B.....13
Bain, Forée.....11
Baker & Company..... 3
Haker & Co., W. E.....13
Barnett Company, G. & H....22
Beardslee Chandelier Mfg.Co.—
Benjamin Electric Mfg. Co..—
Hennett, I. A..... 8
Berthold & Jennings.....18
Big Fonr Route.....12
Bissell Co., The F..... 3
Bossert Electric Construction Co..... 1
Brooks, Hall L.....19
Bryan-Marsh Co.....—
Bryan, Wm. H.....13
Buckeye Electric Co.....—
Bullock Elec. Mfg. Co..... 2
Burlington R. R.....18
Butterfield, J. F.....13
Bylesby & Co., H. M.....13

Cantwell Press, The.....—
Carhartt & Co., Hamilton....—
Central Electric Co..... 5
Cent. Stat. Improvement Co 12
Central Tel. & El. Co.....16
Century Electric Co.....15
Chicago Die & Electric Co....—
Chicago Edison Co.....4, 12
Chic. Fuse Wire & Mfg. Co...—
Chicagu Insulated Wire Co...—
Chicago Mica Co.....10
Cincinnati Gas & Elec. Co...12
Clinton Stamping & Elec Co.16
Colonial Sign & Insulator Co.11
Columbia Incand. Lamp Co..—
Columbia Mfg. Co.....18
Continuons Rail Joint Company of America..... 3
Cooper-Hewitt Elec. Co..... 8
Cope, T. J..... 9
Crawfordsville Electric Co..—
Crescent Ins. Wire & Cbl. Co. 1
Crocker-Wheeler Company... 7
Crolius & Son, E. R.....11
Cutler-Hammer Mfg. Co..... 5
Cutter Elec. & Mfg. Company 1

D. & W. Fuse Company.....—
Dearborn Drug & Chem. Wks.14
Detroit Electric Co.....15
Diamond Meter Company....15
Directory of Engineers.....13
Dixon Crucible Co., Joseph..14
Duncan Elec. Mfg. Co.....21

Edison Decorative & Miniature Lamp Departm't.....10
Edison Mfg. Company.....—
Edwards & Co.....18
Egan, J. J.....12
Electric Appliance Co..... 10
Electric Storage Battery Co.. 3
Electrical Appliance Co.....—
Electrical Engineer Institute.15
Electrician Pub. Company...13
Erie Ry.....19
Evans, Almirall & Co 13
Evans & Co., W. R 13

Faries Mfg. Co..... 8
"For Sale" Advertisements..12
Ft. Wayne Elec. Works, Inc..21
Fustoria Incand. Lamp Co...—
Fowler, John H.....19
Fowler-Jacobs Company.....19
Franklin Elec. Mfg. Co .....—

General Electric Co..... 9
General Engineering Co., The 13
General Incandescent Arc Light Compauy.....—
General Incand. Lamp Co....—
Gould Storage Battery Co.... 6
Gt. Western Smelting & Refining Co 12
Green Fuel Economizer Co..14
Gregory Electric Company...12

Hallberg, J. H 13
Hart Mfg. Co.....16
Hartford Steam Boiler Inspection & Insurance Co....—
Hazard Manufacturing Co...—
Highland Park College. ... 15
Hipwell Mfg. Co..... 17
Hobart Elec. Mfg. Co..... 1
Hoffman, G. W.....12
Holmes Fibre-Graph. Co.....—
Holophane Glass Co.....—
Humphrey, Henry H.....—
Hunt & Co., Rubt. W.....13

Illinois Central Ry.....17
Incandescent Electric Light Manipulator Company.....15
Indiana Rub. & Ins. W. Co.... 1
India Rubber & Gutta Percha Insulating Company.....—
International Elec. Meter Co 12
International Tel. Mfg. Co...16

Jackson, D. G. & W. B.....13
Jeffrey Manufacturing Co....14
Johns-Manville Co., H. W..... 8

Kartavert Manufacturing Co.—
Kellogg Switchboard & Supply Company.....17, 19
Kemp, R. W..... 13
Kester Elec. Mfg. Co.....11
Klein & Sons, Mathias.... 11
Kohler Brothers.....13
Kuhlman Electric Co..... 1

Leather Preserv. M. Corp....12
Leffel & Co., James.....14
Lindsley Brothers Company..19
Loud's Sons Co., H. M.....—

Machado & Roller.....10
Malthy Cedar Company.....19
Manhattan El. Supply Co....22
Manross, F. N..... .....—
Marinette Gas Engine Co.....14
Matthews & Bros., W. N.....11
McLaughlin & Co., Jas..... 9
McLennan & Company, K....10
Mechanical Appliance Co....14
Mica Insulator Company.....10
Miscellaneous Advs.....12
Monon Railroad..... ...12
Morrison Lbr. Co., J. W.....19
Mueller Company, William..19
Munsell & Co., Eugene.....10

National Electric Co..... 4
National India Rubber Co.... 1
New England Butt Co.....19
Newgard & Co., Henry.....18
New York Cent. Ry.....19
New York Ins. Wire Co.....11
Northern Elect'l Mfg. Co....10
Northern Wire & Cable Co... 3
Northwestern Storage Battery Co.. 1

Okonite Co., The..... 1
Osburn Flexible Conduit Co. 9

Pacific Coast Pule Co.....18
Paragon Fan & Motor Co.....—
Pardridge Shade & Refl. Co..—
Pass & Seymour, Inc..... 8
Phelan, D. W.....19
Phillips, Eugene F.....11
Phillips Insulated Wire Co...11
Phœnix Glass Co.....—
Phosphor-Bronze S. Co.....14
Pignolet, L. M.....10
Pittsburg & L. S. Iron Co....18
Plume & Atwood Mfg. Co....15
Porter Cedar Company.....19
Prometheus Electric Co., The22

Reisinger, Hugo..... 9
Replogle Governor Works.. .10
Reynolds El. Flasher Mfg.Co.10
Roehling's Sons Co., J. A....15
Ruebel-Schwedtmann-Wells..13
Runzel-Lenz Elec. Mfg. Co...22

Safety Ins. Wire & Cable Co.. 1
Sargent & Lundy.....—
Sauquoit Silk Mfg. Co..... 1
Schutt, W. H.....13
Signaloid Chemical Works...17
Simplex Electrical Co., The.. 1
Simplex Elec. Heating Co....13
Speer Carbon Co..... .—
Sprague Electric Company...15
Squire Electric Co.....—
Standard Elec. Mfg. Co..... 1
Standard Underg. Cable Co...—
Stanley Elec. Mfg. Co., The 11
Stanley Instrument Co..... 5
Stanton, LeRoy W..... . 13
Sterling & Son, W. C.....18
Sterling Electrical Mfg.Co.... 1
Sterling Varnish Co., The....10
Stow Mfg. Company.....—
Stromberg-Carlson Tel. Mfg. Company.....16
Sturtevant Company, B. F...22

Temple Pump Co.....10
Torrey Cedar Company.....18
Trumbull Elec. Mnfg. Co.....—
Turner Brass Works.....22

Union Electric Mfg. Co.....—

Valentine-Clark Co., The....—
Vulcanized Fibre Company..22

Wagner Electric Mfg. Co..... 4
Walsh's Sons & Company..... 1
Warren Elec. Mfg. Co.....17
Wesco Supply Co.....10
Western Electric Company... 5
Westinghouse Electric & Manufacturing Co.....20
Weston Electrical Inst. Co... 1
Whitehead Machinery Co... 12
Wilmerding, C. H.....—
Wisconsin Central Ry.....19
Woolley Fdy. & Mach. Wks..14
Worcester Company, C. H....18

Yesbera Mfg. Co..... .. 16
Yost Electric Mfg. Co 10

Zero Marx Sign Works .....—

For Classified Index of Advertisements See Page 6.

Motors,
Switches,
Arc Lamps,
Circuit Breakers, Etc., Etc.

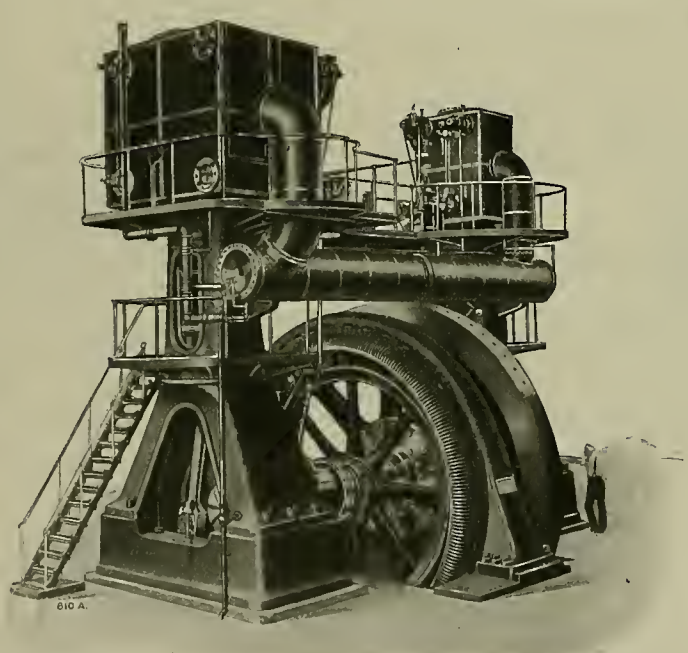
ALWAYS IN STOCK.

MANUFACTURED BY

G. I. Co.

CHICAGO EDISON COMPANY, 139 Adams Street, CHICAGO.

For Immediate Delivery



MODERN DESIGN SUPERIOR PERFORMANCE

Gold Medal Generator Unit

Hamilton Corliss Cross Compound Vertical Condensing Engine, 2,250 horsepower.

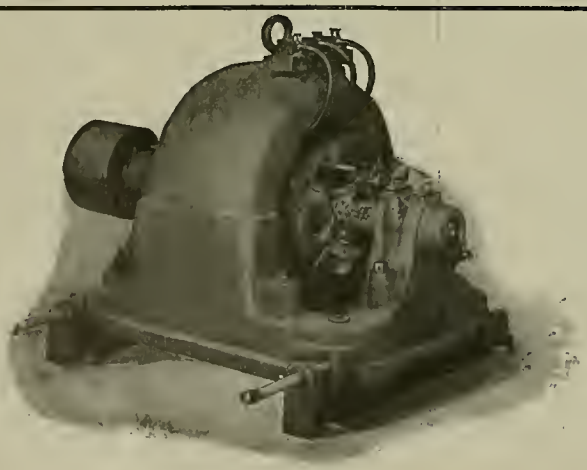
1,500 K. W., 3 Phase 25 cycles, 6,600-Volt National Alternator.

Released at close of St. Louis Exposition.

For prices and terms apply to

HOOVEN, OWENS, RENTSCHLER CO.
HAMILTON, OHIO

National Electric Company
Milwaukee



CENTRAL STATION MANAGERS

Don't Be Afraid

of the Gas Plant

WORK UP A MOTOR LOAD

We can furnish you

SINGLE PHASE MOTORS

that will start under full load in sizes ranging from 1/8 to 35 H. P.

Wagner Electric Mfg. Co.
ST. LOUIS, MO., U. S. A.

CHRISTMAS TREE OUTFITS

Of inestimable value for decorative lighting; complete and ready for use. Outfit consists of 24 lamps, of assorted colors, made up in three strands with lamp-cord and attaching plug.

OUR PRICE WILL INTEREST YOU

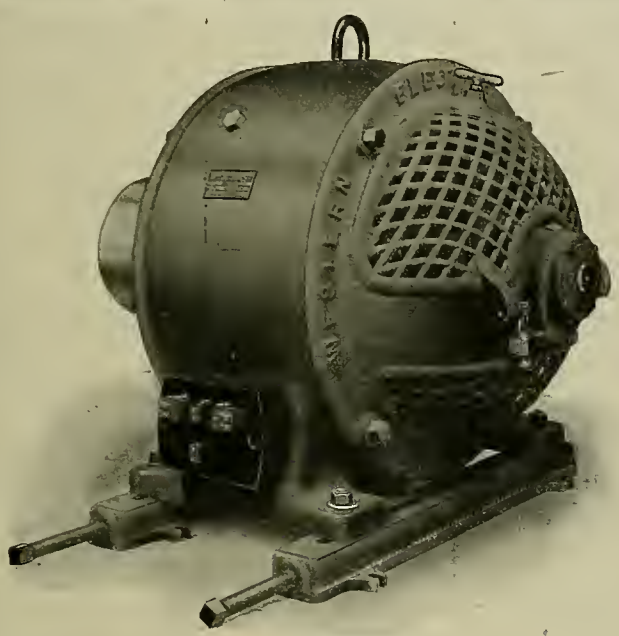
OKONITE — IT NEVER DISAPPOINTS

Central Electric Company,

SALES AGENTS

264-266-268-270 Fifth Avenue, CHICAGO

OKONITE — IT NEVER DISAPPOINTS



DIRECT CURRENT

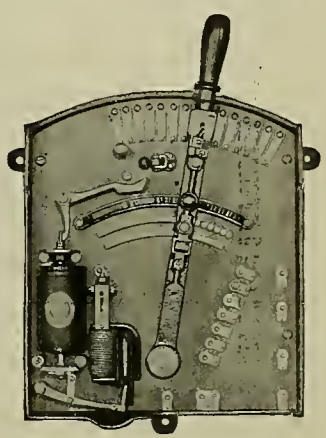
Generators and Motors

Western Electric Company

CHICAGO NEW YORK

And Other Large Cities.

Flat Bed and Small Rotary Press Controllers



One of the six "Carpenter" types.

The "Carpenter" system gives such a wide range of speed and such perfect control that a press can be moved an eighth of an inch at a time, and from that to top speed, with every desirable intermediate speed.

Six types, alike in principle, different in detail. Bulletins 81 to 86 explain. We'll send them if you let us know that you want them.

The Cutler-Hammer Mfg. Co.,

Electric Controller Manufacturers and Electrical Engineers.

MILWAUKEE, WIS.

New York, Boston, Chicago, Pittsburg.

ELECTRICITY FOR ENGINEERS.

424 PAGES. ILLUSTRATED. PRICE $2.50.

ELECTRICIAN PUBLISHING CO., 510 Marquette Building, CHICAGO

STANLEY RECORDING WATTMETERS

FOR ALTERNATING-CURRENT CIRCUITS

BALANCED THRUST — No Jewel Wear from Hammer or Side Thrust. Glass or Metal Covers, Second Alone to the STANLEY MAGNETIC SUSPENSION WATTMETERS

Missouri, Kansas, Arkansas
FRANK ADAM ELECTRIC CO.
St. Louis

Colorado, Idaho, Montana, Wyoming
New Mexico, Utah
HENDRIE-BOLTHOFF MFG. AND SUPPLY CO.
Denver

SEND FOR BULLETINS AND INFORMATION ABOUT METERS TO

STANLEY INSTRUMENT CO.

GREAT BARRINGTON MASS., U. S. A.

Mexico
VICTOR M. BRASHI & CO.
Mexico City

California, Oregon, Washington
Nevada, Arizona
BROOKS-FOLLIS ELECTRIC CORP.
San Francisco

Gould Storage Battery Co.

Complete Storage Battery Plants

Railway Line and Regulating
Isolated and Train Lighting
Central Lighting and Power
Electric Vehicle and Telephone

GOULD COUNTER E. M. F. BOOSTER SYSTEMS

Sales Offices { NEW YORK, 1 W. 34th Street. BOSTON, 89 State Street. CHICAGO, The "Rookery." SAN FRANCISCO, Century Electric Co.

WORKS: DEPEW, N. Y.

Bulletins.

CLASSIFIED INDEX OF ADVERTISEMENTS.

Accountants and Auditors.
Audit Co. of Illinois

Adjusters, Cord.
Iacandes. El. Lt. Manip. Co.

Adjusters, Inc. Lamps.
Inc. El. Lt. Manipulator Co.

Anchors (Tel. & Tel.)
Bennett, I. A.
Matthews & Bro., W. N.

Annunciators.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.

Batteries and Jars.
Bissell Co., The F.
Central Electric Co.
Edison Mfg. Co.
Edwards & Company.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.

Bells, Buzzers, Etc.
Central Electric Co.
Edwards & Co.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.

Belt Dressing.
Dixon Crucible Co., Jos.
Leather Preserver Mfg. Corp.

Belting.
Leather Preserver Mfg. Corp

Blow Pipes.
Turner Brass Works

Blowers.
Sturtevant Co., B. F.

Boiler Compounds.
Dearborn Drug & Chem. Wks.

Boilers.
Allis-Chalmers Company.
Babcock & Wilcox Co.

Books, Electrical.
Cantwell Press, The.
Electrician Publishing Co.

Booths, Telephone.
Yesbera Mfg. Co.

Brackets.
Faries Mfg. Co.

Brushes.
Central Electric Co.
Hobart Elec. Mfg. Co.
Holmes Fibre-Graphite Co.
Speer Carbon Co.
Western Electric Company.

Cable Hangers.
Bissell Co., B. F.
Wesco Supply Co.
Western Electric Co.

Cables (See Wires and Cables)

Canopies.
Faries Mfg. Co.

Carbons, Points and Plates.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
Raisinger, Hugo.
Speer Carbon Co.
Wesco Supply Co.

Castings.
Faries Mfg. Co.
New England Butt Co.
National Electric Co.

Chains.
Jeffrey Mfg. Co.

Chandeliers.
Faries Mfg. Co.

Circuit Brenkers.
Cutler-Hammer Mfg. Co.
Cutter Elec. & Mfg. Co.
Ft. Wayne Elec. Wks. Inc.
Union Electric Mfg. Co.
Wesco Supply Co.
Western Electric Company.
Westinghouse El. & Mfg. Co.

Cinders.
Benjamin Elec. Mfg. Co.
Faries Mfg. Co.

Coal and Ashes Handling Machinery.
Jeffrey Mfg. Co.

Coils and Magnets.
Western Electric Co.

Coloring, Lamp.
Signaloid Chemical Works.

Commutator Compound
Crollus & Son, E. R.
Egan, J. J.
McLaughlin & Co., Jas.
McLennan & Co., K.

Condensers, Electric.
Stanley Elec. Mfg Co.

Conduit and Conduits.
American Circular Loom Co.
American Conduit Company
Central Electric Co.
Electric Appliance Co.
Osburn Flexible Conduit Co.
Sprague Electric Co.
Wesco Supply Co.

Contractors and Electric Light Plants.
Allis-Chalmers Company.
Bullock El. Mfg. Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
National Electric Co.
Northern Electrical Mfg. Co.
Sprague Electric Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co

Controllers, Crane.
Amer. Elec. Fuse Co.

Copper, Scrap.
Great Western Smelting & Refining Co.

Cord.
Runzel-Lenz Elec. Mfg. Co

Cross-Arms, Pins and Brackets.
Berthold & Jennings.
Central Electric Co.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Company.

Cut-Outs and Switches.
Bissell Co., The F.
Bossert Elec. Const. Co.
Central Electric Co.
Chicago Edison Co.
Clinton Stamping & Elec. Co.
Cutter Elec. & Mfg. Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
General Inc. Arc Light Co.
Hart Manufacturing Co.
Manhattan Elec. Supply Co.
Trumbull Elec. Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Dynamos and Motors.
Allis-Chalmers Company.
Bissell Co., The F.
Bullock Elec. Mfg. Co.
Central Electric Co.
Century Electric Co.
Crawfordsville Electric Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks. Inc.
General Elec. Co.
General Inc. Arc Light Co.
Gregory Electric Co.
Hobart Elec. Mfg. Co.
Mechanical Appliance Co.
National Electric Co.
Northern Electrical Mfg. Co.
Sprague Electric Co.
Stanley Elec. Mfg. Co.
Stow Manufacturing Co.
Sturtevant Co., B. F.
Wagner Electric Mfg. Co.
Warren Elec. Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Economizers, Fuel.
Green Fuel Economizer Co.

Electric Heating Appl.
Electric Appliance Co.
Prometheus Electric Co.
Simplex Elec. Heating Co.
Western Electric Co.

Electric Railways.
Crocker-Wheeler Co.
General Electric Co.
Sprague Electric Co.
Westinghouse El. & Mfg. Co.

Electrical and Mechanical Engineers.
Arnold Elec. Power Stat'n Co.
Badt, F. B.
Baker & Co., W. E.
Bryan, Wm. B.
Butterfield, J. F.
Byllesby & Co., H. M.
Evans, Almirall & Co.
General Engineering Co., The.
Hallberg, J. B.
Humphrey, Henry H.
Hunt & Co., Robt. W.
Jackson, D. C. & W. B.
Kemp, R. W.
Kohler Brothers.
Newgard & Co., Henry.
Northern Electrical Mfg. Co.
Ruebel, Schwedtman, Wells.
Sargent & Lundy.
Schott, W. H.
Squire Electric Co.
Stanley Elec. Mfg. Co.
Stanton, LeRoy W.
Wilmerding, C. H.

Electrical Instruments. (Recording and Testing.)
Bissell Co., The F.
Central Electric Co.
Detroit Electric Co.
Diamond Meter Co.
Duncan Elec. Mfg. Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
General Inc. Arc Light Co.
Machado & Roller.
Pignolet, L. M.
Stanley Elec. Mfg. Co.
Stanley Instrument Co.
Wagner Electric Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co
Weston Electrical Inst. Co.

Electro-Plating Mach'y
Crocker-Wheeler Company.
General Electric Co.

Elevators-Conveyors.
Jeffrey Mfg. Co.

Engines, Gas and Gasoline.
Allis-Chalmers Company.
Marinette Gas Engine Co.
Temple Pump Co.
Woolley Fdy. & Mach. Wks.

Engines, Oil.
American Diesel Engine Co.

Engines, Steam.
Allis-Chalmers Company.
Sturtevant Co., B. F.

Fans and Fan Motors.
Central Electric Co.
Crocker-Wheeler Company.
Edison Mfg. Co.
General Electric Co.
General Inc. Arc Light Co.
Sprague Electric Co.
Sturtevant Co., B. F.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Fibre.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Files.
Barnett Co., G. & H.

Fittings.
Faries Mfg. Co.

Fixtures, Gas and Elec.
Beardslee Chandelier Mfg. Co.

Flashers.
Bissell Co., The F.
Reynolds El. Flasher Mfg. Co
Wesco Supply Co.

Flexible Shafts.
Stow Mfg. Co.

Forges.
Sturtevant Co., B. F.

Fuses and Fuse Wire.
Amer. Elec. Fuse Co.
Bissell Co., The F.
Central Electric Co.
Central Tel. & El. Co.
Chicago Dle & Electric Co.
Chicago Fuse Wire & Mfg. Co.
Clinton Stamping & Elec. Co.
D. & W. Fuse Company.
Electric Appliance Co.
Johns-Manville Co., H. W.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Company.

Globes, Reflectors and Shades.
Fostoria Incan. Lamp Co.
Holophane Glass Co.
Pardridge Shade & Refl. Co.
Phœnix Glass Co.
Wesco Supply Co.
Western Electric Co.

Governors, Water Wheel.
Replogle Governor Works.

Graphite Specialties.
Dixon Crucible Co., Jos.
Holmes Fibre-Graphite Co.

Heating (Exhaust Steam).
Amer. District Steam Co.

Heating and Ventilating Apparatus.
Sturtevant Co., B. F.

Heating, Hot Water.
Evans, Almirall & Co.

Holders, Inc. Lamps.
Electric Appliance Co.
Incandescent Electric Light Manipulator Co.

Inspection & Insurance
Bartford Steam Boiler Inspection & Insurance Co.

Insulating Machinery.
New England Butt Co.

Insulators and Insulating Materials.
American Electrical Works.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Inc. Arc Light Co.
Indiana Rub. & Ins. Wire Co.
Johns-Manville Co., H. W.
Kartavert Mfg. Co.
Manhattan Elec. Supply Co.
Mica Insulator Co.
Munsell & Co., Eugene.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Sterling Varnish Co.
Vulcanized Fibre Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Junction Boxes.
Bossert Elect. Const. Co.
General Inc. Arc Light Co.

Lamps, Arc.
Bissell Co., The F.
Central Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
General Inc. Arc Lt. Co.
Gregory Electric Co.
Bipwell Manufacturing Co
Manhattan Elec. Supply Co.
Stanley Elec. Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Lamps, Incandescent.
Bissell Co., The F.
Bryan-Marsh Company.
Buckeye Electric Company.
Central Electric Co.
Chicago Edison Co.
Columbia Incan. Lamp Co.
Edison Decorative & Miniature Lamp Dept.
Electric Appliance Co.
Fostoria Incand. Lamp Co.
Franklin Electric Mfg. Co.
General Electric Co.
General Inc. Arc Light Co.
Sawyer-Man Elec. Co.
Standard Elec'l Mfg. Co.
Sterling Electrical Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Lamps, Incandescent—Replacers & Cleaners.
Inc. El. Lt. Manipulator Co.

Lamps, Vapor.
Cooper, Hewitt Elec. Co.

Letters, Sign.
Colonial Sign & Insulator Co.

Lightning Arresters.
Central Electric Co.
Clinton Stamping & Elec. Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
Manhattan Elec. Supply Co.
Stanley Elec. Mfg. Co.
Wesco Supply Co.
Western Electric Co.

Linemen's Climbers.
Klein & Sons, Mathias.

Magnet Wires.
(See Wires and Cables.)

Mechanical Draft.
Sturtevant Co., B. F.

Mica.
Chicago Mica Co.
Mica Insulator Co.
Munsell & Co., Eugene.

Mining Apparatus, Elec.
Allis-Chalmers Company.
Crocker-Wheeler Company.
General Electric Co.
Jeffrey Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Motors. (See Dynamos and Motors.)

Nippers and Pliers.
Klein & Sons, Mathias.

Nozzles.
Faries Mfg. Co.

Overalls.
Carhartt & Co., Hamilton.

Patent Attorneys.
Bain, Force.

Phosphor Bronze.
Phosphor Bronze Sm. Co. Ltd

Platinum, Wire and Sheet.
Baker & Company Inc.

Poles and Ties.
Berthold & Jenninga.
Brooks, Hall L.
Columbia Mfg. Co.
Fowler, John H.
Fowler-Jacobs Company.
Kellogg Switch. & Sup. Co.
Lindsley Bros. Co.
Loud's Sons Co., H. M.
Maltby Cedar Co.
Morrison Lbr. Co., J. W.
Mueller Company, William.
Pacific Coast Pole Co.
Phelan, D. W.
Pittsburg & L. S. Iron Co.
Porter Cedar Company.
Sterling & Son, W. C.
Torrey Cedar Co.
Valentine-Clark Co., The.
Worcester Co., C. H.

Polish (Metal).
Allen Co., Inc., L. B.
Hoffman, Geo. W.

Portables.
Faries Mfg. Co.

Power Transmission Machinery.
Jeffrey Mfg. Co.

Rail Joints.
Continuous Rail Joint Company of America.

Railway Supplies.
Wesco Supply Co.

Rectifiers.
Electrical Appliance Co.

Refiners.
Gt. West Smelt. & Refining Co

Re-Winding—Repairs.
Chicago Edison Co.
Gregory Electric Co.

Rheostats.
Amer. Electric Fuse Co.
Cutler-Hammer Mfg. Co.
General Electric Co.
Gen'l Inc. Arc Lt. Co.
Union Electric Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Rods, Conduit.
Cope, T. J,

Schools and Colleges.
Electrical Engineer Inst.
Highland Park College

Second-Hand Mach'y.
Bissell Co., The F.
Cent. Stat. Improvement Co.
Cincinnati Gas & Elec. Co.
Gregory Electric Co.
Matthews & Bro., W. N.
Walsh's Sons & Co.

Shades, Lamp.
Faries Mfg. Co.

Sheet Brass & Copper.
Plume & Atwood Mfg. Co.

Signs, Electric.
Zero Marx Sign Works.

Silks, Insulating and Braiding.
Sauquoit Silk Mfg. Co.

Sockets & Receptacles.
Pass & Seymour.
Yost Elec. Mfg. Co.

Soldering Sticks, Salts and Paste.
Crollus & Son, E. R.
Kester Elec. Mfg. Co.
Western Electric Co.

Speaking Tubes.
Central Electric Co.
Edwards & Co.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.

Speed Indicators.
Weston Electrical Inst. Co.

Storage Batteries.
American Battery Co.
Electric Storage Battery Co.
Gould Storage Battery Co.

Supplies, General Elec.
Bissell Co., The F.
Central Electric Co.
Century Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Electric Co.
Manhattan Elect'l Supply Co
Wesco Supply Co.
Western Electric Co.

Switchboards.
Bissell Co., The F.
Gen. Incan. Arc Light Co.

Telephones, Telephone Material and Switchboards.
American El. Telephone Co
Automatic Electric Co.
Bissell Co., The F.
Central Electric Co.
Central Tel. & El. Co.
Electric Appliance Co.
International Tel. Mfg. Co.
Kellogg Switchb. & Sup. Co.
Manhattan Elec. Supply Co.
Stromberg-Carlson Tel. M. Co
Wesco Supply Co.
Western Electric Co.

Time Switches.
Bissell Co., The F.

Tools.
Klein & Sons, Mathias.
Western Electric Co.

Transformers.
Central Electric Co.
Crawfordsville Electric Co.
Crocker-Wheeler Co.
Electric Appliance Co.
Ft. Wayne Elec. Works, Inc.
General Electric Co.
Gregory Electric Co.
Kublman Electric Co.
Manhattan Elec. Supply Co.
National Electric Co.
Stanley Elec. Mfg. Co.
Wagner Electric Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Trucks, Electric Car.
General Electric Co.
Westinghouse El. & Mfg. Co.

Turbines, Steam.
Allis-Chalmers Co.
General Electric Co.
Westinghouse El. & Mfg. Co

Turbine Water Wheels
Leffel & Co., Jas.

Varnishes.
Sterling Varnish Co.

Vulcanized Fibre.
Vulcanized Fibre Co.

Whistles, Electric.
Electrical Appliance Co.

Wires & Cables—Magnet Wires.
American Electrical Works.
Bissell Co., The F.
Central Electric Co.
Chicago Insulated Wire Co.
Crescent Ins. Wire & Cble. Co.
Electric Appliance Co.
General Electric Co.
Hazard Manufacturing Co.
Indiana Rub. & Ins. Wire Co
India Rubber & Gutta Percha Insulating Co.
Kellogg Switch. & Sup. Co.
Manhattan Elec. Supply Co.
National India Rubber Co
New York Insulated Wire Co.
Northern Wire & Cable Co.
Okonite Co., The.
Phillips, Eugene F.
Phillips Insulated Wire Co
Roebling's Sons Co., J. A.
Runzel-Lenz Elec. Mfg. Co.
Safety Ins. Wire & Cable Co.
Simplex Electrical Co.
Standard Underground C. Co
Wesco Supply Co.
Western Electric Company.

For Alphabetical Index of Advertisements See Page 3.

CROCKER-WHEELER

Alternators

for Lighting and Power

CROCKER-WHEELER STANDARD REVOLVING FIELD ENGINE TYPE ALTERNATOR

As American licensees of the celebrated Swiss engineers Brown, Boveri & Cie., we are able to build alternating current generators of the same excellence as our long-established direct current apparatus.

ADDRESS INQUIRIES TO OUR CHICAGO OFFICE, 12 OLD COLONY BLDG. OR TO

Crocker-Wheeler Company

Manufacturers and Electrical Engineers

AMPERE, N. J.

We were awarded the **Grand Prize** by the **Louisiana Purchase Exposition** for Electric Lighting Work in the development of the **Mercury Vapor Lamps** and also a **Gold Medal** for Vapor Lamps for Photo Engraving

Type H-6 Lamp

This is merely proof that our claims for the efficiency of the

Cooper Hewitt Mercury Vapor Lamps

are based upon positive merit of the highest order and assures purchasers that we have long passed the experimental stage of our work and have a proposition of great commercial value.

For 35 per cent. of your present lighting cost we can furnish you with a light that is far superior to work by and the extreme diffusion of which overcomes the difficulties heretofore experienced in adequately lighting such places as Machine Shops, Factories, Mills, Offices, Freight Depots, Piers, etc.

SEND FOR BOOKLET

Cooper Hewitt Electric Co.

For Direct Current Systems Only

220 W. 29th Street NEW YORK

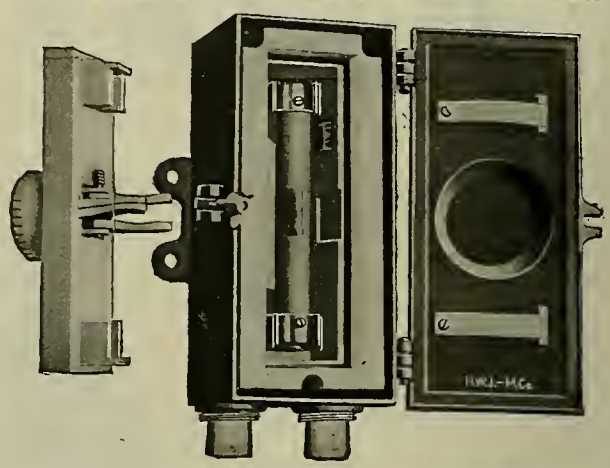
SACHS TRADE NOARK MARK FUSE

PORCELAIN LINED

2,500-VOLT

SERVICE BOXES

ABSOLUTE SAFETY TO PERSON AND PROPERTY.



FOR OVERHEAD CONSTRUCTION

(can be adapted to subway construction)

No bending or twisting of line wire in connecting box. Can be mounted directly on cross arms. 1-30 Amp. size now ready. 31-60 and 61-100 Amp. in preparation.

For further particulars and prices write

MILWAUKEE CHICAGO ST. LOUIS CLEVELAND PITTSBURG

H.W. JOHNS-MANVILLE CO.

BOSTON PHILADELPHIA LONDON PARIS BRUSSELS

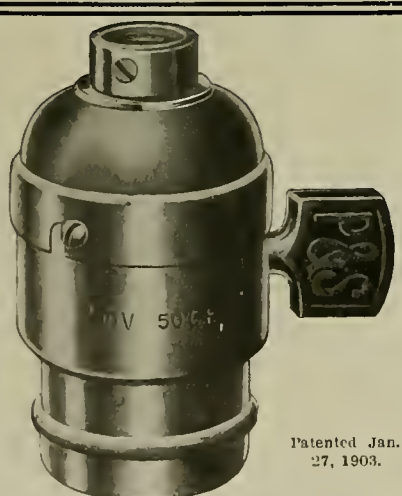
100 WILLIAM ST., NEW YORK.

ANCHORS

That are cheaper to install because of the simple method of burying and the great strain that can be applied—**American Bull-Tongue Anchors** reduce the cost of the process of guying a pole by reduction in labor, they **stay solid,** they do not slip—no take up required. 21 cents worth holds 8,713 pounds, 42 cents worth holds 10,521 pounds, other money's worth in proportion.

I. A. BENNETT,

529 and 530 Monadnock Block - - - CHICAGO



Patented Jan. 27, 1903.

P. & S.

Double Pole Sockets

National Code

Packed 10 to a box.

PASS & SEYMOUR, Inc.

Solvay, N. Y.

New York Chicago San Francisco

FARIES

ADJUSTABLE LAMP HOLDERS, SHADES, PORTABLES, ELECTRIC and COMBINATION FIXTURES

CATALOGUE WILL BE SENT ON REQUEST

FARIES MFG. CO., - DECATUR, ILL.

It Will Interest You to Know What the **Western Electric Company** Have to Say Regarding

HIGHEST GRADE NUERNBERG

CARBONS

in their circular, dated November 23, 1903, which in part reads as follows:

"The Western Electric Company have made an exhaustive test of carbons of all kinds and have found that the 'ELECTRA' Carbons cannot be equaled in quality or efficiency, produce practically no dust and give an excellent and steady light. They produce the highest standard of candlepower in proportion to the current consumed, and are the most economical carbons manufactured."

HUGO REISINGER, Sole Importer, 11 Broadway, NEW YORK CITY.

"FLEXDUCT"

is a trade name for a flexible non-metallic conduit that is approved by all official inspection boards.

"Flexduct" is a tough fiberous tubing, being flexible, strong and enduring. It is a moisture repellant. "Flexduct" has a smooth, even interior, unaffected by swashing, crushing or sharp bends. It is indestructable. Greater lengths can be fished, time saved in construction and a higher class job is possible with "Flexduct."

Osburn Flexible Conduit Company,

New York Chicago San Francisco

"FLEXDUCT"

is for sale by all electrical jobbers. If local dealer cannot furnish, write us and we will arrange for prompt shipment. Specify "Flexduct."

Cope's Patent Quick Coupling Conduit Rod

Remember these rods have no lost motion.
These Couplings are of Steel and are made in the best possible manner.

Write for list of persons using these rods—26,000 sold since May 1902. Made in 3 ft. and 4 ft. lengths.
Price, 3 ft. 75 cents, 4 ft. 85 cents.
Patented February 24, 1903.

T. J. COPE

3244 North Fifteenth Street PHILADELPHIA, PA.

Our Compound Stops Sparking and Saves Commutators.

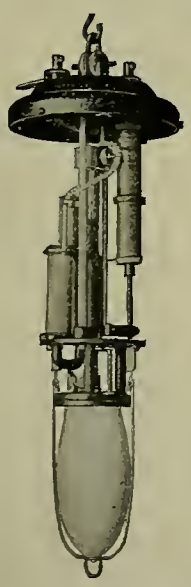
14 Years' Use on Street Ry., Light and Power Commutators Has Proven Its Worth. WE GUARANTEE RESULTS.

Send Your Address for FREE SAMPLE THAT CONVINCES.

JAS. McLAUGHLIN & CO., ELECTRICAL ENGINEERS

586 Fulton Street, - - Chicago, Ill.

General Electric Company



Edgewise Wound Enclosed Arc Lamps

FOR 110-VOLT DIRECT CURRENT SERVICE

Embody the latest features of Arc Lamp manufacture.

INDESTRUCTIBLE.
PERFECT REGULATION.
PERMANENT ADJUSTMENT.
COMPOSED OF FEW PARTS.
SIMPLICITY AND RIGIDITY OF CONNECTIONS.

Write for further information.

GENERAL OFFICES: SCHENECTADY, N. Y.

Chicago Office: Monadnock Block. Sales Offices In All Large Cities.

HIGH ECONOMY LIGHTING

Packard

PRISMO ZENITH LAMPS

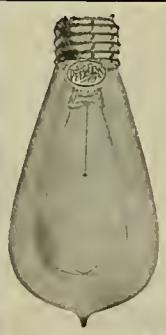
Two watts per candlepower

Large stock carried in Chicago, Warren (Ohio), and San Francisco. Special attention given to orders, and special prices on quantities.

ELECTRIC APPLIANCE COMPANY,

CHICAGO SAN FRANCISCO

LAMPS



Get acquainted with the

PEERLESS—MONEY SAVERS

MADE RIGHT
PRICED RIGHT
ARE RIGHT

THE WESCO SUPPLY CO., ST. LOUIS, MO.
"EVERYTHING ELECTRICAL"

MICA

Of all Qualities, in any Form at Lowest Prices

EUGENE MUNSELL AND CO.
NEW YORK and CHICAGO

INSULATION That Is.

Micanite, Linotape, M. I. C. Compound, Empire Cloth and Paper. For Years the Standard.

MICA INSULATOR CO., Originators
NEW YORK and CHICAGO

WANTED

You Who are Troubled with Sparking and Cutting of Commutators to Use

The only article that will PREVENT SPARKING. Will keep the commutator in good condition and PREVENT CUTTING.

Absolutely will Not Gum The Brushes . . .

It will put that high gloss on the commutator you have so long sought after.

50 Cts. per Stick. $5.00 per Dozen.

For Sale by all Supply Houses, or

FREE, Sample Stick.

K. McLENNAN & CO.,
Sole Manufacturers,
Room 411 Inter Ocean Bldg., 130 Dearborn St., CHICAGO, ILL.

MICABOND

CHICAGO MICA CO.,
"PERFECTORS" VALPARAISO, IND.
THE PEER OF INSULATORS.

YOST SPECIALTIES.

Sockets, Wall Sockets, Weatherproof Sockets, Rosettes, Receptacles, Cord Adjusters.

Catalogue for the asking.

THE YOST ELECTRIC MFG. CO.
TOLEDO, OHIO.

ELECTRIC SIGN

FLASHERS

BEST IN THE WORLD

Write for full particulars
Reynolds Elec. Flasher Mfg. Co.
221 Fifth Ave., Chicago.

Sterling Black Plastic Insulator.

One hundred days' continuous baking at 180° F. will not make it brittle. Water repellent. Oil proof.

THE STERLING VARNISH CO., - - Pittsburg, Pa.

NORTHERN MOTOR DRIVE

for machine tools and miscellaneous machinery. Northern Apparatus in successful daily use in a wide range of progressive American industries. 118

NORTHERN ELECTRICAL MFG. CO., Madison, Wis., U.S.A.

BULLETIN NO. 2535.

VOLT - AMMETERS,

POCKET SIZE,

For Testing Batteries and Battery Circuits, Locating Faults, Grounds, etc.
RELIABLE. ACCURATE.
Send for Circular.

L. M. PIGNOLET,
78-80 Cortlandt St., NEW YORK, N. Y.

Water-Wheel Governors

Our new mechanical governors co-operate with the inertia effect of the water and the momentum of the plant.
They have cut the cost of good government in two. Guaranteed in every particular.

REPLOGLE GOVERNOR WORKS
AKRON, OHIO.
WRITE FOR DESCRIPTIVE MATTER W.

Made in four sizes: 8 lights, 16 lights, 24 lights, 32 lights — $5.00 and upwards

Electric Lighting Outfits

READY FOR USE

Very popular for electric lighting decorations and especially adapted to the lighting of Christmas trees.

Safe, Simple and Convenient

EDISON DECORATIVE & MINIATURE LAMP DEPARTMENT

GENERAL ELECTRIC COMPANY,
Harrison, N. J.

Diam. of body, 6 in., of base flange 7½ in.

THE "I. P." (ISOLATED PLANT) TYPE DIRECT-CURRENT INSTRUMENTS

Are winners. Scales are equally divided, indications are dead beat, high range ammeters have separate shunts and the cases are of heavy polished brass.

Prices are right, the list figure for the meter illustrated, for instance, being $16.50.

WRITE FOR DISCOUNTS TO

MACHADO & ROLLER,
203 BROADWAY, NEW YORK CITY, N. Y., Or Your Nearest Supply House.

GASOLINE ENGINES FOR ELECTRIC LIGHTING.

Don't buy until you have investigated the "Master Workman," a two-cylinder gasoline engine, superior to all one-cylinder engines for electric lighting; quick and easy started. Has little or no vibration. Maintains a steady unflickering light. Weighs less than half of one-cylinder engine and furnishes the following sizes: 4, 5, 6, 8, 10, 12, 16 and 18 horsepower. Ten 16-candlepower lights to the horse. Solely manufactured by the TEMPLE PUMP COMPANY. Established 51 years ago.
Please mention this paper.
15th Street and 15th Place near Canal Street, Chicago.

FRANK N. PHILLIPS, PRESIDENT. C. H. WAGENSEIL, TREASURER. EUGENE F. PHILLIPS, GENERAL MANAGER. E. ROWLAND PHILLIPS, VICE-PRES. G. R. REMINGTON, JR., SEC

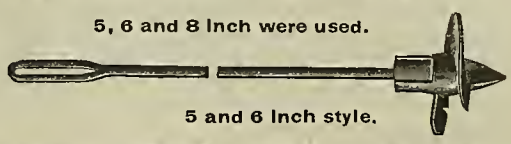
AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.

BARE AND INSULATED ELECTRIC WIRE,
ELECTRIC LIGHT LINE WIRE,
INCANDESCENT AND FLEXIBLE CORDS,
Railway Feeder and Trolley Wire,
AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR WIRES.
CABLES FOR AERIAL AND UNDERGROUND USE.

NEW YORK STORE, W. J. Watson, 26 Cortlandt St.
CHICAGO STORE, F. E. Donohoe, 82 Lake St.
MONTREAL BRANCH, Eugene F. Phillips' Electrical Works.
MAIN OFFICES AND FACTORIES, PHILLIPSDALE, R.I.

THE UNITED STATES GOVERNMENT
USED
The Stombaugh Guy Anchor
EXCLUSIVELY FOR
Anchoring Electric Light and Telephone Poles at Our Largest Military Post, Fort Riley, Kan.
5, 6 and 8 Inch were used.



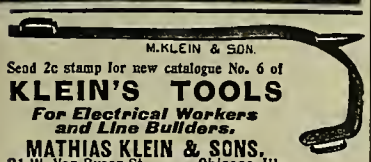
5 and 6 Inch style.
W. N. MATTHEWS & BRO., Manufacturers
603 Carleton Building, St. Louis

EXPERT IN ELECTRICITY MECHANICS PATENT CAUSES
SOLICITOR OF **PATENTS**
U. S. & FOREIGN
FORÉE BAIN, 1652-3 Monadnock Blk., CHICAGO

"AMERICAN" STORAGE CELLS
ARE THE BEST. Send for descriptive Circular.
AMERICAN BATTERY CO.,
EST'D 1882. 171 S. Clinton St., Chicago.

DOES THE WORK

Write Now for Free Sample of above Stick
Convenient—Non-Corrosive—Effective
We also make the famous Crolius Commutator Compound; eliminates sparking and all commutator troubles. Free sample on request.
E. R. CROLIUS & SON
741½ Peoria Street - CHICAGO, ILL.



M. KLEIN & SON.
Send 2c stamp for new catalogue No. 6 of
KLEIN'S TOOLS
For Electrical Workers and Line Builders.
MATHIAS KLEIN & SONS,
81 W. Van Buren St., Chicago, Ill.

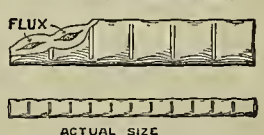
NATIONAL CODE STANDARD

WEATHER-PROOF TRADE MARK "O.K." LINE AND HOUSE WIRES

"O. K." Weatherproof Wire.
Slow-Burning Weatherproof and Ideal Wire.
Prices and Samples on Application.

Phillips Insulated Wire Co.
Office and Factory: PAWTUCKET, R. I.

KESTER SELF FLUXING SOLDER
A Tube of Solder Filled with Flux.
Requires no Acid.
SAVES—LABOR—TIME—MONEY.



PATENTED.
Send for Free Samples.
L. F. Mahler Co., R. 1008 Chemical Bldg., St. Louis, Mo., Gen. Western Agent.
KESTER ELECTRIC M'F'G CO.,
48 N. UNION STREET, CHICAGO, ILL.

WHITE PORCELAIN LETTERS—FIREPROOF
FOR ELECTRIC SIGNS
AGENTS WANTED WHEREVER THERE ARE CENTRAL STATIONS.
COLONIAL SIGN AND INSULATOR CO., - - - AKRON, O.

Crimshaw

Raven White Core

Raven Black Core

ALL OUR WIRES pass inspection and carry the above TRADE-MARKS on our tags. We also manufacture Crimshaw and Competition Tapes and Splicing Compounds.

NEW YORK INSULATED WIRE COMPANY,

MAIN OFFICE: 114, 116 & 118 Liberty St., New York.
BRANCHES: CHICAGO: 192 Desplaines St. BOSTON: 7 Otis St. SAN FRANCISCO: 33 Second St.

THE B. O. TRANSFORMER

Do you expect to need new transformers this fall? If you do, the B. O. will interest you.

Low Losses
High Efficiencies
High Insulation
Low Price.

Are you familiar with oil duct transformers?
Send us your address and we will tell you about our insulation and the advantages of slab windings in connection with oil ducts.

THE STANLEY ELECTRIC MANUFACTURING COMPANY
PITTSFIELD, MASSACHUSETTS

Atlanta, Ga., Empire Building
CHICAGO, ILL., MONADNOCK BLOCK
New York, N. Y., 29 Broadway
St. Louis, Mo., Century Bldg.
Boston, Mass., Oliver Building
Denver, Col., Hendrie & Bolthoff Mfg. & Supply Co.
Philadelphia, Pa., North American Building
San Francisco, Cal., 69-75 New Montgomery St.
Seattle, Wash., Pioneer Bldg.

Representatives for the Dominion of Canada, THE CANADIAN GENERAL ELECTRIC CO. of Toronto

"THE S. K. C. SYSTEM"

WANTED, FOR SALE *and similar* **WANT COLUMN** *advertisements (50 words or less), $1.50 an insertion; additional words 3c each.* **POSITION WANTED** *advertisements (50 words or less), $1.00 an insertion; additional words 2c each.*

POSITION WANTED.

As superintendent of electric-light plant in Minnesota or Dakota town either large or small. Am competent to handle plant from one end to the other and in small plant intend to do the wiring or running. Should my service not be satisfactory, I ask no pay for same. E. HEINRICH, BOX 64, Rugby, North Dakota.

POSITION WANTED.

By a young electrical engineer with good testimonials who studied in Germany and has some practical experience as calculator and designer. Would prefer firm installing lighting plants and electric railways. Address, BOX 424, care of Western Electrician, 510 Marquette Bldg., Chicago, Ill.

FOR SALE.

Electric-light plant in Central Ohio. Population 4,500. The greatest bargain ever offered for cash. Address, BOX 423, care Western Electrician, 510 Marquette Bldg., Chicago, Ill.

FOR SALE.

One 100-H. P. American Engine, 13 x 24 in good repair.

One 100-H. P Woodberry High-speed engine, 13 x 16 in good repair, must be sold. Address FREDERICK GAS & ELECTRIC CO., Frederick, Md

FOR SALE

1 Stanley generator, two-phase, 16,000 alternations, 1,000-2,000 volts, 40 K. W., 1333 R. P. M. and exciter.

1 Stanley generator, two-phase, 16,000 alternations, 1,000-2,000 volts, 60 K. W., 1,000 R. P. M. with exciter.

Complete marble switchboard with new instruments for above.

1 Westinghouse generator, 75 K. W., single-phase, 1,100 volts, 7,200 alternations, exciter, switchboard, new instruments complete, 750 R. P. M.

2 New belts.

1 Russell 13x20 4-valve engine, 200 R. P. M.

1 Ball 9½x10 engine, 350 R. P. M.

2 Boilers, 16x54 inch, 42 4-inch tubes, allowed 110 lbs. pressure, complete with 50-foot stack.

1 Hoppes heater. All steam pipe, valves, etc.

All in good condition. Can be seen running until December 15th. We are abandoning this plant on account of removal, and will sell all or in part. For further information, address

TIBBE ELECTRIC CO., Washington, Mo., or RUEBEL-SCHWEDTMANN WEILS, St. Louis.

Corliss Engines.

1000 h. p., 36x48, Allis Corliss, 1890 heavy duty.
900 h. p., 34x60, International.
825 h. p., 32x48, Allis Corliss, 1890 heavy duty.
900 h. p., 22x42x48, Hamilton, Tand. Comp.
750 h. p., 32x54, Hamilton, 1890 Frame.
650 h. p., 30x54, St. Louis, 1890 Frame.
600 h. p., 28x60, Philadelphia.
500 h. p., 16x32x42, Corliss Cross Comp., latest type.
450 h. p., 16x30x42, Allis Cross Comp.
400 h. p., 23½x60, Geo. H. Corliss.
450 h. p., 24x48, Harris, latest type.
450 h. p., 24x48, Brown.
350 h. p., 22x42, Allis, 1890 Frame.
350 h. p., 22x42, Slater, 1890 Frame.
300 h. p., 20x48, Harris.
300 h. p., 20x42, Hamilton.
225 h. p., 12x22x42, Atlas Tandem Comp.
225 h. p., 18x42, Hamilton.
175 h. p., 16x42, Allis.
165 h. p., 16x36, Sioux, 1902.
150 h. p., 15x38, Brown.
140 h. p., 14x42, Allis.
125 h. p., 14x36, Putnam.
90 h. p., 12x36, Harris.
600 h. p., 28½x52, Buckeye Automatic.
500 h. p., 17½x30½x27, Buckeye Cross Comp.
450 h. p., 16½x28½x27, Buckeye Cross Comp.
450 h. p., 24x48, Buckeye Automatic.
350 h. p., 16x26x18, Ideal Tandem Comp.
275 h. p., 14x22x16, Ideal Tandem Comp.
250 h. p., 16x27x16, Westinghouse Comp.
150 h. p., 15x24, Cummer.
150 h. p., 10½x18x18, Williams Tandem Comp.

Whitehead Machinery Company, DAVENPORT, IOWA.

REPAIRING RECALIBRATING

ELECTRIC METERS.

INTERNATIONAL ELECTRIC METER CO.
167 S. CANAL STREET. CHICAGO.

Like Finding Money.

Save your scrap copper, brass and platinum, also incandescent lamp bases, etc., and send them to us. We pay the highest market prices for this material. What have you?

We manufacture copper, hard babbitt, the best on earth for electrical work, wire solder, pig lead, ingot copper, spelter, etc. It will pay you to get our prices.

GREAT WESTERN SMELTING & REFINING COMPANY, CHICAGO.

WORKS QUICK AND EASY. KEEPS ITS LUSTER. HOLDS OLD TRADE AND MAKES NEW. DOES NOT DETERIORATE. ESTABLISHED 16 YEARS. SOLD BY AGENTS AND DEALERS ALL OVER THE WORLD

U.S. METAL POLISH

3 OUNCE BOX 10 CENTS
SAMPLES SENT FREE
GEO. W. HOFFMAN

POLISHES ALL METALS. BRANCHES NEW YORK, CHICAGO, SAN FRANCISCO. 295 E. WASHINGTON ST. INDIANAPOLIS, IND.

BOILERS.

One 42-in. x 16 ft. 9-in., 250 H. P. Worthington Water Tube.
One 60-in. x 16 ft., John Mohr Return Tubular Boiler.
One 54-in. x 16 ft., John Mohr Return Tubular Boiler.
One 54-in. x 16 ft., Devine Tubular Boiler.

ENGINES.

One 600 H. P., 21 x 36 x 30, Williams Tandem Horizontal Compound, 140 R. P. M.
Two 600 H. P., 20 x 30 x 24, Porter-Allen Tandem Compound, 200 R. P. M.
One 250 H. P., 12 x 24 x 18 Williams Tandem Compound, 250 R. P. M.
Two 100 H. P., 13 x 12, Dick & Church, High Speed Automatic.

PARTIAL LIST ONLY.

Send for latest Catalogue for bargains in Engines, Boilers, Dynamos and Motors.

CENTRAL STATION IMPROVEMENT CO., 938 Monadnock Block, Chicago

All Supply Houses

J. J. EGAN'S "ACME" COMMUTATOR COMPOUND.

J. J. EGAN'S "ACME" COMMUTATOR COMPOUND absolutely prevents sparking or cutting. One stick of "Acme" is equal to one gallon of oil for lubricating commutators. Free Sample. AGENTS WANTED.
50c per Stick. $5.00 per doz.
J. J. Egan Sale Mfg., 317 Austin Ave., Tel. Polk, 1779 Chicago

FOR SALE.

Central Station Equipments

One Plant Complete Consisting of the Following Principal Items:

BOILERS.

Six 200-h. p. Stirling water-tube boilers, equipped for Hawley down-draft furnaces.
Two 150-h. p. Stirling boilers, with plain grates.

HEATERS.

Two 250-h. p. Hoppes open heaters.
Two 400-h. p. Excelsior heaters.

PUMPS.

Two 7x4½x10 Laidlaw Dunn boiler feeders for 150 pounds' pressure.

ENGINES.

Three 250-h. p. Ball tandem compound engines, 15x25x16 inches, 200 revolutions.
Two 150-h. p. Porter-Allen engines, 14x20 inches, 230 revolutions.
One 150-h. p. Russell engine, 15x20 inches, 230 revolutions.
One 125-h. p. Hamilton Corliss, 16x30 inches, 90 revolutions.

GENERATORS.

Three 150-k. w. 250-volt Westinghouse generators. These generators directly connected to three 250-h. p. Ball engines.
Four 42.5-k. w. 125-volt Mather generators.
Four 37½-k. w. 250-volt Mather generators.
Four 37½-k. w. 125-volt Mather generators.

SWITCHBOARDS.

Two switchboards, with switches, measuring instruments, rheostats, etc., for control of above generators.

Another plant complete except boilers, consisting of the following principal items:

ENGINES.

Two Lane & Bodley Corliss engines, 24-inch diameter cylinders, 48-inch stroke, 70 revolutions.
Two Lane & Bodley Corliss engines, 30-inch diameter cylinders, 48-inch stroke, 70 revolutions.
Two Ball engines, cylinders 20-inch diameter, 18-inch stroke, 150 revolutions.
One Westinghouse vertical compound engine, with cylinders 16 inches and 26 inches x 18-inch stroke.
One Westinghouse vertical compound engine, with cylinders 18 inches and 30 inches diameter x 18-inch stroke.

GENERATORS.

Two Edison bipolar generators, 150 k. w., 500 volts.
Two C. & C. bipolar generators, 100 k. w., 500 volts.
One C. & C. bipolar generator, 30 k. w., 500 volts.
Two T.-H., alternating current, 133 cycles, 1,100 volts, 150 k. w.
Two Fort Wayne, alternating current, 133 cycles, 1,100 volts, 150 k. w.
Two Fort Wayne, alternating current, 133 cycles, 1,100 volts, 100 k. w.
Ten 100-light 9.6-ampere multiple circuit Brush arc machines.
One 60-light 9.6-ampere wood arc machine.

SWITCHBOARD.

Switchboard, with all switches, transformers, measuring instruments, etc., for control of above generators.

SHAFTING.

Two lines shafting, together with pedestal, hearings, clutches, pulleys, etc., used in connection with the large Corliss engines.

Both plants located in Cincinnati.
We will consider bids for all or any part of the above.
Bids must be made f. o. b. Cincinnati.

The Cincinnati Gas & Electric Co.

DON'T STOP! KEEP ON! READ! IMPROVE!

ELECTRICIAN PUBLISHING CO., 510 Marquette Bldg.
Publishers and Dealers of Electrical Books

FOR SALE

1-360	K. W.	General Electric	Alternator,	Three Phase
1-240	"	Westinghouse	"	Single "
2-150	"	Warren	"	" "
1-150	"	Westinghouse	"	" "
1-150	"	Wood	"	" "
1-150	"	Stanley	"	" "
1-120	"	General Electric	"	Three "
1-120	"	General Electric	"	Single "
1 120	"	Westinghouse	"	" "
1- 90	"	General Electric	"	" "
1- 75	"	Westinghouse	"	Two "
1- 75	"	Westinghouse	"	Single "
1- 75	"	Westinghouse	"	Two "

Direct connected to Gates' Engine.

Send for our **Monthly Bargain Sheet** with complete list and net prices.

GREGORY ELECTRIC CO.
54-62 S. Clinton St., Chicago, Ill.

WE BUY OLD BELTS

OR SCRAPS, ANY SIZE OR CONDITION.

WE CLEAN, REPAIR AND RENEW OLD BELTS.

LEATHER PRESERVER MFG. CORP.
27 W. MONROE ST., CHICAGO

Louisville and Chicago

And the places north
And the places south
And the places between are reached by the quick day and night trains of

THE

MONON ROUTE

CHICAGO, INDIANAPOLIS & LOUISVILLE RAILWAY

Also the celebrated health resorts, French Lick and West Baden Springs, are reached only by this road.

Booklets about the Springs, their wonderful waters and the fine hotels, sent free.

CHAS. H. ROCKWELL Traffic Manager
FRANK J. REED Gen. Pass. Agt.
202 Custom House Place, Chicago

"Big Four"

"The Way of the World"

between

St. Louis and New York, Boston and the East

W. J. LYNCH
G. P. & T. A., Cincinnati, Ohio

Don't Stop! Keep On! Read! Improve!
ELECTRICIAN PUBLISHING CO.
510 MARQUETTE BLDG.
Publishers and dealers of electrical books

CHICAGO EDISON COMPANY REPAIR SHOPS

76 MARKET STREET, CHICAGO. TELEPHONE MAIN 1280.

Machine and Carpenter Work of All Kinds
Correspondence Solicited.

OPEN DAY AND NIGHT.

FIRST-CLASS EQUIPMENT THROUGHOUT.

Dynamos, Armatures, Motors, Arc Lamps, Fans, Instruments.

ARNOLD ELECTRIC POWER STATION Co.
Engineers, Constructors for Complete Electric Plants. Results Guaranteed.
SUITE 1539, MARQUETTE BLDG., CHICAGO. NEW YORK OFFICE: 711 TRANSIT BLDG.

BUTTERFIELD, J. F.
ELECTRICAL ENGINEER AND CONTRACTOR.
Complete Telephone Exchanges Built and Material Furnished.
Cable Construction and Underground Conduit Construction a Specialty.
Room 595, 113 Adams Street. CHICAGO, ILL.

J. H. HALLBERG
Consulting Engineer
Electric Light, Power and Railway Plants
Suggestions to secure Economy, Specifications, Examinations and Reports
45 Broadway, NEW YORK
Long Distance Telephone 4578 Broad

KOHLER BROS.,
Contracting Electrical Engineers, Lighting Power Railways,
1804-1806-1808-1810-1812 Fisher Building, CHICAGO.

F. B. BADT,
Monadnock Chicago

BYLLESBY, H. M. & Co.
(Incorporated)
ENGINEERS
Design, Construct and Operate Railway, Light, Power and Hydraulic Plants.
Examinations and Reports.
New York Life Building, - CHICAGO, ILL.

TRY IT.
Keep your name and address in this directory where it will be seen by possible clients.

RUEBEL - SCHWEDTMANN-WELLS,
CONSULTING, MECHANICAL AND ELECTRICAL ENGINEERS,
Suite 801 Chemical Building, ST. LOUIS, U. S. A.

TRY IT. Keep your name and address in this directory where it will be seen by possible clients.

ENGINEERS
Represented in this "Directory" are enabled to come in touch with many prospective customers who cannot be reached through any other source.

ROBERT W. HUNT & Co.,
ENGINEERS
1121 The Rookery, Chicago. 66 Broadway, New York.
Monongahela Bank Bldg., Pittsburg.
Norfolk House, Cannon St., London.

IT WILL PAY
engineers not represented in this department to carry a card regularly.

W. E BAKER. H. B. BISHOP.
BAKER, W. E. & CO.
ENGINEERS,
ELECTRIC RAILWAYS.
27 William St., NEW YORK.

EVANS, ALMIRALL & CO.,
Central Station Heating,
High Pressure Piping.
1057 Monadnock Blk., Chicago.

A WEEKLY REPRESENTATION
in this "Directory" enables engineers to keep before all possible customers.

Long Distance Phone Central 2443.
SCHOTT, W. H.,
ENGINEER AND CONTRACTOR,
SPECIALTIES—Central Station Heating Plants, Water Works Steam Plants, Electric Light, Gas and Street Railway Plants.
1220-21 MARQUETTE BUILDING, CHICAGO.

BRYAN, WILLIAM H.
M. Am. Soc. M. E.,
Consulting Mechanical and Electrical Engineer.
Lincoln Trust Building, ST. LOUIS.

E. W Hammer, Pres. and Treas. H. J. Minhinnick, Sec. and Gen'l Sup't.
GENERAL ENGINEERING Co., THE
Consulting and Contracting Engineers.
Telephones, Electric Light, Power Transmission
Suite 1112, 135 ADAMS ST., CHICAGO.
Long Distance Telephone Central 478.

KEMP, R. W.
Consulting and Contracting Telephone Engineer.
Plans and Specification for complete plants. Old plants overhauled and placed on paying basis. Territory, Kansas, Oklahoma and Indian Territory.
WELLINGTON, - - - KANSAS.

STANTON, LE ROY W.
Consulting Telephone Engineer
Plans, Specifications and Supervision of Installation of Complete Telephone Plants
Special Reports on Telephone Properties and Apparatus
411 Electrical Bldg., Cleveland, Ohio

DUGALD C. JACKSON, C. E.
WILLIAM B. JACKSON, M. E.
MEMBERS
AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS
AMERICAN SOCIETY OF MECHANICAL ENGINEERS
AMERICAN SOCIETY OF CIVIL ENGINEERS
ENGINEERS. EXPERTS.
MADISON, WIS.

Reports and Estimates Furnished.
General Contractors
High-Grade Securities Accepted or Negotiated.

W. R. EVANS & COMPANY
Incorporated
Electrical, Civil and Mechanical Engineers
Telephone Main 3153 Traction Bldg., Cincinnati

Electric Heating Apparatus
SEND FOR 62-PAGE CATALOGUE.
UNIT" ENAMELED RHEOSTATS
SIMPLEX ELECTRIC HEATING CO.,
Cambridgeport, Mass.

BARGAINS IN SHELF-WORN BOOKS

You may have been looking for some of these volumes for years. Now you can get them and get them at a bargain, too. We have only one or two copies of each of the following:

	List Price	Sale Price
ELECTRICITY AS A MOTIVE POWER. by Count Th. du Moncel, London, 1883..	$3.00	$1.80
DECORATIVE ELECTRICITY, by Mrs. J. E. H. Gordon, London, 1891.....	2.50	1.50
ELECTRICAL APPLIANCES OF THE PRESENT DAY, by Major D. P. Heap, U. S. A., being a report of the Paris Electrical Exhibition of 1881.....	2.00	1.20
TABLES AND MEMORANDA FOR ELECTRICAL ENGINEERS, by Frederick Walker, C.E.	.80	.45
MAGNETISM AND ELECTRICITY, by R. Wormell	1.25	.75
STEAM HEATING DATA, by Wm. J. Baldwin, N. Y., 1897.....	.50	.30
THE TELEGRAPHIST'S GUIDE: THE NEW EXAMINATIONS OF TECHNICAL TELEGRAPHY, by Jas. Bell, A. I. E. E., London, 1895	.50	.30
THE MECHANICAL ARTS SIMPLIFIED, by D. B. Dixon, Chicago, 1897.....	2.50	1.60
ELECTRIC LIGHTING, translated from the French of Count du Moncel. by Robt. Rontledge, B. S. C., London, 1883...	1.25	.75
THE ARITHMETIC OF THE STEAM ENGINE, by E. Sherman Gould, N. Y., 1897	1.00	.60
TIPS TO INVENTORS, by Robt. Grimshaw, Ph. D., N. Y., 1893.....	1.00	.60
MECHANICAL GRAPHICS, by Geo. Halliday, London, 1889	2.00	1.20
PHYSICAL UNITS, by Magnus Maclean, D. Sc.	1.00	.60
THE INDICATOR AND DYNAMOMETER, by Thos. J. Main, M. A., Philadelphia, 1883	1.50	.90
HOW TO WORK AND FIX A DYNAMO-ELECTRIC MACHINE. by W. C. Mountain..	.35	.20
THE INDICATOR HANDBOOK, by Chas. N. Pickworth	.75	.45
THE HISTORY AND PROGRESS OF THE ELECTRIC TELEGRAPH, by Robt. Sabine, C. E., London, 1869. Cloth...	1.25	.75
Paper	.75	.25
LOCAL DISTRIBUTION OF ELECTRIC POWER IN WORKSHOPS, by Ernest Kilburn Scott, A. I. E. E.	.50	.30
BEARINGS AND LUBRICATION, by A. J. Wallis-Taylor, C. E.	1.50	.90
FIRST PRINCIPLES OF MECHANICAL ENGINEERING, by Imray & Biggs, London	1.00	.60
ELECTRICITY IN OUR HOMES AND WORKSHOPS, by Sidney F. Walker, London, 1889	1.50	.90
ELECTRICITY IN THE SERVICE OF MAN, by R. Wormell, D. Sc., M. A., New York, 1886	$3.00	$1.80
THE MATHEMATICAL THEORY OF ELECTRICITY AND MAGNETISM, by Watson & Burbury, London, 1885. Vol I, Electrostatics	2.75	1.65
Vol. II, Magnetism and Electrodynamics	2.60	1.60
CHAPTERS ON ELECTRICITY, by Samuel Sheldon, Ph. D.	1.10	.65
ELECTRICITY, ITS THEORY, SOURCES AND APPLICATION, by John T. Sprague, London, 1892	6.00	3.60
MAGNETISM AND ELECTRICITY, by H. C. Tarn, M. C. P., London, 1889.....	.80	.45
ELECTRICITY UP TO DATE, by John B. Verity, M. I. E. E., London, 1896..	1.00	.60
TELEGRAPHY, by W. H. Preece and J. Sivewright, London, 1888.....	2.00	1.20
ELECTRICITY AND THE ELECTRIC TELEGRAPH, in two volumes, by Geo. B. Prescott, New York, 1888.....	7.00	4.20
USEFUL RULES AND TABLES, relating to Mensuration, Engineering, Structures and Machines, by Wm. John Macquorn Rankine, London, 1889.....	4.00	2.40
ELECTRICITY AND MAGNETISM, by Francis Nipher, A. M., St. Louis, 1895..	3.25	2.00
THE ACTION OF LIGHTNING, by Arthur Parnell, London, 1882.....	3.00	1.80
MODERN AMERICAN METHODS OF COPPER SMELTING, by Edw. Dyer Peters, Jr., M. E., New York, 1891.....	5.00	3.00
ELECTRICITY, by Fleming Jenkin, F.R.S.	.40	.25
MAGNETISM AND ELECTRICITY, by Wm. Adler Miller, M. D., LL. D., N. Y., 1888	1.50	.90
THE STEAM-BOILER CATECHISM, by Robt. Grimshaw, M. E.	2.00	1.20
THE STEAM-ENGINE CATECHISM, by Robt. Grimshaw, M. E., New York, 1896	2.00	1.20
ELECTRICAL PAPERS, Vols. I and II, by Oliver Heaviside, New York, 1894..	7.00	4.20
A GUIDE FOR THE ELECTRICAL TESTING OF TELEGRAPH CABLES, by Col. V. Hoskiaer, London, 1889.....	1.50	.90
SOLUTIONS OF THE QUESTIONS IN MAGNETISM AND ELECTRICITY, set at the Intermediate Science and Preliminary Scientific Pass Examinations of the University of London, 1860 to 1884, by F. W. Levander, London, 1885....	1.00	.40
DOMESTIC ELECTRICITY FOR AMATEURS, translated from the French of E. Hospitalier, London, 1889.....	$2.50	$1.50
FOUR LECTURES ON STATIC ELECTRIC INDUCTION, by J. E. H. Gordon, B. A., New York, 1881.....	.80	.45
CONSTRUCTION OF MILL DAMS, Jas. Leffel & Co., Springfield, O., 1874.....	2.50	1.00
A PRACTICAL TREATISE ON ELECTRIC LIGHTING, by J. E. H. Gordon, B. A., New York, 1884.....	4.50	2.70
GRAY'S TREATISE ON MAGNETISM AND ELECTRICITY, Vol. I, by Andrew Gray, LL. D., F. R. S., London, 1898	4.50	2.70
EXERCISES IN ELECTRICAL AND MAGNETIC MEASUREMENTS, by R. E. Day, M. A., London, 1889.....	1.00	.60
ELECTRICITY, by Robt. M. Ferguson, Ph. D., F. R. S. E., London, 1890...	1.50	.90
COIL AND CURRENT, OR THE TRIUMPHS OF ELECTRICITY, by Henry Fritb, London, 1897.....	1.25	.75
A CENTURY OF ELECTRICITY, by T. C. Mendenhall, Cambridge, 1887.....	1.25	.75
MAGNETISM AND ELECTRICITY, by Arthur Wm. Poyser, M. A., London, 1890...	.80	.45
POTENTIAL AND ITS APPLICATION POPULARLY TREATED, by Dr. Tumlirz, London, 1889.....	1.50	.90
CONTINENTAL ELECTRIC LIGHT CENTRAL STATIONS, Killingworth Hedges, London, 1892	6.00	3.60
THEORY OF ELECTRICITY, by Linnæus Cumming, M. A., London, 1885.....	2.25	1.35
ELECTRICITY TREATED EXPERIMENTALLY, by Linnæus Cumming, M. A., London, 1891	1.50	.90
POPULAR ELECTRIC LIGHTING, by Capt. E. Ironside Bax, London, 1892.....	1.00	.60
THE AGE OF ELECTRICITY, by Park Benjamin, New York, 1892.....	2.00	1.20
THE LAW RELATING TO ELECTRIC LIGHTING, by G. Spencer Bower, B. A., London, 1889	5.00	3.00
MATHEMATICAL THEORY OF THE STEAM ENGINE, by T. Baker, C. E., London, 1890	.75	.45
ELEMENTARY TREATISE ON NATURAL PHILOSOPHY, by A. Privat Deschanel, Part 3, Electricity and Magnetism, New York, 1893	1.50	.90
ELECTRICITY IN MODERN LIFE, by G. W. De Tunzelmann, London, 1889.....	1.25	.75

ELECTRICIAN PUBLISHING CO., 510 MARQUETTE BLDG., CHICAGO

DEARBORN WATER TREATMENT

Stops that expense and worry over scale in boilers.
We correct waters of all classes for boiler purposes.

Send gallon sample to Chicago Laboratory for Analysis.
Write for Booklet "R."

DEARBORN DRUG & CHEMICAL WORKS,

27-34 RIALTO BUILDING, CHICAGO, ILL. WM. H EDGAR, President Telephone: Harrison 3930 and 3931.

JEFFREY ELEVATING, CONVEYING, POWER TRANSMISSION **MACHINERY** FOR CATALOGUE, ADDRESS THE JEFFREY MFG. CO. COLUMBUS, O.

Dixon's Solid Belt Dressing

In Handy 1-lb. Bars
ends all slipping, without hardening or otherwise injuring the leather.
Circular 125O and free samples upon request.
JOSEPH DIXON CRUCIBLE CO., JERSEY CITY, N. J.

Diesel Engines

Suitable for all stationary power operating on CRUDE or FUEL oil by Gradual Continuous Combustion.

NO EXPLOSIONS

GUARANTEED COST OF FUEL WITH OIL AT 4 CENTS PER GALLON:

3.4 mills per K. W. Hour on the full load.
5.1 mill per K. W. Hour on the half load.

For Further Particulars Apply to

AMERICAN DIESEL ENGINE COMPANY

11 Broadway, - New York

REG. TRADE MARKS "Phosphor Bronze" DELTA

THE PHOSPHOR BRONZE SMELTING CO. LIMITED,
2200 WASHINGTON AVE., PHILADELPHIA.
"ELEPHANT BRAND PHOSPHOR-BRONZE"
INGOTS, CASTINGS, WIRE, RODS, SHEETS, ETC.
— DELTA METAL —
CASTINGS, STAMPINGS AND FORGINGS
ORIGINAL AND SOLE MAKERS IN THE U.S.

BEST ON EARTH.

BURGER AUTOMATIC.

For Electric Work

REGULATION AND ECONOMY OF FUEL UNSURPASSED.

WRITE FOR CATALOGUE H

Then compare it with some Gas Engine hand books that cost $1.00.

Woolley
Foundry & Mach. Works
Box 400, Anderson, Ind. U. S. A.

ARE YOU LOOKING FOR MONEY?

If so, buy WALRATH GAS OR GASOLINE ENGINES and get light on the subject.

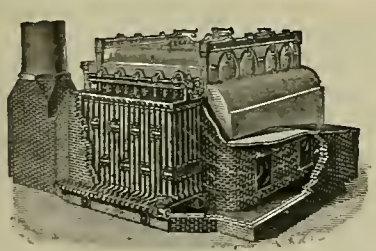
THE WALRATH

Received the Highest Award at the Pan-American Exposition.

It will produce as good a commercial light as that of an automatic steam engine, either belted or direct-connected generator. Simple, Economical and Reliable
Send for Catalogue W

MARINETTE GAS ENGINE CO.,
CHICAGO HEIGHTS, ILL.

AGENCIES:
Keystone Engineering Co., Farmer's Bank Bldg., Pittsburg, Pa.
Strong, Carlisle & Hammond Co., 61-67 Frankfort St., Cleveland, Ohio
Mackay Engineering Co., 149 Broadway, N. Y.
C. H. Seidenglanz, 52 Wheo Bldg., Indianapolis, Ind.



In supplying boilers with hot purified water, thus keeping a larger heating surface, as well as meeting sudden demands for power, the

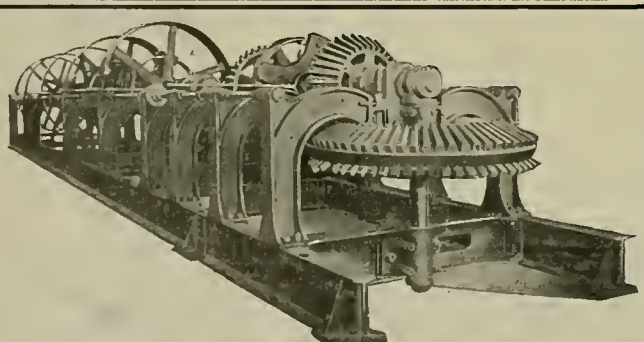
GREEN'S ECONOMIZER

is but beginning its savings to plant owners. What has been, and possibly will again be—cost of fuel—one of the greatest expenses of a plant, is reduced from 10 to 20 per cent. ELECTRIC LIGHT AND POWER PLANTS having a Green's Economizer realize the greatest saving. We will be pleased to send our free booklet showing construction and how applied.

THE GREEN FUEL ECONOMIZER CO.
Sole Manufacturers in the U. S. A. MATTEAWAN, N. Y.

Watson Motors

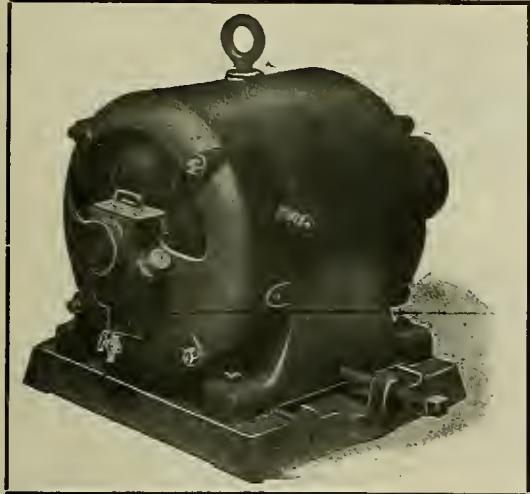
If you want a small motor for a special purpose, write us.
Mechanical Appliance Co.
Milwaukee, Wis.



SAMSON TURBINE

Almost every one knows that for a given amount of power, the quicker the speed of a turbine, the better. This is due to the fact that LIGHTER and consequently CHEAPER TRANSMISSION MACHINERY can be used. The SAMSON has a QUICKER SPEED than any other turbine of the same dimensions operating under the same conditions.

THE JAMES LEFFEL & CO.
307 LAGONDA ST.,
Springfield, Ohio, U. S. A.



SINGLE-PHASE SELF-STARTING ALTERNATING CURRENT MOTORS

That will start under full load are our specialty. Can be mounted on floor, ceiling, or side wall. It is to your interest financially to become acquainted with them before placing your next order.

CENTURY ELECTRIC COMPANY

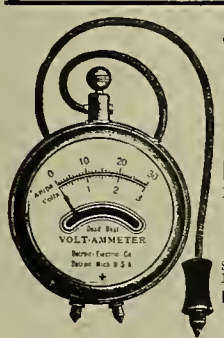
Main Office and Works
1007-9-11 Locust Street. St. Louis, Mo.

Engineering

MECHANICAL, ELECTRICAL, STEAM, CIVIL.

Complete and short courses. Thoroughly equipped engineering shops. Shop work from the beginning. Short courses in Steam and Electrical Engineering. Expenses low. Accommodations the best. School all year. Students may enter any time. Correspondence steam and electrical courses. Send for catalogue. Mention course in which interested.

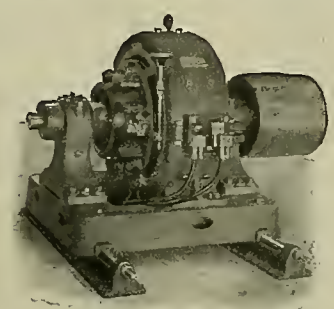
HIGHLAND PARK COLLEGE, DES MOINES, IOWA.



ROBERT
VOLT-AMMETER
DEAD BEAT
Accurate,
Durable,
Guaranteed
List Price $6.00
Incl. Leather Case
Sample instrument forwarded prepaid on receipt of $4 50
Special Discount to Dealers and Jobbers
Detroit Elect. Co.
56 Shelby St., Detroit, Mich.

DIRECT CURRENT

GENERATORS

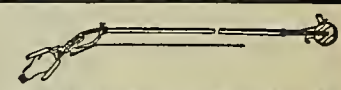


FOR LIGHT AND POWER

Our generators have a high efficiency and great endurance under the most exacting conditions of service. Sizes up to 1,000 K. W.
Write for bulletin No. 10514.

SPRAGUE
ELECTRIC COMPANY

General Offices:
527 West 34th Street, New York
Chicago Office: Fisher Building



The Incandescent Lamp Replacer and Cleaner replaces and cleans any o. p. lamp at any height or angle.
Incandescent Electric Light Manipulator Co.,
116 Bedford St., Boston, Mass.

ARE YOU WORRIED because your present occupation and salary are unsatisfactory? We can change your condition. We point out to you the right way to better pay and a better position, and help you get it. We have helped thousands. It is done by our practical mail system in your spare time. Our FREE 80-page book (illustrated) tells of actual experiences, and mentions many examples of how our students have been able to qualify for advancement and good salaried positions. Courses in Electrical Engineering, Steam Engineering, Mechanical Engineering, Telephony, Telegraphy, Electric Lighting, Electric Railways, Electric Motorman's Course, Short Electrical Course, Dynamo Tender's Course, Arithmetic, Algebra. Write TO-DAY for our free book. Mention subject which interests you. ELECTRICAL ENGINEERING INSTITUTE, Dep't K, 240A West 23rd St., New York.

THE RIGHT WAY TO BETTER PAY

JOHN A. ROEBLING'S SONS CO.

Insulated Wire of All Kinds

Bare Copper Wire

MAIN OFFICE AND WORKS TRENTON, N. J.

AGENCIES AND BRANCHES
New York Chicago Cleveland San Francisco Philadelphia Atlanta

---

BRASS & BRASS GOODS

ASK FOR CATALOG

THE PLUME & ATWOOD MFG. CO.
New York Boston San Francisco Chicago

TYPE E.

ALTERNATING CURRENT.

SCHEEFFER INTEGRATING WATTMETER

Type E for Alternating Current Type F for Direct Current Circuits

DUST AND BUG PROOF
IMPROVED CONSTRUCTION

MOVING PARTS ARE EXTREMELY LIGHT, INSURING A HIGHLY SENSITIVE AND ACCURATE METER.

WRITE FOR PRICES AND DESCRIPTIVE LITERATURE.

DIAMOND METER COMPANY,

PEORIA, ILL., - - - - U. S. A.

TYPE F.

DIRECT CURRENT.

STROMBERG-CARLSON

GENERATOR-CALL

VISUAL SIGNAL SWITCHBOARDS

are inexpensive to maintain and nearly as rapid as a lamp signal switchboard.

SIGNALS SELF-CONTAINED

NO WORKING PARTS EXPOSED

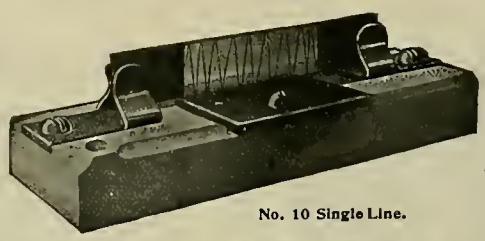
This illustrates our No. A-1249 cabinet equipped with 100 line signals and 10 clearing-out signals. Our standard cabinets have a capacity for 50, 60, 70, 100, 140, 180 and 200 line signals of the above type.

Bulletins No. 6 and 7-E describe these boards very thoroughly. Mailed free upon request.

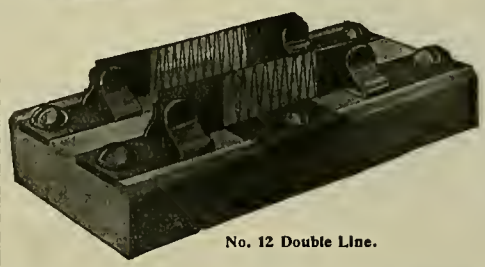
STROMBERG-CARLSON TELEPHONE MFG. CO.,

GENERAL OFFICES, ROCHESTER, N. Y.

WESTERN SALES OFFICE, CHICAGO, ILL.



No. 10 Single Line.



No. 12 Double Line.

PROTECTORS THAT PROTECT.

Our patent wrapped fuse used in our protectors are an insurance policy against lightning.

Sample free by mail to any Exchange or Toll Line

CENTRAL TELEPHONE AND ELECTRIC CO.,
909 Market St.,
ST. LOUIS, U. S. A.

BITUMINIZED FIBER CONDUIT

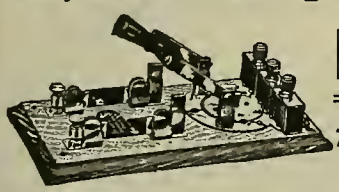
FOR UNDERGROUND CONSTRUCTION

American Conduit Co.

Main Offices: 1005-6 Manhattan Bldg., Chicago

Other Offices:
170 Broadway, New York *336 Macy St., Los Angeles*

They Are All Talking About The "Tornquist"



King of Protectors

The Only Sure Protector Made

HIGH GRADE BABY KNIFE SWITCHES

None Better Made

STAMPING AND PLATING

Better buy a "**Tornquist**" it is the greatest success in the telephone field. Order sample now. Sold by all jobbers.

Clinton Stamping & Electric Co.

CLINTON, IOWA

"Diamond H" Switches

Trade H Mark

This Trade-Mark guarantees quality.

The Hart Mfg. Co., Hartford, Conn.

New York Boston Chicago Toronto, Ont.

TELEPHONE BOOTHS

When in want of the Right Kind write us.

Catalogue Free

Yesbera Mfg. Co.
TOLEDO, OHIO.

INTERNATIONAL

Mechanical Self-Restoring Drop Switchboard.

A PERFECT APPARATUS.

Made in any desired capacity.
Sample parts and quotations on request.

INTERNATIONAL TELEPHONE MANUFACTURING CO.
CHICAGO, U. S. A.

COLOR YOUR OWN LAMPS WITH "Signaloid"

Signaloid Chemical Works
KLIEGL BROS., Props.
1393-5 BROADWAY, NEW YORK

ELECTRICAL AND OTHER INDUSTRIES ARE OFFERED LOCATIONS WITH Satisfactory Inducements, Favorable Freight Rates, Good Labor Conditions, Healthful Communities, ON THE LINES OF THE ILLINOIS CENTRAL R. R. AND THE YAZOO & MISSISSIPPI VALLEY R. R.

For full information and descriptive pamphlet address

J. C. CLAIR,
Industrial Commissioner
1 Park Row, Chicago, Ill

Send your Book Orders to
ELECTRICIAN PUBLISHING CO.,
510 Marquette Bldg., Chicago.

Kellogg Telephone Apparatus

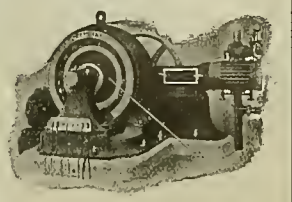
A glance at the Kellogg desk set will prejudice you in its favor, but its working, wearing and lasting qualities are what have made its name.

It helped to win the Grand Prize at the St. Louis Exposition—the highest award. Write us for catalogues telling you all about it.

Kellogg Switchboard and Supply Company
Green and Congress Streets, CHICAGO

LOS ANGELES Seymour Building
CLEVELAND Electric Building
PHILADELPHIA Keystone Telephone Building

Warren Alternator



Experience

Sheds new light on the

Warren Alternators

Discovering their attributes for safe, economical and efficient operation. If you are to replace a machine that is too small, or one that you have found inefficient, investigate the WARREN ALTERNATOR.

WARREN ELECTRIC MFG. CO.
Sandusky, O.

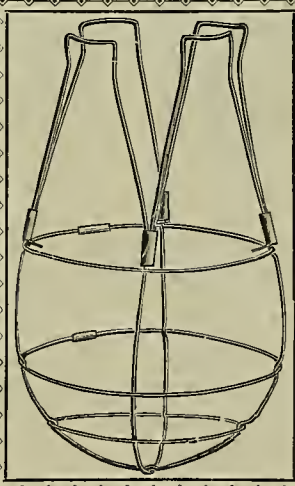
AMERICAN ELECTRIC TELEPHONE CO.

LARGEST MANUFACTURERS

This Company Sends Prepaid upon request any of the following bulletins:

Bulletin No. 7—Combined Telephone and Switchboard
" " 8—Wall Switchboard
" " 9—Samson Telephone
" " 10—American Express Switchboards
" " 11—Desks — Toll and Private Branch
" " 12—Visual Signal and Bell Style Switchboards
" " 13—Intercommunicating Systems
" " 14—Line Material and Supplies
" " 15—Bell Express Self-Restoring Switchboards
" " 16—Operator's Set and Accessories
" " 17—Parts of Apparatus
Bulletin No. 18—Magneto Telephones of All Kinds
" " 19—Central Energy Switchboards
" " 20—Central Energy Telephones
" " 21—Protective Apparatus and Terminal Equipment
" " 22—Construction of Country Telephone Lines
" " 23—Eight-Party Selective Ringing Telephones
" " 24—Composite Telephone and Telegraph Lines
" " 25—Four-Party "Leich" Selective Telephone System
" " 26—Telephone Power and Ringing Equipment

CHICAGO, ILL., U. S. A.



HIPWELL

Expanding Wire Guard; also manufacturer of high-grade, long-distance

TELEPHONES

Switchboards and Cable Terminals.

Hipwell Mfg. Co.
ALLEGHENY, PA.

THE AUTOMATIC

is the recognized competitive system of telephony. Its manifold advantages over the manual system, mechanically, financially and commercially, make it so. Automatic telephone service is more prompt and more accurate and absolutely secret. It can be furnished at less cost to both company and patrons than any other. Progressive Independent telephone companies all over the country are rapidly adopting it; the new ones in preference to manual and the old ones to replace manual equipment. It is a success everywhere.

Among the cities in which it has been adopted are:

Chicago, Ill.
Grand Rapids, Mich.
Columbus, Ohio
Dayton, Ohio
Lincoln, Neb.
Portland, Maine
Auburn, N. Y.
Lewiston, Maine
Auburn, Maine
Fall River, Mass.
New Bedford, Mass.
Los Angeles, Cal.
San Diego, Cal.
Hopkinsville, Ky.
Sioux City, Iowa
Cleburne, Texas
Columbus, Ga.
Augusta, Ga.
Medford, Wis.
St. Mary's, Ohio
Woodstock, N. B.
Westerly, R. I.
Berlin, Germany
Manchester, Iowa
Princeton, N. J.
Albuquerque, N. M.
Van Wert, Ohio
Battle Creek, Mich.
Clayton, Mo.
Pentwater, Mich.
Toronto Junction, Can.
Wilmington, Del.
Riverside, Cal.
Traverse City, Mich.

AUTOMATIC ELECTRIC COMPANY
Van Buren and Morgan Streets, CHICAGO, U. S. A.

PRODUCERS AND WHOLESALERS OF WHITE CEDAR PRODUCTS

CEDAR POLES

YARDS
KOSS MICH.
L'ANSE "
MUNISING "
ONTONAGON
WAGNER, WIS
PESHTIGO "

SPECIAL PRICES ON SMALL POLES.
Write for a copy of our TELEGRAPH CODE FOR CEDAR PRODUCTS

C. H. WORCESTER CO.
SUITE 1206 TRIBUNE BLDG. CHICAGO.

POLES. WHITE CEDAR. IDAHO CEDAR up to 80 ft.

BERTHOLD & JENNINGS, ST. LOUIS. Chemical Building.

CROSS ARMS. LONG LEAF PINE AND FIR.

BRACKETS—X ARMS—PINS
little things it is true, but they cut a big figure in line construction.
OUR MOTTO IS:
Prompt Shipment Quality Satisfaction Right Price
COLUMBIA MFG. CO. ANTIGO, WIS.

Cedar Poles.
Pittsburg and Lake Superior Iron Co. Producers and Wholesalers. Escanaba, Mich.

POLES W. C. STERLING & SON, MONROE, MICH. **TIES.**
Eleven Pole Yards in Michigan
Wholesale Producers for 20 years.

Idaho Cedar Poles
PACIFIC COAST POLE CO. SPOKANE, WASH.

Cedar TORREY CEDAR CO., CLINTONVILLE, WIS. **Poles**
Large Stock Constantly on Hand

HENRY NEWGARD & CO.
ELECTRICAL CONSTRUCTION
Power and Light Plants. Switchboards and Panel Boards.
We install Municipal and Isolated Electric Lighting Plants.
We manufacture Switchboards, Table boards, Iron Cutout Boxes and Electrical Specialties.
We sell Dynamos, Motors and Electrical Supplies.
We wire old as well as new Residences, Factory Buildings, School and College Buildings.
87 Fifth Avenue, Chicago, Illinois.

FACTORIES WANTED
ALONG THE
BURLINGTON ROUTE
to supply the demand for Electrical Goods.
Burlington Route
N 548
W. H. MANSS.
INDUSTRIAL COMMISSIONER,
209 ADAMS STREET, CHICAGO.

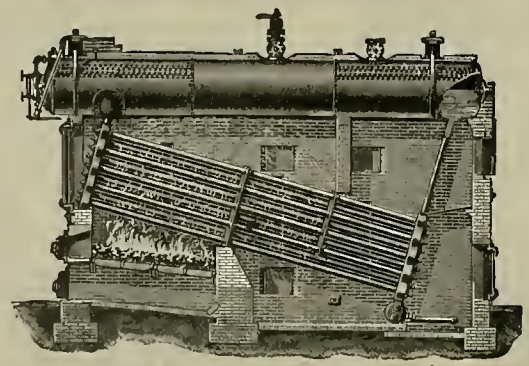
EDWARDS AND CO. New York, N.Y. U.S.A.
ELECTRO-MECHANICAL GONG

Is entirely encased in iron and is weather-proof. The mechanism is very powerful and gives 375 blows to each winding. Continuous ringing or single stroke.
Western Electric Co., Selling Agents.

The Electrician Publishing Co., 510 Marquette Bldg., Chicago. Headquarters for all latest Electrical Books. Write for Catalogue.

THE BABCOCK & WILCOX CO., 85 LIBERTY ST., N. Y.

BRANCH OFFICES:
BOSTON, 35 FEDERAL STREET.
PHILADELPHIA, 1110-1112 NORTH AM. BLDG.
SAN FRANCISCO, 83 FIRST STREET.
PITTSBURG, 1218 FRICK BUILDING.
NEW ORLEANS, 339 CARONDELET STREET.
CHICAGO, 1215 MARQUETTE BLDG.
ATLANTA, EMPIRE BLDG.
CLEVELAND, 706 NEW ENGLAND BLDG.
MEXICO CITY, 7 AVENIDA JUAREZ.
HAVANA, CUBA, 116 1-2 CALLE DE LA HABANA


200 Pounds Working Pressure

WATER TUBE STEAM BOILERS

STEAM SUPERHEATERS

Our Book, STEAM, mailed free on application.

MICHIGAN WHITE LARGE STOCK.
CEDAR POLES
PROMPT SHIPMENTS. KELLOGG SWITCHBOARD & SUPPLY CO., Chicago.

JUST RECEIVED a new batch of 20 and 25 ft. Poles and have reduced prices accordingly. Also, we have plenty of those "Trolley" Ties yet. May we quote you now?

MALTBY CEDAR COMPANY, 509 Phoenix Block, Bay City, Michigan
Pittsburg Agents: Tipper & Patton, 509 Bessemer Bldg.

TELEPHONE POLES
Yards at Red Cliff, Wis., Aitkin, Feeley, Cohasset, Deer River, Tenstrike and Black Duck, Minnesota.
Large stocks. Prompt shipments. Carefully inspected stock at low prices.
J. W. MORRISON LUMBER CO., 918-19 Lumber Exchange MINNEAPOLIS, MINN.

Locations for Industries
Erie Railroad
Chicago to New York
The Erie Railroad Company's Industrial Department has all the territory traversed by the railroad districted in relation to resources, adaptability, markets and advantages for manufacturing, and can advise with manufacturers in relation to the most suitable locations. For full information address
LUIS JACKSON
Industrial Commissioner, Erie Railroad Company
21 Cortlandt Street, New York

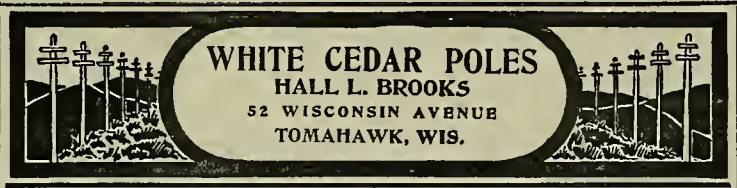
CEDAR POLES
ESTABLISHED 1862
WM. MUELLER COMPANY
1211-12-13 MARQUETTE BLDG. CHICAGO.
EIGHT DISTRIBUTING YARDS

Poles and Ties
The Fowler Companies
TRADE MARK
Fisher Bldg. Chicago

H. N. FENNER, President J. F. BLAUVELT, Agent RUSSELL W. KNIGHT, Treasurer
NEW ENGLAND BUTT COMPANY
MANUFACTURERS OF
Machinery for Insulating Electrical Wires
Braiding, Taping, Winding, Twinning, Cabling, Stranding, Polishing and Measuring Machines. Cable Covering Braiders
FINE CASTINGS A SPECIALTY
304 PEARL STREET, - - - PROVIDENCE, R. I., U. S. A.

Points in Wisconsin and the Northwest
are covered by Wisconsin Central Railway's convenient, solid, wide vestibuled trains, equipped with Pullman sleepers, free reclining chair cars and modern coaches which leave Central Station, 12th Street and Park Row (Lake Front), Chicago for St. Paul, Minneapolis, Ashland and Duluth, connecting with all western lines. Meals in dining and cafe cars served a la carte.
For tickets and further information apply to nearest ticket agent, or write
JAS. C. POND, Gen'l Pass. Agt., Milwaukee, Wis.

FREE CHRISTMAS DINNERS
for 10,000 of Chicago's Poor
will be supplied by the Salvation Army. Will you help by sending a donation, no matter how Small to the
Salvation Army
CHICAGO
Headquarters
399 State Street
Chicago, Ill.



Southern Cedar POLES Are the Best.
NO ROTTEN BUTTS. D. W. PHELAN, 277 Broadway, New York

MICHIGAN AND WESTERN CEDAR POLES
ALL LENGTHS AND SIZES
LINDSLEY BROS CO.
TRIBUNE BLDG., CHICAGO

POLES, TIES, POSTS. THE PORTER CEDAR CO., SAGINAW, MICH.
PRODUCERS. We want your inquiries always.

"A great deal in a little space."
—*The Press.*
"THE FOUR-TRACK SERIES"
This is the title of a series of books of travel and education issued by the Passenger Department of the
NEW YORK CENTRAL LINES
These small books are filled with information regarding the best modes of travel and the education that can best be obtained by travel.
They relate specifically to the great resorts of America — to trips to the islands of the sea and around the world.
They also contain numerous illustrations and new and accurate maps of the country described.
A copy of the 40-page Illustrated Catalogue of the "Four Track Series" will be sent free postpaid, upon receipt of postage stamp by George H. Daniels, General Passenger Agt., New York Central & Hudson River Railroad, Grand Central Station, New York.

CENTRAL STATION HEATING
We are the originators and builders of the underground system of live and exhaust steam heating. Our system is used for the utilization and distribution of exhaust steam from electric and power plants for heating purposes. 250 Plants in successful operation. We have the only Meter System. Also manufacturers of Wooden Water Pipe, Steam Pipe Casing, Steam Traps, Condensation Meters, Valves, Economizing Coils, Separators and full line of Steam Fitters' Supplies.
WRITE FOR PAMPHLET AND PRICE LIST
AMERICAN DISTRICT STEAM COMPANY
MENTION WESTERN ELECTRICIAN. LOCKPORT, N.Y. CHICAGO, ILL.

NOW

look over your accounts and equipment to learn the cost of failures of your

PROTECTIVE APPARATUS

Avoid the same experience next season, by writing us for expert advice and suggestions

GET READY FOR 1905

Westinghouse Electric & Mfg. Co.

Pittsburg, Pa.

Address our nearest sales office

New York, Dallas, Atlanta, Baltimore, Boston, Buffalo, Chicago, Cincinnati, Cleveland, Detroit, Los Angeles, Minneapolis, New Orleans, Philadelphia, Pittsburg, St. Louis, Salt Lake City, San Francisco, Sycamore, Seattle, Denver, Mountain Electric Co.
For Canada: Canadian Westinghouse Co., Limited, Hamilton, Ontario. Mexico, G. & O. Braniff & Co., City of Mexico.

Do you know we sell Incandescent Lamps and carry large stocks in all important cities? Write for our new Lamp Catalogue.

Form C Arc Lamps

Easy to

trim
adjust
inspect

thoroughly

reliable
efficient
durable

investigate

without
restrictions
of any kind

Complete

bulletins
instructions
catalogues

information

on lamps
for any
circuit

available

to any one
sending us
his address

Fort Wayne Electric Works

"Wood Systems"

Fort Wayne - - Indiana

260

WE shall be glad to supply any of the books catalogued below upon receipt of your order and remittance. We prepay charges.

THE PRINCIPLES OF THE TRANSFORMER. By Frederick Bedell	$3.25
INDUCTION COILS. By G. E. Bonney	1.00
ELECTRICITY AND MAGNETISM. By S. R. Bottone	.90
ELECTRICITY, ELECTROMETER, MAGNETISM AND ELECTROLYSIS. By G. Chrystal and W. N. Shaw	1.60
THEORY OF ELECTRICITY. By L Cumming	2.25
THEORY OF ELECTRICITY AND MAGNETISM. By Charles Emerson Curry	2.50
THE ELEMENTS OF ALTERNATING CURRENTS. By W. S. Franklin and R. B. Williamson	2.50
PRACTICAL EXERCISES IN MAGNETISM AND ELECTRICITY. By H. E. Hadley	.60
MISCELLANEOUS PAPERS. By Heinrich Hertz	3.25
A TEXT-BOOK ON ELECTROMAGNETISM AND THE CONSTRUCTION OF DYNAMOS. By Dugald C. Jackson	2.25
ALTERNATING CURRENTS AND ALTERNATING CURRENT MACHINERY. By D. C. Jackson and John Price Jackson	3.50
AN ELEMENTARY BOOK ON ELECTRICITY AND MAGNETISM AND THEIR APPLICATIONS. By D. C. Jackson and John Price Jackson.	1.40
A FIRST-BOOK OF ELECTRICITY AND MAGNETISM. By W. P. Maycock	.60
ALTERNATING CURRENTS OF ELECTRICITY AND THE THEORY OF TRANSFORMERS. By Alfred Still	1.50
PRACTICAL ELECTRIC LIGHT FITTING. By A. C. Allsop	1.50
ELECTRICAL EXPERIMENTS. By G. E. Bonney	.75
RADIOGRAPHY AND THE "X" RAYS IN PRACTICE AND THEORY. By S. R. Bottone	1.00
THE DYNAMO: HOW MADE AND HOW USED. By S. R. Bottone	.90
HOW TO MANAGE THE DYNAMO. By S. R. Bottone	.60
A GUIDE TO ELECTRIC LIGHTING. By S. R. Bottone	.75
ELECTRIC LIGHT ARITHMETIC. By R. E. Day	.40
THE DYNAMO: ITS THEORY, DESIGN AND MANUFACTURE. By C. C. Hawkins and F. Wallis	3.00
THE ALTERNATING CURRENT CIRCUIT. By W. P. Maycock	1.00
ELECTRIC WIRING FITTINGS, ETC. By W. P. Maycock	1.75
ELECTRIC WIRING TABLE. By W. P. Maycock	1.50
A MANUAL OF TELEPHONY. By W. H. Preece and A. J. Stubbs	4.50
PRACTICAL TELEPHONE HANDBOOK AND GUIDE TO THE TELEPHONIC EXCHANGE. By Joseph Poole	1.50
ELECTRIC WIRING. By Russell Robb	2.50
ELECTRIC LIGHT CABLES AND THE DISTRIBUTION OF ELECTRICITY. By Stuart A. Russell	3.00
ELECTRICITY IN TOWN AND COUNTRY HOUSES. By Percy E. Scrutton	1.00
THE STORAGE BATTERY. By Augustus Treadwell	1.75

Electrician Publishing Company
510 Marquette Building, Chicago

Good Advice

One of the foremost doctors of electrical engineering was recently called upon to examine into the ills of a profitless direct-current light and power plant and, after making a diagnosis, he immediately prescribed Duncan Meters, with instructions that the remedy should be continued indefinitely to prevent a recurrence of the malady.

Send for Bulletin and Prices

DUNCAN ELECTRIC MFG. CO.
LAFAYETTE, IND.

Cords, Cables, Wires

We Manufacture

Cords for Telephones and Switchboards. Cables and Wires for Switchboards. Cables for Interior Purposes.

Write us concerning our No. 100 Switchboard Cord

Secure Our Prices

RUNZEL - LENZ ELECTRIC MFG. COMPANY
97-101 So. Clinton St. CHICAGO, ILL.

VULCANIZED FIBRE

Highest grades for electrical insulation and mechanical purposes, in sheets, tubes, rods and special shapes. Catalogues and samples on application.

VULCANIZED FIBRE CO., - Wilmington, Del.

PROMETHEUS
Electric Heating and Cooking Apparatus.

Most Modern and Efficient System.

Send for Illustrated Catalogue.

THE
Prometheus Electric Co.,
39 CORTLANDT STREET, NEW YORK.

DON'T BUY ELECTRICAL SUPPLIES

Until you have seen our new Catalogue and new Price List.
Free to the trade.

Manhattan Electrical Supply Co.
NEW YORK: 32 Cortlandt St.
CHICAGO: 188 Fifth Ave.

Perfect Control — Indefinite Regulation
No Flashing—No Repairs
Burnouts Impossible—Last Forever

ALLEN-BRADLEY
RHEOSTATS

For All Purposes of Electric Current Control

Prices Reasonable—Satisfaction Guaranteed

SEND IN A TRIAL ORDER

Ask your Engineer or Electrician about it.

AMERICAN ELECTRIC FUSE CO.
48-50 West Jackson Boul.
CHICAGO, ILL.

STURTEVANT ECONOMIZERS

For all boiler plants of 50 H. P. and over. Increase temperature of feed water 150° and 175°. Save 10 to 20 per cent in fuel. Increase boiler capacity 20 to 40 per cent. Prolong life of boilers.

B. F. Sturtevant Co., Boston, Mass.
General Office and Works, Hyde Park, Mass.
NEW YORK PHILADELPHIA CHICAGO LONDON
406

Black Diamond File Works

Est. 1863. Inc. 1895.

Twelve Medals Awarded at International Expositions

Special Prize Gold Medal at Atlanta, 1895.

OUR GOODS ARE ON SALE IN EVERY LEADING HARDWARE STORE IN THE UNITED STATES AND CANADA.

G. & H. BARNETT COMPANY,
PHILADELPHIA, PA.

THE BEST BRAZING TORCH

FOR ELECTRICIANS

HOTTEST ON EARTH

The Turner 4B Gasoline Brazing Torch is used by all mechanics for light work in brazing, annealing, tempering and drawing temper of small tools, etc. This torch produces an intensely hot, pointed flame of over 3,000° Fahr. Burns 4 hours from one filling.

PRICE $4.50 NET

THE TURNER BRASS WORKS
23 N. Franklin St., Chicago

Western Electrician

Vol. XXXV. $3.00 Per Annum. Copyright, 1904, by Electrician Publishing Company, Chicago. CHICAGO, DECEMBER 10, 1904. Entered at Chicago Postoffice as mail matter of the second class. 10 Cents a Copy. No. 24.

SIMPLEX INSULATED WIRES AND CABLES.

RUBBER COVERED, WEATHERPROOF, UNDERGROUND AND SUBMARINE.

WESTERN SELLING AGENT, H. R. HILSON, 1144 Monadnock Block, CHICAGO.

The Simplex Electrical Co., 110 State Street, BOSTON, MASS.

CHICAGO INSULATED WIRE CO.

152-154 LAKE ST., CHICAGO

1108-1110 PINE ST., ST. LOUIS, MO.

Bare and Insulated Wires and Cables

Galvanized Steel Strands

OKONITE TRADE MARK

1889—Paris Exposition, Medal for Rubber Insulation.

1893—World's Fair, Medal for Rubber Insulation.

THE STANDARD FOR RUBBER INSULATION.

Sole Manufaoturers of

Okonite Wires, Okonite Tape, Manson Tape, Candee Weather-proof Wires.

THE OKONITE CO., LTD.

Willard L. Candee, Grant Cheever, } Managers. 253 Broadway, New York. Geo. T. Manson, Gen'l Sup't. W. H. Hodgins, Secy.

TRADE MARK. CRESCENT INSULATED WIRE & CABLE CO. TRENTON, N. J.

CRESCENT RUBBER INSULATED WIRES AND CABLES

National Code Standard.

CRESCENT INSULATED WIRE AND CABLE CO.,

New York Office, 83 BARCLAY STREET. Main Office and Factory, TRENTON, N. J.

"STANDARD" U.S.A. PAT.

STANDARD UNDERGROUND CABLE CO.

322 The Rookery, Chicago. Westinghouse Bldg., Pittsburg. 56 Liberty St., New York City. 1225 Betz Bldg., Philadelphia, Pa. Crossley Bldg., San Francisco. 10 Post Office Square, Boston.

BARE AND WEATHERPROOF WIRES AND CABLES.

Rubber Covered Wires and Cables. Underground Cables for all Purposes.

INDIANA RUBBER AND INSULATED WIRE CO.,

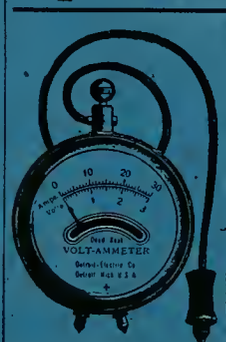
MANUFACTURERS OF

Paranite Rubber Covered Wires and Cables,

UNDERGROUND, AERIAL, SUBMARINE AND INSIDE USE;

TELEPHONE, TELEGRAPH AND FIRE ALARM CABLES.

All Wires are tested at Factory. JONESBORO, IND.



ROBERT VOLT-AMMETER

DEAD BEAT

Accurate, Durable, Guaranteed

List Price $6.00

Incl. Leather Case

Sample instrument forwarded prepaid on receipt of $4 50 Special Discount to Dealers and Jobbers

Detroit Elect. Co. 56 Shelby St., Detroit, Mich.

M. KLEIN & SON.

Send 2c stamp for new catalogue No. 6 of

KLEIN'S TOOLS

For Electrical Workers and Line Builders.

MATHIAS KLEIN & SONS, 81 W. Van Buren St., Chicago, Ill.

THOUSANDS IN USE.

Motors, ⅛ h. p. to 100 h. p. Dynamos, 1 k. w. to 75 k. w. Highest Quality. Reasonable Price. THE HOBART ELECTRIC MFG. CO. TROY, OHIO.

Engineering MECHANICAL, ELECTRICAL, STEAM, CIVIL.

Complete and short courses. Thoroughly equipped engineering shops. Shop work from the beginning. Short courses in Steam and Electrical Engineering. Expenses low. Accommodations the best. School all year. Students may enter any time. Correspondence steam and electrical courses. Send for catalogue. Mention course in which interested.

HIGHLAND PARK COLLEGE, DES MOINES, IOWA.

"CIRCULAR LOOM" THE FLEXIBLE CONDUIT

AMERICAN CIRCULAR LOOM CO. TRADE MARK REGISTERED

CONDUITS FOR INTERIOR WIRING.

American Circular Loom Co.

Chelsea, Mass., New York, Chicago, San Francisco.

THE PHOENIX GLASS CO. Pittsburg, New York, Chicago

Manufacturers of

Electric Globes and Shades, both Arc and Incandescent

Inner and Outer Globes for all enclosed arc systems

CATALOGUES SENT ON REQUEST

ELECTRIC SIGN FLASHERS

BEST IN THE WORLD

Write for full particulars Reynolds Elec. Flasher Mfg. Co. 221 Fifth Ave., Chicago.

Electric Heating Apparatus

SEND FOR 62-PAGE CATALOGUE.

UNIT" ENAMELED RHEOSTATS

SIMPLEX ELECTRIC HEATING CO., Cambridgeport, Mass.

THERMOPILES 1½ VOLTS 1½ AMPERES

For Electrolytic analysis, charging storage batteries, and other constant current requirements. $3 Each.

WALSH'S SONS & CO., 264 Washington Street. Newark, N. J.

Cope's Patent Quick Coupling Conduit Rod

Remember these rods have no lost motion. These Couplings are of Steel and are made in the best possible manner.

Write for list of persons using these rods—25,000 sold since May 1902. Made in 3 ft. and 4 ft. lengths. Price, 3 ft. 75 cents, 4 ft. 85 cents. Patented February 24, 1903.

T. J. COPE

3244 North Fifteenth Street PHILADELPHIA, PA.

"FLEXDUCT"

is a trade name for a flexible non-metallic conduit that is approved by all official inspection boards.

"Flexduct" is a tough fibrous tubing, being flexible, strong and enduring. It is a moisture repellant. "Flexduct" has a smooth, even interior, unaffected by swashing, crushing or sharp bends. It is indestructible. Greater lengths can be fished, time saved in construction and a higher class job is possible with "Flexduct."

Osburn Flexible Conduit Company,

New York Chicago San Francisco

"FLEXDUCT"

is for sale by all electrical jobbers. If local dealer cannot furnish, write us and we will arrange for prompt shipment. Specify "Flexduct."

WESTON Electrical Instrument Co.,

Waverly Park, NEWARK, N. J.

Weston "Round Pattern" Voltmeter, Type K.

We desire to call attention to a line of low priced but excellent Switchboard Instruments for Direct-Current Circuits, which we designate as

"Round Pattern," Type K.

These instruments are particularly suitable for Isolated Plants and Feeder Circuits in Railway and Power Plants. All Weston Instruments are unsurpassed in excellence of workmanship, in accuracy and economy of operation.

BERLIN—European Weston Electrical Instrument Co., Ritterstrasse No. 88.

LONDON—Elliott Bros., Century Works, Lewisham.

PARIS, FRANCE—E. H. Cadiat, 12 Rue St. Georges.

New York Office—74 Cortlandt St.

HAVE YOU SEEN

"UNION" SWITCHBOX?

If not, let us send you a sample.

This Box will fit all Standard Switches and Receptacles and has been approved by the Underwriters' National Electric Association.

Gangs of 2, 3, 4, 5 and 6 carried in stock provided with clamps for holding Sprague Cable. Tandem Boxes made to order.

PATENTS PENDING.

CHICAGO FUSE WIRE & MFG. CO.

CHICAGO BUFFALO NEW YORK

Everybody Knows

We make the largest
Engines in the world

But Do You Know

We make smaller Engines, in sizes from 25 horsepower upward

?

Allis-Chalmers Standard Corliss Engine

Corliss Engines for all power purposes

Bullock Motors

for operating Machine Tools.

Bullock

(Patented) Three-Wire Multiple Voltage Balancing System for control of Motors, received the

Highest Award at the St. Louis Exposition

Many of the largest machine shops in the country are operating their tools on the Bullock (Patented) Multiple Voltage System.

When a motor operating on their system is set at any speed, it will run at that speed regardless of the load.

As many as twelve different speeds forward or backward can be secured through this system.

For further particulars address

Allis-Chalmers Co., Milwaukee

Electrical Department

The Bullock Electric Mfg. Co.

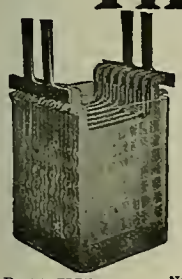
General Sales Offices, New York Life Bldg., Chicago.

Electrical Works, Cincinnati, O.

Canadian representatives, Allis-Chalmers-Bullock Ltd., Montreal

THE ELECTRIC STORAGE BATTERY CO.

PHILADELPHIA



MANUFACTURER OF THE

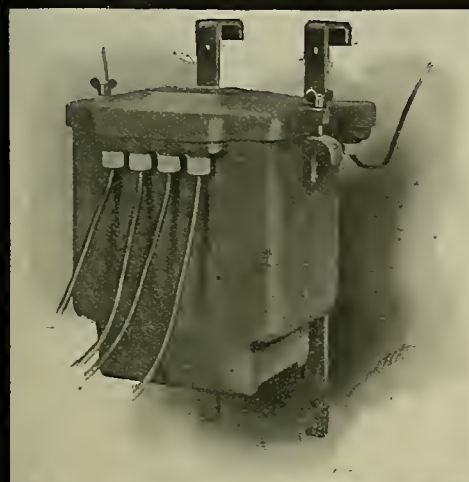
"Chloride Accumulator"

For Central Stations, Electric Railways, Isolated Lighting and Power Stations, Fire Alarm, Telegraph, Train Lighting, etc., etc.

PRICE LISTS AND DESCRIPTIVE BULLETINS FORWARDED UPON REQUEST.

SALES OFFICES:

PHILADELPHIA, Allegheny Ave. and 19th St. | NEW YORK, 100 Broadway, | BOSTON, 60 State St. | CHICAGO, Marquette Bldg. | ST. LOUIS, Wainwright Bldg. | SAN FRANCISCO, Rialto Bldg. | CLEVELAND, Citizens Bldg. | CANADA, Canadian General Electric Co., Ltd. Toronto | HAVANA, CUBA, G. F. Greenwood, Manager 34 Empedrado St.



THE B. O. TRANSFORMER

Do you expect to need new transformers this fall? If you do, the B. O. will interest you.

Low Losses
High Efficiencies
High Insulation
Low Price.

Are you familiar with oil duct transformers?
Send us your address and we will tell you about our insulation and the advantages of slab windings in connection with oil ducts.

THE STANLEY ELECTRIC MANUFACTURING COMPANY
PITTSFIELD, MASSACHUSETTS

Atlanta, Ga., Empire Building
CHICAGO, ILL., MONADNOCK BLOCK
New York, N. Y., 29 Broadway
St. Louis, Mo., Century Bldg.
Boston, Mass., Oliver Building
Denver, Col., Hendrie & Bolthoff Mfg. & Supply Co.
Philadelphia, Pa., North American Building
San Francisco, Cal., 69-75 New Montgomery St.
Seattle, Wash., Pioneer Bldg.

Representatives for the Dominion of Canada, THE CANADIAN GENERAL ELECTRIC CO. of Toronto

"THE S. K. C. SYSTEM"

WHITE PORCELAIN LETTERS — FIREPROOF
FOR ELECTRIC SIGNS
AGENTS WANTED WHEREVER THERE ARE CENTRAL STATIONS.
COLONIAL SIGN AND INSULATOR CO., - - - AKRON, O.

PLATINUM

PLATINUM RIVETS FOR CONTACT POINTS IN TELEPHONES—SPARK COILS AND OTHER ELECTRICAL APPARATUS. PLATINUM SHEET AND WIRE IN ANY FORM AND DEGREE OF HARDNESS. PLATINUM SCRAP PURCHASED.

BAKER & COMPANY, Inc.
ARTISANS IN PLATINUM
408-410-412-414 N. J. R. R. AVE. - NEWARK, N. J.
New York Office: 120 Liberty St.

ALPHABETICAL INDEX TO ADVERTISEMENTS.

Adams-Bagnall Electric Co.. 7
Allis-Chalmers Company..... 2
American Battery Co.....—
Amer. Circular Loom Co.... ... 1
American Conduit Co.....20
American Diesel Engine Co..18
Amer. District Steam Co.....23
Amer. Elec. Fuse Co..... 9
Amer. El. Telephone Co.....20
American Electrical Works..15
American Platinum Works..11
Arnold Elec. Power Station Co.....19
Audit Co. of Ill., The..... —
Automatic Electric Co..... 21

Babcock & Wilcox Co.....—
Badt, F. B.....19
Bain, Forée.....15
Baker & Company..... 3
Baker & Co., W. E.....19
Barnett Company, G. & H....26
Beardslee Chandelier Mfg.Co.14
Benjamin Electric Mfg. Co.. 5
Bennett, I. A.....12
Berthold & Jennings.....23
Bissell Co., The F..... 9
Bossert Electric Construction Co.....16
Brooks, Hall L.....23
Bryan-Marsh Co.....—
Bryan, Wm. H.....19
Buckeye Electric Co.....10
Bullock Elec. Mfg. Co..... 2
Burlington R. R.....22
Butterfield, J. F.....—
Bylesby & Co., H. M.....19

Cantwell Press, The.....21
Carhartt & Co., Hamilton.. .—
Central Electric Co..... 5
Cent. Stat. Improvement Co 16
Central Tel. & El. Co.....—
Century Electric Co.....—
Chicago Die & Electric Co....—
Chicago Edison Co.....4, 16
Chic. Fuse Wire & Mfg. Co... 1
Chicago Insulated Wire Co.. 1
Chicago Mica Co.....14
Cincinnati Gas & Elec. Co...16
Clinton Stamping & Elec. Co.21
Colonial Sign & Insulator Co. 3
Columbia Incand. Lamp Co..13
Columbia Mfg. Co.....22
Continuous Rail Joint Company of America..... 14
Cooper-Hewitt Elec. Co..... 8
Cope, T. J..... 1
Crawfordsville Electric Co.. 6
Crescent Ins. Wire & Cbl. Co. 1
Crocker-Wheeler Company...26
Crolius & Son, E. R.....—
Cutler-Hammer Mfg. Co.....11
Cutter Elec. & Mfg. Company—

D. & W. Fuse Company.....—
Dearborn Drug & Chem. Wks.18
Detroit Electric Co..... 1
Diamond Meter Company....—
Directory of Engineers.....19
Dixon Crucible Co., Joseph..18
Duncan Elec. Mfg. Co.....25

Edison Decorative & Miniature Lamp Departm't.... 4, 14
Edison Mfg. Company.....20
Edwards & Co.....12
Egan, J. J.....16
Electric Appliance Co..... 14
Electric Storage Battery Co.. 3
Electrical Appliance Co..... —
Electrical Engineer Institute.—
Electrician Pub. Company...17
Erie Ry.....22
Evans, Almirall & Co 19
Evans & Co., W. R 19

Faries Mfg. Co..... 4
"For Sale" Advertisements..16
Ft. Wayne Elec. Works, Inc..25
Fostoria Incand. Lamp Co...—
Fowler, John H.....23
Fowler-Jacobs Company.....23
Franklin Elec. Mfg. Co .....—

General Electric Co..... 9
General Engineering Co., The 19
General Incandescent Arc Light Company.....—
General Incand. Lamp Co....—
Gould Storage Battery Co....—
Gt. Western Smelting & Refining Co .....—
Green Fuel Economizer Co..—
Gregory Electric Company...16

Hallberg, J. H 19
Hart Mfg. Co..... 6
Hartford Steam Boiler Inspection & Insurance Co....18
Hazard Manufacturing Co...26
Highland Park College. ... 1
Hipwell Mfg. Co..... .... —
Hobart Elec. Mfg. Co..... 1
Hoffman, G. W.....16
Holmes Fibre-Graph. Co.....18
Holophane Glass Co.....—
Humphrey, Henry H.....—
Hunt & Co., Robt. W.....19

Illinois Central Ry.....23
Incandescent Electric Light Manipulator Company.....—
Indiana Rub. & Ins. W. Co.... 1
India Rubber & Gutta Percha Insulating Company.....14
International Elec. Meter Co 14
International Tel. Mfg. Co...20

Jackson, D. C. & W. B.....19
Jeffrey Manufacturing Co....18
Johns-Manville Co., H. W.....—

Kartavert Manufacturing Co.26
Kellogg Switchboard & Supply Company.....21, 22
Kemp, R. W..... 19
Kester Elec. Mfg. Co.....15
Klein & Sons, Mathias.... ... 1
Kohler Brothers.....19
Kuhlman Electric Co.....15

Leather Preserv. M. Corp....—
Leffel & Co., James.....18
Lindsley Brothers Company..22
Loud's Sons Co., H. M.....22

Machado & Roller .....—
Maltby Cedar Company.....23
Manhattan El. Supply Co....11
Manross, F. N..... 12
Marinette Gas Engine Co.....18
Matthews & Bros., W. N.....15
McLaughlin & Co., Jas.....11
McLennan & Company, K....14
Mechanical Appliance Co....—
Mica Insulator Company.....14
Miscellaneous Advs.....16
Monon Railroad..... ..—
Morrison Lbr. Co., J. W.....—
Mueller Company, William..22
Munsell & Co., Eugene.....14

National Electric Co.....11
National India Rubber Co....—
New England Butt Co.....18
Newgard & Co., Henry..... 8
New York Cent. Ry.....23
New York Ins. Wire Co.....15
Northern Elect'l Mfg. Co.... 4
Northern Wire & Cable Co...—
Northwestern Storage Battery Co.. ... .14

Okonite Co., The..... 1
Osburn Flexible Conduit Co. 1

Pacific Coast Pole Co.....23
Paragon Fan & Motor Co.....—
Pardridge Shade & Refl. Co..—
Pass & Seymour, Inc.....—
Phelan, D. W.....22
Phillips, Eugene F.....15
Phillips Insulated Wire Co...15
Phœnix Glass Co..... 1
Phosphor-Bronze S. Co.....18
Pignolet, L. M.....14
Pittsburg & L. S. Iron Co....23
Plume & Atwood Mfg. Co....—
Porter Cedar Company.....23
Prometheus Electric Co., The11

Reisinger, Hugo.....11
Replogle Governor Works.. .—
Reynolds El. Flasher Mfg. Co. 1
Roche, Wm..... 8
Roebling's Sons Co., J. A.....26
Ruebel-Schwedtmann-Wells..19
Runzel-Lenz Elec. Mfg. Co...—

Safety Ins. Wire & Cable Co..14
Sargent & Lundy.....—
Sauquoit Silk Mfg. Co.....12
Schott, W. H.....19
Signaloid Chemical Works...—
Simplex Electrical Co., The.. 1
Simplex Elec. Heating Co.... 1
Speer Carbon Co..... .12
Sprague Electric Company...15
Squire Electric Co.....19
Standard Elec. Mfg. Co.....26
Standard Underg. Cable Co.... 1
Stanley Elec. Mfg. Co., The 3
Stanley Instrument Co..... 5
Stanton, LeRoy W..... 19
Sterling & Son, W. C.....22
Sterling Electrical Mfg. Co... 15
Sterling Varnish Co., The....18
Stow Mfg. Company.....11
Stromberg-Carlson Tel. Mfg. Company.....20
Sturtevant Company, B. F...26

Temple Pump Co.....—
Torrey Cedar Company.....23
Trumbull Elec. Mnfg. Co.....—
Turner Brass Works.....—

Union Electric Mfg. Co.....15

Valentine-Clark Co., The....22
Vulcanized Fibre Company..26

Wagner Electric Mfg. Co.....—
Walsh's Sons & Company..... 1
Warren Elec. Mfg. Co..... 9
Wesco Supply Co.....—
Western Electric Company...12
Westinghouse Electric & Manufacturing Co.....24
Weston Electrical Inst. Co... 1
Whitehead Machinery Co... —
Wilmerding, C. H.....19
Woolley Fdy. & Mach. Wks..—
Worcester Company, C. H....22

Yesbera Mfg. Co..... .. —
Yost Electric Mfg. Co 26

Zero Marx Sign Works 15

For Classified Index of Advertisements See Page 6.

Motors, Switches, Arc Lamps, Circuit Breakers, Etc., Etc.

ALWAYS IN STOCK.

MANUFACTURED BY

G. E. Co.

CHICAGO EDISON COMPANY, 139 Adams Street. CHICAGO.

ADJUST YOUR LIGHT

by means of our

Wall, Desk, Floor or Ceiling Adjustable Fixtures

TO ANY DESIRED POSITION INSTANTLY.

Many shapes and styles—plain and ornamental—for shop, factory, store, office, residence—in fact, wherever the incandescent lamp is used.

Catalog mailed upon request.

FARIES MFG. CO.,
DECATUR, ILL.

155

NORTHERN SMALL MOTORS

Compact....Efficient....Superior

High type of construction....susceptible of good speed variation....multipolar....form-wound armatures....simple....hardy....trustworthy.

Booklet No. 3325

NORTHERN ELECTRICAL MFG. CO.
Engineers...Manufacturers Madison, Wis., U. S. A.

EDISON TELEPHONE LAMPS

ARE THE

Standard for Visual Signals

They Save the "Exchange" time and money; because every lamp is perfect—sure to fit—sure to burn. The life is extremely long, running into years.

EDISON DECORATIVE AND MINIATURE LAMP DEPARTMENT

GENERAL ELECTRIC COMPANY.

Main Sales Office, Harrison, N. J.

BENJAMIN

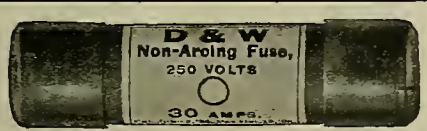
WIRELESS CLUSTERS

Benjamin
Wireless
Clusters

SUITABLE FOR
Residences
Offices
Hotels, Etc.

CHICAGO **BENJAMIN ELECTRIC MFG. CO.** NEW YORK

D. & W. FUSES AND SAFETY DEVICES



TYPE C INDICATING FUSE BEFORE BLOWING

TYPE C INDICATING FUSE AFTER BLOWING

DELTABESTON MAGNET WIRE

SAFE—EFFICIENT—ABSOLUTELY THE BEST.

WRITE US ABOUT THEM.

OKONITE IT NEVER DISAPPOINTS

Central Electric Company,

GENERAL WESTERN AGENTS

264-266-268-270 Fifth Avenue, CHICAGO

OKONITE IT NEVER DISAPPOINTS

ELECTRICITY FOR ENGINEERS.

424 PAGES. ILLUSTRATED. PRICE $2.50.

ELECTRICIAN PUBLISHING CO.,
510 Marquette Building, • • CHICAGO.

STANLEY RECORDING WATTMETERS

FOR ALTERNATING-CURRENT CIRCUITS

BALANCED THRUST No Jewel Wear from Hammer or Side Thrust. Glass or Metal Covers, Second Alone to the

STANLEY MAGNETIC SUSPENSION WATTMETERS

Missouri, Kansas, Arkansas
FRANK ADAM ELECTRIC CO.
St. Louis

Colorado, Idaho, Montana, Wyoming
New Mexico, Utah
HENDRIE-BOLTHOFF MFG. AND SUPPLY CO.
Denver

SEND FOR BULLETINS AND INFORMATION ABOUT METERS TO

STANLEY INSTRUMENT CO.

GREAT BARRINGTON MASS., U. S. A.

Mexico
VICTOR M. BRASHI & CO.
Mexico City

California, Oregon, Washington
Nevada, Arizona
BROOKS-FOLLIS ELECTRIC CORP.
San Francisco

HORNBERGER-IRWIN

Transformers

(LARGE AND SMALL)

½ K. W. to 500 K. W.

This transformer represents the latest improvements in transformer construction; made in three types; multi-coil construction; ventilated cores; built for all commercial voltages and frequencies; **higher efficiencies together with lower temperatures than have heretofore been attained are guaranteed.**

Catalogue just issued explains details.

Manufactured by

Crawfordsville Electric Co.

CRAWFORDSVILLE, INDIANA, U. S. A.

"Diamond H" Switches

Trade H Mark

This Trade-Mark guarantees quality.

The Hart Mfg. Co., Hartford, Conn.

New York Boston Chicago Toronto, Ont.

CLASSIFIED INDEX OF ADVERTISEMENTS.

Accountants and Auditors.
Audit Co. of Illinois

Adjusters, Cord.
Incandes. El. Lt. Manip. Co.

Adjusters, Inc. Lamps.
Inc. El. Lt. Manipulator Co.

Anchors (Tel. & Tel.)
Bennett, I. A.
Matthews & Bro., W. N.

Annunciators.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.

Batteries and Jars.
Bissell Co., The F.
Central Electric Co.
Edison Mfg. Co.
Edwards & Company.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Roche, Wm.
Wesco Supply Co.
Western Electric Co.

Bells, Buzzers, Etc.
Central Electric Co.
Edwards & Co.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.

Belt Dressing.
Dixon Crucible Co., Jos.
Leather Preserver Mfg. Corp.

Belting.
Leather Preserver Mfg. Corp.

Blow Pipes.
Turner Brass Works

Blowers.
Sturtevant Co., B. F.

Boiler Compounds.
Dearborn Drug & Chem. Wks.

Boilers.
Allis-Chalmers Company.
Babcock & Wilcox Co.

Books, Electrical.
Cantwell Press, The.
Electrician Publishing Co.

Booths, Telephone.
Yesbera Mfg. Co.

Brackets.
Faries Mfg. Co.

Brushes.
Central Electric Co.
Hobart Elec. Mfg. Co.
Holmes Fibre-Graphite Co.
Speer Carbon Co.
Western Electric Company.

Cable Hangers.
Bissell Co., B. F.
Wesco Supply Co.
Western Electric Co.

Cables (See Wires and Cables)

Canopies.
Faries Mfg. Co.

Carbons, Points and Plates.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
Reisinger, Hugo.
Speer Carbon Co.
Wesco Supply Co.

Castings.
Faries Mfg. Co.
New England Butt Co.
National Electric Co.

Chains.
Jeffrey Mfg. Co.

Chandeliers.
Faries Mfg. Co.

Circuit Breakers.
Cutler-Hammer Mfg. Co.
Cutter Elec. & Mfg. Co.
Ft. Wayne Elec. Wks. Inc.
Union Electric Mfg. Co.
Wesco Supply Co.
Western Electric Company.
Westinghouse El. & Mfg. Co.

Cinders.
Benjamin Elec. Mfg. Co.
Faries Mfg. Co.

Coal and Ashes Handling Machinery.
Jaffrey Mfg. Co.

Coils and Magnets.
Western Electric Co.

Coloring, Lamp.
Signaloid Chemical Works.

Commutator Compound
Crollus & Son, E. R.
Egan, J. J.
McLaughlin & Co., Jas.
McLennan & Co., K.

Condensers, Electric.
Stanley Elec. Mfg Co.

Conduit and Conduits.
American Circular Loom Co.
American Conduit Company
Central Electric Co.
Electric Appliance Co.
Osburn Flexible Conduit Co.
Sprague Electric Co.
Wesco Supply Co.

Contractors and Electric Light Plants.
Allis-Chalmers Company.
Bullock El. Mfg. Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
National Electric Co.
Northern Electrical Mfg. Co.
Sprague Electric Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Controllers, Crane.
Amer. Elec. Fuse Co.

Copper, Scrap.
Great Western Smelting & Refining Co.

Cord.
Runzel-Lenz Elec. Mfg. Co.

Cross-Arms, Pins and Brackets.
Berthold & Jennings.
Central Electric Co.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Company.

Cut-Outs and Switches.
Bissell Co., The F.
Bossert Elec. Const. Co.
Central Electric Co.
Chicago Edison Co.
Clinton Stamping & Elec. Co.
Cutter Elec. & Mfg. Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
General Inc. Arc Light Co.
Hart Manufacturing Co.
Manattan Elec. Supply Co.
Trumbull Elec. Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Dynamos and Motors.
Allis-Chalmers Company.
Bissell Co., The F.
Bullock Elec. Mfg. Co.
Central Electric Co.
Century Electric Co.
Crawfordsville Electric Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks. Inc.
General Elec. Co.
General Inc. Arc Light Co.
Gregory Electric Co.
Hobart Elec. Mfg. Co.
Mechanical Appliance Co.
National Electric Co.
Northern Electrical Mfg. Co.
Sprague Electric Co.
Stanley Elec. Mfg. Co.
Stow Manufacturing Co.
Sturtevant Co., B. F.
Wagner Electric Mfg. Co.
Warren Elec. Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Economizers, Fuel.
Green Fuel Economizer Co.

Electric Heating Appl.
Electric Appliance Co.
Prometheus Electric Co.
Simplex Elec. Heating Co.
Western Electric Co.

Electric Railways.
Crocker-Wheeler Co.
General Electric Co.
Sprague Electric Co.
Westinghouse El. & Mfg. Co.

Electrical and Mechanical Engineers.
Arnold Elec. Power Stat'n Co.
Badt, F. B.
Baker & Co., W. E.
Bryan, Wm. H.
Butterfield, J. F.
Byllesby & Co., H. M.
Evans, Almirall & Co.
General Engineering Co., The.
Hallberg, J. H.
Humphrey, Henry B.
Hunt & Co., Robt. W.
Jackson, D. C. & W. B.
Kemp, R. W.
Kohler Brothers.
Newgard & Co., Henry.
Northern Electrical Mfg. Co.
Ruebel, Schwedtman, Wells.
Sargent & Lundy.
Schott, W. H.
Squire Electric Co.
Stanley Elec. Mfg. Co.
Stanton, LeRoy W.
Wilmerding, C. H.

Electrical Instruments. (Recording and Testing.)
Bissell Co., The F.
Central Electric Co.
Detroit Electric Co.
Diamond Meter Co.
Duncan Elec. Mfg. Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
General Inc. Arc Light Co.
Machado & Roller.
Pignolet, L. M.
Stanley Elec. Mfg. Co.
Stanley Instrument Co.
Wagner Electric Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co
Weston Electrical Inst. Co.

Electro-Plating Mach'y
Crocker-Wheeler Company.
General Electric Co.

Elevators-Conveyors.
Jeffrey Mfg. Co.

Engines, Gas and Gasoline.
Allis-Chalmers Company.
Marinette Gas Engine Co.
Temple Pump Co.
Woolley Fdy. & Mach. Wks.

Engines, Oil.
American Diesel Engine Co.

Engines, Steam.
Allis-Chalmers Company.
Sturtevant Co., B. F.

Fans and Fan Motors.
Central Electric Co.
Crocker-Wheeler Company.
Edison Mfg. Co.
General Electric Co.
General Inc. Arc Light Co.
Sprague Electric Co.
Sturtevant Co., B. F.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Fibre.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Files.
Barnett Co., G. & H.

Fittings.
Faries Mfg. Co.

Fixtures, Gas and Elec.
Beardslee Chandelier Mfg. Co.

Flashers.
Bissell Co., The F.
Reynolds El. Flasher Mfg. Co
Wesco Supply Co.

Flexible Shafts.
Stow Mfg. Co.

Forges.
Sturtevant Co., B. F.

Fuses and Fuse Wire.
Amer. Elec. Fuse Co.
Bissell Co., The F.
Central Electric Co.
Central Tel. & El. Co.
Chicago Dle & Electric Co.
Chicago Fuse Wire & Mfg. Co.
Clinton Stamping & Elec. Co.
D. & W. Fuse Company.
Electric Appliance Co.
Johns-Manville Co., H. W.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Company.

Globes, Reflectors and Shades.
Fostoria Incan. Lamp Co.
Holophane Glass Co.
Pardridge Shade & Refl. Co.
Phœnix Glass Co.
Wesco Supply Co.
Western Electric Co.

Governors, Water Wheel.
Replogle Governor Works.

Graphite Specialties.
Dixon Crucible Co., Jos.
Holmes Fibre-Graphite Co.

Heating (Exhaust Steam).
Amer. District Steam Co.

Heating and Ventilating Apparatus.
Sturtevant Co., B. F.

Heating, Hot Water.
Evans, Almirall & Co.

Holders, Inc. Lamps.
Electric Appliance Co.
Incandesent Electric Light Manipulator Co.

Inspection & Insurance
Hartford Steam Boiler Inspection & Insurance Co.

Insulating Machinery.
New England Butt Co.

Insulators and Insulating Materials.
American Electrical Works.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Inc. Arc Light Co.
Indiana Rub. & Ins. Wire Co.
Johns-Manville Co., H. W.
Kartavert Mfg. Co.
Manhattan Elec. Supply Co.
Mica Insulator Co.
Munsell & Co., Eugene.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Sterling Varnish Co.
Vulcanized Fibre Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Junction Boxes.
Bossert Elect. Const. Co.
General Inc. Arc Light Co.

Lamps, Arc.
Bissell Co., The F.
Central Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
General Inc. Arc Lt. Co.
Gregory Electric Co.
Kipwell Manufacturing Co
Manhattan Elec. Supply Co.
Stanley Elec. Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Lamps, Incandescent.
Bissell Co., The F.
Bryan-Marsh Company.
Buckeye Electric Company.
Central Electric Co.
Chicago Edison Co.
Columbia Incan. Lamp Co.
Edison Decorative & Miniature Lamp Dept.
Electric Appliance Co.
Fostoria Incand. Lamp Co.
Franklin Electric Mfg. Co.
General Electric Co.
General Inc. Arc Light Co.
Sawyer-Man Elec. Co.
Standard Elec'l Mfg. Co.
Sterling Electrical Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Lamps, Incandescent—Repincers & Cleaners.
Inc. El. Lt. Manipulator Co.

Lamps, Vapor.
Cooper, Hewitt Elec. Co.

Letters, Sign.
Colonial Sign & Insulator Co.

Lightning Arresters.
Central Electric Co.
Clinton Stamping & Elec. Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
Manhattan Elec. Supply Co.
Stanley Elec. Mfg. Co.
Wesco Supply Co.
Western Electric Co.

Linemen's Climbers.
Klein & Sons, Mathias.

Magnet Wires.
(See Wires and Cables.)

Mechanical Draft.
Sturtevant Co., B. F.

Mica.
Chicago Mica Co.
Mica Insulator Co.
Munsell & Co., Eugene.

Mining Apparatus, Elec.
Allis-Chalmers Company.
Crocker-Wheeler Company.
General Electric Co.
Jeffrey Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Motors. (See Dynamos and Motors.)

Nippers and Pliers.
Klein & Sons, Mathias.

Nozzles.
Faries Mfg. Co.

Overalls.
Carhartt & Co., Hamilton.

Patent Attorneys.
Bain, Foree.

Phosphor Bronze.
Phosphor Bronze Sm. Co. Ltd.

Platinum, Wire and Sheet.
American Platinum Works.
Baker & Company Inc.

Poles and Ties.
Berthold & Jennings.
Brooks, Hall L.
Columbia Mfg. Co.
Fowler, John H.
Fowler-Jacobs Company.
Kellogg Switch. & Sup. Co.
Lindsley Bros. Co.
Loud's Sons Co., H. M.
Maltby Cedar Co.
Morrison Lbr. Co., J. W.
Mueller Company, William.
Pacific Coast Pole Co.
Phelan, D. W.
Pittsburg & L. S. Iron Co.
Porter Cedar Company.
Sterling & Son, W. C.
Torrey Cedar Co.
Valentine-Clark Co., The.
Worcester Co., C. H.

Polish (Metal).
Allen Co., Inc., L. B.
Hoffman, Geo. W.

Portables.
Faries Mfg. Co.

Power Transmission Machinery.
Jeffrey Mfg. Co.

Rail Joints.
Continuous Rail Joint Company of America.

Railway Supplies.
Wesco Supply Co.

Rectifiers.
Electrical Appliance Co.

Refiners.
Gt. West Smelt. & Refining Co

Re-Winding—Repairs.
Chicago Edison Co.
Gregory Electric Co.

Rheostats.
Amer. Electric Fuse Co.
Cutler-Hammer Mfg. Co.
General Electric Co.
Gen'l Inc. Arc Lt. Co.
Union Electric Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Rods, Conduit.
Cope, T. J.

Schools and Colleges.
Electrical Engineer Inst.
Highland Park College

Second-Hand Mach'y.
Bissell Co., The F.
Cent. Stat. Improvement Co.
Cincinnati Gas & Elec. Co.
Gregory Electric Co.
Matthews & Bro., W. N.
Walsh's Sons & Co.

Shades, Lamp.
Faries Mfg. Co.

Sheet Brass & Copper.
Plume & Atwood Mfg. Co.

Signs, Electric.
Zero Marx Sign Works.

Silks, Insulating and Braiding.
Sauquoit Silk Mfg. Co.

Sockets & Receptacles.
Pass & Seymour.
Yost Elec. Mfg. Co.

Soldering Sticks, Salts and Paste.
Crollus & Son, E. R.
Kester Elec. Mfg. Co.
Western Electric Co.

Speaking Tubes.
Central Electric Co.
Edwards & Co.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.

Speed Indicators.
Weston Electrical Inst. Co.

Storage Batteries.
American Battery Co.
Electric Storage Battery Co.
Gould Storage Battery Co.

Supplies, General Elec.
Bissell Co., The F.
Central Electric Co.
Century Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Electric Co.
Manhattan Elect'l Supply Co.
Wesco Supply Co.
Western Electric Co.

Switchboards.
Bissell Co., The F.
Gen. Incan. Arc Light Co.

Telephones, Telephone Materials and Switchboards.
American El. Telephone Co
Automatic Electric Co.
Bissell Co., The F.
Central Electric Co.
Central Tel. & El. Co.
Electric Appliance Co.
International Tel. Mfg. Co.
Kellogg Switchb. & Sup. Co.
Manhattan Elec. Supply Co.
Stromberg-Carlson Tel. M. Co
Wesco Supply Co.
Western Electric Co.

Time Switches.
Bissell Co., The F.

Tools.
Klein & Sons, Mathias.
Western Electric Co.

Transformers.
Central Electric Co.
Crawfordsville Electric Co.
Crocker-Wheeler Co.
Electric Appliance Co.
Ft. Wayne Elec. Works, Inc.
General Electric Co.
Gregory Electric Co.
Kuhlman Electric Co.
Manhattan Elec. Supply Co.
National Electric Co.
Stanley Elec. Mfg. Co.
Wagner Electric Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Trucks, Electric Car.
General Electric Co.
Westinghouse El. & Mfg. Co.

Turbines, Steam.
Allis-Chalmers Co.
General Electric Co.
Westinghouse El. & Mfg. Co

Turbine Water Wheels
Leffel & Co., Jas.

Varnishes.
Sterling Varnish Co.

Vulcanized Fibre.
Vulcanized Fibre Co.

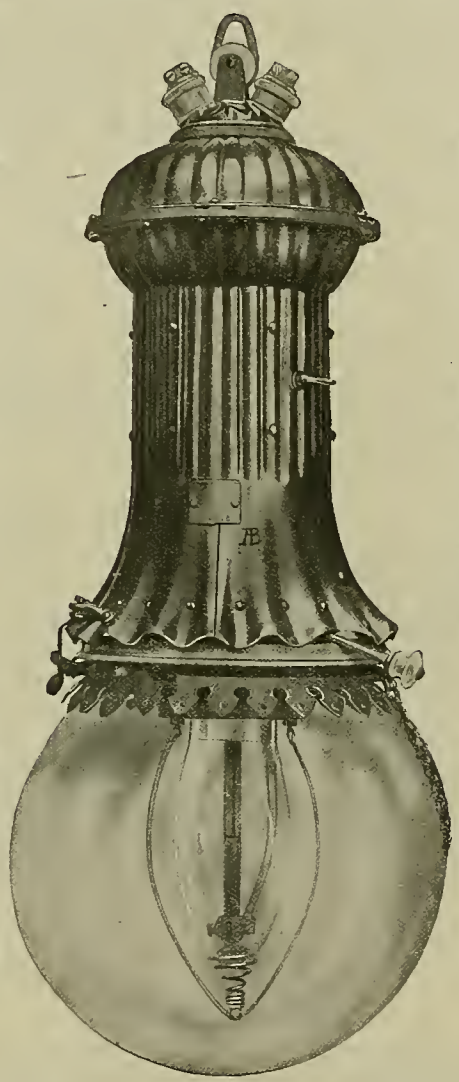
Whistles, Electric.
Electrical Appliance Co.

Wires & Cables—Magnet Wires.
American Electrical Works.
Bissell Co., The F.
Central Electric Co.
Chicago Insulated Wire Co.
Crescent Ins. Wire & Cble. Co.
Electric Appliance Co.
General Electric Co.
Bazard Manufacturing Co.
Indiana Rub. & Ins. Wire Co
India Rubber & Gutta Percha Insulating Co.
Kellogg Switch. & Sup. Co.
Manhattan Elec. Supply Co.
National India Rubber Co
New York Insulated Wire Co.
Northern Wire & Cable Co.
Okonite Co., The.
Phillips, Eugene F.
Phillips Insulated Wire Co
Roebling's Sons Co., J. A.
Runzel-Lenz Elec. Mfg Co.
Safety Ins. Wire & Cable Co.
Simplex Electrical Co.
Standard Underground C. Co
Wesco Supply Co.
Western Electric Company.

For Alphabetical Index of Advertisements See Page 3.

A-B ARC LAMPS

FOR ALL CIRCUITS



SPECIAL FEATURES

Accessibility of Mechanism,

Ease of Removing Inner and Outer Globe,

Ease of Trimming,

Weatherproof Construction,

Stamped Copper Cases and Simplicity of Mechanism.

THERE IS

A greater number of Adams-Bagnall Constant Direct Current Series Enclosed Arc Lamps used for street lighting throughout the United States, Canada and Mexico than all other makes of this type of lamp combined.

SEND FOR CATALOGUE

AGENCIES

Doubleday-Hill Electric Co., Pittsburg, Pa.
Electric Appliance Co., Chicago, Ill.
The Wesco Supply Co., St. Louis, Mo.
H. C. Roberts Electric Supply Co., Philadelphia, Pa.
Pettingell-Andrews Co., Boston, Mass.
Cia. Benbow-Dutton, S. A., City of Mexico, Mex.
Geo. F. Rohn, Milwaukee, Wis.

AGENCIES

B-R Electric Co., Kansas City, Mo.
A. J. Michell, Atlanta, Ga.
Interstate Electric Co., New Orleans, La.
Post-Glover Electric Co., Cincinnati, O.
Miller-Seldon Electric Co., Detroit, Mich.
W. G. Nagel Electric Co., Toledo, Ohio.
R. E. T. Pringle Co., Ltd., Montreal Que.

THE ADAMS - BAGNALL ELECTRIC CO.

New York Office: 136 Liberty St. CLEVELAND, OHIO Chicago Office: 303 Dearborn St.

"Just As Good As Day Light"

No Shadows, No Glare, No Flicker.

Cooper Hewitt Mercury Vapor Lamps

TYPE H-6 LAMP.

diffuse their light so that it strikes your work from all sides. There is no "standing in your own light." There is no need of adjusting brackets, cords or lamp holder. The cost is but 35% of other Electric Lighting. There is no consumption of light-giving element and no need of trimming. Have twice the efficiency of the arc lamp and from 7 to 9 times the efficiency of the incandescent.

Especially adapted for use in drafting rooms, machine shops, press rooms, factories and offices.

Send for Booklet.

For Direct Current Systems Only.

We were awarded by the Louisiana Purchase Exposition a Gold Medal for Vapor Lamps for Photo-Eograving and also the Grand Prize for Electric Lighting Work in the development of the Mercury Vapor Lamp.

Cooper Hewitt Electric Co.

220 W. 29th St. New York City

Philadelphia Office, 1121 Walnut Street.

HENRY NEWGARD & CO.

ELECTRICAL CONSTRUCTION

Power and Light Plants. Switchboards and Panel Boards.

We install Municipal and Isolated Electric Lighting Plants.
We manufacture Switchboards, Table boards, Iron Cutout Boxes and Electrical Specialties.
We sell Dynamos, Motors and Electrical Supplies.
We wire old as well as new Residences, Factory Buildings, School and College Buildings.

87 Fifth Avenue, Chicago, Illinois.

"NEW STANDARD" DRY BATTERIES

Are the Standard of

OUR NAVY AND THE WORLD.

An experience of many years in dry battery manufacture has given this battery the supremacy it holds over all others. It is the best dry cell ever made.

They are made in all standard and special sizes.

THE "AUTOGAS" DRY BATTERY

For Portable Service is the Best Made.

For Automobiles, Launches, and all ignition work where compactness is a requisite.

WM. ROCHE,

INVENTOR AND SOLE MANUFACTURER,
52-54 PARK PLACE, NEW YORK

NOW READY!

WESTERN ELECTRICIAN'S

MOONLIGHT SCHEDULE

FOR 1905.

TEN CENTS A COPY.

Electrician Publishing Co.,

510 MARQUETTE BUILDING,

CHICAGO.

SWITCHBOARDS

Prices on the spot and orders —with good goods.

Engineers and contractors will find our Hand Book, 117 W, a great convenience.

THE F. BISSELL COMPANY
BUILDERS OF SWITCHBOARDS
TOLEDO, O.

Perfect Control — Indefinite Regulation
No Flashing—No Repairs
Burnouts Impossible—Last Forever

ALLEN-BRADLEY
RHEOSTATS

For All Purposes of Electric Current Control

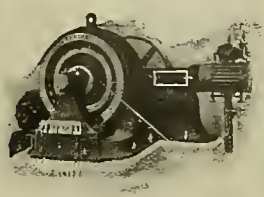
Prices Reasonable—Satisfaction Guaranteed

SEND IN A TRIAL ORDER

Ask your Engineer or Electrician about it.

AMERICAN ELECTRIC FUSE CO.
48-50 West Jackson Boul.
CHICAGO, ILL.

Warren Alternator



OVER 600
WARREN
CENTRAL
STATIONS
RUNNING TO-DAY IN THE
UNITED STATES

WARREN ELECTRIC MFG. CO.
Sandusky, O.

General Electric Company

THREE-PHASE TRANSFORMERS
ARE
CHEAPER, LIGHTER, MORE COMPACT
AND MORE READILY INSTALLED
than an equal capacity of Single-Phase Transformers

50 Kw. 40 Kw. 30 Kw. 20 Kw. 15 Kw. 10 Kw. 7.5 Kw. 5 Kw.

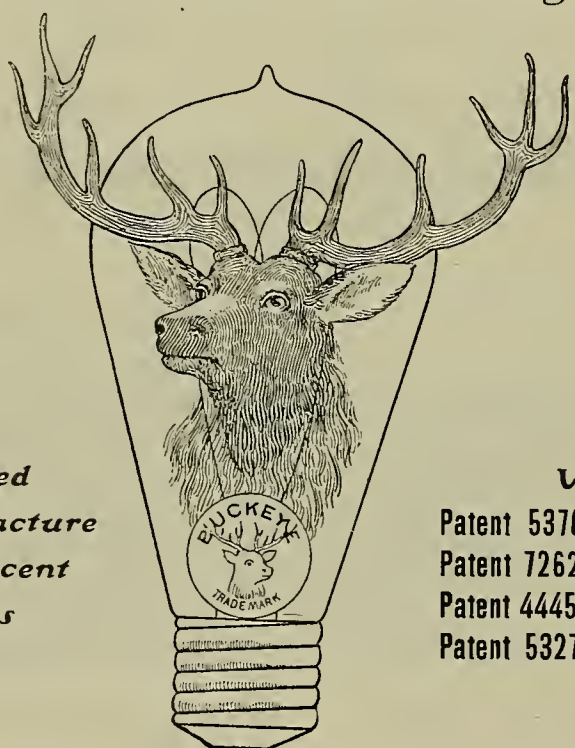
Principal Offices, Schenectady, N. Y.

Chicago Office, Monadnock Block. Sales Offices in all Large Cities.

"BUCKEYE"

THE LAMP OF QUALITY

Uniform Selection.
Longest Maintenance of Life.
Uniform Distribution of Light.



Licensed to Manufacture Incandescent Lamps

Under
Patent 537693, April 16, '95
Patent 726293, April 28, '03
Patent 444530, Jan. 13, '91
Patent 532760, Jan. 22, '95

Buckeye Quality is produced by using the very best materials, methods and skilled labor and proved by

31 RIGID INSPECTIONS.

Buckeye Electric Co.,

Main Sales Office and Works
CLEVELAND, OHIO.

CHICAGO,
1537 Monadnock Bldg.

PITTSBURG,
1102 Empire Bldg.

It Will Interest You to Know What the **Western Electric Company** Have to Say Regarding

ELECTRA
TRADE MARK

HIGHEST GRADE NUERNBERG

CARBONS

in their circular letter dated October 7, 1904, which in part reads as follows:

"It seems almost an unnecessary proceeding to write a letter advertising the 'ELECTRA' Carbon, or to dwell upon its merits, to any great extent, inasmuch as the 'ELECTRA' Carbon is the STANDARD OF PERFECTION, to which all other manufacturers of carbons endeavor to reach. We think this is a sufficient recommendation in itself.

If you have not been using these carbons in your arc lamps, it would certainly pay you to give them a trial. You will find that the expenses of trimming are reduced from 15 to 20 per cent."

HUGO REISINGER, Sole Importer, 11 Broadway, NEW YORK CITY

Platinum

In Sheet or Wire for all Purposes.
SCRAP PURCHASED.
AMERICAN PLATINUM WORKS
CHAS. ENGELHARD, Gen. Mgr.
251 to 255 New Jersey R. R. Ave., Newark, N. J.

Our Compound Stops Sparking and Saves Commutators.
14 Years' Use on Street Ry., Light and Power Commutators Has Proven its Worth. WE GUARANTEE RESULTS.
Send Your Address for FREE SAMPLE THAT CONVINCES.
JAS. McLAUGHLIN & CO., ELECTRICAL ENGINEERS
586 Fulton Street, - - Chicago, Ill.

PROMETHEUS
Electric Heating and Cooking Apparatus.

Most Modern and Efficient System.

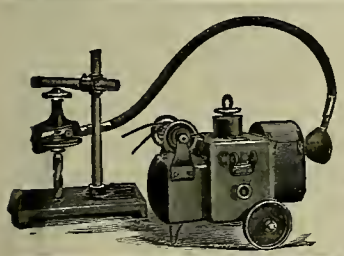
Send for Illustrated Catalogue.

THE
Prometheus Electric Co.,
39 CORTLANDT STREET, NEW YORK.

DON'T BUY ELECTRICAL SUPPLIES

Until you have seen our new Catalogue and new Price List.
Free to the trade.

Manhattan Electrical Supply Co.
NEW YORK: 32 Cortlandt St.
CHICAGO: 188 Fifth Ave.

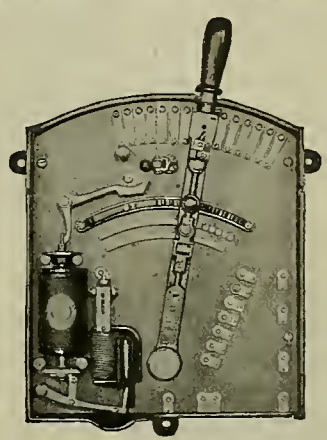


ESTABLISHED 1875.
COMBINATION OF
Stow Flexible Shaft
AND
MULTI-SPEED MOTOR

Practically dust and water proof. For Portable Drilling, Tapping, Reaming, Emery Grinding, etc. Write for Catalogue and Prices.

STOW MFG. CO., Binghamton, N. Y.
Gen'l European Agents, Selig, Sonnentbal & Co., 85 Queen Victoria Street, London, England

Flat Bed and Small Rotary Press Controllers

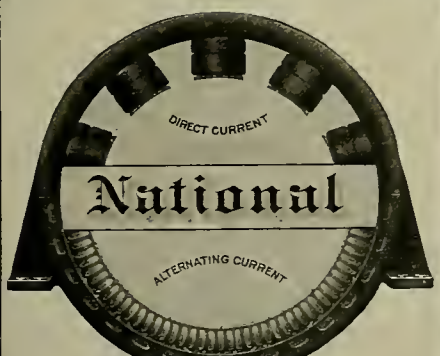


One of the six "Carpenter" types.

The "Carpenter" system gives such a wide range of speed and such perfect control that a press can be moved an eighth of an inch at a time, and from that to top speed, with every desirable intermediate speed.

Six types, alike in principle, different in detail. Bulletins 81 to 86 explain. We'll send them if you let us know that you want them.

The Cutler-Hammer Mfg. Co.,
Electric Controller Manufacturers and Electrical Engineers.
MILWAUKEE, WIS.
New York, Boston, Chicago, Pittsburg.



TRADE MARK

Lundell
"Universal"
Apparatus

Represents finality of design. Constant and Variable Speeds. Ratio: 3 to 1.

Direct and Alternating Current
Generators

Built in all capacities for Lighting, Power and Railway Service.

National Electric Company

General Sales Office and Works
MILWAUKEE
New York Philadelphia Charleston, W. Va. Pittsburg Chicago Seattle San Francisco

FLEXDUCT

XXXX

LIST OF ELECTRICAL FITTINGS.
Tubing, Flexible.
Alphaduct Manufacturing Co, New York, N. Y., "Alphaduct."
American Circular Loom Company, Chelsea, Mass., "Circular Loom," 1905 type.
Osburn Flexible Conduit Co., Hoboken, N. J., "Flexduct."

OCTOBER, 19
SUPPLEMENT TO THE NATIONAL ELECTRICAL CODE
LIST OF
TRICAL FITTINGS

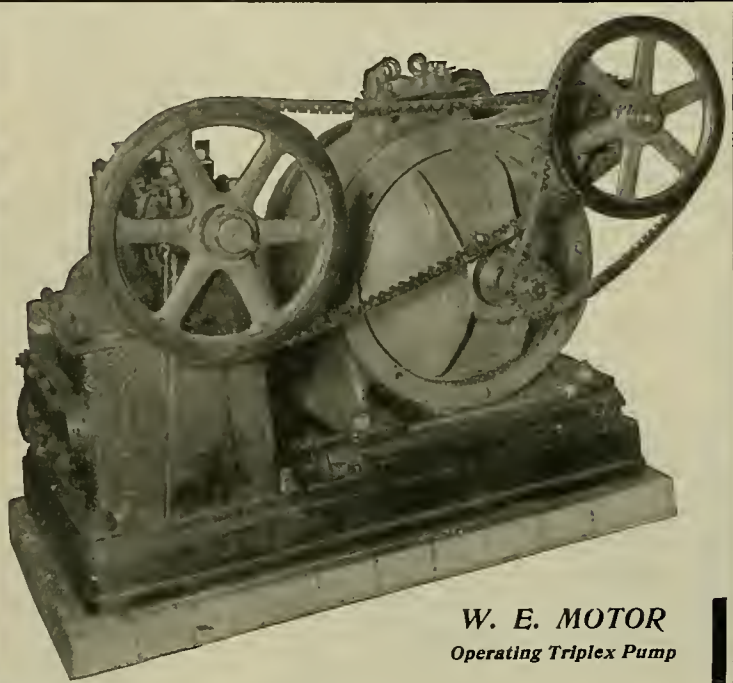
"Flexduct" the old reliable meets all conditions without a criticism — it stands without a flaw — no uncertainties approved by all official boards of inspection. Specify "Flexduct"
For sale by all jobbers + dealers

SAUQUOIT SILK MFG. COMPANY.

INSULATING and BRAIDING SILKS

MILLS:
BETHLEHEM, PA.
PHILADELPHIA, PA.
SCRANTON, PA.

NEW YORK REPRESENTATIVES:
WILLIAM RYLE & COMPANY
54 Howard St.
PHILADELPHIA OFFICE:
4015 Clarissa St.
CHICAGO OFFICE:
210 Monroe St.
BOSTON OFFICE:
78 Chauncy St



W. E. MOTOR
Operating Triplex Pump

WESTERN ELECTRIC COMPANY

CHICAGO NEW YORK

OTHER LARGE CITIES
BULLETINS ON REQUEST

EDWARDS AND CO

THE "RECTI" BELL

FOR AUTOMOBILES AND ELECTROMOBILES.

No. 100.

This Bell may be placed on the outside of the vehicle without being cased. The gong is adjusted with the concavity downward, so that mud and dust can not collect and deaden the sound.

WESTERN ELECTRIC CO., Selling Agts.

NEW YORK N.Y

"MANROSS" HAIR SPRINGS

For Electric Indicating and Recording Gauges, Steam Gauges, Etc

LARGEST MANUFACTURER OF HAIR SPRINGS in the United States.

F. N. MANROSS,
FORESTVILLE, CONN.

ARE YOU LOOKING FOR TROUBLE?
IF SO, GET A COPY OF
TELEPHONE TROUBLES
AND HOW TO FIND THEM
—IN—
BOTH MAGNETO AND COMMON BATTERY SYSTEMS.
9th Edition Just Out. Price, 25c.
Electrician Publishing Co.,
510 Marquette Building,
CHICAGO.

IMPORTANT TELEPHONE BOOKS.

THE TELEPHONE HANDBOOK. By Herbert Laws Webb. 16mo, 150 pp. Price $1.00.
This handbook is a reliable treatise on telephony, and a practical book on telephone working and management, based entirely on standard American practice. It is extremely useful to telephone inspectors and operators.

AMERICAN TELEPHONE PRACTICE. By Kempster B. Miller, M. E. 510 pp. 380 illustrations. Price $3.00.
This is the first complete treatise on telephony in the English language. The text is profusely illustrated by cuts of commercial apparatus and carefully prepared diagrams of circuits. No diagram is given without a full explanation. The apparatus, circuits and methods of the American Bell Telephone Company and of the various independent companies are fully described. The apparatus and methods used in making all of the tests required in commercial telephone work are fully treated.

THE INSPECTOR AND TROUBLE MAN. By A. E. Dobbs. 166 pp. Price $1.00.
A practical book, written in plain language. Full of information and diagrams for the operator, exchange manager, inspector, trouble man and lineman. A complete description of telephones, how to find and remedy their troubles, together with working plans for exchange construction, complete with diagrams of all up-to-date telephones and switchboards.

A, B, C, OF THE TELEPHONE. By J. E. Homans, A. M. 352 pp. 269 illustrations. Price $1.00.
Owing to the demand for a comprehensive book giving a clear, terse idea of the principles governing the construction, installation, care and management of telephones and their appliances, this book has been compiled. It has been the aim of the author to make this the most complete elementary book on the subject for the practical electrician, wireman, lineman and engineer, and it is written in a clear and careful style.

THE PRACTICAL TELEPHONE HANDBOOK. By Joseph Poole, A. I. E. E. Second edition, revised and enlarged. 360 pp. 288 illustrations. Price $1.50.
In this work the writer has endeavored to produce a manual of moderate size and cost, but thoroughly practical, and detailing, as far as space will allow, the most recent methods of telephone working. While the requirements of telephone employes have been kept constantly in view it is fully intended also that the book shall be of service as a source of information on telephonic matters to users of the telephone and to the public generally.

PRACTICAL FEATURES OF TELEPHONE WORK. By A. E. Dobbs. 134 pp. Price 75 cents.
A simple, plain-speaking handbook for the practical telephone man.

TELEPHONE TROUBLES AND HOW TO FIND THEM. A complete handbook for telephone inspectors. By W. Hyde and J. H. McManman, edited by Prof. C. H. Haskins. Eighth edition. 16mo, 48 pp. Price 25 cents.
This little volume is an extremely practical work for telephone employes, written in a popular style and devoid of technicalities.

TELEPHONE LINES AND THEIR PROPERTIES. By Wm. J. Hopkins. Sixth edition. 272 pp. Illustrated. Price $1.50.

A MANUAL OF TELEPHONY. A new and large edition. By W. H. Preece, F. R. S., and A. J. Stubbs. 508 pp. 333 illustrations. Price $4.50.

TELEPHONES, THEIR CONSTRUCTION AND FITTING. A Practical Manual on the Fitting Up and Maintenance of Telephone and Auxiliary Apparatus. By F. C. Allsop. 191 pp. 168 illustrations. Price $1.25.

PATENTED TELEPHONY. A Review of the Patents Pertaining to Telephones and Telephonic Apparatus. Published by the American Electrical Engineering Association. Cloth bound; fully illustrated. Price, $1.50.

THE ELECTRIC TELEPHONE. By E. J. Houston, Ph. D., and A. E. Kennelly, Sc. D.; 12mo, cloth, 422 pp., 142 illustrations. Price $1.00.

HOW TO MAKE AND USE THE TELEPHONE. By Geo. B. Cary. 136 pp.; illustrated. Price $1.00.

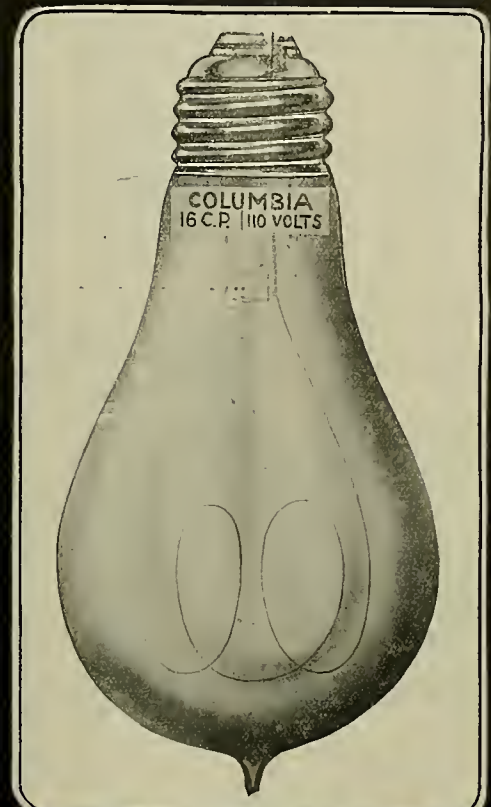
The Above, or Any Other Electrical Work Published, Sent on Receipt of Price.

ELECTRICIAN PUBLISHING CO., 510 MARQUETTE BLDG., CHICAGO.

SPEER HIGH GRADE CARBON BRUSHES
MOTOR AND GENERATOR CARBON BRUSHES
SPEER CARBON CO., - St. Marys, Pa.

COLUMBIA-LAMPS

GIVE MOST LIGHT



UNEQUALED IN QUALITY

If your customers are complaining about their lamps, and you find your coal bills are running high, it is certain you are not using Columbia lamps.

Remember, we sell our lamps under a positive guarantee that they will be found exactly as represented. Absolutely *uniform in initial readings for candle-power, voltage* and *efficiency*, and *highest in maintenance of candle-power.*

Place a trial order for present or future shipment, and satisfy yourself as to the truth of our claims.

LAMPS IN STOCK AT BRANCH OFFICES. *SEND FOR REDUCED PRICE LIST.*

Columbia Lamps are manufactured under a License to use the Chemical Exhaust Process of exhausting lamps. This process is vitally necessary in the production of the highest quality of lamp. Every package of Columbia Lamps carries a label reading

Licensed Under { Patent No. 537,693, April 16, '95. Patent No. 444,530, Jan. 13, '91. Patent No. 726,293, April 28, '03. Patent No 532,760, Jan. 22, '95.

Send for our catalogue of Crystal Lamps (Meridian type). We are prepared to furnish a complete line of Pagoda Reflectors and Holophane Globes. Write for prices. Copy of our "Wallet Full of Wisdom" mailed on request.

New York Office, 1311 Bavemeyer Bldg.
Philadelphia, 1227 Real Estate Trust Bldg.
Chicago, Central Electric Co.
Minneapolis, 638 Boston Block.
Memphis, Tenn., 302 Scimitar Bldg.
San Francisco, Paul Seiler Electric Works.
Mexico, Monterey, Van Voorhis, Bros.

The Columbia Incandescent Lamp Co.

ST. LOUIS, MO., U. S. A.

SATISFIED CUSTOMERS

Are those who are buying such specialties from us as

Packard Lamps and Transformers,
Adams-Bagnall Arc Lamps,
"O. K." Weatherproof Wire,
Peerless and Paranite Rubber Covered Wire,
Brunt Porcelain,
Ansonia Magnet Wire,
Circular Loom, Etc., Etc.

ELECTRIC APPLIANCE COMPANY,
CHICAGO AND SAN FRANCISCO.

Made in four sizes { 8 lights, 16 "", 24 "", 32 "" } $5.00 and upwards

Electric Lighting Outfits

READY FOR USE

Very popular for electric lighting decorations and especially adapted to the lighting of Christmas trees.

Safe, Simple and Convenient

EDISON DECORATIVE & MINIATURE LAMP DEPARTMENT

GENERAL ELECTRIC COMPANY,
Harrison, N. J.

MICA

Of all Qualities, in any Form at Lowest Prices
EUGENE MUNSELL AND CO.
NEW YORK and CHICAGO

INSULATION That Is.

Micanite, Linotape, M. I. C. Compound, Empire Cloth and Paper. For Years the Standard.

MICA INSULATOR CO., Originators
NEW YORK and CHICAGO

SPARKING

Reduces the working capacity of a motor or dynamo, wears out the commutator, wastes power and may cause a fire. All this may be avoided if you use . . . . . .

The only article that will PREVENT SPARKING. Will keep the Commutator in good condition and PREVENT CUTTING.

Absolutely Will Not Gum The Brushes.

50 Cents per Stick. $5.00 per Dozen.
SEND FOR FREE SAMPLE STICK.
For sale by all supply houses, or

It will put that high gloss on the Commutator you have so long sought after.

K. McLENNAN & CO., Sole Mfrs., Room 411 Inter Ocean Bldg., 130 Dearborn St., CHICAGO

BEARDSLEE CHANDELIER M'F'G CO. 256 AND 257 SO. CANAL ST. CHICAGO
GAS & ELECTRIC FIXTURES FOR THE TRADE.
CATALOG SENT PREPAID TO DEALERS MENTION THIS PAPER

MICA—BOND

Notice how our competitors try gradually to raise Cut Mica prices—same thing would occur in manufactured mica if we were not the leaders

CHICAGO MICA CO
"PERFECTORS" VALPARAISO, IND.

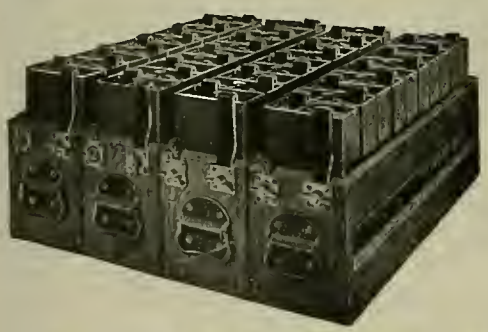
REPAIRING RECALIBRATING

ELECTRIC METERS.
INTERNATIONAL ELECTRIC METER CO.
167 S. CANAL STREET, CHICAGO.

VOLT - AMMETERS,

POCKET SIZE.
For Testing Batteries and Battery Circuits, Locating Faults, Grounds, etc.
RELIABLE. ACCURATE.
Send for Circular.
L. M. PIGNOLET,
78-80 Cortlandt St., NEW YORK, N. Y.

GIVES BEST RESULTS



Northwestern Storage Battery

Cannot be equaled for

Great Capacity, Lightness and Efficiency

LOW TENSION WORK

Write for Catalogue.

Northwestern Storage Battery Co.,
285 Madison Street, - - - - Chicago, Ill.

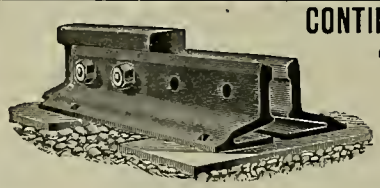
USE

"SAFETY" RUBBER COVERED WIRE AND CABLE

FOR EVERY ELECTRICAL SERVICE.

M. B. AUSTIN & CO.,
CHICAGO REPRESENTATIVE.

THE SAFETY INSULATED WIRE & CABLE CO.,
WORKS: Bayonne, N. J. 114-116 LIBERTY STREET, N. Y.



CONTINUOUS RAIL JOINT CO. OF AM.

GENL. OFFICES: CENTURY BLDG., NEWARK, N.J.

OVER 20,000 MILES IN USE

See our exhibit, World's Fair, St. Louis, Mo., Transportation Bldg., Aisle "C," Posts 7 and 8.

There is No Higher-Class India-Rubber Insulation For Wires and Cables than

HABIRSHAW.

Authorized Manufacturers of the

ATTIX FLEXIBLE TUBE WIRE.

The India-Rubber and Gutta-Percha Insulating Co.,

MAIN OFFICE, Glenwood Works,

Sales Office,
15 Cortlandt St., New York.

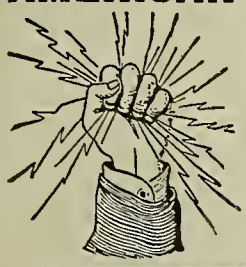
YONKERS, N. Y.

(10928)

FRANK N. PHILLIPS, President. EUGENE F. PHILLIPS, General Manager. E. ROWLAND PHILLIPS, Vice-Pres. C. H. WAGENSEIL, Treasurer. C. R. REMINGTON, Jr., Sec.

AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.



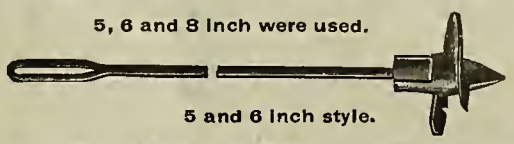
BARE AND INSULATED ELECTRIC WIRE,
ELECTRIC LIGHT LINE WIRE,
INCANDESCENT AND FLEXIBLE CORDS,
Railway Feeder and Trolley Wire,
AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR WIRES.
CABLES FOR AERIAL AND UNDERGROUND USE.

New York Store, W. J. Watson, 26 Cortlandt St.
Chicago Store, F. E. Donohoe, 82 Lake St.
Montreal Branch, Eugene F. Phillips' Electrical Works.
MAIN OFFICES AND FACTORIES, PHILLIPSDALE, R. I.

DO YOU?
BUY LAMPS-OR-BUY CANDLE POWER
16 THIS LAMP AVERAGES 12
THE STERLING ELECTRICAL MANUFACTURING CO.
STERLING SPECIAL NEW YORK, N. Y. WARREN, O. CHICAGO, ILL.

REGULAR TYPE

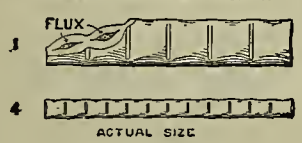
THE UNITED STATES GOVERNMENT
USED
The Stombaugh Guy Anchor
EXCLUSIVELY FOR
Anchoring Electric Light and Telephone Poles at Our Largest Military Post, Fort Riley, Kan.
5, 6 and 8 Inch were used.



5 and 6 Inch style.
W. N. MATTHEWS & BRO., Manufacturers
603 Carleton Building, St. Louis

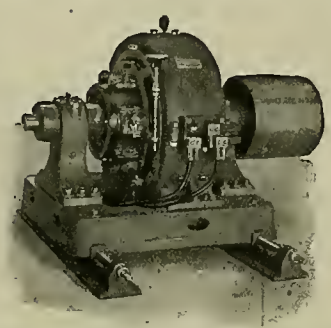
EXPERT IN ELECTRICITY MECHANICS PATENT CAUSES
SOLICITOR OF U. S. & FOREIGN PATENTS
FORÉE BAIN, 1652-3 Monadnock Blk., CHICAGO

KESTER
SELF FLUXING SOLDER
A Tube of Solder Filled with Flux.
Requires no Acid.
SAVES—LABOR—TIME—MONEY.



PATENTED.
Send for Free Samples.
L. F. Mahler Co., R. 1008 Chemical Bldg., St. Louis, Mo., Gen. Western Agent.
KESTER ELECTRIC M'F'G CO.,
48 N. UNION STREET, CHICAGO, ILL.

DIRECT CURRENT
GENERATORS
FOR LIGHT AND POWER



Our generators have a high efficiency and great endurance under the most exacting conditions of service. Sizes up to 1,000 K. W.
Write for bulletin No. 10514.
SPRAGUE
ELECTRIC COMPANY
General Offices:
527 West 34th Street, New York
Chicago Office: Fisher Building

SINGLE AND POLYPHASE
TRANSFORMERS
KUHLMAN ELECTRIC CO., - - Elkhart, Ind.

Controlling Devices
OF ALL KINDS
MOTOR STARTERS
SPEED REGULATORS
FIELD REGULATORS

Motor Starter with Automatic Release.
Manufactured under our own patents.
SEND FOR CATALOG
Union Electric Mfg. Co.
Milwaukee, Wis.

Crimshaw

Raven White Core

Raven Black Core

ALL OUR WIRES pass inspection and carry the above TRADE-MARKS on our tags. We also manufacture Crimshaw and Competition Tapes and Splicing Compounds.

NEW YORK INSULATED WIRE COMPANY,

MAIN OFFICE: 114, 116 & 118 Liberty St., New York.
BRANCHES: CHICAGO: 192 Desplaines St. BOSTON: 7 Otis St. SAN FRANCISCO: 33 Second St.

NATIONAL CODE STANDARD

"O. K." Weatherproof Wire.
Slow-Burning Weatherproof and Ideal Wire.
Prices and Samples on Application.
Phillips Insulated Wire Co.
Office and Factory: PAWTUCKET, R. I.

ELECTRIC SIGNS
INCREASE YOUR CURRENT CONSUMPTION.
Assist us to sell ELECTRIC SIGNS to the best merchants in your city.

No repair bills with our signs we furnish the best—all metal raised letters equipped with removable copper shell sockets. WRITE US, we will conscientiously study your sign wants and gladly submit drawings with very low quotations for the best work.

ZEROMARX SIGN WORKS
CHICAGO, ILL.

WANTED, FOR SALE *and similar* **WANT COLUMN** *advertisements (50 words or less), $1.50 an insertion; additional words 3c each.* **POSITION WANTED** *advertisements (50 words or less), $1.00 an insertion; additional words 2c each.*

WANTED.

A man familiar with pole-line construction, interior wiring, general work around a central station and can handle men to an advantage. References required. Apply by letter to Supt. ELECTRIC LIGHT PLANT, Highland Park, Ill.

FOR SALE.

Electric-light plant in Central Ohio. Population 4,500. The greatest bargain ever offered for cash. Address, BOX 423, care Western Electrician, 510 Marquette Bldg., Chicago, Ill.

FOR SALE

1 Stanley generator, two-phase, 16,000 alternations, 1,000-2,000 volts, 40 K. W., 1333 R. P. M. and exciter.

1 Stanley generator, two-phase, 16,000 alternations, 1,000-2,000 volts, 60 K. W., 1,000 R. P. M. with exciter.
Complete marble switchboard with new instruments for above.

1 Westinghouse generator, 75 K. W., single-phase, 1,100 volts, 7,200 alternations, exciter, switchboard, new instruments complete, 750 R. P. M.

2 New belts.

1 Russell 13x20 4-valve engine, 200 R. P. M.

1 Ball 9½x10 engine, 350 R. P. M.

2 Boilers, 16x54 inch, 42 4-inch tubes, allowed 110 lbs. pressure, complete with 50-foot stack.

1 Hoppes heater. All steam pipe, valves, etc.

All in good condition. Can be seen running until December 15th. We are abandoning this plant on account of removal, and will sell all or in part. For further information, address

TIBBE ELECTRIC CO., Washington, Mo., or RUEBEL-SCHWEDTMANN-WELLS, St. Louis.

BOILERS.

One 42-in. x 16 ft. 9-in., 250 H. P. Worthington Water Tube.
One 60-in. x 16 ft., John Mohr Return Tubular Boiler.
One 64-in. x 16 ft., John Mohr Return Tubular Boiler.
One 54-in. x 16 ft., Devine Tubular Boiler.

ENGINES.

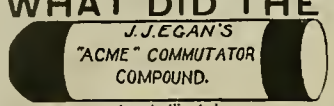
One 600 H. P., 21 x 36 x 30, Williams Tandem Horizontal Compound, 140 R. P. M.
Two 600 H. P., 20 x 30 x 24, Porter-Allen Tandem Compound, 200 R. P. M.
One 250 H. P., 12 x 24 x 18 Williams Tandem Compound, 250 R. P. M.
Two 100 H. P., 13 x 12, Dick & Church, High Speed Automatic.

PARTIAL LIST ONLY.

Send for latest Catalogue for bargains in Engines, Boilers, Dynamos and Motors.

CENTRAL STATION IMPROVEMENT CO., 938 Monadnock Block, Chicago

WHAT DID THE WOGGLE BUG SAY?



Agents Wanted.

YOU CAN'T DO LESS than give a good thing a trial. FREE SAMPLE J. J. Egan's Acme Commutator Compound, the only article that will absolutely prevent sparking, cutting or unnecessary wear of the commutator. Commutator always bright.

50 CENTS PER STICK ALL SUPPLY HOUSES OR $5.00 PER DOZEN

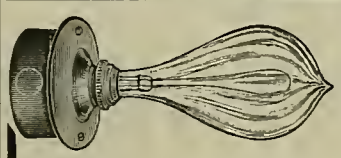
J. J. ECAN, 317 Austin Ave., CHICAGO

WORKS QUICK AND EASY. KEEPS ITS LUSTER. HOLDS OLD TRADE AND MAKES NEW. DOES NOT DETERIORATE. ESTABLISHED 16 YEARS. SOLD BY AGENTS AND DEALERS ALL OVER THE WORLD

U.S. METAL POLISH

3 Ounce Box 10 Cents
Samples Sent Free
GEO. W. HOFFMAN

POLISHES ALL METALS. Branches New York, Chicago, San Francisco. 295 E. Washington St. Indianapolis, Ind.



Some More Light on our Drawn Steel Junction Boxes

Take time to figure out the cost of cast-iron boxes plus the loss from breakage and time used in producing a round hole. Compare with this the cost of drawn steel boxes.

NO BREAKAGE,

Clean round hole produced with one blow of a hammer. Write for catalog and see what you can save.

BOSSERT ELECTRIC CONSTRUCTION CO. - - UTICA, N. Y.

A LIBRARY OF WELL SELECTED ELECTRICAL BOOKS

is of inestimable value to electricians. Such a library is best formed by occasional and carefully chosen purchases. ELECTRICIAN PUB CO., 510 Marquette Building, Chicago.

For Sale!

Combined Electric Light and Water Works Plant

in a live, growing town of about 2,500 population, within a radius of 300 miles of Chicago. Excellent opportunity for right man. Only small amount of capital required. Further particulars cheerfully given. Address BOX 425, care Western Electrician, 510 Marquette Building, Chicago.

FOR SALE

1-360 K. W.	General Electric	Alternator,	Three	Phase
1-240 "	Westinghouse	"	Single	"
2-150 "	Warren	"	"	"
1-150 "	Westinghouse	"	"	"
1-150 "	Wood	"	"	"
1-150 "	Stanley	"	"	"
1-120 "	General Electric	"	Three	"
1-120 "	General Electric	"	Single	"
1 120 "	Westinghouse	"	"	"
1- 90 "	General Electric	"	"	"
1- 75 "	Westinghouse	"	Two	"
1- 75 "	Westinghouse	"	Single	"
1- 75 "	Westinghouse	"	Two	"

Direct connected to Gates' Engine.

Send for our **Monthly Bargain Sheet** with complete list and net prices.

GREGORY ELECTRIC CO.
54-62 S. Clinton St., Chicago, Ill.

ELECTRICAL BOOKS

All Kinds

ELECTRICIAN PUBLISHING COMPANY,
Suite 510 Marquette, CHICAGO.

FOR SALE.

Central Station Equipments

One Plant Complete Consisting of the Following Principal Items:

BOILERS.

Six 200-h. p. Stirling water-tube boilers, equipped for Hawley down-draft furnaces.
Two 150-h. p. Stirling boilers, with plain grates.

HEATERS.

Two 250-h. p. Hoppes open heaters.
Two 400-h. p. Excelsior heaters.

PUMPS.

Two 7x4½x10 Laidlaw Dunn boiler feeders for 150 pounds' pressure.

ENGINES.

Three 250-h. p. Ball tandem compound engines, 15x25x16 inches, 200 revolutions.
Two 150-h. p. Porter-Allen engines, 14x20 inches, 230 revolutions.
One 150-h. p. Russell engine, 15x20 inches, 230 revolutions.
One 125-h. p. Hamilton Corliss, 16x30 inches, 90 revolutions.

GENERATORS.

Three 150-k. w. 250-volt Westinghouse generators. These generators directly connected to three 250-h. p. Ball engines.
Four 42.5-k. w. 125-volt Mather generators.
Four 37½-k. w. 250-volt Mather generators.
Four 37½-k. w. 125-volt Mather generators.

SWITCHBOARDS.

Two switchboards, with switches, measuring instruments, rheostats, etc., for control of above generators.
Another plant complete except boilers, consisting of the following principal items:

ENGINES.

Two Lane & Bodley Corliss engines, 24-inch diameter cylinders, 48-inch stroke, 70 revolutions.
Two Lane & Bodley Corliss engines, 30-inch diameter cylinders, 48-inch stroke, 70 revolutions.
Two Bull engines, cylinders 20-inch diameter, 18-inch stroke, 150 revolutions.
One Westinghouse vertical compound engine, with cylinders 16 inches and 26 inches x 18-inch stroke.
One Westinghouse vertical compound engine, with cylinders 18 inches and 30 inches diameter x 18-inch stroke.

GENERATORS.

Two Edison bipolar generators, 150 k. w., 500 volts.
Two C. & C. bipolar generators, 100 k. w., 500 volts.
One C. & C. bipolar generator, 30 k. w., 500 volts.
Two T.-H., alternating current, 133 cycles, 1,100 volts, 150 k. w.
Two Fort Wayne, alternating current, 133 cycles, 1,100 volts, 150 k. w.
Two Fort Wayne, alternating current, 133 cycles, 1,100 volts, 100 k. w.
Ten 100-light 9.6-ampere multiple circuit Brush arc machines.
One 60-light 9.6-ampere wood arc machine.

SWITCHBOARD.

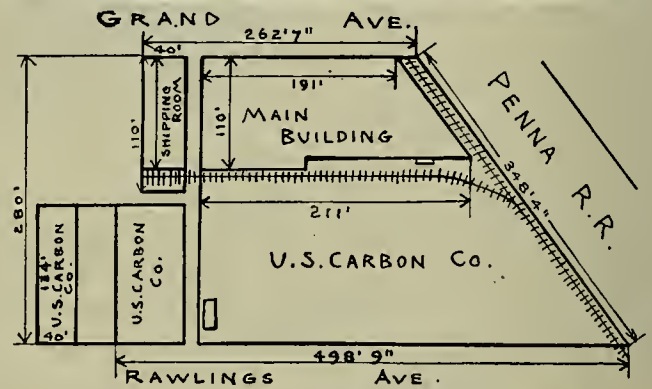
Switchboard, with all switches, transformers, measuring instruments, etc., for control of above generators.

SHAFTING.

Two lines shafting, together with pedestal, bearings, clutches, pulleys, etc., used in connection with the large Corliss engines.

Both plants located in Cincinnati.
We will consider bids for all or any part of the above.
Bids must be made f. o. b. Cincinnati.

The Cincinnati Gas & Electric Co.



FOR SALE.

PLANT OF THE UNITED STATES CARBON COMPANY including land, buildings, machinery, etc., situated on the Pennsylvania Railroad within the city limits of Cleveland, Ohio.

LAND—Vacant and covered by buildings about 2½ acres, bounded on two sides by streets and having a frontage of 348 ft. 4 in. on the Pennsylvania Railroad.

BUILDINGS—Main building is a two and one story brick building with gravel roof, the two-story part having a frontage of 191 ft. on Grand Ave., by about 50 ft. The one-story part having a frontage of 211 ft. on the switch from the Pennsylvania Railroad by about 55 ft. The shipping room is 40 ft. front on Grand Ave., by 110 ft. deep to a switch from the Pennsylvania Railroad and is a two story brick building, with gravel roof; the second floor, however, only covers a space of 14 by 40 ft. in the front part of the building. See diagram of land and buildings above.

MACHINERY—Pulleys, shafting, belting and complete machinery for the manufacture of electric-light carbons and for furnishing power, heat and light for the plant. Capacity of plant about 50,000 carbons per day.

For information address,

THE GUARDIAN SAVINGS & TRUST COMPANY,
CLEVELAND, OHIO.

CHICAGO EDISON COMPANY REPAIR SHOPS

76 MARKET STREET, CHICAGO. TELEPHONE MAIN 1280.

OPEN DAY AND NIGHT.

Machine and Carpenter Work of All Kinds Correspondence Solicited.

Dynamos Armatures, Motors, Arc Lamps, Fans, Instruments.

FIRST-CLASS EQUIPMENT THROUGHOUT.

BARGAINS IN SHELF-WORN BOOKS

You may have been looking for some of these volumes for years. Now you can get them and get them at a bargain, too. We have only one or two copies of each of the following:

	List Price	Sale Price
Electricity as a Motive Power, by Count Th. du Moncel, London, 1883..	$3.00	$1.80
Decorative Electricity, by Mrs. J. E. H. Gordon, London, 1891.....	2.50	1.50
Electrical Appliances of the Present Day, by Major D. P. Heap, U. S. A., being a report of the Paris Electrical Exhibition of 1881.....	2.00	1.20
Tables and Memoranda for Electrical Engineers, by Frederick Walker, C.E.	.80	.45
Magnetism and Electricity, by R. Wormell	1.25	.75
Steam Heating Data, by Wm. J. Baldwin, N. Y., 1897.....	.50	.30
The Telegraphist's Guide: The New Examinations of Technical Telegraphy, by Jas. Bell, A. I. E. E., London, 1895	.50	.30
The Mechanical Arts Simplified, by D. B. Dixon, Chicago, 1897.....	2.50	1.60
Electric Lighting, translated from the French of Count du Moucel, by Robt. Routledge, B. S. C., London, 1883...	1.25	.75
The Arithmetic of the Steam Engine, by E. Sherman Gould, N. Y., 1897	1.00	.60
Tips to Inventors, by Robt. Grimshaw, Ph. D., N. Y., 1893.....	1.00	.60
Mechanical Graphics, by Geo. Halliday, London, 1889	2.00	1.20
Physical Units, by Magnus Maclean, D. Sc.	1.00	.60
The Indicator and Dynamometer, by Thos. J. Main, M. A., Philadelphia, 1883	1.50	.90
How to Work and Fix a Dynamo-Electric Machine, by W. C. Mountain..	.35	.20
The Indicator Handbook, by Chas. N. Pickworth	.75	.45
The History and Progress of the Electric Telegraph, by Robt. Sabine, C. E., London, 1869. Cloth...	1.25	.75
Paper	.75	.25
Local Distribution of Electric Power in Workshops, by Ernest Kilburn Scott, A. I. E. E.	.50	.30
Bearings and Lubrication, by A. J. Wallis-Taylor, C. E.	1.50	.90
First Principles of Mechanical Engineering, by Imray & Biggs, London	1.00	.60
Electricity in our Homes and Workshops, by Sidney F. Walker, London, 1889	1.50	.90
Electricity in the Service of Man, by R. Wormell, D. Sc., M. A., New York, 1886	$3.00	$1.80
The Mathematical Theory of Electricity and Magnetism, by Watson & Burbury, London, 1885. Vol I, Electrostatics	2.75	1.65
Vol. II, Magnetism and Electrodynamics	2.60	1.60
Chapters on Electricity, by Samuel Sheldon, Ph. D.	1.10	.65
Electricity, Its Theory, Sources and Application, by John T. Sprague, London, 1892	6.00	3.60
Magnetism and Electricity, by H. C. Tarn, M. C. P., London, 1889.....	.80	.45
Electricity Up To Date, by John B. Verity, M. I. E. E., London, 1896..	1.00	.60
Telegraphy, by W. H. Preece and J. Sivewright, London, 1888.....	2.00	1.20
Electricity and the Electric Telegraph, in two volumes, by Geo. B. Prescott, New York, 1888.....	7.00	4.20
Useful Rules and Tables, relating to Mensuration, Engineering, Structures and Machines, by Wm. John Macquorn Rankine, London, 1889.....	4.00	2.40
Electricity and Magnetism, by Francis Nipher, A. M., St. Louis, 1895..	3.25	2.00
The Action of Lightning, by Arthur Parnell, London, 1882.....	3.00	1.80
Modern American Methods of Copper Smelting, by Edw. Dyer Peters, Jr., M. E., New York, 1891.....	5.00	3.00
Electricity, by Fleming Jenkin, F.R.S.	.40	.25
Magnetism and Electricity, by Wm. Adler Miller, M. D., LL. D., N. Y., 1888	1.50	.90
The Steam-Boiler Catechism, by Robt. Grimshaw, M. E.	2.00	1.20
The Steam-Engine Catechism, by Robt. Grimshaw, M. E., New York, 1896	2.00	1.20
Electrical Papers, Vols. I and II, by Oliver Heaviside, New York, 1894..	7.00	4.20
A Guide for the Electrical Testing of Telegraph Cables, by Col. V. Hoskiaer, London, 1889.....	1.50	.90
Solutions of the Questions in Magnetism and Electricity, set at the Intermediate Science and Preliminary Scientific Pass Examinations of the University of London, 1860 to 1884, by F. W. Levander, London, 1885....	1.00	.40
Domestic Electricity for Amateurs, translated from the French of E. Hospitalier, London, 1889.....	$2.50	$1.50
Four Lectures on Static Electric Induction, by J. E. H. Gordon, B. A., New York, 1881.....	.80	.45
Construction of Mill Dams, Jas. Leffel & Co., Springfield, O., 1874.....	2.50	1.00
A Practical Treatise on Electric Lighting, by J. E. H. Gordon, B. A., New York, 1884.....	4.50	2.70
Gray's Treatise on Magnetism and Electricity, Vol. I, by Andrew Gray, LL. D., F. R. S., London, 1898	4.50	2.70
Exercises in Electrical and Magnetic Measurements, by R. E. Day, M. A., London, 1889.....	1.00	.60
Electricity, by Robt. M. Ferguson, Ph. D., F. R. S. E., London, 1890...	1.50	.90
Coil and Current, or the Triumphs of Electricity, by Henry Frith, London, 1897.....	1.25	.75
A Century of Electricity, by T. C. Meadenhall, Cambridge, 1887.....	1.25	.75
Magnetism and Electricity, by Arthur Wm. Poyser, M. A., London, 1890...	.80	.45
Potential and Its Application Popularly Treated, by Dr. Tumlirz, London, 1889.....	1.50	.90
Continental Electric Light Central Stations, Killingworth Hedges, London, 1892	6.00	3.60
Theory of Electricity, by Linnæus Cumming, M. A., London, 1885.....	2.25	1.35
Electricity Treated Experimentally, by Linnæus Cumming, M. A., London, 1891	1.50	.90
Popular Electric Lighting, by Capt. E. Ironside Bax, London, 1892.....	1.00	.60
The Age of Electricity, by Park Benjamin, New York, 1892.....	2.00	1.20
The Law Relating to Electric Lighting, by G. Spencer Bower, B. A., London, 1889	5.00	3.00
Mathematical Theory of the Steam Engine, by T. Baker, C. E., London, 1890	.75	.45
Elementary Treatise on Natural Philosophy, by A. Privat Deschanel, Part 3, Electricity and Magnetism, New York, 1893	1.50	.90
Electricity in Modern Life, by G. W. De Tunzelmann, London, 1889.....	1.25	.75

ELECTRICIAN PUBLISHING CO., 510 MARQUETTE BLDG., CHICAGO

SUBSCRIPTION OPPORTUNITY

NEW subscribers who order the WESTERN ELECTRICIAN for the year 1905 will receive the November and December issues of this year FREE. Order at once.

The WESTERN ELECTRICIAN has helped and informed its readers for nearly eighteen years. It will help and inform you.

WESTERN ELECTRICIAN

510 MARQUETTE BUILDING, CHICAGO

SUBSCRIPTION RATES:

United States, Canada and Mexico $3 a Year

Foreign Countries, $5.00 a Year

FILL OUT THIS FORM AND SEND WITH REMITTANCE.

WESTERN ELECTRICIAN
CHICAGO

Please send me the Western Electrician, weekly, for 1905, for which I enclose $3.00 ($5.00 if to foreign country). Also send me free the November and December issues of 1904.

Name.....

Street.....

Date.....City.....State.....

DEARBORN WATER TREATMENT

Stops that expense and worry over scale in boilers.
We correct waters of all classes for boiler purposes.

Send gallon sample to Chicago Laboratory for Analysis.
Write for Booklet "R."

DEARBORN DRUG & CHEMICAL WORKS,

27-34 RIALTO BUILDING, CHICAGO, ILL. WM. H EDGAR, President Telephone: Harrison 3930 and 3931.

Dixon's Pure Flake Graphite

As a Cylinder Lubricant
Makes cylinders, valves and rods wonderfully smooth and bright. Reduces friction, saving oil and packing.
Booklet 125C and sample upon request.
JOSEPH DIXON CRUCIBLE CO., JERSEY CITY, N. J.

JEFFREY DETACHABLE STEEL ROLLER SPECIAL **CHAINS** FOR CATALOGUE, ADDRESS THE JEFFREY MFG. CO COLUMBUS, OHIO.

STERLING BLACK PLASTIC INSULATOR.

WATER REPELLENT. OIL PROOF.
One hundred days' continuous baking at 180° F. will not make it brittle.
THE STERLING VARNISH CO, - - Pittsburg. Pa.

Diesel Engines

Suitable for all stationary power operating on CRUDE or FUEL oil

By Gradual Continuous Combustion
NO EXPLOSIONS

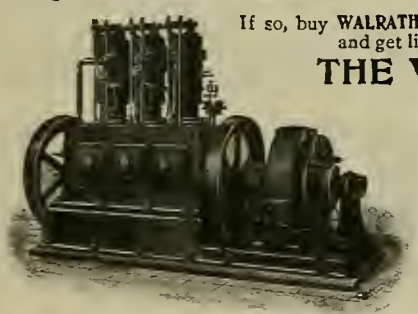
GUARANTEED COST OF FUEL WITH OIL AT 4 CENTS PER GALLON:

4.5 mills per K. W. Hour on the full load.
5.1 mills per K. W. Hour on the half load.

For Further Particulars Apply to
AMERICAN DIESEL ENGINE COMPANY
11 Broadway, - New York

There's No Friction
with the Fibre-Graphite Commutator Brush. Being 90 per cent. pure graphite, it insures low resistance, no sparking under a varying load, and longer wear. There is no greasing required. The Fibre-Graphite is therefore the most economic brush on the market. Send for price list.
HOLMES FIBRE-GRAPHITE MFG. CO.
5155 Wakefield St., Germantown, PHILADELPHIA.

ARE YOU LOOKING FOR MONEY?



If so, buy WALRATH GAS OR GASOLINE ENGINES and get light on the subject.

THE WALRATH

Received the Highest Award at the Pan-American Exposition.

It will produce as good a commercial light as that of an automatic steam engine, either belted or direct-connected generator. Simple, Economical and Reliable
Send for Catalogue W

MARINETTE GAS ENGINE CO.,
CHICAGO HEIGHTS, ILL.

AGENCIES:
Keystone Engineering Co., Farmer's Bank Bldg., Pittsburg, Pa.
Strong, Carlisle & Hammond Co., 61-67 Frankfort St., Cleveland, Ohio
Mackay Engineering Co., 149 Broadway, N. Y.
C. H. Seidenglanz., 52 When Bldg., Indianapolis, Ind.

REG. TRADE MARKS
"Phosphor Bronze" DELTA
THE PHOSPHOR BRONZE SMELTING CO. LIMITED.
2200 WASHINGTON AVE., PHILADELPHIA.
"ELEPHANT BRAND PHOSPHOR-BRONZE"
INGOTS, CASTINGS, WIRE, RODS, SHEETS, ETC.
— DELTA METAL —
CASTINGS, STAMPINGS AND FORGINGS
ORIGINAL AND SOLE MAKERS IN THE U.S.

HARTFORD STEAM BOILER INSPECTION AND INSURANCE CO. HARTFORD, CONN.

STUDENTS

Will find that the WESTERN ELECTRICIAN can help them wonderfully in the study of electricity. Subscribe now. $3.00 per year, in advance.

ELECTRICIAN PUBLISHING CO.,
Suite 510 Marquette Bldg., CHICAGO.

H. N. FENNER, President J. F. BLAUVELT, Agent RUSSELL W. KNIGHT, Treasurer

NEW ENGLAND BUTT COMPANY

MANUFACTURERS OF

Machinery for Insulating Electrical Wires

Braiding, Taping, Winding, Twinning, Cabling, Stranding, Polishing and Measuring Machines. Cable Covering Braiders
FINE CASTINGS A SPECIALTY

304 PEARL STREET, - - - PROVIDENCE, R. I., U. S. A.

SAMSON TURBINE

We show below a record of tests made in the official testing flume at Holyoke, of a 35-inch SAMSON TURBINE which was built from the same patterns as those we sell to our customers.

Gateage.	Head.	R. P. M.	Cu. Ft. Per Sec.	H. P.	Efficiency.
Full	15.29	194	102	143	81.08 %
⅞	16.56	188	92	147	84.78 %
¾	17.33	178	84	138	83.88 %
⅝	17.54	176	69	110	80.09 %

THE JAMES LEFFEL & CO.
307 LAGONDA ST., Springfield, Ohio. U. S. A.

ARNOLD ELECTRIC POWER STATION Co.
Engineers, Constructors for Complete Electric Plants. Results Guaranteed.
SUITE 1539, MARQUETTE BLDG., CHICAGO, NEW YORK OFFICE: 711 TRANSIT BLDG.

BYLLESBY, H. M. & Co.
(Incorporated)
ENGINEERS
Design, Construct and Operate Railway, Light, Power and Hydraulic Plants.
Examinations and Reports.
New York Life Building, - CHICAGO, ILL.

J. H. HALLBERG
Consulting Engineer
Electric Light, Power and Railway Plants
Suggestions to secure Economy, Specifications, Examinations and Reports
45 Broadway, NEW YORK
Long Distance Telephone 4578 Broad

RUEBEL - SCHWEDTMANN-WELLS,
CONSULTING, MECHANICAL AND ELECTRICAL ENGINEERS,
Suite 801 Chemical Building, ST. LOUIS, U. S. A.

F. B. BADT,
Monadnock Chicago

EVANS, ALMIRALL & CO.,
Central Station Heating, High Pressure Piping.
1057 Monadnock Blk., Chicago.

ROBERT W. HUNT & Co.,
ENGINEERS
1121 The Rookery, Chicago. 66 Broadway, New York.
Monongahela Bank Bldg., Pittsburg.
Norfolk House, Cannon St., London.

Long Distance Phone Central 2443.
SCHOTT, W. H.,
ENGINEER AND CONTRACTOR,
SPECIALTIES—Central Station Heating Plants, Water Works Steam Plants, Electric Light, Gas and Street Railway Plants.
1220-21 MARQUETTE BUILDING, CHICAGO.

W. E BAKER. H. S. BISHOP.
BAKER, W. E. & CO.
ENGINEERS,
ELECTRIC RAILWAYS.
27 William St., NEW YORK.

TRY IT. Keep your name and address in this directory where it will be seen by possible clients.

IT WILL PAY
engineers not represented in this department to carry a card regularly.

SQUIRE ELECTRIC CO.
Engineers and Contractors
113 E. Eighth St., KANSAS CITY, MO.
Consulting, Designing and Supervising Engineers.
Plans and Specifications Furnished.

ENGINEERS
Represented in this "Directory" are enabled to come in touch with many prospective customers who cannot be reached through any other source.

E. W Hammer, Pres. and Treas. H. J. Minhinnick, Sec. and Gen'l Sup't.
GENERAL ENGINEERING Co., THE
Consulting and Contracting Engineers.
Telephones, Electric Light, Power Transmission
Suite 1112, 135 ADAMS ST., CHICAGO.
Long Distance Telephone Central 478.

KEMP, R. W.
Consulting and Contracting Telephone Engineer.
Plans and Specification for complete plants. Old plants overhauled and placed on paying basis. Territory, Kansas, Oklahoma and Indian Territory.
WELLINGTON, - - - KANSAS.

STANTON, LE ROY W.
Consulting Telephone Engineer
Plans, Specifications and Supervision of Installation of Complete Telephone Plants
Special Reports on Telephone Properties and Apparatus
411 Electrical Bldg., Cleveland, Ohio

BRYAN, WILLIAM H.
M. Am. Soc. M. E.,
Consulting Mechanical and Electrical Engineer.
Lincoln Trust Building, ST. LOUIS.

A WEEKLY REPRESENTATION
in this "Directory" enables engineers to keep before all possible customers.

KOHLER BROS.,
Contracting Electrical Engineers, Lighting Power Railways,
1804-1806-1808-1810-1812 Fisher Building, CHICAGO.

Telephone Main 3123.
WILMERDING, C. H.
CONSULTING ENGINEER
1100 Old Colony Bldg., CHICAGO.

DUGALD C. JACKSON, C. E.
WILLIAM B. JACKSON, M. E.
MEMBERS
AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS
AMERICAN SOCIETY OF MECHANICAL ENGINEERS
AMERICAN SOCIETY OF CIVIL ENGINEERS
ENGINEERS. EXPERTS.
MADISON, WIS.

Reports and Estimates Furnished.
General Contractors
High-Grade Securities Accepted or Negotiated.

W. R. EVANS & COMPANY
Incorporated
Electrical, Civil and Mechanical Engineers
Telephone Main 3153 Traction Bldg., Cincinnati

PLACE YOUR
"Want" and "For Sale" advertisements in the
WESTERN ELECTRICIAN,
Immediate Returns.

ELECTRICITY FOR ENGINEERS.

Latest Edition, Now Published in One Complete Volume, 424 Pages, Profusely Illustrated.
Just the Work for Engineers, Electricians, Dynamo Tenders, etc.

PART I. CONTENTS.—CHAPTER I: Electricity; Positive and Negative; Conductors, Non-Conductors and Insulators; Electro-Motive Force; Volts; Resistance; Ohms; Current; Amperes.—CHAPTER II: Dynamos; Magnets; Field Coils; Electro Magnets; Permaneot Magoets.—CHAPTER III: Armatures, Construction of, Different Kinds of; Commutators, How Made and Connected; Heating of Armatures; Eddy Currents.—CHAPTER IV: The Current: How Produced; Induction; Series Wound Dynamos; Shunt Wound Dynamos; Exciting the Fields; Constant Current and Constant Potential Dynamos; Series and Parallel; Parallel or Multiple Arc System.—CHAPTER V: Incandescent Lamps; Filaments; Connections; Flashing; Exhausting; Testing; Candle Power; Operated in Series; Automatic Cut-Out; In Multiple Arc or Parallel; Multiple Series; Multiple Series Cut-Out; Three Wire System.—CHAPTER VI: The Arc Light: How Formed; Causes of Unsteadiness; Remedy; Effect of Shades or Globes; Shape of Carbons Under Different Conditions of Burning; Arc Lamps; Regulating and Cut-Out Mechanism; Action of Current; Clutch Lamps; Clockwork Lamps; Double Lamps; Troubles in Lamps.—CHAPTER VII: Commutators and Brushes; The Brush Commutators; Brushes; Different Styles of Brushes; Double Brushes; Single Brushes; Troubles with Commutators and Brushes; Correct Position of Brushes; Sparking at Brushes; Care of Brushes and Commutators; Flashing.—CHAPTER VIII: Current Regulation; Hand Regulation; By Position of Brushes; Resistance Box; Resistance Coils.—CHAPTER IX: American System of Automatic Current Regulation; The Dynamo; Regulator; Action of Regulator. CHAPTER X: Brush System of Automatic Current Regulation; Brush Armature; Diagram of Circuits through Dynamo, Regulator and Lamps; Dial or Regulator; Care and Adjustment of Dial; Dial Controller; Circuits and Connections of No. 8 Brush Dynamo; Circuits of Compound Wound Constant Potential Brush Dynamo.—CHAPTER XI: The Edison System; Automatic Regulator; Circuits of Regulator: Circuits of Dynamo; Action of Regulator; Howell Pressure Indicator; Diagram of Circuits; Description of Parts and Operation.—CHAPTER XII: Excelsior System of Automatic Current Regulation; Dynamo; Armature; Diagram of Circuits; The Regulator and Motor; Action of Regulator.—CHAPTER XIII: Schuyler System of Automatic Current Regulation; Dynamo; Armature, Commutator and Brushes; Diagram of Circuits in Armature and Field; Regulator; Circuits in Regulator.—CHAPTER XIV: Thomson-Houston System of Automatic Current Regulation; Dynamo; Armature; Commutator and Brushes; Controlling Magnet; Wall Controller; Diagram of Circuits; Air Blast.—CHAPTER XV: Waterhouse System of Three-Brush Automatic Current Regulation; Dynamo; Extra Brush; Resistance Coils and Regulator. CHAPTER XVI: Ampere Meters; Tangential Scale; Solenoid Meters.—CHAPTER XVII: Voltmeters; Pressure and Potential Indicators.—CHAPTER XVIII: Testing; Galvanometers; Astatic Needle; Differential Apparatus.—CHAPTER XIX: Wheatstone Bridge or Electrical Balance; Diagram of Circuits and Methods of use; Bridge and Rheostat; Round Form; Square Form.—CHAPTER XX: The Magneto as a Testing Instrument; Armature; Field; Bell; Diagram of Circuits.—CHAPTER XXI: Coupling Dynamos Together; In Series; In Shunt; Series, Shunt and Compound Wound Machines.—CHAPTER XXII: Switches and Switchboards; Loop Switch; Plug and Socket; Change Over Plug and Socket; Conclusion. CHAPTER XXXIII: Electric Motors; General Principles the same as in Dynamos; Types; Shunt and Series Motors Suitable for all General Purposes; Regulation of Shunt Motors; Of Series Motors; Counter E. M. F.; Direction of Rotation and Direction of Current; Starting Motors; Diagram of Connection.

PART II. CONTENTS.—CHAPTER I: Alternate Current Dynamos; Principles of the Field; Field Current Armature; Winding; Connections; Lamination; Different Types of Alternators; Regulation; Leading Systems; The Brush Generators; Magnets; Armature; Principles of Induction.—CHAPTER II: Dynamos, Continued; The Mordey Alternator; Stationary Armatures; Field Magnets; Ferranti Armature; Field Magnets; Winding; Collectors.—CHAPTER III: Dynamos Concluded; Siemens Dynamo; Best Magnetic Circuits; Stanley Constant Current Dynamo; The Armature; Self Induction; Regulation.—CHAPTER IV: Induction Coils; Converters; Transformers; Economy of Distribution; An Electrical H. P.; Losses in Conductor; Induction Coils; Effect of Induction; Transformers.—CHAPTER V: Transformers Continued; Induction Coils; Converters; Transforming Up and Down; Design of Transformers; The Static Charge; Protection Against; Grounding the Secondary; Other Devices; The Foil Protector; Different Types of Transformers.—CHAPTER VI: Transformers, Concluded; Fuses; Regulation; Winding of Transformers, Connecting to Circuit; Regulation; Safety Fuses.—CHAPTER VII: Parallel System; Series Arc Light System; Diagram of Circuits; Parallel System; Primary Circuit; Secondary Circuit; Placing of Transformers; Fuses; Diagram of Series Arc Light Circuit.—CHAPTER VIII: Lines of Force; Hysteresis; Magnetic Penetration; The Circuit of Lines of Force; Experiments with Magnet; Rapidity of Reversals and Hysteresis.—CHAPTER IX: Arc Lamps; In Series; The Westinghouse Arc Lamp; Diagram of Circuits in Lamp; Action of the Mechanism; Flat Carbons.—CHAPTER X: Arc Lamps, in Multiple; Slattery Differential Lamp; Mechanism of Lamp; Its Operation.—CHAPTER XI: Measuring and Indicating Apparatus; Instruments for Use with Alternating Currents Differ from those used with Continuous Currents; Ammeters; Voltmeters; Description of Several Forms of Instruments.—CHAPTER XII: Measuring Instruments, Continued; Hot Wire Instruments; The Cardew Voltmeter; Details of the Instrument; Low Potential Voltmeter.—CHAPTER XIII: Voltmeters; Double Coil Voltmeter; Two Types.—CHAPTER XIV: Spring Meters; Curled Spring Meter.—CHAPTER XV: Twisted Strip Instruments; Diagram of Connections and Operation of Instrument.—CHAPTER XVI: Recording Meters; Stanley Meter; Construction and Principles of Operation; Diagrams of Parts; Slattery Induction Meter; Description of Parts and Principles of Operation; Watt Meter; Thomson Meter.—CHAPTER XVII: Generators in Parallel, Difficulties in Operating; Alternate Current Generators in Parallel; Arrangements of Circuits and Machines for Operating in Parallel; Diagram of Common Arrangement of Machines and Circuits.—CHAPTER XVIII: Ohm's Law; Strength of Current; Formulas and Examples; Power and Heating Effects of Currents.—CHAPTER XIX: Ground Alarms and Leak Detectors.

PRICE, $2.50.

Orders for above book, or any electrical work published promptly sent on receipt of price, postage prepaid.

ELECTRICIAN PUBLISHING CO., 510 Marquette Bldg., CHICAGO.

BITUMINIZED FIBER CONDUIT

FOR UNDERGROUND CONSTRUCTION

The unusual length of unit, the light weight and the simplicity of joining unit to unit make the amount of conduit laid per man per day greater than in other conduits and greatly lessens the cost of an underground system.

American Conduit Co.

Main Offices: 1005-6 Manhattan Building, Chicago

Other Offices:
170 Broadway, New York. 336 Macy St., Los Angeles

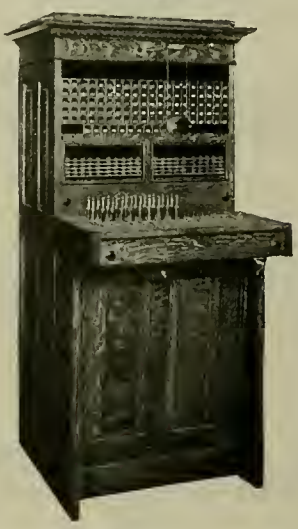
STROMBERG-CARLSON

GENERATOR-CALL

VISUAL SIGNAL SWITCHBOARDS

are inexpensive to maintain and nearly as rapid as a lamp signal switchboard.

SIGNALS SELF-CONTAINED



NO WORKING PARTS EXPOSED

This illustrates our No. A-1249 cabinet equipped with 100 line signals and 10 clearing-out signals. Our standard cabinets have a capacity for 50, 60, 70, 100, 140, 180 and 200 line signals of the above type.

Bulletins No. 6 and 7-E describe these boards very thoroughly. Mailed free upon request.

STROMBERG-CARLSON TELEPHONE MFG. CO.,

GENERAL OFFICES, ROCHESTER, N. Y.

WESTERN SALES OFFICE, CHICAGO, ILL.

AMERICAN ELECTRIC TELEPHONE CO.

LARGEST MANUFACTURERS

This Company Sends Prepaid upon request any of the following bulletins:

Bulletin No. 7—Combined Telephone and Switchboard
" 8—Wall Switchboard
" 9—Samson Telephone
" 10—American Express Switchboards
" 11—Desks Toll and Private Branch
" 12—Visual Signal and Bell Style Switchboards
" 13—Intercommunicating Systems
" 14—Line Material and Supplies
" 15—Bell Express Self-Restoring Switchboards
" 16—Operator's Set and Accessories
" 17—Parts of Apparatus
" 18—Magneto Telephones of All Kinds
" 19—Central Energy Switchboards
" 20—Central Energy Telephones
" 21—Protective Apparatus and Terminal Equipment
" 22—Construction of Country Telephone Lines
" 23—Eight-Party Selective Ringing Telephones
" 24—Composite Telephone and Telegraph Lines
" 25—Four-Party Leich Selective Telephone System
" 26—Telephone Power and Ringing Equipment

CHICAGO, ILL., U. S. A.

INTERNATIONAL

Mechanical Self-Restoring Drop Switchboard.

A PERFECT APPARATUS.

Made in any desired capacity.

Sample parts and quotations on request.

INTERNATIONAL TELEPHONE MANUFACTURING CO.

CHICAGO, U. S. A.

EDISON PRIMARY BATTERIES

FORMERLY EDISON-LALANDE

These batteries are simple in construction and can be easily and quickly renewed. The renewal parts and supplies are inexpensive and readily obtained. You would appreciate this if you could read the description of Battery Renewals in our catalogue No. 7. May we not send it?

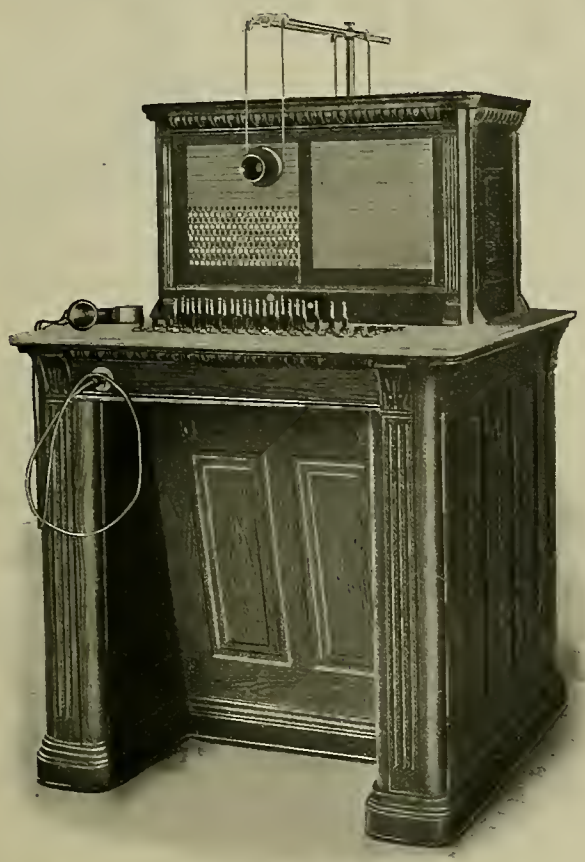
TRADE Thomas A Edison MARK

EDISON MFG. CO.

Factory, ORANGE, N. J.

NEW YORK: 83 Chambers Street

CHICAGO: 304 Wabash Avenue



Kellogg Private Branch Exchange in Government Building at Washington.

KELLOGG TELEPHONE APPARATUS

Winner of the Highest Award at the St. Louis Exposition

THERE WAS BUT ONE GRAND PRIZE ISSUED FOR "TELEPHONE SYSTEMS AND APPARATUS" AND THAT WAS AWARDED TO THE

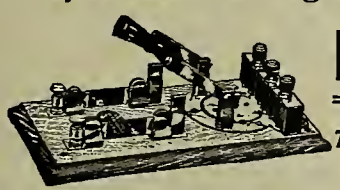
KELLOGG SWITCHBOARD AND SUPPLY COMPANY

GREEN AND CONGRESS STREETS

CHICAGO

Seymour Bldg., LOS ANGELES | Electric Bldg., CLEVELAND | Keystone Telephone Bldg., PHILADELPHIA

They Are All Talking About The "Tornquist"



King of Protectors

The Only Sure Protector Made

HIGH GRADE BABY KNIFE SWITCHES

None Better Made

STAMPING AND PLATING

Better buy a "**Tornquist**" it is the greatest success in the telephone field. Order sample now. Sold by all jobbers.

Clinton Stamping & Electric Co.

CLINTON, IOWA

TELEPHONE PRINCIPLES AND PRACTICE

A NEW BOOK IN TELEPHONY

By

GEORGE WALKER WILDER, PH. D.

Professor in Telephony in the Armour Institute of Technology

Complete and up-to-date, written by a practical man. All about modern telephone apparatus, their principles and use:

I. Fundamental Ideas
II. Telephone Apparatus
III. Systems of Communication
IV. Construction and Equipment

IN 32 CHAPTERS, 450 PAGES, 375 ILLUSTRATIONS. PRICE $2.00 POSTPAID.

Send Postal Money Order to

THE CANTWELL PRESS - Madison, Wis.

THE AUTOMATIC

is the recognized competitive system of telephony. Its manifold advantages over the manual system, mechanically, financially and commercially, make it so. Automatic telephone service is more prompt and more accurate and absolutely secret. It can be furnished at less cost to both company and patrons than any other. Progressive Independent telephone companies all over the country are rapidly adopting it; the new ones in preference to manual and the old ones to replace manual equipment. It is a success everywhere.

Among the cities in which it has been adopted are:

Chicago, Ill.
Grand Rapids, Mich.
Columbus, Ohio
Dayton, Ohio
Lincoln, Neb.
Portland, Maine
Auburn, N. Y.
Lewiston, Maloe
Auburn, Maine
Fall River, Mass.
New Bedford, Mass.
Los Angeles, Cal.
San Diego, Cal.
Hopkinsville, Ky.
Sioux City, Iowa
Cleburne, Texas
Columbus, Ga.
Augusta, Ga.
Medford, Wis.
St. Mary's, Ohio
Woodstock, N. B.
Westerly, R. I.
Berlin, Germany
Manchester, Iowa
Princeton, N. J.
Albuquerque, N. M.
Van Wert, Ohio
Battle Creek, Mich.
Clayton, Mo.
Pentwater, Mich.
Toronto Junction, Can.
Wilmington, Del.
Riverside, Cal.
Traverse City, Mich.

AUTOMATIC ELECTRIC COMPANY

Van Buren and Morgan Streets, CHICAGO, U. S. A.

PRODUCERS AND WHOLESALERS OF WHITE CEDAR PRODUCTS

CEDAR POLES

SPECIAL PRICES ON SMALL POLES.
Write for a copy of our TELEGRAPH CODE FOR CEDAR PRODUCTS

C. H. WORCESTER CO.
SUITE 1206 TRIBUNE BLDG. CHICAGO.

YARDS
KOSS MICH.
L'ANSE "
MUNISING "
ONTONAGON
WAGNER, WIS
PESHTIGO "

Southern Cedar POLES Are the Best.
NO ROTTEN BUTTS.
D. W. PHELAN,
277 Broadway, New York

MICHIGAN AND WESTERN CEDAR POLES
ALL LENGTHS AND SIZES
LINDSLEY BROS CO.
TRIBUNE BLDG., CHICAGO

POLES W. C. STERLING & SON, MONROE, MICH. TIES.
Eleven Pole Yards in Michigan
Wholesale Producers for 20 years.

CEDAR POLES
THE
Valentine-Clark Co.
234 La Salle Street, CHICAGO
YARDS:
Pinconning, Mich. : Green Bay, Wis. : New London, Wis.

FACTORIES WANTED
ALONG THE
BURLINGTON ROUTE
to supply the demand
for Electrical Goods.
Burlington Route
N 548
W. H. MANSS.
INDUSTRIAL COMMISSIONER,
209 ADAMS STREET, CHICAGO.

BRACKETS—X ARMS—PINS
little things it is true, but they cut a big figure in line construction.
OUR MOTTO IS:
Prompt Shipment Quality Satisfaction Right Price
COLUMBIA MFG. CO. ANTIGO, WIS.

CEDAR POLES, POSTS, TIES,
H. M. LOUD'S SONS CO., Au Sable, Mich.

POLE DEALERS ADVERTISING IN THE WESTERN ELECTRICIAN OBTAIN MOST EXCELLENT RESULTS BECAUSE IT PLACES THEM IN TOUCH WITH ACTUAL BUYERS OF POLES. TRY A CARD.

FREE CHRISTMAS DINNERS
for 10,000 of Chicago's Poor
will be supplied by the Salvation Army. Will you help by sending a donation, no matter how Small to the Salvation Army
CHICAGO
Headquarters
399 State Street
Chicago, Ill.

CEDAR POLES
ESTABLISHED 1862
WM. MUELLER COMPANY
1211-12-13 MARQUETTE BLDG. CHICAGO.
EIGHT DISTRIBUTING YARDS

Locations for Industries
Erie Railroad
Chicago to New York
The Erie Railroad Company's Industrial Department has all the territory traversed by the railroad districted in relation to resources, adaptability, markets and advantages for manufacturing, and can advise with manufacturers in relation to the most suitable locations. For full information address
LUIS JACKSON
Industrial Commissioner, Erie Railroad Company
21 Cortlandt Street, New York

MICHIGAN WHITE CEDAR POLES LARGE STOCK.
PROMPT SHIPMENTS. KELLOGG SWITCHBOARD & SUPPLY CO., Chicago.

Cedar Poles.

Pittsburg and Lake Superior Iron Co. Producers and Wholesalers. Escanaba, Mich.

JUST RECEIVED a new batch of 20 and 25 ft. Poles and have reduced prices accordingly. Also, we have plenty of those "Trolley" Ties yet. May we quote you now?

MALTBY CEDAR COMPANY, 509 Phoenix Block, Bay City, Michigan
Pittsburg Agents: Tipper & Patton, 509 Bessemer Bldg.

POLES. WHITE CEDAR. IDAHO CEDAR up to 80 ft.

BERTHOLD & JENNINGS, ST. LOUIS. Chemical Building.

CROSS ARMS. LONG LEAF PINE AND FIR.

"A great deal in a little space."
—*The Press.*

"THE FOUR-TRACK SERIES"

This is the title of a series of books of travel and education issued by the Passenger Department of the

NEW YORK CENTRAL LINES

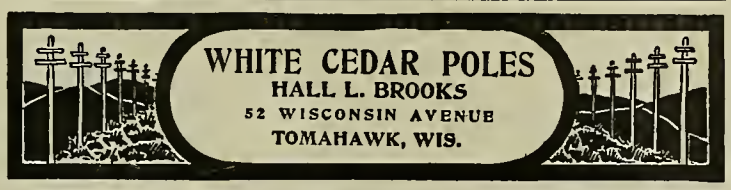
These small books are filled with information regarding the best modes of travel and the education that can best be obtained by travel.

They relate specifically to the great resorts of America — to trips to the islands of the sea and around the world.

They also contain numerous illustrations and new and accurate maps of the country described.

A copy of the 40-page Illustrated Catalogue of the "Four Track Series" will be sent free postpaid, upon receipt of postage stamp by George H. Daniels, General Passenger Agt., New York Central & Hudson River Railroad, Grand Central Station, New York.

POLES, TIES, POSTS. THE PORTER CEDAR CO., SAGINAW, MICH.
PRODUCERS. We want your inquiries always.



Poles and Ties

The Fowler Companies
TRADE MARK
Fisher Bldg. Chicago

Cedar Poles TORREY CEDAR CO., CLINTONVILLE, WIS.
Large Stock Constantly on Hand

Idaho Cedar Poles
PACIFIC COAST POLE CO. SPOKANE, WASH.

ELECTRICAL AND OTHER INDUSTRIES ARE OFFERED LOCATIONS WITH
Satisfactory Inducements,
Favorable Freight Rates,
Good Labor Conditions,
Healthful Communities,
ON THE LINES OF
THE ILLINOIS CENTRAL R. R.
AND THE
YAZOO & MISSISSIPPI VALLEY R. R.
For full information and descriptive pamphlet address
J. C. CLAIR,
Industrial Commissioner
1 Park Row, Chicago, Ill.

Have YOU read the

NEW DYNAMO TENDERS' HAND-BOOK

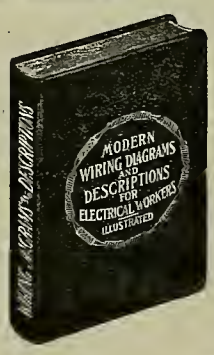
By F. B. BADT?

IF NOT, WHY NOT?

Dynamo tenders cannot get along without it.

Sent prepaid on receipt of price, $1.00.

ELECTRICIAN PUBLISHING CO.,
510 Marquette Building, - CHICAGO.



A PRACTICAL BOOK FOR PRACTICAL MEN

"MODERN WIRING DIAGRAMS AND DESCRIPTIONS FOR ELECTRICAL WORKERS."

By Henry C. Horstmann and Victor H. Tousley. 160 pages, over 200 illustrations. Full leather binding, red edges. Pocket size 4 x 6. Price, net, $1.50.

A work that not only tells you how to do it, but shows you.

THIS BOOK tells how to wire for call and alarm bells. For burglar and fire alarm. How to run bells from dynamo current. How to install and manage batteries. How to test batteries. How to test circuits. How to wire for annunciators; for telegraph and gas lighting. It tells how to locate "trouble" and "ring out" circuits. It tells about meters and transformers. It contains 30 diagrams of electric lighting circuits alone. It explains dynamos and motors; alternating and direct current. It gives 10 diagrams of ground detectors alone. It gives "Compensator" and Storage Battery installation. It gives simple and explicit explanations of the "Wheatstone Bridge" and its uses as well as volt meter and other testing. It gives a new and simple wiring table, covering all voltages and all losses or distances, etc., etc.

SENT PREPAID ON RECEIPT OF PRICE

ELECTRICIAN PUBLISHING CO.
510 Marquette Building, Chicago

THE TELEPHONE HAND-BOOK

BY
HERBERT LAWS WEBB.
Price $1.00.
A complete and practical work in handy pocket size.
PUBLISHED BY
THE ELECTRICIAN PUBLISHING CO.,
Suite 510 Marquette Building, Chicago.

CENTRAL STATION HEATING

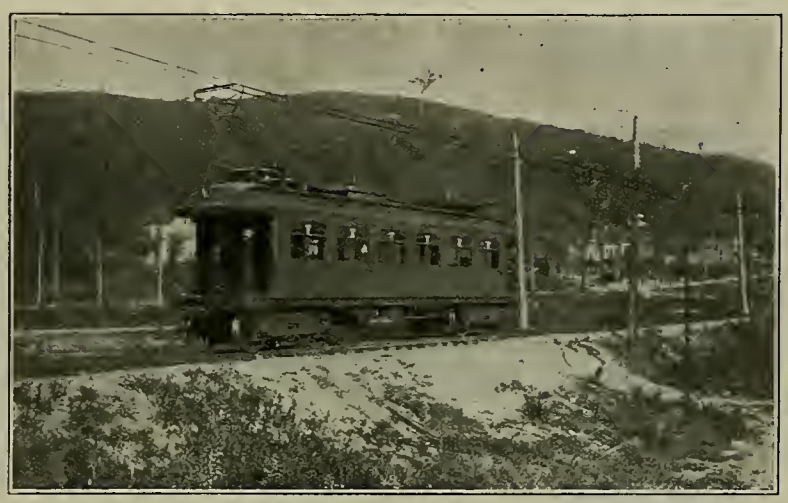
We are the originators and builders of the underground system of live and exhaust steam heating. Our system is used for the utilization and distribution of exhaust steam from electric and power plants for heating purposes. 250 Plants in successful operation. We have the only Meter System. Also manufacturers of Wooden Water Pipe, Steam Pipe Casing, Steam Traps, Condensation Meters, Valves, Economizing Coils, Separators and full line of Steam Fitters' Supplies.

WRITE FOR PAMPHLET AND PRICE LIST

AMERICAN DISTRICT STEAM COMPANY
LOCKPORT, N.Y. CHICAGO, ILL.
MENTION WESTERN ELECTRICIAN.

The Westinghouse Single-Phase Railway System

Reduces both the cost of construction and the cost of operation of electric railway lines



Car on Interworks Railway Equipped with Four 75 H. P. Westinghouse Single-Phase Railway Motors. Photograph taken with a time exposure of 1-300 of a second, while car was traveling 40 miles per hour.

It renders profitable the building of roads through districts the population of which would not warrant a direct-current system

For particulars address nearest office of

Westinghouse Electric & Mfg. Co.

Pittsburg, Pa.

New York, Atlanta, Dallas, Baltimore, Boston, Buffalo, Chicago, Cincinnati, Cleveland, Detroit, Los Angeles, Minneapolis, New Orleans, Philadelphia, Pittsburg, St. Louis, Salt Lake City, San Francisco, Syracuse, Seattle, Denver, Mountain Electric Co.

For Canada: Canadian Westinghouse Co., Limited, Hamilton, Ontario. Mexico: G. & O. Braniff Co., City of Mexico.

Form C Arc Lamps

Easy to

trim
adjust
inspect

thoroughly

reliable
efficient
durable

investigate

without
restrictions
of any kind

Complete

bulletins
instructions
catalogues

information

on lamps
for any
circuit

available

to any one
sending us
his address

Fort Wayne Electric Works

"Wood Systems"

Fort Wayne - - Indiana

260

WE shall be glad to supply any of the books catalogued below upon receipt of your order and remittance. We prepay charges.

THE PRINCIPLES OF THE TRANSFORMER. By Frederick Bedell	$3.25
INDUCTION COILS. By G. E. Bonney	1.00
ELECTRICITY AND MAGNETISM. By S. R. Bottone	.90
ELECTRICITY, ELECTROMETER, MAGNETISM AND ELECTROLYSIS. By G. Chrystal and W. N. Shaw	1.60
THEORY OF ELECTRICITY. By L. Cumming	2.25
THEORY OF ELECTRICITY AND MAGNETISM. By Charles Emerson Curry	2.50
THE ELEMENTS OF ALTERNATING CURRENTS. By W. S. Franklin and R. B. Williamson	2.50
PRACTICAL EXERCISES IN MAGNETISM AND ELECTRICITY. By H. E. Hadley	.60
MISCELLANEOUS PAPERS. By Heinrich Hertz	3.25
A TEXT-BOOK ON ELECTROMAGNETISM AND THE CONSTRUCTION OF DYNAMOS. By Dugald C. Jackson	2.25
ALTERNATING CURRENTS AND ALTERNATING CURRENT MACHINERY. By D. C. Jackson and John Price Jackson	3.50
AN ELEMENTARY BOOK ON ELECTRICITY AND MAGNETISM AND THEIR APPLICATIONS. By D. C. Jackson and John Price Jackson.	1.40
A FIRST-BOOK OF ELECTRICITY AND MAGNETISM. By W. P. Maycock	.60
ALTERNATING CURRENTS OF ELECTRICITY AND THE THEORY OF TRANSFORMERS. By Alfred Still	1.50
PRACTICAL ELECTRIC LIGHT FITTING. By A. C. Allsop	1.50
ELECTRICAL EXPERIMENTS. By G. E. Bonney	.75
RADIOGRAPHY AND THE "X" RAYS IN PRACTICE AND THEORY. By S. R. Bottone	1.00
THE DYNAMO: HOW MADE AND HOW USED. By S. R. Bottone	.90
HOW TO MANAGE THE DYNAMO. By S. R. Bottone	.60
A GUIDE TO ELECTRIC LIGHTING. By S. R. Bottone	.75
ELECTRIC LIGHT ARITHMETIC. By R. E. Day	.40
THE DYNAMO: ITS THEORY, DESIGN AND MANUFACTURE. By C. C. Hawkins and F. Wallis	3.00
THE ALTERNATING CURRENT CIRCUIT. By W. P. Maycock	1.00
ELECTRIC WIRING FITTINGS, ETC. By W. P. Maycock	1.75
ELECTRIC WIRING TABLE. By W. P. Maycock	1.50
A MANUAL OF TELEPHONY. By W. H. Preece and A. J. Stubbs	4.50
PRACTICAL TELEPHONE HANDBOOK AND GUIDE TO THE TELEPHONIC EXCHANGE. By Joseph Poole	1.50
ELECTRIC WIRING. By Russell Robb	2.50
ELECTRIC LIGHT CABLES AND THE DISTRIBUTION OF ELECTRICITY. By Stuart A. Russell	3.00
ELECTRICITY IN TOWN AND COUNTRY HOUSES. By Percy E. Scrutton	1.00
THE STORAGE BATTERY. By Augustus Treadwell	1.75

Electrician Publishing Company
510 Marquette Building, Chicago

DUNCAN

DIRECT CURRENT

WATTMETERS

Most Sensitive
Most Accurate
Most Reliable

WRITE FOR BULLETIN AND PRICES

DUNCAN ELECTRIC MFG. CO.
LAFAYETTE, IND.

YOST SPECIALTIES.

Sockets, Wall Sockets, Weatherproof Sockets, Rosettes, Receptacles, Cord Adjusters.

Catalogue for the asking.

THE YOST ELECTRIC MFG. CO.
TOLEDO, OHIO.

KARTAVERT.

HARD AND FLEXIBLE FIBER IN SHEETS, RODS AND TUBING.

For Electrical and Mechanical Purposes, Railway Dust Guards, Washers and Packings. Patent Insulating Cleats.

MANUFACTURED BY
THE KARTAVERT MANUFACTURING CO. Wilmington. Del.

VULCANIZED FIBRE

Highest grades for electrical insulation and mechanical purposes, in sheets, tubes, rods and special shapes. Catalogues and samples on application.

VULCANIZED FIBRE CO., - Wilmington, Del.

WIRES AND CABLES

HIGH-GRADE, RUBBER-COVERED, WEATHER-PROOF
MAGNET, OFFICE, ANNUNCIATOR WIRE.
HAZARD MANUFACTURING CO.,
GENERAL OFFICE AND WORKS, Wilkesbarre, Pa.
NEW YORK OFFICE. 50 Dey St.
CHICAGO OFFICE. 71 and 73 West Adams St.

"STAR" INCANDESCENT LAMPS

LONG LIFE
GUARANTEED CANDLEPOWER,
HIGHEST EFFICIENCY.

MADE BY THE MOST SKILLED WORKMEN.

STANDARD ELECTRICAL MFG. COMPANY, : Niles, Ohio.

Crocker-Wheeler Motor Dynamos

For Telephone Service
are of Established Excellence

Crocker-Wheeler Company
Manufacturers and Electrical Engineers
Chicago Office, Old Colony Bldg.
Ampere, N. J.

STURTEVANT ECONOMIZERS

With their patent system of "Staggered Pipes" are increasing temperature of feed-water 150 and 175°. For all plants of 50 H. P. and over, save 10 to 20% in fuel and increase boiler capacity, 20 to 40%.

B. STURTEVANT CO., Boston, Mass.
General Office and Works, Hyde Park, Mass.
NEW YORK PHILADELPHIA CHICAGO LONDON
407

Black Diamond File Works

Est. 1803. Inc. 1895.

Twelve Medals Awarded at International Expositions

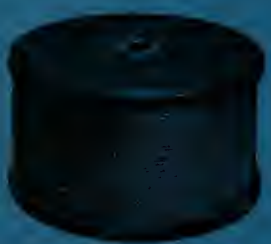
Special Prize Gold Medal at Atlanta, 1895.

OUR GOODS ARE ON SALE IN EVERY LEADING HARDWARE STORE IN THE UNITED STATES AND CANADA.

G. & H. BARNETT COMPANY,
PHILADELPHIA, PA.

JOHN A. ROEBLING'S SONS CO.

Insulated Wire of All Kinds



Bare Copper Wire

MAIN OFFICE AND WORKS TRENTON, N. J.

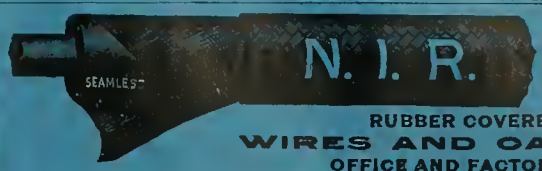
AGENCIES AND BRANCHES
New York Chicago Cleveland San Francisco Philadelphia Atlanta

Western Electrician

Vol. XXXV. $3.00 Per Annum. Copyright, 1904, by Electrician Publishing Company, Chicago. CHICAGO, DECEMBER 17, 1904. Entered at Chicago Postoffice as mail matter of the second class. 10 Cents a Copy. No. 25

Technology Quarterly
Mass. Inst. of Tech-
nology
Boston Mass

SIMPLEX INSULATED WIRES AND CABLES.
RUBBER COVERED, WEATHERPROOF, UNDERGROUND AND SUBMARINE.
WESTERN SELLING AGENT H. R. HIXSON, [illegible] Monadnock Block, CHICAGO.
The Simplex Electrical Co., 110 State Street, BOSTON, MASS.



National India Rubber Co.'s
RUBBER COVERED
WIRES AND CABLES.
OFFICE AND FACTORY: BRISTOL, R. I.

OKONITE
TRADE MARK
1889—Paris Exposition, Medal for Rubber Insulation.
1893—World's Fair, Medal for Rubber Insulation.
THE STANDARD FOR RUBBER INSULATION.
Sole Manufacturers of
Okonite Wires, Okonite Tape, Manson Tape, Candee Weather-proof Wires.
THE OKONITE CO., LTD.
Willard L. Candee, Gerant Cheever, Managers. 253 Broadway, New York. Geo. T. Manson, Gen'l Supt. W. H. Hodgins, Secy.

TRADE MARK
CRESCENT INSULATED WIRE & CABLE CO. TRENTON, N.J.
CRESCENT RUBBER INSULATED WIRES AND CABLES
National Code Standard.
CRESCENT INSULATED WIRE AND CABLE CO.,
New York Office, 63 BARCLAY STREET. Main Office and Factory, TRENTON, N. J.

Platinum
In Sheet or Wire for all Purposes,
SCRAP PURCHASED.
AMERICAN PLATINUM WORKS
CHAS. ENGELHARD. Gen. Mgr.
251 to 255 New Jersey R. R. Ave., Newark, N. J.

PARANITE
INDIANA RUBBER AND INSULATED WIRE CO.,
MANUFACTURERS OF
Paranite Rubber Covered Wires and Cables,
UNDERGROUND, AERIAL, SUBMARINE AND INSIDE USE.
TELEPHONE, TELEGRAPH AND FIRE ALARM CABLES.
All Wires are tested at Factory. JONESBORO, IND.

Water-Wheel Governors
Our new mechanical governors co-operate with the inertia effect of the water and the momentum of the plant.
They have cut the cost of good government in two. Guaranteed in every particular.
REPLOGLE GOVERNOR WORKS
AKRON, OHIO.
WRITE FOR DESCRIPTIVE MATTER W.

THOUSANDS IN USE.
Motors, ⅛ h. p. to 100 h. p.
Dynamos, 1 k. w. to 75 k. w.
Highest Quality. Reasonable Prices.
THE HOBART ELECTRIC MFG. CO.
TROY, OHIO.

I-T-E
CIRCUIT BREAKERS
CUTTER ELECTRICAL CO., PHILADELPHIA

SINGLE AND POLYPHASE
TRANSFORMERS
KUHLMAN ELECTRIC CO., - - Elkhart, Ind.

THERMOPILES 1½ VOLTS 1½ AMPERES
For Electrolytic analysis, charging storage batteries, and other constant current requirements. $3 Each.
WALSH'S SONS & CO.,
264 Washington Street. Newark, N. J.

PROMETHEUS
Electric Heating and Cooking Apparatus.
Most Modern and Efficient System.
Send for Illustrated Catalogue.
THE
Prometheus Electric Co.,
39 CORTLANDT STREET, NEW YORK.

"CIRCULAR LOOM"
THE FLEXIBLE CONDUIT
AMERICAN CIRCULAR LOOM CO.
TRADE MARK
REGISTERED
CONDUITS FOR INTERIOR WIRING.
American Circular Loom Co.
Chelsea, Mass., New York, Chicago, San Francisco.

WHITNEY WATCH
POCKET INSTRUMENTS

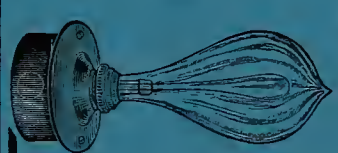
STANDARD RANGES

VOLTMETERS	AMMETERS
0 to 3 Volts.	0 to 150 Milliamp
0 to 5 Volts.	0 to 1 Ampere.
0 to 10 Volts.	0 to 5 Amperes.
0 to 15 Volts.	0 to 10 Amperes.

All have carefully aged permanent magnets and jewel bearings and are hand calibrated.
Invaluable for battery testing.
Send for prices to
MACHADO & ROLLER,
203 Broadway, New York, N. Y.
Or your nearest supply dealer.

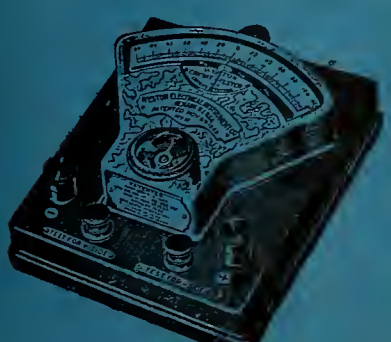
YOST SPECIALTIES.

Sockets, Wall Sockets, Weatherproof Sockets, Rosettes, Receptacles, Cord Adjusters.
Catalogue for the asking.
THE YOST ELECTRIC MFG. CO.
TOLEDO, OHIO.



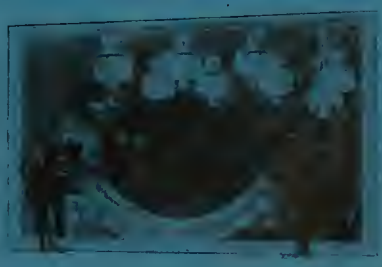
Some More Light on our Drawn Steel Junction Boxes
Take time to figure out the cost of cast-iron boxes plus the loss from breakage and time used in producing a round hole. Compare with this the cost of drawn steel boxes.
NO BREAKAGE,
Clean round hole produced with one blow of a hammer. Write for catalog and see what you can save.
BOSSERT ELECTRIC CONSTRUCTION CO. - - UTICA, N. Y.

WESTON Electrical Instrument Co.,
Waverly Park, NEWARK, N. J.

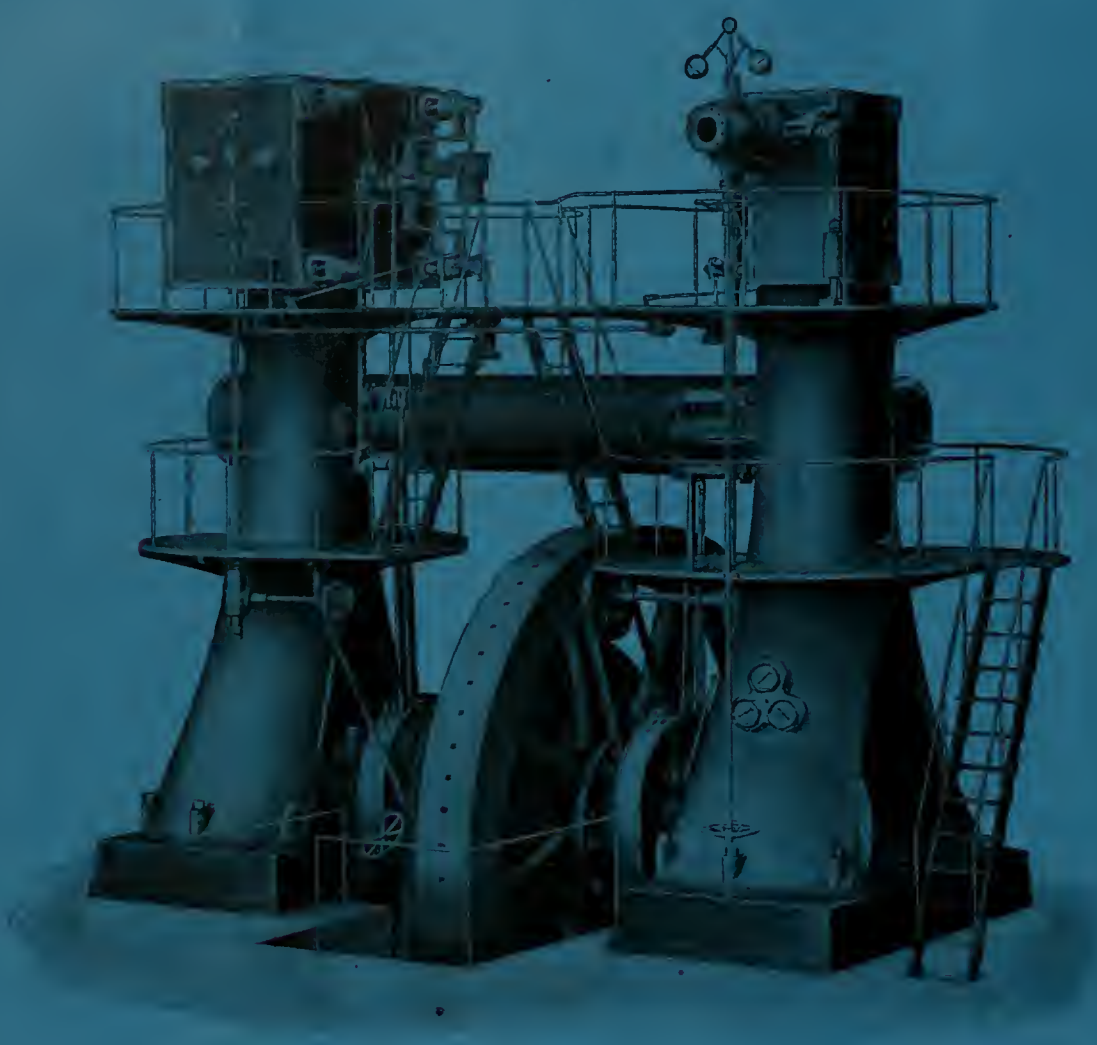

Weston Ground Detector and Circuit Tester.

Weston Standard Portable Direct Reading
Voltmeters,
Millivoltmeters,
Voltammeters,
Ammeters,
Milammeters,
Ground Detectors and Circuit Testers,
Ohmmeters,
Portable Galvanometers.
Our Portable Instruments are recognized as The Standard the world over. The Semi-Portable Laboratory Standards are still better.
Our Station Voltmeters and Ammeters are unsurpassed in point of extreme accuracy and lowest consumption of energy.
BERLIN—European Weston Electrical Instrument Co., Bitterstrasse No. 58.
LONDON—Elliott Bros., Century Works, Lewisham.
PARIS, FRANCE—E. H. Cadiot, 12 Rue St. Georges
New York Office—74 Cortlandt St.

Latest Novelty in Electric Lighting
—THE—
WEISSMANN PEARL SYSTEM


Endorsed for its Safety and Attractiveness by the best authorities in the world.
The sensation of the Ladies' Gowns Exhibit in the French Section at St. Louis.
Described in Western Electrician October 29 and November 26
Descriptive Matter and Patents mailed on application
PAUL LETHEULE, 4808 Delmar Bd., St. Louis

Vertical Cross Compound
Electric Light and Street Railway Engine.



Allis-Chalmers Vertical Cross Compound Engine
(Direct Connected)

This type of Engine is especially designed for large central-station work, or for places where floor space is limited.

It is used in the leading large stations, such as Metropolitan Street Railway Co., New York City, where ELEVEN of above type engine are installed; Milwaukee Electric Railway & Light Co.; Union Light & Power Co., St. Louis; Metropolitan Elevated, Chicago; Twin City Traction Co., Minneapolis; Chicago Edison Co., Chicago; Cincinnati Gas & Electric Co., Cincinnati; Metropolitan Street Railway Co., Kansas City, Mo., and others.

Allis-Chalmers Co.

Milwaukee, Wis., U. S. A.

Canadian Representatives, Allis-Chalmers-Bullock, Ltd., Montreal

THE ELECTRIC STORAGE BATTERY CO.

PHILADELPHIA

MANUFACTURER OF THE

"Chloride Accumulator"

For Central Stations, Electric Railways, Isolated Lighting and Power Stations, Fire Alarm, Telegraph, Train Lighting, etc., etc.

PRICE LISTS AND DESCRIPTIVE BULLETINS FORWARDED UPON REQUEST.

SALES OFFICES:

PHILADELPHIA, Allegheny Ave. and 19th St. | NEW YORK, 100 Broadway, | BOSTON, 60 State St. | CHICAGO, Marquette Bldg. | ST. LOUIS, Wainwright Bldg. | SAN FRANCISCO, Rialto Bldg. | CLEVELAND, Citizens Bldg. | CANADA, Canadian General Electric Co., Ltd. Toronto | HAVANA, CUBA, G. F. Greenwood, Manager 34 Empedrado St.

REPAIRING RECALIBRATING
ELECTRIC METERS.
INTERNATIONAL ELECTRIC METER CO.
167 S. CANAL STREET, CHICAGO.

INSULATED WIRES
COTTON AND SILK
NORTHERN WIRE & CABLE CO.
OFFICES: Milwaukee, 731-738 Wells Bldg. Chicago, 1202 Marquette Bldg.
MAGNET WIRES
South Milwaukee Wis.

WE BUY OLD BELTS
OR SCRAPS, ANY SIZE OR CONDITION.
WE CLEAN, REPAIR AND RENEW OLD BELTS.
LEATHER PRESERVER MFG. CORP.
27 W. MONROE ST., CHICAGO

Robert Volt-Ammeter
Dead Beat
Accurate, Durable
Guaranteed
List Price, $6.00 including lea ther case.
Sample instrument forwarded prepaid on receipt of $4.50.
Discount to Dealers
THE ROBERT INSTRUMENT CO.
56 Shelby Street
DETROIT - MICH.

Sheet Brass, *All Tempers*
Brass and Bronze Drill Rods
Brass and Copper Wire
German Silver Sheet and Rod
Brazed and Seamless Tubing

Eagle Brand *Copper Rivets and Burrs, Brass Escutcheon Pins*

Brass Butts, *Desk Narrow, Brosd Middle, Ball Tipped and Water Closet*

Brass and Iron Jack Chain, Brass Safety Chain, Etc.
Catalogues on Application

THE PLUME & ATWOOD MFG. CO.
New York *Boston* *San Francisco* *Chicago*

"STAR" INCANDESCENT LAMPS

LONG LIFE
GUARANTEED CANDLEPOWER,
HIGHEST EFFICIENCY.
MADE BY THE MOST SKILLED WORKMEN.
STANDARD ELECTRICAL MFG. COMPANY, : Niles, Ohio.

Engineering MECHANICAL, ELECTRICAL, STEAM, CIVIL.
Complete and short courses. Thoroughly equipped engineering shops. **Shop work from the beginning.** Short courses in Steam and Electrical Engineering. Expenses low. Accommodations the best. School all year. Students may enter any time. Correspondence steam and electrical courses. Send for catalogue. Mention course in which interested.
HIGHLAND PARK COLLEGE, DES MOINES, IOWA.

PLATINUM

PLATINUM RIVETS FOR CONTACT POINTS IN TELEPHONES—SPARK COILS AND OTHER ELECTRICAL APPARATUS. PLATINUM SHEET AND WIRE IN ANY FORM AND DEGREE OF HARDNESS. PLATINUM SCRAP PURCHASED.

BAKER & COMPANY, Inc.
ARTISANS IN PLATINUM
408-410-412-414 N. J. R. R. AVE. - NEWARK, N. J.
New York Office: 120 Liberty St.

ALPHABETICAL INDEX TO ADVERTISEMENTS.

Adams-Bagnall Electric Co...—
Allis-Chalmers Company..... 2
American Battery Co.....13
Amer. Circular Loom Co.... ...1
American Conduit Co.....19
American Diesel Engine Co..16
Amer. District Steam Co.....20
Amer. Elec. Fuse Co..... 8
Amer. EL Telephone Co.....19
American Electrical Works..13
American Platinum Works.. 1
Arnold Elec. Power Station Co.....17
Audit Co. of Ill., The..... —
Automatic Electric Co..... 19

Babcock & Wilcox Co.....—
Badt, F. B.....17
Bain, Forée.....13
Baker & Company..... 3
Baker & Co., W. E.....17
Barnett Company, G. & H....24
Beardslee Chandelier Mfg. Co.—
Benjamin Electric Mfg. Co...—
Bennett, L A.....12
Bertbold & Jennings.....20
Bissell Co., The F.....24
Bossert Electric Construction Co..... 1
Brooks, Hall L.....20
Bryan-Marsh Co.....—
Bryan, Wm. H.....17
Buckeye Electric Co.....—
Bullock Elec. Mfg. Co..... 2
Burlington R. R.....20
Butterfield, J. F.....17
Bylesby & Co., H. M.....17

Cantwell Press, The.....—
Carhartt & Co., Hamilton.. .—
Central Electric Co..... 5
Cent. Stat. Improvement Co 14
Central Tel. & El. Co.....18
Century Electric Co.....10
Chicago Die & Electric Co....14
Chicago Edison Co.....4, 14
Chic. Fuse Wire & Mfg. Co...—
Chicago Insulated Wire Co..—
Chicago Mica Co.....12
Cincinnati Gas & Elec. Co...14
Colonial Sign & Insulator Co.11
Columbia Incand. Lamp Co..—
Columbia Mfg. Co.....21
Continuous Rail Joint Company of America..... 13
Cooper-Hewitt Elec. Co 8
Cope, T. J..... 5
Crawfordsville Electric Co..—
Crescent Ins. Wire & Chl. Co. 1
Crocker-Wheeler Company...15
Crolius & Son, E. R.....—
Cutler-Hammer Mfg. Co..... 5
Cutter Elec. & Mfg. Company 1

D. & W. Fuse Company.....18
Dearborn Drug & Chem. Wks.16
Diamond Meter Company....21
Directory of Engineers.....17
Dixon Crucible Co., Joseph..16
Duncan Elec. Mfg. Co.....23

Edison Decorative & Miniature Lamp Departm't... 11, 12
Edison Mfg. Company.....—
Edwards & Co.....13
Egan, J. J.....14
Electric Appliance Co..... 12
Electric Storage Battery Co.. 3
Electrical Engineer Institute.—
Electrician Pub. Company...17
Erie Ry.....21
Evans, Almirall & Co 17
Evans & Co., W. R 17

Faries Mfg. Co.....
"For Sale" Advertisements..14
Ft. Wayne Elec. Works, Inc..23
Fostoria Incand. Lamp Co...—
Fowler, John H.....21
Fowler-Jacobs Company.....21
Franklin Elec. Mfg. Co .....—

General Electric Co..... 9
General Engineering Co., The 17
General Incandescent Arc Light Company..... 8
General Incand. Lamp Co....—
Gould Storage Battery Co.... 6
Gt. Western Smelting & Refining Co .....—
Green Fuel Economizer Co..16
Gregory Electric Company...14

Hallberg, J. H 17
Hamacek, A. F.....11
Hart Mfg. Co.....15
Hartford Steam Holler Inspection & Insurance Co....—
Hazard Manufacturing Co...—
Highland Park College. ... 3
Hipwell Mfg. Co..... 18
Hobart Elec. Mfg. Co..... 1
Hoffman, G. W.....14
Holmes Fibre-Graph. Co.....—
Holophane Glass Co.....—
Humphrey, Henry H.....17
Hunt & Co., Robt. W.....17

Illinois Central Ry.....20
Incandescent Electric Light Manipulator Company.....—
Indiana Rub. & Ins. W. Co.... 1
India Rubber & Gutta Percha Insulating Company.....—
International Elec. Meter Co 3
International Tel. Mfg. Co...18

Jackson, D. C. & W. B.....17
Jeffrey Manufacturing Co....16
Johns-Manville Co., H. W..... 7

Kartavert Manufacturing Co.—
Kellogg Switchboard & Supply Company.....19, 21
Kemp, R. W.....17
Kester Elec. Mfg. Co.....24
Klein & Sons, Mathias..... ...24
Kohler Brothers.....17
Kuhlman Electric Co..... 1

Leather Preserv. M. Corp.... 3
Leffel & Co., James.....16
Letheule, Paul..... 1
Lindsley Brothers Company..21
Loud's Sons Co., H. M.....—

Machado & Roller..... 1
Maltby Cedar Company.....21
Manhattan El. Supply Co....24
Manross, F. N. ....—
Marinette Gas Engine Co.....16
Matthews & Bros., W. N.....13
McLaughlin & Co., Jas..... 5
McLennan & Company, K....12
Mechanical Appliance Co....16
Mica Insulator Company.....12
Miscellaneous Advs.....14
Monon Railroad..... 14
Morrison Lbr. Co., J. W.....20
Mueller Company, William..21
Munsell & Co., Eugene..... 12

National Carbon Co..... 7
National Electric Co.....10
National India Rubber Co.... 1
New England Butt Co.....13
Newgard & Co., Henry.....21
New York Cent. Ry.....20
New York Ins. Wire Co.....13
Northern Elect'l Mfg. Co....12
Northern Wire & Cable Co... 3
Northwestern Storage Battery Co.. 5

Okonite Co., The..... 1
Osburn Flexible Conduit Co.13

Pacific Coast Pole Co.....21
Paragon Fan & Motor Co.....—
Pardridge Shade & Refl. Co..—
Pass & Seymour, Inc.....10
Phelan, D. W.....21
Phillips, Eugene F.....13
Phillips Insulated Wire Co...13
Phœnix Glass Co.....—
Phosphor-Bronze S. Co.....16
Pignolet, L. M.....12
Pittsburg & L. S. Iron Co....20
Plume & Atwood Mfg. Co.... 3
Porter Cedar Company.....21
Prometheus Electric Co., The 1

Reisinger, Hugo..... 9
Replogle Governor Works.. . 1
Reynolds EL Flasher Mfg. Co.12
Robert Instrument Co., The.. 3
Roche, Wm.....15
Roebling's Sons Co., J. A.....24
Ruebel-Schwedtmann-Wells..17
Runzel-Lenz Elec. Mfg. Co...—

Safety Ins. Wire & Cable Co..24
Sargent & Lundy.....17
Sauquoit Silk Mfg. Co.....13
Schott, W. H.....17
Signaloid Chemical Works...12
Simplex Electrical Co., The.. 1
Simplex Elec. Heating Co....12
Speer Carbon Co..... .—
Sprague Electric Company...12
Squire Electric Co.....—
Standard Elec. Mfg. Co..... 3
Standard Underg. Cable Co....—
Stanley Elec. Mfg. Co., The 4
Stanley Instrument Co..... 5
Stanton, LeRoy W.....17
Sterling & Son, W. C.....21
Sterling Electrical Mfg. Co... 15
Sterling Varnish Co., The....11
Stow Mfg. Company.....—
Stromberg-Carlson Tel. Mfg. Company.....18
Sturtevant Company, B. F...24

Temple Pump Co.....—
Torrey Cedar Company.....21
Trumbull Elec. Mnfg. Co.....—
Turner Brass Works..... 9

Union Electric Mfg. Co.....—

Valentine-Clark Co., The....—
Vulcanized Fibre Company..24

Wagner Electric Mfg. Co.....15
Walsh's Sons & Company..... 1
Warren Elec. Mfg. Co.....24
Wesco Supply Co.....12
Western Electric Company... 7
Westinghouse Electric & Manufacturing Co.....22
Weston Electrical Inst. Co... 1
Whitehead Machinery Co... 14
Wilmerding, C. H.....—
Woolley Fdy. & Mach. Wks..—
Worcester Company, C. H....20

Yeshera Mfg. Co..... .. 18
Yost Electric Mfg. Co 1

Zero Marx Sign Works .....—

For Classified Index of Advertisements See Page 6.

If you want Wires or Cables insulated with the HIGHEST CLASS INDIA RUBBER INSULATION you should buy . . . . . .

HABIRSHAW

Complete stock of all sizes constantly on hand and for sale at lowest market prices by

CHICAGO EDISON COMPANY,

WRITE FOR PRICES. 139 ADAMS STREET, CHICAGO.

NOW READY!

WESTERN ELECTRICIAN'S

MOONLIGHT SCHEDULE

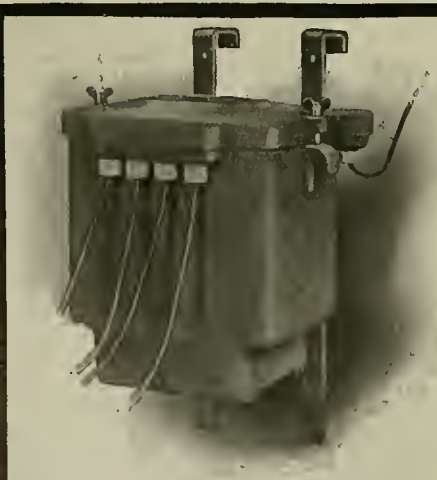
FOR 1905.

TEN CENTS A COPY.

Electrician Publishing Co.,

510 MARQUETTE BUILDING,

CHICAGO.



THE B. O. TRANSFORMER

Do you expect to need new transformers this fall? If you do, the B. O. will interest you.

Low Losses
High Efficiencies
High Insulation
Low Price.

Are you familiar with oil duct transformers?
Send us your address and we will tell you about our insulation and the advantages of slab windings in connection with oil ducts.

THE STANLEY ELECTRIC MANUFACTURING COMPANY

PITTSFIELD, MASSACHUSETTS

Atlanta, Ga., Empire Building
CHICAGO, ILL., MONADNOCK BLOCK
New York, N. Y., 29 Broadway
St. Louis, Mo., Century Bldg.
Boston, Mass., Oliver Building
Denver, Col., Hendrie & Bolthoff Mfg. & Supply Co.
Philadelphia, Pa., North American Building
San Francisco, Cal., 69-75 New Montgomery St.
Seattle, Wash., Pioneer Bldg.

Representatives for the Dominion of Canada, THE CANADIAN GENERAL ELECTRIC CO. of Toronto.

"THE S. K. C. SYSTEM"

WE DON'T WANT TO MAKE YOU BUY IT

OKONITE TRADE MARK.

But we do want to convince you of its superior qualities, which are sure to appeal to every buyer who wants the best for the money.

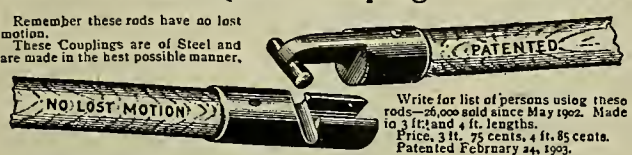
OKONITE TRADE MARK.

OKONITE IS FOR GENERAL USE WHERE AN INSULATED WIRE IS REQUIRED.

Central Electric Company, 264-266-268-270 FIFTH AVE., CHICAGO.

Cope's Patent Quick Coupling Conduit Rod

Remember these rods have no lost motion.
These Couplings are of Steel and are made in the best possible manner.



Write for list of persons using these rods—26,000 sold since May 1902. Made in 3 ft. and 4 ft. lengths. Price, 3 ft. 75 cents, 4 ft. 85 cents. Patented February 24, 1903.

T. J. COPE

3244 North Fifteenth Street PHILADELPHIA, PA.

SATISFACTION ASSURED

Every battery has its own guarantee.

Lighting Batteries,

Automobile Sparkers.

Prompt delivery made on rush orders.

We work night and day.

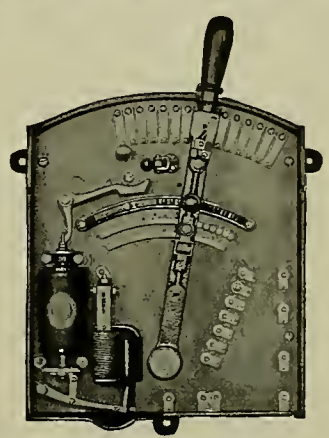
Northwestern Storage Battery Co.,
285 Madison St., - - - Chicago, Ill.

Our Compound Stops Sparking and Saves Commutators.

14 Years' Use on Street Ry., Light and Power Commutators Has Proven its Worth. WE GUARANTEE RESULTS. Send Your Address for FREE SAMPLE THAT CONVINCES.

JAS. McLAUGHLIN & CO., ELECTRICAL ENGINEERS
586 Fulton Street, - - Chicago, Ill.

Flat Bed and Small Rotary Press Controllers



One of the six "Carpenter" types.

The "Carpenter" system gives such a wide range of speed and such perfect control that a press can be moved an eighth of an inch at a time, and from that to top speed, with every desirable intermediate speed.

Six types, alike in principle, different in detail. Bulletins 81 to 86 explain. We'll send them if you let us know that you want them.

The Cutler-Hammer Mfg. Co.,

Electric Controller Manufacturers and Electrical Engineers.

MILWAUKEE, WIS.

New York, Boston, Chicago, Pittsburg.

ELECTRICITY FOR ENGINEERS.

424 PAGES. ILLUSTRATED. PRICE $2.50.

ELECTRICIAN PUBLISHING CO., 510 Marquette Building, CHICAGO

STANLEY INSTRUMENT CO.

GREAT BARRINGTON, MASS., U. S. A.

UNIVERSAL EXPOSITION ST. LOUIS 1904

GOLD MEDALS

PAN-AMERICAN EXPOSITION BUFFALO 1901

THE HIGHEST AWARDS AT BOTH EXPOSITIONS FOR

WATTMETERS

Gould Storage Battery Co.

Complete Storage Battery Plants

Railway Line and Regulating Isolated and Train Lighting Central Lighting and Power Electric Vehicle and Telephone

GOULD COUNTER E. M. F. BOOSTER SYSTEMS

Sales Offices { NEW YORK, 1 W. 34th Street. BOSTON, 89 State Street. CHICAGO, The "Rookery." SAN FRANCISCO, Century Electric Co.

WORKS: DEPEW, N. Y.

Bulletins.

CLASSIFIED INDEX OF ADVERTISEMENTS.

Accountants and Auditors.
Audit Co. of Illinois

Adjusters, Cord.
Incandes. El. Lt. Manip. Co.

Adjusters, Inc. Lamps.
Inc. El. Lt. Manipulator Co.

Anchors (Tel. & Tel.)
Bennett, I. A.
Matthews & Bro., W. N.

Annunciators.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.

Batteries and Jars.
Bissell Co., The F.
Central Electric Co.
Edison Mfg. Co.
Edwards & Company.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Roche, Wm.
Wesco Supply Co.
Western Electric Co.

Bells, Buzzers, Etc.
Central Electric Co.
Edwards & Co.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.

Belt Dressing.
Dixon Crucible Co., Jos.
Leather Preserver Mfg. Corp.

Belting.
Leather Preserver Mfg. Corp

Blow Pipes.
Turner Brass Works

Blowers.
Green Fuel Economizer Co.
Sturtevant Co., B. F.

Boiler Compounds.
Dearborn Drug & Chem. Wks.

Boilers.
Allis-Chalmers Company.
Babcock & Wilcox Co.

Books, Electrical.
Cantwell Press, The.
Electrician Publishing Co.

Booths, Telephone.
Yesbera Mfg. Co.

Brackets.
Faries Mfg. Co.

Brushes.
Central Electric Co.
Hobart Elec. Mfg. Co.
Holmes Fibre-Graphite Co.
Speer Carbon Co.
Western Electric Company.

Cable Hangers.
Bissell Co., B. F.
Wesco Supply Co.
Western Electric Co.

Cables (See Wires and Cables)

Canopies.
Faries Mfg. Co.

Carbons, Points and Plates.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
National Carbon Co.
Reisinger, Hugo.
Speer Carbon Co.
Wesco Supply Co.

Castings.
Faries Mfg. Co.
New England Butt Co.
National Electric Co.

Chains.
Jeffrey Mfg. Co.

Chandeliers.
Faries Mfg. Co.

Circuit Breakers.
Cutler-Hammer Mfg. Co.
Cutter Elec. & Mfg. Co.
Ft. Wayne Elec. Wks. Inc.
Union Electric Mfg. Co.
Wesco Supply Co.
Western Electric Company.
Westinghouse El. & Mfg. Co.

Clusters.
Benjamin Elec. Mfg. Co.
Faries Mfg. Co.

Coal and Ashes Handling Machinery.
Jeffrey Mfg. Co.

Coils and Magnets.
Western Electric Co.

Coloring, Lamp.
Signaloid Chemical Works.

Commutator Compound
Crollus & Son, F. R.
Egan, J. J.
McLaughlin & Co., Jas.
McLenoan & Co., K.

Condensers, Electric.
Stanley Elec. Mfg Co.

Conduit and Conduits.
American Circular Loom Co.
American Conduit Company
Central Electric Co.
Electric Appliance Co.
Oshurn Flexible Conduit Co.
Sprague Electric Co.
Wesco Supply Co.

Contractors and Electric Light Plants.
Allis-Chalmers Company.
Bullock El. Mfg. Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
Natioual Electric Co.
Northern Electrical Mfg. Co.
Sprague Electric Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Controllers, Crane.
Amer. Elec. Fuse Co.

Copper, Scrap.
Great Western Smelting & Refining Co.

Cord.
Runzel-Leoz Elec. Mfg. Co.

Cross-Arms, Pins and Brackets.
Berthold & Jennings.
Central Electric Co.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Company.

Cut-Outs and Switches.
Bissell Co., The F.
Bossert Elec. Const. Co.
Central Electric Co.
Chicago Edison Co.
Clinton Stamping & Elec. Co.
Cutter Elec. & Mfg. Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
General Inc. Arc Light Co.
Humacek, A. F.
Hart Manufacturing Co.
Manhattan Elec. Supply Co.
Trumbull Elec. Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Dynamos and Motors.
Allis-Chalmers Company.
Bissell Co., The F.
Bullock Elec. Mfg. Co.
Central Electric Co.
Century Electric Co.
Crawfordsville Electric Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks. Inc.
General Elec. Co.
General Inc. Arc Light Co.
Gregory Electric Co.
Hobart Elec. Mfg. Co.
Mechanical Appliance Co.
National Electric Co.
Northern Electrical Mfg. Co.
Sprague Electric Co.
Stanley Elec. Mfg. Co.
Stow Manufacturing Co.
Sturtevant Co., B. F.
Wagner Electric Mfg. Co.
Warren Elec. Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Economizers, Fuel.
Green Fuel Economizer Co.

Electric Heating Appl.
Electric Appliance Co.
Prometheus Electric Co.
Simplex Elec. Heating Co.
Western Electric Co.

Electric Railways.
Crocker-Wheeler Co.
General Electric Co.
Sprague Electric Co.
Westinghouse El. & Mfg. Co.

Electrical and Mechanical Engineers.
Arnold Elec. Power Stat'n Co.
Badt, F. B.
Baker & Co., W. E.
Bryan, Wm. H.
Butterfield, J. F.
Bylleshy & Co., B. M.
Evans, Almirall & Co.
General Engineering Co., The.
Hallberg, J. H.
Humphrey, Henry B.
Hunt & Co., Robt. W.
Jackson, D. C. & W. B.
Kemp, R. W.
Kohler Brothers.
Newgard & Co., Henry.
Northern Electrical Mfg. Co.
Ruehel, Schwedtmao, Wells.
Sargent & Lundy.
Schott, W. H.
Squire Electric Co.
Stanley Elec. Mfg. Co.
Stanton, LeRoy W.
Wilmerding, C. H.

Electrical Instruments. (Recording and Testing.)
Bissell Co., The F.
Central Electric Co.
Diamond Meter Co.
Duncan Elec. Mfg. Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
General Inc. Arc Light Co.
Machado & Roller.
Pignolet, L. M.
Robert Inst. Co., The
Stanley Elec. Mfg. Co.
Stanley Instrument Co.
Wagner Electric Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co
Weston Electrical Inst. Co.

Electro-Plating Mach'y
Crocker-Wheeler Company.
General Electric Co.

Elevators-Conveyors.
Jeffrey Mfg. Co.

Engines, Gas and Gasoline.
Allis-Chalmers Company.
Marinette Gas Engine Co.
Temple Pump Co.
Woolley Fdy. & Mach. Wks.

Engines, Oil.
American Diesel Engine Co.

Engines, Steam.
Allis-Chalmers Company.
Sturtevant Co., B. F.

Fans and Fan Motors.
Central Electric Co.
Crocker-Wheeler Company.
Edison Mfg. Co.
General Electric Co.
General Inc. Arc Light Co.
Sprague Electric Co.
Sturtevant Co., B. F.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Fibre.
Kartavert Mfg. Co.
Vulcanized Fibra Co.

Files.
Barnett Co., G. & H.

Fittings.
Faries Mfg. Co.

Fixtures, Gas and Elec.
Beardslee Chandelier Mfg. Co.

Finishers.
Bissell Co., The F.
Reynolds El. Flasher Mfg. Co
Wesco Supply Co.

Flexible Shafts.
Stow Mfg. Co.

Forges.
Sturtevant Co., B. F.

Fuses and Fuse Wire.
Amer. Elec. Fuse Co.
Bissell Co., The F.
Central Electric Co.
Central Tel. & El. Co.
Chicago Die & Electric Co.
Chicago Fuse Wire & Mfg. Co.
Clinton Stamping & Elec. Co.
D. & W. Fuse Company.
Electric Appliance Co.
Johns-Manville Co., H. W.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Company.

Globes, Reflectors and Shades.
Fostoria Incan. Lamp Co.
Holophane Glass Co.
Pardridge Shade & Refl. Co.
Phœnix Glass Co.
Wesco Supply Co.
Western Electric Co.

Governors, Water Wheel.
Replogle Governor Works.

Graphite Specialties.
Dixon Crucible Co., Jos.
Holmes Fibra-Graphite Co.

Heating (Exhaust Steam).
Amer. District Steam Co.

Heating and Ventilating Apparatus.
Sturtevant Co., B. F.

Heating, Hot Water.
Evans, Almirall & Co.

Holders, Inc. Lamps.
Electric Appliance Co.
Incandesent Electric Light Manipulator Co.

Inspection & Insurance
Hartford Steam Boiler Inspection & Insurance Co.

Insulating Machinery.
New England Butt Co.

Insulators and Insulating Materials.
American Electrical Works.
Ceotral Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Ioc. Arc Light Co.
Indiana Rub. & Ins. Wire Co.
Johns-Manville Co., H. W.
Kartavert Mfg. Co.
Manhattan Elec. Supply Co.
Mica Insulator Co.
Munsell & Co., Eugene.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Starling Varnish Co.
Vulcanized Fibra Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Lamps, Arc.
Bissell Co., The F.
Central Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
General Inc. Arc Lt. Co.
Gregory Electric Co.
Hipwell Manufacturing Co
Manhattan Elec. Supply Co.
Stanley Elec. Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Lamps, Incandescent.
Bissell Co., The F.
Bryan-Marsh Company.
Buckeye Electric Company.
Central Electric Co.
Chicago Edison Co.
Columbia Incan. Lamp Co.
Edison Decorative & Miniature Lamp Dept.
Electric Appliance Co.
Fostoria Incand. Lamp Co.
Franklin Electric Mfg. Co.
General Electric Co.
General Inc. Arc Light Co.
Sawyer-Man Elec. Co.
Standard Elec'l Mfg. Co.
Sterling Electrical Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Lamps, Incandescent—Repiacers & Cleaners.
Inc. El. Lt. Manipulator Co.

Lamps, Vapor.
Cooper, Hewitt Elec. Co.

Letters, Sign.
Colonial Sign & Insulator Co.

Lightning Arresters.
Central Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
Manhattan Elec. Supply Co.
Stanley Elec. Mfg. Co.
Wesco Supply Co.
Western Electric Co.

Linemen's Climbers.
Klein & Sons, Mathias.

Magnet Wires.
(See Wires and Cables.)

Mechanical Draft.
Green Fuel Economizer Co.
Sturtevant Co., B. F.

Mica.
Chicago Mica Co.
Mica Insulator Co.
Munsell & Co., Eugene

Mining Apparatus, Elec.
Allis-Chalmers Company.
Crocker-Wheeler Company.
General Electric Co.
Jeffrey Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Motors. (See Dynamos and Motors.)

Nippers and Pliers.
Klein & Sons, Mathias.

Novelties, Lighting.
Lethenia, Paul

Nozzles.
Faries Mfg. Co.

Overalls.
Carhartt & Co., Hamilton.

Patent Attorneys.
Bain, Foree.

Phosphor Bronze.
Phosphor Bronze Sm. Co. Ltd.

Platinum, Wire and Sheet.
American Platinum Works.
Baker & Company Inc.

Poles and Ties.
Berthold & Jennings.
Brooks, Hall L.
Columbia Mfg. Co.
Fowler, John H.
Fowler-Jacobs Company.
Kellogg Switch. & Sup. Co.
Lindsley Bros. Co.
Loud's Sons Co., H. M.
Maltby Cedar Co.
Morrison Lbr. Co., J. W.
Mueller Company, William.
Pacific Coast Pole Co.
Phelan, D. W.
Pittsburg & L. S. Iron Co.
Porter Cedar Company.
Sterling & Son, W. C.
Torrey Cedar Co.
Valentine-Clark Co., The.
Worcester Co., C. H.

Polish (Metal).
Allen Co., Inc., L. B.
Hoffman, Geo. W.

Portables.
Faries Mfg. Co.

Power Transmission Machinery.
Jeffrey Mfg. Co.

Rail Joints.
Continuous Rail Joint Company of America.

Railway Supplies.
Wesco Supply Co.

Refiners.
Gt. West Smalt. & Refining Co

Re-Winding—Repairs.
Chicago Edison Co.
Gregory Electric Co.

Rheostats.
Amer. Electric Fuse Co.
Cutler-Hammer Mfg. Co.
General Electric Co.
Gen'l Inc. Arc Lt. Co.
Union Electric Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Rods, Conduit.
Cope, T. J.

Schools and Colleges.
Electrical Engineer Inst.
Highland Park College

Second-Hand Mach'y.
Bissell Co., The F.
Cent. Stat. Improvement Co.
Cincinnati Gas & Elec. Co.
Gregory Electric Co.
Matthews & Bro., W. N.
Walsh's Sons & Co.

Shades, Lamp.
Faries Mfg. Co.

Sheet Brass & Copper.
Plume & Atwood Mfg. Co.

Signs, Electric.
Zero Marx Sign Works.

Silks, Insulating and Braiding.
Sauquoit Silk Mfg. Co.

Sockets & Receptacles.
Pass & Seymour.
Yost Elec. Mfg. Co.

Soldering Sticks, Salts and Paste.
Crollus & Son, F. R.
Kester Elec. Mfg. Co.
Western Electric Co.

Speaking Tubes.
Central Electric Co.
Edwards & Co.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.

Speed Indicators.
Weston Electrical Inst. Co.

Storage Batteries.
American Battery Co.
Electric Storage Battery Co.
Gould Storage Battery Co.

Supplies, General Elec.
Bissell Co., The F.
Central Electric Co.
Century Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Electric Co.
Manhattan Elect'l Supply Co.
Wesco Supply Co.
Western Electric Co.

Switchboards.
Bissell Co., The F.
Geo. Incan. Arc Light Co.

Telephones, Telephone Material and Switchboards.
American El. Telephone Co
Automatic Electric Co.
Bissell Co., The F.
Central Electric Co.
Central Tel. & El. Co.
Electric Appliance Co.
International Tel. Mfg. Co.
Kellogg Switchb. & Sup. Co.
Manhattan Elec. Supply Co.
Stromberg-Carlson Tel. M.Co
Wesco Supply Co.
Western Electric Co.

Time Switches.
Bissell Co., The F.

Tools.
Klein & Sons, Mathias.
Western Electric Co.

Transformers.
Central Electric Co.
Crawfordsville Electric Co.
Crocker-Wheeler Co.
Electric Appliance Co.
Ft. Wayne Elec. Works, Inc.
General Electric Co.
Gregory Electric Co.
Kuhlman Electric Co.
Manhattan Elec. Supply Co.
National Electric Co.
Stanley Elec. Mfg. Co.
Wagner Electric Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Trucks, Electric Car.
General Electric Co.
Westinghouse El. & Mfg. Co.

Turbines, Steam.
Allis-Chalmers Co.
General Electric Co.
Westinghouse El. & Mfg. Co

Turbine Water Wheels
Leffel & Co., Jas.

Varnishes.
Sterling Varnish Co.

Vulcanized Fibre.
Vulcanized Fibra Co.

Whistles, Electric.
Electrical Appliance Co.

Wires & Cables—Magnet Wires.
American Electrical Works.
Bissell Co., The F.
Central Electric Co.
Chicago Insulated Wire Co.
Crescent Ins. Wire & Cble. Co
Electric Appliance Co.
General Electric Co.
Hazard Manufacturing Co.
Indiana Rub. & Ins. Wire Co
India Rubber & Gutta Percha Insulating Co.
Kellogg Switch. & Sup. Co.
Manhattan Elec. Supply Co.
National India Rubber Co
New York Insulated Wire Co.
Northern Wire & Cable Co.
Okonite Co., The.
Phillips, Eugene F.
Phillips Insulated Wire Co
Roebling's Sons Co., J. A.
Runzel-Lenz Elec. Mfg Co.
Safety Ins. Wire & Cable Co.
Simplex Electrical Co.
Standard Underground C. Co
Wesco Supply Co.
Western Electric Company.

For Alphabetical Index of Advertisements See Page 3.

GRAND PRIZE

Awarded by LOUISIANA PURCHASE EXPOSITION, St. Louis

TO

NATIONAL CARBON CO.

CLEVELAND, OHIO

FOR ALL CARBON PRODUCTS

INCLUDING

COLUMBIA

ENCLOSED ARC CARBONS

N. E. CODE STANDARD SACHS TRADE NDARK MARK FUSE SPOT SHOWS WHEN BLOWN

OUR LABEL

NATIONAL ELECTRIC CODE

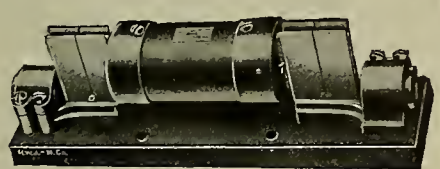
STANDARD FUSE DEVICES ARE READY

250-VOLT

TYPE B (Ferrule Contact).
1-30 Amps., 1, 2, 3 Pole, Main Line.
31-60 Amps., 1, 2, 3 Pole, Main Line.

TYPE E (Knife Blade Contact).
61-100 Amps., 1, 2, 3 Pole, Main Line.

TYPE E (Knife Blade Contact).
101-200 Amps., 1 Pole, Main Line.
201-400 Amps., 1 Pole, Main Line.
401-600 Amps., 1 Pole, Main Line.



600-VOLT

TYPE B (Ferrule Contact).
1-30 Amps., 1 Pole, Main Line.
31-60 Amps., 1 Pole, Main Line.

TYPE E (Knife Blade Contact).
61-100 Amps., 1 Pole Main Line.

TYPE E (Knife Blade Contact).
101-200 Amps., 1 Pole, Main Line.
201-400 Amps., 1 Pole, Main Line.
401-600 Amps., 1 Pole, Main Line.

MILWAUKEE CHICAGO ST. LOUIS CLEVELAND PITTSBURG

H. W. JOHNS-MANVILLE CO.

Mfrs. Asbestos and Magnesia Pipe and Boiler Coverings, Roofing and Packings

100 WILLIAM ST., NEW YORK.

BOSTON PHILADELPHIA LONDON PARIS BRUSSELS

DIRECT-CURRENT

Motors and Generators

Arc Lighting Systems

Bulletins On Request

Western Electric Company

CHICAGO NEW YORK

OTHER LARGE CITIES

"Just As Good As Day Light"

No Shadows, No Glare, No Flicker.

Cooper Hewitt Mercury Vapor Lamps

TYPE H-6 LAMP.

diffuse their light so that it strikes your work from all sides. There is no "standing in your own light." There is no need of adjusting brackets, cords or lamp holder. The cost is but 35% of other Electric Lighting. There is no consumption of light-giving element and no need of trimming. Have twice the efficiency of the arc lamp and from 7 to 9 times the efficiency of the incandescent.

Especially adapted for use in drafting rooms, machine shops, press rooms, factories and offices.

Send for Booklet.

For Direct Current Systems Only.

We were awarded by the Louisiana Purchase Exposition a Gold Medal for Vapor Lamps for Photo-Engraving and also the Grand Prize for Electric Lighting Work in the development of the Mercury Vapor Lamp.

Cooper Hewitt Electric Co.

220 W. 29th St. New York City

Philadelphia Office, 1121 Walnut Street.

Perfect Control—Indefinite Regulation
No Flashing—No Repairs
Burnouts Impossible—Last Forever

ALLEN-BRADLEY
RHEOSTATS

For All Purposes of Electric Current Control

Prices Reasonable—Satisfaction Guaranteed

SEND IN A TRIAL ORDER

Ask your Engineer or Electrician about it.

AMERICAN ELECTRIC FUSE CO.

48-50 West Jackson Boul.
CHICAGO, ILL.

Check Here

.....	D. C. Multiple, 100 to 125 V. Arc Lamps "O."	G. I. White Catalogue
.....	D. C. Series C. P., 200 to 600 V. Arc Lamps "L 3."	
.....	D. C. Series, Constant Current Arc Lamps "L 5."	
.....	A. C. Multiple, 60 to 133 Cycle Arc Lamps "L 6."	
.....	A. C. Arc Lamps "L 7," Series Shuntwound.	
.....	A. C. Differential Arc Lamps "L 8," Series.	
.....	D. C. Multiple, 200 to 250 V. Arc Lamps "L 12."	
.....	D. C. Multiple, 100 to 125 V. Lamps "L 11" and "L 21."	
.....	D. C. Multiple, 100 to 125, 200 to 250 V., Types "L 31," "L 41," "L 22" Arc Lamps.	
.....	Catalogue of Parts of Types "L 11" and "L 21" Arc Lamps	Arc and Incandescent Lamps
.....	Concentric Arc Light Diffuser Outfits.	
...	Hanger Board for Multiple Arc Lamps.	
...	Combined Hanger and Absolute Cutouts.	
.....	New Trimming Device for High-tension G. I. Arc Lamps.	
.....	Carbons for Enclosed Arc Lamps, "Electra."	
.....	G. I. Incandescent Lamps.	
.....	"Zodiac" Incandescent Lamps.	
.....	Open Bottom Globes.	
.....	Automatic Switches.	G. I. Pink Catalogue
.....	Knife Switches, Slow and Quick Break.	
.....	G. I. Type Two-knife Switches.	
.....	Oil Switches and High-tension Apparatus.	
.....	Stab Switches, for Series Arc or Incandescent Circuits.	
.....	Voltmeter and Ammeter Switches.	
.....	Circuit-breakers, Under and Over Load.	
.....	Circuit-breakers, Special Small Sizes (Type C. B.).	
.....	Protective Fuse Devices.	Switchboard Appliances
.....	S. K. C. Instruments.	
.....	Portable and Small Pocket Type Voltmeters and Ammeters.	
.....	Round Pattern Voltmeters and Ammeters.	
.....	Lightning Arresters.	
.....	Primary Fuse Box, Insulator Type.	G. I. Buff Catalogue
.....	Floor Outlet Boxes (Water-tight).	
.....	Flush Receptacles and Plugs.	
.....	Flush Wall Pocket Receptacles.	
.....	Flush Push Button Switches.	
....	Pendant Push Button.	Wiring and General Appliances
.....	Snap Switches.	
.....	Punched Clip Knife Switches.	
.....	Transformer, Type Z.	
...	Rheostats and Field Regulators.	G. I. Yellow Catalogue
.....	D. C. Motors and Generators.	
.....	A. C. Small Motors.	
.....	Grinding and Buffing Motors.	
.....	Rotary Converters and Motor Generators.	
....	D. C. and A. C. Sewing Machine Transmitters.	Motors and Generators
.....	D. C. Desk, Bracket and Trunnion Fan Motors.	
..	D. C. Ceiling Fans.	
.....	General Instruction Bulletin Paragon Motors.	
.....	Small Plunt Switch Panels.	G. I. Blue Catalogue Panels
.....	Plug Panel Boards.	
.....	G. I. Panel Boards and Fuse Carriers.	
.....	Wright Discount Indicator.	G. I. Green Catalogue Miscellaneous
.....	Blue Printing Outfit.	
.....	Underground Apparatus.	

Cut This Out
and
Mail To

General Incandescent Arc Light Co.

529 W. 34th Street = New York City

Information and Data on any item checked would be appreciated.

Name.....

Address.....

City and State.....

It Will Interest You to Know What the **Western Electric Company** Have to Say Regarding

ELECTRA
TRADE MARK

HIGHEST GRADE NUERNBERG

CARBONS

in their circular letter dated October 7, 1904, which in part reads as follows:

"It seems almost an unnecessary proceeding to write a letter advertising the 'ELECTRA' Carbon, or to dwell upon its merits, to any great extent, inasmuch as the 'ELECTRA' Carbon is the STANDARD OF PERFECTION, to which all other manufacturers of carbons endeavor to reach. We think this is a sufficient recommendation in itself.

If you have not been using these carbons in your arc lamps, it would certainly pay you to give them a trial. You will find that the expenses of trimming are reduced from 15 to 20 per cent."

HUGO REISINGER, Sole Importer, 11 Broadway, NEW YORK CITY

THE BEST **BRAZING TORCH**

FOR ELECTRICIANS

HOTTEST ON EARTH

The Turner 4B Gasoline Brazing Torch is used by all mechanics for light work in brazing, annealing, tempering and drawing temper of small tools, etc. This torch produces an intensely hot, pointed flame of over 3,000° Fahr. Burns 4 hours from one filling.

PRICE $4.50 NET

THE TURNER BRASS WORKS
23 N. Franklin St., Chicago

FARIES FIXTURES

Shades
Brackets
Clusters
Portables
Canopies
Chandeliers
Nozzles
Fittings
Castings

are UNIVERSALLY USED

Catalog Mailed on Application

FARIES MFG. CO.
DECATUR, ILL.

General Electric Company

TRANSFORMERS FOR THAWING OUT WATER PIPES

LIGHT SIMPLE PORTABLE

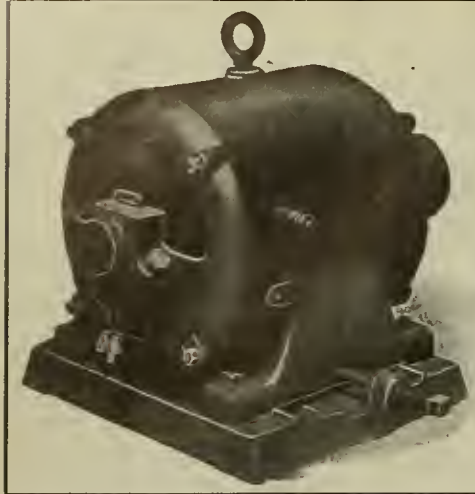
Are furnished for installation on alternating current lighting or power circuits below 3,500 volts, and give absolute control of current and voltage from zero to maximum.

IT WILL QUICKLY PAY FOR ITSELF

Order now and be equipped for cold weather.
It is fully described in Pamphlet No. 1047. Write for it.

General Office: SCHENECTADY, N. Y.

Chicago Office: Monadnock Block **Sales Offices in all Large Cities**



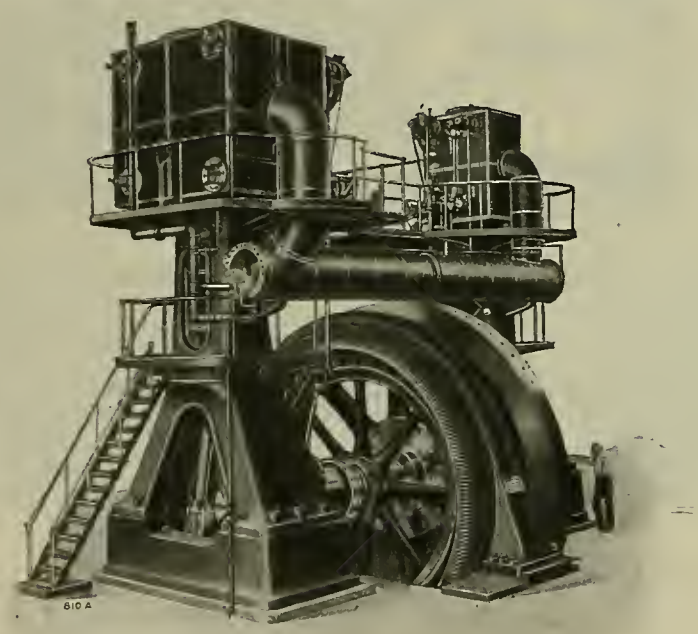
SINGLE-PHASE SELF-STARTING ALTERNATING CURRENT MOTORS

That will start under full load are our specialty. Can be mounted on floor, ceiling, or side wall. It is to your interest financially to become acquainted with them before placing your next order.

CENTURY ELECTRIC COMPANY

Main Office and Works
1007-9-11 Locust Street St. Louis, Mo.

For Immediate Delivery



MODERN DESIGN SUPERIOR PERFORMANCE

Gold Medal Generator Unit

Hamilton Corliss Cross Compound Vertical Condensing Engine, 2,250 horsepower.

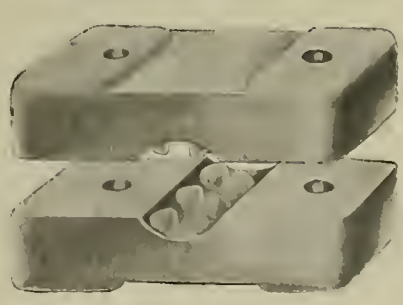
1,500 K. W., 3 Phase 25 cycles, 6,600-Volt National Alternator.

Released at close of St. Louis Exposition.

For prices and terms apply to

HOOVEN, OWENS, RENTSCHLER CO.
HAMILTON, OHIO

National Electric Company
Milwaukee



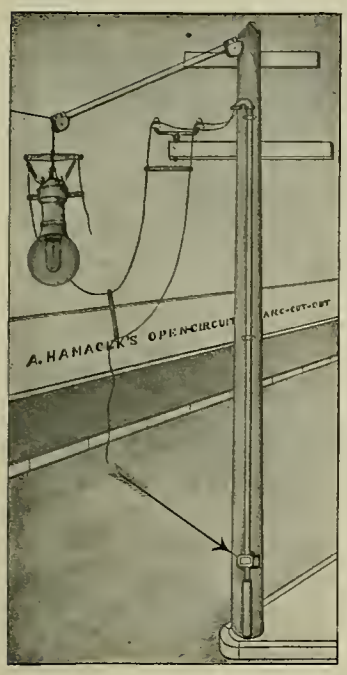
P. & S. SINGLE WIRE CLEATS

Made in 5 sizes to take wires from No. 14 to 400,000 C. M.

Packed Twenty-five Pair to a Box

PASS & SEYMOUR, Inc., Solvay, N. Y.

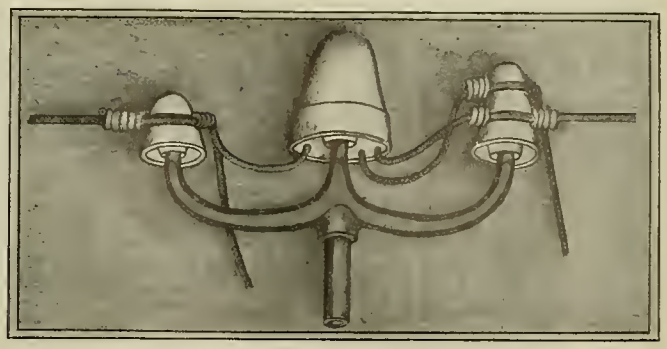
NEW YORK CHICAGO SAN FRANCISCO



SERIES ARC LIGHTING, D. C. OR A. C. IS NOT COMPLETE WITHOUT

SERIES CUT-OUTS

Not more so than A. C. transformer system would be complete without cut-outs.



No. 1. Series Cut-Out with Porcelain Housing

Send all orders to A. F. HAMACEK, No. 2039 Kenmore Ave., Chicago.
Will sell interest in the manufacturing of these Cut-Outs and Arc Lamps.

A UNIVERSAL DEMAND

A. F. HAMACEK

No. 2039 Kenmore Avenue CHICAGO, ILLINOIS

WHITE PORCELAIN LETTERS — FIREPROOF
FOR ELECTRIC SIGNS
AGENTS WANTED WHEREVER THERE ARE CENTRAL STATIONS.
COLONIAL SIGN AND INSULATOR CO., - - - AKRON, O.

BUY Your Electrical Books of the Electrician Publishing Co., Suite 510 Marquette Bldg., Chicago. You will save TIME and MONEY by doing so. . . . . .

STERLING BLACK PLASTIC INSULATOR.
WATER REPELLENT. OIL PROOF.
One hundred days' continuous baking at 180° F. will not make it brittle.
THE STERLING VARNISH CO, - - Pittsburg, Pa.

EDISON TELEPHONE LAMPS

ARE THE

Standard for Visual Signals

They Save the "Exchange" time and money; because every lamp is perfect—sure to fit—sure to burn. The life is extremely long, running into years.

EDISON DECORATIVE AND MINIATURE LAMP DEPARTMENT

GENERAL ELECTRIC COMPANY.

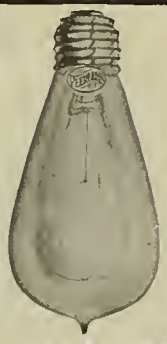
Main Sales Office, Harrison, N. J.

SATISFIED CUSTOMERS

Are those who are buying such specialties from us as

Packard Lamps and Transformers,
Adams-Bagnall Arc Lamps,
"O. K." Weatherproof Wire,
Peerless and Paranite Rubber Covered Wire,
Brunt Porcelain,
Ansonia Magnet Wire,
Circular Loom, Etc., Etc.

ELECTRIC APPLIANCE COMPANY,
CHICAGO AND SAN FRANCISCO.



LAMPS

Get acquainted with the
PEERLESS—MONEY SAVERS

MADE RIGHT
PRICED RIGHT
ARE RIGHT

WESCO

THE WESCO SUPPLY CO., ST. LOUIS, MO.
"EVERYTHING ELECTRICAL"

153

NORTHERN APPARATUS
DIRECT CURRENT
DYNAMOS AND MOTORS

Compact, Simple, Trustworthy, Economical In Operation

Superior

Get Generator Bulletin No. 2530

Northern Electrical Mfg. Co., Madison, Wis., U.S.A.
ENGINEERS :: MANUFACTURERS

MICA

Of all Qualities, in any Form at Lowest Prices
EUGENE MUNSELL AND CO.
NEW YORK and CHICAGO

INSULATION That Is.

Micanite, Linotape, M. I. C. Compound, Empire Cloth and Paper. For Years the Standard.

MICA INSULATOR CO., Originators
NEW YORK and CHICAGO

MICABOND

CHICAGO MICA CO.,
"PERFECTORS" VALPARAISO, IND.
THE PEER OF INSULATORS.

FLEXIDUCT

XXXX

LIST OF ELECTRICAL FITTINGS.

Tubing, Flexible.

Alphaduct Manufacturing Co., New York, N. Y., "Alphaduct"

American Circular Loom Company, Chelsea, Mass., "Circular Loom," 1903 type.

Osborn Flexible Conduit Co., Hoboken, N. J., "Flexduct"

OCTOBER, 19—
SUPPLEMENT TO THE NATIONAL ELECTRICAL CODE
LIST OF ELECTRICAL FITTINGS

"Flexduct" the old reliable meets all conditions without a criticism — it stands without a flaw — no uncertainties approved by all official boards of inspection! Specify "Flexduct" for sale by all jobbers + dealers

COLOR YOUR OWN LAMPS WITH "Signaloid"

Signaloid Chemical Works
KLIEGL BROS., Props.
1393-5 BROADWAY, NEW YORK

ELECTRIC SIGN
FLASHER

BEST IN THE WORLD
Write for full particulars
Reynolds Elec. Flasher Mfg. Co.
221 Fifth Ave., Chicago.

YOU NEED IT!

GALE'S COMMUTATOR COMPOUND

Gale's Commutator Compound.
The Only Article That Will Prevent Sparking.

Will keep the Commutator in good condition and prevent cutting. Absolutely will not gum the brushes.

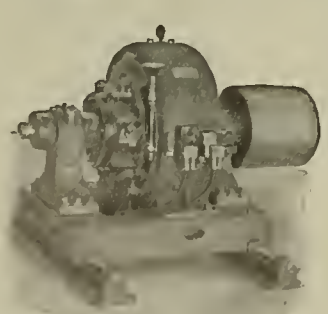
50c. per stick. $5.00 per dozen Send 50c. for trial stick.

FOR SALE BY ALL SUPPLY HOUSES OR
K. McLENNAN & CO., Sole Manufacturers, Room 411 Inter Ocean Bldg., 130 Dearborn Street CHICAGO

Electric Heating Apparatus
BEND FOR 82-PAGE CATALOGUE.
UNIT" ENAMELED RHEOSTATS
SIMPLEX ELECTRIC HEATING CO.,
Cambridgeport, Mass.

VOLT - AMMETERS,
POCKET SIZE.
For Testing Batteries and Battery Circuits, Locating Faults, Grounds, etc.
RELIABLE. ACCURATE.
Send for Circular.
L. M. PIGNOLET,
78-80 Cortlandt St., NEW YORK, N. Y.

DIRECT CURRENT
GENERATORS
FOR LIGHT AND POWER



Our generators have a high efficiency and great endurance under the most exacting conditions of service. Sizes up to 1,000 K. W.
Write for bulletin No. 10514.

SPRAGUE
ELECTRIC COMPANY
General Offices:
527 West 34th Street, New York
Chicago Office: Fisher Building

Made in four sizes { 8 lights, 16 ", 24 ", 32 " } $5.00 and upwards

Electric Lighting Outfits
READY FOR USE

Very popular for electric lighting decorations and especially adapted to the lighting of Christmas trees.

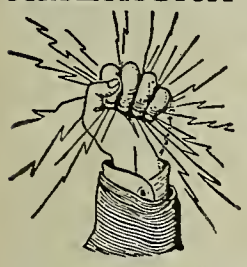
Safe, Simple and Convenient

EDISON DECORATIVE & MINIATURE LAMP DEPARTMENT
GENERAL ELECTRIC COMPANY,
Harrison, N. J.

FRANK N. PHILLIPS, PRESIDENT. C. H. WAGENSEIL, TREASURER. EUGENE F. PHILLIPS, GENERAL MANAGER. E. ROWLAND PHILLIPS, VICE-PRES. O. R. REMINGTON, JR., SEC.

AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.



BARE AND INSULATED ELECTRIC WIRE,

ELECTRIC LIGHT LINE WIRE, INCANDESCENT AND FLEXIBLE CORDS,

Railway Feeder and Trolley Wire,

AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR WIRES.

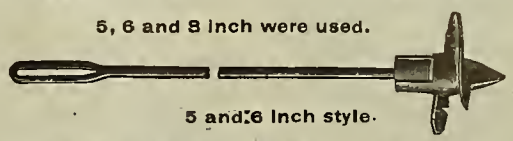
CABLES FOR AERIAL AND UNDERGROUND USE.

NEW YORK STORE, W. J. Watson, 26 Cortlandt St.
CHICAGO STORE, F. E. Donohoe, 82 Lake St.
MONTREAL BRANCH, Eugene F. Phillips' Electrical Works.

MAIN OFFICES AND FACTORIES, PHILLIPSDALE, R.I.

THE UNITED STATES GOVERNMENT
USED
The Stombaugh Guy Anchor
EXCLUSIVELY FOR
Anchoring Electric Light and Telephone Poles at Our Largest Military Post, Fort Riley, Kan.

5, 6 and 8 inch were used.



5 and 6 inch style.

W. N. MATTHEWS & BRO., Manufacturers
603 Carleton Building, St. Louis

EXPERT IN ELECTRICITY MECHANICS PATENT CAUSES
SOLICITOR OF U. S. & FOREIGN **PATENTS**
FORÉE BAIN, 1652-3 Monadnock Blk., CHICAGO

"AMERICAN" STORAGE CELLS
ARE THE BEST. Send for descriptive Circular.
AMERICAN BATTERY CO.,
EST'D 1887. 171 S. Clinton St., Chicago.

"FLEXDUCT"
is a trade name for a flexible non-metallic conduit that is approved by all official inspection boards.

"Flexduct" is a tough fibrous tubing, being flexible, strong and enduring. It is a moisture repellant. "Flexduct" has a smooth, even interior, unaffected by swashing, crushing or sharp bends. It is indestructible. Greater lengths can be fished, time saved in construction and a higher class job is possible with "Flexduct."

Osburn Flexible Conduit Company,
New York Chicago San Francisco

"FLEXDUCT"
is for sale by all electrical jobbers. If local dealer cannot furnish, write us and we will arrange for prompt shipment. Specify "Flexduct."

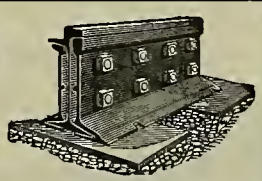
SAUQUOIT SILK MFG. COMPANY,
INSULATING and BRAIDING SILKS.

MILLS:
BETHLEHEM, PA.
PHILADELPHIA, PA.
SCRANTON, PA.

NEW YORK REPRESENTATIVES:
WILLIAM RYLE & COMPANY
54 Howard St.
PHILADELPHIA OFFICE:
4015 Clarissa St.
CHICAGO OFFICE:
210 Monroe St.
BOSTON OFFICE:
78 Chauncy St

CONTINUOUS RAIL JOINT CO. OF AM.

GENERAL OFFICES: CENTURY BUILDING
NEWARK, N. J.
OVER 20,000 MILES IN USE
Highest Award at Paris Exposition, 1900, Buffalo, 1901



NATIONAL CODE STANDARD

WEATHER-PROOF TRADE MARK "O.K." LINE AND HOUSE WIRES

"O. K." Weatherproof Wire.
Slow-Burning Weatherproof and Ideal Wire.
Prices and Samples on Application.

Phillips Insulated Wire Co.
Office and Factory: PAWTUCKET, R. I.

EDWARDS AND CO

The R. E.-A. L. Monitor Bell.
(Patented.)

Hammer rod supported in two places and thrown straight out and in by the armature, striking gong on inside, near edge, thus giving a full, clear tone.
All springs made of Phosphor Bronze and so formed that there is least possible strain.
Contacts are platinized, adjustment is made by pressure on the standard which supports one contact. No screws or nuts being used in the adjustment, bell does not get out of order by operation.
Ordinarily the weak point is the pivot, the unreliable one the adjusting screw and nut. As these defects have been eliminated, this bell will stand hard usage and operate under adverse conditions.
The hammer entirely concealed by gong and cannot be tampered with.
It is especially adapted for use on street cars, as in addition to the advantages mentioned, it is dust, insect and moisture proof.

WESTERN ELECTRIC COMPANY,
SELLING AGENTS.

NEW YORK N.Y.

Crimshaw

Raven White Core

Raven Black Core

ALL OUR WIRES pass inspection and carry the above TRADE-MARKS on our tags. We also manufacture Crimshaw and Competition Tapes and Splicing Compounds.

NEW YORK INSULATED WIRE COMPANY,

MAIN OFFICE: 114, 116 & 118 Liberty St., New York.
BRANCHES: CHICAGO: 192 Desplaines St. BOSTON: 7 Otis St. SAN FRANCISCO: 33 Second St.

H. N. FENNER, President J. F. BLAUVELT, Agent RUSSELL W. KNIGHT, Treasurer

NEW ENGLAND BUTT COMPANY
MANUFACTURERS OF
Machinery for Insulating Electrical Wires
Braiding, Taping, Winding, Twinning, Cabling, Stranding, Polishing and Measuring Machines. Cable Covering Braiders
FINE CASTINGS A SPECIALTY
304 PEARL STREET, - - - PROVIDENCE, R. I., U. S. A.

WANTED, FOR SALE *and similar* **WANT COLUMN** *advertisements (50 words or less), $1.50 an insertion; additional words 3c each.* **POSITION WANTED** *advertisements (50 words or less), $1.00 an insertion; additional words 2c each.*

POSITION WANTED.

As superintendent of electric railway or lighting interests. Technical graduate, seven years' business experience and three years in shops, testing rooms of largest electrical concern in U. S. If exceptional opportunities for advancement exist, any opportunity will be considered. Address "A", 113—9th St., Pittsburg.

WANTED

Good, honest, bright shop man to take charge of small factory. Wages and commission to right man. Address BOX 426, care Western Electrician, 610 Marquette Bldg., Chicago.

FOR SALE

On mortgage foreclosure, all property of the Corning Electric Light Plant, consisting of grounds, buildings, franchises, poles, lines, electric appliances, etc., located at Corning, Iowa, on main line of Chicago, Burlington & Quincy Railway. County seat town. Population, 2,500. Good proposition. Address M. E. WILMARTH, Trustee, Corning, Iowa.

FOR SALE

1-360	K. W.	General Electric	Alternator,	Three Phase
1-240	"	Westinghouse	"	Single "
2-150	"	Warren	"	" "
1-150	"	Westinghouse	"	" "
1-150	"	Wood	"	" "
1-150	"	Stanley	"	" "
1-120	"	General Electric	"	Three "
1-120	"	General Electric	"	Single "
1 120	"	Westinghouse	"	" "
1- 90	"	General Electric	"	" "
1- 75	"	Westinghouse	"	Two "
1- 75	"	Westinghouse	"	Single "
1- 75	"	Westinghouse	"	Two "

Direct connected to Gates' Engine.

Send for our **Monthly Bargain Sheet** with complete list and net prices.

GREGORY ELECTRIC CO.
54-62 S. Clinton St., Chicago, Ill.

WORKS QUICK AND EASY. KEEPS ITS LUSTER. HOLDS OLD TRADE AND MAKES NEW. DOES NOT DETERIORATE. ESTABLISHED 16 YEARS. SOLD BY AGENTS AND DEALERS ALL OVER THE WORLD

U.S. METAL POLISH $ OUNCE BOX 10 CENTS SAMPLES SENT FREE GEO. W. HOFFMAN

POLISHES ALL METALS. BRANCHES: NEW YORK CHICAGO SAN FRANCISCO 295 E WASHINGTON ST INDIANAPOLIS, IND

BOILERS.

One 42-in. x 15 ft. 9-in., 250 H. P. Worthington Water Tube.
One 60-in. x 16 ft., John Mohr Return Tubular Boiler.
One 54-in. x 16 ft., John Mohr Return Tubular Boiler.
One 54-in. x 16 ft., Devine Tubular Boiler.

ENGINES.

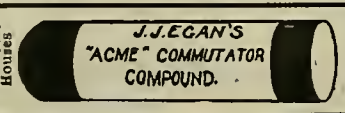
One 600 H. P., 21 x 36 x 30, Williams Tandem Horizontal Compound, 140 R. P. M.
Two 600 H. P., 20 x 30 x 24, Porter-Allen Tandem Compound, 200 R. P. M.
One 250 H. P., 12 x 24 x 18 Williams Tandem Compound, 250 R. P. M.
Two 100 H. P., 13 x 12, Dick & Church, High Speed Automatic.

PARTIAL LIST ONLY.

Send for latest Catalogue for bargains in Engines, Boilers, Dynamos and Motors.

CENTRAL STATION IMPROVEMENT CO., 938 Monadnock Block, Chicago

All supply Houses



J. J. EGAN'S "ACME" COMMUTATOR COMPOUND absolutely prevents sparking or cutting. One stick of "Acme" is equal to one gallon of oil for lubricating commutators. Free Sample. AGENTS WANTED. 50c per Stick. $5.00 per doz.

J. J. Egan Sole Mfg., 317 Austin Ave., Tel. Polk, 1779 Chicago

FOR SALE

By City of Kendallville, Ind.

1 No. 8 Wood Arc Dynamo. 60 Lt., 9.6 amp.
1 Extra Armature for above dynamo.
60 Open Arc Lamps. Wood. 9.6 amp. 50 double carbon; 10 single carbon.
50 Street Hoods.
26 Clear Globes.
1 Marble Switchboard panel. Blue Vermont marble. 2 circuits.
1 Dynamo belt, 9 inches wide, 49 feet long.
1 Dynamo belt, 10 inches wide, 61½ feet long.
This material taken out in changing over to the enclosed arc lamp system.
Will be sold at your own price.
Address all communications to

F. E. JOHNSON, Supt.

Send your Book Orders to

ELECTRICIAN PUBLISHING CO.,
510 Marquette Bldg., Chicago.

Corliss Engines.

1000 h. p., 36x48, Allis Corliss, 1890 heavy duty.
900 h. p., 34x60, International.
825 h. p., 32x48, Allis Corliss, 1890 heavy duty.
900 h. p., 22x42x48, Hamilton, Tand. Comp.
750 h. p., 32x54, Hamilton, 1890 Frame.
650 h. p., 30x54, St. Louis, 1890 Frame.
600 h. p., 28x60, Philadelphia.
500 h. p., 16x32x42, Corliss Cross Comp., latest type.
450 h. p., 16x30x42, Allis Cross Comp.
400 h. p., 23½x60, Geo. H. Corliss.
450 h. p., 24x48, Harris, latest type.
450 h. p., 24x48, Brown.
350 h. p., 22x42, Allis, 1890 Frame.
350 h. p., 22x42, Slater, 1890 Frame.
300 h. p., 20x48, Harris.
300 h. p., 20x42, Hamilton.
225 h. p., 12x22x42, Atlas Tandem Comp.
225 h. p., 18x42, Hamilton.
175 h. p., 16x42, Allis.
165 h. p., 16x36, Sioux, 1902.
150 h. p., 15x38, Brown.
140 h. p., 14x42, Allis.
125 h. p., 14x36, Putnam.
90 h. p., 12x36, Harris.
600 h. p., 28½x52, Buckeye Automatic.
500 h. p., 17½x30½x27, Buckeye Cross Comp.
450 h. p., 16½x28½x27, Buckeye Cross Comp.
450 h. p., 24x48, Buckeye Automatic.
350 h. p., 16x26x18, Ideal Tandem Comp.
275 h. p., 14x22x16, Ideal Tandem Comp.
250 h. p., 16x27x16, Westinghouse Comp.
150 h. p., 15x24, Cummer.
150 h. p., 10½x18x18, Williams Tandem Comp.

Whitehead Machinery Company,
DAVENPORT, IOWA.

FOR SALE

1 Stanley generator, two-phase, 16,000 alternations, 1,000-2,000 volts, 40 K. W., 1333 R. P. M. and exciter.
1 Stanley generator, two-phase, 16,000 alternations, 1,000-2,000 volts, 60 K. W., 1,000 R. P. M. with exciter.
Complete marble switchboard with new instruments for above.
1 Westinghouse generator, 75 K. W., single-phase, 1,100 volts, 7,200 alternations, exciter, switchboard, new instruments complete, 750 R. P. M.
2 New belts.
1 Russell 13x20 4-valve engine, 200 R. P. M.
1 Ball 9½x10 engine, 350 R. P. M.
2 Boilers, 16x54 inch, 42 4-inch tubes, allowed 110 lbs. pressure, complete with 50-foot stack.
1 Boppes heater. All steam pipe, valves, etc.

All in good condition. Can be seen running until December 15th. We are abandoning this plant on account of removal, and will sell all or in part. For further information, address

TIBBE ELECTRIC CO., Washington, Mo., or
RUEBEL-SCHWEDTMANN-WELLS, St. Louis.

Louisville and Chicago

And the places north
And the places south
And the places between are reached by the quick day and night trains of
THE

MONON ROUTE
CHICAGO, INDIANAPOLIS & LOUISVILLE RAILWAY

Also the celebrated health resorts, French Lick and West Baden Springs, are reached only by this road.

Booklets about the Springs, their wonderful waters and the fine hotels, sent free.

CHAS. H. ROCKWELL, Traffic Manager
FRANK J. REED, Gen. Pass. Agt.
202 Custom House Place, Chicago

Western Electrician
WANT ADS
Bring Results.

FOR SALE.
Central Station Equipments

One Plant Complete Consisting of the Following Principal Items:

BOILERS.

Six 200-h. p. Stirling water-tube boilers, equipped for Hawley down-draft furnaces.
Two 150-h. p. Stirling boilers, with plain grates.

HEATERS.

Two 250-h. p. Hoppes open heaters.
Two 400-h. p. Excelsior heaters.

PUMPS.

Two 7x4½x10 Laidlaw Dunn boiler feeders for 150 pounds' pressure.

ENGINES.

Three 250-h. p. Ball tandem compound engines, 15x25x16 inches, 200 revolutions.
Two 150-h. p. Porter-Allen engines, 14x20 inches, 230 revolutions.
One 150-h. p. Russell engine, 15x20 inches, 230 revolutions.
One 125-h. p. Hamilton Corliss, 16x30 inches, 90 revolutions.

GENERATORS.

Three 150-k. w. 250-volt Westinghouse generators. These generators directly connected to three 250-h. p. Ball engines.
Four 42.5-k. w. 125-volt Mather generators.
Four 37½-k. w. 250-volt Mather generators.
Four 37½-k. w. 125-volt Mather generators.

SWITCHBOARDS.

Two switchboards, with switches, measuring instruments, rheostats, etc., for control of above generators.
Another plant complete except boilers, consisting of the following principal items:

ENGINES.

Two Lane & Bodley Corliss engines, 24-inch diameter cylinders, 48-inch stroke, 70 revolutions.
Two Lane & Bodley Corliss engines, 30-inch diameter cylinders, 48-inch stroke, 70 revolutions.
Two Ball engines, cylinders 20-inch diameter, 18-inch stroke, 150 revolutions.
One Westinghouse vertical compound engine, with cylinders 16 inches and 26 inches x 18-inch stroke.
One Westinghouse vertical compound engine, with cylinders 18 inches and 30 inches diameter x 18-inch stroke.

GENERATORS.

Two Edison bipolar generators, 150 k. w., 500 volts.
Two C. & C. bipolar generators, 100 k. w., 500 volts.
One C. & C. bipolar generator, 30 k. w., 500 volts.
Two T.-H., alternating current, 133 cycles, 1,100 volts, 150 k. w.
Two Fort Wayne, alternating current, 133 cycles, 1,100 volts, 150 k. w.
Two Fort Wayne, alternating current, 133 cycles, 1,100 volts, 100 k. w.
Ten 100-light 9.6-ampere multiple circuit Brush arc machines.
One 60-light 9.6-ampere wood arc machine.

SWITCHBOARD.

Switchboard, with all switches, transformers, measuring instruments, etc., for control of above generators.

SHAFTING.

Two lines shafting, together with pedestal, bearings, clutches, pulleys, etc., used in connection with the large Corliss engines.

Both plants located in Cincinnati.
We will consider bids for all or any part of the above.
Bids must be made f. o. b. Cincinnati.

The Cincinnati Gas & Electric Co.

CHICAGO DIE AND ELECTRIC CO.

87-89-91 WEST LAKE STREET
CHICAGO

Manufacturers of

Patent Improved American Wire Joints
Maxstadt Patent Mica Fuses
Maxstadt Patent Lightning Arresters
Maxstadt Patent Fuse Blocks
Paper Sleeves, Etc.

Expert Die Makers and Machinists

DON'T STOP! KEEP ON! READ! IMPROVE!

ELECTRICIAN PUBLISHING CO., 510 Marquette Bldg.
Publishers and Dealers of Electrical Books

CHICAGO EDISON COMPANY REPAIR SHOPS

76 MARKET STREET, CHICAGO. TELEPHONE MAIN 1280.

Machine and Carpenter Work of All Kinds
Correspondence Solicited.

OPEN DAY AND NIGHT.

FIRST-CLASS EQUIPMENT THROUGHOUT.

Dynamos, Armatures, Motors, Arc Lamps, Fans, Instruments.

SOMETHING NEW!

"PIG" AND "STAG'S HEAD" LAMPS

The accompanying cuts show our latest novelties in

SPECIAL AND MINIATURE LAMPS.

The Stag's Head lamp is a "real burning" incandescent lamp equipped with either standard Edison base or candelabra base; voltage 104, 110, 115 or any normal voltage.

The "Pig" is made in two sizes, one for candelabra and the other for regular socket; made to fit any Edison socket.

If Interested, Write for More Details and Prices.

STERLING ELECTRICAL MFG. CO.

WARREN, O.

NEW YORK: 100 William St. SAN FRANCISCO: Croesby Bldg. CHICAGO: 1610 Masonic Temple.

"Diamond H" Switches

Trade H Mark

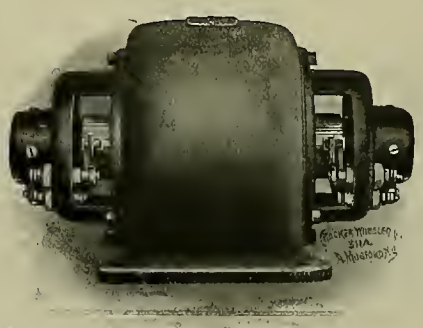
This Trade-Mark guarantees quality.

The Hart Mfg. Co., Hartford, Conn.

New York Boston Chicago Toronto, Ont.

Crocker-Wheeler Dynamotors

For Telephone Service
are of Established Excellence



Form L Dynamotor

Crocker-Wheeler Company

Manufacturers and Electrical Engineers

Chicago Office, Old Colony Bldg.

Ampere, N. J.

"NEW STANDARD" DRY BATTERIES

Are the Standard of

OUR NAVY AND THE WORLD.

An experience of many years in dry battery manufacture has given this battery the supremacy it holds over all others.

It is the best dry cell ever made.

They are made in all standard and special sizes.

THE "AUTOGAS" DRY BATTERY

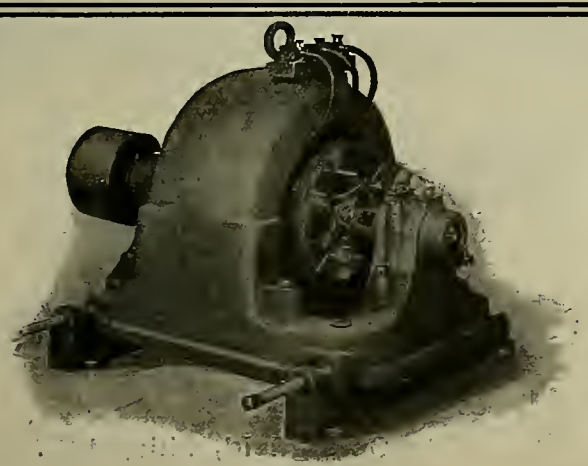
For Portable Service is the Best Made.

For Automobiles, Launches, and all ignition work where compactness is a requisite.

WM. ROCHE,

INVENTOR AND SOLE MANUFACTURER,
52-54 PARK PLACE, NEW YORK

READ THE BLUE ELECTRICAL PAPER.



CENTRAL STATION MANAGERS

Don't Be Afraid

of the Gas Plant

WORK UP A MOTOR LOAD

We can furnish you

SINGLE PHASE MOTORS

that will start under full load in sizes ranging from 1/8 to 35 H. P.

Wagner Electric Mfg. Co.

ST. LOUIS, MO., U. S. A.

GOLD MEDAL

Awarded Dearborn Methods of Treating Boiler Waters and Dearborn Vegetable Feed-Water Treatment at the World's Fair, St. Louis.

DEARBORN DRUG & CHEMICAL WORKS,

27-34 RIALTO BUILDING, CHICAGO, ILL. WM. H EDGAR, President Telephone: Harrison 3930 and 3931.

Diesel Engines

Suitable for all stationary power operating on CRUDE or FUEL oil

By Gradual Continuous Combustion

NO EXPLOSIONS

GUARANTEED COST OF FUEL WITH OIL AT 4 CENTS PER GALLON:

4.5 mills per K. W. Hour on the full load.

5.1 mills per K. W. Hour on the half load.

For Further Particulars Apply to

AMERICAN DIESEL ENGINE COMPANY

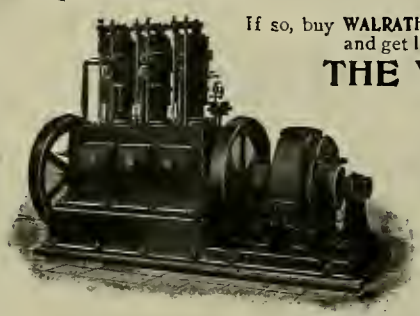
11 Broadway, - New York

JEFFREY Elevating, Conveying, Power Transmission, Screening, Crushing Dredging, Rock and Coal Drilling, Coal Cutting, Hauling and Washing Machinery.

OUR CATALOGUES ARE YOURS FOR THE ASKING.

The JEFFREY MANUFACTURING CO., Columbus, O., U. S. A.

ARE YOU LOOKING FOR MONEY?



If so, buy WALRATH GAS OR GASOLINE ENGINES and get light on the subject.

THE WALRATH

Received the Highest Award at the Pan-American Exposition.

It will produce as good a commercial light as that of an automatic steam engine, either belted or direct-connected generator. Simple, Economical and Reliable

Send for Catalogue W

MARINETTE GAS ENGINE CO.,

CHICAGO HEIGHTS, ILL.

AGENCIES:

Keystone Engineering Co., Farmer's Bank Bldg., Pittsburg, Pa.
Strong, Carlisle & Hammond Co., 61-67 Frankfort St., Cleveland, Ohio
Mackay Engineering Co., 149 Broadway, N. Y.
C. H. Seidenglanz., 52 When Bldg., Indianapolis, Ind.

January, 1905, "Graphite" A SPECIAL ISSUE ON LUBRICATION.

COPIES ARE FREE TO ALL.

JOSEPH DIXON CRUCIBLE CO., JERSEY CITY, N. J.

REG. TRADE MARKS

"Phosphor Bronze" DELTA

THE PHOSPHOR BRONZE SMELTING CO. LIMITED, 2200 WASHINGTON AVE., PHILADELPHIA.

"ELEPHANT BRAND PHOSPHOR-BRONZE" INGOTS, CASTINGS, WIRE, RODS, SHEETS, ETC.

— DELTA METAL —

CASTINGS, STAMPINGS AND FORGINGS

ORIGINAL AND SOLE MAKERS IN THE U.S.

PRESERVE YOUR COPIES

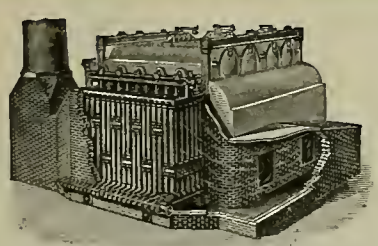
OF THE

WESTERN ELECTRICIAN

BINDERS $1.00 EACH.

ELECTRICIAN PUBLISHING CO.,

Suite 510 Marquette Building, - - - CHICAGO.



You are spending over one-fifth more on fuel supply if you have not a

GREEN'S ECONOMIZER

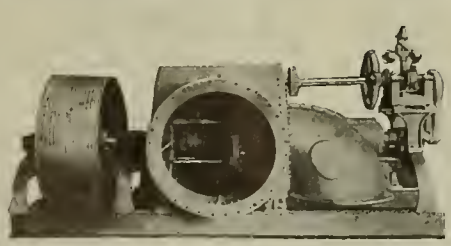
in your plant than other plants so provided. We have testimonial letters from thousands of users, many from the largest electric light and power plants, bearing out our statement. Just how we make this saving—how we keep a reserve of HOT WATER always on hand for sudden calls—how we save in boiler repairs, is all explained in our free booklet.

THE GREEN FUEL ECONOMIZER CO., MATTEAWAN, N. Y.

Sole Manufacturers in the U. S. A.

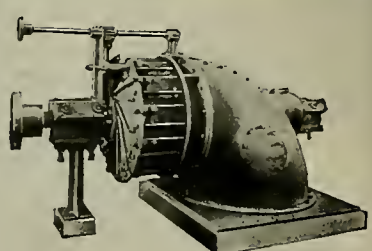
Watson Motors

If you want a small motor for a special purpose—Write us—Mechanical Appliance Co.—Milwaukee—Wis.



SAMSON TURBINE

The higher the SPEED of a GENERATOR the LOWER its COST. We can SAVE YOU MONEY if you will use the SAMSON to drive the generator, because there is not another turbine built that will attain as quick a SPEED when operating under the same conditions.



THE JAMES LEFFEL & CO.

307 Lagonda Street Springfield, Ohio, U. S. A.

ARNOLD ELECTRIC POWER STATION Co.
Engineers, Constructors for Complete Electric Plants. Results Guaranteed.
SUITE 1539, MARQUETTE BLDG., CHICAGO, NEW YORK OFFICE: 711 TRANSIT BLDG.

BUTTERFIELD, J. F.
ELECTRICAL ENGINEER AND CONTRACTOR.
Complete Telephone Exchanges Built and Material Furnished.
Cable Construction and Underground Conduit Construction a Specialty.
Room 595, 113 Adams Street. CHICAGO, ILL.

J. H. HALLBERG
Consulting Engineer
Electric Light, Power and Railway Plants
Suggestions to secure Economy, Specifications, Examinations and Reports
45 Broadway, NEW YORK
Long Distance Telephone 4578 Broad

KOHLER BROS.,
Contracting Electrical Engineers, Lighting Power Railways,
1804-1806-1808-1810-1812 Fisher Building, CHICAGO.

F. B. BADT,
Monadnock Chicago

BYLLESBY, H. M. & Co.
(Incorporated)
ENGINEERS
Design, Construct and Operate Railway, Light, Power and Hydraulic Plants.
Examinations and Reports.
New York Life Building. - CHICAGO, ILL.

HUMPHREY, HENRY H.,
CONSULTING ENGINEER.
Central Lighting Stations,
Electric Power Transmission.
SUITE 1305, CHEMICAL BLDG., ST. LOUIS.

RUEBEL - SCHWEDTMANN-WELLS,
CONSULTING, MECHANICAL AND ELECTRICAL ENGINEERS,
Suite 801 Chemical Building, ST. LOUIS, U. S. A.

TRY IT. Keep your name and address in this directory where it will be seen by possible clients.

ENGINEERS
Represented in this "Directory" are enabled to come in touch with many prospective customers who cannot be reached through any other source.

ROBERT W. HUNT & Co.,
ENGINEERS
1121 The Rookery, Chicago. 66 Broadway, New York.
Monongahela Bank Bldg., Pittsburg.
Norfolk House, Cannon St., London.

SARGENT & LUNDY,
ENGINEERS,
RAILWAY EXCHANGE,
Cor. Jackson and Michigan Boulevards, CHICAGO.
FREDERICK SARGENT. A. D. LUNDY.

W. E. BAKER. H. B. BISHOP.
BAKER, W. E. & CO.
ENGINEERS,
ELECTRIC RAILWAYS.
27 William St., NEW YORK.

EVANS, ALMIRALL & CO.,
Central Station Heating,
High Pressure Piping.
1057 Monadnock Blk., Chicago.

A WEEKLY REPRESENTATION
in this "Directory" enables engineers to keep before all possible customers.

Long Distance Phone Central 2443.
SCHOTT, W. H.,
ENGINEER AND CONTRACTOR,
SPECIALTIES—Central Station Heating Plants, Water Works Steam Plants, Electric Light, Gas and Street Railway Plants.
1220-21 MARQUETTE BUILDING, CHICAGO.

BRYAN, WILLIAM H.
M. Am. Soc. M. E.,
Consulting Mechanical and Electrical Engineer.
Lincoln Trust Building, ST. LOUIS.

E. W. Hammer, Pres. and Treas. H. J. Minhinnick, Sec. and Gen'l Sup't.
GENERAL ENGINEERING Co., THE Consulting and Contracting Engineers.
Telephones, Electric Light, Power Transmission
Suite 1112, 135 ADAMS ST., CHICAGO.
Long Distance Telephone Central 478.

KEMP, R. W.
Consulting and Contracting Telephone Engineer.
Plans and specification for complete plants. Old plants overhauled and placed on paying basis. Territory, Kansas, Oklahoma and Indian Territory.
WELLINGTON, - - - KANSAS.

STANTON, LE ROY W.
Consulting Telephone Engineer
Plans, Specifications and Supervision of Installation of Complete Telephone Plants
Special Reports on Telephone Properties and Apparatus
411 Electrical Bldg., Cleveland, Ohio

DUGALD C. JACKSON, C. E.
WILLIAM B. JACKSON, M. E.
MEMBERS
AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS
AMERICAN SOCIETY OF MECHANICAL ENGINEERS
AMERICAN SOCIETY OF CIVIL ENGINEERS
ENGINEERS. EXPERTS.
MADISON, WIS.

Reports and Estimates Furnished.
General Contractors
High-Grade Securities Accepted or Negotiated.

W. R. EVANS & COMPANY
Incorporated
Electrical, Civil and Mechanical Engineers
Telephone Main 3153 Traction Bldg., Cincinnati

PLACE YOUR
"Want" and "For Sale" advertisements in the
WESTERN ELECTRICIAN,
Immediate Returns.

SUBSCRIPTION OPPORTUNITY

NEW subscribers who order the WESTERN ELECTRICIAN for the year 1905 will receive the November and December issues of this year FREE. Order at once.

The WESTERN ELECTRICIAN has helped and informed its readers for nearly eighteen years. It will help and inform you.

WESTERN ELECTRICIAN

510 MARQUETTE BUILDING, CHICAGO

SUBSCRIPTION RATES:
United States, Canada and Mexico $3 a Year
Foreign Countries, $5.00 a Year

FILL OUT THIS FORM AND SEND WITH REMITTANCE.

WESTERN ELECTRICIAN
CHICAGO

Please send me the WESTERN ELECTRICIAN weekly, for 1905, for which I enclose $3.00 ($5.00 if to foreign country). Also send me free the December issues of 1904

Name.....

Street.....

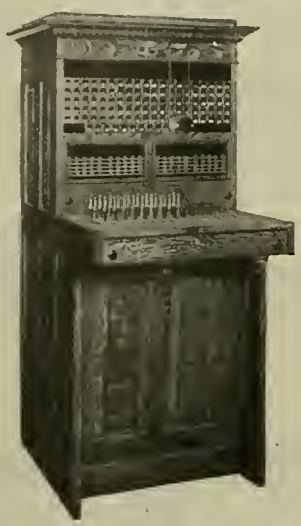
Date..... City..... State.....

STROMBERG-CARLSON

GENERATOR-CALL

VISUAL SIGNAL SWITCHBOARDS

are inexpensive to maintain and nearly as rapid as a lamp signal switchboard.



SIGNALS SELF-CONTAINED

NO WORKING PARTS EXPOSED

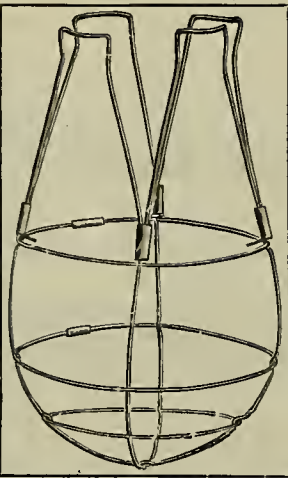
This illustrates our No. A-1249 cabinet equipped with 100 line signals and 10 clearing-out signals. Our standard cabinets have a capacity for 50, 60, 70, 100, 140, 180 and 200 line signals of the above type.

Bulletins No. 6 and 7-E describe these boards very thoroughly. Mailed free upon request.

STROMBERG-CARLSON TELEPHONE MFG. CO.,

GENERAL OFFICES, ROCHESTER, N. Y.

WESTERN SALES OFFICE, CHICAGO, ILL.



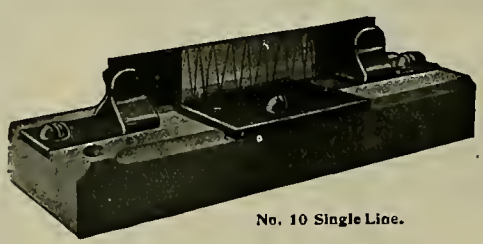
HIPWELL

Expanding Wire Guard; also manufacturer of high-grade, long-distance

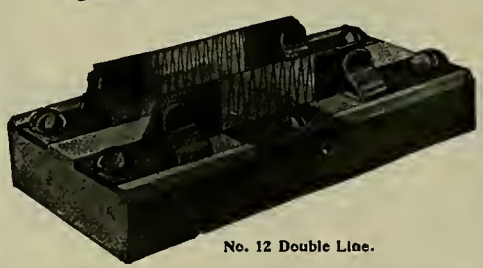
TELEPHONES

Switchboards and Cable Terminals.

Hipwell Mfg. Co.
ALLEGHENY, PA.



No. 10 Single Line.



No. 12 Double Line.

PROTECTORS THAT PROTECT.

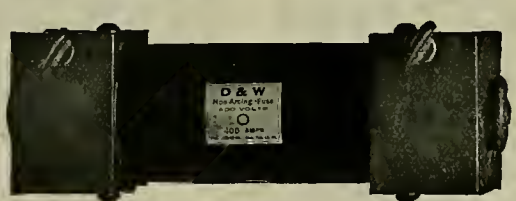
Our patent wrapped fuse used in our protectors are an insurance policy against lightning.

Sample free by mail to any Exchange or Toll Line

CENTRAL TELEPHONE AND ELECTRIC CO.,
909 Market St.,
ST. LOUIS, U. S. A.

"SURVIVAL OF THE FITTEST"

THIS IS THE FUSE ADAPTED BY INTERBOROUGH RAPID TRANSIT CO. OF NEW YORK.



FOR ENTIRE FUSE EQUIPMENT OF THE MANHATTAN ELEVATED AND SUBWAY DIVISIONS.

After competitive tests in which the ***"D & W"*** was THE ONLY FUSE capable of fulfilling all of the conditions imposed upon it.

D. & W. FUSE COMPANY, PROVIDENCE, R. I.

A. HALL BERRY, New York Representative, 97 Warren Street.

AGENCIES:

BOSTON, Pettingell-Andrews Co.
CHICAGO, Central Electric Co.
CINCINNATI, Standard Electric Co.
NEW YORK, Western Electric Co.
PITTSBURG, Western Electric Co.
DENVER, Western Electric Co.
SAN FRANCISCO, California Electrical Works.
KANSAS CITY, Western Electric Co.
PHILADELPHIA, Western Electric Co.
ST. PAUL, American Electric Co.
ST. LOUIS, Western Electric Co.

INTERNATIONAL

Mechanical Self-Restoring Drop Switchboard.

A PERFECT APPARATUS.

Made in any desired capacity.
Sample parts and quotations on request.

INTERNATIONAL TELEPHONE MANUFACTURING CO.
CHICAGO, U. S. A.

TELEPHONE BOOTHS

When in want of the Right Kind write us.

Catalogue Free

Yesbera Mfg. Co.
TOLEDO, OHIO.

Kellogg Private Branch Exchange in Government Building at Washington.

KELLOGG TELEPHONE APPARATUS

Winner of the Highest Award at the St. Louis Exposition

THERE WAS BUT ONE GRAND PRIZE ISSUED FOR "TELEPHONE SYSTEMS AND APPARATUS" AND THAT WAS AWARDED TO THE

KELLOGG SWITCHBOARD AND SUPPLY COMPANY

GREEN AND CONGRESS STREETS

CHICAGO

Seymour Bldg., LOS ANGELES — Electric Bldg., CLEVELAND — Keystone Telephone Bldg., PHILADELPHIA

AMERICAN ELECTRIC TELEPHONE CO.

LARGEST MANUFACTURERS

This Company Sends Prepaid upon request any of the following bulletins:

Bulletin No. 7—Combined Telephone and Switchboard
" " 8—Wall Switchboard
" " 9—Samson Telephone
" " 10—American Express Switchboards
" " 11—Desks — Toll and Private Branch
" " 12—Visual Signal and Bell Style Switchboards
" " 13—Intercommunicating Systems
" " 14—Line Material and Supplies
" " 15—Bell Express Self-Restoring Switchboards
" " 16—Operator's Set and Accessories
" " 17—Parts of Apparatus
" " 18—Magneto Telephones of All Kinds
" " 19—Central Energy Switchboards
" " 20—Central Energy Telephones
" " 21—Protective Apparatus and Terminal Equipment
" " 22—Construction of Country Telephone Lines
" " 23—Eight-Party Selective Ringing Telephones
" " 24—Composite Telephone and Telegraph Lines
" " 25—Four-Party "Leich" Selective Telephone System
" " 26—Telephone Power and Ringing Equipment

CHICAGO, ILL., U. S. A.

BITUMINIZED FIBER CONDUIT

FOR UNDERGROUND CONSTRUCTION

American Conduit Co.

Main Offices: 1005-6 Manhattan Bldg., Chicago

Other Offices:
170 Broadway, New York — *336 Macy St., Los Angeles*

THE AUTOMATIC

is the recognized competitive system of telephony. Its manifold advantages over the manual system, mechanically, financially and commercially, make it so. Automatic telephone service is more prompt and more accurate and absolutely secret. It can be furnished at less cost to both company and patrons than any other. Progressive Independent telephone companies all over the country are rapidly adopting it; the new ones in preference to manual and the old ones to replace manual equipment. It is a success everywhere.

Among the cities in which it has been adopted are:

Chicago, Ill.
Grand Rapids, Mich.
Columbus, Ohio
Dayton, Ohio
Lincoln, Neb.
Portland, Maine
Auburn, N. Y.
Lewiston, Maine
Auburn, Maine
Fall River, Mass.
New Bedford, Mass.
Los Angeles, Cal.
San Diego, Cal.
Hopkinsville, Ky.
Sioux City, Iowa
Cleburne, Texas
Columbus, Ga.
Augusta, Ga.
Medford, Wis.
St. Mary's, Ohio
Woodstock, N. B.
Westerly, R. I.
Berlin, Germany
Manchester, Iowa
Princeton, N. J.
Albuquerque, N. M.
Van Wert, Ohio
Battle Creek, Mich.
Clayton, Mo.
Pentwater, Mich.
Toronto Junction, Can.
Wilmington, Del.
Riverside, Cal.
Traverse City, Mich.

AUTOMATIC ELECTRIC COMPANY

Van Buren and Morgan Streets, CHICAGO, U. S. A.

PRODUCERS AND WHOLESALERS OF WHITE CEDAR PRODUCTS

CEDAR POLES

YARDS
KOSS MICH.
L'ANSE "
MUNISING "
ONTONAGON
WAGNER, WIS
PESHTIGO "

SPECIAL PRICES ON SMALL POLES.
Write for a copy of our TELEGRAPH CODE FOR CEDAR PRODUCTS

C. H. WORCESTER CO.
SUITE 1206 TRIBUNE BLDG. CHICAGO.

TELEPHONE POLES

Yards at Bed Cliff, Wis., Aitkin, Feeley, Cohasset, Deer River, Tenstrike and Black Duck, Minnesota.
Large stocks. Prompt shipments. Carefully inspected stock at low prices.
J. W. MORRISON LUMBER CO., 918-19 Lumber Exchange MINNEAPOLIS, MINN.

POLES.

WHITE CEDAR.
IDAHO CEDAR up to 80 ft.

BERTHOLD & JENNINGS,
ST. LOUIS.
Chemical Building.

CROSS ARMS.

LONG LEAF PINE AND FIR.

Cedar Poles.

Pittsburg and Lake Superior Iron Co. Producers and Wholesalers. Escanaba, Mich.

ELECTRICAL AND OTHER INDUSTRIES ARE OFFERED LOCATIONS

WITH
Satisfactory Inducements,
Favorable Freight Rates,
Good Labor Conditions,
Healthful Communities,
ON THE LINES OF
THE ILLINOIS CENTRAL R. R.
AND THE
YAZOO & MISSISSIPPI VALLEY R. R.

For full information and descriptive pamphlet address

J. C. CLAIR,
Industrial Commissioner
1 Park Row, Chicago, Ill.

FREE CHRISTMAS DINNERS

for 10,000 of Chicago's Poor will be supplied by the Salvation Army. Will you help by sending a donation, no matter how Small to the Salvation Army CHICAGO
Headquarters 399 State Street Chicago, Ill.

WHITE CEDAR POLES
HALL L. BROOKS
52 WISCONSIN AVENUE
TOMAHAWK, WIS.

FACTORIES WANTED

ALONG THE

BURLINGTON ROUTE

to supply the demand for Electrical Goods.

Burlington Route
N 548

W. H. MANSS.
INDUSTRIAL COMMISSIONER,
209 ADAMS STREET, CHICAGO.

"A great deal in a little space."
—*The Press.*

"THE FOUR-TRACK SERIES"

This is the title of a series of books of travel and education issued by the Passenger Department of the

NEW YORK CENTRAL LINES

These small books are filled with information regarding the best modes of travel and the education that can best be obtained by travel.

They relate specifically to the great resorts of America — to trips to the islands of the sea and around the world.

They also contain numerous illustrations and new and accurate maps of the country described.

A copy of the 40-page Illustrated Catalogue of the "Four Track Series" will be sent free, postpaid, upon receipt of postage stamp by George H. Daniels, General Passenger Agt., New York Central & Hudson River Railroad, Grand Central Station, New York.

A VALUABLE BOOK OF REFERENCE.

TELEPHONES—Their CONSTRUCTION and FITTING.

A Practical Treatise on the Fitting-up and Maintenance of Telephones and the Auxiliary Apparatus.

BY F. C. ALLSOP.

CONTENTS:

CHAPTER I.—Receivers; II.—Transmitters; III.—Magneto Switch-Bells; IV.—Battery Switch-Bells; V.—Complete Instruments; VI.—Switches, Switchboards and Extension Bells; VII.—Batteries for Telephone Work; VIII.—Erecting Wires, Instruments, Etc.; IX.—Arranging the Circuits; X.—Intercommunicating System; XI.—Testing for and Removing Faults.

184 PAGES. 156 ILLUSTRATIONS AND FOLDING PLATES. PRICE, $1.25.
Sent prepaid on receipt of price.

ELECTRICIAN PUBLISHING CO., 510 Marquette Bldg., Chicago.

"Practical and to the Point"

IS ALL THAT NEED BE SAID OF

THE TELEPHONE HAND-BOOK

By HERBERT LAWS WEBB.

160 Pages, 133 Illustrations, Cloth, Price $1.00.

The book for those interested in telephony.

ELECTRICIAN PUBLISHING CO.,
510 Marquette Bldg.,
CHICAGO.

CENTRAL STATION HEATING

We are the originators and builders of the underground system of live and exhaust steam heating. Our system is used for the utilization and distribution of exhaust steam from electric and power plants for heating purposes. 250 Plants in successful operation. We have the only Meter System. Also manufacturers of Wooden Water Pipe, Steam Pipe Casing, Steam Traps, Condensation Meters, Valves, Economizing Coils, Separators and full line of Steam Fitters' Supplies.

WRITE FOR PAMPHLET AND PRICE LIST

AMERICAN DISTRICT STEAM COMPANY
MENTION WESTERN ELECTRICIAN. LOCKPORT, N.Y. CHICAGO, ILL.

JUST RECEIVED a new batch of 20 and 25 ft. Poles and have reduced prices accordingly. Also, we have plenty of those "Trolley" Ties yet. May we quote you now?

MALTBY CEDAR COMPANY, 509 Phoenix Block, Bay City, Michigan
Pittsburg Agents: Tipper & Patton, 509 Bessemer Bldg.

BRACKETS—X ARMS—PINS
little things it is true, but they cut a big figure in line construction.
OUR MOTTO IS:
Prompt Shipment Quality Satisfaction Right Price
COLUMBIA MFG. CO. **ANTIGO, WIS.**

MICHIGAN WHITE LARGE STOCK.
CEDAR POLES
PROMPT SHIPMENTS. KELLOGG SWITCHBOARD & SUPPLY CO., Chicago.

POLES W. C. STERLING & SON, MONROE, MICH. Eleven Pole Yards in Michigan Wholesale Producers for 20 years. **TIES.**

Southern Cedar POLES Are the Best.
NO ROTTEN BUTTS. D. W. PHELAN, 277 Broadway, New York

Locations for Industries
Erie Railroad
Chicago to New York
The Erie Railroad Company's Industrial Department has all the territory traversed by the railroad districted in relation to resources, adaptability, markets and advantages for manufacturing, and can advise with manufacturers in relation to the most suitable locations. For full information address
LUIS JACKSON
Industrial Commissioner, Erie Railroad Company
21 Cortlandt Street, New York

CEDAR POLES
ESTABLISHED 1862
WM. MUELLER COMPANY
1211-12-13 MARQUETTE BLDG. CHICAGO.
EIGHT DISTRIBUTING YARDS

Poles and Ties

TRADE MARK
The Fowler Companies
Fisher Bldg. Chicago

POLES, TIES, POSTS. THE PORTER CEDAR CO., SAGINAW, MICH.
PRODUCERS. We want your inquiries always.

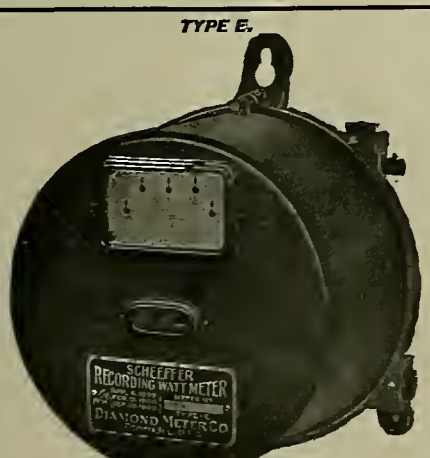
HENRY NEWGARD & CO.
ELECTRICAL CONSTRUCTION
Power and Light Plants. Switchboards and Panel Boards.
We install Municipal and Isolated Electric Lighting Plants.
We manufacture Switchboards, Table boards, Iron Cutout Boxes and Electrical Specialties.
We sell Dynamos, Motors and Electrical Supplies.
We wire old as well as new Residences, Factory Buildings, School and College Buildings.
87 Fifth Avenue, Chicago, Illinois.

TELEPHONE TROUBLES Price 25c
DO YOU NEED ONE IN YOUR BUSINESS?
ELECTRICIAN PUBLISHING COMPANY, 510 Marquette Building, Chicago

MICHIGAN AND WESTERN **CEDAR POLES**
ALL LENGTHS AND SIZES
LINDSLEY BROS CO.
TRIBUNE BLDG., CHICAGO

Cedar TORREY CEDAR CO., CLINTONVILLE, WIS. **Poles**
Large Stock Constantly on Hand

Idaho Cedar Poles
PACIFIC COAST POLE CO. SPOKANE, WASH.

TYPE E.


ALTERNATING CURRENT.

SCHEEFFER INTEGRATING WATTMETER
Type E for Alternating Current Type F for Direct Current Circuits
DUST AND BUG PROOF IMPROVED CONSTRUCTION
MOVING PARTS ARE EXTREMELY LIGHT, INSURING A HIGHLY SENSITIVE AND ACCURATE METER.
WRITE FOR PRICES AND DESCRIPTIVE LITERATURE.
DIAMOND METER COMPANY,
PEORIA, ILL., - - - - U. S. A.

TYPE F.

DIRECT CURRENT.

Static Protection

The Westinghouse Electric & Mfg. Co. is prepared to consider your requirements and offer advice, based on 15 years' experience, as to the best disposition of lightning arresters for your needs.

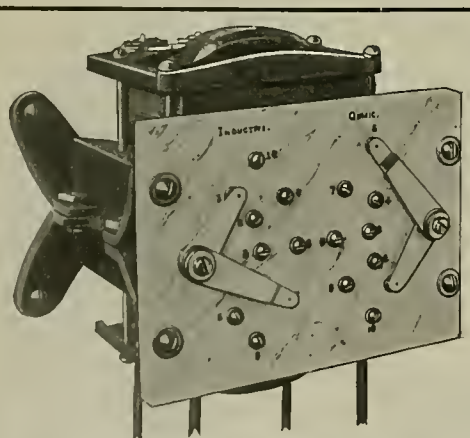
Westinghouse Electric & Mfg. Co.

Pittsburg, Pa.

Address our nearest sales office

New York, Dallas, Atlanta, Baltimore, Boston, Buffalo, Chicago, Cincinnati, Cleveland, Detroit, Los Angeles, Minneapolis, New Orleans, Philadelphia, Pittsburg, St. Louis, Salt Lake City, San Francisco, Sycamore, Seattle, Denver, Mountain Electric Co.
For Canada: Canadian Westinghouse Co., Limited, Hamilton, Ontario. Mexico, G. & O. Braniff & Co., City of Mexico.

Do you know we sell Incandescent Lamps and carry large stocks in all important cities? Write for our new Lamp Catalogue.



The Mershon Compensator

Serves to modify the reading of the station voltmeter, without using pressure wires, so that **the reading** corresponds with the actual voltage at the point of consumption.

For particulars address

Westinghouse Electric & Mfg. Co.

Sales Offices in all Large Cities. Pittsburg, Pa.

For Canada: Canadian Westinghouse Co., Ltd., Hamilton, Ontario.

Fort Wayne Electric Works

"WOOD" LIGHTING AND POWER SYSTEMS

200-Kw., 48-Pole, 2,300-Volt, Revolving Field Engine Type Multiphase Alternator

Direct and Alternating Current

Generating Apparatus

No matter what system of lighting by electricity is planned we have a generator that will give the current required. Power requirements are also fully served by our efficient, reliable types of D. C. and A. C. generators.

Detailed Information Ready for all Inquiries

Main Office: Fort Wayne, Ind. **Branch Offices:** Chicago, St. Louis, St. Paul, San Francisco, Cincinnati, Pittsburg, Atlanta, Grand Rapids, Syracuse, Philadelphia, New York, Boston

286

The Inspector AND Trouble Man.

By A. E. DOBBS.

Full of information and diagrams for the operator, exchange owner, exchange manager, inspector, trouble man, lineman.

A complete description of telephones and their troubles. How to find and remedy them, together with working plans for exchange construction, complete with diagrams of all up-to-date telephones and switchboards.

This is a practical book, written in **plain language,** and for **anyone** interested in telephony.

Mailed anywhere on receipt of price . . . ONE DOLLAR.

No technicalities. Substantially bound in cloth.

ELECTRICIAN PUBLISHING CO.,

510 MARQUETTE BUILDING, CHICAGO.

DUNCAN

DIRECT CURRENT

WATTMETERS

Most Sensitive
Most Accurate
Most Reliable

WRITE FOR BULLETIN AND PRICES!

DUNCAN ELECTRIC MFG. CO.

LAFAYETTE, IND.

KESTER
SELF FLUXING SOLDER
A Tube of Solder Filled with Flux.
Requires no Acid.
SAVES—LABOR—TIME—MONEY.

ACTUAL SIZE
PATENTED.
Send for Free Samples.
L. F. Mahler Co., R. 1008 Chemical Bldg., St. Louis, Mo., Gen. Western Agent.
KESTER ELECTRIC M'F'G CO.,
48 N. UNION STREET, CHICAGO, ILL.

VULCANIZED FIBRE
Highest grades for electrical insulation and mechanical purposes, in sheets, tubes, rods and special shapes. Catalogues and samples on application.
VULCANIZED FIBRE CO., - Wilmington, Del.

M. KLEIN & SON.
Send 2c stamp for new catalogue No. 6 of
KLEIN'S TOOLS
For Electrical Workers and Line Builders.
MATHIAS KLEIN & SONS,
81 W. Van Buren St., Chicago, Ill.

USE
"SAFETY" RUBBER COVERED
WIRE AND CABLE
FOR EVERY ELECTRICAL SERVICE.
M. B. AUSTIN & CO.,
CHICAGO REPRESENTATIVE.
THE SAFETY INSULATED WIRE & CABLE CO.,
WORKS: Bayonne, N. J. 114-116 LIBERTY STREET, N. Y.

DON'T BUY
ELECTRICAL SUPPLIES
Until you have seen our new Catalogue and new Price List.
Free to the trade.
Manhattan Electrical Supply Co.
NEW YORK: 32 Cortlandt St.
CHICAGO: 188 Fifth Ave.

JANDUS
Interchangeable
Arc Lamp

THE IDEAL LAMP
FOR
Central Stations
AND Isolated Plants
200 hrs.' life on Multiple D.C. Circuits
150 hrs.' life on Multiple A.C. Circuits
150 hrs.' life on Series A.C. and D.C. "
Send for Bulletin W 20
THE F. BISSELL COMPANY
DISTRIBUTORS
TOLEDO, O.

ECONOMIZE
IN YOUR BOILER PLANT. INSTALL A
STURTEVANT ECONOMIZER

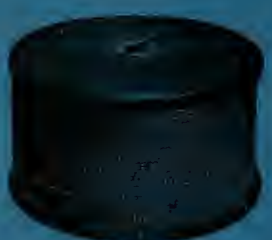
Boiler capacity increased 20 to 40 per cent. Patent system of "staggered pipes" give increased saving over straight pipe economizers.
For high or low pressures. No leaky joints. Easily accessible. Send for catalogue.
B. F. STURTEVANT CO.
BOSTON, MASS.
General Office and Works, Hyde Park, Mass.
New York Philadelphia Chicago London
387

Warren
Alternator

A Dozen Cities
IN
JAPAN
ARE LIGHTED
FROM THE
WARREN
ALTERNATOR
WARREN ELECTRIC MFG. CO.
Sandusky, O.

Black Diamond File Works
Est. 1863. Inc. 1895.
Twelve Medals Awarded at International Expositions

Special Prize Gold Medal at Atlanta, 1895.
OUR GOODS ARE ON SALE IN EVERY LEADING HARDWARE STORE IN THE UNITED STATES AND CANADA.
G. & H. BARNETT COMPANY,
PHILADELPHIA, PA.

JOHN A. ROEBLING'S SONS CO.
Insulated Wire of All Kinds

Bare Copper Wire
MAIN OFFICE AND WORKS TRENTON, N. J.
AGENCIES AND BRANCHES
New York Chicago Cleveland San Francisco Philadelphia Atlanta

Western Electrician

Vol. XXXV. $3.00 Per Annum. Copyright, 1904, by Electrician Publishing Company, Chicago. CHICAGO, DECEMBER 24, 1904. Entered at Chicago Postoffice as mail matter of the second class. 10 Cents a Copy. No. 26.

Technology Quarterly
Mass. Inst. of Technology
Boston Mass

SIMPLEX INSULATED WIRES AND CABLES.
RUBBER COVERED, WEATHERPROOF, UNDERGROUND AND SUBMARINE.
WESTERN SELLING AGENT H. R. HIXSON, 1744 Monadnock Block, CHICAGO.
The Simplex Electrical Co., 110 State Street, BOSTON, MASS.

CHICAGO INSULATED WIRE CO.
152-154 LAKE ST., CHICAGO
1108-1110 PINE ST., ST. LOUIS, MO.
Bare and Insulated Wires and Cables
Galvanized Steel Strands

OKONITE
TRADE MARK
1889—Paris Exposition, Medal for Rubber Insulation.
1893—World's Fair, Medal for Rubber Insulation.
THE STANDARD FOR RUBBER INSULATION.
Sole Manufacturers of
Okonite Wires, Okonite Tape, Manson Tape, Candee Weatherproof Wires.
THE OKONITE CO., LTD.
Willard L. Candee, Gerard Cheever, Managers. 253 Broadway, New York. Geo. T. Manson, Gen'l Supt. W. H. Hodgins, Secy.

TRADE MARK
CRESCENT INSULATED WIRE & CABLE CO. TRENTON, N.J.
CRESCENT RUBBER INSULATED WIRES AND CABLES
National Code Standard.
CRESCENT INSULATED WIRE AND CABLE CO.,
New York Office, 63 BARCLAY STREET. Main Office and Factory, TRENTON, N. J.

INDIANA RUBBER AND INSULATED WIRE CO.,
MANUFACTURERS OF
Paranite Rubber Covered Wires and Cables,
UNDERGROUND, AERIAL, SUBMARINE AND INSIDE USE.
TELEPHONE, TELEGRAPH AND FIRE ALARM CABLES.
All Wires are tested at Factory. JONESBORO, IND.

STANDARD
STANDARD UNDERGROUND CABLE CO.
322 The Rookery, Chicago. Westinghouse Bldg., Pittsburg. 56 Liberty St., New York City. 1225 Betz Bldg., Philadelphia, Pa.
Crossley Bldg., San Francisco. 10 Post Office Square, Boston.
BARE AND WEATHERPROOF WIRES AND CABLES.
Rubber Covered Wires and Cables. Underground Cables for all Purposes.

WHAT DID THE WOGGLE BUG SAY?
J. J. EGAN'S "ACME" COMMUTATOR COMPOUND.
YOU CAN'T DO LESS than give a good thing a trial. FREE SAMPLE J. J. Egan's Acme Commutator Compound, the only article that will absolutely prevent sparking, cutting or unnecessary wear of the commutator. Commutator always bright.
Agents Wanted.
50 CENTS PER STICK ALL SUPPLY HOUSES OR $5.00 PER DOZEN
J. J. EGAN, 317 Austin Ave., CHICAGO

THE PHOENIX GLASS CO. Pittsburg New York Chicago
Manufacturers of
Electric Globes and Shades, both Arc and Incandescent
Inner and Outer Globes for all enclosed arc systems
CATALOGUES SENT ON REQUEST

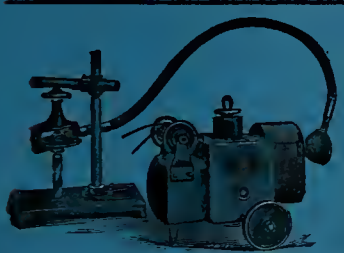
"CIRCULAR LOOM"
THE FLEXIBLE CONDUIT
AMERICAN CIRCULAR LOOM CO.
TRADE MARK
REGISTERED
CONDUITS FOR INTERIOR WIRING.
American Circular Loom Co.
Chelsea, Mass., New York, Chicago, San Francisco.

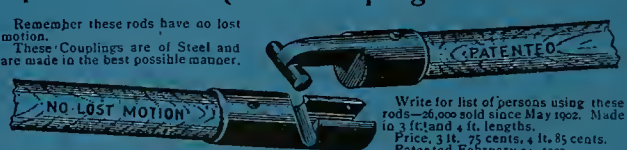
THOUSANDS IN USE.
Motors, ¼ h. p. to 100 h. p.
Dynamos, 1 k. w. to 75 k. w.
Highest Quality. Reasonable Price.
THE HOBART ELECTRIC MFG. CO.
TROY, OHIO.

ELECTRIC SIGN
FLASHERS
BEST IN THE WORLD
Write for full particulars
Reynolds Elec. Flasher Mfg. Co.
221 Fifth Ave., Chicago.

THERMOPILES 1½ VOLTS 1½ AMPERES
For Electrolytic analysis, charging storage batteries, and other constant current requirements. $3 Each.
WALSH'S SONS & CO.,
264 Washington Street. Newark, N. J.

H. N. FENNER, President J. F. BLAUVELT, Agent RUSSELL W. KNIGHT, Treasurer
NEW ENGLAND BUTT COMPANY
MANUFACTURERS OF
Machinery for Insulating Electrical Wires
Braiding, Taping, Winding, Twinning, Cabling, Stranding, Polishing and Measuring Machines. Cable Covering Braiders
FINE CASTINGS A SPECIALTY
304 PEARL STREET, - - - PROVIDENCE, R. I., U. S. A.


ESTABLISHED 1875.
COMBINATION OF
Stow Flexible Shaft
—AND—
MULTI-SPEED MOTOR
Practically dust and water proof. For Portable Drilling, Tapping, Reaming, Emery Grinding, etc. Write for Catalogue and Prices.
STOW MFG. CO., Binghamton, N. Y.
Gen'l European Agents, Selig, Sonnenthal & Co., 65 Queen Victoria Street, London, England

Cope's Patent Quick Coupling Conduit Rod
Remember these rods have no lost motion.
These Couplings are of Steel and are made in the best possible manner.


Write for list of persons using these rods—26,000 sold since May 1902. Made in 3 ft. and 4 ft. lengths.
Price, 3 ft. 75 cents, 4 ft. 85 cents.
Patented February 24, 1903.
T. J. COPE
3244 North Fifteenth Street PHILADELPHIA, PA.

WESTON Electrical Instrument Co.,
Waverly Park, NEWARK, N. J.

Illuminated Dial Station Instruments.
These instruments are constructed upon the same general principle as our regular Standard Portable Direct Current Voltmeters and Ammeters, but are much larger, and the working parts are inclosed in a neatly designed, dust-proof cast-iron case which effectively shields the instruments from disturbing influences of external magnetic fields.
BERLIN—European Weston Electrical Instrument Co., Ritterstrasse No. 88.

Weston Standard Illuminated Dial Potential Indicator, Style B.

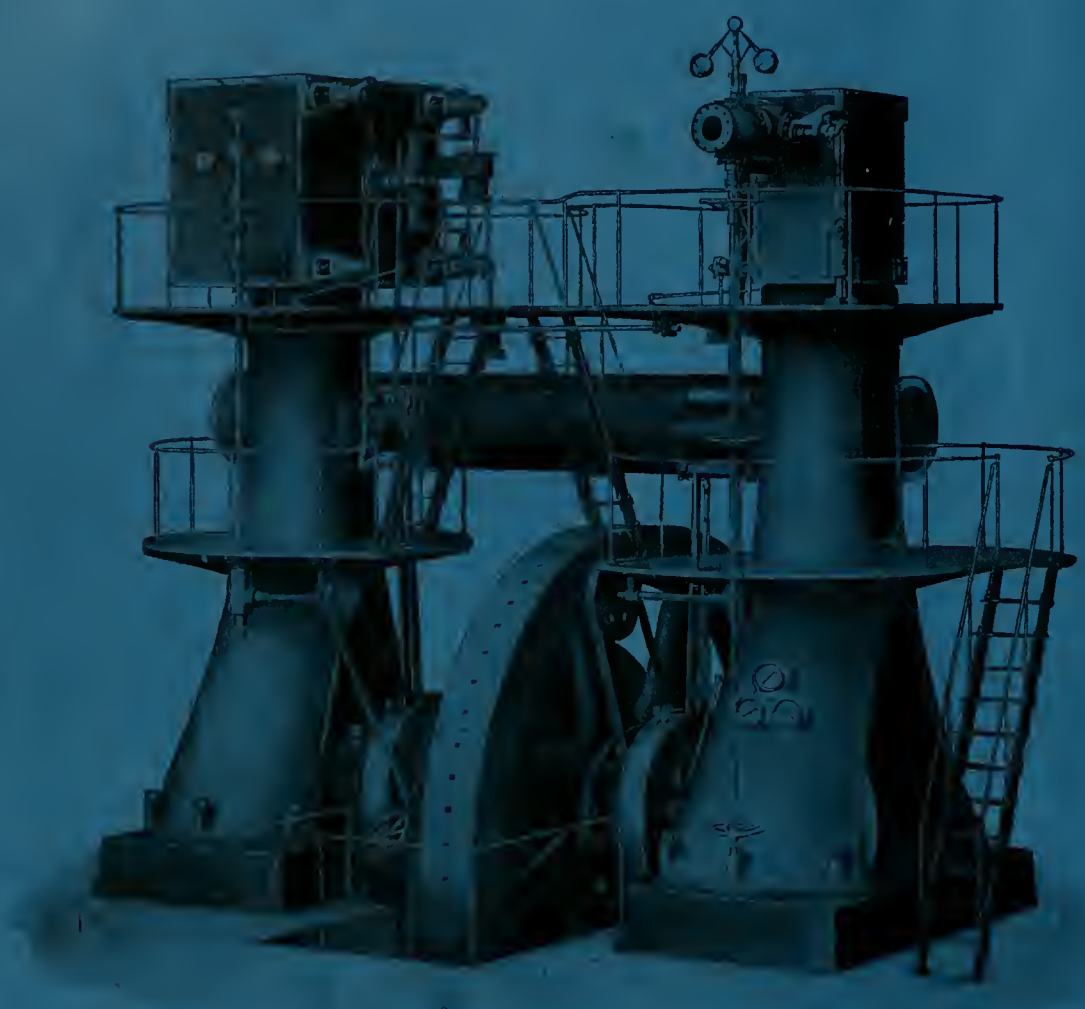
Weston Standard
Portable Direct Reading Voltmeters and Millivoltmeters. Ammeters and Milammeters, Wattmeters and Voltmeters, for Alternating and Direct Current Circuits.
Our portable instruments are recognized as standards throughout the civilized world.
Our Semi-Portable Laboratory Standard Voltmeters and Ammeters are still better.
They are the most reliable, absolute standards for Laboratory use.
LONDON—Elliott Bros., Century Works, Lewisham.
PARIS, FRANCE—E. H. Cadiot, 12 Rue St Georges. New York Office—74 Cortlandt St.

REFLECTIONS ON FARIES REFLECTORS

Fit any socket.
Quickly attached or detached.
Made of aluminum or steel.
Very light and will not rack socket to pieces.
Finish not affected by heat.
Made in many styles and finishes.

Catalogue mailed upon application.
FARIES MFG. CO.
DECATUR, ILL.

Vertical Cross Compound Electric Light and Street Railway Engine.



Allis-Chalmers Vertical Cross Compound Engine
(Direct Connected)

This type of Engine is especially designed for large central-station work, or for places where floor space is limited.

It is used in the leading large stations, such as Metropolitan Street Railway Co., New York City, where ELEVEN of above type engine are installed; Milwaukee Electric Railway & Light Co.; Union Light & Power Co., St. Louis; Metropolitan Elevated, Chicago; Twin City Traction Co., Minneapolis; Chicago Edison Co., Chicago; Cincinnati Gas & Electric Co., Cincinnati; Metropolitan Street Railway Co., Kansas City, Mo., and others.

Allis-Chalmers Co.

Milwaukee, Wis., U. S. A.

Canadian Representatives, Allis-Chalmers-Bullock, Ltd., Montreal

THE ELECTRIC STORAGE BATTERY CO.

PHILADELPHIA

MANUFACTURER OF THE

"Chloride Accumulator"

For Central Stations, Electric Railways, Isolated Lighting and Power Stations, Fire Alarm, Telegraph, Train Lighting, etc., etc.

PRICE LISTS AND DESCRIPTIVE BULLETINS FORWARDED UPON REQUEST.

SALES OFFICES:

PHILADELPHIA, Allegheny Ave. and 19th St. | NEW YORK, 100 Broadway, | BOSTON, 60 State St. | CHICAGO, Marquette Bldg. | ST. LOUIS, Wainwright Bldg. | SAN FRANCISCO, Rialto Bldg. | CLEVELAND, Citizens Bldg. | CANADA, Canadian General Electric Co., Ltd. Toronto | HAVANA, CUBA, G. F. Greenwood, Manager 34 Empedrado St.

YOST SPECIALTIES.

Sookets, Wall Sockets, Weatherproof Sockets, Rosettes, Receptacles, Cord Adjusters.

Catalogue for the asking.

THE YOST ELECTRIC MFG. CO.
TOLEDO, OHIO.

PATENTS PENDING.

HAVE YOU SEEN

"UNION" SWITCHBOX?

If not, let us send you a sample.

This Box will fit all Standard Switches and Receptacles and has been approved by the Underwriters' National Electric Association.

Gangs of 2, 3, 4, 5 and 6 carried in stock, provided with clamps for holding Sprague Cable. Tandem Boxes made to order.

CHICAGO FUSE WIRE & MFG. CO.
CHICAGO BUFFALO NEW YORK

"STAR" INCANDESCENT LAMPS

LONG LIFE
GUARANTEED CANDLEPOWER,
HIGHEST EFFICIENCY.

MADE BY THE MOST SKILLED WORKMEN.

STANDARD ELECTRICAL MFG. COMPANY, : Niles, Ohio.

WHITE PORCELAIN LETTERS — FIREPROOF
FOR ELECTRIC SIGNS

AGENTS WANTED WHEREVER THERE ARE CENTRAL STATIONS.
COLONIAL SIGN AND INSULATOR CO., - - - AKRON, O.

PLATINUM

PLATINUM RIVETS FOR CONTACT POINTS IN TELEPHONES—SPARK COILS AND OTHER ELECTRICAL APPARATUS. PLATINUM SHEET AND WIRE IN ANY FORM AND DEGREE OF HARDNESS. PLATINUM SCRAP PURCHASED.

BAKER & COMPANY, Inc.

ARTISANS IN PLATINUM

408-410-412-414 N. J. R. R. AVE. - NEWARK, N. J.
New York Office: 120 Liberty St.

ALPHABETICAL INDEX TO ADVERTISEMENTS.

Adams-Bagnall Electric Co..—
Allis-Chalmers Company..... 2
American Battery Co.....—
Amer. Circular Loom Co.... ... 1
American Conduit Co.....16
American Diesel Engine Co..11
Amer. District Steam Co.....19
Amer. Elec. Fuse Co..... 4
Amer. El. Telephone Co.....16
American Electrical Works..13
American Platinum Works..—
Arnold Elec. Power Station Co.....15
Audit Co. of Ill., The..... —
Automatic Electric Co..... 17

Babcock & Wilcox Co.....—
Badt, F. B.....15
Bain, Forée.....13
Baker & Company..... 3
Baker & Co., W. E.....15
Barnett Company, G. & H....22
Beardslee Chandelier Mfg. Co.12
Benjamin Electric Mfg. Co..—
Bennett, L. A..... 8
Berthold & Jennings.....19
Bissell Co., The F.....23
Bossert Electric Construction Co..... 12
Brooks, Hall L.....18
Bryan-Marsh Co.....—
Bryan, Wm. H.....15
Buckeye Electric Co.....—
Bullock Elec. Mfg. Co..... 2
Burlington R. R 18
Butterfield, J. F.....—
Byllesby & Co., H. M.....15

Cantwell Press, The.....16
Carhartt & Co., Hamilton.. .—
Central Electric Co..... 5
Cent. Stat. Improvement Co.14
Central Tel. & El. Co.....—
Century Electric Co.....—
Chicago Die & Electric Co....—
Chicago Edison Co.....4, 14
Chic. Fuse Wire & Mfg. Co... 3
Chicago Insulated Wire Co.. 1
Chicago Mica Co.....12
Cincinnati Gas & Elec. Co...14
Colonial Sign & Insulator Co. 3
Columbia Incand. Lamp Co..—
Columbia Mfg. Co.....19
Continuous Rail Joint Company of America..... 12
Cooper-Hewitt Elec. Co..... 8
Cope, T. J..... 1
Crawfordsville Electric Co.. 9
Crescent Ins. Wire & Cbl. Co. 1
Crocker-Wheeler Company... 8
Crolius & Son, E. R.....—
Cutler-Hammer Mfg. Co.....12
Cutter Elec. & Mfg. Company—

D. & W. Fuse Company.....—
Dearborn Drug & Chem. Wks.11
Diamond Meter Company....—
Directory of Engineers.....15
Dixon Crucible Co., Joseph..11
Dorsee Elec'l. Co., A. S..... 8
Duncan Elec. Mfg. Co.....21

Edison Decorative & Miniature Lamp Departm't..... 12
Edison Mfg. Company.....16
Edwards & Co.....18
Egan, J. J..... 1
Electric Appliance Co..... 12
Electric Storage Battery Co.. 3
Electrical Engineer Institute.—
Electrician Pub. Company...10
Erie Ry.....19
Evans, Almirall & Co 15
Evans & Co., W. R 15

Faries Mfg. Co..... 1
"For Sale" Advertisements..14
Ft. Wayne Elec. Works, Inc..21
Fostoria Incand. Lamp Co....—
Fowler, John H.....19
Fowler-Jacobs Company.....19
Franklin Elec. Mfg. Co .....—

General Electric Co..... 9
General Engineering Co., The 15
General Incandescent Arc Light Company.....—
General Incand. Lamp Co....—
Gould Storage Battery Co....—
Gt. Western Smelting & Refining Co .....—
Green Fuel Economizer Co.—
Gregory Electric Company...14

Hallberg, J. H 15
Hamacek, A. F.....—
Hart Mfg. Co..... 9
Hartford Steam Boiler Inspection & Insurance Co....11
Hazard Manufacturing Co...22
Highland Park College. 13
Hipwell Mfg. Co.....—
Hobart Elec. Mfg. Co..... 1
Hoffman, G. W.....14
Holmes Fibre-Graph. Co.....11
Holophane Glass Co.....—
Humphrey, Henry H.....—
Hunt & Co., Robt. W.....15

Illinois Central Ry.....19
Incandescent Electric Light Manipulator Company.....—
Indiana Rub. & Ins. W. Co.... 1
India Rubber & Gutta Percha Insulating Company.....18
International Elec. Meter Co 15
International Tel. Mfg. Co...17

Jackson, D. C. & W. B.....15
Jeffrey Manufacturing Co....11
Johns-Manville Co., H. W.....—

Kartavert Manufacturing Co.22
Kellogg Switchboard & Supply Company.....17, 19
Kemp, R. W..... 15
Kester Elec. Mfg. Co.....13
Klein & Sons, Mathias..... 13
Kohler Brothers.....15
Kuhlman Electric Co.....13

Leather Preserv. M. Corp....—
Leffel & Co., James.....11
Letheule, Paul.....12
Lindsley Brothers Company..18
Loud's Sons Co., H. M.....18

Machado & Roller.....—
Maltby Cedar Company.....19
Manhattan El. Supply Co....17
Manross, F. N..... 18
Marinette Gas Engine Co.....11
Matthews & Bros., W. N.....13
McLaughlin & Co., Jas.....14
McLennan & Company, K....12
Mechanical Appliance Co....—
Mica Insulator Company.....12
Miscellaneous Advs.....14
Monon Railroad.....—
Morrison Lbr. Co., J. W.....—
Mueller Company, William..18
Munsell & Co., Eugene.....12

National Carbon Co.....—
National Electric Co..... 5, 7
National India Rubber Co....—
New England Butt Co..... 1
Newgard & Co., Henry.....22
New York Cent. Ry.....14
New York Ins. Wire Co.....13
Northern Elect'l Mfg. Co.... 8
Northern Wire & Cable Co..—
Northwestern Storage Battery Co.. ... .13

Okonite Co., The..... 1
Osburn Flexible Conduit Co. 6

Pacific Coast Pole Co.....19
Paragon Fan & Motor Co.....—
Pardridge Shade & Refl. Co..—
Pass & Seymour, Inc.....—
Phelan, D. W.....19
Phillips, Eugene F.....13
Phillips Insulated Wire Co...13
Phœnix Glass Co..... 1
Phosphor-Bronze S. Co.....11
Pignolet, L. M.....12
Pittsburg & L. S. Iron Co....18
Plume & Atwood Mfg. Co....—
Porter Cedar Company.....19
Prometheus Electric Co., The--

Reisinger, Hugo..... 9
Replogle Governor Works.. .—
Reynolds El. Flasher Mfg. Co. 1
Richardson Lubricating Co..11
Robert Instrument Co., The..14
Roche, Wm.....—
Roebling's Sons Co., J. A.....22
Ruebel-Schwedtmann-Wells..15
Runzel-Lenz Elec. Mfg. Co...—

Safety Ins. Wire & Cable Co..11
Sargent & Lundy.....—
Sauquoit Silk Mfg. Co.....14
Schott, W. H.....15
Signaloid Chemical Works...—
Simplex Electrical Co., The.. 1
Simplex Elec. Heating Co....12
Speer Carbon Co..... .19
Sprague Electric Company...13
Squire Electric Co.....—
Standard Elec. Mfg. Co..... 3
Standard Underg. Cable Co.... 1
Stanley Elec. Mfg. Co., The 8
Stanley Instrument Co..... 5
Stanton, LeRoy W..... 15
Sterling & Son, W. C.....19
Sterling Electrical Mfg. Co.... 4
Sterling Varnish Co., The....11
Stow Mfg. Company..... 1
Strombergs-Carlson Tel. Mfg. Company..... 17
Sturtevant Company B. F...22

Temple Pump Co.....—
Torrey Cedar Company.....19
Trumbull Elec. Mfg. Co.....—
Turner Brass Works.....—

Union Electric Mfg. Co.....—

Valentine-Clark Co., The....19
Vulcanized Fibre Company..22

Wagner Electric Mfg. Co.....—
Walsh's Sons & Company..... 1
Warren Elec. Mfg. Co.....22
Wesco Supply Co.....—
Western Electric Company... 4
Westinghouse Electric & Manufacturing Co.....20
Weston Electrical Inst. Co... 1
Whitehead Machinery Co... —
Wilmerding, C. H.....15
Woolley Fdy. & Mach. Wks..—
Worcester Company, C. H....18

Yesbera Mfg. Co..... .. —
Yost Electric Mfg. Co 3

Zero Marx Sign Works .....—

For Classified Index of Advertisements See Page 6.

Motors,
Switches,
Arc Lamps,
Circuit Breakers, Etc., Etc.

ALWAYS IN STOCK.

MANUFACTURED BY

G. I. Co.

CHICAGO EDISON COMPANY, 139 Adams Street, CHICAGO.

Arc Lamps

MULTIPLE SERIES
CONSTANT CURRENT
DIRECT CURRENT
CIRCUITS

Type 414 is extensively adopted in replacing Open Series Arc Lamps with Enclosed Series Arc Lamps operating at 9.6 Amperes on the old Arc Machine.
Bulletin 7030

MOTORS AND GENERATORS
SWITCHBOARDS.
(Bulletins on Request)

Western Electric Company
CHICAGO NEW YORK
Other Large Cities

Perfect Control—Indefinite Regulation
No Flashing—No Repairs
Burnouts Impossible—Last Forever

ALLEN-BRADLEY
RHEOSTATS

For All Purposes of Electric Current Control

Prices Reasonable—Satisfaction Guaranteed

SEND IN A TRIAL ORDER

Ask your Engineer or Electrician about it.

AMERICAN ELECTRIC FUSE CO.
48-50 West Jackson Boul.
CHICAGO, ILL.

READ THE BLUE ELECTRICAL PAPER.

SOMETHING NEW!

"PIG" AND "STAG'S HEAD" LAMPS

The accompanying cuts show our latest novelties in

SPECIAL AND MINIATURE LAMPS.

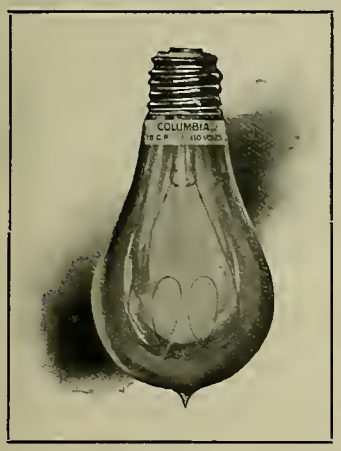
The Stag's Head lamp is a "real burning" incandescent lamp equipped with either standard Edison base or candelabra base; voltage 104, 110, 115 or any normal voltage.

The "Pig" is made in two sizes, one for candelabra and the other for regular socket; made to fit any Edison socket.

If Interested, Write for More Details and Prices.

STERLING ELECTRICAL MFG. CO.
WARREN, O.

NEW YORK: 100 William St. SAN FRANCISCO: Crossby Bldg. CHICAGO: 1610 Masonic Temple.



COLUMBIA LAMPS

Are furnished in accordance with the most rigid specifications. We invite a comparison of the COLUMBIA with other makes and request central stations and isolated plants to make thorough and comprehensive tests for life, sustained candle-power and total illuminated area. LET US SEND YOU OUR PROPOSAL FORM.

Columbia Lamps are manufactured under a License to use the Chemical Exhaust Process of exhausting lamps. This process is vitally necessary in the production of the highest quality of Lamp.

OKONITE IT NEVER DISAPPOINTS

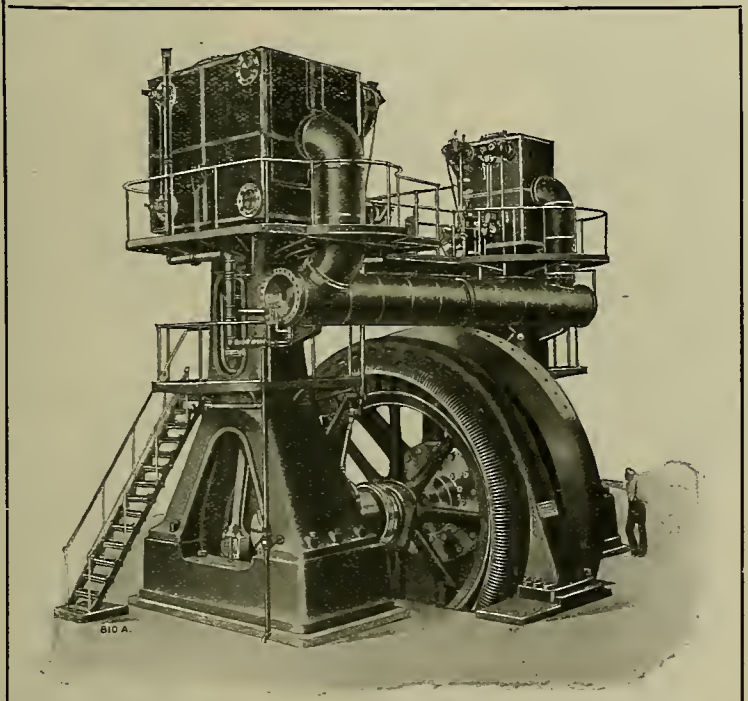
Central Electric Company,

GENERAL WESTERN AGENTS

264-266-268-270 FIFTH AVENUE, CHICAGO.

OKONITE IT NEVER DISAPPOINTS

For Immediate Delivery



MODERN DESIGN SUPERIOR PERFORMANCE

Gold Medal Generator Unit

Hamilton Corliss Cross Compound Vertical Condensing Engine, 2,250 horsepower.

1,500 K. W., 3 Phase 25 cycles, 6,600-Volt National Alternator.

Released at close of St. Louis Exposition.

For prices and terms apply to

HOOVEN, OWENS, RENTSCHLER CO.
HAMILTON, OHIO

National Electric Company
Milwaukee

ELECTRICITY FOR ENGINEERS. 424 PAGES. ILLUSTRATED. PRICE $2.50.
ELECTRICIAN PUBLISHING CO.,
510 Marquette Building, CHICAGO

STANLEY INSTRUMENT CO.

GREAT BARRINGTON, MASS., U. S. A.

UNIVERSAL EXPOSITION ST. LOUIS 1904

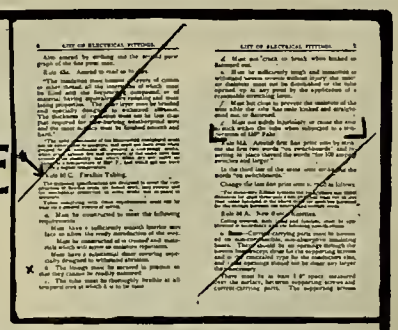
GOLD MEDALS

PAN-AMERICAN EXPOSITION BUFFALO 1901

THE HIGHEST AWARDS AT BOTH EXPOSITIONS FOR

WATTMETERS

SANTA CLAUS PRESENTS
THE NEW SUPPLEMENT
TO THE
NATIONAL ELECTRICAL CODE



The New Standard
An Established Fact

"Flexduct" the standard flexible non-metallic conduit is an established fact. The highest interpretation of the new code for safety, durability and strength. "Flexduct" is the practical conduit for practical workmen. The high standard desired by all men. "Flexduct" smooth interior and indestructible features make wiring easy. For sale by all electrical jobbers and supply houses. Specify "Flexduct," do not accept substitution, as there is no duct but "Flexduct." No equal, no combination of ideal qualities such as found in Flexduct.

OSBURN FLEXIBLE CONDUIT COMPANY

Main Office: 21 Park Row, New York.
San Francisco Office: C. F. Sloan Co., Crossley Bldg.
Chicago Office: I. A. Bennett, 529-530 Monadnock Block.

CLASSIFIED INDEX OF ADVERTISEMENTS.

Accountants and Auditors.
Audit Co. of Illinois

Adjusters, Cord.
Incandes. El. Lt. Manip. Co.

Adjusters, Inc. Lamps.
Inc. El. Lt. Manipulator Co.

Anchors (Tel. & Tel.)
Bennett, I. A.
Matthews & Bro., W. N.

Annunciators.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.

Batteries and Jars.
Bissell Co., The F.
Central Electric Co.
Edison Mfg. Co.
Edwards & Company.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Roche, Wm.
Wesco Supply Co.
Western Electric Co.

Bells, Buzzers, Etc.
Central Electric Co.
Edwards & Co.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.

Belt Dressing.
Dixon Crucible Co., Jos.
Leather Preserver Mfg. Corp.

Belting.
Leather Preserver Mfg. Corp.

Blow Pipes.
Turner Brass Works

Blowers.
Green Fuel Economizer Co.
Sturtevant Co., B. F.

Boiler Compounds.
Dearborn Drug & Chem. Wks.

Boilers.
Allis-Chalmers Company.
Babcock & Wilcox Co.

Books, Electrical.
Cantwell Press, The.
Electrician Publishing Co.

Booths, Telephone.
Yesbera Mfg. Co.

Brackets.
Faries Mfg. Co.

Brushes.
Central Electric Co.
Hobart Elec. Mfg. Co.
Holmes Fibre-Graphite Co.
Spear Carbon Co.
Western Electric Company.

Cable Hangers.
Bissell Co., B. F.
Wesco Supply Co.
Western Electric Co.

Cables (See Wires and Cables)

Canopies.
Faries Mfg. Co.

Carbons, Points and Plates.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
National Carbon Co.
Reisinger, Hugo.
Speer Carbon Co.
Wesco Supply Co.

Castings.
Faries Mfg. Co.
New England Butt Co.
National Electric Co.

Chains.
Jeffrey Mfg. Co.

Chandeliers.
Faries Mfg. Co.

Circuit Breakers.
Cutler-Hammer Mfg. Co.
Cutter Elec. & Mfg. Co.
Ft. Wayne Elec. Wks. Inc.
Union Electric Mfg. Co.
Wesco Supply Co.
Western Electric Company.
Westinghouse El. & Mfg. Co.

Clusters.
Benjamin Elec. Mfg. Co.
Faries Mfg. Co.

Coal and Ashes Handling Machinery.
Jeffrey Mfg. Co.

Coils and Magnets.
Western Electric Co.

Coloring, Lamp.
Signaloid Chemical Works.

Commutator Compound
Crollus & Son, E. R.
Egan, J. J.
McLaughlin & Co., Jas.
McLennan & Co., K.

Condensers, Electric.
Stanley Elec. Mfg Co.

Conduit and Conduits.
American Circular Loom Co.
American Conduit Company
Central Electric Co.
Electric Appliance Co.
Osburn Flexible Conduit Co.
Sprague Electric Co.
Wesco Supply Co.

Contractors and Electric Light Plants.
Allis-Chalmers Company.
Bullock El. Mfg. Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
National Electric Co.
Northern Electrical Mfg. Co.
Sprague Electric Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Controllers, Crane.
Amer. Elec. Fuse Co.

Copper, Scrap.
Great Western Smelting & Refining Co.

Cord.
Runzel-Lenz Elec. Mfg. Co.

Cross-Arms, Pins and Brackets.
Berthold & Jennings.
Central Electric Co.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Company.

Cut-Outs and Switches.
Bissell Co., The F.
Bossert Elec. Const. Co.
Central Electric Co.
Chicago Edison Co.
Clinton Stamping & Elec. Co.
Cutter Elec. & Mfg. Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
General Inc. Arc Light Co.
Hamacek, A. F.
Hart Manufacturing Co.
Manhattan Elec. Supply Co.
Trumbull Elec. Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Dynamos and Motors.
Allis-Chalmers Company.
Bissell Co., The F.
Bullock Elec. Mfg. Co.
Central Electric Co.
Century Electric Co.
Crawfordsville Electric Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks. Inc.
General Elec. Co.
General Inc. Arc Light Co.
Gregory Electric Co.
Hobart Elec. Mfg. Co.
Mechanical Appliance Co.
National Electric Co.
Northern Electrical Mfg. Co.
Sprague Electric Co.
Stanley Elec. Mfg. Co.
Stow Manufacturing Co.
Sturtevant Co., B. F.
Wagner Electric Mfg. Co.
Warren Elec. Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Economizers, Fuel.
Green Fuel Economizer Co.

Electric Heating Appl.
Electric Appliance Co.
Prometheus Electric Co.
Simplex Elec. Heating Co.
Western Electric Co.

Electric Railways.
Crocker-Wheeler Co.
General Electric Co.
Sprague Electric Co.
Westinghouse El. & Mfg. Co.

Electrical and Mechanical Engineers.
Arnold Elec. Power Stat'n Co.
Radt, F. R.
Baker & Co., W. E.
Bryan, Wm. B.
Butterfield, J. F.
Byllesby & Co., H. M.
Evans, Almirall & Co.
General Engineering Co., The.
Hallberg, J. H.
Humphrey, Henry H.
Hunt & Co., Robt. W.
Jackson, D. C. & W. B.
Kemp, R. W.
Kohler Brothers.
Newgard & Co., Henry.
Northern Electrical Mfg. Co.
Ruebel, Schwedtman, Wells.
Sargent & Lundy.
Schott, W. H.
Squire Electric Co.
Stanley Elec. Mfg. Co.
Stanton, LeRoy W.
Wilmerding, C. H.

Electrical Instruments. (Recording and Testing.)
Bissell Co., The F.
Central Electric Co.
Diamond Meter Co.
Duncan Elec. Mfg. Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
General Inc. Arc Light Co.
Machado & Roller.
Pignolet, L. M.
Robert Inst. Co., The
Stanley Elec. Mfg. Co.
Stanley Instrument Co.
Wagner Electric Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co
Weston Electrical Inst. Co.

Electro-Plating Mach'y
Crocker-Wheeler Company.
General Electric Co.

Elevators-Conveyors.
Jeffrey Mfg. Co.

Engines, Gas and Gasoline.
Allis-Chalmers Company.
Marinette Gas Engine Co.
Temple Pump Co.
Woolley Fdy. & Mach. Wks.

Engines, Oil.
American Diesel Engine Co.

Engines, Steam.
Allis-Chalmers Company.
Sturtevant Co., B. F.

Fans and Fan Motors.
Central Electric Co.
Crocker-Wheeler Company.
Edison Mfg. Co.
General Electric Co.
General Inc. Arc Light Co.
Sprague Electric Co.
Sturtevant Co., B. F.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Fibre.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Files.
Barnett Co., G. & H.

Fittings.
Faries Mfg. Co.

Fixtures, Gas and Elec.
Beardslee Chandelier Mfg. Co.

Flashers.
Bissell Co., The F.
Doxsee Elec'l. Co., A. S.
Reynolds El. Flasher Mfg. Co
Wesco Supply Co.

Flexible Shafts.
Stow Mfg. Co.

Forges.
Sturtevant Co., B. F.

Fuses and Fuse Wire.
Amer. Elec. Fuse Co.
Bissell Co., The F.
Central Electric Co.
Central Tel. & El. Co.
Chicago Die & Electric Co.
Chicago Fuse Wire & Mfg. Co.
Clinton Stamping & Elec. Co.
D. & W. Fuse Company.
Electric Appliance Co.
Johns-Manville Co., H. W.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Company.

Globes, Reflectors and Shades.
Fostoria Incan. Lamp Co.
Holophane Glass Co.
Pardridge Shade & Refl. Co.
Phœnix Glass Co.
Wesco Supply Co.
Western Electric Co.

Governors, Water Wheel.
Replogle Governor Works.

Graphite Specialties.
Dixon Crucible Co., Jos.
Holmes Fibre-Graphite Co.

Heating (Exhaust Steam).
Amer. District Steam Co.

Heating and Ventilating Apparatus.
Sturtevant Co., B. F.

Heating, Hot Water.
Evans, Almirall & Co.

Holders, Inc. Lamps.
Electric Appliance Co.
Incandescent Electric Light Manipulator Co.

Inspection & Insurance
Bartford Steam Boiler Inspection & Insurance Co.

Insulating Machinery.
New England Butt Co.

Insulators and Insulating Materials.
American Electrical Works.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Inc. Arc Light Co.
Indiana Rub. & Ins. Wire Co.
Johns-Manville Co., H. W.
Kartavert Mfg. Co.
Manhattan Elec. Supply Co.
Mica Insulator Co.
Munsell & Co., Eugene.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Sterling Varnish Co.
Vulcanized Fibra Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Junction Boxes.
Bossert Elect. Const. Co.
General Inc. Arc Light Co.

Lamps, Arc.
Bissell Co., The F.
Central Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
General Inc. Arc Lt. Co.
Gregory Electric Co.
Hipwell Manufacturing Co
Manhattan Elec. Supply Co.
Stanley Elec. Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Lamps, Incandescent.
Bissell Co., The F.
Bryan-Marsh Company.
Buckeye Electric Company.
Central Electric Co.
Chicago Edison Co.
Columbia Incan. Lamp Co.
Edison Decorative & Miniatura Lamp Dept.
Electric Appliance Co.
Fostoria Incand. Lamp Co.
Franklin Electric Mfg. Co.
General Electric Co.
General Inc. Arc Light Co.
Sawyer-Man Elec. Co.
Standard Elec'l Mfg. Co.
Sterling Electrical Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Lamps, Incandescent—Replacers & Cleaners.
Inc. El. Lt. Manipulator Co.

Lamps, Vapor.
Cooper, Hewitt Elec. Co.

Letters, Sign.
Colonial Sign & Insulator Co.

Lightning Arresters.
Central Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
Manhattan Elec. Supply Co.
Stanley Elec. Mfg. Co.
Wesco Supply Co.
Western Electric Co.

Linemen's Climbers.
Klein & Sons, Mathias.

Lubricating, Oil, Grease.
Richardson Lubricating Co.

Magnet Wires.
(See Wires and Cables.)

Mechanical Draft.
Green Fuel Economizer Co.
Sturtevant Co., B. F.

Mica.
Chicago Mica Co.
Mica Insulator Co.
Munsell & Co., Eugene.

Mining Apparatus, Elec.
Allis-Chalmers Company.
Crocker-Wheeler Company.
General Electric Co.
Jeffrey Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Motors. (See Dynamos and Motors.)

Nippers and Pliers.
Klein & Sons, Mathias.

Novelties, Lighting.
Letheule, Paul

Nozzles.
Faries Mfg. Co.

Overalls.
Carhartt & Co., Hamilton

Patent Attorneys.
Bain, Foree.

Phosphor Bronze.
Phosphor Bronze Sm. Co. Ltd.

Platinum, Wire and Sheet.
American Platinum Works.
Baker & Company Inc.

Poles and Ties.
Berthold & Jennings.
Brooks, Hall L.
Columbia Mfg. Co.
Fowler, John H.
Fowler-Jacobs Company.
Kellogg Switch. & Sup. Co.
Lindsley Bros. Co.
Loud's Sons Co., H. M.
Maltby Cedar Co.
Morrison Lbr. Co., J. W.
Mueller Company, William.
Pacific Coast Pole Co.
Phelan, D. W.
Pittsburg & L. S. Iron Co.
Porter Cedar Company.
Sterling & Son, W. C.
Torrey Cedar Co.
Valentine-Clark Co., The.
Worcester Co., G. H.

Polish (Metal).
Allen Co., Inc., L. B.
Hoffman, Geo. W.

Portables.
Faries Mfg. Co.

Power Transmission Machinery.
Jeffrey Mfg. Co.

Rail Joints.
Continuous Rail Joint Company of America.

Railway Supplies.
Wesco Supply Co.

Refiners.
Gt. West Smelt. & Refining Co

Re-Winding—Repairs.
Chicago Edison Co.
Gregory Electric Co.

Rheostats.
Amer. Electric Fuse Co.
Cutler-Hammer Mfg. Co.
General Electric Co.
Gen'l Inc. Arc Lt. Co.
Union Electric Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Rods, Conduit.
Cope, T. J.

Schools and Colleges.
Electrical Engineer Inst.
Highland Park College

Second-Hand Mach'y.
Bissell Co., The F.
Cent. Stat. Improvement Co.
Cincinnati Gas & Elec. Co.
Gregory Electric Co.
Matthews & Bro., W. N.
Walsh's Sons & Co.

Shades, Lamp.
Faries Mfg. Co.

Sheet Brass & Copper.
Plume & Atwood Mfg. Co.

Signs, Electric.
Zero Marx Sign Works.

Silks, Insulating and Braiding.
Sauquoit Silk Mfg. Co.

Sockets & Receptacles.
Pass & Seymour.
Yost Elec. Mfg. Co.

Soldering Sticks, Salts and Paste.
Crollus & Son, E. R.
Kester Elec. Mfg. Co.
Western Electric Co.

Speaking Tubes.
Central Electric Co.
Edwards & Co.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.

Speed Indicators.
Weston Electrical Inst. Co.

Storage Batteries.
American Battery Co.
Electric Storage Battery Co.
Gould Storage Battery Co.

Supplies, General Elec.
Bissell Co., The F.
Central Electric Co.
Century Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Electric Co.
Manhattan Elect'l Supply Co.
Wesco Supply Co.
Western Electric Co.

Switchboards.
Bissell Co., The F.
Gen. Incan. Arc Light Co.

Telephones, Telephone Material and Switchboards.
American El. Telephone Co
Automatic Electric Co.
Bissell Co., The F.
Central Electric Co.
Central Tel. & El. Co.
Electric Appliance Co.
International Tel. Mfg. Co.
Kellogg Switchb. & Sup. Co.
Manhattan Elec. Supply Co.
Stromberg-Carlson Tel. M. Co
Wesco Supply Co.
Western Electric Co.

Time Switches.
Bissell Co., The F.

Tools.
Klein & Sons, Mathias.
Western Electric Co.

Transformers.
Central Electric Co.
Crawfordsville Electric Co.
Crocker-Wheeler Co.
Electric Appliance Co.
Ft. Wayne Elec. Works, Inc.
General Electric Co.
Gregory Electric Co.
Kuhlman Electric Co.
Manhattan Elec. Supply Co.
National Electric Co.
Stanley Elec. Mfg. Co.
Wagner Electric Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Weatinghouse El. & Mfg. Co.

Trucks, Electric Car.
General Electric Co.
Westinghouse El. & Mfg. Co.

Turbines, Steam.
Allis-Chalmers Co.
General Electric Co.
Westinghouse El. & Mfg. Co

Turbine Water Wheels
Leffel & Co., Jas.

Varnishes.
Sterling Varnish Co.

Vulcanized Fibre.
Vulcanized Fibra Co.

Whistles, Electric.
Electrical Appliance Co.

Wires & Cables—Magnet Wires.
American Electrical Works.
Bissell Co., The F.
Central Electric Co.
Chicago Insulated Wire Co.
Crescent Ins. Wire & Cble. Co.
Electric Appliance Co.
General Electric Co.
Hazard Manufacturing Co.
Indiana Rub. & Ins. Wire Co
India Rubber & Gutta Percha Insulating Co.
Kellogg Switch. & Sup. Co.
Manhattan Elec. Supply Co.
National India Rubber Co
New York Insulated Wire Co.
Northern Wire & Cable Co.
Okonite Co., The.
Phillips, Eugene F.
Phillips Insulated Wire Co
Roebling's Sons Co., J. A.
Runzel-Lenz Elec. Mfg Co.
Safety Ins. Wire & Cable Co.
Simplex Electrical Co.
Standard Underground C. Co
Wesco Supply Co.
Western Electric Company.

For Alphabetical Index of Advertisements See Page 3.

The National Policy

3 TO 1

For Speed Range of
Individual Motors by
Field Regulation.

TRADE

MARK

Lundell

"Universal" Motors

National Electric Company

General Sales Office and Works

Milwaukee

DISTRICT OFFICES
New York, 135 Broadway
Philadelphia, 1509 Land Title Building
Pittsburg, A. W. Wyckoff Co.
Chicago, Old Colony Building
Boston and Cincinnati

SALES OFFICES
Charleston, W. Va., Agnew Electric Co.
Cleveland, Barton, Stevenson & Co.
Detroit, Miller Seldon Electric Co.
Denver, Hendrie & Bolthoff Mfg. & Supply Co.
Seattle, San Francisco } Kilbourne & Clark Co.

THE WORK OF THE NIGHT SHIFT

is usually less productive than that done by day on account of the inconvenience caused by artificial light.

Notice in this picture taken at 10 p. m. how perfectly tools are lighted at night by

The Cooper Hewitt

Mercury Vapor Lamps

In such a plant the night is just as good as day for working.

The extreme diffusion of light prevents the usual shadows from getting in the way of the work, and the freedom from glare or flicker makes it "just as good as daylight."

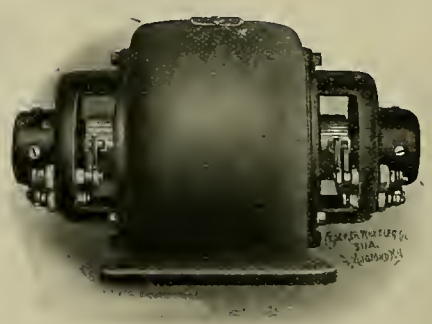
The cost of this superior light is only 35 per cent. of what you are now paying, and in addition there is no trimming needed and no consumption of light-giving element.

Adapted to all **Direct-Current Systems.** For use in Mills, Factories, Printing Shops, Photographic Establishments, Docks, Freight Houses, Draughting Rooms and Offices. Send for Booklet.

Cooper Hewitt Electric Co.

Crocker-Wheeler Dynamotors

For Telephone Service are of Established Excellence



Form L Dynamotor

Crocker-Wheeler Company

Manufacturers and Electrical Engineers

Chicago Office, Old Colony Bldg.

Ampere, N. J.

It Can't Be Beat—The Guthrie Flasher

A SIGN FLASHER WITHOUT A MOTOR

Agents Wanted

A FEW ADVANTAGES OF THIS FLASHER OVER ALL OTHERS:

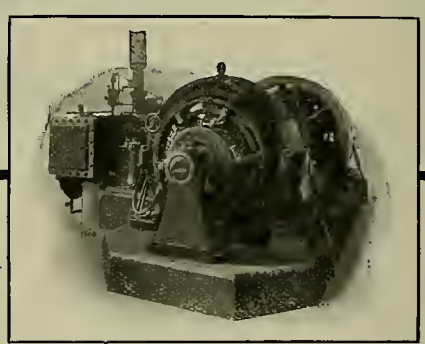
First.—The Price is lower.
Second.—It has fewer parts and is therefore the simplest flasher on the market.
Third.—It has no motor to cause trouble and consume current.
Fourth.—It costs nothing to operate this flasher.
Fifth.—It only occupies a space of 5 x 8 inches.
Sixth.—It can be regulated to flash any signs or show window lights in any manner desired.

Any combination of lights, without motor or cylinder.
Simplest and best on the market.
Works on any current.
The disadvantage of a flasher was the motor question.
We have overcome this and are putting out an article that meets a long felt want.

A. S. DOXSEE ELECTRICAL CO.

1108-1110 Pine St., ST. LOUIS

General Agents for United States and Canada



147

As Good as The Best—"And Then Some."

Ball Compound Engine — Northern Dynamos

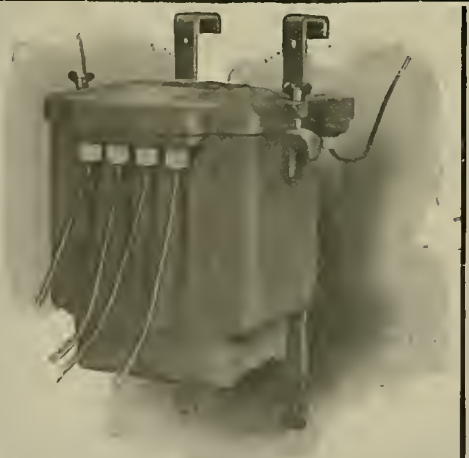
Northern Direct Current Apparatus possesses all the characteristics of economical, convenient operation common to excellent electric dynamos and motors and

Many exclusive meritorious features that make it worth your while to get acquainted by reading Bulletin No. 2,530.

NORTHERN ELECTRICAL MFG. CO.,

Engineers Manufacturers.

MADISON, WIS., - - - - U. S. A.



THE B. O. TRANSFORMER

Do you expect to need new transformers this fall? If you do, the B. O. will interest you.

Low Losses
High Efficiencies
High Insulation
Low Price.

Are you familiar with oil duct transformers?
Send us your address and we will tell you about our insulation and the advantages of slab windings in connection with oil ducts.

THE STANLEY ELECTRIC MANUFACTURING COMPANY

PITTSFIELD, MASSACHUSETTS

Atlanta, Ga., Empire Building
Boston, Mass., Oliver Building
CHICAGO, ILL., MONADNOCK BLOCK
Denver, Col., Hendrie & Bolthoff Mfg. & Supply Co.
New York, N. Y., 29 Broadway
Philadelphia, Pa., North American Building
St. Louis, Mo., Century Bldg.
San Francisco, Cal., 69-75 New Montgomery St.
Seattle, Wash., Pioneer Bldg.

Representatives for the Dominion of Canada, THE CANADIAN GENERAL ELECTRIC CO. of Toronto

"THE S. K. C. SYSTEM"

It Will Interest You to Know What the **Western Electric Company** Have to Say Regarding

ELECTRA
TRADE MARK

HIGHEST GRADE NUERNBERG

CARBONS

n their circular letter dated October 7, 1904, which in part reads as follows:

"It seems almost an unnecessary proceeding to write a letter advertising the 'ELECTRA' Carbon, or to dwell upon its merits, to any great extent, inasmuch as the 'ELECTRA' Carbon is the STANDARD OF PERFECTION, to which all other manufacturers of carbons endeavor to reach. We think this is a sufficient recommendation in itself.

If you have not been using these carbons in your arc lamps, it would certainly pay you to give them a trial. You will find that the expenses of trimming are reduced from 15 to 20 per cent."

HUGO REISINGER, Sole Importer, 11 Broadway, NEW YORK CITY

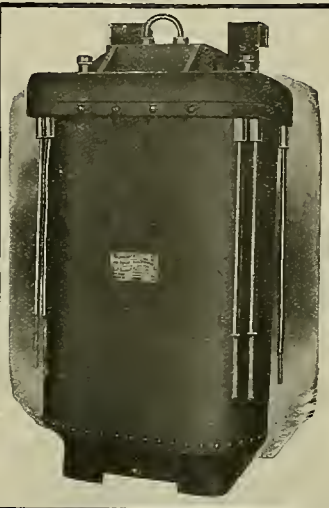
"Diamond H" Switches

Trade H Mark

This Trade-Mark guarantees quality.

The Hart Mfg. Co., Hartford, Conn.

New York Boston Chicago Toronto, Ont.



HORNBERGER-IRWIN

Transformers

(LARGE AND SMALL)

½ K.W. to 500 K.W.

This transformer represents the latest improvements in transformer construction; made in three types; multi-coil construction; ventilated cores; built for all commercial voltages and frequencies; **higher efficiencies together with lower temperatures than have heretofore been attained are guaranteed.** Catalogue just issued explains details.

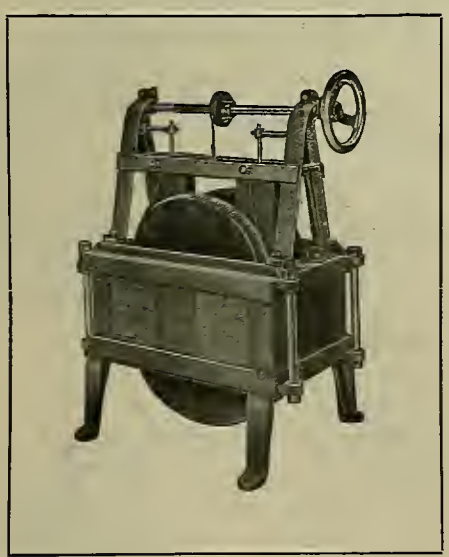
Manufactured by

Crawfordsville Electric Co.

CRAWFORDSVILLE, INDIANA, U. S. A.

General Electric Company

TRANSFORMERS FOR THAWING OUT WATER PIPES



LIGHT SIMPLE PORTABLE

Are furnished for installation on alternating current lighting or power circuits below 3,500 volts, and give absolute control of current and voltage from zero to maximum.

IT WILL QUICKLY PAY FOR ITSELF

Order now and be equipped for cold weather.
It is fully described in Pamphlet No. 1047. Write for it.

General Office: SCHENECTADY, N. Y.

Chicago Office: Monadnock Block **Sales Offices in all Large Cities**

The New Years Number of the Western Electrician will be a noteworthy contribution to electrical journalism. In addition to having a handsome cover which competent critics have pronounced a beautiful specimen of color printing, this number will contain many special and valuable features which will appeal to the electrical public.

A large attractive advertising announcement in this excellent number would prove beneficial to your business.

Send in your copy <u>today</u>

GOLD MEDAL

Awarded Dearborn Methods of Treating Boiler Waters and Dearborn Vegetable Feed-Water Treatment at the World's Fair, St. Louis.

DEARBORN DRUG & CHEMICAL WORKS,

27-34 RIALTO BUILDING, CHICAGO, ILL. WM. H EDGAR, President Telephone: Harrison 3930 and 3931.

NOXALL CUP GREASE. A PERFECT LUBRICANT. HIGH QUALITY, LOW PRICE.
RICHARDSON LUBRICATING CO., - Quincy, Ill.

STERLING BLACK PLASTIC INSULATOR.
WATER REPELLENT. OIL PROOF.
One hundred days' continuous baking at 180° F. will not make it brittle.
THE STERLING VARNISH CO., - - Pittsburg, Pa.

JEFFREY CHAIN BUCKET DREDGES FOR CATALOGUE, ADDRESS THE JEFFREY MFG. CO. COLUMBUS, OHIO.

January, 1905. A SPECIAL ISSUE
"Graphite" ON LUBRICATION.
COPIES ARE FREE TO ALL.
JOSEPH DIXON CRUCIBLE CO., Jersey City, N. J.

REG. TRADE MARKS

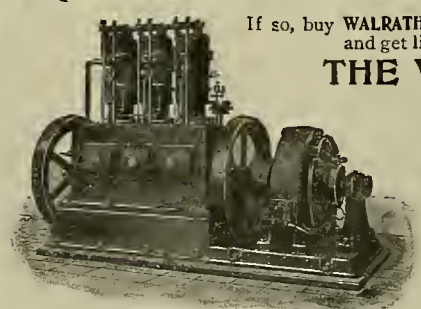
THE PHOSPHOR BRONZE SMELTING CO. LIMITED,
2200 WASHINGTON AVE., PHILADELPHIA.
"ELEPHANT BRAND PHOSPHOR-BRONZE"
INGOTS, CASTINGS, WIRE, RODS, SHEETS, ETC.
— DELTA METAL —
CASTINGS, STAMPINGS AND FORGINGS
ORIGINAL AND SOLE MAKERS IN THE U.S.

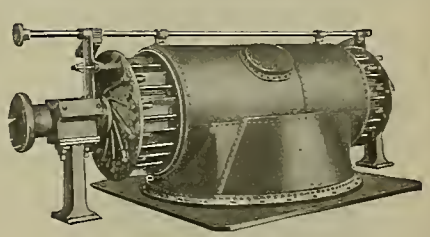
USE
"SAFETY" RUBBER COVERED WIRE AND CABLE
FOR EVERY ELECTRICAL SERVICE.
M. B. AUSTIN & CO.,
CHICAGO REPRESENTATIVE.
THE SAFETY INSULATED WIRE & CABLE CO.,
WORKS: Bayonne, N. J. 114-116 LIBERTY STREET, N. Y.

STUDENTS
Will find that the WESTERN ELECTRICIAN can help them wonderfully in the study of electricity. Subscribe now. $3.00 per year, in advance.
ELECTRICIAN PUBLISHING CO.,
Suite 510 Marquette Bldg., CHICAGO.

DIESEL ENGINES
Operating on CRUDE or FUEL Oil
Guaranteed Fuel Consumption
on variable load, ranging from ¼ to full load
12½ Gals. per 100 Kw. Hours
SUITABLE FOR ALL STATIONARY POWER
For further information address
AMERICAN DIESEL ENGINE COMPANY
11 Broadway NEW YORK

There's No Friction
with the Fibre-Graphite Commutator Brush. Being 90 per cent. pure graphite, it insures low resistance, no sparking under a varying load, and longer wear. There is no greasing required. The Fibre-Graphite is therefore the most economic brush on the market. Send for price list.
HOLMES FIBRE-GRAPHITE MFG. CO.
5155 Wakefield St., Germantown, PHILADELPHIA.

ARE YOU LOOKING FOR MONEY?
If so, buy WALRATH GAS OR GASOLINE ENGINES and get light on the subject.

THE WALRATH
Received the Highest Award at the Pan-American Exposition.
It will produce as good a commercial light as that of an automatic steam engine, either belted or direct-connected generator. Simple, Economical and Reliable.
Send for Catalogue W
MARINETTE GAS ENGINE CO.,
CHICAGO HEIGHTS, ILL.
AGENCIES:
Keystone Engineering Co., Farmer's Bank Bldg., Pittsburg, Pa.
Strong, Carlisle & Hammond Co., 61-67 Frankfort St., Cleveland, Ohio
Mackay Engineering Co., 149 Broadway, N. Y.
C. H. Seidenglanz., 52 When Bldg., Indianapolis, Ind.

SAMSON TURBINE
The gates on the SAMSON are so constructed that all movable parts have a maximum wearing surface, furthermore, the material used in their construction is of the finest. These two points insure a long life to the gate, and consequently prevent leakage.

THE JAMES LEFFEL & CO., 307 Lagonda St., Springfield, Ohio, U. S. A.

SATISFIED CUSTOMERS

Are those who are buying such specialties from us as

Packard Lamps and Transformers,
Adams-Bagnall Arc Lamps,
"O. K." Weatherproof Wire,
Peerless and Paranite Rubber Covered Wire,
Brunt Porcelain,
Ansonia Magnet Wire,
Circular Loom, Etc., Etc.

ELECTRIC APPLIANCE COMPANY,
CHICAGO AND SAN FRANCISCO.

Latest Novelty in Electric Lighting

—THE—
WEISSMANN PEARL SYSTEM

Endorsed for its Safety and Attractiveness by the best authorities in the world.
The sensation of the Ladies' Gowns Exhibit in the French Section at St. Louis.

Described in Western Electrician October 29 and November 26
Descriptive Matter and Patents mailed on application

PAUL LETHEULE, 4808 Delmar Bd., St. Louis

WANTED

You Who are Troubled with Sparking and Cutting of Commutators to Use

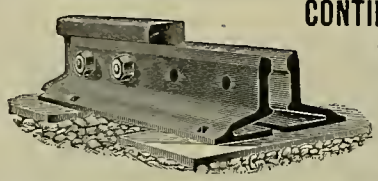
The only article that will PREVENT SPARKING. Will keep the commutator in good condition and PREVENT CUTTING.

Absolutely will Not Gum The Brushes . . .

It will put that high gloss on the commutator you have so long sought after.

50 Cts. per Stick. $5.00 per Dozen.
For Sale by all Supply Houses, or
FREE, Sample Stick.

K. McLENNAN & CO.,
Sole Manufacturers,
Room 411 Inter Ocean Bldg., 130 Dearborn St., CHICAGO, ILL.



CONTINUOUS RAIL JOINT CO. OF AM.

GENL. OFFICES: CENTURY BLDG., NEWARK, N. J.

OVER 20,000 MILES IN USE

See our exhibit, World's Fair, St. Louis, Mo., Transportation Bldg., Aisle "C," Posts 7 and 8.

MICA—BOND

Notice how our competitors try gradually to raise Cut Mica prices—same thing would occur in manufactured mica if we were not the leaders

CHICAGO MICA CO
"PERFECTORS" VALPARAISO, IND.

Electric Lighting Outfits

READY FOR USE

Very popular for electric lighting decorations and especially adapted to the lighting of Christmas trees.

Safe, Simple and Convenient

EDISON DECORATIVE & MINIATURE LAMP DEPARTMENT

Made in four sizes { 8 lights, 16 ", 24 ", 32 " } $5.00 and upwards

GENERAL ELECTRIC COMPANY,
Harrison, N. J.

MICA

Of all Qualities, in any Form at Lowest Prices
EUGENE MUNSELL AND CO.
NEW YORK and CHICAGO

INSULATION That Is.

Micanite, Linotape, M. I. C. Compound, Empire Cloth and Paper. For Years the Standard.

MICA INSULATOR CO., Originators
NEW YORK and CHICAGO

BEARDSLEE CHANDELIER MFG. CO. 256 AND 257 5TH CANAL ST. CHICAGO
GAS & ELECTRIC FIXTURES FOR THE TRADE.
CATALOG SENT PREPAID TO DEALERS MENTION THIS PAPER

THE ONLY TOOL REQUIRED

Next time you hammer, ream and file a cast-iron junction box, wasting time, breaking boxes, and finally fail to produce a round hole, think of

BOSSERT DRAWN STEEL JUNCTION BOXES.

They are punched out of one piece of steel and have holes closed with hermetically sealed plugs which can be removed with one blow of a hammer. No time wasted. No broken boxes. No filing or reaming. A clear round hole every time. Write for particulars.

BOSSERT ELECTRIC CONSTRUCTION CO., Office and Works, Utica, N.Y.

Electric Heating Apparatus

SEND FOR 82-PAGE CATALOGUE.

UNIT" ENAMELED RHEOSTATS
SIMPLEX ELECTRIC HEATING CO.,
Cambridgeport, Mass.

VOLT - AMMETERS,

POCKET SIZE,

For Testing Batteries and Battery Circuits, Locating Faults, Grounds, etc.
RELIABLE. ACCURATE.
Send for Circular.

L. M. PIGNOLET,
78-80 Cortlandt St., NEW YORK, N. Y.

THE
Standard Motor Starter of the World

Copied by almost every starter maker. Prompt prosecutions of infringements and the upholding of our patents by the courts prevented its duplication.

The strongest proof that it is as we claim, "the least expensive motor starter safe to use on any installation," is found in the attempts to build as much like it as possible without infringing.

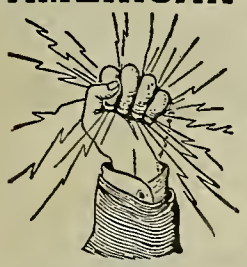
THE CUTLER HAMMER MFG. CO.

NEW YORK BOSTON MILWAUKEE, WIS. CHICAGO PITTSBURG

FRANK N. PHILLIPS, President. EUGENE F. PHILLIPS, General Manager. E. ROWLAND PHILLIPS, Vice-Pres. C. H. WAGENSEIL, Treasurer. C. R. REMINGTON, Jr., Sec

AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.

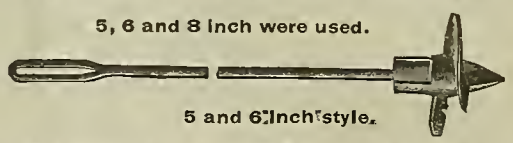


BARE AND INSULATED ELECTRIC WIRE,

ELECTRIC LIGHT LINE WIRE,
INCANDESCENT AND FLEXIBLE CORDS,
Railway Feeder and Trolley Wire,
AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR WIRES.
CABLES FOR AERIAL AND UNDERGROUND USE.

New York Store, W. J. Watson, 26 Cortlandt St.
Chicago Store, F. E. Donohoe, 82 Lake St.
Montreal Branch, Eugene F. Phillips' Electrical Works.
MAIN OFFICES AND FACTORIES, PHILLIPSDALE, R.I.

THE UNITED STATES GOVERNMENT
USED
The Stombaugh Guy Anchor
EXCLUSIVELY FOR
Anchoring Electric Light and Telephone Poles at Our Largest Military Post, Fort Riley, Kan.
5, 6 and 8 inch were used.



5 and 6 Inch Style.
W. N. MATTHEWS & BRO., Manufacturers
603 Carleton Building, St. Louis

Engineering MECHANICAL, ELECTRICAL, STEAM, CIVIL.
Complete and short courses. Thoroughly equipped engineering shops. Shop work from the beginning. Short courses in Steam and Electrical Engineering. Expenses low. Accommodations the best. School all year. Students may enter any time. Correspondence steam and electrical courses. Send for catalogue. Mention course in which interested.
HIGHLAND PARK COLLEGE, DES MOINES, IOWA.

M. KLEIN & SON.
Send 2c stamp for new catalogue No. 6 of
KLEIN'S TOOLS
For Electrical Workers and Line Builders.
MATHIAS KLEIN & SONS.
81 W. Van Buren St., Chicago, Ill.

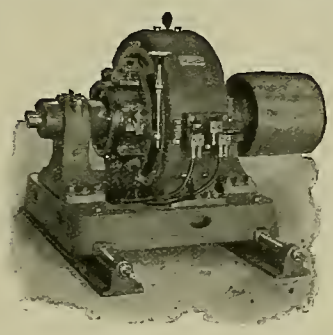
EXPERT IN ELECTRICITY MECHANICS PATENT CAUSES
SOLICITOR OF **PATENTS**
U. S. & FOREIGN
FORÉE BAIN, 1652-3 Monadnock Blk., CHICAGO

SINGLE AND POLYPHASE
TRANSFORMERS
KUHLMAN ELECTRIC CO., - - Elkhart, Ind.

KESTER
SELF FLUXING SOLDER
A Tube of Solder Filled with Flux.
Requires no Acid.
SAVES—LABOR—TIME—MONEY.

ACTUAL SIZE
PATENTED.
Send for Free Samples.
L. F. Mahler Co., R. 1008 Chemical Bldg., St. Louis, Mo., Gen. Western Agent.
KESTER ELECTRIC M'F'G CO.,
48 N. UNION STREET, CHICAGO, ILL

DIRECT CURRENT
GENERATORS
FOR LIGHT AND POWER



Our generators have a high efficiency and great endurance under the most exacting conditions of service. Sizes up to 1,000 K. W.
Write for bulletin No. 10514.
SPRAGUE
ELECTRIC COMPANY
General Offices:
527 West 34th Street, New York
Chicago Office: Fisher Building

SAUQUOIT SILK MFG. COMPANY
INSULATING and BRAIDING SILKS
MILLS:
BETHLEHEM, PA.
PHILADELPHIA, PA.
SCRANTON, PA.
NEW YORK REPRESENTATIVES:
WILLIAM RYLE & COMPANY.
54 Howard St.
PHILADELPHIA OFFICE:
4015 Clarissa St.
CHICAGO OFFICE:
210 Monroe St.
BOSTON OFFICE:
78 Chauncy St

Crimshaw

Raven White Core

Raven Black Core

ALL OUR WIRES pass inspection and carry the above TRADE-MARKS on our tags. We also manufacture Crimshaw and Competition Tapes and Splicing Compounds.

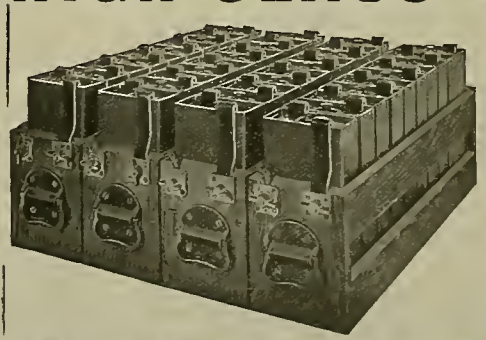
NEW YORK INSULATED WIRE COMPANY,

MAIN OFFICE: 114, 116 & 118 Liberty St., New York.
BRANCHES: CHICAGO: 192 Desplaines St. BOSTON: 7 Otis St. SAN FRANCISCO: 33 Second St.

NATIONAL CODE STANDARD

"O. K." Weatherproof Wire.
Slow-Burning Weatherproof and Ideal Wire.
Prices and Samples on Application.
Phillips Insulated Wire Co.
Office and Factory: PAWTUCKET, R. I.

HIGH CLASS WORK



is assured when you use the
NORTHWESTERN STORAGE BATTERY
on all low-tension work.
Great Capacity, Light, Efficient and Compact.
Send for catalogue. Let us figure with you.
Northwestern Storage Battery Co.,
285 Madison St., - - - Chicago, Ill.

WANTED, FOR SALE *and similar* **WANT COLUMN** *advertisements (50 words or less), $1.50 an insertion; additional words 3c each.*
POSITION WANTED *advertisements (50 words or less), $1.00 an insertion; additional words 2c each.*

POSITION WANTED.

As superintendent, chief engineer or electrician of lighting, or combined light and waterworks plant; 20 years' experience with boiler, high-speed and Corliss engines, and waterworks; 16 years in all branches of electric-lighting business. Would be pleased to correspond with anybody wishing a first-class mechanic and all around man. Address BOX 427, Care Western Electrician, 510 Marquette Building, Chicago, Ill.

POSITION WANTED.

By armature winder and repair worker on fields, commutators, generators, motors, etc.; electric rail oad preferred; experienced; best of references; married. Address BOX 428, care of Western Electrician, 510 Marquette Bldg., Chicago.

FOR SALE.

A bargain if taken at once. One 45 K. W., A.-C. dynamo, 1,100 volts, 16,000 alternations, single-phase toothed armature compound wound self-oiling bearings. In A-1 condition. Will be sold cheap if taken at once. Can be seen running until January 1st, 1905. BEMENT ELECTRIC LIGHT and POWER CO., Bement, Ill.

FOR SALE

On mortgage foreclosure, all property of the Corning Electric Light Plant, consisting of grounds, buildings, franchises, poles, lines, electric appliances, etc., located at Corning, Iowa, on main line of Chicago, Burlington & Quincy Railway. County seat town. Population, 2,500. Good proposition. Address M. E. WILMARTH, Trustee, Corning, Iowa.

FOR SALE.

A telephone system of 160 subscribers and 80 miles of toll lines. Located in county seat town of 1,500 inhabitants. System all new and up-to-date, only been in a year. Reason it's for sale is to settle an estate. Address, T. H. MINOR, Troy, Mo.

PROPOSAL

SANITARY DISTRICT OF CHICAGO TO CONTRACTORS

Sealed Proposals Addressed to the Board of Trustees of the Sanitary District of Chicago and Indorsed:

"Proposals for furnishing and installing alternating-current generators and generators for exciters" will be received by the clerk of the said Sanitary District at Room 1110 Security Building, Chicago, Ill., until 12 m. (standard time) of Wednesday, the 15th day of February, A. D. 1905, and will be publicly opened by said board of trustees at a meeting of the board held that day.

The generators for which tenders are invited consist of four 4,000-kilowatt, 6,600-volt, three-phase, 60-cycle generators, 164 revolutions per minute and two 350-kilowatt, 250-volt, direct-current generators, 300 revolutions per minute.

Each bid must be accompanied by a certified check or cash to the amount of three thousand ($3,000) dollars. All certified checks must be drawn on some responsible bank doing business in the city of Chicago and made payable to the order of the clerk of the Sanitary District of Chicago. Said amount of three thousand ($3,000) dollars deposited with bids will be held by the Sanitary District until all of the respective bids for said installation have been canvassed and the contract awarded and signed, the return of said check or cash being conditioned upon the appearance within ten (10) days after receiving notice of award to him of the bidder to whom the award of said work shall have been made, with bondsmen, and executing a contract with the Sanitary District for the work so awarded and giving a bond satisfactory to the board of trustees for the fulfillment of the contract for furnishing and installing the generators and exciters in the sum of fifty thousand ($50,000) dollars.

All bids must be made upon blank forms furnished by the Sanitary District.

No bid will be considered unless the party making it shall furnish evidence satisfactory to the board of trustees that he has constructed and has in successful operation generators of practically as large capacity as those called for by this advertisement and his financial ability successfully to prosecute the said contract in case the same shall be awarded to him.

Bidders are required to state in their bids their individual names and places of residence in full.

The said board of trustees reserves the right to reject any and all bids.

THE SANITARY DISTRICT OF CHICAGO.
By Zina R. Carter, President of its Board of Trustees.
Attest: S. D. Griffin, Clerk.
Chicago, Dec. 14, 1904.

ELECTRICAL BOOKS.

All Kinds.

ELECTRICIAN PUBLISHING COMPANY,
Suite 510 Marquette Bldg., CHICAGO

BOILERS.

One 42-in. x 16 ft. 9-in., 250 H. P. Worthington Water Tube.
One 60-in. x 16 ft., John Mohr Return Tubular Boiler.
One 54-in. x 16 ft., John Mohr Return Tubular Boiler.
One 54-in. x 16 ft., Devine Tubular Boiler.

ENGINES.

One 600 H. P., 21 x 36 x 30, Williams Tandem Horizontal Compound, 140 R. P. M.
Two 600 H. P., 20 x 30 x 24, Porter-Allen Tandem Compound, 200 R. P. M.
One 250 H. P., 12 x 24 x 18 Williams Tandem Compound, 250 R. P. M.
Two 100 H. P., 13 x 12, Dick & Church, High Speed Automatic.

PARTIAL LIST ONLY.

Send for latest Catalogue for bargains in Engines, Boilers, Dynamos and Motors.

CENTRAL STATION IMPROVEMENT CO., 938 Monadnock Block, Chicago

WORKS QUICK AND EASY. KEEPS ITS LUSTER. HOLDS OLD TRADE AND MAKES NEW. DOES NOT DETERIORATE. ESTABLISHED 15 YEARS. SOLD BY AGENTS AND DEALERS ALL OVER THE WORLD

U.S. METAL POLISH GEO. W. HOFFMAN

3 OUNCE BOX 10 CENTS. SAMPLES SENT FREE

POLISHES ALL METALS. BRANCHES, NEW YORK, CHICAGO, SAN FRANCISCO. 295 E. WASHINGTON ST. INDIANAPOLIS, IND.
HIGHEST AWARD, CHICAGO WORLD'S FAIR, 1893. LOUISIANA PURCHASE EXPOSITION 1904.

FOR SALE.

Central Station Equipments

One Plant Complete Consisting of the Following Principal Items:

BOILERS.

Six 200-h. p. Stirling water-tube boilers, equipped for Hawley down-draft furnaces.
Two 150-h. p. Stirling boilers, with plain grates.

HEATERS.

Two 250-h. p. Hoppes open heaters.
Two 400-h. p. Excelsior heaters.

PUMPS.

Two 7x4½x10 Laidlaw Dunn boiler feeders for 150 pounds' pressure.

ENGINES.

Three 250-h. p. Hall tandem compound engines, 15x25x16 inches, 200 revolutions.
Two 150-h. p. Porter-Allen engines, 14x20 inches, 230 revolutions.
One 150-h. p. Russell engine, 15x20 inches, 230 revolutions.
One 125-h. p. Hamilton Corliss, 16x30 inches, 90 revolutions.

GENERATORS.

Three 150-k. w. 250-volt Westinghouse generators. These generators directly connected to three 250-h. p. Ball engines.
Four 42.5-k. w. 125-volt Mather generators.
Four 37½-k. w. 250-volt Mather generators.
Four 37½-k. w. 125-volt Mather generators.

SWITCHBOARDS.

Two switchboards, with switches, measuring instruments, rheostats, etc., for control of above generators.

Another plant complete except boilers, consisting of the following principal items:

ENGINES.

Two Lane & Bodley Corliss engines, 24-inch diameter cylinders, 48-inch stroke, 70 revolutions.
Two Lane & Bodley Corliss engines, 30-inch diameter cylinders, 48-inch stroke, 70 revolutions.
Two Ball engines, cylinders 20-inch diameter, 18-inch stroke, 150 revolutions.
One Westinghouse vertical compound engine, with cylinders 16 inches and 26 inches x 18-inch stroke.
One Westinghouse vertical compound engine, with cylinders 18 inches and 30 inches diameter x 18-inch stroke.

GENERATORS.

Two Edison bipolar generators, 150 k. w., 500 volts.
Two C. & C. bipolar generators, 100 k. w., 500 volts.
One C. & C. bipolar generator, 30 k. w., 500 volts.
Two T.-H., alternating current, 133 cycles, 1,100 volts, 150 k. w.
Two Fort Wayne, alternating current, 133 cycles, 1,100 volts, 150 k. w.
Two Fort Wayne, alternating current, 133 cycles, 1,100 volts, 100 k. w.
Ten 100-light 9.6-ampere multiple circuit Brush arc machines.
One 60-light 9.6-ampere wood arc machine.

SWITCHBOARD.

Switchboard, with all switches, transformers, measuring instruments, etc., for control of above generators.

SHAFTING.

Two lines shafting, together with pedestal, bearings, clutches, pulleys, etc., used in connection with the large Corliss engines.

Both plants located in Cincinnati.
We will consider bids for all or any part of the above.
Bids must be made f. o. b. Cincinnati.

The Cincinnati Gas & Electric Co.

Our Compound Stops Sparking and Saves Commutators.

14 Years' Use on Street Ry., Light and Power Commutators Has Proven its Worth. WE GUARANTEE RESULTS.

Send Your Address for FREE SAMPLE THAT CONVINCES.

JAS. McLAUGHLIN & CO., ELECTRICAL ENGINEERS
586 Fulton Street, - - Chicago, Ill.

PRESERVE YOUR COPIES

OF THE

WESTERN ELECTRICIAN

BINDERS $1.00 EACH.

ELECTRICIAN PUBLISHING CO.,
Suite 510 Marquette Building, - - - CHICAGO.

BIDS

will be received by the city of Anadarko up to and including January 2, 1905, for a complete electric-lighting plant consisting of 150 K. W. 200 H. P. engine necessary pole line, transformers, arc lights, etc. Address communications to CONSULTING ENGINEER, Anadarko, Okla.

FOR SALE

1-360 K. W.	General Electric	Alternator,	Three Phase		
1-240 "	Westinghouse	"	Single	"	
2-150 "	Warren	"	"	"	
1-150 "	Westinghouse	"	"	"	
1-150 "	Wood	"	"	"	
1-150 "	Stanley	"	"	"	
1-120 "	General Electric	"	Three	"	
1-120 "	General Electric	"	Single	"	
1 120 "	Westinghouse	"	"	"	
1- 90 "	General Electric	"	"	"	
1- 75 "	Westinghouse	"	Two	"	
1- 75 "	Westinghouse	"	Single	"	
1- 75 "	Westinghouse	"	Two	"	

Direct connected to Gates' Engine.

Send for our **Monthly Bargain Sheet** with complete list and net prices.

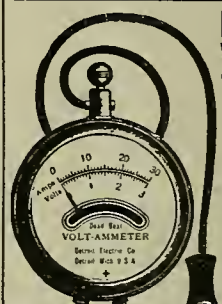
GREGORY ELECTRIC CO.
54-62 S. Clinton St., Chicago, Ill.

FACTORY
FOR SALE

near CHESTER, PA., WITH DEEP WATER FRONT ON DELAWARE RIVER and intersected by three TRUNK LINES and two trolley lines; extensive buildings, Foundry, Machine Shop, etc., with traveling cranes and machinery, and well adapted for any kind of heavy business; abundance of cheap labor of all kinds in the immediate vicinity. Large engines, boilers, electric plant; good water supply and sewerage.

For full particulars apply to

NICHOLSON & CO.,
SOLE AGENTS.
150 BROADWAY, NEW YORK,
REAL ESTATE AND FACTORY BROKERS.



Robert Volt-Ammeter

Dead Beat
Accurate, Durable
Guaranteed

List Price, $6.00 including leather case.

Sample instrument forwarded prepaid on receipt of $4.50.

Discount to Dealers

THE ROBERT INSTRUMENT CO
56 Shelby Street
DETROIT - MICH.

"A great deal in a little space."
—*The Press.*

"THE FOUR-TRACK SERIES"

This is the title of a series of books of travel and education issued by the Passenger Department of the

NEW YORK CENTRAL LINES

These small books are filled with information regarding the best modes of travel and the education that can best be obtained by travel.

They relate specifically to the great resorts of America — to trips to the islands of the sea and around the world.

They also contain numerous illustrations and new and accurate maps of the country described.

A copy of the 40-page Illustrated Catalogue of the "Four Track Series" will be sent free, postpaid, upon receipt of postage stamp by George H. Daniels, General Passenger Agt., New York Central & Hudson River Railroad, Grand Central Station, New York.

CHICAGO EDISON COMPANY REPAIR SHOPS

76 MARKET STREET, CHICAGO. TELEPHONE MAIN 1280.

Machine and Carpenter Work of All Kinds
Correspondence Solicited.

OPEN DAY AND NIGHT.

FIRST-CLASS EQUIPMENT THROUGHOUT.

Dynamos Armatures, Motors, Arc Lamps, Fans, Instruments.

ARNOLD ELECTRIC POWER STATION Co.
Engineers, Constructors for Complete Electric Plants. Results Guaranteed.
SUITE 1539, MARQUETTE BLDG., CHICAGO. NEW YORK OFFICE: 711 TRANSIT BLDG.

BYLLESBY, H. M. & Co.
(Incorporated)
ENGINEERS
Design, Construct and Operate Railway, Light, Power and Hydraulic Plants.
Examinations and Reports.
New York Life Building, CHICAGO, ILL.

J. H. HALLBERG
Consulting Engineer
Electric Light, Power and Railway Plants
Suggestions to secure Economy, Specifications, Examinations and Reports
45 Broadway, NEW YORK
Long Distance Telephone 4578 Broad

RUEBEL - SCHWEDTMANN-WELLS,
CONSULTING, MECHANICAL AND ELECTRICAL ENGINEERS,
Suite 801 Chemical Building, ST. LOUIS, U. S. A.

F. B. BADT,
Monadnock Chicago

EVANS, ALMIRALL & CO.,
Central Station Heating, High Pressure Piping.
1057 Monadnock Blk., Chicago.

ROBERT W. HUNT & Co.,
ENGINEERS
1121 The Rookery, Chicago. 66 Broadway, New York.
Monongahela Bank Bldg., Pittsburg.
Norfolk House, Cannon St., London.

Long Distance Phone Central 2443.
SCHOTT, W. H.,
ENGINEER AND CONTRACTOR,
SPECIALTIES—Central Station Heating Plants, Water Works Steam Plants, Electric Light, Gas and Street Railway Plants.
1220-21 MARQUETTE BUILDING, CHICAGO.

W. E. BAKER. H. B. BISHOP.
BAKER, W. E. & CO.
ENGINEERS,
ELECTRIC RAILWAYS.
27 William St., NEW YORK.

TRY IT. Keep your name and address in this directory where it will be seen by possible clients.

IT WILL PAY
engineers not represented in this department to carry a card regularly.

TRY IT.
Keep your name and address in this directory where it will be seen by possible clients.

ENGINEERS
Represented in this "Directory" are enabled to come in touch with many prospective customers who cannot be reached through any other source.

E. W. Hammer, Pres. and Treas. H. J. Minhinnick, Sec. and Gen'l Sup't.
GENERAL ENGINEERING Co., THE
Consulting and Contracting Engineers.
Telephones, Electric Light, Power Transmission
Suite 1112, 135 ADAMS ST., CHICAGO.
Long Distance Telephone Central 473.

KEMP, R. W.
Consulting and Contracting Telephone Engineer.
Plans and Specification for complete plants. Old plants overhauled and placed on paying basis. Territory, Kansas, Oklahoma and Indian Territory.
WELLINGTON, - - - KANSAS.

STANTON, LE ROY W.
Consulting Telephone Engineer
Plans, Specifications and Supervision of Installation of Complete Telephone Plants
Special Reports on Telephone Properties and Apparatus
411 Electrical Bldg., Cleveland, Ohio

BRYAN, WILLIAM H.
M. Am. Soc. M. E.,
Consulting Mechanical and Electrical Engineer.
Lincoln Trust Building, ST. LOUIS.

A WEEKLY REPRESENTATION
in this "Directory" enables engineers to keep before all possible customers.

KOHLER BROS.,
Contracting Electrical Engineers, Lighting Power Railways,
1804-1806-1808-1810-1812 Fisher Building, CHICAGO.

Telephone Main 3123.
WILMERDING, C. H.
CONSULTING ENGINEER
1100 Old Colony Bldg., CHICAGO.

DUGALD C. JACKSON, C. E.
WILLIAM B. JACKSON, M. E.
MEMBERS
AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS
AMERICAN SOCIETY OF MECHANICAL ENGINEERS
AMERICAN SOCIETY OF CIVIL ENGINEERS
ENGINEERS. EXPERTS.
MADISON, WIS.

Reports and Estimates Furnished.
General Contractors
High-Grade Securities Accepted or Negotiated.

W. R. EVANS & COMPANY
Incorporated
Electrical, Civil and Mechanical Engineers
Telephone Main 3153 Traction Bldg., Cincinnati

REPAIRING
RECALIBRATING
ELECTRIC METERS.
INTERNATIONAL ELECTRIC METER CO.
167 S. CANAL STREET. CHICAGO.

BARGAINS IN SHELF-WORN BOOKS

You may have been looking for some of these volumes for years. Now you can get them and get them at a bargain, too.
We have only one or two copies of each of the following:

	List Price	Sale Price
ELECTRICITY AS A MOTIVE POWER, by Count Th. du Moncel, London, 1883..	$3.00	$1.80
DECORATIVE ELECTRICITY, by Mrs. J. E. H. Gordon, London, 1891.....	2.50	1.50
ELECTRICAL APPLIANCES OF THE PRESENT DAY, by Major D. P. Heap, U. S. A., being a report of the Paris Electrical Exhibition of 1881.....	2.00	1.20
TABLES AND MEMORANDA FOR ELECTRICAL ENGINEERS, by Frederick Walker, C.E.	.80	.45
MAGNETISM AND ELECTRICITY, by R. Wormell	1.25	.75
STEAM HEATING DATA, by Wm. J. Baldwin, N. Y., 1897.....	.50	.30
THE TELEGRAPHIST'S GUIDE: THE NEW EXAMINATIONS OF TECHNICAL TELEGRAPHY, by Jas. Bell, A. I. E. E., London, 1895	.50	.30
THE MECHANICAL ARTS SIMPLIFIED, by D. B. Dixon, Chicago, 1897.....	2.50	1.60
ELECTRIC LIGHTING, translated from the French of Count du Moncel, by Roht. Routledge, B. S. C., London, 1883...	1.25	.75
THE ARITHMETIC OF THE STEAM ENGINE, by E. Sherman Gould, N. Y., 1897	1.00	.60
TIPS TO INVENTORS, by Robt. Grimshaw, Ph. D., N. Y., 1893.....	1.00	.60
MECHANICAL GRAPHICS, by Geo. Halliday, London, 1889	2.00	1.20
PHYSICAL UNITS, by Magnus Maclean, D. Sc.	1.00	.60
THE INDICATOR AND DYNAMOMETER, by Thos. J. Main, M. A., Philadelphia, 1883	1.50	.90
HOW TO WORK AND FIX A DYNAMO-ELECTRIC MACHINE, by W. C. Mountain..	.35	.20
THE INDICATOR HANDBOOK, by Chas. N. Pickworth	.75	.45
THE HISTORY AND PROGRESS OF THE ELECTRIC TELEGRAPH, by Robt. Sabine, C. E., London, 1869. Cloth...	1.25	.75
Paper	.75	.25
LOCAL DISTRIBUTION OF ELECTRIC POWER IN WORKSHOPS, by Ernest Kilburn Scott, A. I. E. E.	.50	.30
BEARINGS AND LUBRICATION, by A. J. Wallis-Taylor, C. E.	1.50	.90
FIRST PRINCIPLES OF MECHANICAL ENGINEERING, by Imray & Biggs, London	1.00	.60

	List Price	Sale Price
ELECTRICITY IN OUR HOMES AND WORKSHOPS, by Sidney F. Walker, London, 1889	1.50	.90
ELECTRICITY IN THE SERVICE OF MAN, by R. Wormell, D. Sc., M. A., New York, 1886	$3.00	$1.80
THE MATHEMATICAL THEORY OF ELECTRICITY AND MAGNETISM, by Watson & Burbury, London, 1885. Vol I, Electrostatics	2.75	1.65
Vol. II, Magnetism and Electrodynamics	2.60	1.60
CHAPTERS ON ELECTRICITY, by Samuel Sheldon, Ph. D.	1.10	.65
ELECTRICITY, ITS THEORY, SOURCES AND APPLICATION, by John T. Sprague, London, 1892	6.00	3.60
MAGNETISM AND ELECTRICITY, by H. C. Tarn, M. C. P., London, 1889.....	.80	.45
ELECTRICITY UP TO DATE, by John B. Verity, M. I. E. E., London, 1896..	1.00	.60
TELEGRAPHY, by W. H. Preece and J. Sivewright, London, 1888.....	2.00	1.20
ELECTRICITY AND THE ELECTRIC TELEGRAPH, in two volumes, by Geo. B. Prescott, New York, 1888.....	7.00	4.20
USEFUL RULES AND TABLES, relating to Mensuration, Engineering, Structures and Machines, by Wm. John Macquorn Rankine, London, 1889.....	4.00	2.40
ELECTRICITY AND MAGNETISM, by Francis Nipher, A. M., St. Louis, 1895..	3.25	2.00
THE ACTION OF LIGHTNING, by Arthur Parnell, London, 1882.....	3.00	1.80
MODERN AMERICAN METHODS OF COPPER SMELTING, by Edw. Dyer Peters, Jr., M. E., New York, 1891.....	5.00	3.00
THE STEAM-BOILER CATECHISM, by Robt. Grimshaw, M. E.	2.00	1.20
THE STEAM-ENGINE CATECHISM, by Robt. Grimshaw, M. E., New York, 1896	2.00	1.20
ELECTRICAL PAPERS, Vols. I and II, by Oliver Heaviside, New York, 1894..	7.00	4.20
A GUIDE FOR THE ELECTRICAL TESTING OF TELEGRAPH CABLES, by Col. V. Hoskiaer, London, 1889.....	1.50	.90
SOLUTIONS OF THE QUESTIONS IN MAGNETISM AND ELECTRICITY, set at the Intermediate Science and Preliminary Scientific Pass Examinations of the University of London, 1860 to 1884, by F. W. Levander, London, 1885....	1.00	.40

	List Price	Sale Price
DOMESTIC ELECTRICITY FOR AMATEURS, translated from the French of E. Hospitaller, London, 1889.....	$2.50	$1.50
FOUR LECTURES ON STATIC ELECTRIC INDUCTION, by J. E. H. Gordon, B. A., New York, 1881.....	.80	.45
CONSTRUCTION OF MILL DAMS, Jas. Leffel & Co., Springfield, O., 1874.....	2.50	1.00
A PRACTICAL TREATISE ON ELECTRIC LIGHTING, by J. E. H. Gordon, B. A., New York, 1884.....	4.50	2.70
GRAY'S TREATISE ON MAGNETISM AND ELECTRICITY, Vol. I, by Andrew Gray, LL. D., F. R. S., London, 1898	4.50	2.70
ELECTRICITY, by Robt. M. Ferguson, Ph. D., F. R. S. E., London, 1890...	1.50	.90
COIL AND CURRENT, OR THE TRIUMPHS OF ELECTRICITY, by Henry Frith, London, 1897.....	1.25	.75
A CENTURY OF ELECTRICITY, by T. C. Mendenhall, Cambridge, 1887.....	1.25	.75
MAGNETISM AND ELECTRICITY, by Arthur Wm. Poyser, M. A., London, 1890...	.80	.45
POTENTIAL AND ITS APPLICATION POPULARLY TREATED, by Dr. Tumlirz, London, 1889.....	1.50	.90
CONTINENTAL ELECTRIC LIGHT CENTRAL STATIONS, Killingworth Hedges, London, 1892	6.00	3.60
THEORY OF ELECTRICITY, by Linæus Cumming, M. A., London, 1885.....	2.25	1.35
ELECTRICITY TREATED EXPERIMENTALLY, by Linæus Cumming, M. A., London, 1891	1.50	.90
POPULAR ELECTRIC LIGHTING, by Capt. E. Ironside Bax, London, 1892.....	1.00	.60
THE AGE OF ELECTRICITY, by Park Benjamin, New York, 1892.....	2.00	1.20
THE LAW RELATING TO ELECTRIC LIGHTING, by G. Spencer Bower, B. A., London, 1889	5.00	3.00
MATHEMATICAL THEORY OF THE STEAM ENGINE, by T. Baker, C. E., London, 1890	.75	.45
ELEMENTARY TREATISE ON NATURAL PHILOSOPHY, by A. Privat Deschanel, Part 3, Electricity and Magnetism, New York, 1893	1.50	.90
ELECTRICITY IN MODERN LIFE, by G. W. De Tunzelmann, London, 1889.....	1.25	.75

ELECTRICIAN PUBLISHING CO., 510 MARQUETTE BLDG., CHICAGO

BITUMINIZED FIBER CONDUIT

FOR UNDERGROUND CONSTRUCTION

Bituminized Fiber Conduit is made with the idea of combining the good and eliminating the bad features of other conduits, and incorporating valuable features not found in other ducts. Testimonials, which we are getting from users, point to the fact that we have succeeded.

American Conduit Co.

Main Offices: 1005-6 Manhattan Building, Chicago

Other Offices:

170 Broadway, New York. 336 Macy St., Los Angeles.

TELEPHONE PRINCIPLES AND PRACTICE

A NEW BOOK IN TELEPHONY

By

GEORGE WALKER WILDER, PH. D.

Professor in Telephony in the Armour Institute of Technology

Complete and up-to-date, written by a practical man. All about modern telephone apparatus, their principles and use:

I. Fundamental Ideas
II. Telephone Apparatus
III. Systems of Communication
IV. Construction and Equipment

IN 32 CHAPTERS, 460 PAGES, 375 ILLUSTRATIONS. PRICE $2.00 POSTPAID.

Send Postal Money Order to

THE CANTWELL PRESS - Madison, Wis.

AMERICAN ELECTRIC TELEPHONE CO.

LARGEST MANUFACTURERS

This Company Sends Prepaid upon request any of the following bulletins:

Bulletin No. 7—Combined Telephone and Switchboard
" " 8—Wall Switchboard
" " 9—Samson Telephone
" " 10—American Express Switchboards
" " 11—Desks — Toll and Private Branch
" " 12—Visual Signal and Bell Style Switchboards
" " 13—Intercommunicating Systems
" " 14—Line Material and Supplies
" " 15—Bell Express Self-Restoring Switchboards
" " 16—Operator's Set and Accessories
" " 17—Parts of Apparatus
Bulletin No. 18—Magneto Telephones of All Kinds
" " 19—Central Energy Switchboards
" " 20—Central Energy Telephones
" " 21—Protective Apparatus and Terminal Equipment
" " 22—Construction of Country Telephone Lines
" " 23—Eight-Party Selective Ringing Telephones
" " 24—Composite Telephone and Telegraph Lines
" " 25—Four-Party "Leich" Selective Telephone System
" " 26—Telephone Power and Ringing Equipment

CHICAGO, ILL., U. S. A.

THE TELEPHONE HAND-BOOK

NEW AND REVISED EDITION, WITH A NEW CHAPTER ON "RECENT PROGRESS," BRINGING THE BOOK UP TO DATE.

BY HERBERT LAWS WEBB.

Member of the American Institute of Electrical Engineers, and of the Institution of Electrical Engineers, London. Author of "A Practical Guide to the Testing of Insulated Wires and Cables." Joint Author of "Electricity in Daily Life."

160 Pages, 133 Illustrations, Cloth, Hand-Book Size, Price $1.00.

Extract from Preface.—"This little book has no pretension to be considered a complete treatise on telephony as it exists in America. The time for such a work is not yet come. But it is felt that there is a demand for a practical book on telephone working and management, and the TELEPHONE HAND-BOOK is an attempt at meeting that demand. With the exception of a few chapters dealing with certain forms of transmitters and receivers used in Europe, which are given for the information of those who may wish to engage in the manufacture of telephones, the book is based entirely on standard American practice; and most of the material, apparatus and methods described are peculiar to or have originated in this country."

No pains have been spared to make it the best book of its kind. It is right up to date, intensely practical, and so plain and clear in its language that anyone can understand and learn from it everything regarding telephone work and management. It conforms in size and style to our other Hand-Books which have been so favorably received by the entire electrical fraternity.

CONTENTS

CHAPTER 1. The Invention of the Telephone.
2. Sound Waves. Articulate Speech.
3. Electric Telephony. The Bell Telephone.
4. The Microphone.
5. Current Induction. Electromagnetic Induction.
6. The Induction Coil: Its Use in the Telephone Transmitter.
7. The Complete Telephone Circuit.
8. Magnet Telephones.
9. The Bell Telephone Receiver.
10. Other forms of Magnet Telephones.
11. The Gower, Ader and D'Arsonval Receivers, Mercadier's Bi-Telephone.
12. The Siemens, Kotyra, Neumayer and Böttcher Receivers.
13. Carbon Transmitters.
14. The Blake Transmitter.
15. The Long Distance Transmitter.
16. The Solid-back Transmitter.
17. The Berliner Transmitter.
18. The Cuttriss Transmitter.
19. Various European Transmitters.
20. The Efficiency of Carbon Transmitters.
21. Batteries for Telephone Work.
22. Open Circuit Batteries.
23. Closed Circuit Batteries.
24. The Practical Management of Batteries.
25. Magneto Bell.
26. Automatic Switches.
27. Telephone Line Construction.
28. Metallic Circuit.
29. Underground Wires
30. Lightning Arresters.
31. Inside Wiring.
32. Installation of Telephone Instruments.
33. Inspection and Maintenance.
34. The Condenser; Its Use in Telephony.
35. Electromagnetic Retardation.
36. Exchange Working.
37. Small Exchanges.
38. Party Lines: The Bridging Bell.
39. Long Distance Telephony.
40. Duplex Telephony.
41. Simultaneous Telegraphy and Telephony.
42. Recent Progress. Appendix.

Published and for sale by ELECTRICIAN PUBLISHING CO., 510 Marquette Building, Chicago

EDISON PRIMARY BATTERIES

FORMERLY EDISON-LALANDE

These batteries are simple in construction and can be easily and quickly renewed. The renewal parts and supplies are inexpensive and readily obtained. You would appreciate this if you could read the description of Battery Renewals in our catalogue No. 7. May we not send it?

TRADE Thomas A Edison MARK

EDISON MFG. CO.

Factory, ORANGE, N. J.

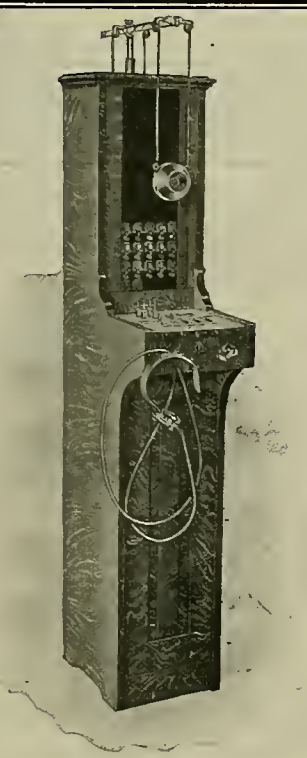
NEW YORK: 83 Chambers Street

CHICAGO: 304 Wabash Avenue

Kellogg Express Switchboard Cabinet

The graceful Appearance comes from Simple Lines.

This Attractive Design has been so popular that it has been much copied by other manufacturers



Fifty-Line Capacity Quarter Sawed Oak for the entire Exterior of the Cabinet

Thoroughly seasoned wood

Finished in Light or Golden Oak

Gold Medal Highest Award Buffalo Exposition 1902

Grand Prize Highest Award St. Louis Exposition 1904

The Strongest, Longest Lived, Most Efficient Switchboards made. All telephone experts will tell you that.

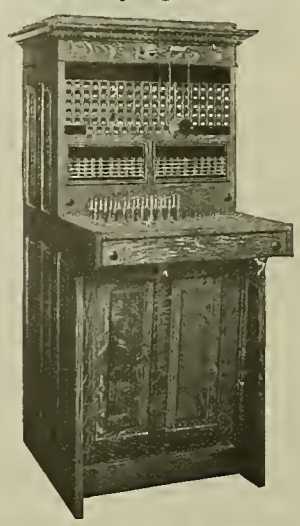
Kellogg Switchboard & Supply Co.
Congress & Green Streets
CHICAGO
LOS ANGELES CLEVELAND PHILADELPHIA

STROMBERG-CARLSON

GENERATOR-CALL
VISUAL SIGNAL SWITCHBOARDS

are inexpensive to maintain and nearly as rapid as a lamp signal switchboard.

SIGNALS SELF-CONTAINED



NO WORKING PARTS EXPOSED

This illustrates our No. A-1249 cabinet equipped with 100 line signals and 10 clearing-out signals. Our standard cabinets have a capacity for 50, 60, 70, 100, 140, 180 and 200 line signals of the above type.

Bulletins No. 6 and 7-E describe these boards very thoroughly. Mailed free upon request.

STROMBERG-CARLSON TELEPHONE MFG. CO.,
GENERAL OFFICES, ROCHESTER, N. Y.
WESTERN SALES OFFICE, CHICAGO, ILL.

AS SIMPLE AS ITS NAME.

A B C
—OF—
THE TELEPHONE

By J. E. HOMANS, A. M.
352 pages.
Cloth, Price $1.00.

An up-to-date, practical treatise on the construction, theory, installation, care and management of telephones and their appliances.
Sent prepaid on receipt of price.

Electrician Publishing Co.,
510 Marquette Building, Chicago, Ill.

INTERNATIONAL
Mechanical Self-Restoring Drop Switchboard.

A PERFECT APPARATUS.
Made in any desired capacity.
Sample parts and quotations on request.

INTERNATIONAL TELEPHONE MANUFACTURING CO.
CHICAGO, U. S. A.

DON'T BUY ELECTRICAL SUPPLIES

Until you have seen our new Catalogue and new Price List.
Free to the trade.

Manhattan Electrical Supply Co.
NEW YORK: 32 Cortlandt St.
CHICAGO: 188 Fifth Ave.

Practical Running of Dynamos.

A little booklet on the care and the locating and remedying of troubles in dynamos and motors.

Price, 10 Cents.

Catalogue of mechanical and electrical books free.

ELECTRICIAN PUBLISHING COMPANY.
510 Marquetta Bldg., Chicago.

THE AUTOMATIC

is the recognized competitive system of telephony. Its manifold advantages over the manual system, mechanically, financially and commercially, make it so. Automatic telephone service is more prompt and more accurate and absolutely secret. It can be furnished at less cost to both company and patrons than any other. Progressive Independent telephone companies all over the country are rapidly adopting it; the new ones in preference to manual and the old ones to replace manual equipment. It is a success everywhere.

Among the cities in which it has been adopted are:

Chicago, Ill.
Grand Rapids, Mich.
Columbus, Ohio
Dayton, Ohio
Lincoln, Neb.
Portland, Maine
Auburn, N. Y.
Lewiston, Maine
Auburo, Maine
Fall River, Mass.
New Bedford, Mass.
Los Angeles, Cal.
San Diego, Cal.
Hopkinsville, Ky.
Sioux City, Iowa
Cleburne, Texas
Columbus, Ga.
Augusta, Ga.
Medford, Wis.
St. Mary's, Ohio
Woodstock, N. B.
Westerly, R. I.
Berlin Germany
Manchester, Iowa
Princeton, N. J.
Albuquerque, N. M.
Van Wert, Ohio
Battle Creek, Mich.
Clayton, Mo.
Pentwater, Mich.
Toronto Junction, Can.
Wilmington, Del.
Riverside, Cal.
Traverse City, Mich.

AUTOMATIC ELECTRIC COMPANY
Van Buren and Morgan Streets, CHICAGO, U. S. A.

PRODUCERS AND WHOLESALERS OF WHITE CEDAR PRODUCTS

CEDAR POLES

YARDS
KOSS MICH.
L'ANSE "
MUNISING "
ONTONAGON
WAGNER, WIS
PESHTIGO "

SPECIAL PRICES ON SMALL POLES.
Write for a copy of our TELEGRAPH CODE FOR CEDAR PRODUCTS

C. H. WORCESTER CO.
SUITE 1206 TRIBUNE BLDG. CHICAGO.

FREE CHRISTMAS DINNERS
for
10,000
of Chicago's
Poor
will be supplied by the Salvation Army. Will you help by sending a donation, no matter how Small to the
Salvation Army
CHICAGO
Headquarters
399 State Street
Chicago, Ill.

CEDAR POLES

ESTABLISHED 1862
WM. MUELLER COMPANY
1211-12-13 MARQUETTE BLDG. CHICAGO.
EIGHT DISTRIBUTING YARDS

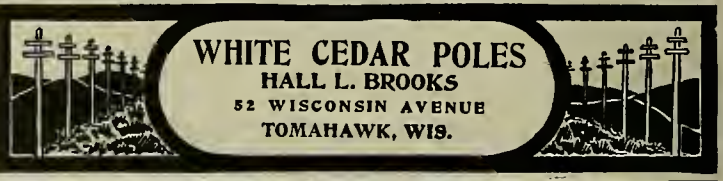
"MANROSS"
HAIR SPRINGS
For Electric Indicating and Recording Gauges, Steam Gauges, Etc

LARGEST MANUFACTURER OF
HAIR SPRINGS in the United States.
F. N. MANROSS,
FORESTVILLE, CONN.

Cedar Poles.

Pittsburg and Lake Superior Iron Co. Producers and Wholesalers. Escanaba, Mich.

MICHIGAN AND WESTERN CEDAR POLES
ALL LENGTHS AND SIZES
LINDSLEY BROS CO.
TRIBUNE BLDG., CHICAGO



WHITE CEDAR POLES
HALL L. BROOKS
52 WISCONSIN AVENUE
TOMAHAWK, WIS.

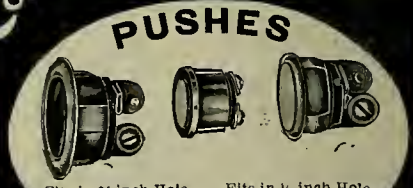
CEDAR POLES, POSTS, TIES,
H. M. LOUD'S SONS CO., Au Sable, Mich.

FACTORIES WANTED
ALONG THE
BURLINGTON ROUTE
to supply the demand
for Electrical Goods.

Burlington Route
N 548

W. H. MANSS.
INDUSTRIAL COMMISSIONER,
209 ADAMS STREET, CHICAGO.

EDWARDS AND CO.
New York, N.Y. U.S.A.



PUSHES
Fits in ¾-inch Hole. Fits in ⅞-inch Hole
Fits in ⅝-inch Hole.
No screws needed to fasten them as the spring clips hold them securely in place.
WESTERN ELECTRIC CO., SELLING AGENTS

There is No Higher-Class India-Rubber Insulation
For Wires and Cables than

HABIRSHAW.

Authorized Manufacturers of the
ATTIX FLEXIBLE TUBE WIRE.

The India-Rubber and Gutta-Percha Insulating Co.,
MAIN OFFICE, Glenwood Works,
YONKERS, N. Y.

Sales Office,
15 Cortlandt St., New York.

(10923)

MICHIGAN WHITE
CEDAR POLES
LARGE STOCK.
PROMPT SHIPMENTS. KELLOGG SWITCHBOARD & SUPPLY CO., Chicago.

JUST RECEIVED a new batch of 20 and 25 ft. Poles and have reduced prices accordingly. Also, we have plenty of those "Trolley" Ties yet. May we quote you now?

MALTBY CEDAR COMPANY, 509 Phoenix Block, Bay City, Michigan
Pittsburg Agents: Tipper & Patton, 509 Bessemer Bldg.

POLES. WHITE CEDAR. IDAHO CEDAR up to 80 ft.
BERTHOLD & JENNINGS, ST. LOUIS. Chemical Building.
CROSS ARMS. LONG LEAF PINE AND FIR.

Poles and Ties
The Fowler Companies
TRADE MARK
Fisher Bldg. Chicago

Locations for Industries
Erie Railroad
Chicago to New York

The Erie Railroad Company's Industrial Department has all the territory traversed by the railroad districted in relation to resources, adaptability, markets and advantages for manufacturing, and can advise with manufacturers in relation to the most suitable locations. For full information address

LUIS JACKSON
Industrial Commissioner, Erie Railroad Company
21 Cortlandt Street, New York

POLES, TIES, POSTS. THE PORTER CEDAR CO., SAGINAW, MICH.
PRODUCERS. We want your inquiries always.

Idaho Cedar Poles
PACIFIC COAST POLE CO. SPOKANE, WASH.

CEDAR POLES
THE
Valentine-Clark Co.
234 La Salle Street, CHICAGO
YARDS: Pinconning, Mich. : Green Bay, Wis. : New London, Wis.

ELECTRICAL AND OTHER **INDUSTRIES** ARE **OFFERED LOCATIONS** WITH
Satisfactory Inducements,
Favorable Freight Rates,
Good Labor Conditions,
Healthful Communities,
ON THE LINES OF
THE ILLINOIS CENTRAL R. R.
AND THE
YAZOO & MISSISSIPPI VALLEY R. R.
For full information and descriptive pamphlet address
J. C. CLAIR,
Industrial Commissioner
1 Park Row, Chicago, Ill.

POLES W. C. STERLING & SON, MONROE, MICH. Eleven Pole Yards in Michigan. Wholesale Producers for 20 years. **TIES.**

Southern Cedar **POLES** Are the Best.
NO ROTTEN BUTTS.
D. W. PHELAN,
277 Broadway, New York

SPEER HIGH GRADE CARBON BRUSHES
MOTOR AND GENERATOR CARBON BRUSHES
SPEER CARBON CO., - St. Marys, Pa.

BRACKETS—X ARMS—PINS
little things it is true, but they cut a big figure in line construction.
OUR MOTTO IS:
Prompt Shipment Quality Satisfaction Right Price
COLUMBIA MFG. CO. ANTIGO, WIS.

Cedar TORREY CEDAR CO., CLINTONVILLE, WIS. **Poles**
Large Stock Constantly on Hand

CENTRAL STATION HEATING

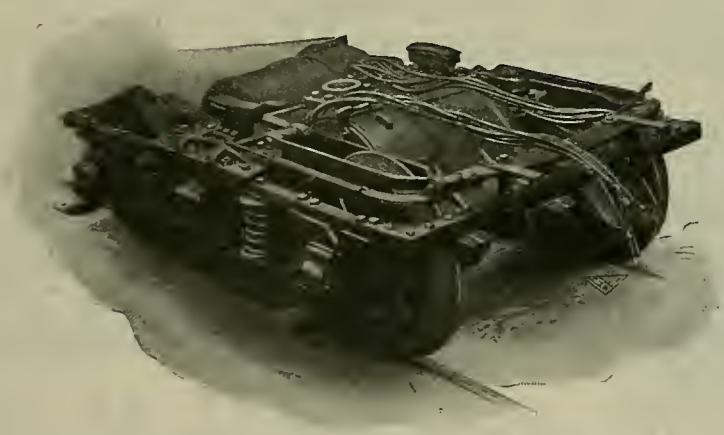
We are the originators and builders of the underground system of live and exhaust steam heating. Our system is used for the utilization and distribution of exhaust steam from electric and power plants for heating purposes. 250 Plants in successful operation. We have the only Meter System. Also manufacturers of Wooden Water Pipe, Steam Pipe Casing, Steam Traps, Condensation Meters, Valves, Economizing Coils, Separators and full line of Steam Fitters' Supplies.

WRITE FOR PAMPHLET AND PRICE LIST

AMERICAN DISTRICT STEAM COMPANY
MENTION WESTERN ELECTRICIAN. LOCKPORT, N.Y. CHICAGO, ILL.

The Westinghouse Single-Phase Railway System

100 H. P. Westinghouse Single-Phase Railway Motor.



A Pair of 100 H. P. Westinghouse Single-Phase Railway Motors, Mounted on Standard Truck.

Advantages

Generating and distributing systems cheapest to install.

Existing lines operated by direct current can be easily and economically converted.

Only one charged conductor used.

The controlling apparatus simpler than that of direct-current system.

Conversion losses are reduced and consequent economy in energy effected.

For particulars address nearest office of

Westinghouse Electric & Mfg. Co.

Pittsburg, Pa.

New York, Atlanta, Dallas, Baltimore, Boston, Buffalo, Chicago, Cincinnati, Cleveland, Detroit, Los Angeles, Minneapolis, New Orleans, Philadelphia, Pittsburg, St. Louis, Salt Lake City, San Francisco, Syracuse, Seattle, Denver, Mountain Electric Co.

For Canada: Canadian Westinghouse Co., Limited, Hamilton, Ontario. Mexico: G. & O. Braniff Co., City of Mexico.

DUNCAN

DIRECT CURRENT

WATTMETERS

Most Sensitive
Most Accurate
Most Reliable

WRITE FOR BULLETIN AND PRICES

DUNCAN ELECTRIC MFG. CO.

LAFAYETTE, IND.

Just Out!

WESTERN ELECTRICIAN'S
MOONLIGHT SCHEDULE
FOR 1905.

10 Cents Per Copy
Discount on Large Orders.

ELECTRICIAN PUB. CO.,
510 Marquette Building, CHICAGO.

LARGE POWER GENERATORS

DIRECT-CONNECTED
DIRECT-CURRENT

Direct-Connected Generator, Type M. P. L. 10-400-120

All true engineers say that symmetry of form is a strong indication of theoretically correct design.

The outward appearance of Fort Wayne apparatus is but the reflection of inherent excellence of design and construction.

FORT WAYNE ELECTRIC WORKS

Wood Systems

Main Office and Factory, - Fort Wayne, Indiana

165

HENRY NEWGARD & CO.

ELECTRICAL CONSTRUCTION

Power and Light Plants. Switchboards and Panel Boards.

We install Municipal and Isolated Electric Lighting Plants.
We manufacture Switchboards, Table boards, Iron Cutout Boxes and Electrical Specialties.
We sell Dynamos, Motors and Electrical Supplies.
We wire old as well as new Residences, Factory Buildings, School and College Buildings.

87 Fifth Avenue, Chicago, Illinois.

WIRES AND CABLES

HIGH-GRADE, RUBBER-COVERED, WEATHER-PROOF
MAGNET, OFFICE, ANNUNCIATOR WIRE.
HAZARD MANUFACTURING CO.,
GENERAL OFFICE AND WORKS, Wilkesbarre, Pa. NEW YORK OFFICE, 50 Dey St. CHICAGO OFFICE, 71 and 73 West Adams St.

VULCANIZED FIBRE

Highest grades for electrical insulation and mechanical purposes, in sheets, tubes, rods and special shapes. Catalogues and samples on application.

VULCANIZED FIBRE CO., - Wilmington, Del.

KARTAVERT.

HARD AND FLEXIBLE FIBER IN SHEETS, RODS AND TUBING.

For Electrical and Mechanical Purposes, Railway Dust Guards, Washers and Packings. Patent Insulating Cleats.

MANUFACTURED BY
THE KARTAVERT MANUFACTURING CO. Wilmington, Del.

JANDUS

Interchangeable

Arc Lamp

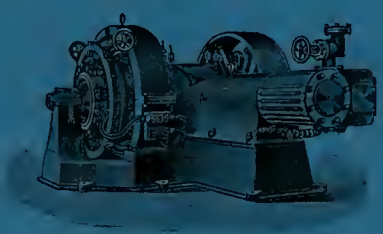
THE IDEAL LAMP
FOR
Central Stations
AND Isolated Plants

200 hrs.' life on Multiple D.C. Circuits
150 hrs.' life on Multiple A.C. Circuits
150 hrs.' life on Series A.C. and D.C. "

Send for Bulletin W 20

THE F. BISSELL COMPANY
DISTRIBUTORS
TOLEDO, O.

STURTEVANT
GENERATING SETS



For Lighting and Power

All Types and Sizes
Between 1½ and 250 K. W.

We Build Both Engine and Generator

B. F. STURTEVANT CO.

BOSTON, MASS.

General Office and Works, Hyde Park, Mass.

NEW YORK PHILADELPHIA CHICAGO LONDON

393

Warren Alternator

To Our Productions Apply This Invariable Rule:

WE GUARANTEE WHAT WE SELL

and

SELL WHAT WE GUARANTEE.

WARREN ELECTRIC MFG. CO.

Sandusky, O.

Black Diamond File Works

Est. 1863. Inc. 1895.

Twelve Medals Awarded at International Expositions

Special Prize Gold Medal at Atlanta, 1895.

OUR GOODS ARE ON SALE IN EVERY LEADING HARDWARE STORE IN THE UNITED STATES AND CANADA.

G. & H. BARNETT COMPANY,

PHILADELPHIA, PA.

JOHN A. ROEBLING'S SONS CO.

Insulated Wire of All Kinds

Bare Copper Wire

MAIN OFFICE AND WORKS TRENTON, N. J.

AGENCIES AND BRANCHES

New York Chicago Cleveland San Francisco Philadelphia Atlanta

Western Electrician

Vol. XXXV. $3.00 Per Annum. Copyright, 1905, by Electrician Publishing Company, Chicago. CHICAGO, DECEMBER 31, 1904. Entered at Chicago Postoffice as mail matter of the second class. 10 Cents a Copy. No. 27.

Technology Quarterly
Mass. Inst. of Tech.
Boston Mass

SIMPLEX INSULATED WIRES AND CABLES.
RUBBER COVERED, WEATHERPROOF, UNDERGROUND AND SUBMARINE.
WESTERN SELLING AGENT, H. R. HIXSON, 1104 Monadnock Block, CHICAGO.
The Simplex Electrical Co., 110 State Street, BOSTON, MASS.

N. I. R.
National India Rubber Co.'s
RUBBER COVERED
WIRES AND CABLES.
OFFICE AND FACTORY: BRISTOL, R. I.

OKONITE
TRADE MARK
1889—Paris Exposition, Medal for Rubber Insulation.
1893—World's Fair, Medal for Rubber Insulation.
THE STANDARD FOR RUBBER INSULATION.
Sole Manufacturers of
Okonite Wires, Okonite Tape, Manson Tape, Candee Weather-proof Wires.
THE OKONITE CO., LTD.
Willard L. Candee, A. Durant Cheever, } Managers. 253 Broadway, New York. Geo. T. Manson, Gen'l Supt. W. H. Hodgins, Secy.

TRADE MARK
CRESCENT INSULATED WIRE & CABLE CO. TRENTON, N. J.
CRESCENT RUBBER INSULATED WIRES AND CABLES
National Code Standard.
CRESCENT INSULATED WIRE AND CABLE CO.,
New York Office, 83 BARCLAY STREET. Main Office and Factory, TRENTON, N. J.

STERLING BLACK PLASTIC INSULATOR.
WATER REPELLENT. OIL PROOF.
One hundred days' continuous baking at 180° F. will not make it brittle.
THE STERLING VARNISH CO., - - Pittsburg, Pa.

INDIANA RUBBER AND INSULATED WIRE CO.,
MANUFACTURERS OF
Paranite Rubber Covered Wires and Cables,
UNDERGROUND, AERIAL, SUBMARINE AND INSIDE USE:
TELEPHONE, TELEGRAPH AND FIRE ALARM CABLES.
All Wires are tested at Factory. JONESBORO, IND.

"CIRCULAR LOOM" THE FLEXIBLE CONDUIT
AMERICAN CIRCULAR LOOM CO.
TRADE MARK
REGISTERED
CONDUITS FOR INTERIOR WIRING.
American Circular Loom Co.
Chelsea, Mass., New York, Chicago, San Francisco.

THOUSANDS IN USE.
Motors, ½ h. p. to 100 h. p.
Dynamos, 1 k. w. to 75 k. w.
Highest Quality. Reasonable Price.
THE HOBART ELECTRIC MFG. CO.
TROY, OHIO.

I-T-E
CIRCUIT BREAKERS
CUTTER ELECTRICAL CO., PHILADELPHIA

THE ONLY TOOL REQUIRED
Next time you hammer, ream and file a cast-iron junction box, wasting time, breaking boxes, and finally fail to produce a round hole, think of
BOSSERT DRAWN STEEL JUNCTION BOXES.
They are punched out of one piece of steel and have holes closed with hermetically sealed plugs which can be removed with one blow of a hammer. No time wasted. No broken boxes. No filing or reaming. A clear round hole every time. Write for particulars.
BOSSERT ELECTRIC CONSTRUCTION CO., Office and Works, Utica, N.Y.

THERMOPILES 1½ VOLTS 1½ AMPERES
For Electrolytic analysis, charging storage batteries, and other constant current requirements. $3 Each.
WALSH'S SONS & CO.,
264 Washington Street. Newark, N. J.

SAUQUOIT SILK MFG. COMPANY
INSULATING and BRAIDING SILKS
MILLS:
BETHLEHEM, PA.
PHILADELPHIA, PA.
SCRANTON, PA.
NEW YORK REPRESENTATIVES:
WILLIAM RYLE & COMPANY
54 Howard St.
PHILADELPHIA OFFICE:
4015 Clarissa St.
CHICAGO OFFICE:
210 Monroe St.
BOSTON OFFICE:
78 Chauncy St

"STAR" INCANDESCENT LAMPS
LONG LIFE
GUARANTEED CANDLEPOWER,
HIGHEST EFFICIENCY.
MADE BY THE MOST SKILLED WORKMEN.
STANDARD ELECTRICAL MFG. COMPANY, : Niles, Ohio.

SINGLE AND POLYPHASE
TRANSFORMERS
KUHLMAN ELECTRIC CO., - - Elkhart, Ind.

SOLDERING PASTE
We have the best formula for making Soldering Paste or Stick known. Guaranteed not to corrode or injure the wire or insulation. Positively the finest thing out. Actual cost of making, 15 cents per pound. This formula is worth $10.00 to anyone using a soldering flux. We send it for $1.00.
BUTLER CHEMICAL WORKS
BUTLER, OHIO

WESTON Electrical Instrument Co.,
Waverly Park, NEWARK, N. J.

Illuminated Dial Station Instruments.
These instruments are constructed upon the same general principle as our regular Standard Portable Direct Current Voltmeters and Ammeters, but are much larger, and the working parts are inclosed in a neatly designed, dust-proof cast-iron case which effectively shields the instruments from disturbing influences of external magnetic fields.
BERLIN.—European Weston Electrical Instrument Co., Bitterstrasse No. 83.

Weston Standard Illuminated Dial Potential Indicator, Style B. "Flush Type."

Weston Standard
Portable Direct Reading Voltmeters and Millivoltmeters. Ammeters and Milliammeters, Wattmeters and Voltmeters, for Alternating and Direct Current Circuits.
Our portable instruments are recognized as standards throughout the civilized world.
Our Semi-Portable Laboratory Standard Voltmeters and Ammeters are still better.
They are the most reliable, absolute standards for Laboratory use.
LONDON.—Elliott Bros., Century Works, Lewisham.

PARIS, FRANCE. F. H. Cadiot, 12 Rue St Georges New York Office—74—Cortlandt St.

"Diamond H" Switches
Trade H Mark
This Trade-Mark guarantees quality.
The Hart Mfg. Co., Hartford, Conn.
New York Boston Chicago Toronto, Ont.

Corliss Engines

for

Street Railway, Lighting and Power Purposes

Allis-Chalmers Horizontal Cross-Compound Direct Connected Engine

More of these Engines installed in Central Station power plants than of any other make on the market.

Perfect material and workmanship only are used as shown by successful operation at speeds as high as 150 R. P. M.

We build this engine in sizes from 200 h. p. up to 3,000 h. p.

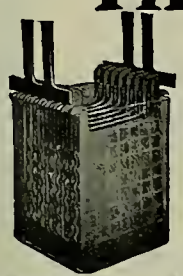
Allis-Chalmers Co.

Milwaukee, Wis., U. S. A.

Canadian representatives, Allis-Chalmers-Bullock, Ltd., Montreal.

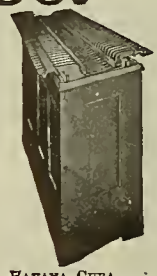
THE ELECTRIC STORAGE BATTERY CO.

PHILADELPHIA



MANUFACTURER OF THE

"Chloride Accumulator"



For Central Stations, Electric Railways, Isolated Lighting and Power Stations, Fire Alarm, Telegraph, Train Lighting, etc., etc.

PRICE LISTS AND DESCRIPTIVE BULLETINS FORWARDED UPON REQUEST.

SALES OFFICES:

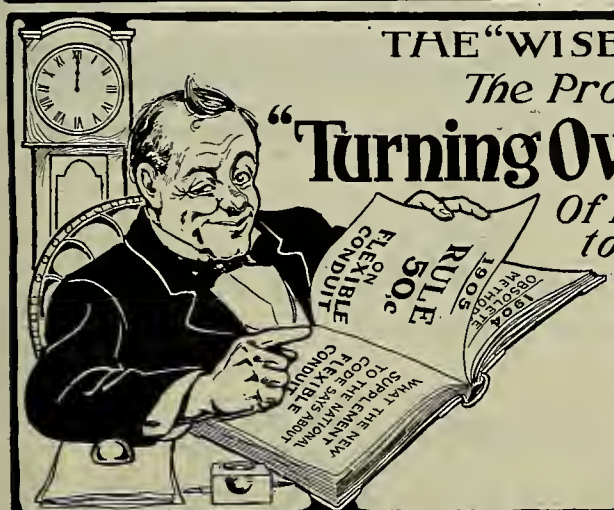
PHILADELPHIA, Allegheny Ave. and 19th St. | NEW YORK, 100 Broadway, | BOSTON, 60 State St. | CHICAGO, Marquette Bldg. | ST. LOUIS, Wainwright Bldg. | SAN FRANCISCO, Rialto Bldg. | CLEVELAND, Citizens Bldg. | CANADA, Canadian General Electric Co., Ltd. Toronto | HAVANA, CUBA, G. F. Greenwood, Manager 34 Empedrado St.

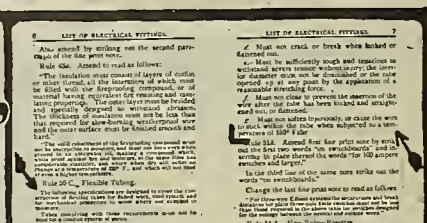
THE "WISE ONE" IS ON

The Proverbial

"Turning Over a New Leaf"

Of Particular Significance to the Wise Buyer





New Year--New Standard.

We all at least have a fleeting thought of the next year being a better year. How to get it? Is it not by higher standards? Higher standards in anything give promise of better results.

"Flexduct" is the higher standard Flexible conduit. The new standards just adopted by those who know mean endurance, safety, less labor and surer results.

Where is this new standard more faithfully interpreted than in "Flexduct." No questions asked if you use "Flexduct", the known standard.

OSBURN FLEXIBLE CONDUIT CO., New York, Chicago, San Francisco.

WHITE PORCELAIN LETTERS — FIREPROOF

FOR ELECTRIC SIGNS

AGENTS WANTED WHEREVER THERE ARE CENTRAL STATIONS.

COLONIAL SIGN AND INSULATOR CO., - - - AKRON, O.

PLATINUM

PLATINUM RIVETS FOR CONTACT POINTS IN TELEPHONES—SPARK COILS AND OTHER ELECTRICAL APPARATUS. PLATINUM SHEET AND WIRE IN ANY FORM AND DEGREE OF HARDNESS. PLATINUM SCRAP PURCHASED.

BAKER & COMPANY, Inc.

ARTISANS IN PLATINUM

408-410-412-414 N. J. R. R. AVE. - NEWARK, N. J.

New York Office: 120 Liberty St.

ALPHABETICAL INDEX TO ADVERTISEMENTS.

Adams-Bagnall Electric Co...—
Allis-Chalmers Company..... 2
American Battery Co.....11
Amer. Circular Loom Co.... ...1
American Conduit Co..... 9
American Diesel Engine Co..15
Amer. District Steam Co.....19
Amer. Elec. Fuse Co..... 8
Amer. El. Telephone Co.....16
American Electrical Works..13
American Platinum Works..—
Arnold Elec. Power Station Co.....11
Andit Co. of Ill., The..... —
Antomatic Electric Co..... 17

Babcock & Wilcox Co.....—
Badt, F. B.....11
Bain, Forée.....13
Baker & Company..... 3
Baker & Co., W. E.....11
Barnett Company, G. & H....22
Beardslee Chandelier Mfg. Co.—
Benjamin Electric Mfg. Co..—
Bennett, L. A..... 3
Berthold & Jennings.....19
Bissell Co., The F.....22
Bossert Electric Construction Co..... 1
Brooks, Hall L.....19
Bryan-Marsh Co.....—
Bryan, Wm. H.....11
Buckeye Electric Co.....—
Bullock Elec. Mfg. Co..... 2
Burlington R. R.....18
Butler Chemical Works..... 1
Butterfield, J. F.....11
Byllesby & Co., H. M.....11

Cantwell Press, The.....—
Carhartt & Co., Hamilton.. .—
Central Electric Co..... 5
Cent. Stat. Improvement Co.14
Central Tel. & El. Co.....16
Century Electric Co.....11
Chicago Die & Electric Co....—
Chicago Edison Co.....4, 14
Chic. Fuse Wire & Mfg. Co...—
Chicago Insulated Wire Co..—
Chicago Mica Co.....12
Colonial Sign & Insulator Co. 3
Columbia Incand. Lamp Co..—
Columbia Mfg. Co.....18
Continuous Rail Joint Company of America..... 13
Cooper-Hewitt Elec. Co..... 8
Cope, T. J.....15
Crawfordsville Electric Co..—
Crescent Ins. Wire & Cbl. Co. 1
Crocker-Wheeler Company...21
Crolius & Son, E. R.....—
Cutler-Hammer Mfg. Co..... 8
Cutter Elec. & Mfg. Company 1

D. & W. Fuse Company.....—
Dearborn Drug & Chem. Wks.15
Diamond Meter Company....18
Directory of Engineers.....11
Dixon Crucible Co., Joseph..15
Doxsee Elec'l. Co., A. S. ....—
Duncan Elec. Mfg. Co.....21

Edison Decorative & Miniature Lamp Departm't..... 12
Edison Mfg. Company.....—
Edwards & Co.....14
Egan, J. J.....14
Electric Appliance Co..... 12
Electric Storage Battery Co.. 3
Electrical Engineer Institute.—
Electrician Pub. Company...10
Erie Ry.....19
Evans, Almirall & Co 11
Evans & Co., W. R 11

Faries Mfg. Co.....16
"For Sale" Advertisements..14
Ft. Wayne Elec. Works, Inc..21
Fostoria Incand. Lamp Co...—
Fowler, John H.....19
Fowler-Jacobs Company.....19
Franklin Elec. Mfg. Co .....—

General Electric Co..... 9
General Engineering Co., The 11
General Incandescent Arc Light Company.....—
General Incand. Lamp Co....—
Gould Storage Battery Co.... 6
Green Fuel Economizer Co..15
Gregory Electric Company...14

Hallberg, J. H 11
Hamacek, A. F.....—
Hart Mfg. Co..... 1
Hartford Steam Boiler Inspection & Insurance Co....—
Hazard Manufacturing Co...—
Highland Park College. 22
Hipwell Mfg. Co..... 16
Hobart Elec. Mfg. Co..... 1
Hoffman, G. W.....14
Holmes Fibre-Graph. Co.....—
Holophane Glass Co.....—
Humphrey, Henry H.....—
Hunt & Co., Robt. W.....11

Illinois Central Ry.....18
Incandescent Electric Light Manipulator Company.....—
Indiana Rub. & Ins. W. Co.... 1
India Rubber & Gutta Percha Insulating Company.....—
International Elec. Meter Co 14
International Tel. Mfg. Co...16

Jackson, D. C. & W. B.....11
Jeffrey Manufacturing Co....15
Johns-Manville Co., H. W..... 5

Kartavert Manufacturing Co.—
Kellogg Switchboard & Supply Company.....17, 19
Kemp, R. W.....11
Kester Elec. Mfg. Co.....12
Klein & Sons, Mathias.... 14
Kohler Brothers.....11
Kuhlman Electric Co..... 1

Leather Preserv. M. Corp....19
Leffel & Co., James.....15
Lethcule, Paul.....13
Lindsley Brothers Company..18
Loud's Sons Co., H. M.....—

Machado & Roller.....—
Maltby Cedar Company.....19
Manhattan El. Supply Co....22
Manross, F. N..... .....—
Marinette Gas Engine Co....15
Matthews & Bros., W. N.....13
McLaughlin & Co., Jas.....14
McLennan & Company, K....12
Mechanical Appliance Co....15
Mica Insulator Company.....12
Miscellaneous Advs.....14
Monon Railroad.....14
Morrison Lbr. Co., J. W.....19
Mueller Company, William..19
Munsell & Co., Eugene.....12

National Carbon Co.....—
National Electric Co..... 4, 7
National India Rubber Co.... 1
New England Butt Co.....19
Newgard & Co., Henry..... 8
New York Cent. Ry.....14
New York Ins. Wire Co.....13
Northern Elect'l Mfg. Co....12
Northern Wire & Cable Co...13
Northwestern Storage Battery Co.. 11

Okonite Co., The..... 1
Osburn Flexible Conduit Co. 3

Pacific Coast Pole Co.....18
Paragon Fan & Motor Co.....—
Pardridge Shade & Refl. Co..—
Pass & Seymour, Inc.....12
Phelan, D. W.....19
Phillips, Eugene F.....13
Phillips Insulated Wire Co...13
Phœnix Glass Co.....—
Phosphor-Bronze S. Co.....15
Pignolet, L. M.....12
Pittsburg & L. S. Iron Co....19
Plume & Atwood Mfg. Co.... 8
Porter Cedar Company.....19

Reisinger, Hugo..... 9
Replogle Governor Works.. .14
Reynolds El. Flasher Mfg. Co.14
Richardson Lubricating Co..12
Robert Instrument Co., The..12
Roche, Wm.....—
Roebling's Sons Co., J. A.....22
Ruebel-Schwedtmann-Wells..11
Runzel-Lenz Elec. Mfg. Co...—

Safety Ins. Wire & Cable Co..22
Sargent & Lundy.....—
Sauquoit Silk Mfg. Co..... 1
Schott, W. H.....11
Simplex Electrical Co., The.. 1
Simplex Elec. Heating Co....13
Speer Carbon Co.....—
Sprague Electric Company... 9
Squire Electric Co.....—
Standard Elec. Mfg. Co..... 1
Standard Underg. Cable Co....—
Stanley Elec. Mfg. Co., The 13
Stanley Instrument Co..... 5
Stanton, LeRoy W..... 11
Sterling & Son, W. C.....18
Sterling Electrical Mfg. Co....—
Sterling Varnish Co., The.... 1
Stow Mfg. Company.....—
Stromberg-Carlson Tel. Mfg. Company..... 17
Sturtevant Company B. F...22

Temple Pump Co.....—
Torrey Cedar Company.....18
Trumbull Elec. Mnfg. Co.....—
Turner Brass Works.....11

Union Electric Mfg. Co.....—

Valentine-Clark Co., The....—
Vulcanized Fibre Company..22

Wagner Electric Mfg. Co.... 4
Walsh's Sons & Company..... 1
Warren Elec. Mfg. Co.....22
Wesco Supply Co.....12
Western Electric Company... 5
Westinghouse Electric & Manufacturing Co.....20
Weston Electrical Inst. Co... 1
Whitehead Machinery Co... 14
Wilmerding, C. H.....—
Woolley Fdy. & Mach. Wks..—
Worcester Company, C. H....18

Yesbera Mfg. Co..... .. 16
Yost Electric Mfg. Co 22

Zero Marx Sign Works .....—

For Classified Index of Advertisements See Page 6.

Motors,
Switches,
Arc Lamps,
Circuit Breakers, Etc., Etc.

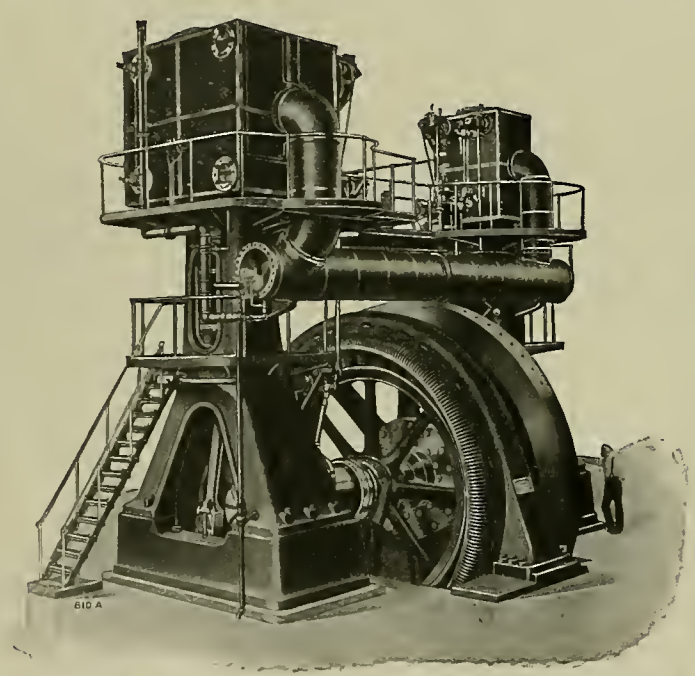
ALWAYS IN STOCK.

MANUFACTURED BY

G. E. Co.

CHICAGO EDISON COMPANY, 139 Adams Street. CHICAGO.

For Immediate Delivery



MODERN DESIGN SUPERIOR PERFORMANCE

Gold Medal Generator Unit

Hamilton Corliss Cross Compound Vertical Condensing Engine, 2,250 horsepower.

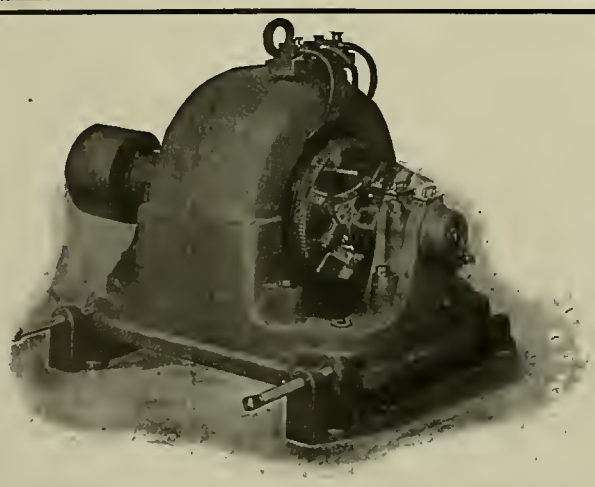
1,500 K. W., 3 Phase 25 cycles, 6,600-Volt National Alternator.

Released at close of St. Louis Exposition.

For prices and terms apply to

HOOVEN, OWENS, RENTSCHLER CO.
HAMILTON, OHIO

National Electric Company
Milwaukee



CENTRAL STATION MANAGERS

Don't Be Afraid

of the Gas Plant

WORK UP A MOTOR LOAD

We can furnish you

SINGLE PHASE MOTORS

that will start under full load in sizes ranging from 1/8 to 35 H. P.

Wagner Electric Mfg. Co.
ST. LOUIS, MO., U. S. A.

COLUMBIA LAMPS

Are furnished in accordance with the most rigid specifications. We invite a comparison of the COLUMBIA with other makes and request central stations and isolated plants to make thorough and comprehensive tests for life, sustained candle-power and total illuminated area. LET US SEND YOU OUR PROPOSAL FORM.

Columbia Lamps are manufactured under a License to use the Chemical Exhaust Process of exhausting lamps. This process is vitally necessary in the production of the highest quality of Lamp.

OKONITE IT NEVER DISAPPOINTS

Central Electric Company,

GENERAL WESTERN AGENTS

264-266-268-270 FIFTH AVENUE, CHICAGO.

OKONITE IT NEVER DISAPPOINTS

N. E. CODE STANDARD SACHS TRADE NOARK MARK FUSE SPOT SHOWS WHEN BLOWN

OUR LABEL

NATIONAL ELECTRIC CODE

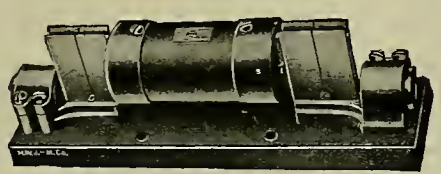
STANDARD FUSE DEVICES ARE READY

250-VOLT

TYPE B (Ferrule Contact).
1-30 Amps., 1, 2, 3 Pole, Main Line.
31-60 Amps., 1, 2, 3 Pole, Main Line.

TYPE E (Knife Blade Contact).
61-100 Amps., 1, 2, 3 Pole, Main Line.

TYPE E (Knife Blade Contact).
101-200 Amps., 1 Pole, Main Line.
201-400 Amps., 1 Pole, Main Line.
401-600 Amps., 1 Pole, Main Line.



600-VOLT

TYPE B (Ferrule Contact).
1-30 Amps., 1 Pole, Main Line.
31-60 Amps., 1 Pole, Main Line.

TYPE E (Knife Blade Contact).
61-100 Amps., 1 Pole Main Line.

TYPE E (Knife Blade Contact).
101-200 Amps., 1 Pole, Main Line.
201-400 Amps., 1 Pole, Main Line.
401-600 Amps., 1 Pole, Main Line.

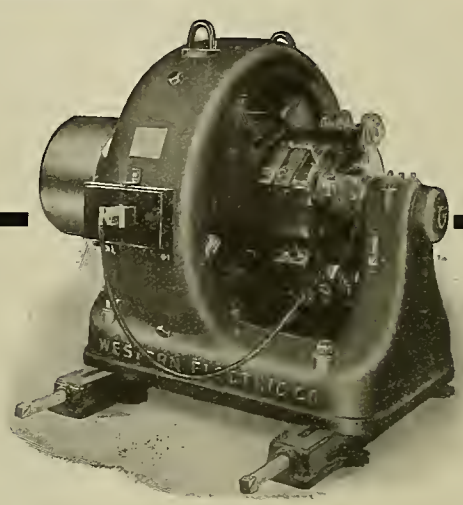
MILWAUKEE CHICAGO ST. LOUIS CLEVELAND PITTSBURG

H. W. JOHNS-MANVILLE CO.

Mfrs. Asbestos and Magnesia Pipe and Boiler Coverings, Roofing and Packings

100 WILLIAM ST., NEW YORK.

BOSTON PHILADELPHIA LONDON PARIS BRUSSELS



DIRECT-CURRENT

Motors and Generators

Arc Lighting Systems

Bulletins On Request

Western Electric Company

CHICAGO NEW YORK

OTHER LARGE CITIES

ELECTRICITY FOR ENGINEERS.

424 PAGES. ILLUSTRATED. PRICE $2.50.

ELECTRICIAN PUBLISHING CO., 510 Marquette Building, CHICAGO

STANLEY INSTRUMENT CO.

GREAT BARRINGTON, MASS., U. S. A.

UNIVERSAL EXPOSITION ST. LOUIS 1904

GOLD MEDALS

PAN-AMERICAN EXPOSITION BUFFALO 1901

THE HIGHEST AWARDS AT BOTH EXPOSITIONS FOR

WATTMETERS

Gould Storage Battery Co.

Complete Storage Battery Plants

Railway Line and Regulating
Isolated and Train Lighting
Central Lighting and Power
Electric Vehicle and Telephone

GOULD COUNTER E. M. F. BOOSTER SYSTEMS

Sales Offices { NEW YORK, 1 W. 34th Street. BOSTON, 89 State Street. CHICAGO, The "Rookery." SAN FRANCISCO, Century Electric Co.

WORKS: DEPEW, N. Y.

Bulletins.

CLASSIFIED INDEX OF ADVERTISEMENTS.

Accountants and Auditors.
Audit Co. of Illinois

Adjusters, Cord.
Incandes. El. Lt. Manip. Co.

Adjusters, Inc. Lamps.
Inc. El. Lt. Manipulator Co.

Anchors (Tel. & Tel.)
Bennett, I. A.
Matthews & Bro., W. N.

Annunciators.
Central Electric Co.
Edwards & Company.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.

Batteries and Jars.
Bissell Co., The F.
Central Electric Co.
Edison Mfg. Co.
Edwards & Company.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Roche, Wm.
Wesco Supply Co.
Western Electric Co.

Bells, Buzzers, Etc.
Central Electric Co.
Edwards & Co.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.

Belt Dressing.
Dixon Crucible Co., Jos.
Leather Preserver Mfg. Corp.

Belting.
Leather Preserver Mfg. Corp.

Blow Pipes.
Turner Brass Works

Blowers.
Green Fuel Economizer Co.
Sturtevant Co., B. F.

Boiler Compounds.
Dearborn Drug & Chem. Wks.

Boilers.
Allis-Chalmers Company.
Babcock & Wilcox Co.

Books, Electrical.
Cantwell Press, The.
Electrician Publishing Co.

Booths, Telephone.
Yesbera Mfg. Co.

Brackets.
Faries Mfg. Co.

Brushes.
Central Electric Co.
Hobart Elec. Mfg. Co.
Holmes Fibre-Graphite Co.
Speer Carbon Co.
Western Electric Company.

Cable Hangers.
Bissell Co., B. F.
Wesco Supply Co.
Western Electric Co.

Cables (See Wires and Cables)

Canopies.
Faries Mfg. Co.

Carbons, Points and Plates.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
National Carbon Co.
Reisinger, Hugo.
Speer Carbon Co.
Wesco Supply Co.

Castings.
Faries Mfg. Co.
New England Butt Co.
National Electric Co.

China.
Jeffrey Mfg. Co.

Chandeliers.
Faries Mfg. Co.

Circuit Breakers.
Cutler-Hammer Mfg. Co.
Cutter Elec. & Mfg. Co.
Ft. Wayne Elec. Wks. Inc.
Union Electric Mfg. Co.
Wesco Supply Co.
Western Electric Company.
Westinghouse El. & Mfg. Co.

Cinders.
Benjamin Elec. Mfg. Co.
Faries Mfg. Co.

Coal and Ashes Handling Machinery.
Jeffrey Mfg. Co.

Coils and Magnets.
Western Electric Co.

Commutator Compound
Crolius & Son, E. R.
Egan, J. J.
McLaughlin & Co., Jas.
McLennan & Co., K.

Condensers, Electric.
Stanley Elec. Mfg Co.

Conduit and Conduits.
American Circular Loom Co.
American Conduit Company
Central Electric Co.
Electric Appliance Co.
Osburn Flexible Conduit Co.
Sprague Electric Co.
Wesco Supply Co.

Contractors and Electric Light Plants.
Allis-Chalmers Company.
Bullock El. Mfg. Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
National Electric Co.
Northern Electrical Mfg. Co.
Sprague Electric Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Controllers, Crane.
Amer. Elec. Fuse Co.

Copper, Scrap.
Great Western Smelting & Refining Co.

Cord.
Runzel-Lenz Elec. Mfg. Co.

Cross-Arms, Pins and Brackets.
Berthold & Jennings.
Central Electric Co.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Company.

Cut-Outs and Switches.
Bissell Co., The F.
Bossert Elec. Const. Co.
Central Electric Co.
Chicago Edison Co.
Clinton Stamping & Elec. Co.
Cutter Elec. & Mfg. Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
General Inc. Arc Light Co.
Hamacek, A. F.
Hart Manufacturing Co.
Manhattan Elec. Supply Co.
Trumbull Elec. Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Dynamos and Motors.
Allis-Chalmers Company.
Bissell Co., The F.
Bullock Elec. Mfg. Co.
Central Electric Co.
Century Electric Co.
Crawfordsville Electric Co.
Crocker-Wheeler Co.
Ft. Wayne Elec. Wks. Inc.
General Elec. Co.
General Inc. Arc Light Co.
Gregory Electric Co.
Hobart Elec. Mfg. Co.
Mechanical Appliance Co.
National Electric Co.
Northern Electrical Mfg. Co.
Sprague Electric Co.
Stanley Elec. Mfg. Co.
Stow Manufacturing Co.
Sturtevant Co., B. F.
Wagner Electric Mfg. Co.
Warren Elec. Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Economizers, Fuel.
Green Fuel Economizer Co.

Electric Heating Appl.
Electric Appliance Co.
Simplex Elec. Heating Co.
Western Electric Co.

Electric Railways.
Crocker-Wheeler Co.
General Electric Co.
Sprague Electric Co.
Westinghouse El. & Mfg. Co.

Electrical and Mechanical Engineers.
Arnold Elec. Power Stat'n Co.
Badt, F. B.
Baker & Co., W. E.
Bryan, Wm. H.
Butterfield, J. F.
Byllesby & Co., H. M.
Evans, Almirall & Co.
General Engineering Co., The.
Hallberg, J. H.
Humphrey, Henry H.
Hunt & Co., Robt. W.
Jackson, D. C. & W. B.
Kemp, R. W.
Kohler Brothers.
Newgard & Co., Henry.
Northern Electrical Mfg. Co.
Ruebel, Schweidtman, Wells.
Sargent & Lundy.
Schott, W. H.
Squire Electric Co.
Stanley Elec. Mfg. Co.
Stanton, LeRoy W.
Wilmerding, C. H.

Electrical Instruments. (Recording and Testing.)
Bissell Co., The F.
Central Electric Co.
Diamond Meter Co.
Duncan Elec. Mfg. Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
General Inc. Arc Light Co.
Machado & Roller.
Pignolet, L. M.
Robert Inst. Co., The
Stanley Elec. Mfg. Co.
Stanley Instrument Co.
Wagner Electric Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co
Weston Electrical Inst. Co.

Electro-Plating Mach'y
Crocker-Wheeler Company.
General Electric Co.

Elevators-Conveyors.
Jeffrey Mfg. Co.

Engines, Gas and Gasoline.
Allis-Chalmers Company.
Marinette Gas Engine Co.
Temple Pump Co.
Woolley Fdy. & Mach. Wks.

Engines, Oil.
American Diesel Engine Co.

Engines, Steam.
Allis-Chalmers Company.
Sturtevant Co., B. F.

Fans and Fan Motors.
Central Electric Co.
Crocker-Wheeler Company.
Edison Mfg. Co.
General Electric Co.
General Inc. Arc Light Co.
Sprague Electric Co.
Sturtevant Co., B. F.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Fibre.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Files.
Barnett Co., G. & H.

Fittings.
Faries Mfg. Co.

Fixtures, Gas and Elec.
Beardslee Chandelier Mfg. Co.

Flashers.
Bissell Co., The F.
Doxsee Elec'l. Co., A. S.
Reynolds El. Flasher Mfg. Co
Wesco Supply Co.

Flexible Shafts.
Stow Mfg. Co.

Forges.
Sturtevant Co., B. F.

Fuses and Fuse Wire.
Amer. Elec. Fuse Co.
Bissell Co., The F.
Central Electric Co.
Central Tel. & El. Co.
Chicago Die & Electric Co.
Chicago Fuse Wire & Mfg. Co.
Clinton Stamping & Elec. Co.
D. & W. Fuse Company.
Electric Appliance Co.
Johns-Manville Co., H. W.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Company.

Globes, Reflectors and Shades.
Fostoria Incan. Lamp Co.
Holophane Glass Co.
Pardridge Shade & Refl. Co.
Phoenix Glass Co.
Wesco Supply Co.
Western Electric Co.

Governors, Water Wheel.
Replogle Governor Works.

Graphite Specialties.
Dixon Crucible Co., Jos.
Holmes Fibre-Graphite Co.

Heating (Exhaust Steam).
Amer. District Steam Co.

Heating and Ventilating Apparatus.
Sturtevant Co., B. F.

Heating, Hot Water.
Evans, Almirall & Co.

Holders, Inc. Lamps.
Electric Appliance Co.
Incandesent Electric Light Manipulator Co.

Inspection & Insurance
Hartford Steam Boiler Inspection & Insurance Co.

Insulating Machinery.
New England Butt Co.

Insulators and Insulating Materials.
American Electrical Works.
Central Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Inc. Arc Light Co.
Indiana Rub. & Ins. Wire Co.
Johns-Manville Co., H. W.
Kartavert Mfg. Co.
Manhattan Elec. Supply Co.
Mica Insulator Co.
Munsell & Co., Eugene.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Sterling Varnish Co.
Vulcanized Fibre Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Junction Boxes.
Bossert Elect. Const. Co.
General Inc. Arc Light Co.

Lamps, Arc.
Bissell Co., The F.
Central Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
General Inc. Arc Lt. Co.
Gregory Electric Co.
Hipwell Manufacturing Co
Manhattan Elec. Supply Co.
Stanley Elec. Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Lamps, Incandescent.
Bissell Co., The F.
Bryan-Marsh Company.
Buckeye Electric Company.
Central Electric Co.
Chicago Edison Co.
Columbia Incan. Lamp Co.
Edison Decorative & Miniature Lamp Dept.
Electric Appliance Co.
Fostoria Incand. Lamp Co.
Franklin Electric Mfg. Co.
General Electric Co.
General Inc. Arc Light Co.
Sawyer-Man Elec. Co.
Standard Elec'l Mfg. Co.
Sterling Electrical Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Lamps, Incandescent—Replacers & Cleaners.
Inc. El. Lt. Manipulator Co.

Lamps, Vapor.
Cooper, Hewitt Elec. Co.

Letters, Sign.
Colonial Sign & Insulator Co.

Lightning Arresters.
Central Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Wks. Inc.
General Electric Co.
Manhattan Elec. Supply Co.
Stanley Elec. Mfg. Co.
Wesco Supply Co.
Western Electric Co.

Linemen's Climbers.
Klein & Sons, Mathias.

Lubricating, Oil, Grease.
Richardson Lubricating Co.

Magnet Wires.
(See Wires and Cables.)

Mechanical Draft.
Green Fuel Economizer Co.
Sturtevant Co., B. F.

Mica.
Chicago Mica Co.
Mica Insulator Co.
Munsell & Co., Eugene.

Mining Apparatus, Elec.
Allis-Chalmers Company.
Crocker-Wheeler Company.
General Electric Co.
Jeffrey Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Motors. (See Dynamos and Motors.)

Nippers and Pliers.
Klein & Sons, Mathias.

Novelties, Lighting.
Letheule, Paul

Nozzles.
Faries Mfg. Co.

Overalls.
Carhartt & Co., Hamilton.

Patent Attorneys.
Bain, Foree.

Phosphor Bronze.
Phosphor Bronze Sm. Co. Ltd.

Platinum, Wire and Sheet.
American Platinum Works.
Baker & Company Inc.

Poles and Ties.
Berthold & Jennings.
Brooks, Hall L.
Columbia Mfg. Co.
Fowler, John H.
Fowler-Jacobs Company.
Kellogg Switch. & Sup. Co.
Lindsley Bros. Co.
Loud's Sons Co., H. M.
Maltby Cedar Co.
Morrison Lbr. Co., J. W.
Mueller Company, William.
Pacific Coast Pole Co.
Phelan, D. W.
Pittsburg & L. S. Iron Co.
Porter Ceder Company.
Sterling & Son, W. C.
Torrey Cedar Co.
Valentine-Clark Co., The.
Worcester Co., G. H.

Polish (Metal).
Allen Co., Inc., L. B.
Hoffman, Geo. W.

Portables.
Faries Mfg. Co.

Power Transmission Machinery.
Jeffrey Mfg. Co.

Rail Joints.
Continuous Rail Joint Company of America.

Railway Supplies.
Wesco Supply Co.

Re-Winding—Repairs.
Chicago Edison Co.
Gregory Electric Co.

Rheostats.
Amer. Electric Fuse Co.
Cutler-Hammer Mfg. Co.
General Electric Co.
Gen'l Inc. Arc Lt. Co.
Union Electric Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Rods, Conduit.
Cope, T. J.

Schools and Colleges.
Electrical Engineer Inst.
Highland Park College

Second-Hand Mach'y.
Bissell Co., The F.
Cent. Stat. Improvement Co.
Gregory Electric Co.
Matthews & Bro., W. N.
Walsh's Sons & Co.

Shades, Lamp.
Faries Mfg. Co.

Sheet Brass & Copper.
Plume & Atwood Mfg. Co.

Signs, Electric.
Zero Marx Sign Works.

Silks, Insulating and Braiding.
Sauquoit Silk Mfg. Co.

Sockets & Receptacles.
Pass & Seymour.
Yost Elec. Mfg. Co.

Soldering Sticks, Salts and Paste.
Butler Chemical Works.
Crolius & Son, E. R.
Kester Elec. Mfg. Co.
Western Electric Co.

Speaking Tubes.
Central Electric Co.
Edwards & Co.
Electric Appliance Co.
Manhattan Elec. Supply Co.
Wesco Supply Co.
Western Electric Co.

Speed Indicators.
Weston Electrical Inst. Co.

Storage Batteries.
American Battery Co.
Electric Storage Battery Co.
Gould Storage Battery Co.

Supplies, General Elec.
Bissell Co., The F.
Central Electric Co.
Century Electric Co.
Chicago Edison Co.
Electric Appliance Co.
General Electric Co.
Manhattan Elect'l Supply Co
Wesco Supply Co.
Western Electric Co.

Switchboards.
Bissell Co., The F.
Gen. Incan. Arc Light Co.

Telephones, Telephone Material and Switchboards.
American El. Telephone Co
Automatic Electric Co.
Bissell Co., The F.
Central Electric Co.
Central Tel. & El. Co.
Electric Appliance Co.
International Tel. Mfg. Co.
Kellogg Switchb. & Sup. Co.
Manhattan Elec. Supply Co.
Stromberg-Carlson Tel. M. Co
Wesco Supply Co.
Western Electric Co.

Time Switches.
Bissell Co., The F.

Tools.
Klein & Sons, Mathias.
Western Electric Co.

Transformers.
Central Electric Co.
Crawfordsville Electric Co.
Crocker-Wheeler Co.
Electric Appliance Co.
Ft. Wayne Elec. Works, Inc.
General Electric Co.
Gregory Electric Co.
Kuhlman Electric Co.
Manhattan Elec. Supply Co.
National Electric Co.
Stanley Elec. Mfg. Co.
Wagner Electric Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Trucks, Electric Car.
General Electric Co.
Westinghouse El. & Mfg. Co.

Turbines, Steam.
Allis-Chalmers Co.
General Electric Co.
Westinghouse El. & Mfg. Co

Turbine Water Wheels
Leffel & Co., Jas.

Varnishes.
Sterling Varnish Co.

Vulcanized Fibre.
Vulcanized Fibre Co.

Whistles, Electric.
Electrical Appliance Co.

Wires & Cables—Magnet Wires.
American Electrical Works.
Bissell Co., The F.
Central Electric Co.
Chicago Insulated Wire Co.
Crescent Ins. Wire & Cble. Co.
Electric Appliance Co.
General Electric Co.
Hazard Manufacturing Co.
Indiana Rub. & Ins. Wire Co
India Rubber & Gutta Percha Insulating Co.
Kellogg Switch. & Sup. Co.
Manhattan Elec. Supply Co.
National India Rubber Co
New York Insulated Wire Co.
Northern Wire & Cable Co.
Okonite Co., The.
Phillips, Eugene F.
Phillips Insulated Wire Co
Roebling's Sons Co., J. A.
Runzel-Lenz Elec. Mfg Co.
Safety Ins. Wire & Cable Co.
Simplex Electrical Co.
Standard Underground C. Co
Wesco Supply Co.
Western Electric Company.

For Alphabetical Index of Advertisements See Page 3.

The National Policy

3 TO 1

For Speed Range of
Individual Motors by
Field Regulation.

TRADE

MARK

Lundell
"Universal" Motors

National Electric Company

General Sales Office and Works

Milwaukee

DISTRICT OFFICES

New York, 135 Broadway
Philadelphia, 1509 Land Title Building
Pittsburg, A. W. Wyckoff Co.
Chicago, Old Colony Building
Boston and Cincinnati

SALES OFFICES

Charleston, W. Va., Agnew Electric Co.
Cleveland, Barton, Stevenson & Co.
Detroit, Miller Seldon Electric Co.
Denver, Hendrie & Bolthoff Mfg. & Supply Co.
Seattle, San Francisco } Kilbourne & Clark Co.

THE WORK OF THE NIGHT SHIFT

is usually less productive than that done by day on account of the inconvenience caused by artificial light.

Notice in this picture taken at 10 p. m. how perfectly tools are lighted at night by

The Cooper Hewitt

Mercury Vapor Lamps

In such a plant the night is just as good as day for working.

The extreme diffusion of light prevents the usual shadows from getting in the way of the work, and the freedom from glare or flicker makes it "just as good as daylight."

The cost of this superior light is only 35 per cent. of what you are now paying, and in addition there is no trimming needed and no consumption of light-giving element.

Adapted to all **Direct-Current Systems**. For use in Mills, Factories, Printing Shops, Photographic Establishments, Docks, Freight Houses, Draughting Rooms and Offices. Send for Booklet.

Cooper Hewitt Electric Co.

220 West 29th St., New York

Perfect Control — Indefinite Regulation
No Flashing—No Repairs
Burnouts Impossible—Last Forever

ALLEN-BRADLEY RHEOSTATS

For All Purposes of Electric Current Control

Prices Reasonable—Satisfaction Guaranteed

SEND IN A TRIAL ORDER

Ask your Engineer or Electrician about it.

AMERICAN ELECTRIC FUSE CO.
48-50 West Jackson Boul.
CHICAGO, ILL.

BRASS & BRASS GOODS

ASK FOR CATALOG

THE PLUME & ATWOOD MFG. CO.

New York Boston San Francisco Chicago

HENRY NEWGARD & CO.

ELECTRICAL CONSTRUCTION

Power and Light Plants. Switchboards and Panel Boards.

We install Municipal and Isolated Electric Lighting Plants.
We manufacture Switchboards, Table boards, Iron Cutout Boxes and Electrical Specialties.
We sell Dynamos, Motors and Electrical Supplies.
We wire old as well as new Residences, Factory Buildings, School and College Buildings.

87 Fifth Avenue, Chicago, Illinois.

THE

Standard Motor Starter of the World

Copied by almost every starter maker. Prompt prosecutions of infringements and the upholding of our patents by the courts prevented its duplication.

The strongest proof that it is as we claim, "the least expensive motor starter safe to use on any installation," is found in the attempts to build as much like it as possible without infringing.

THE CUTLER HAMMER MFG. CO.

NEW YORK BOSTON MILWAUKEE, WIS. CHICAGO PITTSBURG

It Will Interest You to Know What the **Western Electric Company** Have to Say Regarding

HIGHEST GRADE NUERNBERG

CARBONS

ELECTRA
•TRADE MARK•

n their circular letter dated October 7, 1904, which in part reads as follows:

"It seems almost an unnecessary proceeding to write a letter advertising the 'ELECTRA' Carbon, or to dwell upon its merits, to any great extent, inasmuch as the 'ELECTRA' Carbon is the STANDARD OF PERFECTION, to which all other manufacturers of carbons endeavor to reach. We think this is a sufficient recommendation in itself.

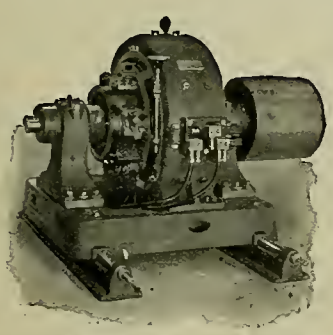
If you have not been using these carbons in your arc lamps, it would certainly pay you to give them a trial. You will find that the expenses of trimming are reduced from 15 to 20 per cent."

HUGO REISINGER, Sole Importer, 11 Broadway, NEW YORK CITY

DIRECT CURRENT

GENERATORS

FOR LIGHT AND POWER



Our generators have a high efficiency and great endurance under the most exacting conditions of service. Sizes up to 1,000 K. W.
Write for bulletin No. 10514.

SPRAGUE ELECTRIC COMPANY

General Offices:
527 West 34th Street, New York
Chicago Office: Fisher Building

BITUMINIZED FIBER CONDUIT

FOR UNDERGROUND CONSTRUCTION

American Conduit Co.

Main Offices: 1005-6 Manhattan Bldg., Chicago

Other Offices:
170 Broadway, New York 336 Macy St., Los Angeles

General Electric Company

THREE-PHASE TRANSFORMERS

ARE

CHEAPER, LIGHTER, MORE COMPACT
AND MORE READILY INSTALLED

than an equal capacity of Single-Phase Transformers

50 Kw. 40 Kw. 30 Kw. 20 Kw. 15 Kw. 10 Kw. 7.5 Kw. 5 Kw.

Principal Offices, Schenectady, N. Y.

Chicago Office, Monadnock Block. Sales Offices in all Large Cities.

The New Years Number of the Western Electrician will be a noteworthy contribution to electrical journalism. In addition to having a handsome cover which competent critics have pronounced a beautiful specimen of color printing, this number will contain many special and valuable features which will appeal to the electrical public.

A large attractive advertising announcement in this excellent number would prove beneficial to your business.

Send in your copy <u>today</u>

ARNOLD ELECTRIC POWER STATION Co.
Engineers, Constructors for Complete Electric Plants. Results Guaranteed.
SUITE 1539, MARQUETTE BLDG., CHICAGO. NEW YORK OFFICE: 711 TRANSIT BLDG.

BUTTERFIELD, J. F.
ELECTRICAL ENGINEER AND CONTRACTOR.
Complete Telephone Exchanges Built and Material Furnished.
Cable Constructing and Underground Conduit Construction a Specialty.
Room 595, 113 Adams Street, CHICAGO, ILL.

J. H. HALLBERG
Consulting Engineer
Electric Light, Power and Railway Plants
Suggestions to secure Economy, Specifications, Examinations and Reports
45 Broadway, NEW YORK
Long Distance Telephone 4578 Broad

KOHLER BROS.,
Contracting Electrical Engineers, Lighting Power Railways,
1804-1806-1808-1810-1812 Fisher Building, CHICAGO.

F. B. BADT,
Monadnock Chicago

BYLLESBY, H. M. & Co.
(Incorporated)
ENGINEERS
Design, Construct and Operate Railway, Light, Power and Hydraulic Plants.
Examinations and Reports.
New York Life Building. - CHICAGO, ILL.

IT WILL PAY
engineers not represented in this department to carry a card regularly.

RUEBEL - SCHWEDTMANN-WELLS,
CONSULTING, MECHANICAL AND ELECTRICAL ENGINEERS,
Suite 801 Chemical Building, ST. LOUIS, U. S. A.

TRY IT. Keep your name and address in this directory where it will be seen by possible clients.

ENGINEERS
Represented in this "Directory" are enabled to come in touch with many prospective customers who cannot be reached through any other source.

ROBERT W. HUNT & Co.,
ENGINEERS
1121 The Rookery, Chicago. 66 Broadway, New York.
Monongahela Bank Bldg., Pittsburg.
Norfolk House, Cannon St., London.

TRY IT.
Keep your name and address in this directory where it will be seen by possible clients.

W. E. BAKER. H. B. BISHOP.
BAKER, W. E. & CO.
ENGINEERS,
ELECTRIC RAILWAYS.
27 William St., NEW YORK.

EVANS, ALMIRALL & CO.,
Central Station Heating, High Pressure Piping.
1057 Monadnock Blk., Chicago.

A WEEKLY REPRESENTATION
in this "Directory" enables engineers to keep before all possible customers.

Long Distance Phone Central 2443.
SCHOTT, W. H.,
ENGINEER AND CONTRACTOR,
SPECIALTIES—Central Station Heating Plants, Water Works Steam Plants, Electric Light, Gas and Street Railway Plants.
1220-21 MARQUETTE BUILDING, CHICAGO.

BRYAN, WILLIAM H.
M. Am. Soc. M. E.,
Consulting Mechanical and Electrical Engineer.
Lincoln Trust Building, ST. LOUIS.

E. W. Hammer, Pres. and Treas. H. J. Minhinnick, Sec. and Gen'l Sup't.
GENERAL ENGINEERING Co., THE Consulting and Contracting Engineers.
Telephones, Electric Light, Power Transmission
Suite 1112, 135 ADAMS ST., CHICAGO.
Long Distance Telephone Central 478.

KEMP, R. W.
Consulting and Contracting Telephone Engineer.
Plans and specification for complete plants. Old plants overhauled and placed on paying basis. Territory, Kansas, Oklahoma and Indian Territory.
WELLINGTON, - - - KANSAS.

STANTON, LE ROY W.
Consulting Telephone Engineer
Plans, Specifications and Supervision of Installation of Complete Telephone Plants
Special Reports on Telephone Properties and Apparatus
411 Electrical Bldg., Cleveland, Ohio

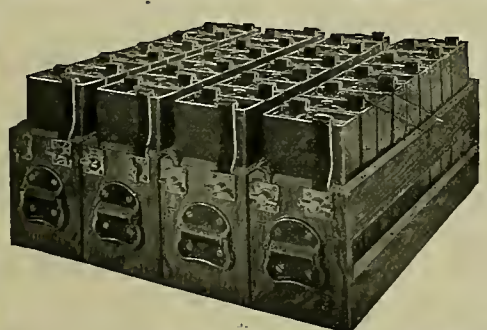
DUGALD C. JACKSON, C. E.
WILLIAM B. JACKSON, M. E.
MEMBERS
AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS
AMERICAN SOCIETY OF MECHANICAL ENGINEERS
AMERICAN SOCIETY OF CIVIL ENGINEERS
ENGINEERS. EXPERTS.
MADISON, WIS.

Reports and Estimates Furnished.
General Contractors
High-Grade Securities Accepted or Negotiated.

W. R. EVANS & COMPANY
Incorporated
Electrical, Civil and Mechanical Engineers
Telephone Main 3153 Traction Bldg., Cincinnati

"AMERICAN" STORAGE CELLS
ARE THE BEST. Send for descriptive Circular.
AMERICAN BATTERY CO.,
EST'D 1890. 171 S. Clinton St., Chicago.

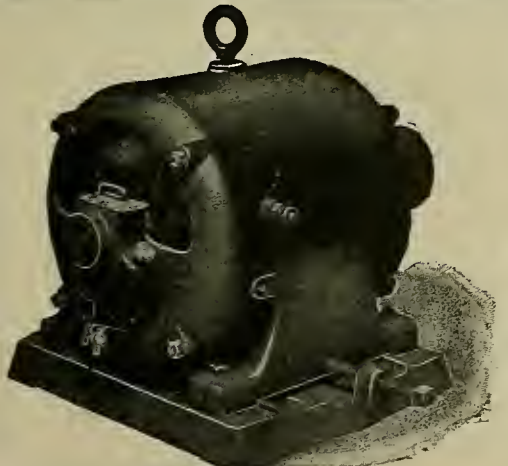
ALL THE ESSENTIALS



of a good storage battery are found in the
NORTHWESTERN
Large Capacity, Light, Efficient, Compact.
To have your order filled promptly, send to us at once.
Northwestern Storage Battery Co.,
285 Madison St., - - - Chicago, Ill.

THE BEST BRAZING TORCH
FOR ELECTRICIANS
HOTTEST ON EARTH

The Turner 4B Gasoline Brazing Torch is used by all mechanics for light work in brazing, annealing, tempering and drawing temper of small tools, etc. This torch produces an intensely hot, pointed flame of over 3,000° Fahr. Burns 4 hours from one filling.
PRICE $4.50 NET
THE TURNER BRASS WORKS
23 N. Franklin St., Chicago



SINGLE-PHASE SELF-STARTING
ALTERNATING CURRENT MOTORS
That will start under full load are our specialty. Can be mounted on floor, ceiling, or side wall. It is to your interest financially to become acquainted with them before placing your next order.
CENTURY ELECTRIC COMPANY
Main Office and Works
1007-9-11 Locust Street St. Louis, Mo.

SATISFIED CUSTOMERS

Are those who are buying such specialties from us as

Packard Lamps and Transformers,
Adams-Bagnall Arc Lamps,
"O. K." Weatherproof Wire,
Peerless and Paranite Rubber Covered Wire,
Brunt Porcelain,
Ansonia Magnet Wire,
Circular Loom, Etc., Etc.

ELECTRIC APPLIANCE COMPANY,
CHICAGO AND SAN FRANCISCO.

LAMPS

Get acquainted with the
PEERLESS—MONEY SAVERS

MADE RIGHT
PRICED RIGHT
ARE RIGHT

WESCO

THE WESCO SUPPLY CO., ST. LOUIS, MO.
"EVERYTHING ELECTRICAL"

MICA

Of all Qualities, in any Form at Lowest Prices
EUGENE MUNSELL AND CO.
NEW YORK and CHICAGO

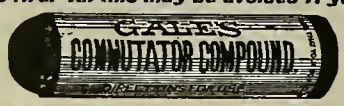
INSULATION That Is.

Micanite, Linotape, M. I. C. Compound, Empire Cloth and Paper. For Years the Standard.

MICA INSULATOR CO., Originators
NEW YORK and CHICAGO

SPARKING

Reduces the working capacity of a motor or dynamo, wears out the commutator, wastes power and may cause a fire. All this may be avoided if you use . . . . . .



The only article that will PREVENT SPARKING. Will keep the Commutator in good condition and PREVENT CUTTING.

Absolutely Will Not Gum The Brushes.

50 Cents per Stick. $5.00 per Dozen.
SEND FOR FREE SAMPLE STICK.
For sale by all supply houses, or

It will put that high gloss on the Commutator you have so long sought after.

K. McLENNAN & CO. Sole Mfrs., Room 411 Inter Ocean Bldg., 130 Dearborn St., CHICAGO

NOXALL CURVE GREASE.

Best Quality, Lowest Prices. Not Affected by Heat, Cold or Dampness.

RICHARDSON LUBRICATING CO., - Quincy, Ill.

MICABOND

CHICAGO MICA CO.,
"PERFECTORS" VALPARAISO, IND.
THE PEER OF INSULATORS.

VOLT - AMMETERS,

POCKET SIZE.

For Testing Batteries and Battery Circuits, Locating Faults, Grounds, etc.
RELIABLE. ACCURATE.
Send for Circular.

L. M. PIGNOLET,
78-80 Cortlandt St., NEW YORK, N. Y.

Robert Volt-Ammeter

Dead Beat
Accurate, Durable
Guaranteed

List Price, $6.00 including leather case.

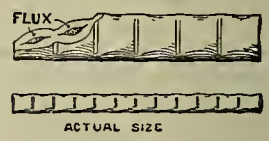
Sample instrument forwarded prepaid on receipt of $5.00.

Discount to Dealers
THE ROBERT INSTRUMENT CO.
56 Shelby Street
DETROIT - MICH.

KESTER SELF FLUXING SOLDER

A Tube of Solder Filled with Flux.
Requires no Acid.

SAVES—LABOR—TIME—MONEY.



PATENTED.

Send for Free Samples.

L. F. Mahler Co., R. 1008 Chemical Bldg., St. Louis, Mo., Gen. Western Agent.

KESTER ELECTRIC M'F'G CO.,
48 N. UNION STREET, CHICAGO, ILL.

Let Edison Lamps Do Your Lighting

They Cost Less Than All Others in the End.

Miniature Lamps
Street Series Lamps
Regular Multiple Lamps

GENERAL ELECTRIC COMPANY
Main Lamp Sales Office, Harrison, N. J.

NORTHERN ELEVATOR MOTORS

MACHINES TO MEET ALL REQUIREMENTS
ILLUSTRATED AND DESCRIBED IN BULLETIN NO. 2542. 40B

MOTORS FOR HIGH-SPEED AND SLOW-SPEED WORK
GOOD MOTORS ALWAYS.

NORTHERN ELECTRICAL MFG. CO., ENGINEERS MANUFACTURERS. MADISON, WIS., U. S. A.

We manufacture Knife Switches in sizes up to 2,000 amperes.

Prompt shipments made from stock.

Special switches made to order.

LET US QUOTE YOU.

Pass & Seymour, Inc.

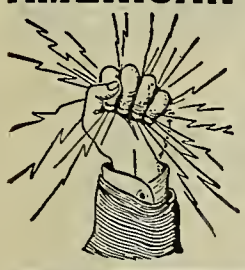
Solvay, N. Y.

New York Chicago San Francisco

FRANK N. PHILLIPS, President. EUGENE F. PHILLIPS, General Manager. E. ROWLAND PHILLIPS, Vice-Pres. C. H. WAGENSEIL, Treasurer. O. R. REMINGTON, Jr., Sec

AMERICAN ELECTRICAL WORKS,

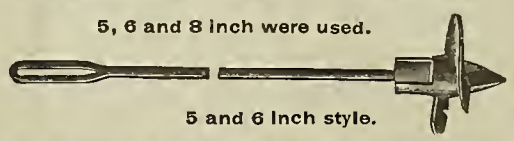
PROVIDENCE, R. I.



BARE AND INSULATED ELECTRIC WIRE,
ELECTRIC LIGHT LINE WIRE,
INCANDESCENT AND FLEXIBLE CORDS,
Railway Feeder and Trolley Wire,
AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR WIRES.
CABLES FOR AERIAL AND UNDERGROUND USE.

New York Store, W. J. Watson, 26 Cortlandt St.
Chicago Store, F. E. Donohoe, 82 Lake St.
Montreal Branch, Eugene F. Phillips' Electrical Works.
MAIN OFFICES AND FACTORIES, PHILLIPSDALE, R.I.

THE UNITED STATES GOVERNMENT
USED
The Stombaugh Guy Anchor
EXCLUSIVELY FOR
Anchoring Electric Light and Telephone Poles at Our Largest Military Post, Fort Riley, Kan.
5, 6 and 8 inch were used.



5 and 6 inch style.
W. N. MATTHEWS & BRO., Manufacturers
603 Carleton Building, St. Louis

CONTINUOUS RAIL JOINT CO. OF AM.
General Offices: Century Building
NEWARK, N. J.
OVER 20,000 MILES IN USE
Highest Award at Paris Exposition, 1900, Buffalo, 1901

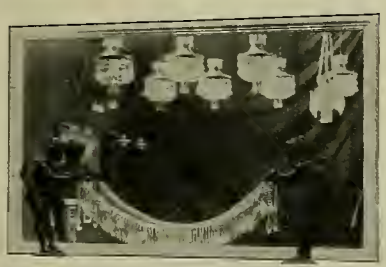
EXPERT IN ELECTRICITY MECHANICS PATENT CAUSES
SOLICITOR OF U. S. & FOREIGN PATENTS
FORÉE BAIN, 1662-3 Monadnock Blk., CHICAGO

INSULATED WIRES
COTTON AND SILK
NORTHERN WIRE & CABLE CO.
OFFICES: Milwaukee, 740-742 Wells Bldg. Chicago, 1202 Marquette Bldg.
MAGNET WIRES
South Milwaukee Wis.

Electric Heating Apparatus
SEND FOR 82-PAGE CATALOGUE.
UNIT" ENAMELED RHEOSTATS
SIMPLEX ELECTRIC HEATING CO.,
Cambridgeport, Mass.

Latest Novelty in Electric Lighting

—THE—
WEISSMANN PEARL SYSTEM



Endorsed for its Safety and Attractiveness by the best authorities in the world.
The sensation of the Ladies' Gowns Exhibit in the French Section at St. Louis.

Described in Western Electrician October 29 and November 26
Descriptive Matter and Patents mailed on application
PAUL LETHEULE, 4808 Delmar Bd., St. Louis

NATIONAL CODE STANDARD

WEATHER-PROOF TRADE MARK "O.K." LINE AND HOUSE WIRES

"O. K." Weatherproof Wire.
Slow-Burning Weatherproof and Ideal Wire.
Prices and Samples on Application.

Phillips Insulated Wire Co.

Office and Factory: PAWTUCKET, R. I.

Grimshaw

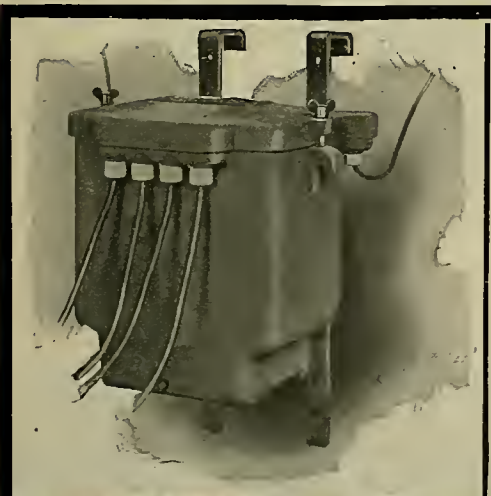
Raven White Core

Raven Black Core

ALL OUR WIRES pass Inspection and carry the above TRADE-MARKS on our tags. We also manufacture Grimshaw and Competition Tapes and Splicing Compounds.

NEW YORK INSULATED WIRE COMPANY,

MAIN OFFICE: 114, 116 & 118 Liberty St., New York.
BRANCHES: CHICAGO: 192 Desplaines St. BOSTON: 7 Otis St. SAN FRANCISCO: 32 Second St.



THE B. O. TRANSFORMER

Do you expect to need new transformers this fall? If you do, the B. O. will interest you.
Low Losses
High Efficiencies
High Insulation
Low Price.
Are you familiar with oil duct transformers?
Send us your address and we will tell you about our insulation and the advantages of slab windings in connection with oil ducts.

THE STANLEY ELECTRIC MANUFACTURING COMPANY
PITTSFIELD, MASSACHUSETTS

Atlanta, Ga., Empire Building
CHICAGO, ILL., Monadnock Block
New York, N. Y., 29 Broadway
St. Louis, Mo., Century Bldg.
Boston, Mass., Oliver Building
Denver, Col., Hendrie & Bolthoff Mfg. & Supply Co.
Philadelphia, Pa., North American Building
San Francisco, Cal., 69-75 New Montgomery St.
Seattle, Wash., Pioneer Bldg.

Representatives for the Dominion of Canada, THE CANADIAN GENERAL ELECTRIC CO. of Toronto

"THE S. K. C. SYSTEM"

WANTED, FOR SALE *and similar* **WANT COLUMN** *advertisements (50 words or less), $1.50 an insertion; additional words 3c each.* **POSITION WANTED** *advertisements (50 words or less), $1.00 an insertion; additional words 2c each.*

[redacted] WANTED.

Outside lineman. Steady work for good man. Married man preferred. Apply to SUPERINTENDENT ELECTRIC LIGHT PLANT, Evanston, Ill.

FOR SALE.

A bargain if taken at once. One 40 K. W., A.-C. dynamo, 1,100 volts, 16,000 alternations, single-phase toothed armature compound-wound self-oiling bearings, in A-1 condition. Will be sold cheap if taken at once. Can be seen running until January 1st, 1905. BEMENT ELECTRIC LIGHT and POWER CO., Bement, Ill.

ANADARKO, OKLAHOMA, December 21st, 1904.

NOTICE TO CONTRACTORS.

Sealed bids addressed to the City Clerk of Anadarko, Oklahoma, will be received by the City Council of Anadarko, Oklahoma, up to eight o'clock p. m. January 9th, 1905, for the construction of an electric lighting plant for said city, according to plans and specifications on file in the office of the City Clerk.

Bids must be accompanied by a certified check for 5 per cent of the amount bid, made payable to the City of Anadarko, Oklahoma, as a guarantee that the successful bidder will enter into a contract and furnish an acceptable bond without delay.

The Council reserves the right to reject any and all bids.

[redacted] B. E. BEEBE, City Clerk.

FOR SALE

A MONEY MAKER.

Electric-light and steam-heating plant in thriving Illinois manufacturing town of 2,500. Income over $7,000 per year. Seventy new patrons added in past six months. Equipment all in first-class condition. City revenue $185.00 per month. A. C. system, meter customers, 15c base. Excellent opportunity for party with money to develop the field. Address, BOX 429, care Western Electrician, 510 Marquette Building, Chicago.

Corliss Engines.

1000 h. p., 36x48, Allis Corliss, 1890 heavy duty.
900 h. p., 34x60, International.
825 h. p., 32x48, Allis Corliss, 1890 heavy duty.
900 h. p., 22x42x48, Hamilton, Tand. Comp.
750 h. p., 32x54, Hamilton, 1890 Frame.
650 h. p., 30x54, St. Louis, 1890 Frame.
600 h. p., 28x60, Philadelphia.
500 h. p., 16x32x42, Corliss Cross Comp., latest type.
450 h. p., 16x30x42, Allis Cross Comp.
400 h. p., 23½x60, Gen. H. Corliss.
450 h. p., 24x48, Harris, latest type.
450 h. p., 24x48, Brown.
350 h. p., 22x42, Allis, 1890 Frame.
350 h. p., 22x42, Slater, 1890 Frame.
300 h. p., 20x48, Harris.
300 h. p., 20x42, Hamilton.
225 h. p., 12x22x42, Atlas Tandem Comp.
225 h. p., 18x42, Hamiltnn.
175 h. p., 16x42, Allis.
165 h. p., 16x36, Sioux, 1902.
150 h. p., 15x38, Brown.
140 h. p., 14x42, Allis.
125 h. p., 14x36, Putnam.
90 h. p., 12x36, Harris.
600 h. p., 28½x62, Buckeye Automatic.
500 h. p., 17½x30½x27, Buckeye Cross Comp.
450 h. p., 16½x28½x27, Buckeye Cross Comp.
450 h. p., 24x48, Buckeye Automatic.
350 h. p., 16x26x18, Ideal Tandem Comp.
275 h. p., 14x22x16, Ideal Tandem Comp.
250 h. p., 16x27x16, Westinghouse Comp.
150 h. p., 15x24, Cummer.
150 h. p., 10½x18x18, Williams Tandem Comp.

Whitehead Machinery Company,
DAVENPORT, IOWA.

Western Electrician
WANT ADS
Bring Results.

FOR SALE

1-360 K. W.	General Electric	Alternator,	Three Phase	
1-240	" Westinghouse	"	Single	"
2-150	" Warren	"	"	"
1-150	" Westinghouse	"	"	"
1-150	" Wood	"	"	"
1-150	" Stanley	"	"	"
1-120	" General Electric	"	Three	"
1-120	" General Electric	"	Single	"
1 120	" Westinghouse	"	"	"
1- 90	" General Electric	"	"	"
1- 75	" Westinghouse	"	Two	"
1- 75	" Westinghouse	"	Single	"
1- 75	" Westinghouse	"	Two	"

Direct connected to Gates' Engine.

Send for our **Monthly Bargain Sheet** with complete list and net prices.

GREGORY ELECTRIC CO.
54-62 S. Clinton St., Chicago, Ill.

M. KLEIN & SON.
Send 2c stamp for new catalogue No. 6 of
KLEIN'S TOOLS
For Electrical Workers and Line Builders.
MATHIAS KLEIN & SONS,
81 W. Van Buren St., Chicago, Ill.

EDWARDS AND CO

ELECTRO-MECHANICAL GONG.

Is entirely encased in iron and is weatherproof. The mechanism is very powerful and gives 375 blows to each winding. Continuous ringing or single stroke.

WESTERN ELECTRIC CO.
Selling Agents.

NEW YORK N.Y

"A great deal in a little space."
—*The Press.*

"THE FOUR-TRACK SERIES"

This is the title of a series of books of travel and education issued by the Passenger Department of the

NEW YORK CENTRAL LINES

These small books are filled with information regarding the best modes of travel and the education that can best be obtained by travel.

They relate specifically to the great resorts of America — to trips to the islands of the sea and around the world.

They also contain numerous illustrations and new and accurate maps of the country described.

A copy of the 40-page Illustrated Catalogue of the "Four Track Series" will be sent free, postpaid, upon receipt of postage stamp by George H. Daniels, General Passenger Agt., New York Central & Hudson River Railroad, Grand Central Station, New York.

WORKS QUICK AND EASY. KEEPS ITS LUSTER. HOLDS OLD TRADE AND MAKES NEW. DOES NOT DETERIORATE. ESTABLISHED 16 YEARS. SOLD BY AGENTS AND DEALERS ALL OVER THE WORLD
U.S. METAL POLISH 3 OUNCE BOX 10 CENTS SAMPLES SENT FREE
GEO. W. HOFFMAN
POLISHES ALL METALS. BRANCHES NEW YORK, CHICAGO, SAN FRANCISCO. 295 E. WASHINGTON ST. INDIANAPOLIS, IND.
HIGHEST AWARD, CHICAGO WORLD'S FAIR, 1893. LOUISIANA PURCHASE EXPOSITION 1904.

BOILERS.

One 42-in. x 16 ft. 9-in., 250 H. P. Worthington Water Tube.
One 60-in. x 16 ft., John Mohr Return Tubular Boiler.
One 54-in. x 16 ft., John Mohr Return Tubular Boiler.
One 54-in. x 16 ft., Devine Tubular Boiler.

ENGINES.

One 600 H. P., 21 x 36 x 30, Williams Tandem Horizontal Compound, 140 R. P. M.
Two 600 H. P., 20 x 30 x 24, Porter-Allen Tandem Compound, 200 R. P. M.
One 250 H. P., 12 x 24 x 18 Williams Tandem Compound, 250 R. P. M.
Two 100 H. P., 13 x 12, Dick & Church, High Speed Automatic.

PARTIAL LIST ONLY.

Send for latest Catalogue for bargains in Engines, Boilers, Dynamos and Motors.

CENTRAL STATION IMPROVEMENT CO., 938 Monadnock Block, Chicago

ELECTRIC SIGN FLASHERS

BEST IN THE WORLD
Write for full particulars
Reynolds Elec. Flasher Mfg. Co.
221 Fifth Ave., Chicago.

REPAIRING RECALIBRATING

ELECTRIC METERS.
INTERNATIONAL ELECTRIC METER CO.
167 S. CANAL STREET, CHICAGO.

Water-Wheel Governors

Our new mechanical governors co-operate with the inertia effect of the water and the momentum of the plant.
They have cut the cost of good government in two. Guaranteed in every particular.

REPLOGLE GOVERNOR WORKS
AKRON, OHIO.
WRITE FOR DESCRIPTIVE MATTER W.

Louisville and Chicago

And the places north
And the places south
And the places between are reached by the quick day and night trains of THE

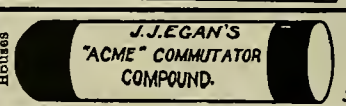
MONON ROUTE
CHICAGO, INDIANAPOLIS & LOUISVILLE RAILWAY

Also the celebrated health resorts, French Lick and West Baden Springs, are reached only by this road.

Booklets about the Springs, their wonderful waters and the fine hotels, sent free.

CHAS. H. ROCKWELL, Traffic Manager
FRANK J. REED, Gen. Pass. Agt.
202 Custom House Place, Chicago

All Supply Houses



J. J. EGAN'S "ACME" COMMUTATOR COMPOUND
absolutely prevents sparking or cutting. One stick of "Acme" is equal to one gallon of oil for lubricating commutators. Free Sample. AGENTS WANTED.
50c per Stick. $5.00 per doz.
J. J. Egan Sole Mfg., 317 Austin Ave., Tel. Polk, 1779 Chicago

Our Compound Stops Sparking and Saves Commutators.
14 Years' Use on Street Ry., Light and Power Commutators Has Proven Its Worth. WE GUARANTEE RESULTS.
Send Your Address for FREE SAMPLE THAT CONVINCES.
JAS. McLAUGHLIN & CO., ELECTRICAL ENGINEERS
586 Fulton Street, - - Chicago, Ill.

OFFICE OF
Town Clerk
A. R. KAUFMAN, CLERK

BOARD OF TRUSTEES
GEO. A. PAINTER
AL V. PANKONIN
J. HERRN
F. VAN SUYK, ATTY.

Summitville Ind. Nov 23 1903

Western Electrician
Chicago Ill.

Gentlemen: You may discontinue our Want Advertisement with the one issue. As I have already received about 40 answers to same. Send me your bill and I will remit same to you Thanking you very kindly for your promptness
I am Yours Resp.

A. R. Kaufman
Clerk.

CHICAGO EDISON COMPANY REPAIR SHOPS
76 MARKET STREET, CHICAGO. TELEPHONE MAIN 1280.
Machine and Carpenter Work of All Kinds
Correspondence Solicited.
OPEN DAY AND NIGHT.
FIRST-CLASS EQUIPMENT THROUGHOUT.
Dynamos Armatures, Motors, Arc Lamps, Fans, Instruments.

GOLD MEDAL

Awarded Dearborn Methods of Treating Boiler Waters and Dearborn Vegetable Feed-Water Treatment at the World's Fair, St. Louis.

DEARBORN DRUG & CHEMICAL WORKS,

27-34 RIALTO BUILDING, CHICAGO, ILL. WM. H EDGAR, President Telephone: Harrison 3930 and 3931.

January, 1905. A SPECIAL ISSUE
"Graphite" ON LUBRICATION.
COPIES ARE FREE TO ALL.
JOSEPH DIXON CRUCIBLE CO., JERSEY CITY, N. J.

JEFFREY ELEVATING, CONVEYING, POWER TRANSMISSION **MACHINERY** FOR CATALOGUE, ADDRESS THE JEFFREY MFG. CO. COLUMBUS, O.

DIESEL ENGINES

Operating on CRUDE or FUEL Oil

Guaranteed Fuel Consumption

on variable load, ranging from ¼ to full load

12½ Gals. per 100 Kw. Hours

SUITABLE FOR ALL STATIONARY POWER

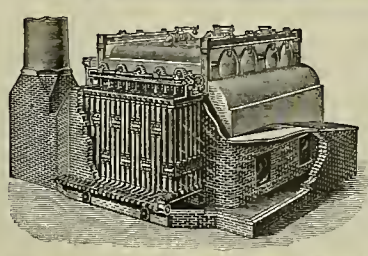
For further information address

AMERICAN DIESEL ENGINE COMPANY

11 Broadway NEW YORK

OVER 350,000 BOILERS

GREEN'S ECONOMIZER



Is in active operation in more than 350,000 Boilers, a large percentage being in **electric light** and **power plants,** and is demonstrating how the greatest amount of steam can be gained from the least amount of fuel. Not only is there a gain of 10 to 20% in reduced fuel supply, but the building can be heated without additional cost. We have a free booklet that is most interesting from a saving standpoint—send for it.

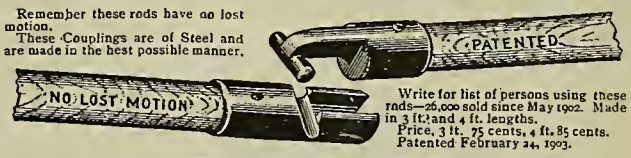
THE
GREEN FUEL ECONOMIZER CO.
MATTEAWAN, N. Y. Sole Manufacturers in the U. S.

REG. TRADE MARKS

THE PHOSPHOR BRONZE SMELTING CO. LIMITED,
2200 WASHINGTON AVE., PHILADELPHIA.
"ELEPHANT BRAND PHOSPHOR-BRONZE"
INGOTS, CASTINGS, WIRE, RODS, SHEETS, ETC.
— DELTA METAL —
CASTINGS, STAMPINGS AND FORGINGS
ORIGINAL AND SOLE MAKERS IN THE U. S.

Cope's Patent Quick Coupling Conduit Rod

Remember these rods have no lost motion.
These Couplings are of Steel and are made in the best possible manner.

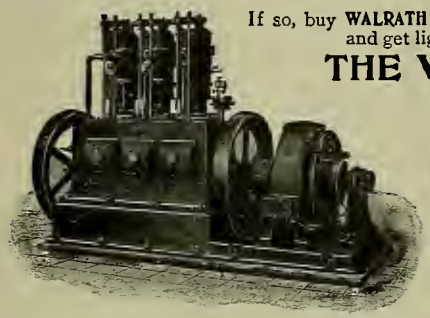


Write for list of persons using these rods—26,000 sold since May 1902. Made in 3 ft. and 4 ft. lengths.
Price, 3 ft. 75 cents, 4 ft. 85 cents.
Patented February 24, 1903.

T. J. COPE

3244 North Fifteenth Street PHILADELPHIA, PA.

ARE YOU LOOKING FOR MONEY?



If so, buy **WALRATH GAS OR GASOLINE ENGINES** and get light on the subject.

THE WALRATH

Received the Highest Award at the Pan-American Exposition.

It will produce as good a commercial light as that of an automatic steam engine, either belted or direct-connected generator. Simple, Economical and Reliable

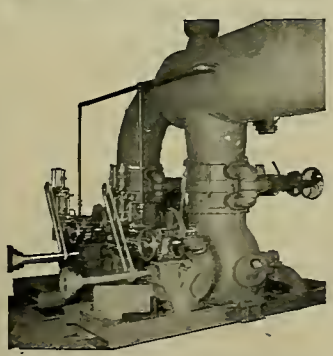
Send for Catalogue W

MARINETTE GAS ENGINE CO.,
CHICAGO HEIGHTS, ILL.

AGENCIES:
Keystone Engineering Co., Farmer's Bank Bldg., Pittsburg, Pa.
Strong, Carlisle & Hammond Co., 61-67 Frankfort St., Cleveland, Ohio
Mackay Engineering Co., 149 Broadway, N. Y.
C. H. Seideoglanz., 52 When Bldg., Indianapolis, Ind.

Watson Motors

If you want a small motor for a special purpose. Write us.
Mechanical Appliance Co.
Milwaukee, Wis.



SAMSON TURBINE

If the SPEED of the turbine is to be controlled by a GOVERNOR, the turbine should be of such capacity that it will develop the MAXIMUM POWER required, when operating at ¾ to ⅞ gate, then when an overload is thrown on the governor can open the gates wider and allow an increase in power. The EFFICIENCY of the SAMSON between ¾ and ⅞ gate is over 84%.

THE JAMES LEFFEL & CO.

307 LAGONDA ST., Springfield, Ohio, U. S. A.

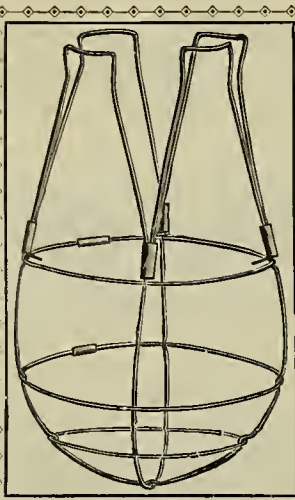
AMERICAN ELECTRIC TELEPHONE CO.

LARGEST MANUFACTURERS

This Company Sends Prepaid upon request any of the following bulletins:

Bulletin No. 7—Combined Telephone and Switchboard
" " 8—Wall Switchboard
" " 9—Samson Telephone
" " 10—American Express Switchboards
" " 11—Desks — Toll and Private Branch
" " 12—Visoal Signal and Bell Style Switchboards
" " 13—Intercommunicating Systems
" " 14—Line Material and Supplies
" " 15—Bell Express Self-Restoring Switchboards
" " 16—Operator's Set and Accessories
" " 17—Parts of Apparatus
Bulletin No. 18—Magneto Telephones of All Kinds
" " 19—Central Energy Switchboards
" " 20—Central Energy Telephones
" " 21—Protective Apparatus and Terminal Equipment
" " 22—Construction of Country Telephone Lines
" " 23—Eight-Party Selective Ringing Telephones
" " 24—Composite Telephone and Telegraph Lines
" " 25—Four-Party "Leich" Selective Telephone System
" " 26—Telephone Power and Ringing Equipment

CHICAGO, ILL., U. S. A.



HIPWELL

Expanding Wire Guard; also manufacturer of high-grade, long-distance

TELEPHONES

Switchboards and Cable Terminals.

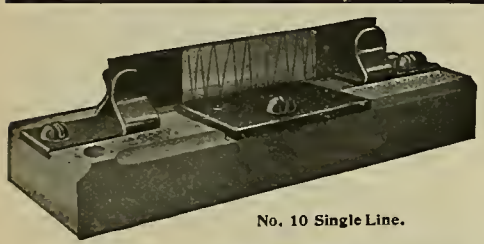
Hipwell Mfg. Co.
ALLEGHENY, PA.

FARIES

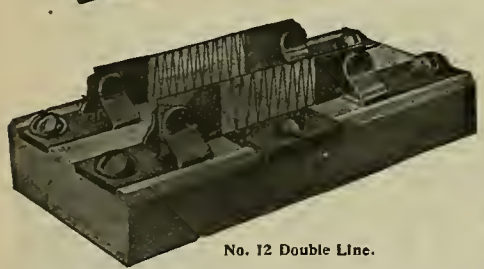
ADJUSTABLE LAMP HOLDERS, SHADES, PORTABLES, ELECTRIC and COMBINATION FIXTURES

CATALOGUE WILL BE SENT ON REQUEST

FARIES MFG. CO., - DECATUR, ILL.



No. 10 Single Line.



No. 12 Double Line.

PROTECTORS THAT PROTECT.

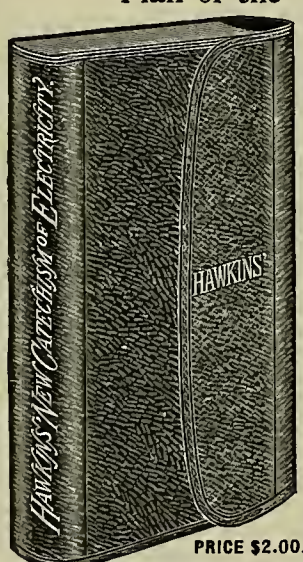
Our patent wrapped fuse used in our protectors are an insurance policy against lightning.

Sample free by mail to any Exchange or Toll Line

CENTRAL TELEPHONE AND ELECTRIC CO.,
909 Market St.,
ST. LOUIS, U. S. A.

HAWKINS' NEW CATECHISM OF ELECTRICITY.

Plan of the Work, Contents, Etc.



PRICE $2.00.

The New Catechism of Electricity will be found to be surprisingly plain, and free from useless and ambiguous terms. The plan upon which it is arranged is unique.

The book is, first of all, intended to be plain and instructive; some 300 illustrations have been introduced, so that the mere pictures will afford almost a knowledge of the subjects.

It is a school book from the manner in which it proceeds from the simple facts to the abstract principles which the facts indicate; it is also a book of reference through the index of seventeen double columns of fine type pages; by means of this index a thousand items of practical importance are at once available.

It is an up-to-date work, which has cost a large outlay of capital and time, and, in short, it is doubtful if any more attractive book has ever been issued—or one more useful.

The subjects treated upon are as follows: Dedication to Thomas A. Edison, with engraving of Mr. Edison; Preface and Introduction; Nature and Source of Electricity and Magnetism.

The Dynamo; Conductors and Non-Conductors; Symbols, abbreviations and definitions relating to electricity; Parts of the Dynamo; The Motor; The Care and Management of the Dynamo and Motor.

Electric Lighting; Wiring; The rules and requirements of the National Board of Underwriters in full; Electrical Measurements.

The Electric Railway; Line Work; Instruction and Cautions for Linemen and the Dynamo Room; Storage Batteries; Care and Management of the Street Car Motor; Electro Plating.

The Telephone and Telegraph; The Electric Elevator; Accidents and Emergencies, etc., etc.

The full one-third part of the whole work has been devoted to the explanation and illustrations of the dynamo, and particular directions relating to its care and management;—all the directions are given in the simplest and most kindly way to assist rather than confuse the learner. The names of the various parts of the machine are also given with pictorial illustrations of the same.

In the Catechism no less than 25 full page illustrations have been given of the various dynamo machines made in different parts of the country, and an equal number of part page illustrations.

ELECTRICIAN PUBLISHING CO., 510 Marquette Bldg., CHICAGO.

PRESERVE YOUR COPIES

OF THE

WESTERN ELECTRICIAN

BINDERS $1.00 EACH.

ELECTRICIAN PUBLISHING CO.,
Suite 510 Marquette Building, - - - CHICAGO.

TELEPHONE BOOTHS

When in want of the Right Kind write us.

Catalogue Free

Yesbera Mfg. Co.
TOLEDO, OHIO.

INTERNATIONAL

Mechanical Self-Restoring Drop Switchboard.

A PERFECT APPARATUS.

Made in any desired capacity.
Sample parts and quotations on request.

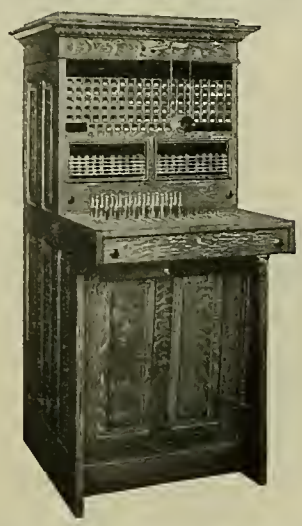
INTERNATIONAL TELEPHONE MANUFACTURING CO.
CHICAGO, U. S. A.

STROMBERG-CARLSON

GENERATOR-CALL

VISUAL SIGNAL SWITCHBOARDS

are inexpensive to maintain and nearly as rapid as a lamp signal switchboard.



SIGNALS SELF-CONTAINED

NO WORKING PARTS EXPOSED

This illustrates our No. A-1249 cabinet equipped with 100 line signals and 10 clearing-out signals. Our standard cabinets have a capacity for 50, 60, 70, 100, 140, 180 and 200 line signals of the above type.

Bulletins No. 6 and 7-E describe these boards very thoroughly. Mailed free upon request.

STROMBERG-CARLSON TELEPHONE MFG. CO.,

GENERAL OFFICES, ROCHESTER, N. Y.

WESTERN SALES OFFICE, CHICAGO, ILL.

Kellogg Express Switchboard Cabinet

The graceful Appearance comes from Simple Lines.

This Attractive Design has been so popular that it has been much copied by other manufacturers

Fifty-Line Capacity Quarter Sawed Oak for the entire Exterior of the Cabinet

Thoroughly seasoned wood

Finished in Light or Golden Oak

Gold Medal Highest Award Buffalo Exposition 1902

Grand Prize Highest Award St. Louis Exposition 1904

The Strongest, Longest Lived, Most Efficient Switchboards made. All telephone experts will tell you that.

Kellogg Switchboard & Supply Co.

Congress & Green Streets

CHICAGO

LOS ANGELES CLEVELAND PHILADELPHIA

THE TELEPHONE HAND-BOOK

NEW AND REVISED EDITION, WITH A NEW CHAPTER ON "RECENT PROGRESS," BRINGING THE BOOK UP TO DATE.

BY HERBERT LAWS WEBB.

Member of the American Institute of Electrical Engineers, and of the Institution of Electrical Engineers, London. Author of "A Practical Guide to the Testing of Insulated Wires and Cables." Joint Author of "Electricity in Daily Life."

160 Pages, 133 Illustrations, Cloth, Hand-Book Size, Price $1.00.

Extract from Preface.—"This little book has no pretension to be considered a complete treatise on telephony as it exists in America. The time for such a work is not yet come. But it is felt that there is a demand for a practical book on telephone working and management, and the TELEPHONE HAND-BOOK is an attempt at meeting that demand. With the exception of a few chapters dealing with certain forms of transmitters and receivers used in Europe, which are given for the information of those who may wish to engage in the manufacture of telephones, the book is based entirely on standard American practice; and most of the material, apparatus and methods described are peculiar to or have originated in this country."

No pains have been spared to make it the best book of its kind. It is right up to date, intensely practical, and so plain and clear in its language that anyone can understand and learn from it everything regarding telephone work and management. It conforms in size and style to our other Hand-Books which have been so favorably received by the entire electrical fraternity.

CONTENTS

CHAPTER 1. The Invention of the Telephone.
2. Sound Waves. Articulate Speech.
3. Electric Telephony. The Bell Telephone.
4. The Microphone.
5. Current Induction. Electromagnetic Induction.
6. The Induction Coil: Its Use in the Telephone Transmitter.
7. The Complete Telephone Circuit.
8. Magnet Telephones.
9. The Bell Telephone Receiver.
10. Other forms of Magnet Telephones.
11. The Gower, Ader and D'Arsonval Receivers, Mercadier's Bi-Telephone.
12. The Siemens, Kotyra, Neumayer and Böttcher Receivers.
CHAPTER 13. Carbon Transmitters.
14. The Blake Transmitter.
15. The Long Distance Transmitter.
16. The Solid-back Transmitter.
17. The Berliner Transmitter.
18. The Cuttriss Transmitter.
19. Various European Transmitters.
20. The Efficiency of Carbon Transmitters.
21. Batteries for Telephone Work.
22. Open Circuit Batteries.
23. Closed Circuit Batteries.
24. The Practical Management of Batteries.
25. Magneto Bell.
26. Automatic Switches.
27. Telephone Line Construction.
CHAPTER 28. Metallic Circuit.
29. Underground Wires
30. Lightning Arresters.
31. Inside Wiring.
32. Installation of Telephone Instruments.
33. Inspection and Maintenance.
34. The Condenser; Its Use in Telephony.
35. Electromagnetic Retardation.
36. Exchange Working.
37. Small Exchanges.
38. Party Lines: The Bridging Bell.
39. Long Distance Telephony.
40. Duplex Telephony.
41. Simultaneous Telegraphy and Telephony.
42. Recent Progress. Appendix.

Published and for sale by ELECTRICIAN PUBLISHING CO., 510 Marquette Building, Chicago

THE AUTOMATIC

is the recognized competitive system of telephony. Its manifold advantages over the manual system, mechanically, financially and commercially, make it so. Automatic telephone service is more prompt and more accurate and absolutely secret. It can be furnished at less cost to both company and patrons than any other. Progressive Independent telephone companies all over the country are rapidly adopting it; the new ones in preference to manual and the old ones to replace manual equipment. It is a success everywhere.

Among the cities in which it has been adopted are:

Chicago, Ill.
Grand Rapids, Mich.
Columbus, Ohio
Dayton, Ohio
Lincoln, Neb.
Portland, Maine
Auburn, N. Y.
Lewiston, Maine
Auburn, Maine
Fall River, Mass.
New Bedford, Mass.
Los Angeles, Cal.
San Diego, Cal.
Hopkinsville, Ky.
Sioux City, Iowa
Cleburne, Texas
Columbus, Ga.
Augusta, Ga.
Medford, Wis.
St. Mary's, Ohio
Woodstock, N. B.
Westerly, R. I.
Berlin, Germany
Manchester, Iowa
Princeton, N. J.
Albuquerque, N. M.
Van Wert, Ohio
Battle Creek, Mich.
Clayton, Mo.
Pentwater, Mich.
Toronto Junction, Can.
Wilmington, Del.
Riverside, Cal.
Traverse City, Mich.

AUTOMATIC ELECTRIC COMPANY

Van Buren and Morgan Streets, CHICAGO, U. S. A.

CEDAR POLES

PRODUCERS AND WHOLESALERS OF WHITE CEDAR PRODUCTS

SPECIAL PRICES ON SMALL POLES.
Write for a copy of our TELEGRAPH CODE FOR CEDAR PRODUCTS

YARDS
KOSS MICH.
L'ANSE "
MUNISING "
ONTONAGON
WAGNER, WIS
PESHTIGO "

C. H. WORCESTER CO.
SUITE 1206 TRIBUNE BLDG. CHICAGO.

BRACKETS—X ARMS—PINS
little things it is true, but they cut a big figure in line construction.
OUR MOTTO IS:
Prompt Shipment Quality Satisfaction Right Price
COLUMBIA MFG. CO. ANTIGO, WIS.

Cedar TORREY CEDAR CO., CLINTONVILLE, WIS. Poles
Large Stock Constantly on Hand

ELECTRICAL AND OTHER INDUSTRIES ARE OFFERED LOCATIONS WITH
Satisfactory Inducements,
Favorable Freight Rates,
Good Labor Conditions,
Healthful Communities,
ON THE LINES OF
THE ILLINOIS CENTRAL R. R.
AND THE
YAZOO & MISSISSIPPI VALLEY R. R.
For full information and descriptive pamphlet address
J. C. CLAIR,
Industrial Commissioner
1 Park Row, Chicago, Ill

Idaho Cedar Poles
PACIFIC COAST POLE CO. SPOKANE, WASH.

POLES W. C. STERLING & SON, MONROE, MICH. TIES.
Eleven Pole Yards in Michigan
Wholesale Producers for 20 years.

MICHIGAN AND WESTERN CEDAR POLES
ALL LENGTHS AND SIZES
LINDSLEY BROS CO.
TRIBUNE BLDG., CHICAGO

On receipt of
10 CENTS
we will send you a
Western Electrician
Moonlight Schedule
for 1905.
Every lighting man should have one.
Electrician Publishing Company,
510 Marquette Bldg., Chicago.

FACTORIES WANTED
ALONG THE
BURLINGTON ROUTE
to supply the demand for Electrical Goods.
Burlington Route
N 548
W. H. MANSS.
INDUSTRIAL COMMISSIONER,
209 ADAMS STREET, CHICAGO.

POLE DEALERS ADVERTISING IN THE WESTERN ELECTRICIAN OBTAIN MOST EXCELLENT RESULTS BECAUSE IT PLACES THEM IN TOUCH WITH ACTUAL BUYERS OF POLES. TRY A CARD.

TYPE E.

ALTERNATING CURRENT.

SCHEEFFER INTEGRATING WATTMETER
Type E for Alternating Current Type F for Direct Current Circuits
DUST AND BUG PROOF
IMPROVED CONSTRUCTION
MOVING PARTS ARE EXTREMELY LIGHT, INSURING A HIGHLY SENSITIVE AND ACCURATE METER.
WRITE FOR PRICES AND DESCRIPTIVE LITERATURE.
DIAMOND METER COMPANY,
PEORIA, ILL., - - - - U. S. A.

TYPE F.

DIRECT CURRENT.

JUST RECEIVED a new batch of 20 and 25 ft. Poles and have reduced prices accordingly. Also, we have plenty of those "Trolley" Ties yet. May we quote you now?

MALTBY CEDAR COMPANY, 509 Phoenix Block, Bay City, Michigan
Pittsburg Agents: Tipper & Patton, 509 Bessemer Bldg.

TELEPHONE POLES
Yards at Red Cliff, Wis., Aitkin, Feeley, Cobasset, Deer River, Tenstrike and Black Duck, Minnesota.
Large stocks. Prompt shipments. Carefully inspected stock at low prices.
J. W. MORRISON LUMBER CO., 918-19 Lumber Exchange MINNEAPOLIS, MINN.

Cedar Poles.
Pittsburg and Lake Superior Iron Co. Producers and Wholesalers. Escanaba, Mich.

Locations for Industries
Erie Railroad
Chicago to New York
The Erie Railroad Company's Industrial Department has all the territory traversed by the railroad districted in relation to resources, adaptability, markets and advantages for manufacturing, and can advise with manufacturers in relation to the most suitable locations. For full information address
LUIS JACKSON
Indostrial Commissioner, Erie Railroad Company
21 Cortlandt Street, New York

CEDAR POLES
ESTABLISHED 1862
WM. MUELLER COMPANY
1211-12-13 MARQUETTE BLDG. CHICAGO.
EIGHT DISTRIBUTING YARDS

Poles and Ties

The Fowler Companies
TRADE MARK
Fisher Bldg. Chicago

Southern Cedar POLES Are the Best.
NO ROTTEN BUTTS.
D. W. PHELAN,
277 Broadway, New York

POLES, TIES, POSTS. THE PORTER CEDAR CO., SAGINAW, MICH.
PRODUCERS. We want your inquiries always.

MICHIGAN WHITE LARGE STOCK.
CEDAR POLES
PROMPT SHIPMENTS. KELLOGG SWITCHBOARD & SUPPLY CO., Chicago.

Practical Running of Dynamos.
A little booklet on the care and the locating and remedying of troubles in dynamos and motors.
Price, 10 Cents.
Catalogue of mechanical and electrical books free.
ELECTRICIAN PUBLISHING COMPANY.
510 Marquette Bldg., Chicago.

WE BUY OLD BELTS
OR SCRAPS, ANY SIZE OR CONDITION.
WE CLEAN, REPAIR AND RENEW OLD BELTS.
LEATHER PRESERVER MFG. CORP.
27 W. MONROE ST., CHICAGO

POLES.
WHITE CEDAR.
IDAHO CEDAR up to 80 ft.

BERTHOLD & JENNINGS,
ST. LOUIS.
Chemical Building.

CROSS ARMS.
LONG LEAF PINE AND FIR.

WHITE CEDAR POLES
HALL L. BROOKS
52 WISCONSIN AVENUE
TOMAHAWK, WIS.

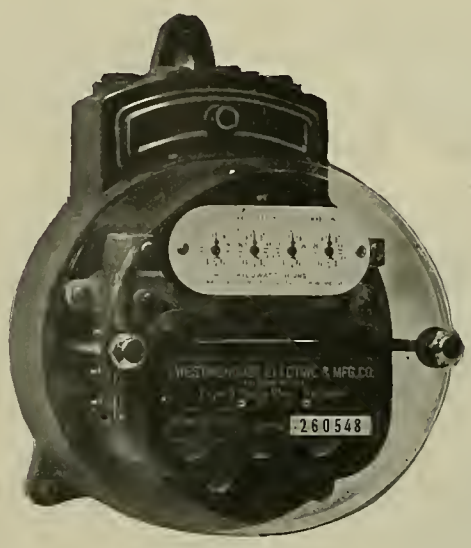
ARE YOU LOOKING FOR TROUBLE?
IF SO, GET A COPY OF
TELEPHONE TROUBLES
AND HOW TO FIND THEM
—IN—
BOTH MAGNETO AND COMMON BATTERY SYSTEMS.
9th Edition Just Out. Price, 25c.
Electrician Publishing Co.,
510 Marquette Building,
CHICAGO.

H. N. FENNER, President J. F. BLAUVELT, Agent RUSSELL W. KNIGHT, Treasurer
NEW ENGLAND BUTT COMPANY
MANUFACTURERS OF
Machinery for Insulating Electrical Wires
Braiding, Taping, Winding, Twinning, Cabling, Stranding, Polishing and Measuring Machines. Cable Covering Braiders
FINE CASTINGS A SPECIALTY
304 PEARL STREET, - - - PROVIDENCE, R. I., U. S. A.

CENTRAL STATION HEATING

We are the originators and builders of the underground system of live and exhaust steam heating. Our system is used for the utilization and distribution of exhaust steam from electric and power plants for heating purposes. 250 Plants in successful operation. We have the only Meter System. Also manufacturers of Wooden Water Pipe, Steam Pipe Casing, Steam Traps, Condensation Meters, Valves, Economizing Coils, Separators and full line of Steam Fitters' Supplies.
WRITE FOR PAMPHLET AND PRICE LIST

AMERICAN DISTRICT STEAM COMPANY
MENTION WESTERN ELECTRICIAN. LOCKPORT, N.Y. CHICAGO, ILL.



The Westinghouse Type "B"

Integrating Wattmeter

Glass or Metal Cases

For Two and Three Wire Single-Phase Circuits

7,200 to 16,000 Alternations

Another Step Forward

in the Westinghouse theory of wattmeter construction

All the well-known Westinghouse characteristics are retained, such as excellence of workmanship, long-lived accuracy of performance, durability and general desirability from every point of view.

Its installation does not require the services of a meter expert.

Westinghouse Electric & Mfg. Co.

Pittsburg, Pa.

Address our nearest sales office

New York, Dallas, Atlanta, Baltimore, Boston, Buffalo, Chicago, Cincinnati, Cleveland, Detroit, Los Angeles, Minneapolis, New Orleans, Philadelphia, Pittsburg, St. Louis, Salt Lake City, San Francisco, Sycamore, Seattle, Denver, Mountain Electric Co.
For Canada: Canadian Westinghouse Co., Limited, Hamilton, Ontario. Mexico, O. & O. Braniff & Co., City of Mexico.

Do you know we sell Incandescent Lamps and carry large stocks in all important cities? Write for our new Lamp Catalogue.

Fort Wayne Electric Works

DIRECT-CURRENT DIRECT-CONNECTED GENERATOR
TYPE M. P. L. 6-50-225

Standard sizes up to 800 kilowatts described in Bulletin 1050. Bulletin 1049 tells where they are used. Both sent when asked for.

Large Power Generators

1st. Cool Running—Obtained by thorough field and armature ventilation.

2nd. Sparkless Commutation — Obtained by correct electrical design.

3rd. The Result — Uniformly good behavior under all conditions of operation.

For Other Facts—Ask Us

Main Office and Factory, Fort Wayne, Ind.

262

Crocker-Wheeler Dynamotors

For Telephone Service are of Established Excellence

Form L Dynamotor

Crocker-Wheeler Company
Manufacturers and Electrical Engineers
Chicago Office, Old Colony Bldg.
Ampere, N. J.

DUNCAN

DIRECT CURRENT

WATTMETERS

Most Sensitive
Most Accurate
Most Reliable

WRITE FOR BULLETIN AND PRICES

DUNCAN ELECTRIC MFG. CO.
LAFAYETTE, IND.

YOST SPECIALTIES.

Sockets, Wall Sockets, Weatherproof Sockets, Rosettes, Receptacles, Cord Adjusters.

Catalogue for the asking.

THE YOST ELECTRIC MFG. CO.
TOLEDO, OHIO.

VULCANIZED FIBRE

Highest grades for electrical insulation and mechanical purposes, in sheets, tubes, rods and special shapes. Catalogues and samples on application.

VULCANIZED FIBRE CO., - Wilmington, Del.

Engineering

MECHANICAL, ELECTRICAL, STEAM, CIVIL.

Complete and short courses. Thoroughly equipped engineering shops. Shop work from the beginning. Short courses in Steam and Electrical Engineering. Expenses low. Accommodations the best. School all year. Students may enter any time. Correspondence steam and electrical courses. Send for catalogue. Mention course in which interested.

HIGHLAND PARK COLLEGE, DES MOINES, IOWA.

USE

"SAFETY" RUBBER COVERED WIRE AND CABLE

FOR EVERY ELECTRICAL SERVICE.

M. B. AUSTIN & CO.,
CHICAGO REPRESENTATIVE.

THE SAFETY INSULATED WIRE & CABLE CO.,
WORKS: Bayonne, N. J. 114-116 LIBERTY STREET, N. Y.

DON'T BUY ELECTRICAL SUPPLIES

Until you have seen our new Catalogue and new Price List.
Free to the trade.

Manhattan Electrical Supply Co.
NEW YORK: 32 Cortlandt St. CHICAGO: 188 Fifth Ave.

INTERCHANGEABLE ARC LAMP

200 HOURS LIFE
on Multiple D. C. Circuits.

150 HOURS LIFE
on Multiple A. C. or on Series A. C. and D. C.

The Jandus is the Ideal Lamp for Central Stations and isolated plants.

THE F. BISSELL COMPANY
DISTRIBUTORS
TOLEDO, O.

STURTEVANT ECONOMIZERS

For all boiler plants of 50 H. P. and over. Increase temperature of feed water 150° and 175°. Save 10 to 20 per cent in fuel. Increase boiler capacity 20 to 40 per cent. Prolong life of boilers.

B. F. Sturtevant Co., Boston, Mass.
General Office and Works, Hyde Park, Mass.
NEW YORK PHILADELPHIA CHICAGO LONDON

406

Warren Alternator

Do not be content with a tolerably good alternator.

GET THE BEST

When you have tried the

"WARREN"

you will be able to judge

We Guarantee What We Sell and Sell What We Guarantee.

WARREN ELECTRIC MFG. CO.
Sandusky, O.

Black Diamond File Works

Est. 1863. Inc. 1895.

Twelve Medals Awarded at International Expositions

Special Prize Gold Medal at Atlanta, 1895.

OUR GOODS ARE ON SALE IN EVERY LEADING HARDWARE STORE IN THE UNITED STATES AND CANADA.

G. & H. BARNETT COMPANY,
PHILADELPHIA, PA.

JOHN A. ROEBLING'S SONS CO.

Insulated Wire of All Kinds

Bare Copper Wire

MAIN OFFICE AND WORKS TRENTON, N. J.

AGENCIES AND BRANCHES
New York Chicago Cleveland San Francisco Philadelphia Atlanta